PORTIA MINE SITE

ML 6346

PROGRAM FOR ENVIRONMENT PROTECTION AND REHABILITATION (PEPR)

SUBMITTED BY BENAGERIE GOLD AND COPPER PTY LIMITED

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The Site operates within Mining Lease (ML) 6346 and comprises two deposits, the previously mined Portia and in-situ North Portia (which is located just north of the Portia open pit). The Site is situated to the north of the Olary Ranges on flat land consisting of low sand dunes and interdune corridors. Defined watercourses are not present within the ML 6346 and vegetation is sparse, limited to some black oak woodland away from the open pit area, low bluebush on the plains, and bladder saltbush on the low dunes. Other less common vegetation types include tall shrublands on sand plains and cane-grass in swampy areas. Soils are thin on the flats and if dune sand is considered to be soil, then thicker on the dunes. The condition of the land has been affected by grazing activities which have significantly diminished environmental values. Weeds are common, as are feral animals including rabbits and goats. None of the resident species of birds expected to be present on the ML area are threatened at either a state or commonwealth level.

Groundwater occurs in basement rocks but not at recoverable rates within the basal Tertiary age Eyre Clay unit and the overlying Namba Formation. Groundwater salinity is generally high to very high, precluding its use for stock watering. The deposits occur outside of the Yarramba Palaeochannel, which lies approximately 3 km to the east.

Benagerie Gold and Copper Pty Ltd (BGC) is the current owner of the Portia Mine Site. In 2003, Havilah Resources Limited (Havilah) acquired the Project from Pasminco to develop an estimated JORC inferred Resource for the base of Tertiary gold mineralisation of 720,000 tonnes @ 2.9% for 67,000 ounces of gold. A ML was granted to Benagerie Gold, the previous name of BGC (which was then a subsidiary company of Havilah), by the Department for Energy and Mining (DEM[1]) on 2 October 2009 for a period of seven years. A ML renewal application was submitted to DEM on 20 June 2016 and extension has been granted for a further 12 years commencing on 2 October 2016. The Program for Environment Protection and Rehabilitation (PEPR) for ML 6346 was first approved as PEPR2014/090 on 17 December 2014, with an update approved as PEPR2016/021 on 20 December 2016. This document, once approved, will supersede both PEPR2014/090 and PEPR2016/021.

Construction commenced in March 2015, with mining of the overburden from the Portia open pit occurring during April 2015 through a partnership between Havilah and Consolidated Mining and Civil (CMC), who managed the mining activities onsite. The first gold ore was mined during March 2016, with the first gold pour occurring in May 2016. The original operations included the excavation of an open pit (Portia), followed by the recovery of particulate (nuggetty) gold from the Eyre Clays using a gravity separation and washing plant. The ore zone is at a depth of approximately 70-76 m. Overburden is placed in an overburden waste dump (OWD), whilst the ore material is placed on the run of mine M) pad for subsequent processing.

Originally the Portia Mine Site was anticipated to have approximately twelve months of overburden removal followed by approximately six months of mining and processing of the gold bearing materials, giving an expected life of mine (LoM) of approximately eighteen months total. Based on subsequent positive drilling results, approval was given to expand the original Portia open pit design to include extensions to the north and south. Majority of the north and south extensions were completed by mid-2018, subsequently in August 2018, the Porta Mine Site was placed in a phase of care and maintenance.. Recent metallurgical studies have been undertaken on the cyanide recoverable gold from the tailings which has highlighted the economic viability of re-processing these materials through a modified processing plant circuit. BGC plan to resume remnant mining of the Portia open pit to complete the excavation of the approved extensions to the north and south, process remaining ore stockpiles located on the ROM pad and process the fine gold

[1] Formerly the Department of State Development (DSD) and Department for the Premier and Cabinet (DPC)

contained within the tailings material stored in the current Tailings Storage Facility's (TSF) cells, TSF-1 (previously referred to as TSFE) and TSF-2 (previously referred to as TSFW).

These planned changes to the Portia Mine Site scope will result in some upgrades required to the current processing facilities. This will include the introduction of chemicals into the processing including sodium cyanide, hydrogen peroxide, caustic soda, silver nitrate and picric acid in small volumes to treat the material from the TSF cells as well as a cyanide detoxification process.

The proposed changes to the Portia Mine Site scope will also require modification of the existing TSF cells including two additional cells (TSF-3 and 4). Tailings material will remain inert, as potentially acid forming material (PAF) is not expected to be encountered under the current mine plan.

Remaining site infrastructure onsite will largely remain the same this includes the camp, office facilities, workshops, go bay, a pit dewatering dam (PDD), raw water dam (RWD) and two balance ponds. These are referred to as balance pond 1 (previously called the process water dam (PWD)) & balance pond 2 (BP1 & BP 2).

Blasting is not required at the Site, within the current mining plan.

Rehabilitation and closure will involve the removal of infrastructure including the camp, office and processing equipment and the rehabilitation of areas disturbed by Site activities. Rehabilitation will also involve the placement of a capping layer on the tailings in the four TSF cells, backfilling and covering of the water dams, the backfilling of drains and surface water retention features, the placement of stockpiled topsoil on all disturbed areas, ripping and seeding to assist in achieving successful establishment of a vegetative cover. The Portia open pit will remain open at closure, but access will be restricted by the placement of an abandonment bund and warning signage. Post mining land use is intended to revert to the pre-mining pastoral use

The document represents an update to PEPR2016/021 and includes information to address DEMs requirements which were matters subsequent to the 2016 PEPR approval. It incorporates the reprocessing of tailings material from the current TSF cells (TSF-1 and TSF-2), which is referred to as Phase 1 approvals. This document will also conceptually discuss expected future construction and operation of a second open cut pit (North Portia (Phase 2 and 3 approvals)) to provide DEM with a line of sight to BCG's future approvals plans for the operation.

It is noted that whilst discussed in this document Phase 2 and 3 (North Portia) will not form part of the scope of this PEPR approval.

1 INTRODUCTION

This is the *Program for Environment Protection and Rehabilitation* (PEPR) for the Portia Mine Site (the 'Project' or the 'Site'). The holder of a Mining Lease (ML), Retention Lease (RL) or Miscellaneous Purposes License (MPL) cannot carry out mining operations unless they have an approved PEPR. The ML was granted to Benagerie Gold (a wholly owned subsidiary of Havilah Resources) by the Department for Energy and Mining (DEM) on 2 October 2009 for a period of seven years. A ML renewal application was submitted to DEM on 20 June 2016 and extension has been granted for a further 12 years commencing on 2 October 2016. The PEPR for ML 6346 was first approved as PEPR2014/090 on 17 December 2014, with an update approved as PEPR2016/021 on 20 December 2016.

In June 2018, Havilah Resources announced that it would sell Benagerie Gold, to its mining partner, Consolidated Mining and Civil (CMC), wholly owned by Consolidated Broken Hill Holdings (CBHH). The sale of Benagerie Gold, now named Benagerie Gold and Copper (BGC) to CBHH was completed in April 2019.

This document represents an update to PEPR2016/021 and addresses requirements which were matters subsequent to the latest PEPR approval, as well as provide an update to the scope of operations to include the remnant mining of Portia Pit Northern cutback and tailings. remining and reprocessing of tailings material from the existing Tailing Storage Facility's (TSF) two cells, TSF-1 (previously referred to as TSFE) and TSF-2 (previously referred to as TSFW) and the construction of a two new TSF cells (TSF-3 and 4). This document has been prepared to satisfy the requirements of DEM and to comply with Regulation 42 (b) (1) under the South Australian *Mining Act 1971* ('Mining Act').

The PEPR covers the mining activities outlined in Section 3 of this document. This document has been prepared in accordance with advice provided by DEM and other government representatives during the consultation process, and in general accordance with the Minerals Regulatory Guidelines *Preparation of a program for environment protection and rehabilitation (PEPR) for metallic and industrial minerals (excluding coal and uranium) in South Australia* (MG2b), dated August 2018. In addition, the PEPR has been prepared in general accordance with the requirements of DEM's Ministerial Determination *Minimum information required to be provided in a program for environment protection and rehabilitation (PEPR) for a mineral lease (ML) and any associated miscellaneous purposes licence (MPL) for metallic and industrial minerals (excluding extractive minerals, coal and uranium)* (MD005), dated 5 November 2015.

This PEPR builds on the Project information provided to DEM during the Mining Lease Proposal (MLP), and the two previous PEPRs. Once approved, this PEPR supersedes the previous version of the PEPR (Version 4.2, dated December 2016).

1.1 Proponent and Declaration of Accuracy

The Proponent is BGC (Australian Company Number 121 124 427). The proponents contact details are shown in Table 1-1 below.

Table 1-1: BGC Contact Details

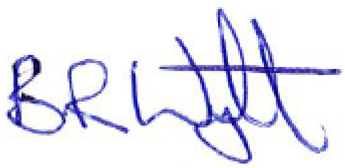
Contact Address	Contact Details
PO BOX 5079 Broken Hill NSW 2880	Mr Brian Wyatt Telephone: (08) 8088 2688 Email: bwyatt@benagerie.com.au

Declaration of Accuracy

The following declaration of accuracy is made in accordance with Regulation 65(8) under the Mining Act.

I Mr Brian Wyatt, holding the position of Mining Executive for the tenement holder BGC, have taken the following steps to review the information in this PEPR to ensure its accuracy:

- Implemented an audit process against the Ministerial Determination MD005 to ensure the minimum requirements have been addressed.
- Undertaken an internal process for review, endorsement and sign-off by senior management of BGC.

Name:	Mr Brian Wyatt
Position:	Mining Executive Benagerie Gold and Copper Pty Ltd
Signature:	
Date:	23 July 2019

1.2 Existing Land Tenure

Details of underlying land tenure and tenure holders are shown in Table 1-2.

Table 1-2: Land tenure and tenement details

Aspect	Details	
Mining Lease	ML 6346	
Land Tenure	Pastoral Use	
Certificate of Land Title / Lease Number	Crown Lease (CL) 1292/4	
Pastoral Number	Mulyungarie (Benagerie Block) 121	
Name of Leaseholder(s)	Mutooroo Pastoral Company Pty Ltd	
Address of Leaseholder(s)	5 King William Rd Unley SA 5061	
Phone number of Leaseholder(s)	James Morgan	(08) 8373 1515
Facsimile	James Morgan	(08) 8373 5775

This region is not covered by a District Council or Corporation.

1.3 Location

The Site is located in the vicinity of latitude 31°26' S and longitude 140°27' E (447,000E, 6,522,500N, GDA94, MGA Zone 54), within the Benagerie Pastoral Block.

The Site is located approximately 430 km north-northeast (direct) of Adelaide, South Australia and approximately 85 km north (direct) of the Barrier Highway (see Figure 1-1). The closest regional centre is Broken Hill, located approximately 110 km (direct) to the southeast, across the border in New South Wales.

Access to the Portia Mine Site is by road from the Barrier Highway via Mulyungarie Station.

1.4 Exempt Land

As defined in Section 9 of the Mining Act, there are no instances of 'exempt land' within the boundary of the ML on the Site. As such, the operation has not had to obtain waivers for the benefit of exemption from mining operations as part of the approvals process.

Figure 1-1: Portia Mine Site Location

2 DESCRIPTION OF THE ENVIRONMENT

This Section describes the pre-mining (baseline) environment in the vicinity of the Site. Where additional knowledge or information about the environment has been obtained since the previous description presented in previous PEPRs, updates have been made under the relevant sub-section.

2.1 Local Community

The closest large regional centre is Broken Hill, located approximately 110 km (direct) to the southeast, across the border in New South Wales. The Site is also located approximately 105km northwest of Cockburn. Cockburn is the nearest town to the Site, with the only other relatively close population centres being pastoral station homesteads and the Honeymoon Uranium Mine Site.

2.2 Land Use

ML 6346 lies on the Benagerie Pastoral Block, which forms part of Mulyungarie Station.

Historically the land has been used as unimproved pasture and for mineral exploration. The area has been described as being in fair rather than good condition and has been subject to grazing by native animals as well as livestock over a long period in the past (Badman, 2008a). Post-mining, land will be returned to pastoral use.

Given the location, hydrology, soil characteristics and vegetation of the land, the potential uses for the land are limited to pastoral, mining and mineral exploration. Public amenity is generally low and there are no unusual habitats, sites of significance or other items that are likely to make the area suitable for conservation.

Agricultural productivity is described as very low and generally supports about 12 sheep per square kilometre. There are no known plans for future changes in land use.

2.3 Proximity to Housing and Infrastructure

The nearest dwellings to the Site are associated with the Mooleulooloo Homestead located approximately 20 km to the south. Other nearby homesteads are Mulyungarie, located 30 km to the east, Yarramba located 30 km to the southeast and Kalkaroo which lies 50 km to the south of the Mine Site.

The nearest small population centres are Cockburn, some 105 km southeast of the Site and Olary, about 110 km to the southwest. The Site is currently accessible only by existing station tracks on pastoral leases as shown on Figure 2-1.

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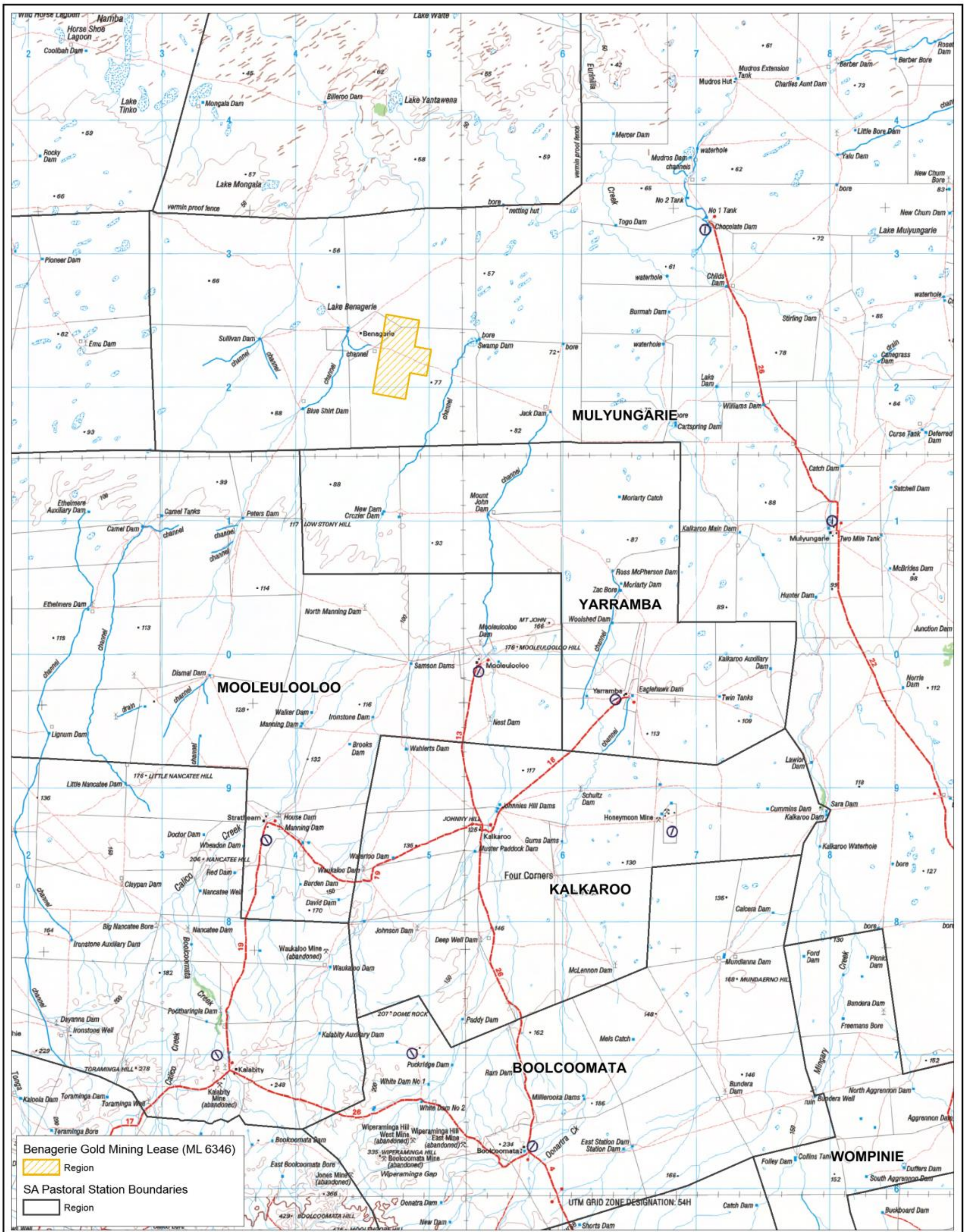


Project: Portia Gold	Author: AW	Reviewed: CG	Adjacent Pastoral Leases
Revision: 0	Date: 12/10/2016		
	N W E S	Scale 1: 250,000 @ A3 Coord System: GDA94 Datum, MGA Z54 Projection	

Figure 2-1: Pastoral Leases

2.4 Amenity

The Site is located in an area of generally low visual and cultural amenity. There are no commercial or recreational facilities within 100 km (with the exception of the privately-owned Honeymoon Uranium Mine Site) and recognised features of outstanding or noteworthy natural beauty are also not known to exist in close proximity to the Site.

2.5 Noise, Dust, Air Quality

The area in which the Site occurs is sparsely populated, and devoid of sources of industrial noise and noise associated with human habitation and movement.

It is also an area of low rainfall and high evaporation, resulting in vegetation being sparse. Overgrazing by native and introduced animals has led to soils becoming exposed, resulting in the generation of large amounts of dust in periods of strong winds.

There are no sources of airborne pollution on Site, apart from dust and emissions from mineral and exploration activities.

2.6 Topography and Landscape

The Site lies within the plains of the Lake Frome Basin. The plains are flat, with the land surface falling gradually at a gradient of about 1 in 1,000 towards Lake Frome, 100 km to the northwest of the Site.

Apart from three isolated low hills near Mooleulooloo Homestead and a rocky knoll at Kalkaroo, the nearest areas of elevated topography are the Olary Ranges about 60 km to the south. To the east, the Barrier Range lies beyond the New South Wales border.

The landscape surrounding the Portia Mine Site is characterised by low sandy dunes with a vertical relief of up to 3 m in height, trending in a south westerly - north easterly direction. The dunes are characterised by a cover of saltbush and bluebush. The Site is approximately 70 m above sea level. Figure 2-2 shows the pre-mining topography of the Site.

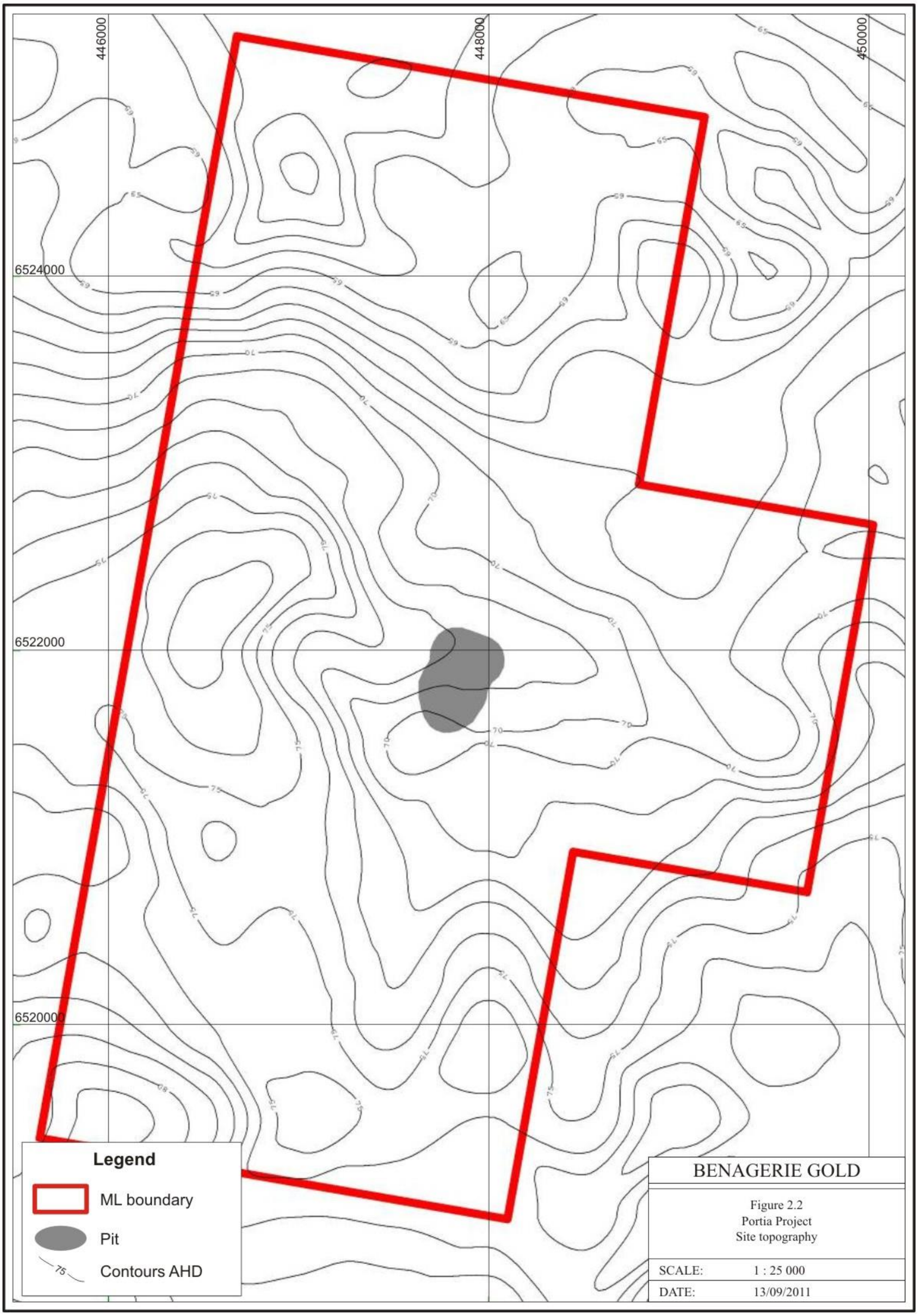


Figure 2-2: Site Topography (with the Location of the Portia Open Pit)

2.7 Climate

Meteorological data has been sourced from the Bureau of Meteorology (BOM). The closest weather stations to the Site are Site Number 020026, 'Yunta', located approximately 150 km southwest of the Site (Lat -32.5819, Long 139.5611) and Site Number 047039, 'Umberumberka Reservoir', located approximately 90 km east of the Site (Lat -31.8153, Long 141.2090).

A summary of the average monthly climate data for Yunta and Umberumberka Reservoir is presented in Table 2-1.

Table 2-1: Climate Summary

Month	Average Monthly Rainfall (mm)		Maximum Monthly Rainfall (mm)		Average Daily Pan Evaporation (mm)		Average Daily Maximum Temperature (°C)		Average 9 AM Wind Speed (km/h)	
	Y[1]	U[2]	Y	U	Y	U	Y	U	Y	U
January	21.1	18.7	176.5	112.6	N/A[3]	12.5	32.6	32.2	11.4	16.4
February	20.8	18.1	146.9	87.9	N/A	11.8	32.1	31.9	10.8	14.3
March	15.6	14.7	146.0	93.9	N/A	9.7	29.3	28.7	11.3	12.6
April	15.9	12.7	116.0	142.2	N/A	6.1	24.2	23.3	10.0	10.3
May	22.9	19.9	123.0	90.8	N/A	3.6	19.1	19.0	9.0	9.7
June	21.7	15.9	70.9	109.0	N/A	2.6	15.9	15.3	9.5	9.2
July	16.8	15.4	71.9	62.0	N/A	2.8	15.4	14.8	10.9	9.2
August	19.0	14.5	58.3	47.0	N/A	4.1	17.3	17.4	12.4	10.1
September	18.3	17.7	97.4	91.7	N/A	6.3	20.8	21.1	14.7	13.9
October	22.5	20.2	99.0	96.2	N/A	7.9	24.3	25.0	15.9	13.3
November	19.7	19.4	113.5	183.4	N/A	10.3	28.3	28.4	12.9	12.8
December	21.7	19.6	154.2	111.1	N/A	11.9	31.1	31.0	12.4	14.2

1 Y = Yunta

2 U = Umberumberka

3 N/A = Not Available

While rainfall is evenly spread across the year, there is a peak in evaporation in the summer. In 90 years of records, the highest daily rainfall recorded at Umberumberka in 1933 was 179.3 mm. In 99 years of records the highest daily rainfall recorded at Yunta was 112.3 mm. The calculated 1:100 year AEP 72 hour storm for Benagerie is 156 mm (BOM, 2012)[2].

Between May and September, the wind prevails mostly from the western semi-circle, with a roughly even distribution of directions between north and south. Between October and April, southerly winds increase markedly in frequency to become the predominant direction at all times of the day, occurring up to a maximum of nearly 50% of the time in the morning and less frequently in the afternoon when directions are more variable. Easterly component winds also increase in frequency during the hotter semester of the year.

2 Intensity Frequency Duration calculator using coordinates for Benagerie returns 156 mm for a ARI 100 year 72 hour storm.

Average wind speeds are higher during the warmest time of the day and year, when atmospheric instability is greatest and lower during the coldest times when the atmosphere is generally most stable. Over the year, surface winds average approximately 6 knots (3.33 m/s).

2.8 Geohazards

2.8.1 Seismicity

The Site is situated approximately 250 km east of a major geologic structural feature known as the Torrens Lineament. The Flinders Range segment of this lineament is one of the two most active seismic zones in Australia.

Based on published earthquake hazard maps (Love, 1996), the Site could experience an earthquake with an acceleration co-efficient exceeding 30 mm/s^2 to 50 mm/s^2 every 500 years. This is substantially lower than the risk experienced in Adelaide where coefficients could reach 70 mm/s^2 every 500 years. Earthquake damage to the proposed mine infrastructure would be minimal due to the small-scale nature of fixed plant and infrastructure proposed.

2.8.2 Radioactive Minerals

No significant radioactive minerals have been discovered at the Site and measured uranium contents are below the 80 ppm trigger level for further investigation. The highest average uranium elemental composition occurs within the gold ore zone and rarely rises above 31 ppm.

Drilling by uranium explorers, including an associated company (Curnamona Energy Limited) has failed to discover any economic uranium mineralisation within the Portia Mine Site region.

2.8.3 Karst Formations

There are no known karst formations associated with the Site.

2.8.4 Minerals Hazardous to Human Health

Ore Material

The results of the geochemical analysis of the gold ore zone, indicates that only minor enrichment in heavy metals occurs within the ore zones being mined. The current average concentrations for these elements are below the Health based Investigation Levels (HILs) for parks, recreational open space and playing fields as described under Schedule B(1) of the National Environmental Protection Council (NEPC) *Guideline on Investigation Levels for Soil and Groundwater*.

Arsenic within the weathered saprolitic ore zone, below the main gold bearing layer is the only element exceeding the HIL guideline trigger values for parkland and recreational environments for some samples. However, whilst it exceeds this value, it does not exceed the HIL guideline threshold value for commercial/industrial sites of 500 mg/kg.

Overburden Waste Rock

No minerals hazardous to human health have been found to occur from geochemical analysis of the overburden material to be mined.

2.9 Hydrology

There are no established or well-defined water courses within approximately 10 km of the Site and no significant drainage channels occur in the ML area, with primary drainages lying well to the north, south and east. The nearest naturally occurring primary drainage is Billeroo Creek lying 8.3 kms due north of the Site, which then feeds into Lake

Yantaweena, 17.5 km north. Both Billeroo Creek and Lake Yantaweena are ephemeral and unlikely to support aquatic flora and fauna.

In the immediate vicinity of the Site, the landscape is characterised by a series of low northeast trending dunes separated by flat interdune corridors. Denuded clay pans between the dunes are common in these basins. Pooled surface water typically occurs only after significant and intense rainfall events. Rainwater generally soaks into surficial soils and sands and may also accumulate on clay pans prior to being evaporated.

Some stock watering dams have been constructed across the existing ephemeral drainage lines, the nearest of these drainage channels feeds Jacks Dam approximately 10 km to the east, Blue Shirt Dam, approximately 7 km to the west and Swamp Dam approximately 5 km northwest of the Site.

Pre-mining surface water drainage is shown in Figure 2-3.

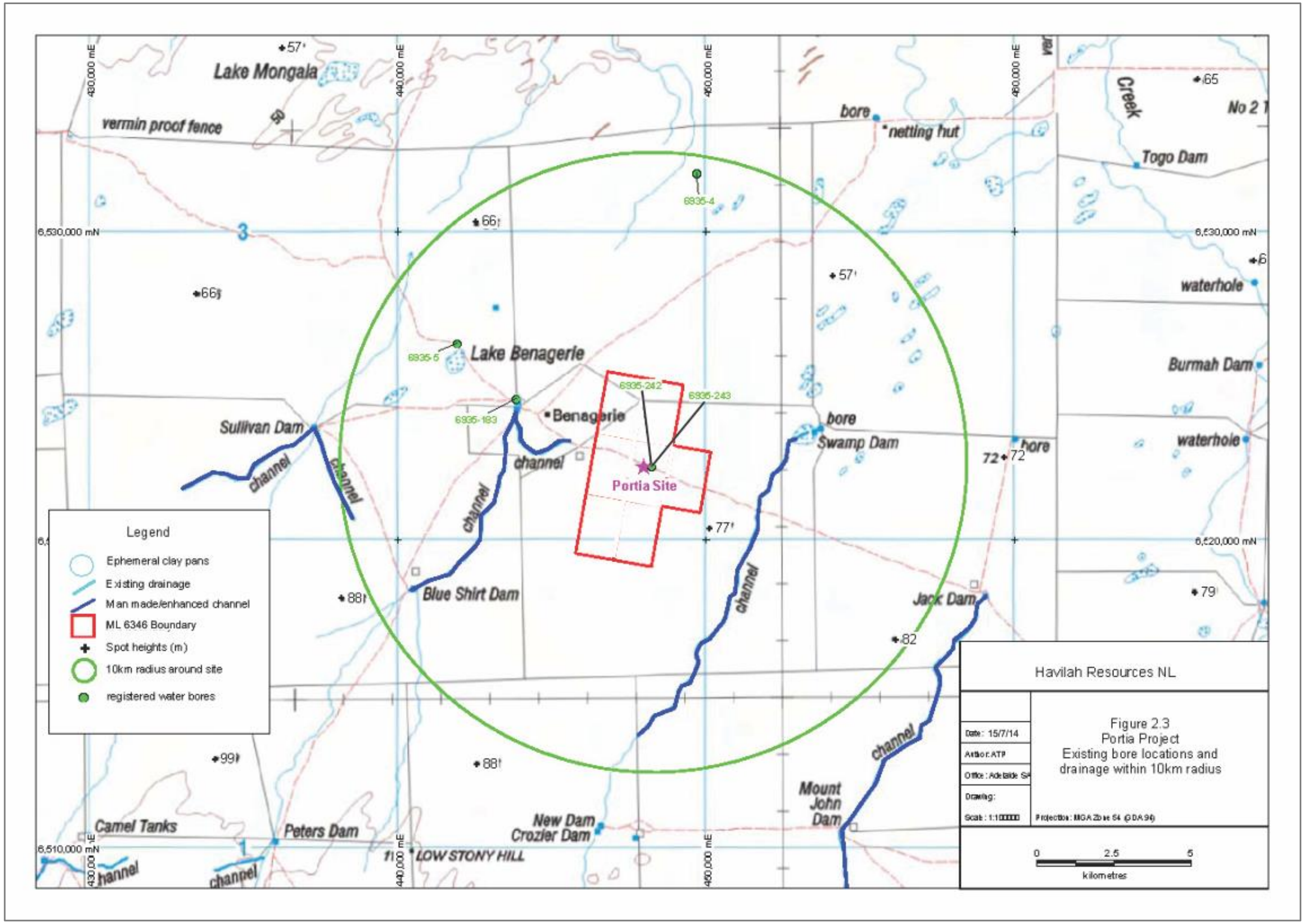


Figure 2-3: Surface Drainage and Groundwater Wells within 10 km Radius

2.10 Groundwater

The stratigraphic succession at the Site includes up to 3 m of 'Recent' age sediments associated with aeolian dunes and outwash deposits of the Frome plains underlain by Namba and Eyre Formations of the Tertiary age Lake Eyre Basin sequence.

The Namba Formation consists of about 70 m thickness of grey to red-brown clay with lenses of clayey sand in the upper part. The Namba Formation is unsaturated, containing approximately 40% by weight water. It is of low permeability, acting as a confining layer rather than an aquifer.

The Eyre Formation occurs beneath the Namba Formation at the Site and consists of white, pink and grey clays with variable silty components and is commonly referred to as the Eyre Clays. This unit varies in thickness up to about 12 m maximum, but is commonly absent, particularly at locations where the basement rocks occur at shallower depths (basement highs). It is thought to have been formed by the transport and deposition of locally derived materials from the nearby basement highs. It is important to note that at the Site, the Eyre Formation has no gravelly or sandy component and is not part of the palaeochannel system, nor is it hydraulically connected to them.

The Yarramba Palaeochannel lies more than 3 km from the Portia Deposit (refer Figure 2-5) and extensive drilling shows that in the intervening area, sandy horizons are generally absent, and in many places clays of the Namba Formation, acting as aquitards, lie directly on the bedrock (Figure 2-6)

Sediments of the Eromanga Basin (and hence Great Artesian Basin) do not occur at the Portia Mine Site.

The Tertiary cover sequence consists of soapy-plastic clays and minor sands, including the basal Tertiary Ore horizon of sandy-gritty clayey silt. The basement below the base of Tertiary Ore horizon (Light Grey Clay) consists of a sequence of five lithological units, which strike to the north-north-east and dip at approximately 45 degrees to the east. In stratigraphic order, these comprise the Footwall Albitite (FA), Pyritic Albitite (PA), Graphitic Pelite (GP), Quartz Albitite (QA) and Hangingwall Pelite (PE) units. The uppermost 50 m or so of the basement units are highly weathered and are saprolitic. Weathering has also led to the development of small depressions in the basement topography which have been infilled by Eyre Clays. The Portia Deposit sits in one of these small depressions (refer to Figure 2-5).

Historical and more recent drilling has confirmed that there is no perched aquifer system within the upper Namba and Eyre Formations. This is further confirmed throughout the Portia open pit mine life to date as there has been no evidence of any seepage from the pit walls from any of the geological units above the weathered basement. If any of these upper units contained groundwater weeping or damp patches would be observed in the pit walls.

The most permeable rock unit encountered to date at the Portia Mine Site is the Hangingwall Pelite, which is highly fractured and capable of well yields in excess of 5 L/s, which has been seen in dewatering wells on the eastern margin of the Portia open pit, e.g. PTDW10, PTDW12 and PTDW13. This unit is believed to extend to the north to form the Hangingwall of the North Portia deposit where similar well yields are expected.

A search of the Water Connect drillhole database administered by the Department for Environment and Water (DEW) that was conducted pre-mining indicates that there are five groundwater wells located within a 10 km radius of the Portia Mine Site (excluding all investigation, monitoring, dewatering and re-injection water wells completed by BGC for the Portia Project). A summary of the available data from these wells are presented in Table 2-2. Well (bore) locations are shown in Figure 2-3.

All existing identified wells are currently abandoned or have an unknown status. None of these wells are currently used for domestic, stock or irrigation water supply. Only one of the five wells had recorded water quality data (Unit 6935-4) in the form of both total dissolved solids (TDS) and electrical conductivity (EC). The values recorded are 200,135 mg/L TDS and 235,453 µS/cm, which is considered hypersaline. Given that the groundwater salinities encountered in hydrogeological investigations conducted for the Site have not been found to be this saline it is possible that the high salinity values in Water Connect are due to data entry error. Unit 6935-243 is used only as a water resource for regional mineral exploration activities.

Hydrogeological investigations conducted at the Portia Deposit included the test pumping and monitoring of groundwater wells within the open pit footprint, and the collection of water samples and their laboratory analysis. The findings from these pre-mining investigations can be found in Appendix C1 and Appendix C3.

Water samples collected from nine individual wells (Jareds, TJ-1, TJ-5, TJ-8 and PTDW1, PTDW3, PTDW4, PTDW6 and WB1), located within and surrounding the immediate vicinity of the Portia open pit location, were submitted to a National Association of Testing Authority (NATA) accredited laboratory (ALS Environmental) for hydrochemical analysis. Laboratory results for each individual sample are summarised in Table 3-36, on page 198 and the average hydrochemical values for these results are reported in Table 2-3. Table 2-3 shows that groundwater at the Site is saline, with an average TDS of 13,625 mg/L and an average pH of around 7.8. Pre-mining depth to water was approximately 26-28 m below ground level (BGL) (approximately 41-43 m AHD).

The environmental value (beneficial use) of the groundwater at the Site has been defined as industrial. This was determined and agreed during consultation with DEM, DEW and the South Australian Environment Protection Authority (SA EPA) in preparation of the original PEPR (PEPR2014/090). Although industrial use is the selected environmental value, there are more stringent values applied for some parameters, notably arsenic, where the livestock trigger level from the ANZECC (2000) guidelines has been adopted, in the absence of a specific trigger level for industrial use. When assessing and presenting chemical concentrations in groundwater, BGC will endeavour to present both the industrial and livestock trigger values for ease of comparison.

Data on standing water levels (SWLs) from available drill holes, including a series of old exploration holes (labelled as BEN) completed prior to November 2014, have been examined and used to construct the pre-dewatering potentiometric surface for the fractured bedrock aquifer (see Figure 2-7 taken from Aqueon, 2016c). The direction of groundwater movement is west-north-west towards the Shylock Palaeochannel, with a hydraulic gradient away from the open pit towards the Shylock Palaeochannel of 0.00047 (~0.5 m per 1100 m). East of the open pit the pre-mining hydraulic gradient in the fractured bedrock is much steeper based on the reported reference SWL of ~46 m AHD for monitoring well W2A prior to mining. Assuming the reported SWL for well W2A is correct, the calculated hydraulic gradient east of the open pit is 0.0028 (~1.0 m per 350 m). The steeper hydraulic gradient to the east of the open pit is most likely a result of the contact between the high yielding Hangingwall Pelite and the significantly lower yielding Quartz Albitite and Graphitic Pelite.

Figure 2.3 shows the potentiometric surface map of the immediate mine area. Additional data will be collected over the next reporting period to extend the potentiometric surface map so that the rest of the ML area will be included in future representations.

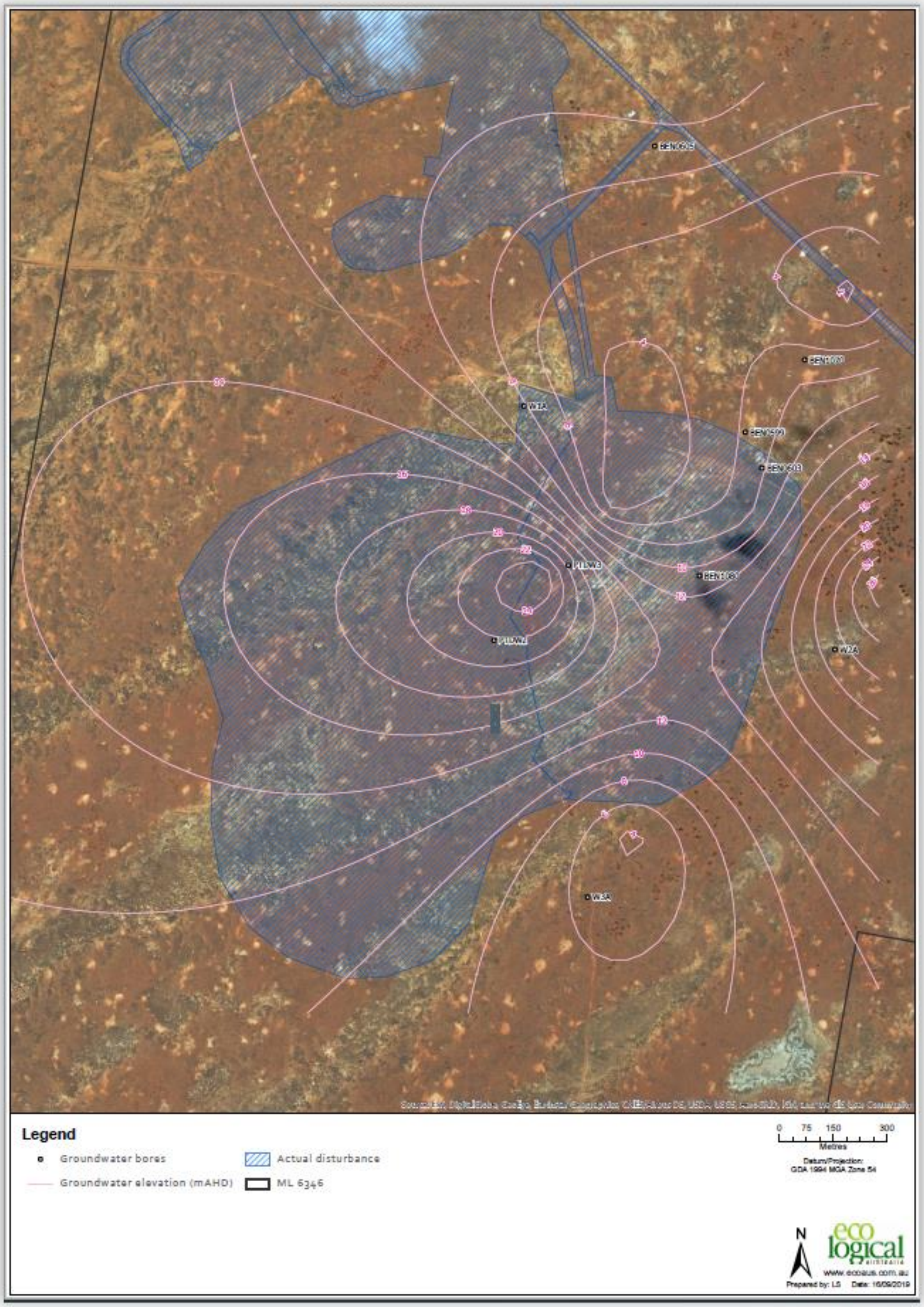


Figure 2-4: Potentiometric Surface Map of Active Mine Area

Table 2-2: Summary of Existing Water Well Locations from Water Connect

Unit No	6935-4	6935-5	6935-183	6935-242	6935-243
Drillhole Name	**-**	**BENAGERIE**	**414 B1**	**-**	**-**
orig drill depth (m)	-	-	28.96	56	91
orig drill date	-	-	27/10/1970	15/04/1998	16/04/1998
max drill depth (m)	182.88	64.92	28.96	56	91
max drill date	1/01/1977	-	27/10/1970	15/04/1998	16/04/1998
late open depth (m)	182.88	64.92	28.96	0	91
late open date	1/01/1977	-	27/10/1970	15/04/1998	16/04/1998
purpose	-	-	-	DOM	DOM
late status	ABD	ABD	UKN	ABD	-
late status date	-	14/06/2011	27/10/1970	15/04/1998	-
SWL (m)	18.29	-	-	-	18.4
RSWL (m)	34.15	-	-	-	46.88
water level date	1/01/1977	-	-	-	16/04/1998
TDS (mg/L)	200,135	-	-	-	-
EC (⍰S/cm)	235,453	-	-	-	-
salinity date	1/01/1977	-	-	-	-
pH	-	-	-	-	-
pH date	-	-	-	-	-
Yield (L/s)	-	-	-	-	3.75
yield date	-	-	-	-	16/04/1998

Source: Water Connect Drill Hole Enquiry System, August 2014

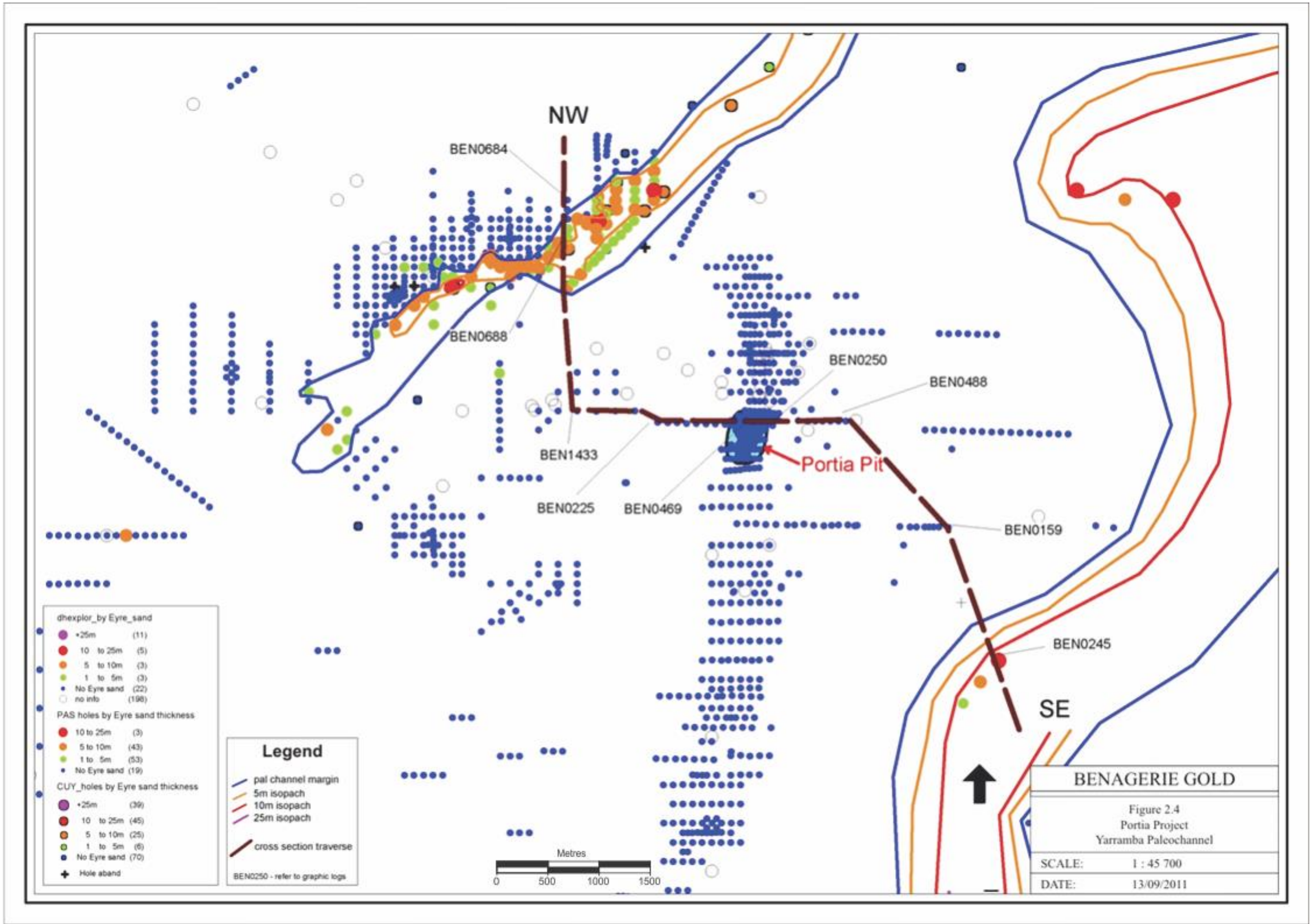


Figure 2-5: Palaeochannels Near the Portia Deposit

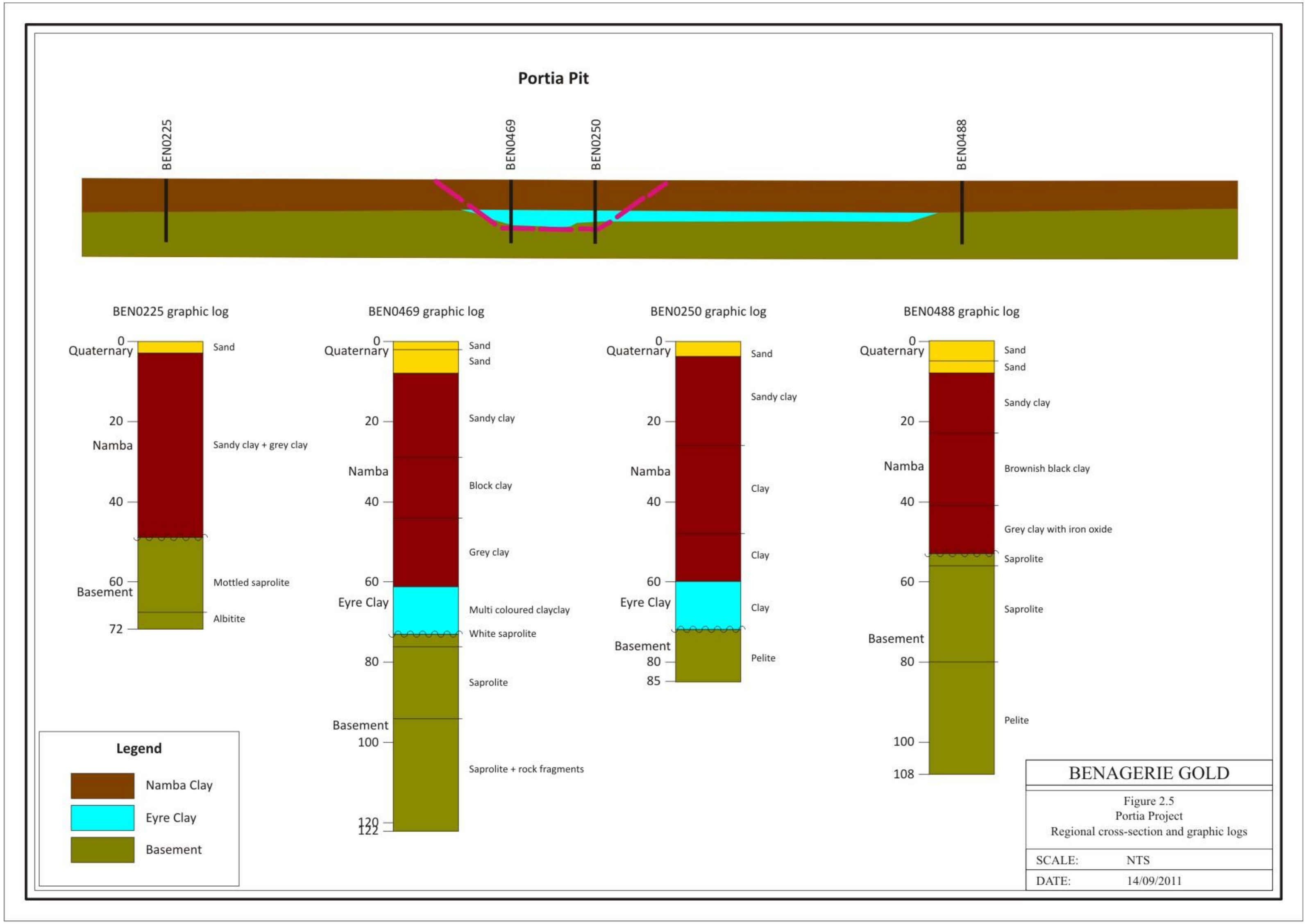


Figure 2-6: Regional Cross-Section and Graphic Logs

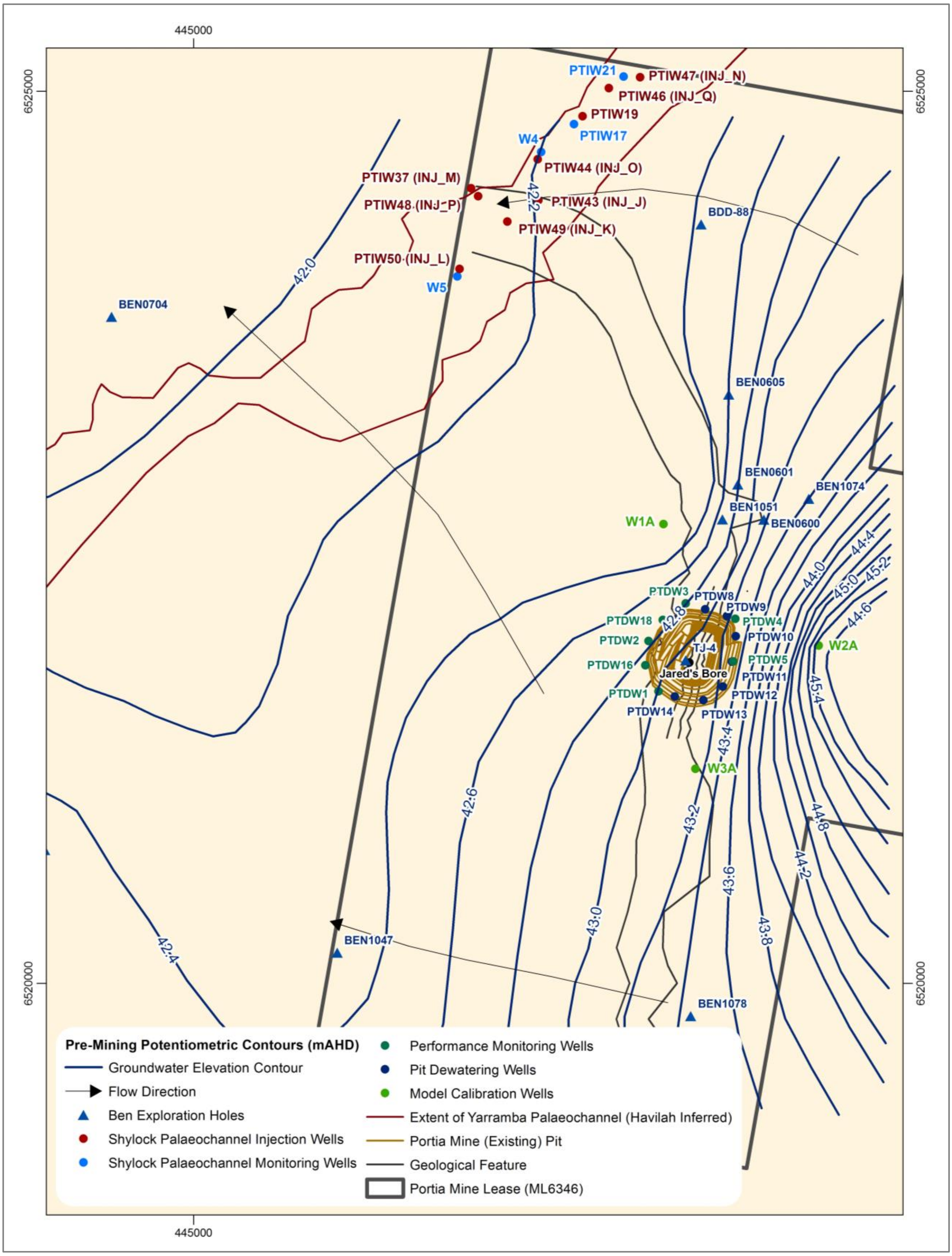


Figure 2-7: Pre-mining Potentiometric Surface for the Fractured Bedrock Aquifer (Aqueon, 2016c)

Table 2-3: Average Mine Groundwater Quality Results

Parameter	Units	LOR	Average Value
pH Value	pH Unit	*0.01*	7.84
Electrical Conductivity @ 25°C	µS/cm	*1*	22,525
Total Dissolved Solids @ 180°C	mg/L	*10*	13,625
Hydroxide Alkalinity as $CaCO_3$	mg/L	*1*	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	*1*	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	*1*	189
Total Alkalinity as $CaCO_3$	mg/L	*1*	191
Sulfate as SO_4 (Turbidimetric)	mg/L	*1*	1,759
Chloride	mg/L	*1*	6,866
Calcium	mg/L	*1*	512
Magnesium	mg/L	*1*	307
Sodium	mg/L	*1*	3,933
Potassium	mg/L	*1*	25
Dissolved Metals			
Arsenic	mg/L	*0.001*	0.406
Barium	mg/L	*0.001*	0.023
Beryllium	mg/L	*0.001*	<0.001
Cadmium	mg/L	*0.0001*	<0.0001
Cobalt	mg/L	*0.001*	0.001
Chromium	mg/L	*0.001*	<0.001
Copper	mg/L	*0.001*	0.004
Nickel	mg/L	*0.001*	<0.001
Lead	mg/L	*0.001*	<0.001
Vanadium	mg/L	*0.01*	<0.01
Zinc	mg/L	*0.005*	<0.006
Iron	mg/L	*0.05*	0.160
Manganese	mg/L	*0.001*	0.529
Mercury	mg/L	*0.0001*	<0.0001

2.11 Vegetation, Weeds and Plant Pathogens

Playfair & Robinson (1997) presented the most recent and detailed review of the vegetation and flora of the region defined as the North Olary Plains (published as Hyde & Playfair, 1997 in Playfair & Robinson, 1997). The fieldwork for this assessment was undertaken from 1995 to 1997.

In addition, the Pastoral Program of DEW (formerly Pastoral Management Branch) undertakes condition assessments of all pastoral leases in the State. It has information about vegetation condition for each paddock on each pastoral property in the region.

Prior to Playfair & Robinson (1997), this region was one of the most poorly researched in South Australia. No comprehensive assessments of flora had been conducted and there were few historical accounts from explorers.

2.11.1 Vegetation Communities in the Bioregion

This area lies within the Broken Hill Complex Bioregion (Neagle, 2003) and consists mainly of sandy-clay plains with low shrubland vegetation (Playfair and Robinson, 1997). The Portia Mine Site area is located within the North Olary Plains region. Thirty-nine vegetation associations (communities), of which twenty-nine were discernible by objective analysis and 448 plant taxa have been recorded in the entire North Olary Plains region (Playfair & Robinson, 1997). Of these communities, a number are represented by small, minor or trace occurrences (less than 0.5%). Chenopod shrublands occupy the largest areas in the region, while only the following three major communities were recorded:

- community 24, *Acacia aneura / Enneapogon* spp. low open woodland, 16.48%
- community 32, *Atriplex vesicaria / Maireana astrotricha* low open shrubland, 11.73%
- communities 25/5, *Maireana astrotricha* low open woodland and *Senna / Eremophila / Rhagodia spinescens* open shrubland, 7.14%.

2.11.2 Baseline Flora and Fauna Investigations

Two baseline vegetation surveys covering the Site on Benagerie Station, now part of Mulyungarie Station were conducted under a South Australian Department for Environment and Heritage (DEH) Permit to Undertake Scientific Research No. G24191 8 held by Dr F.J. Badman. The first survey formed part of an official DEH biological survey, designated “Number 577, Oban – Curnamona Energy”.

The second survey also undertaken by Badman Environmental occurred during the second week of October 2007 and is complementary to the earlier survey in June 2007. Data from the two surveys have been combined and reported on (Appendix A1). Although some rainfall had occurred earlier in the year, conditions were dry at the time of the second survey. Conditions were wet at the time of the first survey, with many ephemeral taxa too immature to be identified to species level at that time.

The surveys were carried out using the methodology of the DEH Biological Survey of South Australia although sites from the second survey were not permanently marked. Voucher collections were made of the plant species that were not recorded during recent surveys at Oban, Mutooroo and Kalkaroo. Voucher collections were lodged with the State Herbarium of South Australia.

Data from 18 sites were analysed using the techniques of classification and ordination and five vegetation groups were identified. These groups are based mainly on domination by different vegetation structures as well as by different species.

A supplementary vegetation survey was conducted by Kellogg Brown & Root Pty Ltd (KBR) in the period 27 February 2011 to 5 March 2011 during the actioning of a fauna survey (Appendix A2). Survey areas were selected within the Site and in areas immediately adjacent to it. Stratification of vegetation, flora and fauna survey sites was non-random, and sites were specifically selected to assess the range and quality of communities and habitat types present and to survey a significant portion of the Site.

2.11.3 Vegetation Communities

Vegetation mapping indicates that the survey area is dominated by low shrublands of *Maireana astrotricha* (Low Bluebush) on the plains, with areas of *Atriplex vesicaria* (Bladder Saltbush) and *Maireana astrotricha* on low dunes. There are some isolated stands of *Casuarina pauper* (Black Oak) low woodlands.

Other less common vegetation types are tall shrublands on sand plains and *Eragrostis australasica* (Cane-grass) in swampy areas. Grasses were recorded in most groups, but do not appear to be a major factor in the composition of any single group.

Vegetation of the Site survey area has been classified within five groups. A brief description of each vegetation groups (association) is summarised below. A map showing the vegetation associations around the ML area is presented in Figure 2-8.

Group 1

This is the most common vegetation association at the Site. It consists of low open or sparse shrublands dominated by *Maireana astrotricha* on sandy-loam soils. *Maireana aphylla* (Cotton-bush) occurs at most sites in this group and *Atriplex vesicaria* was recorded at a majority of sites. *Gunniopsis quadrifida* (Sturt's Pigface) is common at some sites. At the time of the 2007 survey, the understorey was dominated by *Atriplex holocarpa* (Pop Saltbush) and *Sclerolaena ventricosa* (Salt Bindyi).

No other species were dominant in this group and very few tall shrubs and no trees were recorded here. Other species that were often recorded in the understorey include *Austrostipa nitida* (Balcarra Spear-grass), *Dissocarpus biflorus* (Two-horn Saltbush), *Gnephosis arachnoidea* (Spidery Button-flower), *Salsola kali* (Buckbush), *Sclerolaena decurrens* (Green Bindyi), *Sclerolaena intricata* (Tangled Bindyi) and *Tripogon loliiformis* (Five-minute Grass).

Only four introduced species were recorded in this group. The most common of these were *Carrichtera annua* (Ward's Weed) and *Schismus barbatus* (Arabian Grass). Other alien species recorded here are *Brassica tournefortii* (Wild Turnip) and *Sonchus oleraceus* (Common Sow-thistle), neither of which was very common.

Group 2

Group 2 vegetation association includes sites that are similar to those in Group 1, but generally support more trees or tall shrubs. This group was found to occur on sandy or sandy-loam soils, with the upperstorey including some or all of *Acacia aneura* (Mulga), *Dodonaea viscosa* ssp. *angustissima* (Narrow-leaf Hop-bush), *Hakea leucoptera* (Silver Needlewood) and *Senna artemisioides* ssp. *petiolaris* (Senna). The understorey includes the low shrubs *Gunniopsis quadrifida*, *Maireana astrotricha* and *Rhagodia spinescens* (Spiny Saltbush) and the herbs and forbs *Atriplex holocarpa*, *Atriplex limbata* (Fan Saltbush), *Salsola kali*, *Sclerolaena decurrens* and *Sclerolaena diacantha* (Grey Bindyi). Less common species include *Atriplex velutinella* (Sandhill Saltbush), *Austrostipa nitida*, *Enchylaena tomentosa* (Ruby Saltbush) and *Tripogon loliiformis*.

Schismus barbatus was the most commonly recorded alien species in this group, with *Brassica tournefortii* also recorded here.

Group 3

Although only one site was sampled in this group, it is typical of the numerous cane-grass swamps and clay pans that occur throughout the survey area. These have a clay base and hold water for varying periods following significant rainfall events. The dominant species is the hummock grass *Eragrostis australasica* (Cane-grass). The shrubs *Chenopodium nitrariaceum* (Nitre Goosefoot), *Muehlenbeckia florulenta* (Lignum) and *Rhagodia spinescens* are slightly less common. *Dodonaea viscosa* ssp. *angustissima* also occurs here in the upper storey. The understorey is made up mainly of short-lived species with a few biennials, and includes *Atriplex holocarpa*, *Atriplex spongiosa*, *Bulbine* sp. (Bulbine Lily), *Osteocarpum* sp. (Bonefruit), *Sclerolaena brachyptera* (Short-wing Bindyi), *Sclerolaena ventricosa* and *Zygophyllum iodocarpum* (Violet Twinleaf). *Eragrostis setifolia* (Bristly Love-grass) occurs near the margins of swamps. Some swamps are fringed by a narrow band of *Eucalyptus largiflorens* (River Box).

Three introduced species were recorded in this vegetation group, *Brassica tournefortii*, *Schismus barbatus* and *Carrichtera annua*. The first two of these prefer sandy soils and were recorded only on the sandy margins of the swamps.

Group 4

This group contains areas of *Casuarina pauper* (Black Oak) woodland that occur on clay-loam soils just to the east of the central part of the survey area. *Casuarina pauper* dominates the overstorey, but *Alectryon oleifolius* (Bullock Bush) also occurs here. The understorey commonly includes the low shrubs *Maireana aphylla* and *Maireana pyramidata* (Black Bluebush), with *Gunniopsis quadrifida* and *Atriplex vesicaria* being less common. Other understorey species include *Einadia nutans* (Climbing Saltbush), *Enchylaena tomentosa*, *Eremophila glabra* (Tar Bush), *Rhagodia spinescens*, *Sclerolaena decurrens*, *Sclerolaena obliquicuspis*, *Tetragonia eremaea* (Desert Spinach), *Tripogon loliiformis* and *Zygophyllum iodocarpum*.

No introduced species were recorded at the site that forms the basis for the description of vegetation in this group.

Group 5

The final group contains sites on very low sand dunes and sandplain just to the west of centre of the survey area. Vegetation comprises low open shrubland or tall shrubland with a low shrubland understorey. Tall shrublands include *Dodonaea viscosa* ssp. *angustissima* or *Eremophila sturtii* (Turpentine Bush), while low shrublands include *Atriplex vesicaria*, *Gunniopsis quadrifida*, *Maireana astrotricha* and *Sclerolaena decurrens*. Other groundcover species include *Atriplex limbata*, *Erodium* sp(p). (Heron's Bill), *Sclerolaena diacantha/uniflora* and *Tetragonia eremaea*.

No introduced species were recorded within this group.

2.11.4 Threatened Flora

A search for information on threatened species was first carried out using the study area's biogeographic boundaries (Neagle, 2003). A secondary search was carried out under the area's botanical region boundary (Barker *et al*. 2005). The latter boundary (Eastern Botanical Region) is an artificial one based on straight lines of latitude and longitude. It includes a large area of country that is quite dissimilar to the Portia survey area.

No flora species that are listed as threatened under either the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* ('EPBC Act') or the South Australian *National Parks and Wildlife Act 1972* ('NPW Act') was recorded on the ML area during either of the Portia surveys.

Barker *et al*. (2005) list three *Endangered* species for the Eastern Botanical Region of South Australia (Table 2-4). This is the region which contains the Portia survey area. They also list 12 *Vulnerable* and 33 *rare* species from this area (Table 2-4).

Table 2-4: Threatened Species, Eastern Botanic Region

Threatened Species	50 km radius of Portia Prospect	50-100 km radius of Portia Prospect
Endangered		
Atriplex papillata	No	No
Codonocarpus pyramidalis	No	No
Pterostylis lingua	No	No
Vulnerable		
Acacia carneorum	Yes	Yes
Acacia pendula	No	Yes
Cullen parvum	No	No
Dianella poracea	No	Yes
Malacocera gracilis	No	?
Ozothamnus scaber	No	Yes
Ranunculus pumilio var. politis	No	Yes
Santalum spicatum	No	No
Sauropus ramosissimus	No	No
Swainsona fuscoviridis	No	Yes
Swainsona murrayana	No	Yes
Swainsona procumbens	Yes	Yes
Rare		
Acacia barattensis	No	No
Acacia confluens	No	No
Acacia loderi	No	No
Aristida arida	No	No
Atriplex eichleri	No	Yes
Austrodanthonia laevis	No	Yes
Austrodanthonia tenuior	No	No
Austrostipa densiflora	No	No
Austrostipa trichophylla	No	No
Austrostipa tuckeri	No	No
Bothriochloa macra	No	Yes
Brachyscome eriogona	No	No
Calotis lappulacea	No	Yes
Calotis scapigera	No	Yes
Daviesia stricta	No	No
Derwentia derwentiana	No	No
Eragrostis lacunaria	No	Yes
Eucalyptus viridis	No	No
Frankenia cupularis	No	Yes
Geijera parviflora	No	Yes
Gilesia biniflora	No	No
Haeckeria punctulata	No	No
Hakea tephrosperma	No	No
Maireana melanocarpa	No	No

Threatened Species	50 km radius of Portia Prospect	50-100 km radius of Portia Prospect
Muehlenbeckia coccoloboides	No	?
Olearia picridifolia	No	No
Ophioglossum polyphyllum	No	Yes
Potamogeton ochreatus	No	No
Rumex dumosus	No	No
Swainsona oligophylla	No	?
Swainsona pyrophila	No	No
Swainsona tephrotricha	No	No

Species Profile and Threats Sheet (SPRAT) have been completed on behalf of DEH (now DEW) for approximately half of these species and details of the threatened species are as follows:

- ***Acacia carneorum***. This species is known to occur near the Benagerie – Yarramba boundary fence, about 11 km from the centre of the ML area. This species is listed as Vulnerable under both the Commonwealth EPBC Act and the South Australian National Parks and Wildlife Act. It has recently been the subject of a detailed study and a SPRAT sheet has been completed for it (SADEH 2007). This study found that this species occurs at isolated localities in the general area, with many herbarium records from the vicinity of the Mutooroo Mine area to the south east (Badman, 2008a) to Kalabity and Curnamona Stations to the west. In January 2007 there were 73 herbarium records from the Broken Hill Complex IBRA region in South Australia (SADEH, 2007)..

- ***Acacia pendula.*** This species occurs in the Plumbago area, in deep red sandy loam at base of a low sandstone monolith (SADEH, 2008).

- ***Atriplex eichleri.*** There are records from near Mingary and near the Strathearn Homestead (SADEH, 2008). Its habitat appears to be mainly low-lying areas where water concentrates (SADEH, 2008).

- ***Bothriochloa macra.*** There are two nearby herbarium voucher collections; from the roadside near Cockburn, where it was reported to be common, and from near the homestead flats and dam at Kalabity Station, where it was reported to be rare (SADEH, 2008).

- ***Calotis lappulacea.*** The closest herbarium voucher collection to the Portia survey area is from Kalabity Station, where it was reported to be rare (SADEH, 2008).

- ***Calotis scapigera.*** The only nearby herbarium voucher collection is from a flooded creek near Mingary (SADEH, 2008).

- ***Dianella porracea.*** The only nearby records are from granite outcrops on Bulloo Creek Station and from similar habitat half way between Olary and Old Boolcoomatta (SADEH, 2008).

- ***Eragrostis lacunaria.*** There are several herbarium voucher collections from rocky hills around Bulloo Creek Station, Old Boolcoomatta, the Olary Ranges and Kalabity (SADEH, 2008).

- ***Geijera parviflora.*** The closest herbarium voucher collections are from near Mingary and Boolcoomatta (SADEH, 2008).

- ***Muehlenbeckia coccoloboides.*** This is a more northern species and the only record from anywhere near the Portia survey area is from sub-saline swampy flats on Billeroo Station (SADEH, 2008), which may be within 100 km of the Portia survey area.

- ***Ophioglossum polyphyllum.*** The closest herbarium voucher collection to the Portia survey area is from Bulloo Creek Station (SADEH, 2008).

- ***Ranunculus pumilio var. politis****.* The only herbarium voucher collection from this general area is from Tombstone Hill on Plumbago Station (SADEH, 2008).

- ***Sclerolaena holtiana*****.** Although this species was once considered to be rare in South Australia (Neagle 2003), more recent work has shown that this rating is not warranted, and it is no longer listed as such (Barker *et al*., 2005, Lang and Kraehenbuehl, 2006).

- ***Swainsona fuscoviridis.*** There are several herbarium voucher collections from south of the Portia survey area, from Kalkaroo and Boolcoomatta Stations and from further west (SADEH, 2008).

- ***Swainsona procumbens.*** There are no records from the Portia survey area, with the closest records being from Kalkaroo and Boolcoomatta (SADEH, 2008).

During the KBR survey, no species of Commonwealth or State conservation significance was recorded within the Site during the surveys. However, in areas adjacent to the Site, several large patches of the nationally and state vulnerable purple-wood wattle (*Acacia carneorum*) were recorded (refer to Appendix A2).

2.11.5 Introduced Flora (Weeds)

Four introduced species were recorded during the Badman Environmental (2008) surveys. *Brassica tournefortii, Carrichtera annua* and *Schismus barbatus* are the most common introduced species overall. *Schismus barbatus* was recorded at more sites than any other introduced species.

The reason for the low incidence of alien species during this survey appears to be the lack of gullies and creeks flowing through sites in this area.

The most likely method of additional introduced species becoming established in the Portia Mine Site area is by seed being brought in on vehicles, plant and equipment.

The introduced species recorded during the second survey represent 4% of the total species list for this survey. No introduced species were recorded in the July 2007 survey. Playfair and Robinson (1997) list 150 introduced taxa for the North Olary Plains, or 33% of their total species list. However, this list includes many taxa that were identified only to genera level, but distinct species in most of these genera were also listed. It is therefore likely that many taxa were counted twice. Barker *et al.* (2005) list 15% of the flora of the Eastern Botanic Region, which includes Portia and the North Olary Plains, as being introduced. This list is based on vouchered herbarium collections and is the most accurate information available.

Eight additional introduced species were recorded by KBR during the 2011 survey and two of those were recorded outside of the Site. The most common introduced species were Arabian grass and Ward's weed, both of which were also recorded by Badman Environmental (2008a). Introduced species requiring future control are outlined in Table 2-5. Three of these plants are declared plants under the South Australian *Natural Resources Management Act 2004* ('*NRM Act 2004'*). They are all of high priority to control and they have the potential to cause significant environmental, economic or social impacts. They are also high priority weeds for mineral tenements. No weeds of national significance (WoNS) were recorded within the Site during this survey. However, two of the declared plants were in areas adjacent to the Site (Table 2-5).

Table 2-5: Declared Plants within and Adjacent to the Site

Family	Scientific Name	Common Name	Location
Declared plants (NRM Act)			
LABIATAE	*Marrubium vulgare*	Horehound	Occasional in wetter areas
COMPOSITAE (ASTERACEAE)	*Xanthium spinosum*	Bathurst burr	Jack's dam, adjacent to the site
COMPOSITAE (ASTERACEAE)	*Xanthium strumarium sp. agg*	Noogoora burr	Jack's dam, adjacent to the site
High priority weeds			
CRUCIFERAE	*Carrichtera annua*	Ward's weed	General area (i.e., within the site)
COMPOSITAE	*Carthamus lunatus*	Saffron thistle	General area
CUCURBITACEAE	*Cucumis myriocarpus*	Prickly paddy melon	General area
CRUCIFERAE	*Sisymbrium erysimoides*	Smooth mustard	General area

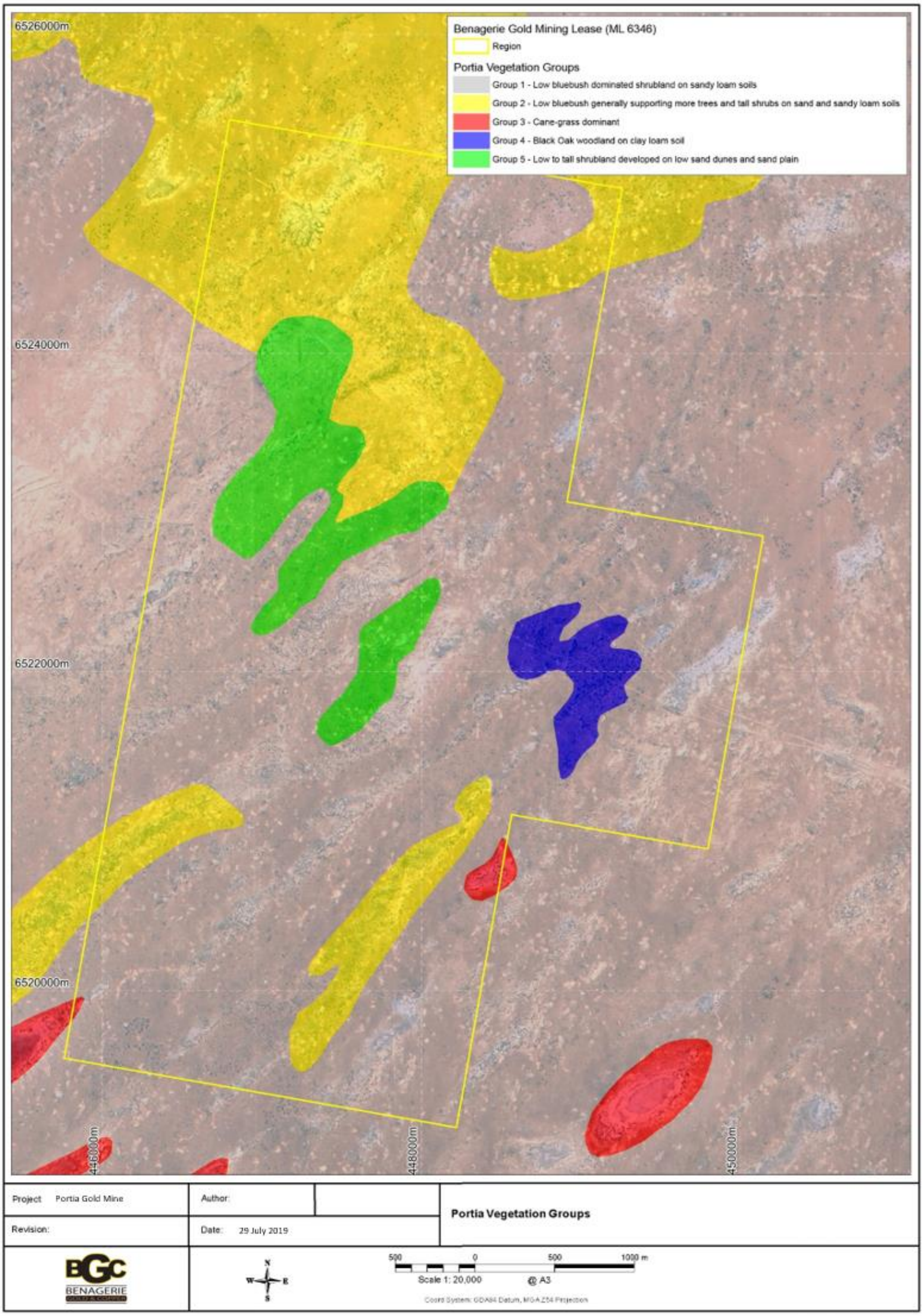


Figure 2-8: Vegetation Association Groups of the Portia Mine Site

2.11.6 Annual Flora Monitoring Investigations

Annual flora monitoring began in October 2015 and has continued each year (Spring 2016, 2017 and 2018) at the Portia Mine Site as part of ongoing compliance monitoring for the operation. Reports from 2015-2018 are presented in Appendix A3 to Appendix A6.

Quantitative flora monitoring is undertaken using an abundance method adapted from a Jessup survey methodology whereby the numbers of individuals are counted in a given area. For this method, species which typically live for an extended period (long-lived Perennials) were chosen so as not to assume differences in seasonality. They were also chosen based on their propensity for indicators of disturbance based on physical characteristics.

The methodology for monitoring has been adapted from baseline survey methodologies undertaken by Badman Environmental in 2007. This is because baseline surveys target the broadest range of species and vegetation communities present in an area in order to establish the best information on the ways that these communities exist and interact. As an ongoing monitoring survey, 1 ha quadrats provide a methodology which is too intense in a large area which results in smaller sample sizes and data which provides little information on impacts. Baseline surveys are used as a tool to identify the species and communities where key indicator species are present. From these, specific areas can be targeted that have suitable species and numbers to give superior data from a statistical standpoint. A higher sample size can be achieved by reducing the intensity and size of the survey sites and specifically targeting species and communities suitable for sampling.

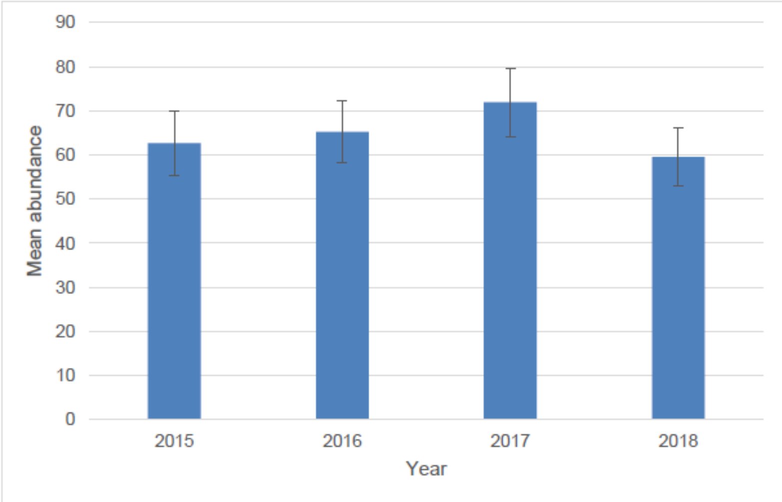
Maireana astrotricha (Low Bluebush), *Atriplex vesicaria* (Bladder Saltbush), *Rhagodia spinescens* (Spiny Saltbush), *Maireana aphylla* (Cotton Bush), *Frankenia serpyllifolia* (Sea Heath) and *Eragrostis setifolia* (Never fail) are targeted as key indicator species for the Portia Mine Site. There are 27 monitoring plots which have been established on 6 transects (labelled PM1 to PM5 and PC5) which measures abundance of the indicator species and total species richness. These also act as part of the weed survey for the mine infrastructure footprint.

Weed specific monitoring is undertaken as a point location on a road or area where there is a higher than average likelihood of infiltration by exotic species. Five weed monitoring sites (labelled as PW1 to PW5) were established from which four weed species were observed. One species, *Argemone ochroleuca* (Mexican Poppy), listed as a priority weed for the north-eastern pastoral zone was observed at a weed monitoring site (PW1) located off the ML.

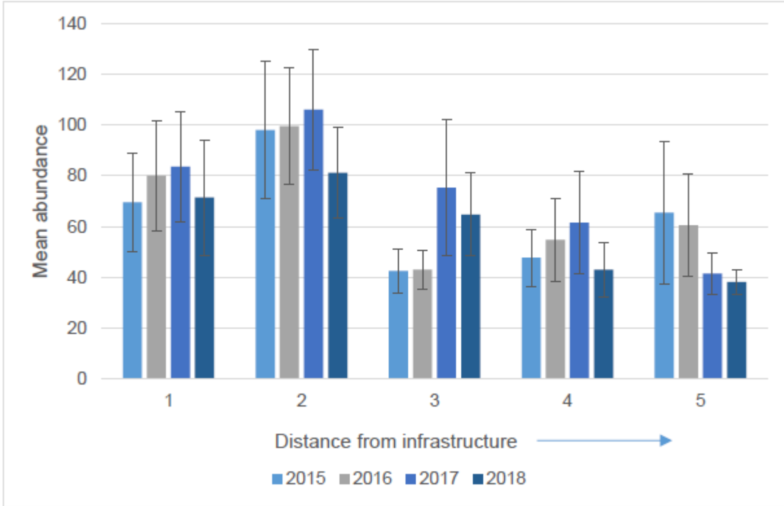
As of the most recent annual survey event (Spring 2018) the following conclusions were drawn when reviewing data across all four-flora survey (2015-2018) events:

- Overall the condition of vegetation in 2018 was generally poor. This was not limited to the Project area but was found to be typical for the region.
- Season conditions have reduced the cover to long lived perennial species only and many of these were heavily reduced in both size and canopy cover.
- There were no observations made which suggest that the changes observed in the Spring 2018 survey are a result of mining activity.

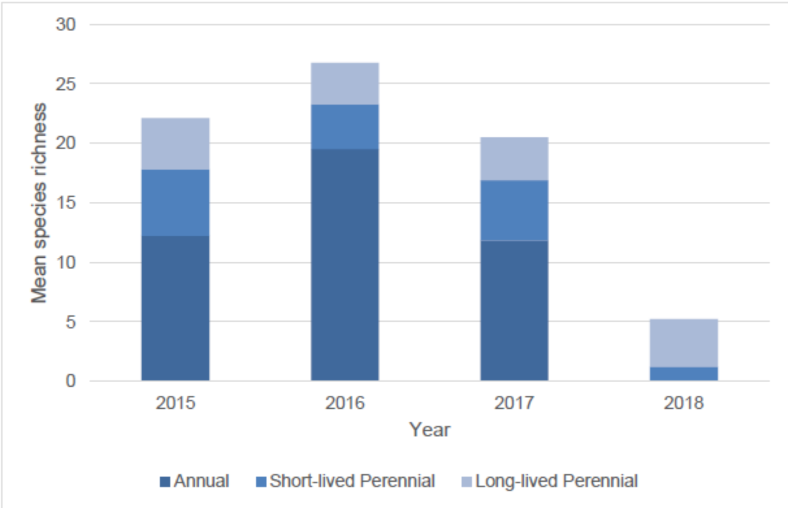
A summary of the information presented from the Spring 2018 flora survey is presented in Figure 2-9.



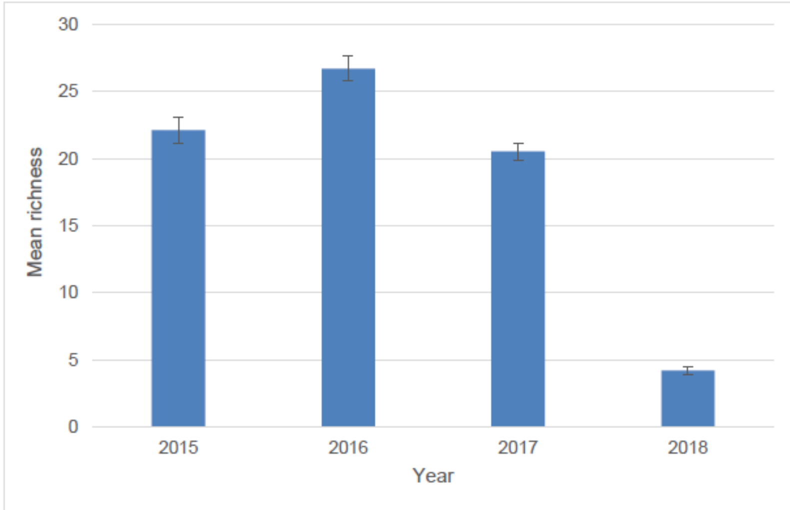
Mean Abundance of Long-Lived Perennial Species with Standard Error



Change in Mean Abundance by Proximity to infrastructure with Standard Error



Mean Species Richness by Lifecycle Change with Standard Errors



Mean Species Richness at all sites 2015-2018

Figure 2-9: Annual Flora Monitoring Summary Adapted from EBS (2018)

2.12 Fauna

A fauna desktop study was conducted on the Portia ML area by Badman Environmental (2008b) (Appendix A1) and includes all information up to February 2008. As part of this study, the Biological Data Base of South Australia (BDBSA) records (SADEH, 2008) were searched initially for an area covering a 50 km radius around the Portia ML, but the area of interest was then reduced to a 5 km radius based on coordinates included within the dataset.

It is stated by Badman Environmental that fauna habitat varies considerably according to the faunal group involved. Currently the arid zone region (both generally and in this region) is species-poor for most groups and that many of the populations of arid zone mammal and bird species have been and are threatened by anthropogenic influences, especially the impacts of pest plants and animals. A few of the larger species, such as kangaroo (two species), euro and emu, and some of the medium sized bird species, have benefited by the introduction of permanent water points.

In addition to the desktop study, a Site baseline fauna survey was carried out by KBR in 2011, which also included additional literature searches for the period 2008 to 2011, including further records from the BDBSA (Appendix A2). Information from the Badman Environmental and KBR (2011) reports is summarised below.

2.12.1 Birds

A total of 111 bird species have been recorded within a 50 km radius of the ML area (Badman, 2008b) with about 90 species being recorded consistently on Mulyungarie Pastoral Lease (Debus *et al*., 2006). However, the actual species assemblage varies considerably according to habitat, with the largest group not being habitat specific, i.e. not having a definite habitat preference. The species recorded here are ubiquitous and use all habitats across the region. Seasonal conditions, primarily rainfall and its season of occurrence, have a major influence on the presence of most avifauna species.

The four most characteristic species assemblages associated with particular habitats were:

- ***Wetland habitat environments:*** These do not occur in the ML area. Although a canegrass swamp vegetation group has been identified within the ML area, the importance of the canegrass swamps (Vegetation Group 3 of Badman, 2008a) as wetland fauna habitat is low. Most of these swamps are shallow and would contain water only after exceptional rainfall events and at such times similar and markedly better wetland habitats are common across northern South Australia. With no deep-water wetland habitat available within the ML area it is very unlikely that any of the migratory wading birds will ever be found at the Portia Mine Site. The lack of deep water also excludes a number of waterbird species, especially grebes and cormorants. It is extremely unlikely that any waterbird species will ever be found breeding in the ML area.

- ***Black oak woodland:*** This community is widespread and is the only woodland that is relatively common in the region. Consequently, it provides an important habitat for a number of species (feeding, roosting and nesting habitat); however, it occurs over a small area just to the east of the ML area.

- ***Eucalyptus woodland:*** This vegetation group does not occur within the ML area, although a very open community of Black box woodland is located on its eastern edge.

- ***Low and open chenopod shrublands*:** This community dominates the region and Project area. It provides habitat for a range of arid zone 'shrubland specialist' species.

The KBR survey of 2011 indicated that avifauna diversity was moderate with a total of 48 bird species recorded at the Site and nearby areas during the study period (Table 2-6). In general, the majority of the avifauna recorded was in woodland areas (black oak and mulga). However, many birds of prey from the Accipitridae (hawks, eagles and allies) and Falconidae (falcons) were recorded throughout the site and the adjacent areas. Habitat for a range of birds of prey is present at the Site and in the surrounding area in 2011. This was primarily due to the abundance of prey (small birds and mammals) present at the Site (and throughout the region) at the time of the survey as a result the above average rainfall conditions and the consequent growth of annual vegetation, especially grasses, over summer.

The majority of avifauna recorded was considered to be common to the region. Two species observed at the Site and in adjacent areas, *Elanus scriptus* (letter-winged kite) and *Lophoictinia isura* (square-tailed kite), have a State conservation status (NPW Act) of Rare and Endangered respectively and are both listed on the International Union for Conservation of Nature (IUCN) Red List. These species were observed on more than one occasion and a pair of square-tailed kites was observed daily adjacent to the ML, near Jack's Dam.

Falco hypoleucus (grey falcon) is listed as near threatened in Australia (IUCN Red List) and Rare in South Australia (NPW Act). Grey falcon was observed well south of the site, on the southern section of Yarramba PL adjacent to the Kalkaroo to Yarramba road, but this species may also occur occasionally at the Site. It was recorded previously to the north on Mulyungarie Pastoral Lease by Debus *et al.* (2006).

Three *Aquila audax* (wedge-tailed eagle) nests were in or south of the Site boundary and occasional observations were made of wedge-tailed eagles flying over the Site. This species is resident but has a large home range and the Site would be part of this home range of the pair.

Emblema pictum (painted finch) was recorded as six to eight birds off the Site and along the access track to the south of Jack's dam. This species is typically associated with central Australia and is an unusual, but not an unexpected or novel sighting in this region. Its presence is a geographical range extension presumably as a result of it moving south in response to the exceptionally good seasonal conditions.

Pedionomus torquatus (plains-wanderer) was not recorded at any of the surveyed sites and marginal habitat is present here for it. This species has been recorded in the wider region on Mulyungarie (Debus *et al.*, 2006), including north of the dog fence (R. Singleton, pers. comm., November 2008), Wompinie, Bindarrah, Kalkaroo and Boolcoomatta, with a recent record from Beverley, well to the north-west of the site in 2010. Pastoralists in this region consider that the species is a seasonal visitor only and it may be present anywhere in the district following above average rainfall and plant growth. During drought, it is rarely recorded.

Turnix velox (little button-quail) is a species of interest for the wider region, but it is not of listed conservation significance. This species was observed in the general area of the Site and on the access tracks adjacent to the Site on a daily basis. Similar to stubble quail, it is an irruptive species occurring in large populations following ideal conditions, such as those occurring in the region from late 2009 onwards.

Table 2-6: Bird Species Recorded at the Site and Adjacent Region During the KBR (2011) Survey

Family	Species	Common Name
PASSERIDAE	**Passer domesticus*	house sparrow
ACANTHIZIDAE	*Acanthiza apicalis*	inland thornbill
ACANTHIZIDAE	*Acanthiza chrysorrhoa*	yellow-rumped thornbill
ACANTHIZIDAE	*Acanthiza uropygialis*	chestnut-rumped thornbill
ANATIDAE	*Anas gracilis*	grey teal
MOTACILLIDAE	*Anthus novaeseelandiae*	Richard's pipit
ACCIPITRIDAE	*Aquila audax*	wedge-tailed eagle
ARTAMIDAE	*Artamus cinereus*	black-faced woodswallow
PSITTACIDAE	*Cacatua sanguinea*	little corella
ACANTHIZIDAE	*Calamanthus campestris*	Calamanthus, rufous fieldwren
SYLVIIDAE	*Cincloramphus cruralis*	brown songlark
EUPETIDAE	*Cinclosoma cinnamomeum*	cinnamon quail-thrush
ACCIPITRIDAE	*Circus approximans*	marsh harrier, swamp harrier
ACCIPITRIDAE	*Circus assimilis*	spotted harrier
ACCIPITRIDAE	*Circus sp.*	harrier (unidentified species)
CORVIDAE	*Corvus coronoides*	Australian raven
CORVIDAE	*Corvus orru*	Torresian crow
PHASIANIDAE	*Coturnix pectoralis*	stubble quail
ARTAMIDAE	*Cracticus tibicen*	Australian magpie
CASUARIIDAE	*Dromaius novaehollandiae*	emu
ACCIPITRIDAE	*Elanus scriptus*	letter-winged kite
ESTRILDIDAE	*Emblema pictus*	painted finch
CACATUIDAE	*Eolophus roseicapillus*	galah
MELIPHAGIDAE	*Epthianura aurifrons*	orange chat
FALCONIDAE	*Falco berigora*	brown falcon
FALCONIDAE	*Falco cenchroides*	nankeen (Australian) kestrel
FALCONIDAE	*Falco berigora*	brown falcon
RALLIDAE	*Fulica atra*	Eurasian coot
COLUMBIDAE	*Geopelia cuneata*	diamond dove
COLUMBIDAE	*Geopelia placida*	peaceful dove
COLUMBIDAE	*Geophaps lophotes*	crested pigeon
DICRURIDAE	*Grallina cyanoleuca*	magpie-lark
ACCIPITRIDAE	*Hieraaetus morphnoides*	little eagle
HIRUNDINIDAE	*Hirundo neoxena*	welcome swallow
MELIPHAGIDAE	*Lichenostomus virescens*	singing honeyeater
ACCIPITRIDAE	*Lophoictinia isura*	square-tailed kite
MALURIDAE	*Malurus leucopterus*	white-winged fairy-wren
MALURIDAE	*Malurus sp.*	fairy-wren (probably variegated)
PSITTACIDAE	*Melopsittacus undulates*	budgerigar
ACCIPITRIDAE	*Milvus migrans*	black kite
PSITTACIDAE	*Northiella haematogaster*	blue bonnet
PSITTACIFORMES	*Nymphicus hollandicus*	cockatiel
POMATOSTOMIDAE	*Pomatostomus ruficeps*	chestnut-crowned babbler
POMATOSTOMIDAE	*Pomatostomus superciliosus*	white-browed babbler
PSITTACIDAE	*Psephotus varius*	mulga parrot
EUPETIDAE	*Psophodes cristatus*	chirruping wedgebill
DICRURIDAE	*Rhipidura leucophrys*	willie wagtail
ESTRILDIDAE	*Taeniopygia guttata*	zebra finch
TURNICIDAE	*Turnix velox*	little button-quail
CHARADRIIDAE	*Vanellus tricolor*	banded lapwing

* indicates introduced species

2.12.2 Mammals

Nine species were recorded in the literature within a 50 km radius surrounding the ML area in Badman (2008b). The larger mammals (kangaroo species) and introduced and pest species dominate records and 4 of the 9 species recorded were introduced.

There is, apparently, a low frequency and diversity of small terrestrial mammals recorded for the wider region which reduces even further within a 5 km search of the ML area with only 3 species being recorded, 1 of which was introduced (namely European rabbit which was recorded as visual sighting in 2007).

The KBR fauna survey in March 2011 was undertaken after exceptional winter and summer rainfall, i.e. under ideal conditions for the occurrence of small mammals. The survey used a variety of methods and techniques including Elliott traps, pitfall traps and direct observation, plus opportunistic searches and night observations.

Mammal captures and observations from the KBR survey within the Site are presented in Table 2-7 and discussed below.

Table 2-7: Mammal Observations and Captures During the KBR (2011) Survey

Family	Species	Common Name
BOVIDAE	**Bos Taurus*	Cattle
FELIDAE	**Felis catus*	Feral cat
MURIDAE	**Mus musculus*	House mouse
LEPORIDAE	**Oryctolagus cuniculus*	European rabbit
BOVIDAE	**Ovis aries*	Sheep
CANIDAE	**Vulpes*	European red fox
MURIDAE	*Leggadina forresti*	Forrest's mouse, desert short-tailed mouse
MACROPODIDAE	*Macropus fuliginosus*	Western grey kangaroo
MACROPODIDAE	*Macropus rufus*	Red kangaroo
MURIDAE	*Notomys fuscus*	Dusky hopping-mouse
MURIDAE	*Pseudomys bolami*	Bolam's mouse
MURIDAE	*Pseudomys hermannsburgensis*	Sandy inland mouse
MURIDAE	*Pseudomys sp.*	Native mouse (unconfirmed identity)
DASYURIDAE	*Sminthopsis macroura*	Stripe-faced dunnart

* indicates introduced species

The diversity of mammal species observed within the Site by KBR was moderate; however, many species were recorded on less than three occasions. The majority of the commonly observed and caught mammal species was the introduced species, house mouse, which was present in plague numbers. Red kangaroos were observed on numerous occasions in the general area and were not specific to any Site or habitat type. Western grey kangaroos were also observed but they were not as abundant as red kangaroos. Domestic sheep and cattle are still present within areas adjacent to the Site. Introduced species such as European red fox and feral cat are known to occur in the wider region. Although none of these species was actually observed, evidence of both was recorded during the survey in the form of scats and footprints. Dingo and dingo-dog hybrid are also present in the region, and, more recently feral pig have been observed. Site personnel have also seen goats on the ML area.

Six small native mammal species were trapped during the survey. Bolam's mouse and Dusky hopping-mouse were captured on one occasion each. The Stripe-faced dunnart was caught on five occasions over three sites. Forrest's mouse was the most commonly recorded small native mammal species and was captured a total of 18 times at six sites.

2.12.3 Reptiles and Amphibians

Thirty reptile and one amphibian species have been recorded for the wider region. Most species recorded during past surveys are typical of those predicted to occur. Similar to the data for mammals, very few sites in the region had large numbers of reptiles and fewer had high species diversity. Only six reptile and one amphibian species had been identified to occur within a 5 km radius of the ML area in Badman (2008b).

The KBR survey (2011) indicates that reptile diversity is low given the range of habitat types present at the site and the surrounding areas. Eleven species were recorded over all trap sites; the most common being *Ctenotus schomburgkii* (sandplain Ctenotus). Table 2-8 shows the reptile species recorded during the survey.

Only two dragon species were observed, a hatchling *Pogona vitticeps* (central bearded dragon) and a juvenile *Ctenophorus nuchalis* (central netted dragon), but it is highly likely that other species also occur at the Site. Additional species potentially occurring here include species of *Ctenophorus pictus* (painted dragon) and two species of *Tympanocryptis* (*lineata* and *tetraporophora*, five-lined earless dragon and Eyrean earless dragon, respectively). Suitable habitat for these species occurs at the Site.

Three gecko species were caught, namely *Nephrurus levis* (knob-tailed gecko), *Lucasium damaeum* (beaded gecko) and *Diplodactylus tessellatus* (tessellated gecko), all of which are common in the region. A number of other common gecko species is likely to occur at the site including *Gehyra variegata* (tree dtella), *Heteronotia binoei* (Bynoe's gecko), *D. furcosus* (ranges stone gecko) and *L. byrnei* (pink-blotched gecko).

Varanus gouldii (Gould's goanna) tracks and scats were present in many sections and all habitat types at the Site and one individual was caught in a patch of black oak.

Table 2-8: Reptile Observations or Captures within the Site and Surrounding Areas

Family	Species	Common Name
AGAMIDAE	*Ctenophorus nuchalis*	Central netted dragon
SCINCIDAE	*Ctenotus orientalis*	Spotted Ctenotus
SCINCIDAE	*Ctenotus regius*	Royal Ctenotus
SCINCIDAE	*Ctenotus schomburgkii*	Sandplain Ctenotus
GEKKONIDAE	*Diplodactylus tessellatus*	Tessellated gecko
SCINCIDAE	*Eremiascincus fasciolatus*	Narrow-banded sand-swimmer
SCINCIDAE	*Lerista labialis*	Eastern two-toed slider
GEKKONIDAE	*Lucasium damaeum*	Beaded gecko
GEKKONIDAE	*Nephrurus levis*	Knob-tailed gecko
SQUAMATA	*Pogona vitticeps*	Central bearded dragon
VARANIDAE	*Varanus gouldii*	Gould's goanna

No amphibian species was recorded at the Site during the KBR survey.

2.12.4 Conservation Significance of Regional Fauna

Badman Environmental (2008b) recorded only bird species of potential conservation significance in the region. Many of the bird species present in this region are nomadic to vagrant and the occurrence of these species at any time is dependent on the amount of food present, i.e. the condition of the vegetation, which in turn is dependent on seasonal conditions, especially rainfall, and some other environmental pressures. The following comment is also presented in Badman (2008b): "*None of the resident species of birds expected to be present on the ML area is threatened*".

Five species are listed under the NPW Act, or in the case of one species, are proposed for listing under this Act (Badman, 2008b) have been recorded within a 50 km radius of the ML area, namely, Australasian Shoveler, Grey Falcon, Crested Bellbird, Plains wanderer, and Freckled Duck. Each is discussed below. None of these species have been recorded in a 5 km radius of the ML area.

Australasian Shoveler

There are very few records of this aquatic species from this part of South Australia because of lack of suitable habitat, and the single record of SADEH (2008), listed in Table 4 of that report may be the only one from this area (Barrett *et al.*, 2003). There are no breeding records from this part of South Australia (Barrett *et al.*, 2003). This species is much more common to the east and south in New South Wales and Victoria.

The coordinates given by SADEH (2008) do not correspond exactly with any wetland, but are close to Cartspring Dam on Mulyungarie Station, about 18 km to the south east of the Portia Mine Site. This is the likely location of the sighting. The date of the record is 3 September 1996 and the reliability is said to be less than 5 metres (SADEH, 2008), which would indicate a hand-held GPS derived coordinate. The database does not indicate the number of birds, or whether they were on water or flying overhead. Read and Badman (1999) found that all records of this species in the Lake Eyre South region were from bore drain swamps, a habitat that does not occur in the Portia area. The lack of dams in the ML would also suggest that this species is very unlikely to occur here.

Grey Falcon

This is Australia's rarest falcon (Hollands, 1984) and is of high conservation significance. The single record of this woodland species listed in SADEH (2008) is from about 42 km north-east of the Portia Mine Site, near Oban tank on Mulyungarie Station according to coordinates given in that database. This record is based on a South Australian Museum record of "sign – slough/skin" on 27 May 1975. Debus *et al.* (2006) have more recent records of the species on

Mulyungarie, north of the homestead. Barrett *et al.* (2003) do not list nearby breeding records from South Australia and only a very low reporting rate for this State. Breeding was reported for South Australia by Blakers *et al.* (1984), with most breeding records from Strzelecki Creek (Cupper and Cupper, 1980).

The likelihood of this species being recorded on the Site is very low and is diminished by the relative scarcity of genuine woodland habitat in this area. Notwithstanding this, the species was recorded in March 2011 between Yarramba and Kalkaroo (well south of the Portia Mine Site) with another record of the species on Bimbowrie Conservation Park in 2011.

Crested Bellbird

This species is currently not listed as Rare in South Australia, but SADEH (2008) recommended that this species should be upgraded to this category. SADEH (2008) list eight records from within 50 km of the Portia Mine Site, but none from within 5 km. Barrett *et al.* (2003) show that this is a common and widespread breeding species across most of the southern two-thirds of Australia, so the reason for the recommendation to upgrade its status is not clear. Blakers *et al.* (1984) reported that its abundance had declined in far north Queensland and east of the Great Dividing Range, but it is still common in southern Australia, including most parts of its range in SA. Barrett *et al.* (2003) show few records and no breeding from the Portia area, probably because of a lack of suitable woodland and tall shrubland habitat. This species is still common in suitable habitat in northern and western parts of the State (Badman, 2008b) and it is not included in the revised list of threatened species in the State (SADEH, 2008). The species was recorded around Jack's Dam.

Plains-wanderer

Up to 2008, this nationally critically endangered species had been recorded twice within 50 km of the Portia Mine Site (SADEH, 2008). These records are from 14 km south-east and 42 km south of the Site, with both sightings made in May 2006. No sightings have been recorded within a 5 km radius of the ML area. More recent sightings have been made of the species, as documented in KBR (2011), but most are well south of the Site.

This species generally relies on extensive areas with a varied community of perennial and annual grasses and other herbs, sometimes within very open woodland (Blakers *et al.*, 1984), a habitat that does not occur around the Portia Mine Site. The species key area is within the Riverina. It is regarded as a rare vagrant in northern South Australia (Read and Badman, 1999).

Freckled Duck

This species is very unlikely to be found on the Portia Mine Site area because of a lack of suitable habitat. Barrett *et al.* (2003) show very few records from this part of South Australia. The two records from the BDBSA (SADEH, 2008) are from just to the south-west of Mulyungarie Homestead, about 24 km east of the Portia Mine Site, and from near the Yaramba Homestead, about 27 km south-east of the Portia Mine Site. The habitat in both cases, are large station dams with flood-out areas. Away from places with large areas of this type of habitat, this species occurs only as a vagrant (Read and Badman, 1999).

KBR (2011) indicates that 3 listed fauna species were recorded at or adjacent to the Site and include Dusky hopping-mouse (listed under the EPBC Act and NPW Act), letter-winged kite (NPW Act) and grey falcon (NPW Act). The report also provided additional information about plains-wanderer. Each species is discussed below in relation to more recent data in the literature and field observations in March 2011.

Dusky hopping-mouse

This species is listed as Vulnerable (EPBC Act, IUCN Red List) in Australia and Vulnerable in South Australia (NPW Act). During the KBR (2011) survey one adult male Dusky hopping-mouse was captured in an Elliott trap at site PO5, which is the most northern fauna site monitored on the ML. It was noted by KBR that suitable habitat for the species was not present at PO5.

KBR determined that suitable habitat did occur at fauna site PO4 and possibly at PO8. During inspection of PO4 the presence of (what KBR classified as) pop holes was observed (pop holes are made by Dusky Hopping-mice and act as vertical escape routes from their underground tunnel systems). Due to this observation KBR increased the Elliot traps at PO4 to 41 medium traps (all other sites had between 10-15 medium Elliot traps) and spotlighting in this area for two nights. Despite this increased survey effort, no Dusky-hopping mice were trapped at PO4.
Observations by KBR (made during other fauna surveys in the region) suggest there was an eruption of the species in the wider region (from Beverley to Quinyambie Pastoral lease's) extending down to include most Pastoral Leases' south to the Barrier highway and west to Plumbago at this time. During the eruption or boom time, the species was observed to be occupying a variety of habitats considered to be atypical, such as low randy rises and drift sand dominated by chenopod shrubland. Letter-winged kite

Letter-winged kite was observed adjacent to the Site and is listed as near threatened in Australia (IUCN Red List) and Rare in South Australia (NPW Act). Letter-winged kite is considered to be a vagrant species, both here and elsewhere, and populations fluctuate drastically depending on its main prey population sizes (native and introduced rat species); making this species sensitive to other threats whilst rat numbers are low. Following high rainfall and local rodent-rat population increases, letter-winged kite numbers also increase markedly, and they are known to become locally abundant (Olsen, 1995). However, population sizes of this species are almost impossible to assess because of its extreme fluctuations (Olsen, 1995).

Above average rainfall would influence the presence and abundance of letter-winged kite in the region as small mammal populations, therefore potential prey, have increased following the rainfall events. If above average rainfall continues, then letter-winged kite numbers could increase, with the possibility of it becoming locally common in the region for a brief time (until prey numbers decrease and the kite moves to another region).

2.13 Topsoil and Subsoil

The Site is located in the north east corner of the Eastern Pastoral Province which forms part of a broad scale resource survey area covering the whole of South Australia (Laut, 1977). The province has been divided into three environmental regions and subdivided into 24 environmental associations. The Site is situated within the Benagerie Association of the Southern Frome Basin Region. Soil types and other parameters are described on a schematic profile basis.

The most widespread soil type is found on the principal landform of the area (flat plain with maximum slope 1%) as a brown calcareous earth. Low undulating dunes, the sub-dominant landform type, are characterised by deep reddish sands and some brown calcareous earths. Both are well drained and contain carbonate nodules in the B horizon and below. Occasional pans (small depressions) occur and are distinguished by poorly drained soils: where Gilgai micro-relief is present, the soil is a uniform brown loam, self-mulching with cracking clays, and where a surface crust occurs, the soil is a crusty red duplex type with a strongly structured B horizon.

All soils in the Benagerie Association described above have an alkaline reaction trend. Most of the soils are sodic and likely to disperse (Mining One, 2016). Clay contents vary significantly (~7 to 23 %) across the Site and all soils show low levels of silt and high levels of fine sand (Mining One, 2016).

Both the deep reddish sands and the brown calcareous earth are susceptible to wind erosion, but this only occurs when the ground cover is removed by overgrazing or other physical disturbance. If unchecked, the deep reddish sands will form drifts and migrate. A soils map is presented as Figure 2-10.

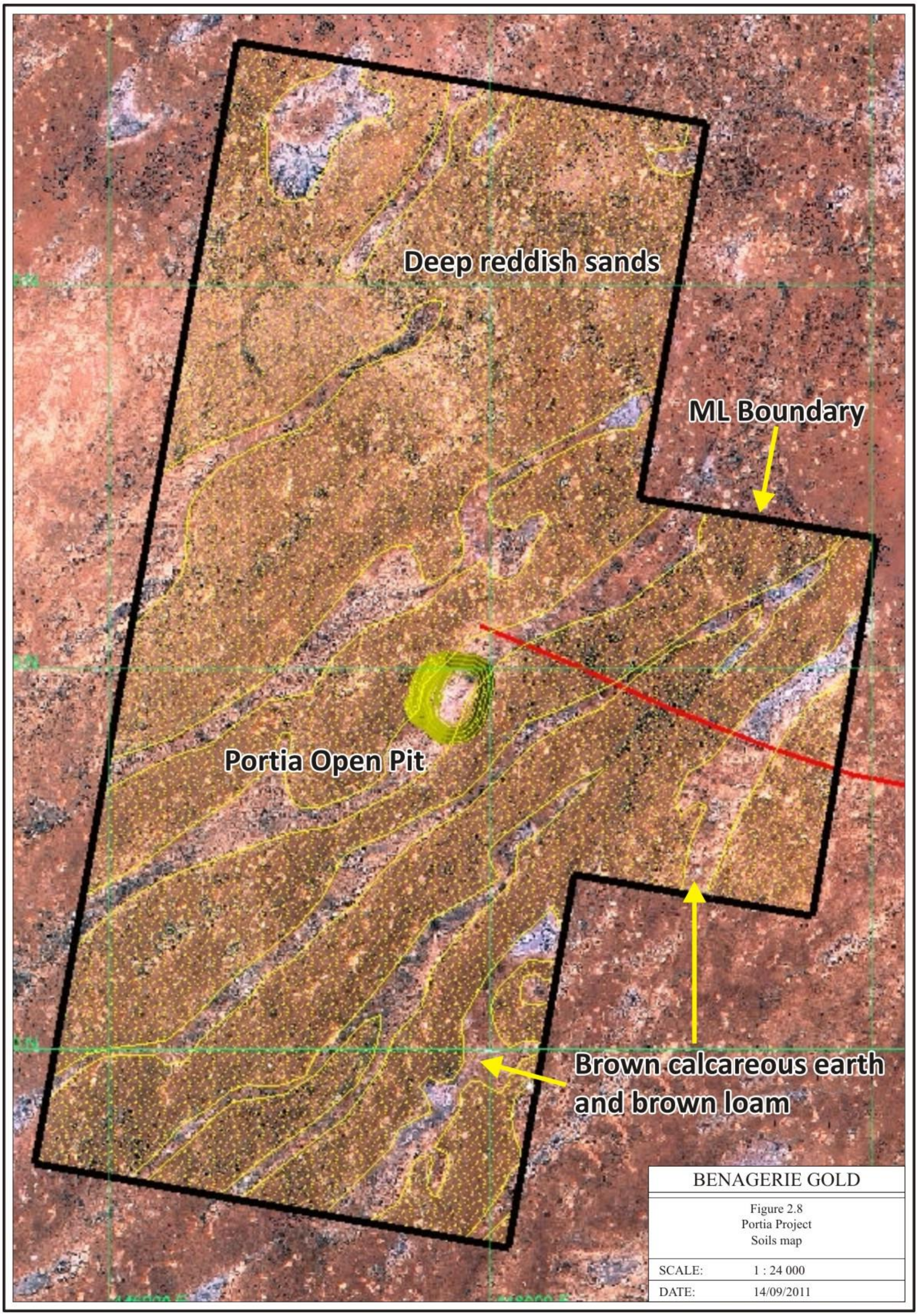


Figure 2-10: Soils of the Portia Mine Site (with Location of the Portia Open Pit)

2.14 History and Heritage

2.14.1 Aboriginal Heritage

At the time of the ML application the ML area was subject to a registered native title application made by the Adnyamathanha People (Adnyamathabha No.1, filed 15/01/1999, Federal Court No. SAD 6001/1998, Tribunal File No. SC 1999/001). As a result, Benagerie (now BGC) entered into a Native Title Mining Agreement (NTMA) with the Adnyamathanha People pursuant to Part 9B of the Mining Act which was entered into PIRSA's (now DEM's) register on 10 October 2008. It has been determined that native title exists in parts of the Adnyamathanha No. 1 determination area on 30/03/2009, 25/02/2014 and 08/12/2015.

Since the granting of a ML a second native title application has been made in the region by the Wilyakali People (Wilyakali #2, filed 25/11/2015, Federal Court No. SAD 417/2015, Tribunal File No. SC 2015/003). BGC will continue to engage with both the Adnyamathanha and Wilyakali Peoples in regard to matters at the Site.

An investigation into the presence of archaeological relics in the area undertaken by the Aboriginal Heritage Unit of the DEW found only scant evidence of aboriginal activity at the Site and the airstrip site. Stone artefacts are exceedingly rare. Occasional camp-oven sites occur in the area and care is taken to protect these from accidental access.

A detailed field survey was undertaken with representatives of the Adnyamathanha People together with an anthropologist and two site representatives on 20 to 21 May 2008. The entire Project area was surveyed plus a possible future Extractive Minerals Lease (EML) area for road sheeting material. Sites which were identified as having some preservation significance during this Survey have been recorded and avoided during the planning phase for the Project. They have also been fenced off to avoid any accidental damage during mining operations.

Additional field surveys have been undertaken by with Adnyamanthanha traditional owners, together with archaeologists and mine site representatives in 2017 and again in 2018. In 2017, surveys were conducted for an exploration drilling program on ML 6346, EL 5873 (Benagerie) and EL 5802 (Muyungarie). The 2018 survey was conducted with consideration to possible future developments including the potential development of the North Portia deposit, the expansion of the current overburden waste dump (OWD), the additional TSF cells, an additional water storage dam (BP2) and upgrades to the processing plant. Additional sites of significance were identified and subsequently fenced to avoid any accidental damage.

Pastoralists and other long-term residents in the region have stated to their knowledge that there are no known living descendants of the original aboriginal occupants of this area, which accords with recorded anthropological data.

An anthropological report commissioned by Geoscience Australia and PIRSA in 2005, prior to a deep seismic crustal survey, details the aboriginal history and notes that the descendants of the original indigenous people moved to an area north of Broken Hill from a camp on Boolcoomatta in 1943. In this report, it is observed that the current Native Title Claimants, the Adnymathanha Group from the Flinders Ranges, have assumed a caretaker role for the area in recent years and are not the original inhabitants of the area.

2.14.2 Non-Aboriginal History and Heritage

The area has been subject to pastoralism since about 1859, although the Government Surveyor, Captain Charles Frome, led a party to the region in 1843. Captain Frome travelled as far as Mt Serle and sighted the lake, which was later to bear his name, although at the time he believed it to be Lake Torrens.

At this period of European settlement in South Australia it was believed that Lakes Frome, Torrens and Eyre formed an unbroken, horseshoe shaped inland lake system around the raised Flinders Ranges.

By 1850 small parcels of land had been leased in the pastoral country of South Australia and taken up around surface and other reliable waters. One such small lease of 10 square miles was taken up in 1854 at 'Ethiadina', in country that subsequently became Plumbago Station. Ethiadina is near a semi-permanent spring. Shepherds moved small flocks of sheep out to pasture and returned them at night to stone and bough yards. They used well-watered areas regularly until drought struck the region in the 1860's.

The area has been used almost continuously for sheep and cattle grazing. Wire fencing was introduced in about 1860. Extensive use was made of storage drains by an early pastoralist, Edwin Crozer. He deepened water courses that flowed to Lake Frome, to form long dams.

Travellers in the area used horse and carriage services from Burra before the railway to Silverton and Broken Hill was constructed in 1884. A fortnightly mail service was also established, which serviced Post Offices at Bimbowrie, Outalpa and old Boolcoomatta. Eating-houses were built along the track from Burra to the northeast. The ruins of some of these eating-houses survive at Karolta and Outalpa.

The townships of Mannahill, Olary and Mingary sprang up to service the railway and station properties in the area. The township of Mingary no longer exists, but its location is marked by a railway siding.

2.15 Proximity to Conservation Areas

The nearest conservation area is Boolcoomatta Station Reserve which was purchased in April 2006 by Bush Heritage Australia, with assistance from the Australian Government and the Nature Foundation of South Australia. Boolcoomatta Homestead lies approximately 60 km to the south of the Portia Mine Site.

The nearest Ramsar site is at Lake Pinaroo situated approximately 250 km to the north-east of the Site within the Sturt Conservation Park, NSW.

2.16 Pre-existing Site Contamination and Previous Disturbance

There are no site contamination issues present. Some previous disturbance has occurred through historical exploration and pastoral activities.

The land has been grazed for the past approximately 150 years, and the area is considered to be in moderate rather than good condition and shows signs of past erosion. Previous exploration activities have resulted in one mineral well and a number of exploration drill sites. Historical drill holes have been capped and rehabilitated in accordance with Information Sheet M21, '*Mineral exploration drillholes - General specifications for construction and backfilling*'.

As reported in the most recent Exploration Compliance Report submitted to DEM for ML 6346 there are also 11 drill holes around the southern portion of the Portia open pit (SPAC001 – SPAC011) which have been rehabilitated but drill collars still remain.

2.17 EPBC Act Implications

An EPBC Act database search and 'self-assessment' was undertaken as part of the MLP application process which indicated that there were no matters of national environmental significance relating to the Portia Project area. The Site does not contain any threatened ecological communities or populations of threatened plant species.

Based on earlier data, no fauna species listed under the EPBC Act have been reported on the Site (or within a 5 km radius area) and are unlikely to occur within the ML area (Badman, 2008b). One bird species, *Pedionomus torquatus* (plains-wanderer) has been recorded twice from the 50 km radius area (SADEH, 2008). These records are both from Kalkaroo Station well to the south of the Site and more recent records of the species are all remote from the ML.

No flora species that are listed as threatened under either the Commonwealth EPBC Act or the South Australian NPW Act were recorded during surveys of the ML area.

It is noted that since the original approval for the Site that once instance of a Dusky Hopping-mouse (listed as vulnerable under the EPBC Act) has been reported on the ML during the KBR (2011) survey. Subsequent surveys in the region have concluded that whilst the species may be observed across a wide variety of habitats when in an irruptive phase (like that known to have occurred in 2011) the habitats present on the ML are not considered to provide a core habitat for this species.

3 DESCRIPTION OF THE OPERATION

3.1 General Description of Operations

The Portia Mine Site (ML 6346) is located in north eastern South Australia, about 105 km north-west of Cockburn. Eastings and northings of the Site are shown on Figure 2-2.

The main infrastructure components of the Site includes:

- one open pit (Portia);
- an overburden waste dump (OWD);
- a pit dewatering dam (PDD);
- a raw water dam (RWD);
- balance ponds 1 and 2 (BP1 and BP2) (BP1 previously referred to as the process water dam (PWD));
- three unlined TSF cells (TSF-1, 2 and 3);
- one small HDPE lined TSF cyanide cell (TSF-4);
- a nominal 150,000 m^3 capacity run-of-mine (ROM) pad;
- a processing plant with gravity circuit;
- a small parallel cyanide leach circuit;
- in pit sumps and pipework (water resource system) around the Portia open pit;
- a mine water disposal re-injection well field and pipework (not in use);
- reverse osmosis (RO) plant;
- a small landfill facility for putrescible and non-recyclable rubbish;
- offices and workshop buildings;
- a nominal 90-person camp; and
- internal haulage roads and internal and external access roads.

The Project design infrastructure components are shown in Figure 3-1. Key characteristics of the Project are summarised in Table 3-1.

Table 3-1: Key Characteristics of the Project

Item	Description
Project footprint (on ML)	Up to 302.35 ha of vegetation clearance or disturbance under the *Native Vegetation Regulations 2017*
Mining inventory	**Remnant Pit Mining and ROM Stockpile Processing** Approximately ~69,000 tonnes of ore from the northern cutback of the Portia Pit and remnant ROM stockpiles will be processed for 7,846 ounces of gold. **Portia Tailings Material (Phase 1):** Approximately ~640,000 tonnes of tailings material will be reprocessed from within TSF-1 and 2 for 6, 000 ounces of gold Approximately ~100,000 tonnes of ore from remnant mining of Portia Northern cutback **North Portia (Phase 2 Conceptual):** Oxide Gold Inferred Resource of 490,000 tonnes @ 1.17 g/t for 18,400 ounces of gold. **North Portia (Phase 3 Conceptual):** Supergene Sulphide Copper-Gold Resource of 3,856,000 tonnes @ 0.73% copper, 154 ppm cobalt and 0.51 g/t gold.
Open pit dimensions (final pit shell, including extensions)	Portia open pit: 750 m long, 500 m wide, 110 m deep (90 m RL to nominally -20 m RL).
Mining rate (predicted)	Approximately 1.7 million bcm of overburden will be moved between September 2019 and June 2020. Approximately 100,000 tonnes of ore will be mined during the same period.
Processing method	The free gold will be recovered via a simple gravity plant with a parallel cyanide leach circuit. The gold will be smelted on Site into impure gold dore' for shipment to an accredited refinery for refining and sale.
Throughput (predicted)	Target ore processing / production at a rate of 140 t/hour.
Operating hours	24 hours per day (two shifts), 7 days per week for mining. 24 hours per day (two shifts), 7 days per week for processing.
Tailings and Waste Rock	Waste material from the continued mining of the Portia open pit and gold recovery process is discharged into three TSF cells (TSF-1, 2 and 3), and a small cyanide TSF cell (TSF-4), located to the north of the Portia open pit. Overburden and waste rock is deposited in the OWD.
Electrical consumption	Predicted power requirements for the operation are estimated to be 660 kW
Power source	Portable diesel generator sets are used to supply power to the mine site and infrastructure.
Raw water source	Water for processing and other Site usage is sourced from in pit sumps.
Raw water licence limit	A water licence limit is not required as the Site is not located within a 'Prescribed Wells Area' of South Australia.
Raw Water Usage (predicted)	Approximately 4ML per day.
Water recycling (predicted)	Variable depending on processing plant operating conditions. Expected average TSF decant water recovery of up to ~54%.
Greenhouse Gas Emissions (CO_2-e) (predicted)	The Project is estimated to liberate approximately 13,374 tonnes CO_2-e annually
Accommodation	A camp accommodating up to 90 people has been constructed near the main access road. The camp incorporates catering and recreational facilities and has a waste water treatment plant.
Employees	Approximately 45 full time personnel are directly employed at the Site. The operation also has additional technical support provided by contractors and specialists in key fields of environmental management, mining engineering, geotechnical engineering and ore processing.

Item	Description
Native vegetation SEB offset	The SEB requirements for the Portia Mine Site will continue to be satisfied by providing ongoing protection and management of a SEB offset area within the Kalkaroo Pastoral Lease, in accordance with the *Native Vegetation Management Plan* (Appendix F1) endorsed by the Native Vegetation Council (NVC) of South Australia. The minimum SEB area requirement to offset native vegetation clearance associated with the Project is 694.8 ha of land under the *Native Vegetation Regulations 2017.*

3.1.1 Project Schedule

A high-level project schedule for the Portia Mine Site until 2025 is summarised in Table 3-2 Due to the nature of the project, the schedule and timing of activities may alter as the project develops. This schedule has been structured across all project phases including construction, operations and rehabilitation/ closure

In order to provide a line of site to the North Portia Phase 2 and Phase 3 approvals (which BGC plan to submit in 2019/2020), and to provide context as to how Phase 2 and Phase 3 approvals will change the project schedule, a conceptual project schedule has been provided in Table 3-3 to 2030.

BGC are also currently reviewing a LoM Plan (oxide resource) which may materially increase the mine life for Portia ML.

Table 3-2: Portia Mine Site Project Schedule

Aspect	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2021	2022	2023	2024	2025
	2019						2020																
Portia Open Pit[1]																							
Processing of stockpiles on the ROM																							
Reprocessing of tailings from TSF-2 (TSFW)																							
Reprocessing of tailings from TSF-1 (TSFE)																							
OWD																							
TSF operations																							
Processing plant operations																							
Mine Closure (post March 2020)[2]																							

[1] Mining of the Portia Pit is above the current pit water level. The pit level will lowered over time for fresh ore mining in 4 months which will initially be above the current pit water level.

[2] Mine closure period has been approximated, actual time will be dependent on monitoring results and demonstrating that completion criteria have been met

Table 3-3: Conceptual Project Schedule with Portia (Phase 1) and North Portia (Phase 2 and Phase 3)

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Portia Open Pit												
Processing of stockpiles on the ROM												
Reprocessing of tailings (TSF-1 and 2)												
North Portia Open Pit (Phase 2 -oxide gold)												
North Portia Open Pit (Phase 3 - supergene gold-copper)												
OWD												
TSF operations												
Processing plant operations												
Mine Closure (post 2024)*												

Note: * Mine closure period has been approximated, actual time will be dependent on monitoring results and demonstrating that completion criteria have been met

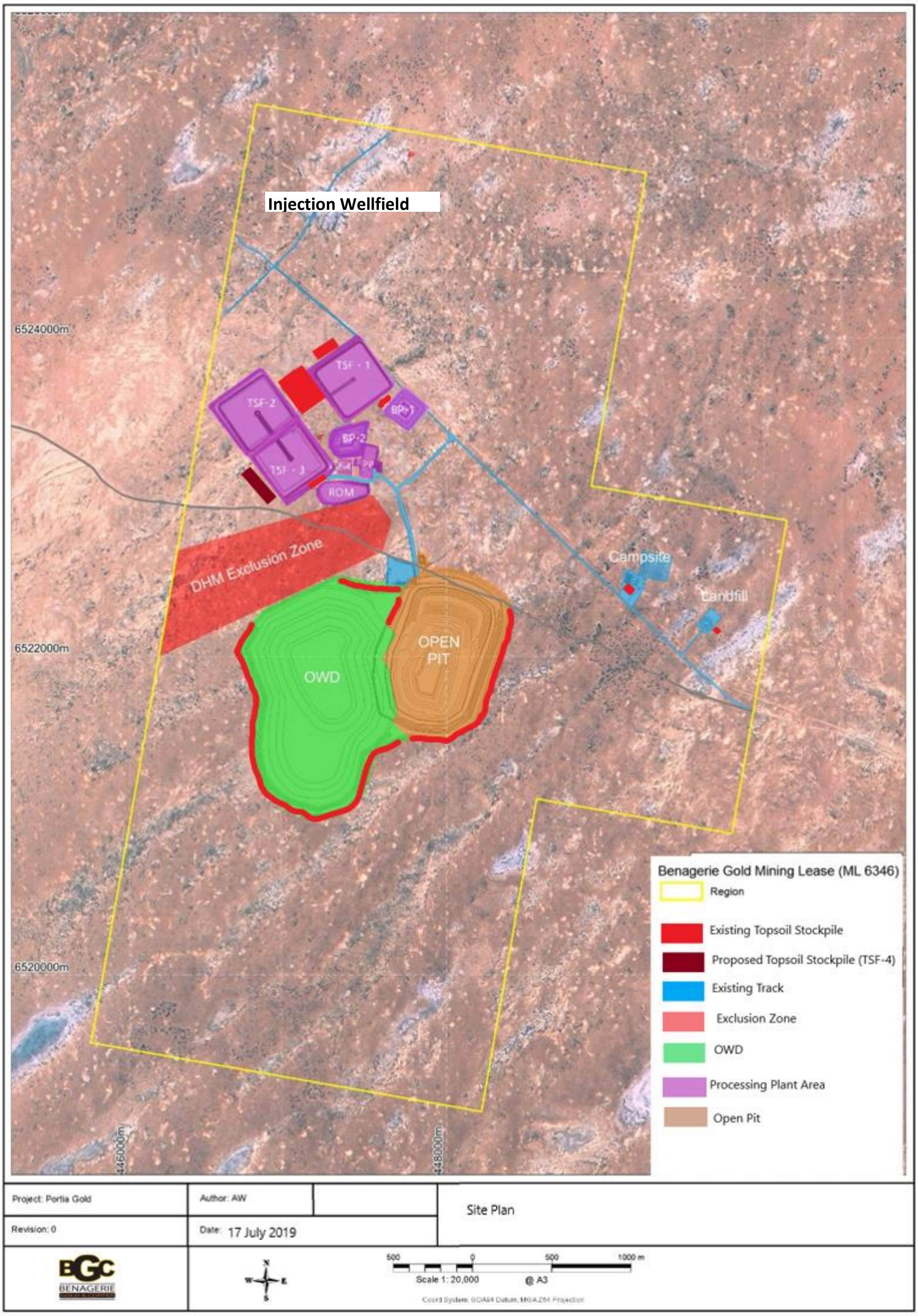


Figure 3-1 Portia Mine Site Layout Plan

3.1.2 Project Alternatives

Resource development projects are restricted in the manner of their development in the following ways:

- Physically, by the location of the orebody and the climatic, topographic and geotechnical constraints imposed by the surrounding landscape.
- Environmentally, by the environmental sensitivities of the setting.
- Socially, by the expectations and concerns of affected communities.
- Economically, by the need to extract and process the ore profitably.

In particular, a fundamental constraint of all mineral resource developments is that they can only occur where a commercial deposit is found. The alternative to the development of the Portia Mine is no development.

The direct consequences of not proceeding with the Project can be summarised as follows:

- The social and economic benefits described in Section 4.1 and 4.2, e.g. wages, royalties and taxes, would be lost at all levels, i.e. local, regional, South Australian and national.
- In particular, about 45 full-time jobs created directly at the Site during operations, and additional indirect jobs created elsewhere would not be available. Normally there is at least a five times multiplier effect for each direct mine job created.
- The land, water and air impacts (and associated physical, biological and social impacts) associated with the development of a well-managed open pit mine located in an isolated setting would not occur.

Alternatives considered in Project planning included:

- Borehole mining; and
- Underground mining.

Borehole (downhole extraction) mining involves drilling into the ore zone and flushing the gold ore out by underground sluicing. After detailed evaluation and investigation of production rates the method was considered less favourable than conventional open pit methods. In view of the soft nature of the material, underground mining was also considered inappropriate.

3.2 Reserves, Products and Market

3.2.1 Ore Reserves and Mineral Resources

Mining will recommence within the Portia open pit in September 2019 and end in June 2020. During this time ore which is currently stockpiled on the ROM pad will also be processed along with ore from the Portia open pit. In August to October 2019 tailings material within TSF-2 will be reprocessed, followed by material within TSF-1 during November 2019 to March 2020.

The current estimated tonnage and ounces for the Portia open pit/ stockpiled and tailings material is detailed in Table 3-4.

Table 3-4 Estimated Ore and Gold

Aspect	Ore (tonnes)	Gold (ounces)
Portia open pit ore and stockpiles	68,936	7,846
TSF-1 and TSF-2 reprocessed	~640,000	6,000
Total	**708,936**	**13,846**

The following resource and reserve information has been provided on the North Portia deposit for a line of sight to the planned future approvals for the operation.

The current estimated mineral resource for the North Portia deposit is shown in Table 3-5. The new resource estimation incorporates assay data and logs for 168 Havilah drillholes totalling 21,309 metres and 128 Pasminco drillholes totalling 20,434 metres. Average drillhole spacing for the resource approximates 25 metres by 25 metres.

The North Portia resource is now divided into three zones:

1. An upper **oxide gold zone (Phase 2)** that comprises completely weathered and oxidized material. The new Inferred Resource estimate for this zone is **490,000 tonnes @ 1.17 g/t gold for 18,400 ounces of gold** (applying a lower cut-off of 0.5 g/t). The Inferred Resource category reflects the variability in shape and grade of this material between section lines. The Inferred Resource estimate has been reported in accordance with the 2012 edition of the JORC code.

2. A **supergene sulphide copper-cobalt-gold zone (Phase 3)** that comprises predominately weathered (clayey) chalcocite-rich, copper sulphide ore with associated recoverable cobalt and gold. The new Measured resource is **3,856,000 tonnes @ 0.73% copper, 154 ppm cobalt and 0.51 g/t gold** (applying a 0.4% copper equivalent lower cut-off). The Measured category reflects the density of drilling and generally good continuity of mineralisation between drill section lines. The Measured Resource estimate has been reported in accordance with the 2012 edition of the JORC code.

3. A **primary sulphide copper-gold zone** that comprises chalcopyrite-rich, copper sulphide ore in fresh host rock. This resource has not been updated since the 23 November 2010 Inferred Resource estimate of 8,610,000 tonnes @ 0.85% copper and 0.64 g/t gold due to a lack of additional data since 2010. As a result, this Inferred Resource has been reported in accordance with the 2004 edition of the JORC code. It is also noted that there is insufficient cobalt data to estimate a cobalt resource for the primary sulphide zone, although the pyrite in this zone is known to be cobalt bearing.

Please note that the primary sulphide copper-gold zone is not proposed to form part of Phase 2 or 3 approvals for this Project, at this stage.

Table 3-5: North Portia Mineral Resource Estimate as of 15 May 2018

Resource Category	Tonnes	Copper (%)	Gold (g/t)	Cobalt (ppm)	Moly (ppm)	Copper Metal (tonnes)	Gold (ounces)	Cobalt Metal (tonnes)	Moly Metal (tonnes)
Total Oxide Gold Inferred	**490,000**		**1.17**				**18,400**		
Supergene Sulphide Copper-Gold Measured	3,237,000	0.77	0.50	151	293				
Supergene-Sulphide Copper-Gold Indicated	480,000	0.53	0.58	157	210				
Supergene-Sulphide Copper-Gold Inferred	138,000	0.45	0.44	209	82				
Total Supergene Sulphide	**3,856,000**	**0.73**	**0.51**	**154**	**275**	**28,200**	**63,200**	**594**	**1,060**
Primary Sulphide Copper-Gold Inferred	8,610,000	0.85	0.64	ISD	531	73,200	177,200	ISD	4,570
Total Sulphide All Categories	**12,466,000**	**0.81**	**0.60**		**452**	**101,400**	**240,400**	**594**	**5,630**
Total Resource Oxide and Sulphide	**12,956,000**					**101,400**	**258,800**	**594**	**5,630**

Notes to table:

1. *The new oxide gold resource is estimated using a lower gold cut off of 0.5 g/t.*

2. *The updated supergene sulphide copper-gold resources are estimated using a lower copper equivalent cut-off of 0.4%. The copper equivalent grade has been calculated using a gold price of US$1,279/oz and a copper price of US$2.91/lb with an exchange rate of AU$1=US$0.75. Comparable recoveries for both metals are applied based on metallurgical test results to date.*

3. *Primary sulphide copper-gold resource has not been re-estimated and relies on the previously published JORC resource estimate details released to the ASX on 23 November 2010. The Company confirms that it is not aware of any new information or data that materially affects the resource figures included in the above table and that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed.*

4. *ISD means insufficient data to make a reliable resource estimate due to the fact that this estimate relies largely on pre-Havilah exploration drillholes that were not always assayed for cobalt. All Havilah drillholes used for the updated supergene sulphide copper-gold resource estimate were assayed for cobalt, providing an adequate level of confidence in this case.*

5. *All numbers cited in the table have been rounded to no more than 5 significant figures. There may be minor differences in quantities due to rounding.*

Steps have been taken to ensure that there has been no sterilisation of current or future ore bodies, this has included exploration activities across the entire ML to define other prospects and the economical extents of the deposits. The placement of all infrastructure required for the TSF reprocessing and remnant mining at the Portia open pit has been carefully selected to ensure that their placement will not prevent the future extraction of known resources, like North Portia or other potential resources.

3.2.2 Production Rate and Products

The mine gate for the Portia Mine will be the point at which product leaves the ML 6346. Product at the mine gate will be gold. To maximise security, the gold is smelted on Site into gold dore' for shipment to an accredited refinery for refining and sale.

Based on the current estimates of remaining gold within the Portia open pit and the calculations of gold within the stockpiles and TSFs it is estimated that:

- approximately 1.7 million bcm of waste and 71,936 tonnes of ore will be mined between September 2019 and June 2020;

- approximately 42,000 tonnes of stockpiled ore will be processed between July and August 2019;

- approximately 640,000 tonnes of tailings will be reprocessed between August 2019 and April 2020;

- this will result in approximately 17,724 ounces of gold produced.

The estimated monthly production schedule from the mine gate is provided in Table 3-6 for the LoM. Estimated annual gold production rates for Phase 2 and 3 have also been provided in Table 3-7 to provide a line of sight.

Table 3-6 Monthly Production Rates

Aspect	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	Total
	2019						2020						
Ore Mined (tonnes)				200	5,000	5,000	2,324	22,444	23,246	1,000	1,000	1,000	**71,936**
Waste Mined (million bcm)				0.5	0.6	0.6							**1.7**
Stockpile processed (tonnes)	22,000	20,000											**42, 000**
Tailings Reprocessed (tonnes)		30,000	81,921	81,921	81,921	81,921	71,000	71,000	71,000	71,000			**640,000**
Gold Produced (ounces)	700	1,500	1,500	1,500	850	850	2,800	2,800	2,800	1,500	710	214	**17,724**

Table 3-7 Phase 2 (Conceptual) Production Rates

Aspect	Phase 2 (oxide gold)	Phase 3 (supergene copper-gold)				Total
	2020	2021	2022	2023	2024	
Ore Mined (tonnes)	490,000	1,000,000	1,000,000	1,000,000	856,000	4,346,000
Waste Mined (million bcm)	9	0.5	0.5	0.5	0.25	11
Gold Produced (ounces)	18,400	63,200				81,600

There are other commodities present within the tenement, namely copper and cobalt, though the extraction, processing and sale of these commodities is not covered by this PEPR. These commodities are present within the supergene sulphide copper-cobalt-gold zone (North Portia), which underlies the oxide gold zone. The supergene zone will be mined as part of a subsequent PEPR approvals process for Phase 3 resulting in the production of gold dore and a copper concentrate.

No extractive minerals (as defined by Section 6 of the Mining Act) will leave the lease.

3.3 Exploration Activities

The purpose of current planned exploration activities at the Site is to further define the resources within the ML for future expansion. Where exploration drilling is deemed to be required it will be undertaken from the ground surface within the ML boundary at known regions of mineralisation. The following outlines the planned exploration activities on the ML as of the time of writing of this PEPR:

- A total of 25 drill holes (approximately 6,125 m) designed to provide verification of the existing block model (provided by Havilah Resources) for the North Portia deposit.

- A total of 6 drill holes (approximately 1,200 m) designed to further define a deposit (North Portia East) approximately 300 m to the east of the North Portia deposit.

- A total of 2 drill holes (approximately 1,020 m) designed to explore deeper primary ore deposit.

The planned exploration drilling is further summarised in Table 3-8, with individual drill hole information details in Table 3-9.

Table 3-8: Planned Exploration Drilling

Drilling Type	Unit	North Portia	North Portia East	North West	Total
RC Only	M	4,095	1,200	0	5,295
RC Pre-collar	M	1,280	0	220	1,500
Diamond	m	750	0	800	1,550

No new geophysical exploration will be undertaken. However, previously acquired gravity and magnetics data will be further interpreted using Inversion Modelling software to refine drilling locations at North Portia.

Access to drill sites on ML 6346 for any future drilling activities will be along existing tracks, then by driving across country. It is unlikely that construction of any graded tracks will be necessary, as the ground is relatively flat with open, sparse vegetation. Areas of thicker vegetation will be avoided.

Field crews normally consist of one geologist and one field assistant, along with a drilling crew of two or three people. Vehicles will consist of the drill rig plus compressor truck and three 4WD utilities. All field crew will be accommodated at the mine camp.

Any mineral exploration on ML 6346 will be conducted in accordance with DEM's information sheets '*Statement of Environmental Objectives & Guidelines for Mineral Exploration Activities in SA*' (M33 - June 2004). Rehabilitation will be in accordance with Lease conditions and will occur progressively during the period of Lease tenure. Where groundwater is encountered, significant flows will be recorded, and water samples and relevant information will be supplied to DEW. All holes will be abandoned in line with DEM's '*General Specifications for the Construction and Abandonment of Mineral Exploration Drillholes*' (M21 – July 2012). Drill sites will be located so as to cause the least impact to vegetation. A small area at each site may be cleared, by hand, for laying out samples.

All drill pads will be levelled using a grader to stockpile topsoil. A loader will then prepare two sumps at each drill site to contain any intersected groundwater discharge. Pad sizes will nominally be 20 m x 10 m. Topsoil will be stockpiled separately for later use in site rehabilitation

For all RC holes the sumps will be 6 m (length) x 3 m (width) x 1 m (depth) and will be lined. For diamond drill holes there would be an additional 3 m (length) x 3 m (width) x 1 m (depth) sump which would also be lined.

All sites will be rehabilitated as soon as practical, with sumps backfilled and topsoil spread over the disturbed area. Drill hole collars will then be plugged. All bagged RC drill spoils will be removed from drill sites within 6 months. The rehabilitation of each site will then be finalised by raking or lightly scarifying.

Any future exploration drilling associated with prospects outside of the ML boundary will be undertaken under the respective Exploration Licence (EL) in accordance with the approved Exploration PEPR for those activities.

Table 3-9: Proposed drillhole locations on ML 6346

PropID	DrillType	EAST	NORTH	RL	AZI	Dip	EOH	Area
PR-001	RC	447825	6522175	68		-90	120	North Portia
PR-002	RC	447900	6522175	68		-90	180	North Portia
PR-003	RC	447850	6522275	68		-90	160	North Portia
PR-004	RC	447950	6522275	68		-90	250	North Portia
PR-005	RC	447951	6522375	68		-90	200	North Portia
PR-006	RC	448077	6522675	66	270	-70	270	North Portia
PR-007	RC	447775	6522875	68		-90	150	North Portia
PR-008	DD	448125	6522300	68	270	-70	320	North Portia
PR-009	RC	448125	6522225	68		-90	100	North Portia
PR-010	RC	447900	6522125	68		-90	200	North Portia
PR-011	RC	447799	6522125	68		-90	150	North Portia
PR-012	RC	447975	6522150	68		-90	120	North Portia
PR-013	DD	448101	6522125	66	270	-70	300	North Portia
PR-014	DD	448224	6522525	67	270	-70	350	North Portia
PR-015	RC	447725	6523375	68		-90	230	North Portia
PR-016	RC	447875	6522475	68		-90	150	North Portia
PR-017	RC	448075	6522426	67		-90	300	North Portia
PR-018	RC	448050	6522480	67		-90	275	North Portia
PR-019	RC	448000	6522576	66	270	-70	200	North Portia
PR-020	RC	447825	6522349	69		-90	100	North Portia
PR-021	RC	448125	6522550	66	270	-70	300	North Portia
PR-022	DD	448351	6522700	65	270	-70	560	North Portia
PR-023	DD	448302	6522750	67	270	-70	500	North Portia
PR-024	RC	448150	6522800	65	270	-70	350	North Portia
PR-025	RC	448052	6522850	65	270	-70	290	North Portia
PR-026	RC	448405	6523599	60	270	-60	200	North Portia East
PR-027	RC	448604	6523604	60	270	-60	200	North Portia East
PR-028	RC	448799	6523602	60	270	-60	200	North Portia East
PR-029	RC	448601	6523198	60	270	-60	200	North Portia East
PR-030	RC	448799	6523200	60	270	-60	200	North Portia East
PR-031	RC	449002	6523207	60	270	-60	200	North Portia East
PR-032	DD	446702	6522800	60	300	-70	560	North West
PR-033	DD	446803	6523000	60	300	-70	560	North West

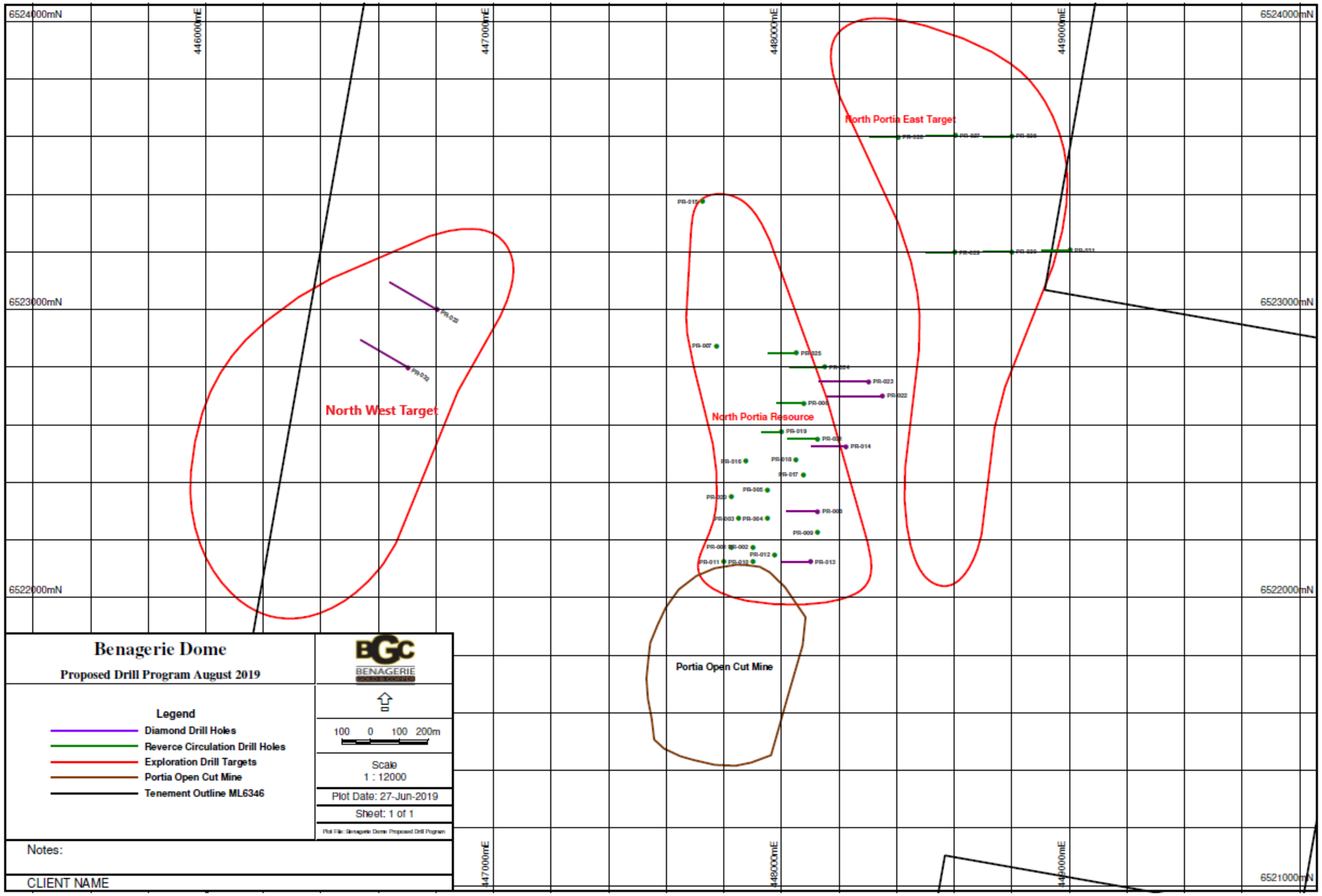


Figure 3-2: Locations of Proposed Exploration Activities

3.4 Description of Mining

3.4.1 Types of Mining Operation to be Carried Out

Under the scope of this PEPR, mining of the material within TSF-1 and TSF-2 and remnant mining of Portia Northern cutback will occur.

Remnant mining of the Portia Pit northern cutback will continue to be via conventional open cut mining methods using a truck and excavator fleet supported by ancillary equipment.

Dry mining of TSF-2 will occur using a 30-tonne excavator and 40 tonne Moxy trucks. Tailings material will be transported to the ROM Pad prior to processing. Material from TSF-1 will be mined via a combination of wet and dry mining. Wet mining will occur via the same process as outlined for TSF-2, however wet mining will be via a pump and reliquification unit within the cell and pumped to the process plant.

Once mining is complete, the TSF cell floors will be retreat by scarifying to 150mm, recompacting to 98% standard. Zones with exposed sands/gypsum layers to have additional 150mm of imported Quaternary clay placed and compacted to 98% SDD.

Ore from the Portia open cut pit was originally processed via a gravity separation method, however ore from the re-processed tailings material will require minor modifications the gravity circuit with a small, parallel cyanide leach circuit. No cyanide will report to the TSF-1 2 and 3

3.4.2 Portia Open Pit

The Portia open pit is 110m deep, 750 m long and 500 m wide. Details of the wall angles, bench heights and berm widths are described in Table 3-10. Details of the full assessments can be found in Appendix B9. Access to the Portia pit is via two access ramps. The north access ramp width is approximately 20 m, whilst the south ramp width is 16 m. An overview of the Portia pit layout is presented in Figure 3-3.

Table 3-10 Portia Open Pit Design Parameters (Appendix B12)

RL	West	South	East
Berm at 35 RL	NA	5 m	6m
Batter Surface to 35RL	30°	30°	30°
Berm at 25 RL	12.5 m	NA	NA
Batter to -20 RL	60°	60°	60°
Berm at -20 RL	10 m	5 m	5 m
Batter to -30 RL	60°	60°	60°

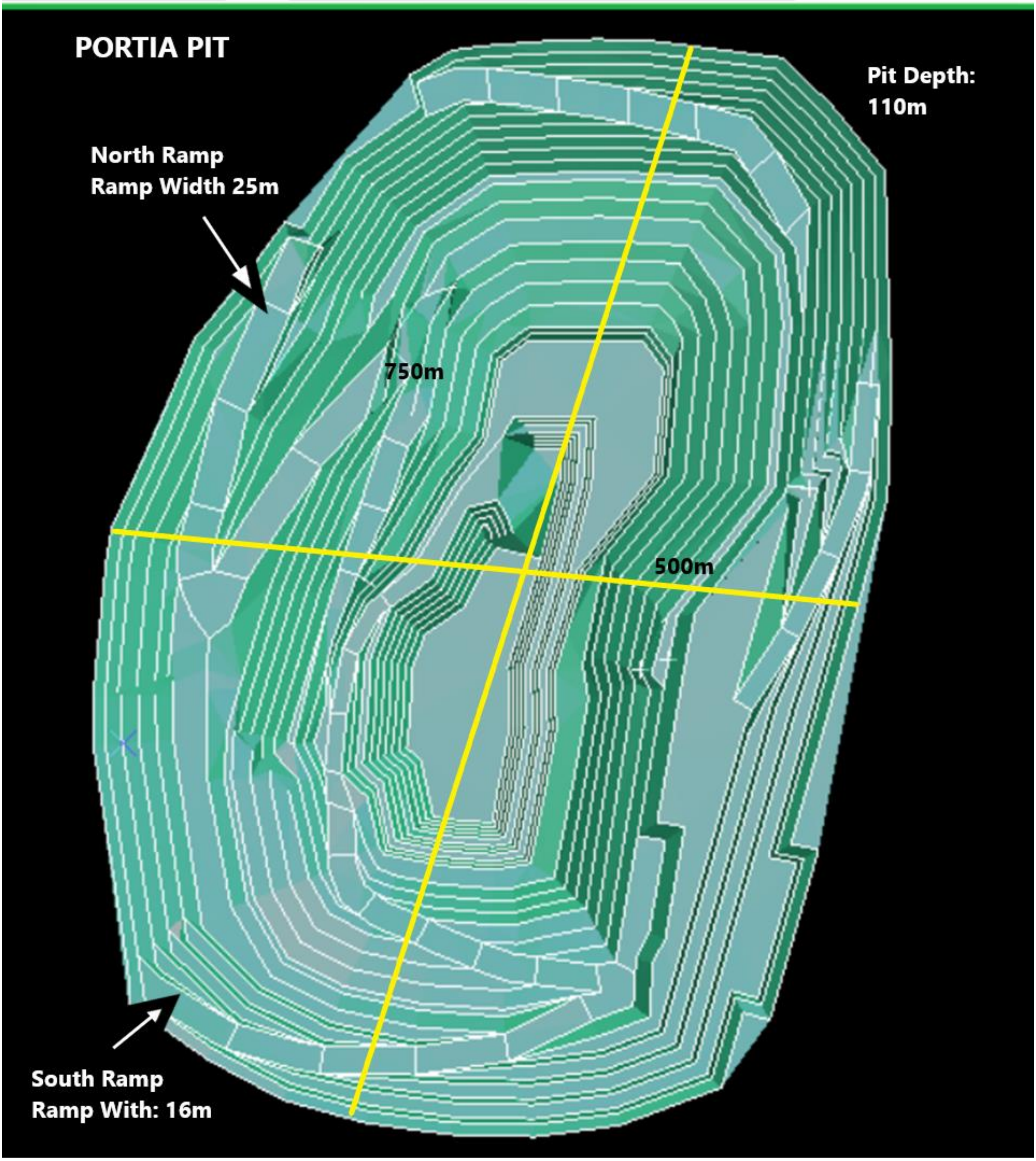


Figure 3-3: Portia Pit Overview

The approved cutbacks to the original Portia open pit design is to be completed in the second half of 2019 / first half of 2020. Mining of the original open pit was largely completed at the time of writing.

The shape of the approved Portia open pit design is shown in the plan view schematic in

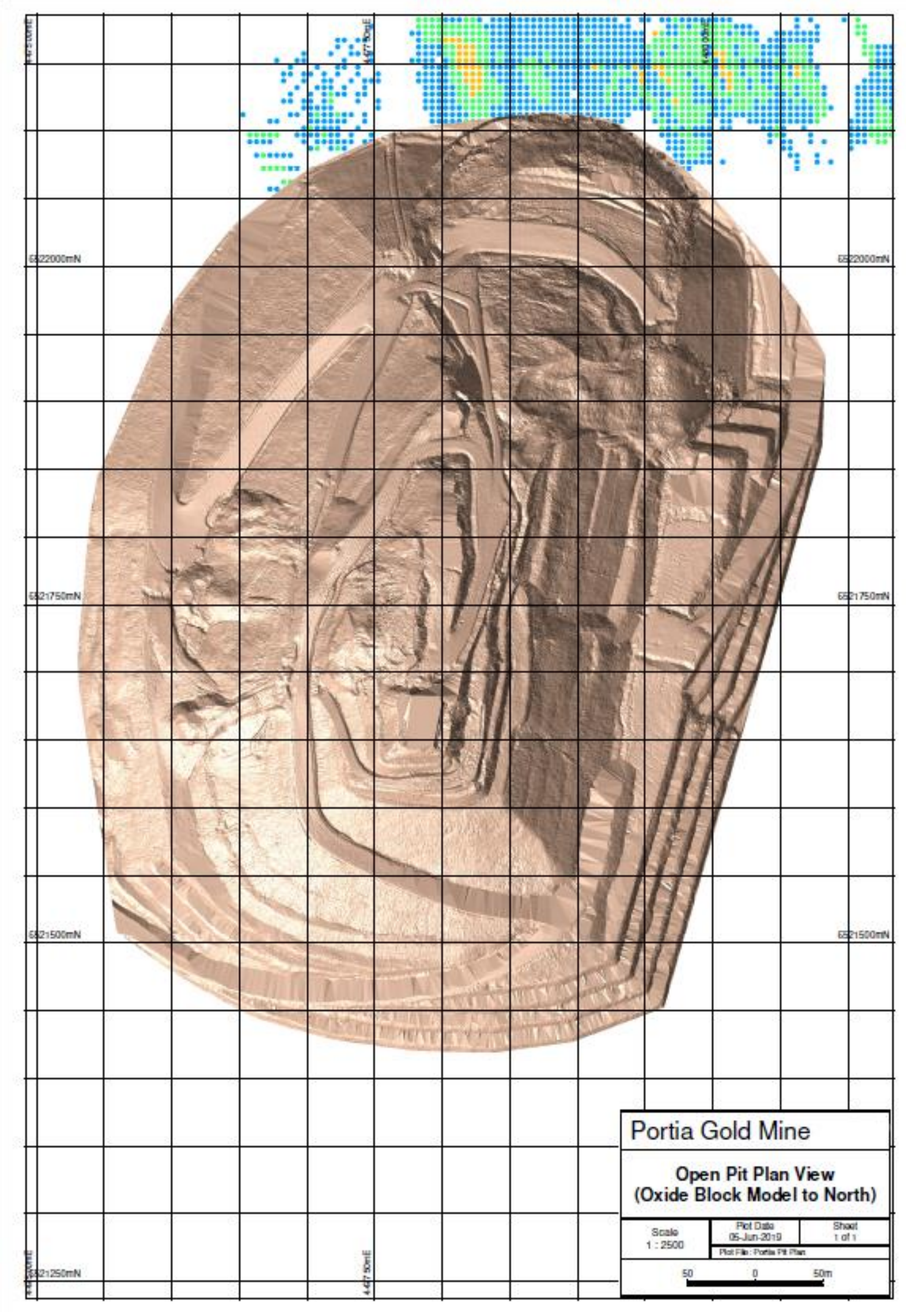


Figure 3-4. Pit plans and cross-sections at the completion of mining and closure are also provided in Section 7.

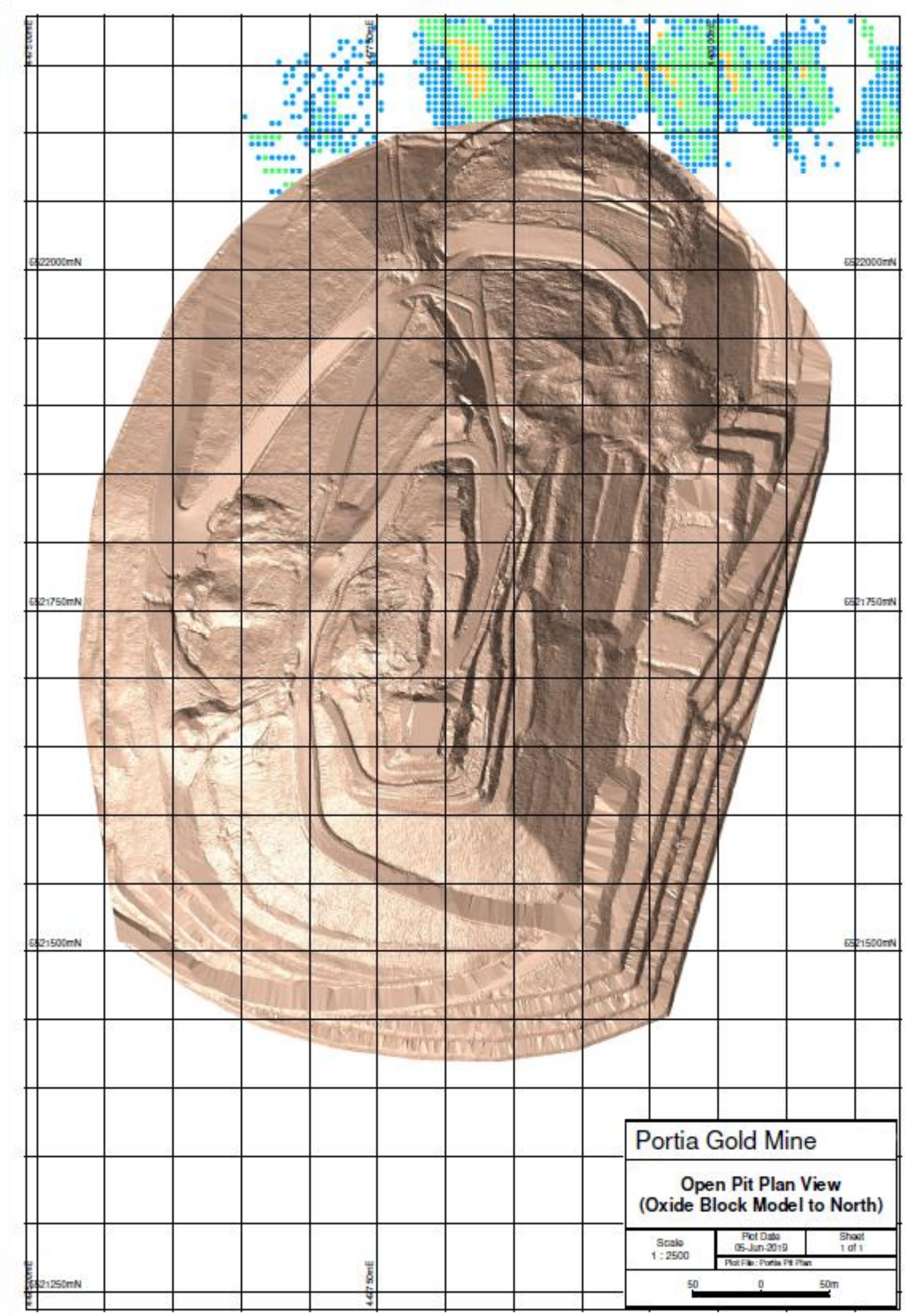


Figure 3-4: Portia Pit Plan View

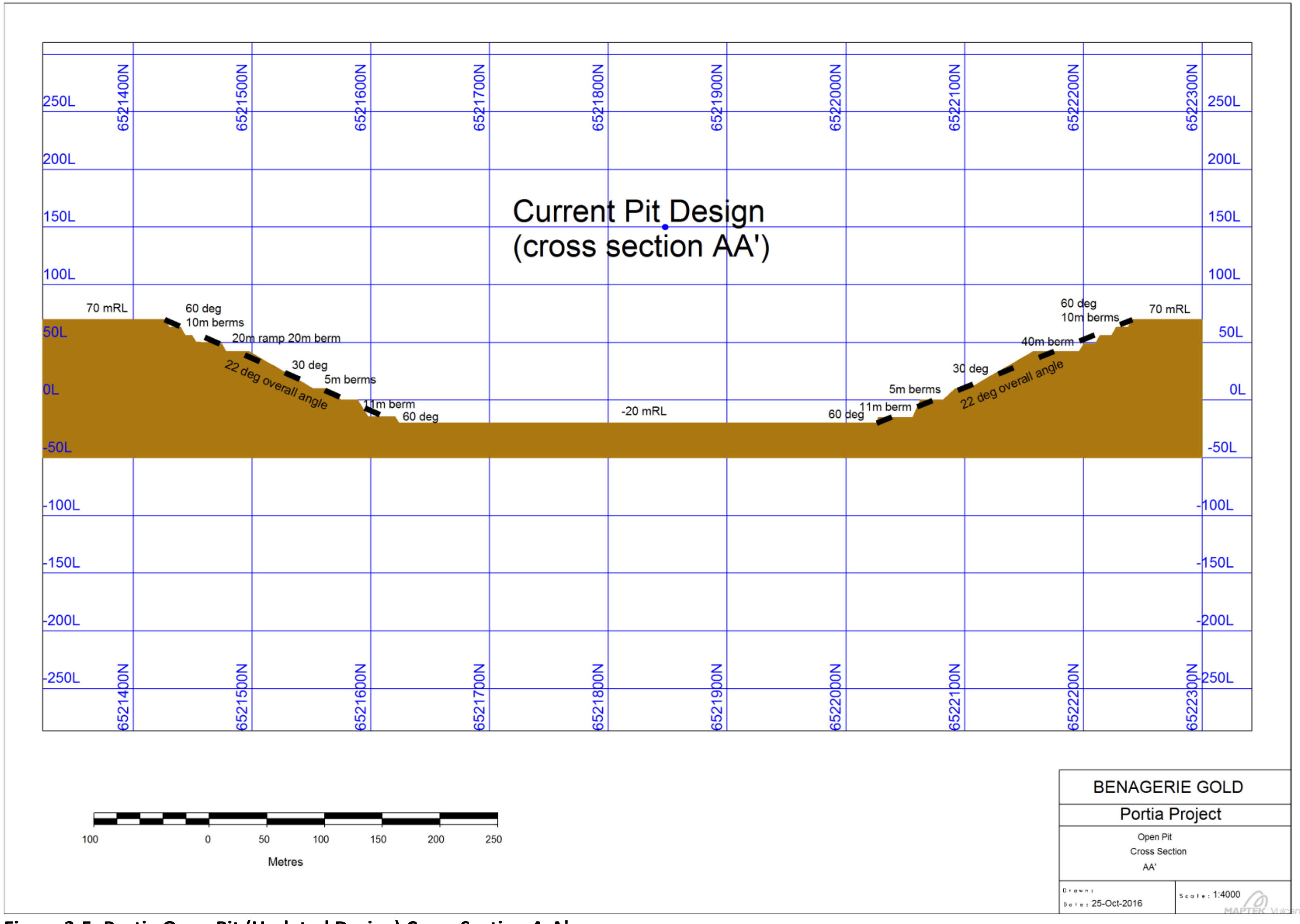


Figure 3-5: Portia Open Pit (Updated Design) Cross-Section A-A'

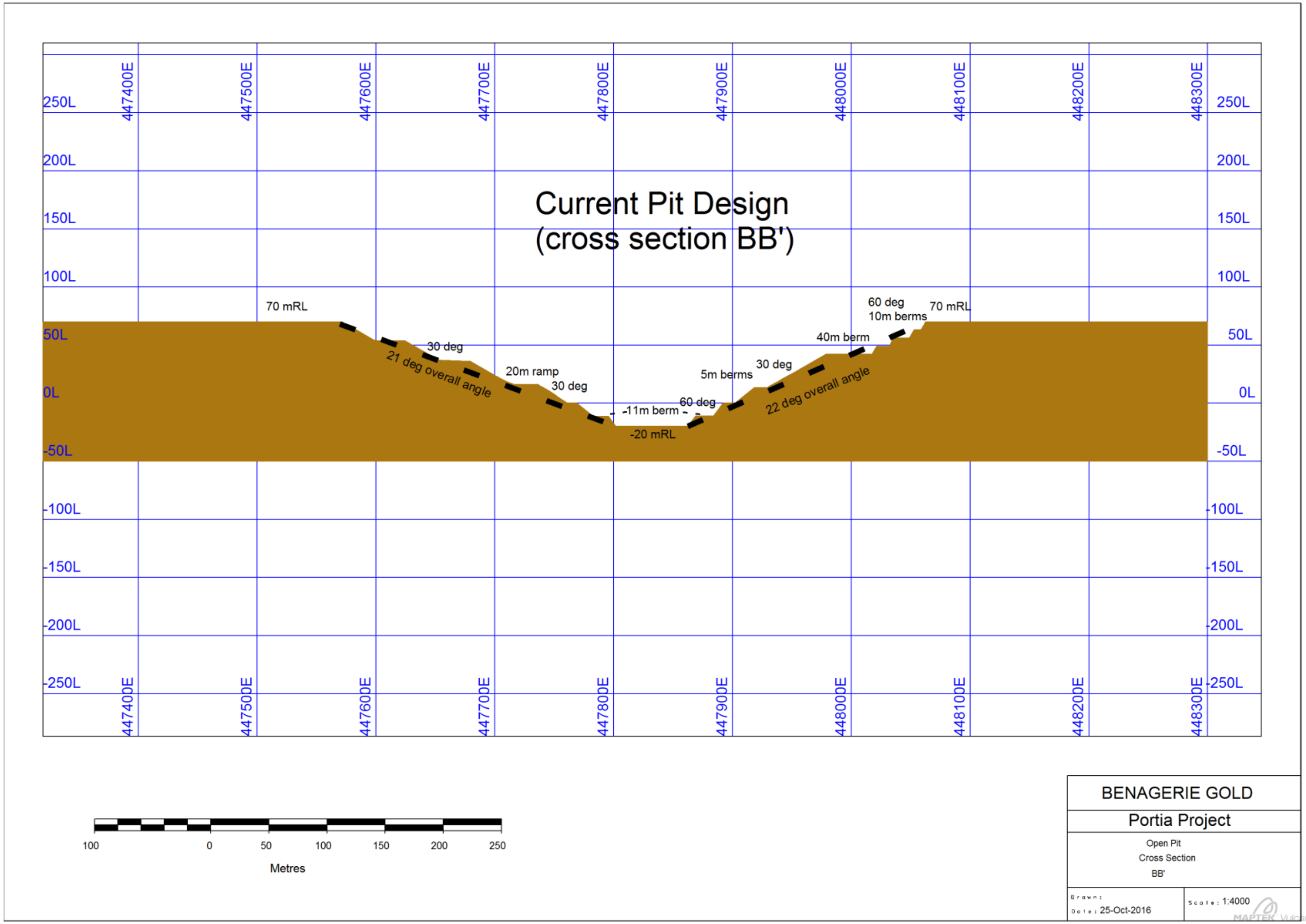


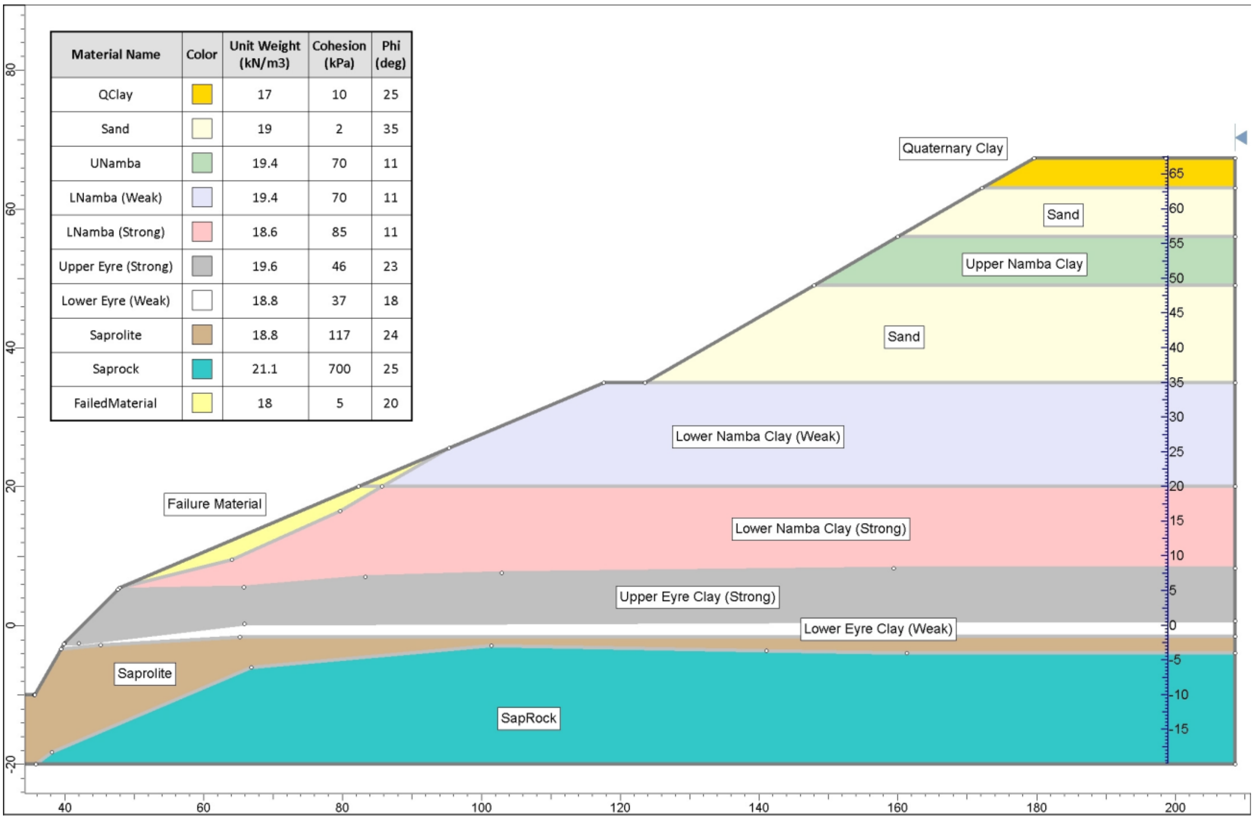
Figure 3-6: Portia Open Pit (Updated Design) Cross-Section B-B'

Geotechnical Analysis and Original Pit Design

A geotechnical investigation for the open pit was completed by Mark Robertson MASc, CPEng. RPEQ of Geo-Eng (Appendix B12) to provide geotechnical slope designs for recutting the northern ore zone down to RL – 10m.

The geological profile consists of approximately 70 m of clay and sand layers overlying weathered rock (Saprolite and Saprock). Figure 3-7 provides a typical cross-section showing the layering. The ore is primarily in the Eyre Clay with some mineralization in the underlying weathered rock.

Back-analysis of the North Wall Failure has been carried out along with large scale shear box testing of the clays, to determine best estimates of material strengths. An assessment of all laboratory testing and back-analysis was provided by MiningOne. The best estimates of material strengths based on the previous reports are shown in Figure 3-7.



Material Name	Color	Unit Weight (kN/m3)	Cohesion (kPa)	Phi (deg)
QClay		17	10	25
Sand		19	2	35
UNamba		19.4	70	11
LNamba (Weak)		19.4	70	11
LNamba (Strong)		18.6	85	11
Upper Eyre (Strong)		19.6	46	23
Lower Eyre (Weak)		18.8	37	18
Saprolite		18.8	117	24
Saprock		21.1	700	25
FailedMaterial		18	5	20

Figure 3-7: Typical Geological Profile and Material Parameters

Unlike rock, the unconsolidated materials are expected to have significant elastic strain movement due to the unloading as the pit is excavated. The movement would occur quickly and thus would not be readily observable, and the largest strains would occur in the lower clay layers. The clays may also experience plastic strain, which may occur more gradually. Both elastic and plastic movement can allow defects to open, and thus reduce the material strength near to the cut surface.

On exposure, the Namba clays also dry and break along small fractures and can crumble completely due to micro-fracturing. Slicken-sided surfaces are common on defects, especially in the weak Lower Namba Clay. The Eyre clay is more competent and doesn't show the same amount of defects.

The strain movement / opening of fractures can result in reducing strength over time for marginally stable slopes. Therefore, it can be advantageous to stage the mining, limiting the time of activity near steeply cut slopes. This reduction in strength is captured in the estimated of strength determined from the back analysis of slope failures.

The North Wall failure is approximately 160 m wide and 200 m from crest to toe and extended 25 m back from the pre-failure slope crest. There was several weeks of movement leading up to the collapse, providing warning for the mine operation. The failure appears to have been a combination of rotational and translational movement, with the base of the failure likely in the range of RL 0 m to RL 7 m at the base of the Lower Namba Clay, based on scan data and slope stability back-analysis. The critical factors of the failure were the steep cut slopes (30° to 32°) and the weakness in the Lower Namba Clay. The underlying Eyre Clay is stronger and does not appear to have failed.

Progressive failures have been observed in both the Upper and Lower Namba Clay which appear to be related to unloading, drying and cracking. The Lower Namba Weak Clay has shown the most movement, and the most recent slope cuts have been flattened to 20° to minimise the failures in this layer. These failures are smaller in scale and develop gradually, extending up slope, in contrast to the large-scale rotational failure of the North Wall. It is expected that slopes flatter than 23° should minimise the potential for progressive failures in the Lower Namba Weak Clay.

Given the significant advance in the understanding of material properties, and the continuous pit slope monitoring system, it would reasonable to use a Factor of Safety (FOS) of 1.2 for short-term slopes and 1.3 for longer-term / ramp slopes.

Redesign of North Walls

The estimated extent of the high-grade ore at RL -10 m has been provided as the target toe for redesign of the northern pit slopes. 6 Slope stability analyses have been carried out to provide a safe/optimal design for the west, north and eastern slopes surrounding the ore target.

Slope designs for the west, north and east slopes of the northern pit are shown in the attached Sections N1, N2 and N3, the locations of the sections are indicated in Figure 3-8. The inclusion of ramps would increase the overall FOS. To obtain a FOS of 1.2 for Section N1, a small 3 m wide berm was included in the design. As this slope has already been cut, it would be difficult to achieve this design.

Alternatives would be to widen the berm cut to a practical width, or accept a lower FOS of 1.17, without the berm as shown in Section N1a. The existing western slope has a FOS of 1.17 and has not shown any instability.

Probabilistic analysis was carried out for the western slope, allowing friction angles for all materials to vary by +/-3° and cohesion to vary by +/-6kPa for all clay layers and +/- 15kPa for the Saprolite. The calculated Probability of Failure (PoF) for 1 million realization of the most likely optimised failure surface8 was zero, as shown in Section N1b, (the minimum simulated FOS was 1.01). An alternative analysis using 1000 statistical realizations of 4500 potential optimized surfaces also indicated a PoF of zero, with a minimum simulated FOS of 1.04.

It is proposed that the re-development of the northern end of the pit would be carried out in progressive stages, working counter-clockwise from east to west. Staging the excavation would limit the time that each slope is a risk to the mining operation, and would reduce the cost of overburden removal by reducing the requirement for cut ramps, while using cut material to form ramps in mined out zones. The staging of cuts and ramp development would require a detailed plan to achieve a practical and safe development, which is beyond the scope of this document. Temporary slopes in fill material should be formed at 18° (1V:3H). The material should be track rolled in layers of 300 mm with at least 4 passes of a sheep's foot roller. Alternatively, 6 passes of a D9 or heavier machine could be used. This compaction should prevent later settlement which could cause local movement and trafficability issues. Fill slopes should be protected from water infiltration by directing run-off to in situ slope locations, and inspected after rainfall events. If there are locations that would be long-term haul roads, compaction control testing may be useful to ensure a good compaction of the material.

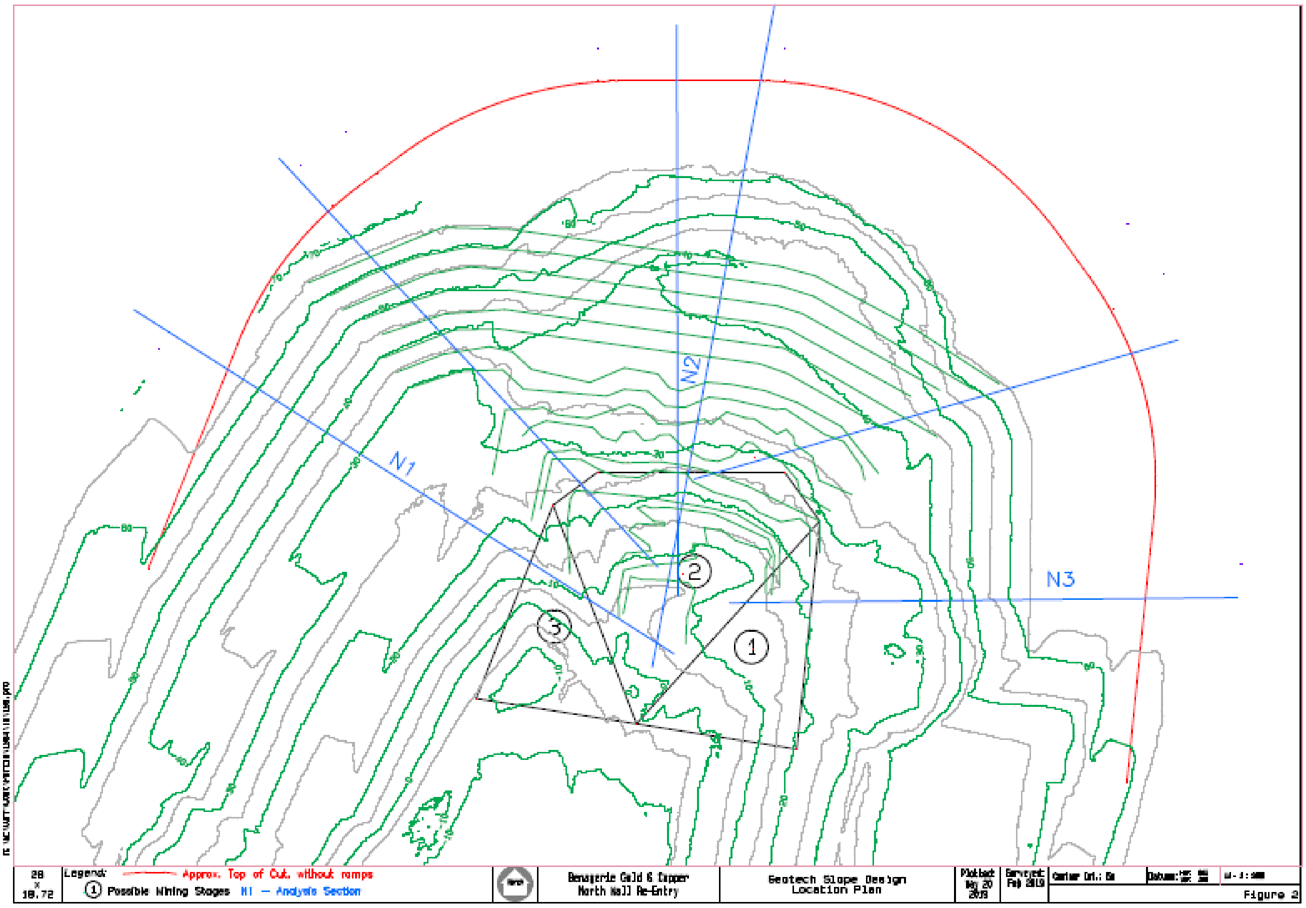


Figure 3-8: Slope Design Location Plan

Open Pit Wall Stability Monitoring

BGC acquired an I-Site Sentry laser scanning system for the specific purpose of regular monitoring of the pit walls at Portia in order to detect any abnormal movements that could be a precursor to failure. This is an extremely versatile and powerful monitoring system that can effectively detect movements of only a few millimetres over distances of hundreds of metres (refer to hyperlink: State of the Art Maptek Sentry Pitwall Monitoring System). Sentry works by comparing multiple scans and detecting small changes between them. These changes in pit wall shape, if consistently observed, may provide early warning of potential failure zones and is therefore a very effective safety tool.

Five monitoring stations have been set up on heavy bollards at a safe distance from the open pit crest. Scanning is conducted up to 24 hours per day to produce a continuous scanning record of the pit walls, which is then interrogated by software to highlight any areas of potential movement. Additionally, "Perfect Dig" software is employed to continually check the mine design against the final shape. This software produces a simple over-dug and under-dug visual output. Negligible discrepancies have been observed between the GPS controlled digger surfaces and the design, indicating a high degree of operator skill.

Use of the I-Site Sentry laser scanning system has another big advantage in that its interrogative software allows accurate dip and strike measurements of joints observable on a scanned face. This data can then be plotted on rose diagrams or stereo nets to determine preferred joint directions and dips. Several detailed scans were undertaken for this specific purpose in various parts of the open pit in order to determine details of the conjugate joint sets observed in the Namba Formation lower clays. Stereo plots of more than 400 measurements of the joint sets show little preferred orientation, but quite consistent 45° dips. This result is important in supporting the batter angles and overall pit wall angles recommended from the slide modelling.

Groundwater and Pit Wall Stability

Groundwater is present in the Proterozoic basement fractured rock aquifer, with a pre-mining piezometric head of approximately RL 41-43 m AHD, as described in Section 2.10. The light grey clay at the base of the Tertiary and the Eyre Formation are of low permeability and act as an aquitard, limiting upward migration of the basement groundwater into rest of the Tertiary cover sequence.

Pockets of groundwater are understood to exist within sandy layers in the cover sequence but are expected to generate negligible pore pressures. The clays are of very low permeability and although they contain moisture within the clay particle structure, there is essentially no aquifer present in the cover sequence. Unloading the clay by mining results in a swelling and opening of clay fissures, reducing any pore water pressure within the clay and possibly providing some suction (negative pore pressure) which is beneficial to slope stability.

Water in the pit is being held at about RL -12.5 m by pumping. Water levels around the pit have been lowered to about RL 0 m, based on available water level information. There was evidence of seepage from the toe of the slumped north wall material. It is understood that there are three unlined drill holes in the Saprolite, which were producing water into the previous excavation, which is now covered by slumped material.
It has been assumed that the water table is not significant relative to the most likely failure surface (i.e. below RL0 m beneath the slopes). It is recommended that the excavation of the pit be worked so that the old drill holes, which produce water from the saprolite, are exposed in the initial development to maintain a low water table.

Further assessment, and likely flatter slopes, would be required if groundwater levels are above the saprolite surface.

Stability analyses were carried out by Geo-Eng in 2019 (Appendix B12) using the Rocscience Slide (v6) software. The post closure scenario uses a slope mined to RL -20 and a pit filled with water to RL 23m. Both the overall slope and abandonment bund criteria are satisfied.

3.4.3 Underground Workings

There are no underground workings proposed as part of the scope of mining at the Portia Mine Site.

3.4.4 Material Movements

The movement of ore and waste rock is shown by year in Table 3-11 over the LoM. This indicates that the total extracted tailings material will be ore and waste rock will be approximately ~68,963 tonnes and 1.7 million bcm, respectively, over the two-year life of the operation.

Conceptual material movements for North Portia Phase 2 have also been included to provide a line of site to future approvals.

Table 3-11 Material Movements

Aspect	Portia		North Portia (Conceptual)					Total LoM
	Phase 1		Phase 2	Phase 3				
	2019	2020	2020	2021	2022	2023	2024	
Ore movement (tonnes)	68,963	*40,000	490,000	1,000,000	1,000,000	1,000,000	856,000	4,454,963
Waste movement (million bcm)	1.5	0.2	9	0.5	0.5	0.5	0.25	12.45
Strip ratio	20:1	5:1	22:1	22:1	5:1	5:1	5:1	

*subject to grade control confirmation

Materials Handling

Quaternary clay overburden material removed from the first bench of the Portia open pit was used in Site construction activities. More specifically, these activities included the constructional earthworks associated with the TSF-1 and 2 cell embankments, the ROM Pad, Site haul roads, hardstand areas and flood protection measures (bunds and windrows).

Quaternary clay overburden material was removed from the first bench of the Portia open pit and systematically stockpiled as follows:

Abandonment Bund

Construction of the pit abandonment bund to design can only occur at the completion of mining when access to the Portia open pit is no longer required and when all haul roads and pipelines are no longer needed. There is a portion of the abandonment which has already been completed around the Portia open pit. When approvals are obtained for the mining of ore within the North Portia open pit it is acknowledged that a portion of the abandonment bund will need to be relocated to provide sufficient set-back from the new proposed North Portia open pit crest (Phase 2 and 3). Sufficient Quaternary clay materials will be stockpiled around the perimeter of the open pit to complete the remainder of the bund at closure.

TSF Capping Stockpiles

During starter TSF cell embankment construction, surcharge stockpiles were built, consisting of Quaternary clay material obtained from the first bench mined from the Portia open pit. This material was hauled to the TSF from the Portia open pit by dump truck and stockpiled on the eastern side of TSF-1 and TSF-2 for later use as rehabilitation capping material of the dried out TSF cells on closure.

These stockpiles, being up to 6 m in height, have been formed with 1V:5H slope angles along with small bunds to minimise erosion and loss of material from surface water run-off and to prevent heavy rainfall from discharging sediment laden water away from the stored material.

Overburden and Ore

Two nominal 250 tonne excavators provide 80-100 tonne payload capacity trucks that haul this material on 3.5 m flitch intervals from the pit. This has been the methodology for all mining activities.

Overburden waste material is removed from the pit and transported by truck to an OWD. This waste material is truck dumped, spread and trimmed progressively during overburden waste mining to build the OWD to design batter angles and design top slopes. This will ensure that on completion of all mining activities, the OWD landform will be formed to the intended final rehabilitation shape, in preparation for rehabilitation activities associated with the OWD to commence.

The ore is planned to be removed in quick succession, after the removal of overburden, to mitigate commercial risk to the Project and will be transported and stockpiled on the ROM pad prior to processing.

3.4.5 Stockpiles

Stockpiles will be limited to those for temporary topsoil storage, permanent overburden / waste rock storage, as well as temporary construction and capping stockpiles and ore holding prior to processing.

Ore stockpiles are developed on the ROM pad. The ROM pad has been designed to accommodate a volume of 150,000 cubic metres of ore stacked to a maximum height of 6.0 metres at the materials' natural angle of repose. The ROM pad has been prepared and cross graded to control storm water runoff, erosion and provide a suitable working surface during use. On the northern side, a sump and trenches capture run-off water from rainfall. Periodically, this sump will be pumped out to the BP1 for re-use in the ore processing circuit.

The clay overburden material and any other waste rock mined from the Portia open pit will continue to be dispatched to the OWD.

Gravel supplied to the Project (if required) will be temporarily stockpiled in a gravel stockpile location adjacent to the open pit prior to re-use. Temporary gravel stockpiles will be built to a maximum height of 6.0 m.

A TSF capping stockpile has been placed on the eastern side of the TSF cells for later use in rehabilitation activities associated with the TSFs.

All stockpiles, including topsoil stockpiles are constructed with small perimeter bunds to minimise erosion and loss of material from surface water run-off and to prevent heavy rainfall from discharging sediment laden water away from the stockpile.

Topsoil stockpiles have been built to a maximum height of 2.0 m and placed at locations to enable efficient re-use and handling during final rehabilitation activities.

Topsoil stockpiles are monitored at quarterly intervals to assess soil stability, vegetation establishment and the presence and removal of weeds. Weeds will be eradicated as they germinate and prior to using the topsoil in Site rehabilitation.

Topsoil stockpiles have been formed adjacent to cleared areas including the OWD, the ROM pad, the open pit, the TSF, and adjacent to the office and mining laydown area.

The proposed locations of all permanent, temporary and ore stockpile locations for the Site can be seen in Figure 3-1. Actual locations may vary as mining progresses with stockpile locations and volumes surveyed and recorded.

A reconciliation of design versus actual topsoil stockpile volumes has been undertaken, as detailed in the *Topsoil Management Plan* (see Appendix F2), to ensure that sufficient topsoil / subsoil material is available at closure for rehabilitation activities.

3.4.6 Use of Explosives

The ore and waste material is of a very low strength and does not require the use of explosives.

3.4.7 Types of Mining Equipment

A standard equipment fleet is used in the excavation of the Portia open pit, as well as in processing operations (Table 3-12), typical of those used in similar metalliferous mining operations. It should be noted that this is indicative only and subject to regular change depending on the requirements of the mining and processing plan. Table 3-13 shows the current light vehicle fleet used.

Diesel fuel for vehicles is dispensed from bowsers in a bunded storage area.

A vehicle workshop and parking area have been prepared near the heavy equipment laydown area.

A heavy equipment laydown area has been prepared near the processing plant.

Processing equipment includes a scrubber, Riffle tables, screens, primary and secondary cyclones, Knelson concentrators, and a final Gemini cleaning table. A parallel cyanide leach circuit comprising of inline leach reactor-detoxification unit and reagent storage, an electrowinning circuit. A diesel-fired furnace is used for dore' production.

There are no noise outputs, exhaust outputs or fire ignition sources relating to mining equipment within the Portia open pit outside of those listed in the manufacturer's specification.

Table 3-12: Mining and Processing Fleet

Type	Size/model	Capacity (tonnes)	Number	Notes
Excavator	EX2500	250	1	Overburden stripping – Cutback
Excavator	EX1200	120	1	Ore mining/waste
Excavator	30T Cat	30	1	Site operations
Haul/Dump truck	CAT 777D	90	6	Ore Removal
Bulldozer	D10	60	2	Stockpile shaping/maintenance
Grader	16H	-	2	Road maintenance
FEL	966	5	2	Ore feeding (back up)
FEL	980	5	2	Ore feeding
Roller	-	13	1	Compaction (e.g. bunds)
Water cart	Cat 773	50	2	Dust suppression/fire fighting

Type	Size/model	Capacity (tonnes)	Number	Notes
Service Truck	-	14	1	Fuel/lube and maintenance
IT Loader	Cat 28	10	1	Multipurpose tool carrier

Table 3-13: Light Vehicle Fleet

Person / Function	Type	Number
Registered Mine Manager	4WD	1
Mining Manager	4WD	1
Production Manager	4WD	1
Plant Supervisor	4WD	1
Fitters	4WD	2
Workshop Manager	4WD	1
Survey	4WD	1
Camp Manager	4WD	1
Operations	4WD	3
Ambulance	4WD	1
Total light vehicles		**13**

3.4.8 Mine Dewatering

Mine dewatering at the Site previously occurred through a dewatering well network. This was found to not be the most efficient method for dewatering of the Portia open pit as such the method has now switched to in pit sumps.

Information has been retained within this Section detailing how the dewatering well network operates as the infrastructure remains, though it is not in use.

Dewatering Well Network

During pre-strip activities, dewatering rates were in excess to Site water requirements and re-injection occurred into the basal sands (Eyre Formation) aquifer of the Shylock Palaeochannel, located within the north-western corner of ML 6346.

A pit dewatering network was established to enable pit dewatering to occur.

Up to six Grundfos Ultrasub 415V (or equivalent) submersible pumps were installed around the Portia open pit during maximum dewatering requirements. The pumps are each capable of pumping at a flow rate of up to 4.6 L/s. The pumps are sized to match the sustainable yield flow rates for each constructed well. Pumps were set at approximately 90 m below ground level (BGL). Each pump was connected to the dewatering ring main around the pit perimeter using 50 to 75 mm diameter PN12.5 HDPE rising main piping.

The 'ring main' consists of a single 160 mm PN10 poly dewatering line. The line is approximately 870 m in length. One inline turbine flow meter and ball valve has been installed to enable the cumulative flow to be measured and maintained. The ring main dewatering lines report back to the PDD.

All pit dewatering wells have been cased using 177mm ID Class 12 PVC casing to a depth of approximately 102 metres. The screened intervals extend from approximately 70 m below ground level to 102 m below ground level and consist of a combination of 4-way slotted casing and 6 mm clean graded gravel. The gravel pack extends from approximately 102 m to 68 m. A 2 m bentonite seal has been placed above this gravel pack and the wells have been pressure cemented (via tremie line) to the surface. The original pit dewatering well locations are shown in Figure 3-9.

Australian Groundwater Technologies Pty Ltd (AGT) were originally commissioned to develop a numerical *groundwater dewatering model* for the Portia Mine Site, as described in AGT (2014) (see Appendix C3). There have been a number of groundwater model iterations with each successive iteration building on the framework of the previous model. The model iterations and enhancements are provided in Appendix C – Groundwater Studies.

In Aqueon (2016a), the re-calibrated model (AGT, 2015) was used to assess the capacity of the Shylock Palaeochannel to support groundwater withdrawals up to 18 L/s (4 wells @ 4.5 L/s per well) for 270 days and to assess the likely drawdown over that time due to both the Portia open pit dewatering and extraction from the Palaeochannel.

The Aqueon (2016a and 2016b) modelling demonstrates the capacity of the Shylock Palaeochannel to support the contingency supply demand at the required 'worst case' rate (i.e. 18 L/s for 270 days).

Aqueon (2016c) undertook a detailed hydrogeological review and update of the numerical groundwater model to support the northern and southern pit extensions to the Portia open pit. The extension of the Portia open pit will result in the loss of seven existing performance monitoring wells and seven existing pit dewatering wells, leaving PTDW2 as the only remaining performance monitoring well. Table 3-14 presents a summary of the wells that will be impacted by the open pit expansion. Well locations are shown in **Error! Reference source not found.**.

Table 3-14: Existing Wells Impacted by the Portia open Pit Expansion

Well Purpose	Well ID	Easting (AGD 66)	Northing (AGD 66)	Formation Monitored
Performance Monitoring Wells	PTDW1	447606.20	6521637.20	Weathered Basement
	PTDW3	447758.70	6522129.20	Weathered Basement
	PTDW4	448036.40	6522043.60	Namba / Eyre Formation
	PTDW5	448025.80	6521804.60	Weathered Basement
	PTDW6	447918.50	6521583.20	Namba / Eyre Formation
	PTDW16	447532.67	6521782.95	Weathered Basement
	PTDW18	447630.73	6522036.98	Weathered Basement
Pit Perimeter Dewatering Wells	PTDW8	447867.81	6522095.98	Weathered Basement
	PTDW9	447989.88	6522057.75	Weathered Basement
	PTDW10	448038.69	6521944.79	Weathered Basement
	PTDW11	448017.62	6521803.02	Weathered Basement
	PTDW12	447967.06	6521663.76	Weathered Basement
	PTDW13	447858.40	6521588.34	Weathered Basement
	PTDW14	447698.22	6521608.20	Weathered Basement

The Aqueon (2016c) and WGA (2017) results identified that pit sumps could not effectively maintain the required rates of drawdown. The environmental impacts associated with the expansion to the Portia open pit where found to not change from those previously reported by AGT (2015) and Aqueon (2016a, 2016b and 2016c). The drawdown contours show impacts at the Shylock Palaeochannel of around 0.5 m consistent with the previous model predictions.

In Pit Sumps

In pit sumping will be undertaken using diesel powered pumps placed adjacent to excavated sumps on the pit floor which will pump to the PDD via HDPE rising main piping. Inline turbine flow meters and ball valves will be installed to enable the cumulative flow to be measured and maintained. An average of 41litres/sec is pumped from the pit to the pit dewatering dam (PDD) extracting approximately 3,541kL per day.

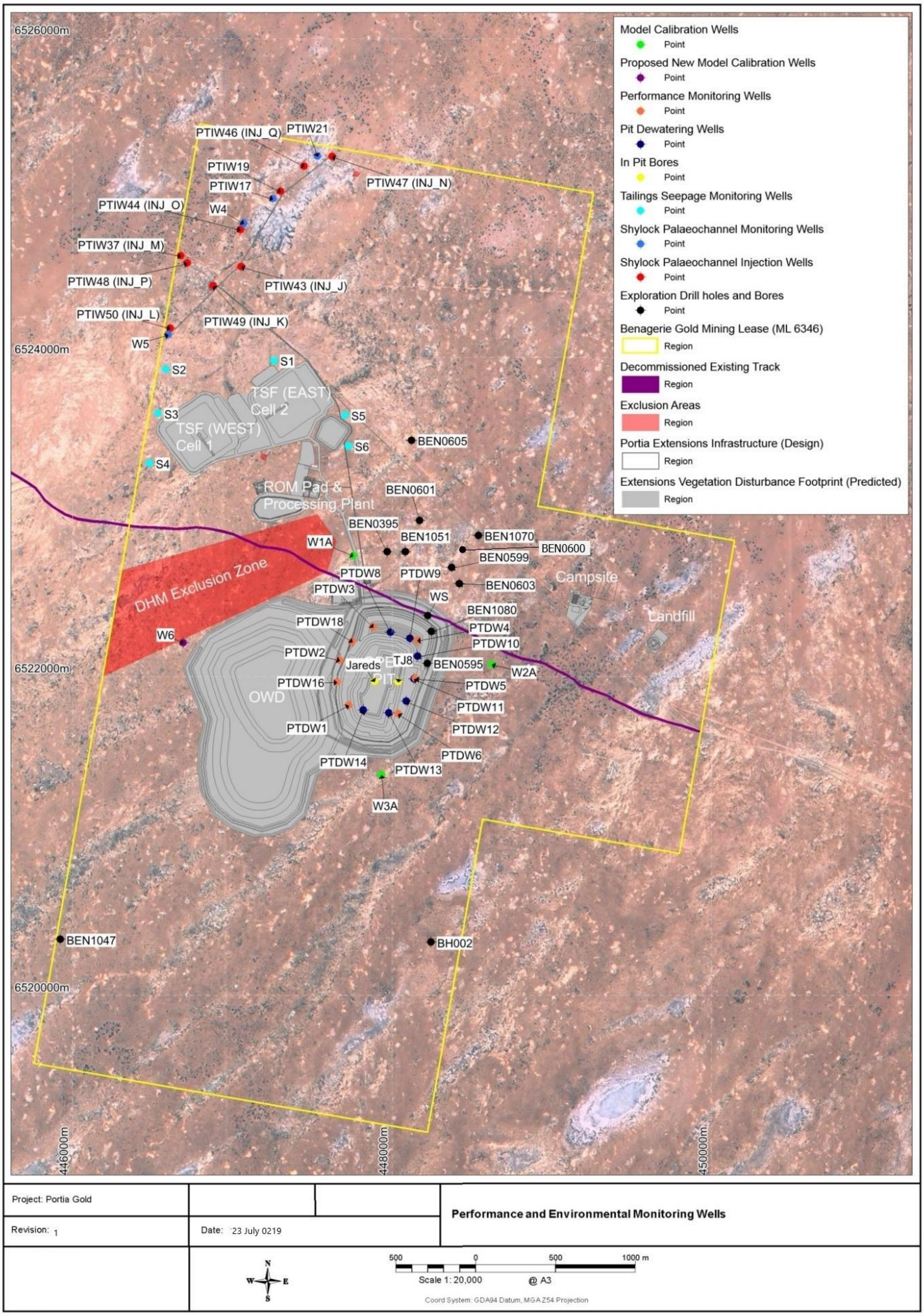


Figure 3-9 Location of Performance and Environmental Monitoring Wells

The PDD consists of a truncated inverted pyramid and measures approximately 10 m x 20 m at the base and 5.0 m deep and has dimensions at the inside crest of 40 m x 50 m. It has a capacity to hold 4.7 ML. The PDD has side slopes of 3H:1V and an embankment crest width of 1.0 m.

The PDD dam is lined with a 1.0 mm HDPE geomembrane on a sand/clay base. The walls and floor of the PDD have been excavated neatly from solid material. All soft, yielding or other unsuitable material has been replaced with sound material and the subgrade compacted to provide a minimum of 95% compaction.

The geomembrane was laid on the clay foundation following specific working procedures and anchored into the ground utilizing a small 300 mm deep V- trench which was backfilled afterwards.

After placement, the geomembrane was inspected for evidence of holes, tears or defective seams. If these features are found to be present the liner shall be repaired in accordance with the manufacturer's specifications. In maintaining an operational freeboard of 1.0 m, the live capacity of the PDD is 3.0 ML. This capacity provides approximately one day of storage from pit dewatering.

The current location of the PDD can be seen in Figure 3-27. The PDD is currently constructed to the direct north of the Portia open pit.

PDD Pumping System and Injection Wellfield Delivery Pipeline

When in use, pumping from the PDD to the reinjection wellfield occurs via the PDD pumping system. This comprises of three vertical multi-stage, pressure controlled, centrifugal pumps mounted on a skid complete with valves.

At present the PDD pumping system is proposed as a duty / standby arrangement, as any issue with the pumping system would shut the Pit Dewatering system down. The pump skid can deliver water approximately 2,600 m to the re-injection wellfield and the RWD through 180NB HDPE extruded white pipeline appropriately classed with a higher burst pressure rating than the peak designed disposal pressures.

To deliver water from the PDD to the RWD, a high flow Grundfos 8/6 pump (model NK 150-315) coupled to a 75kW motor and VFD has been installed and pumps via a 200PN6.3 pipeline to the RWD. This allows simultaneous and independent pumping to both the re-injection wellfield and the RWD from the PDD.

To contain saline water as well as prevent soil erosion should a pipeline burst during operation, all pipelines are appropriately bunded or buried. All pit dewatering infrastructure is monitored regularly throughout each day to ensure suitable operation occurs.

At the high points of the PDD delivery line, a relief valve is installed to negate suction pressure within the line on shutdown.

In the event that the reinjection wells are utilised for extraction purposes, BGC will install nominal 100 mm (4 inch) submersible stainless steel pumps in these wells along with appropriate headworks. The re-injection headworks will simply be removed and retrofitted with submersible pumps, headworks and suitable power sources. Existing flow meters will be utilised to record the extraction volumes. The pumps will each be capable of pumping at a flow rate of up to 4.5 L/s. The pumps will be sized to match the sustainable yield flow rates for each constructed well. Pumps will be directly connected to the existing 180NB HDPE extruded white pipeline and water pumped to the RWD before entering the processing circuit.

<u>Flow Meters</u>

Currently flow meters exist on the pit dewater well ring main, on the inflows and outflows around the processing plant and on each of the re-injection wells. While this is sufficient to monitor water usage, there is no ability to cross-check flows for water balance purposes. An electronic flow metre has been installed to measure the pit sumping inflows to the PDD. Metres area regularly calibrated through an electronic calibration system.

Contingency Measures

Please refer to Section 1.1.1 which details the contingency measures for the Site's water management.

Water Balance

Please refer to Section 3.5.4 which details the water balance for the Site during operation and closure.

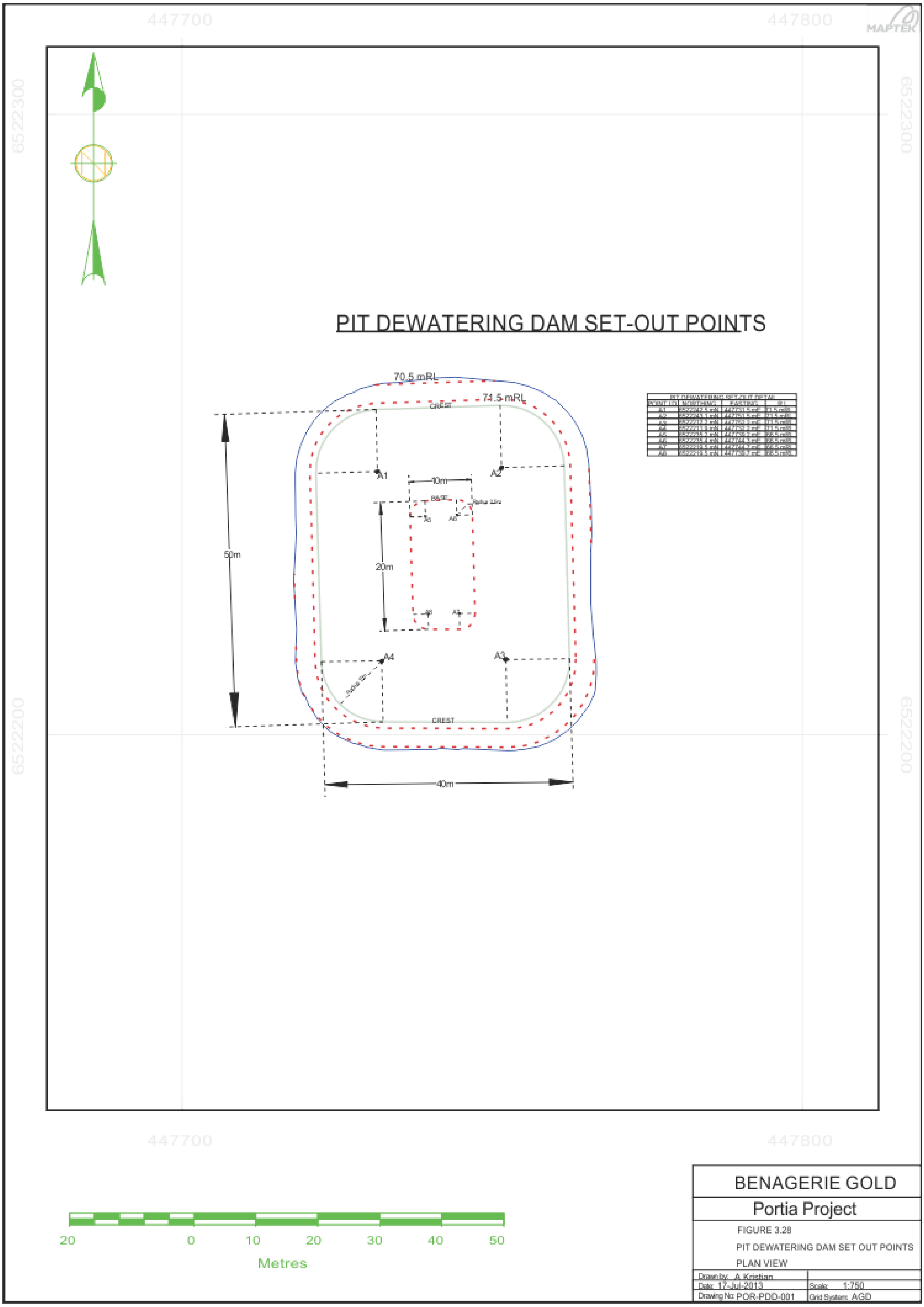


Figure 3-10 Plan View of the Pit Dewatering Dam (Design)

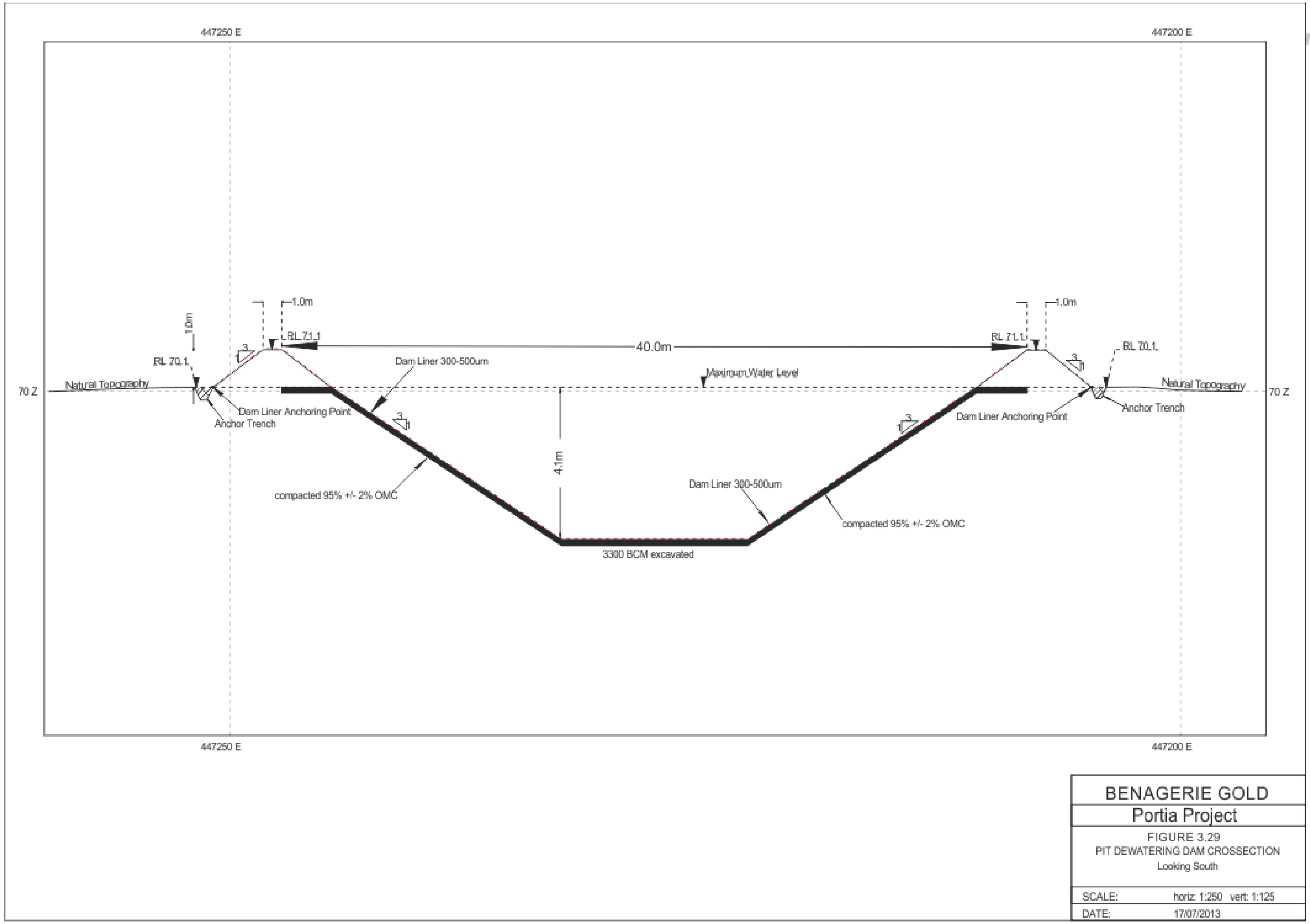


Figure 3-11 Cross-Section Looking South of the Pit Dewatering Dam (Design)

3.4.9 Sequence of Mining and Rehabilitation Operations

Construction commenced during March 2015 with mining of the overburden from the Portia open pit commencing during April 2015. The first gold ore was mined during March 2016, with the first gold pour occurring in May 2016. Since that time the Portia open pit has been progressively mined. A cutback to the south of the original open pit design is complete and an approved cutback will be constructed during the next 12 months.

The Portia pit ceased operations prior to the end of 2018 (without a northern extension to the Portia open pit). The Portia Mine Site plan to begin re-processing of the tailings material for approximately 12 months recommence mining of the Portia open pit, will occur from the grant date of this PEPR update.

Before the completion of the tailings reprocessing and remining of the gold ore, BGC plan to submit to DEM an updated PEPR for the operation to include the construction of the North Portia open pit (Phase 2 and Phase 3). Phase 2 will involve the removal of overburden for approximately 18 months (2020 – 2021) and the processing of the oxide ore (2021). Whilst Phase 3 will involve the processing of sulphidic ore (supergene copper-gold) which would increase LoM by a further four years (2021-2024).

Progressive rehabilitation of the OWD has been incorporated into the operational mine plan. Due to the small scale of the operation and short LoM for the Portia Mine Site there is minimal opportunity to undertake further progressive rehabilitation (besides the rehabilitation of minor access roads and ancillary tracks) as all currently disturbed land will continue to be utilised.

There will be two stages of rehabilitation post ore recovery for the pit. The first will include placing a cover layer on the TSF cells, the covering and rehabilitation of the OWD, the infilling and levelling of the water storage dams and completion of the abandonment bund around the Portia open pit. The second stage will include the removal of the camp, office and workshop facilities, followed by topsoil placement, ripping and seeding. In these activities, overburden material will be used where required to infill structures, the faces of the OWD and TSF cells will be battered and sculpted, topsoil that has been stockpiled will be spread over disturbed areas.

There is no sulphide material present in the re-processing of Portia tailings. Sulphides, however will be present in extraction of North Portia supergene ore in Phase 3. Proposed mining of the North Portia open pit does not form part of this PEPR and approval process.

All effort has been made to ensure that current mine plans have not sterilised any part of the mineral resource from being mined in the future.

The establishment of Site infrastructure is largely complete with the exception of minor upgrades to the processing plant circuit. and construction of the two new TSF cells (TSF-3 and 4).

3.4.10 Rehabilitation Strategies and Timing

Rehabilitation is described in detail in the closure section (Section 7). Due to the small scale of the operation, progressive rehabilitation measures will be limited to the rehabilitation of access and ancillary tracks not used during operations (operational period).

The following rehabilitation strategies are proposed:

- The Portia open pit will remain as an open void and will not be rehabilitated. The walls of the open pit will be left to collapse at the angle of repose.
- All infrastructure within the pit will be removed including pumps, discharge lines, pipes and power supply.

- Remove any remaining material stockpiled on the ROM pad to the Portia open pit.
- Deep ripping (up to 300 mm depth) will occur for all compacted areas around the pit (hardstand and trafficked areas).
- Visual salt crust build-up will be removed.
- Construction of a pit abandonment bund around the Portia open pit.
- Construction of an access track around the pit abandonment bund.
- Where required, any disturbed land between the pit edges and the abandonment bund, and abandonment bund and access track will be shallow ripped (up to 100 mm).
- Warning signage would be installed.

Rehabilitation for the Portia Mine Site will occur in two stages, this is discussed in more detail in Section 7 Mine Closure.

Details of the Portia open pit can be found in

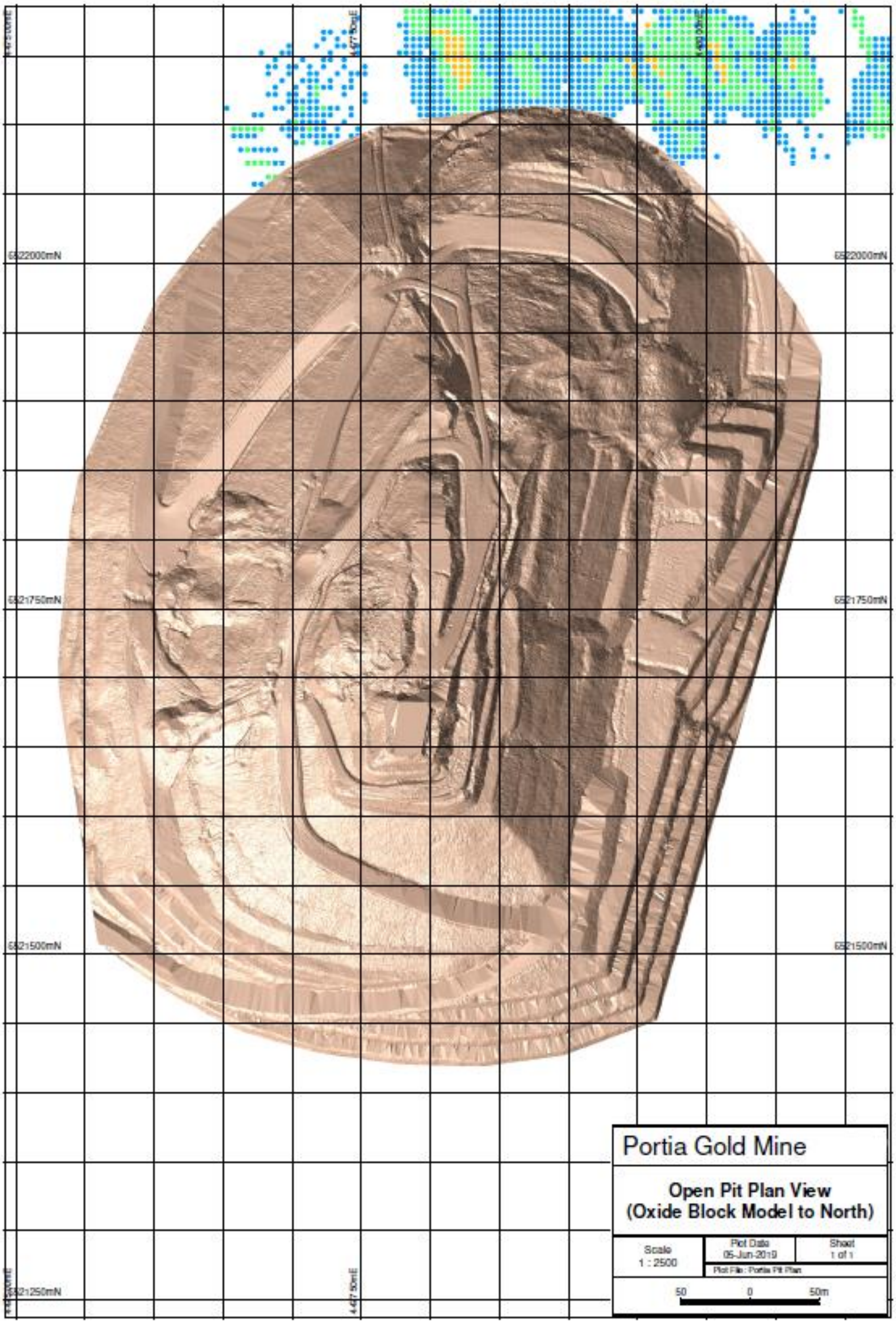


Figure 3-4, Figure 3-5 and Figure 3-6.

Please refer to Section 7 for further maps and cross-sections at closure.

Abandonment Bund

At the completion of open pit mining and processing an abandonment bund is to be completed around the entire perimeter of the two open pits.

An assessment of the stand-off distances from the Portia pit crest to the abandonment bund was undertaken by Mining One (Appendix B6) and the report is provided in Appendix B6. The abandonment bund stand-off distance was initially assessed by Rocktest Consulting in 2013 (see Appendix B3), for initial planning purposes, prior to mining and using estimated geotechnical properties of materials.

Previous Work

The following experience has been gained during operations and was used in the updated Mining One (Appendix B6) assessment:

- Two programs of sampling and geotechnical laboratory testing have been completed and reported by Mining One (2016a), with a third round of testing is in progress (see Mining One, 2016d); and

- The mine has experienced several small to intermediate scale failures and one large failure of the north wall (reported by Mining One, 2016b). While a large failure is unfortunate, it does provide the most valuable information in terms of geotechnical properties of materials. Analyses of the failure, in conjunction with laboratory testing, have provided high-quality information on the shear strengths of the cover sequence.

Further studies were undertaken (Appendix D B12) which found the failure appears to have been a combination of rotational and translational movement, with the base of the failure likely in the range of RL 0 m to RL 7 m at the base of the Lower Namba Clay, based on scan data and slope stability back-analysis. The critical factors of the failure were the steep cut slopes (30° to 32°) and the weakness in the Lower Namba Clay. The underlying Eyre Clay is stronger and does not appear to have failed.

Guidelines

The WA Department of Industry and Resources (DoIR) Document No. ZMA048HA '*Safety Bund Walls around Abandoned Open Pit Mines*' (1997) specifies that the preferred method to minimise inadvertent public access to abandoned pits involves the construction of an abandonment bund "*outside the area designated as being susceptible to wall collapse*". It does not provide any specific guidelines on what "susceptible" means in terms of measurable parameters.

The WA guideline also recommends that, where pit wall conditions have been poor during the operating life, site specific geotechnical studies are required to establish what abandonment criteria are applicable.

As a general guideline, the WA document specifies that a potentially unstable pit edge zone would be defined by projecting a line at 25° from the pit toe to the ground surface for "weathered rock", with the bund to be constructed 10 m outside of that zone. The recommended 25° is steeper than the current operating slope angles at Portia. In Mining One's opinion (Mining One, 2016c), the cover sequence clays at Portia cannot be likened to "weathered rock", which in their experience, is stronger and can typically stand at much steeper slope angles than those of the Portia mine.

In order to meet the WA guideline, the recommendation of "site specific geotechnical studies" was adopted, in consideration of "poor" pit wall conditions. The Site visits conducted by Mining One geotechnical personnel, sampling, laboratory testing, assessment of clay structures and back analysis of the north wall failure to derive pit scale geotechnical parameters all constitute a sufficiently detailed site-specific geotechnical study for the purpose of this assessment.

Adopted Criteria

A minimum FOS of 1.5 is widely accepted, including in civil engineering applications where the public are exposed and is the WA guideline for “major mine infrastructure” and “serious” consequences of failure. Hence a FOS of 1.5 was adopted by Mining One for the assessment. The selected criteria are summarised in Table 3-15.

Table 3-15: Acceptance Criteria for Abandonment Bund at the Portia Mine SIte (Mining One, 2016c)

Design Case	Minimum FOS	Maximum POF
Failures extending to abandonment bund, static	1.5	1%
Failures impacting on abandonment bund, earthquake	No criteria, but check sensitivity and impact	

Earthquake Loading

A design earthquake loading is applied as a horizontal acceleration in the direction of failure, equal to the peak particle acceleration (PPA) of an earthquake that has a 10% probability of exceedance in any 50 year period (return period 500 years). This method is widely recognised as very conservative and some engineers use half the PPA as a more realistic value for sustained, rather than momentary motion. In regions of low seismicity, the effect of earthquake motion on slopes is negligible and Mining One usually adopt the full value.

The Portia Mine is located in a region of low seismic hazard, far from the more active Flinders Ranges to the west. The Geoscience Australia earthquake hazard map gives a PPA of 0.02*g* (where *g* is the acceleration due to gravity).

The adopted seismic acceleration for the assessment was therefore 0.02*g*, which is consistent with the Rocktest Consulting (2013) assessment.

Analysis Methods and Parameters

Analyses of selected cross-sections were carried out using Rocscience Slide software, with the following settings. The methods are consistent with those used to back analyse the north wall failure and to derive the material strengths:

- Dry conditions (short term while pumps are operating) and pit flooded to 30 m RL (long term post closure);
- No allowance for soil suction, which may be slightly conservative but is hard to quantify in the long term;
- Non-circular failure paths, searching for global minimum FOS using Slide’s Path Search method and 10,000 sample failure paths, without optimisation of the global minimum. All plots show the minimum FOS and ten failures with the lowest FOS;
- Generalised Limit Equilibrium (GLE) / Morgenstern-Price method of analysis;
- Probabilistic analysis using Monte-Carlo sampling with 25,000 samples of the material strength distributions; and
- Search limits to force failures through various abandonment bund distances.

Material properties and other parameters used for analysis are described in detail in Mining One (2016c) (see Appendix B6).

Section Locations

The generic section was one of those used for recent assessments of design v1.3_v6 and has an overall slope angle of 21.7° (see Section 3.4.1). It was used to assess various bund stand-off distances. The other two sections were used to assess the specific distance of the abandonment bund at those locations.

The west wall section has an overall slope angle of 18.4°. One section is sufficient through the west wall ramps, because at a distance of 106 m to the inside of the bund, only the overall slope angle has any effect, and specific locations of the ramps in the wall are not significant.

Analysis Results

Generic Section

Bund distances were assessed by varying the minimum extent of failures from the crest, for dry, flooded, static, and seismic cases.

Results show that FOS and POF criteria are met for a 60 m stand-off distance, applying the criteria to the static case, with the long-term flooded case being the worst case. The seismic cases show that FOS remain high in the event of a design earthquake.

Given that space around the pit is not restricted, an 80 m stand-off distance is recommended.

The 80 m minimum stand-off distance applies to all future designs where the overall slope angle, measured from toe to crest as shown in Figure 3-12, is 21.7° or flatter. At this overall slope angle, the minimum FOS for the slope (not for failures extending to the abandonment bund) is 1.30. The west wall section of the v1.6_v3 design is shown in Figure 3-13.

A check was requested of the FOS to the current bund location. Results for the west wall show that the current constructed bund, and the 80 m generic distance, more than satisfy stability criteria.

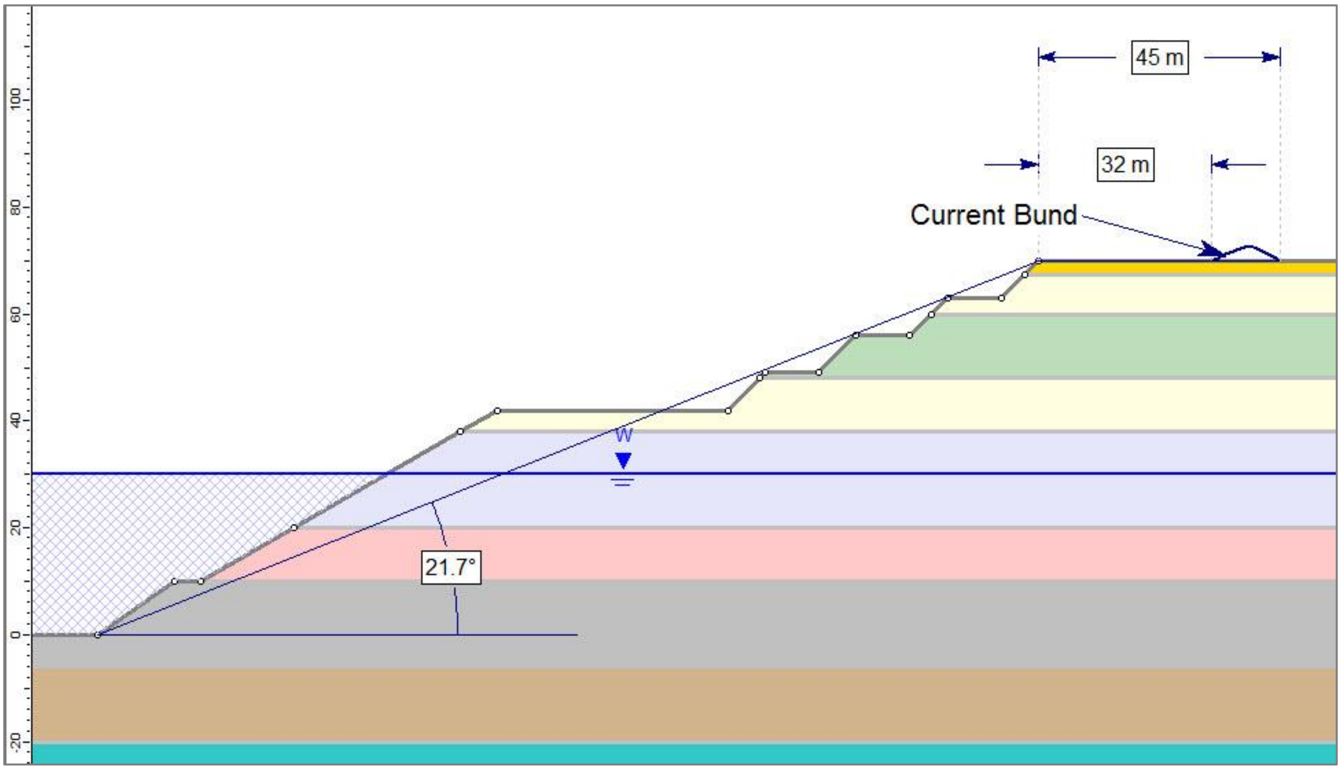


Figure 3-12: Section Geometry – Generic Section for Abandonment Bund Assessment

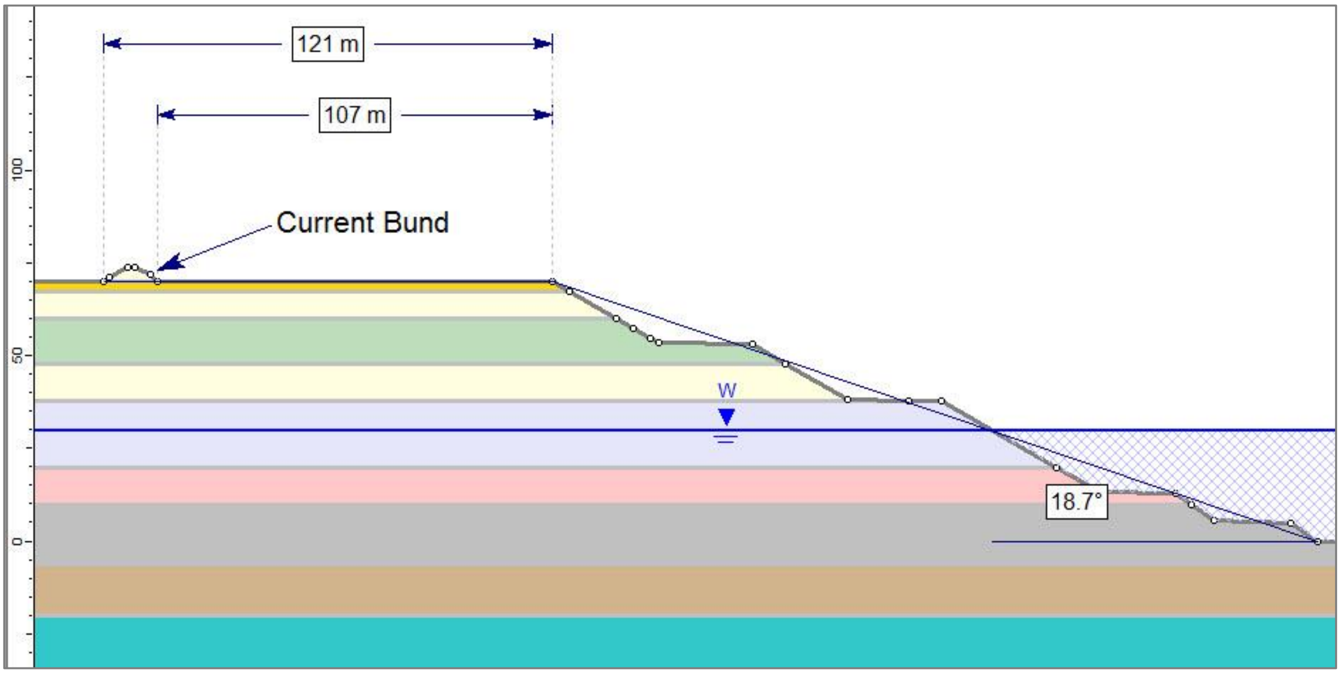


Figure 3-13: Section Geometry – West Wall Section for Abandonment Bund Assessment

North Wall

The north wall section geometry is shown in Figure 3-14. The supplied topography is taken from an end of month survey dated 31 July 2016, and apart from some consolidation of the failure, the geometry has not changed for several months. The base of the failure debris was taken from the failure path of a back analysis of the failure (refer Mining One, 2016b).

A check was required of the current topography, but not for the flooded (long-term) case. Results show that the stability criteria are met at the abandonment bund for dry, static conditions.

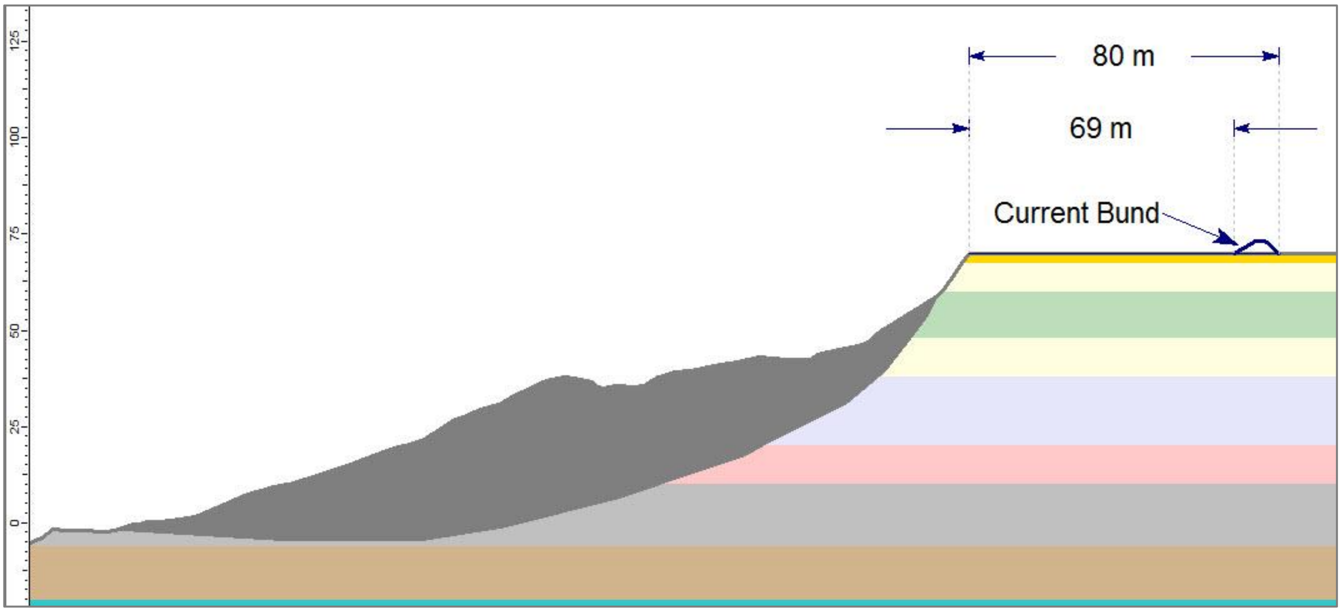


Figure 3-14: Section Geometry – North Wall Section for Abandonment Bund Assessment

<u>Abandonment Bund – Conclusions and Recommendations</u>

Based on the assessment undertaken, Mining One has concluded and recommended that:

- For all future designs with a maximum overall slope angle of 21.7°, a stand-off distance to the abandonment bund of 80 m should be used;
- The generic stand-off distance also satisfies the long-term (flooded pit) static scenario, and earthquake loads do not cause significant reductions in FOS;
- The west wall design is more than adequate at the 80 m stand-off distance, and far exceeds requirements at the current abandonment bund location;
- The current north wall meets stability criteria at the current bund location;
- If the requirement is to place the abandonment bund on the flat-dipping lower slopes of the OWD, then a bund distance of 120 m is required; and
- A further review is recommended if further testing or other data suggests that material properties may be weaker, or significantly different to those used in the assessments.

Abandonment Bund Construction

The WA (DoIR) guideline requires a bund having a minimum height of 2 m and a base width of 5 m. The portion of the abandonment bund at Portia that has been constructed to date is well above the minimum expected in the guidelines and is thus far constructed to the following dimensions: height of 2.7 m, width at base of 18 m, width at crest of 8.9 m, with 1.8H:1V batter (see Figure 3-14). The constructed abandonment bund will however need to be moved out to the new stand-off distances defined by Mining One at closure to accommodate the northern cutback extension to the Portia open pit.

The constructed portion of the bund (northern, eastern and southern walls) comprises a core of compacted clay derived from the Quaternary overburden clay material, sourced from the first bench that was mined in the pit. Sufficient Quaternary clay materials will be stockpiled in or adjacent to the footprint of the final bund location to complete the remainder of the bund at closure. Once built, the clay, being relatively impermeable, prevents overland flows of water that develop outside of the bund from eroding the area between the bund and the pit crest and also prevents surface water flows from entering the pit. The materials from which the bund is being constructed will provide it with long term competence against erosion.

The purpose of the abandonment bund post closure is to create a physical barrier that discourages people and fauna from entering the open pit voids. The abandonment bund should be readily visible from a distance to provide early warning of the hazard behind it. For this reason, the abandonment bund will not be revegetated at closure. Revegetating would essentially camouflage the abandonment bund creating a safety risk for approaching visitors. Unacceptable visual amenity as a result of the abandonment bund is not deemed to be a significant risk post closure due to the remoteness of the Site. Furthermore, the Quaternary clay overburden materials from which the abandonment bund will be constructed at closure are visually in keeping with the colour palette of the surrounding landscape.

The completed height of the bund (minimum 2 m) and the gradient of its outside slope will be sufficient to provide a visual indication of the presence of a feature beyond. Signage noting ‘Danger Deep Excavation’ will be placed on posts at appropriate spacing around the outside of the bund at not greater than 400 m centres.

The abandonment bund forms a part of the planned open pit (Domain 4) rehabilitation requirements. The bund is scheduled to be completed within the first 12 months of commencement of the rehabilitation schedule (refer to Section 7.19).

In the original PEPR (PEPR2014/090) it was proposed to cover the abandonment bund and to infill the haul road entrance to the pit with mined rock at completion. This requirement has since been discussed with DEM (June 2015) and removed due to the fact that no suitable rock is available for this purpose and that the extra volume contained in the wall offsets any possible erosion. If suitable quantities of rock do become available for the covering of the abandonment bund then this the rock will be used to complete the bund as per the original specifications.

The location of the abandonment bund is detailed in Chapter 7 (Figure 7-10).

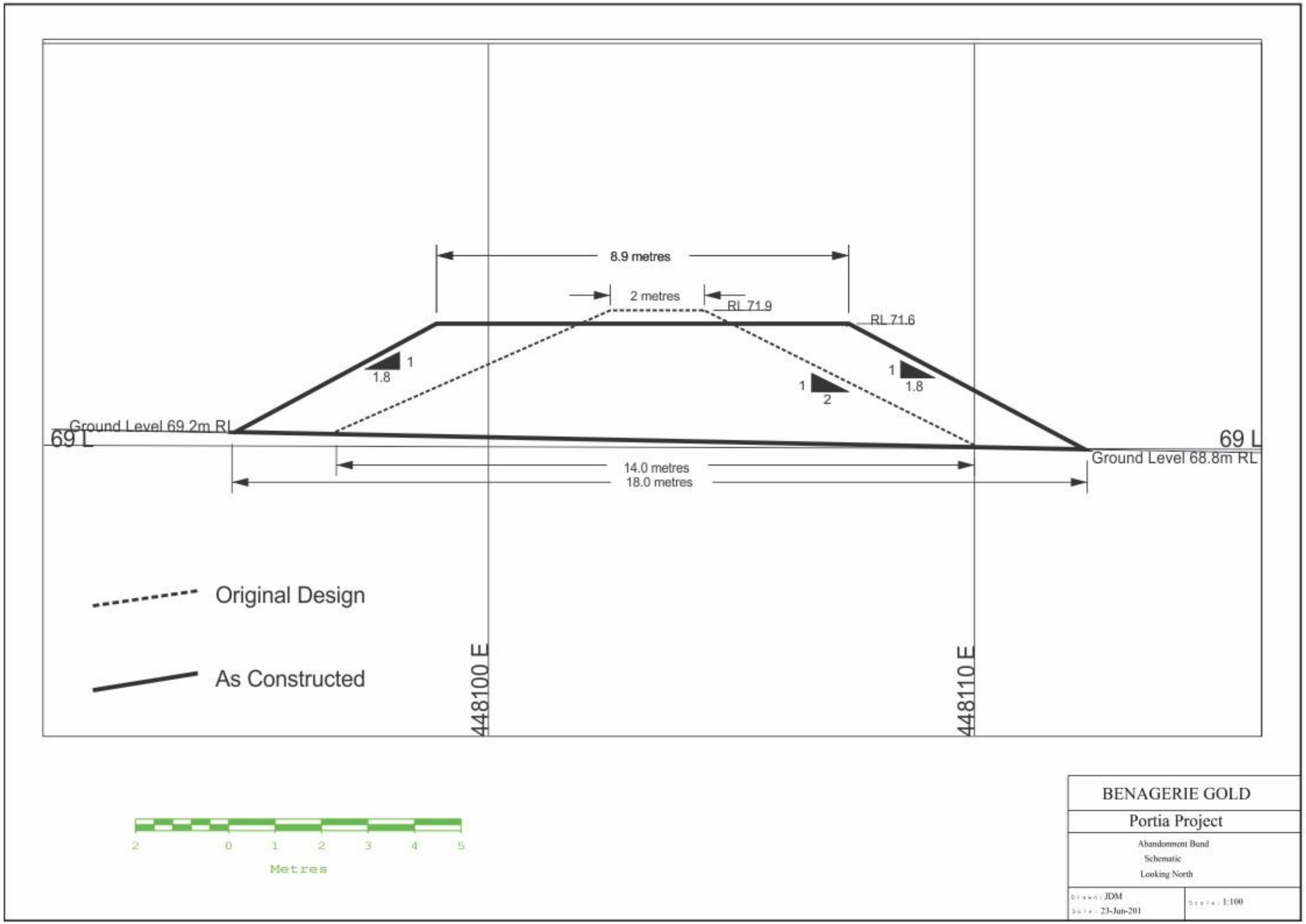


Figure 3-15 Schematic Cross-Section of the Pit Abandonment Bund at Closure

3.4.11 Modes and Hours of Operation

The current roster for mining is 24hours per day (two shifts), 7 days per week. Processing is also 24 hours per day (two shifts), 7 days per week. This may be revised as necessary to suit the mining and processing plan.

3.4.12 Care and Maintenance

The Portia Mine Site is a small operation with an original mine life of approximately 18 months. As such the likelihood of the mine being placed into care and maintenance, after approval of this PEPR, remains low.

Whilst the likelihood is low, mines enter care and maintenance for a number of reasons be they economic, weather, social, environmental, policy or other. A Care and Maintenance Plan was submitted to DEM in October 2018 when Portia entered a temporary Care and Maintenance Phase (Appendix F9). The following provides an overview of the strategies that would be employed by BGC in the event that the Portia Mine Site is put into care and maintenance:

- The site is made safe and site access restricted;
- Safety bunds and/ or fencing will be constructed as required to prevent public access into the Portia open pit;
- Consultation will occur with external and internal stakeholders;
- Top soil stockpiles would remain in situ;
- Any stockpiles on the ROM would be removed for offsite processing;
- No gold doré bars would be left onsite;
- Fuel and chemicals would be removed from site;
- All infrastructure and buildings would remain on site and locked; and
- Environmental monitoring will continue.

All monitoring required to demonstrate compliance against the outcomes and outcome measurement criteria, will still be met by BGC unless a notification of assessment of change has been submitted and approved by DEM. Please refer to Table 6-18 for a summary of all environmental outcomes, outcome measurement criteria and leading indicator criteria.

All existing reporting to government agencies and other third parties required during operations will continue throughout the care and maintenance phase. Any environmental incidents and/ or non-compliances would be reported in accordance with legal and other reporting obligations.

3.5 Crushing, Grinding, Processing and Product Transport

The Processing Plant consists of crushing plant which prepares ore to be fed into the gravity gold recovery plant. Gravity concentrates are either directly smelted or treated using a cyanide leach and gold recovery process to produce metallic gold. The final gold product is a smelted gold doré which is transported off-site and refined by a third party.

3.5.1 Crushing and Grinding Plant

Tailings material within TSF-1 will be reliquefied in a dedicated reliquefication pump and hopper, located adjacent to the wet screening circuit and then fed straight into the wet screening plant. The actual volume will be dependent on ore moisture content (approximately 20%).

Tailings material within TSF-2 will be dry fed into the crushing plant after being stored on the ROM pad. To minimise scrubbing requirements the material may also pass through an impact crushing plant to aid disaggregation.

The tailings (from TSF-1 and 2) which are to be reprocessed have previously been passed through the existing crushing circuit, and therefore minimal size reduction is required.

Ore from the Portia open pit is hauled to the ROM pad (see Figure 3-16) until such time as it can be processed. Experience to date indicates that ore direct from the ore bodies require crushing to facilitate processing. For this, a dual crusher and/or impactor will be used to produce <12 mm material which is stockpiled on the ROM for subsequent processing. Crushing activity occurs periodically during normal day shift operations and only occurs on the ROM pad on an area of approximately 30 x 30 m.

The mobile crushing plant includes:

- A duel crusher/impactor estimated at 500tph capacity which is to be fed with machinery such as excavators or front-end loaders;
- Screening plant to ensure appropriate size reduction; and
- Stacking plant for stockpiling ore prior to it being fed to the processing plant.

Ore from the ROM pad will be fed by a front-end loader into the wet screen circuit/ grizzly hopper. Material is then fed to the trommel (wet screen) for classification and removal of oversize (primary classification). The ore (minus 20 mm) will pass through to the wet plant for further processing. The plus 20 mm material will be rejected as oversize, stockpiled and relocated to the OWD periodically.

The throughput rate for the Site will now come from two feed types:

- Approximately 85% from retreated tailings (from TSF-1 and 2); and
- Approximately 15% from freshly mined ore from the Portia open pit.

This will result in a combined throughput rate of approximately 140 t/h.

There is no grinding circuit at the Site.

Noise will be generated by all machinery within the crushing plant, this will be no more noise than already exists within the previously approved operation. As such appropriate work, health and safety controls are in place for the operation.

Dry crushing ore is a potential source of dust, as is light vehicle movement, trucks and front-end loaders. To minimise dust generation, ore moisture is not completely removed prior to wet screening to manage dust when feeding the plant.

There are no ignition sources apart from diesel fuel in engines powering the generators.

3.5.2 Processing Plant

The processing plant location is shown in Figure 3-16 and is separated into two areas i.e.

1. Beneficiation and Gravity Plant;
2. Cyanide Leach Circuit

Background on Plant Design

The Site Plant design has historically used gravity separation as the primary concentration method which is based on the large difference in specific gravity of gold versus the host materials. This has shown to be effective from considerable experience in the washing-assaying method employed to overcome the coarse gold nugget sampling effect in determining the gold resource. Gravity concentration as a beneficiation stage is a relatively simple, benign process and was well suited to recover gold from ore within the Portia open pit. Other benefits are it is low energy, cost-efficient and simple to operate.

After processing had commenced, to maximise gold recovery and minimise the opportunities for gold theft, a key change to the process plant included replacing the in-line pressure jigs with two fully automated self-cleaning Knelson concentrators because of their improved ability to recover fine gold. The added important advantage is the reduced opportunity for gold theft because the Knelson concentrators are self-cleaning, whereas the in-line pressure jigs require human involvement to remove the recovered free gold from the ragging.

In addition, previous changes to the circuit incorporated:

- Adding a vibrating screen for increased (Knelson) feed classification efficiency;
- Installing additional riffle boxes for increased plant capacity;
- Cycloning the Knelson feed to thicken feed to the Knelson concentrators to improve fine gold recovery; and
- Associated pumps and instruments to facilitate the modifications.

2019 Process Plant Design

As part of this PEPR process further upgrades to the process plant design are proposed. As such, the new process plant will operate in the following manner:

1. **Screening and classification circuits:** The treatment plant incorporates coarse gold recovery (riffles), a dewatering and classification screen (minus 3 mm screen aperture) for the removal of oversize and contaminants. The minus 3 mm product will then report to the cyclone classification (two Stages) for beneficiation of particle size for the recovery of coarse gold (-3 mm to +20 um). The reject fine tailings and processed ore is then directed to the tailings hopper and discharged to the active tailings cell.

2. **Coarse Gold Riffles:** In this process the slurry discharged from the scrubbing process is fed to riffle boxes from which a coarse gold concentrate is collected. The tailings from the riffle boxes are then classified over a vibrating screen. The undersize using cyclones is passed through a pair of parallel Knelson concentrators (a high G centrifuge) to further concentrate the gold.

3. **Gravity circuit:** The course gold particles are captured in two QS30 Knelson concentrators operating in parallel. The concentrate is then transferred into the separate concentrate treatment area (the Gold Room). The remaining reject from the gravity concentration phase is then directed to the hopper and discharged to the active tailings cell.

4. **Intensive Leach Reactor Circuit (ILR):** The concentrate (2-4 t/d) is leached and electrowinned in a separate parallel circuit which is located within the Gold Room. The system incorporates a ILR 2000 leach reactor, an electrowinning circuit (with one electrowinning cell) and a pregnant solution recycle tank. Gold is electrowinned onto stainless steel mesh and high pressure cleaned and conventionally smelted without the use of acid digestion. The ILR circuit uses nominally 17 m^3/d of raw water produced from the RO plant. The ILR uses cyanide and caustic soda for pH control to dissolve fine gold particles taken from the Knelson circuit.

5. **Detox Circuit:** Once the electrowinning process is complete, the baron solution is recycled to the ILR (40%) and what remains is sent to the detox circuit for cyanide destruction. One detoxification has been completed the solution is transferred to the cyanide cell (TSF-4) for storage and evaporation. The detox process will also incorporate the use of hydrogen peroxide as part of the primary neutralisation phase. Cyanide will be deconstructed to levels of less than 50 ppm, in line with the *International Cyanide Management Code.*

The layout of the processing plant is described in Figure 3-17.

Fine gold is smeltered into doré bars containing approximately 90% gold with minor impurities including silver.

Number, Location, Area and Size of Processing Plant

The modified processing circuit is specific only to the gravity product treatment stream, and is confined to the existing gold room side. The treatment of ROM ore and tailings continues to be processed as existing, and reports to existing tailing dams TSF1, 2 & the new proposed TSF-3.

The new treatment circuit (ILR – Inline Leach Reactor) has its own dedicated spent concentrate and detoxified leach solution dam called TSF-4 which is located adjacent to the plant area on the western side.

This concentrate is now kept separate to the original tailings being processed and the final fate of by produce reports to a separate small lined tailing cell – TSF4.

In total the new circuit will process approximately 7500 m^3 of solids and solution in the 12 month period, or about 2 days' worth of annual production compared the original circuit.

The new TSF-4 lined dam is approximately 7,500 m^3 in size.

The new disturbed area for the upgraded plant flow sheet all site within the existing disturbed area with the exception for the RO plant location and the 7500m^3 dam. These are located adjacent to the existing treatment plant to the west.

The existing disturbed areas below remain the same as follows;

- Ball mill, riffles & Knelson area: 667 m^2;
- Workshop area: 40 m^2;
- Gold room area: 896 m^2;
- Scrubber, hopper and conveyor area: 654 m^2; and
- New RO plant area: 1,000 m^2.

The new ILR will be placed in the centre of the existing concrete area of the gold room, shown in Figure 3-18.

The new circuit shown in Figure 3-19 differs from the existing by allowing for the treating of the fine golds particles that were being lost to the tailing dam since inception of treatment activities.

The integration of the ILR circuit greatly changes the economic value of all future reserves due to uplift in final recovered gold in ground.

Ancillary Plant and Infrastructure

The following ancillary plant and infrastructure will be used for the processing of ore and tailings material onsite:

- A small residual cyanide cell (TSF-4) (7,500 ML) will be constructed to hold the detoxified cyanide residual. The cell will be lined with clay and HDPE to mitigate any loss of material, and cyanide will be stored in accordance with the *International Cyanide Management Code* principles and codes of practice;
- 20 m^3 electrowinning solution self-bunded storage tank;
- 20 m^3 detoxification mixing self-bunded tank;
- 8 m^3 cyanide mixing self-bunded tank;
- Minor reagent bulky self-bunded storage platform;
- Dry solid cyanide storage container (10 x 1 tonne boxes);
- 110 L self-bunded diesel storage tank; and
- RO plant including 250,000 L storage tank

Construction notes

All plant is modular and has been constructed off-Site, thereby precluding the need to construct significant concrete footings and reducing on-Site construction times. Concrete footings, where required, have been engineering designed for the individual load requirements of plant. P&ID plans are shown in Figure 3-20.

Processing Reagents

As per the initial PEPR, insignificant quantities of chemicals or reagents will be used as part of the gravity processing circuit. However, the addition of the cyanide ILR processes introduces the requirement for chemical reagents to be dosed into the process to ensure appropriate gold recovery. Monthly usage has been estimated based on optimal conditions developed using laboratory test work and scaled to the anticipated plant feed rate of 140 tph. During the scale up process there may be minor variation to reagent usage rates described to maintain optimal recovery. Maximum chemical quantities to be stored on site at any one time have been identified through usage requirements and standardised storage quantities by EPA. Reagent storage will be located away from incompatible materials.

Reagents used in the flotation process are as described in Table 3-16.

Table 3-16 Reagents

Reagent	Monthly use (kg)	Site Storage (kg)	Description
Magnafloc®	1.2	15	• Used to agglomerate fine particles together to aid settling rates. • Reagent waste will be stored in an approved vessel for collection by an EPA licensed contractor and transported to Adelaide for treatment and disposal. This will occur on a quarterly basis.

Reagents used in the CN leach and gold recovery process are as described in Table 3-17.

Table 3-17 CN Leach and Gold Recovery Reagents

Reagent	Monthly use (t)	Site Storage (t)	Description
Sodium Cyanide (NaCN)	2.52	10	• Used as a lixiviant to dissolve gold, silver and other minor amounts of base metals from crushed and ground ore. To be used at a concentration of 10-20%. • Majority will report to a detoxification unit in the inline leach reactor and deconstructed to acceptable levels of <50ppm. Laboratory titration solution will be stored in an approved vessel for collection by an EPA licensed contractor and transported to Adelaide for treatment and disposal. This will occur on a quarterly basis. • Minor amounts of residual detoxified reagent may report to the tailings disposal bin and join gravity fed tailings. Deposition of residual cyanide will be into the lined, TSF-4 cell
Hydrogen Peroxide (H_2O_2)	5.25	6	• Used as an oxidant in ore leaching, concentrate preparation and cyanide effluent treatment. To be used at a concentration of 60%. • Reagent waste will be stored in an approved vessel for collection by an EPA licensed contractor and transported to Adelaide for treatment and disposal. This will occur on a quarterly basis.
Sodium Hydroxide (NaOH)	5.25	6	• Used in the elution process to remove gold from carbon. Dissolves in water; has no reaction with ore. • Reagent waste will be stored in an approved vessel for collection by an EPA licensed contractor and transported to Adelaide for treatment and disposal. This will occur on a quarterly basis.
GoldiLOX (leach accelerant)	0.15	1	• Used to accelerate gold extraction from ore and shorten cyanidation times. • Reagent waste will be stored in an approved vessel for collection by an EPA licensed contractor and transported to Adelaide for treatment and disposal. This will occur on a quarterly basis.
Copper Sulphate	.059	.04	• Used to aid in the detoxification of the spent electrolyte solution. • A small amount of copper sulphate (maximum 40 kgs) may be stored on site at any time. • Workers involved in its use will be appropriately trained and provided with the necessary safety equipment (including PPE and engineering controls). • Containers of copper sulphate are stored in a designated, secured chemical storage area within the processing plant. The containers are stored away from incompatible materials such as nitromethane, finely powdered metals, steel, hydrazine, hydroxylamine, magnesium and air. • Any waste from the use of Copper Sulphate will be stored within an approved vessel for collection by an appropriately EPA-licensed contractor (e.g. Cleanaway) on a quarterly basis. If required, the IBC will be transported to Adelaide for treatment and disposal.

Additionally, small volumes of picric acid and silver nitrate (less than 4 litres on site at any given time) is required for titration processes confined to the lab. Impurities, such as silver, copper, zinc, arsenic and other trace minerals, are commonly found in alluvial gold deposits such as at the Portia Mine Site. When smelted into gold bars, the presence of certain impurities above threshold concentrations set by the refinery can result in the bars either being rejected by the refinery or financial penalties being applied. Hence, removal of the impurities prior to shipping is highly desirable. Picric acid oxidation provides fast removal of impurities and is similarly used at other gold processing operations in Australia.

Emissions

Noise will be generated by all machinery at the processing site and appropriate work, health and safety controls will be put in place for all operators.

Dust sources within the processing plant will include vehicle movements such as light vehicles, trucks and loaders. No dust will be generated by the ore once it enters the circuit as it is in the form of a slurry.

Picric acid's primary hazard is its function as an explosive. Picric acid will detonate at 300°C, well within the energy range of all normal ignition sources. As a dry material, picric acid is classified as a high explosive. High explosives are characterized by their sensitivity to heat and shock. In its crystalline form, picric acid is very sensitive to heat and shock. It melts at 122°C and detonates at 300°C. Picric acid has a specific gravity of 1.76, a molecular weight of 229, and a vapor density of 7.89. It is slightly soluble in water.

Other potential air emissions (including odour) and their composition include HCN generation. HCN generation is very closely linked to the pH of the leaching circuit. For example, at a pH of 7, 99% of available cyanide in a solution is liberated as HCN gas which is highly poisonous, while at a pH of 11 over 99% remains in solution as free cyanide. HCN has the potential to generate gas in the detoxification tanks area during the detoxification process or when contacting the tails slurry. Any sitting pool or dam which contains cyanide in solution has the potential to generate HCN gas. A pH of greater than 9.1 is generally considered sufficient to maintain cyanide in solution at a safe level and avoid the liberation of cyanide gas at hazardous concentrations.

Cyanide gas is:

- Lighter than air;
- Classified as a flammable gas with explosive limits between 5.6% (560000 ppm) and 40%;
- Has a smell of bitter almonds (40% of people can smell it at low concentrations);
- Is fatal above 110 ppm; and
- Has a ceiling TLV of 10 ppm.

The evolution of the gas is affected by:

- pH. This is the most important factor in reducing levels of HCN gas. The lower the pH becomes, the higher the proportion of free HCN in solution and therefore available to form a gas. Ideally the pH should be above 10.0; and
- Temperature. Higher temperature increases the volatility of the gas. This makes areas such as the ILR and electrowinning circuit a higher risk for HCN evolution, this is part of the reason why a much higher pH is used (+12.0). The ILR uses cold solution.

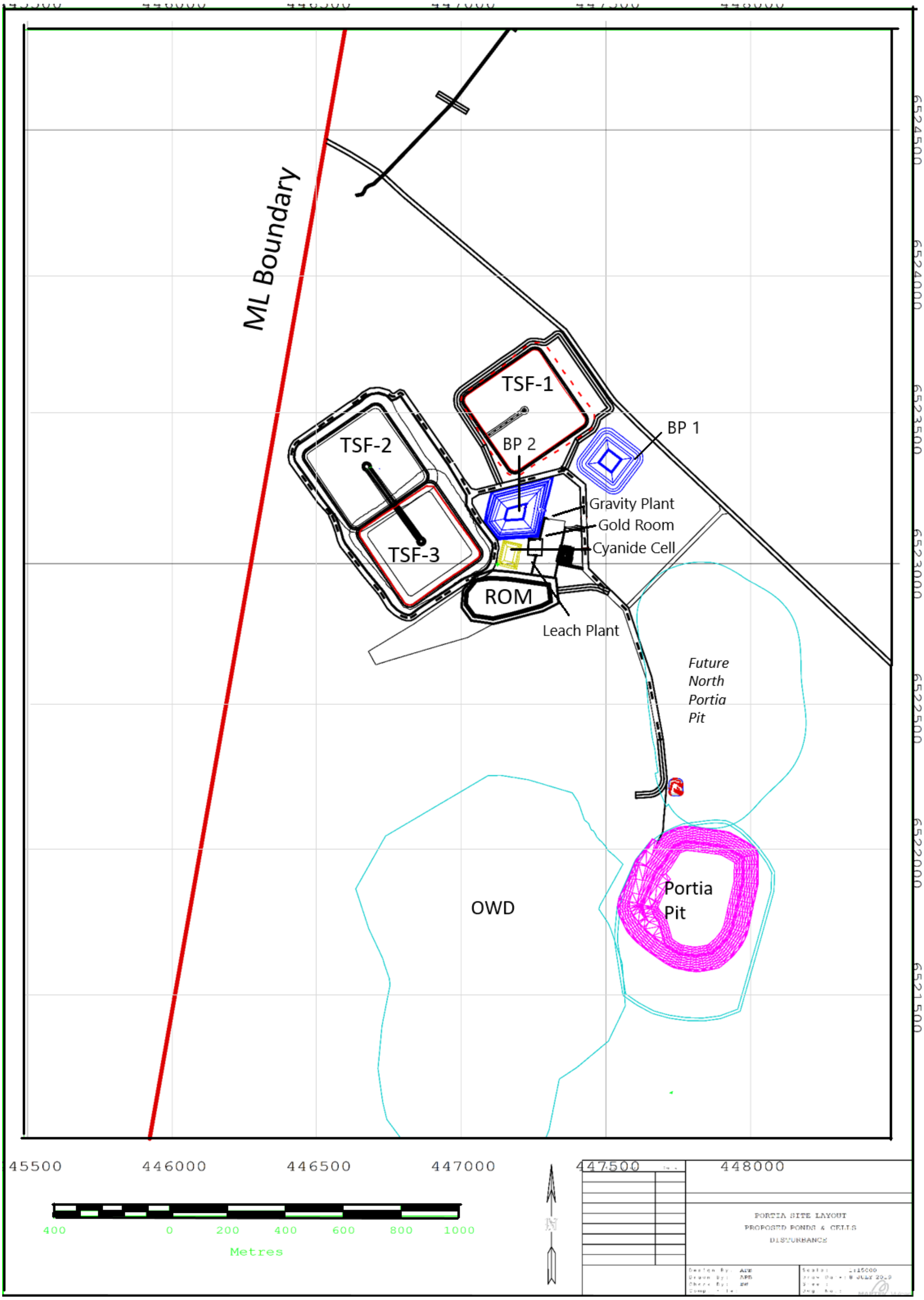


Figure 3-16 Processing Plant Location

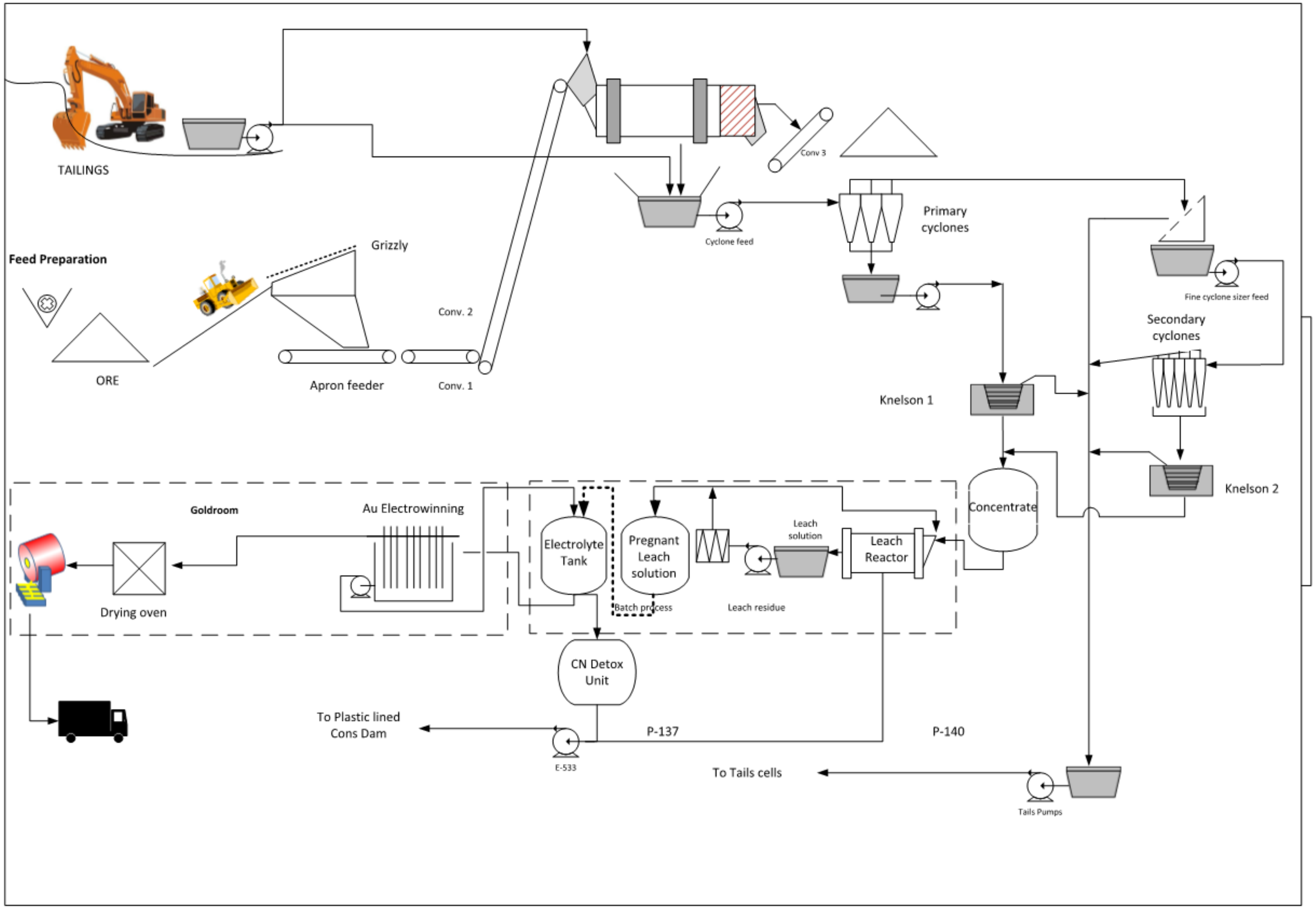


Figure 3-17 Portia Mine Site Processing Circuit

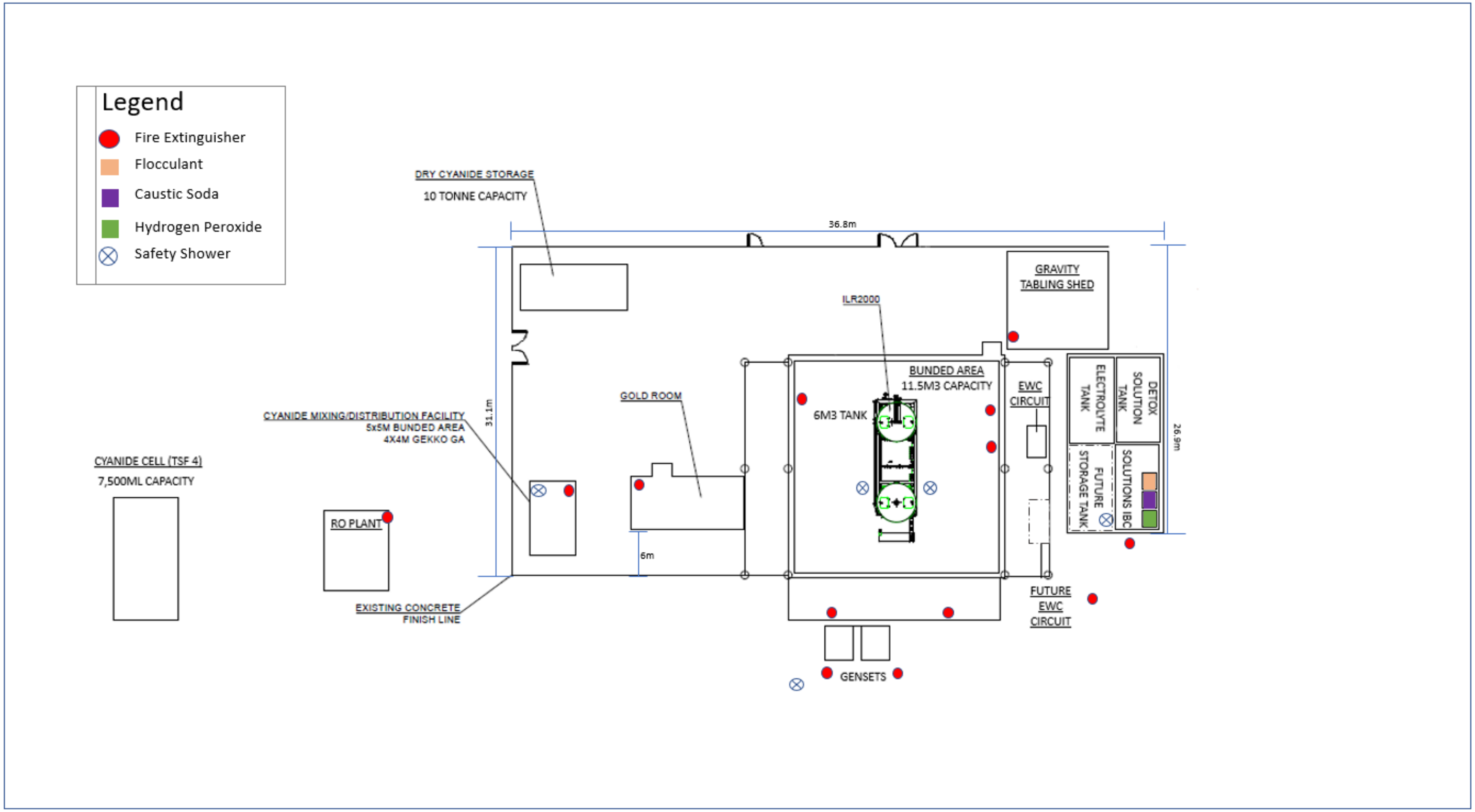


Figure 3-18: Gold Room Layout

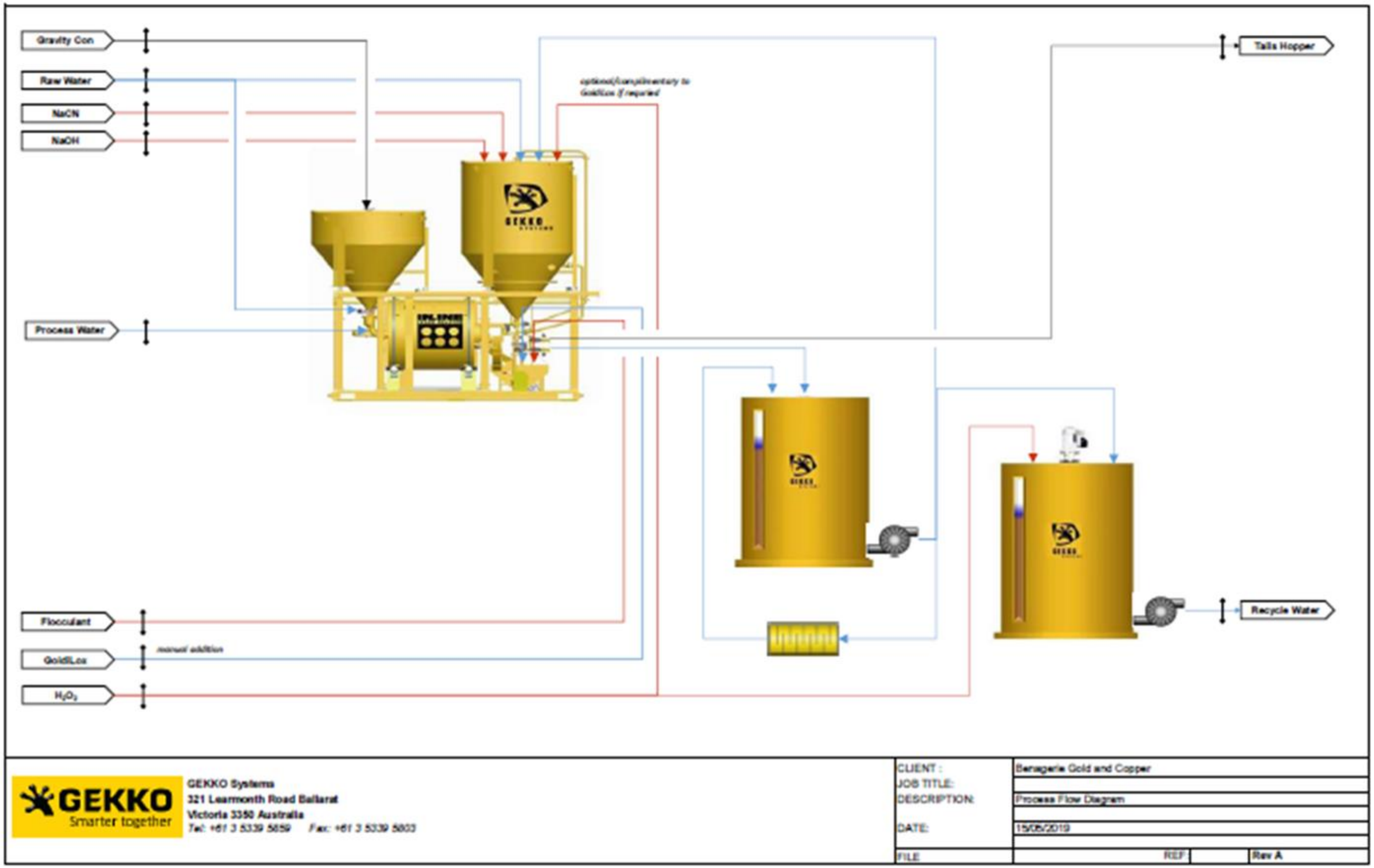


Figure 3-19: Inline Leach Reactor Process Flow Diagram

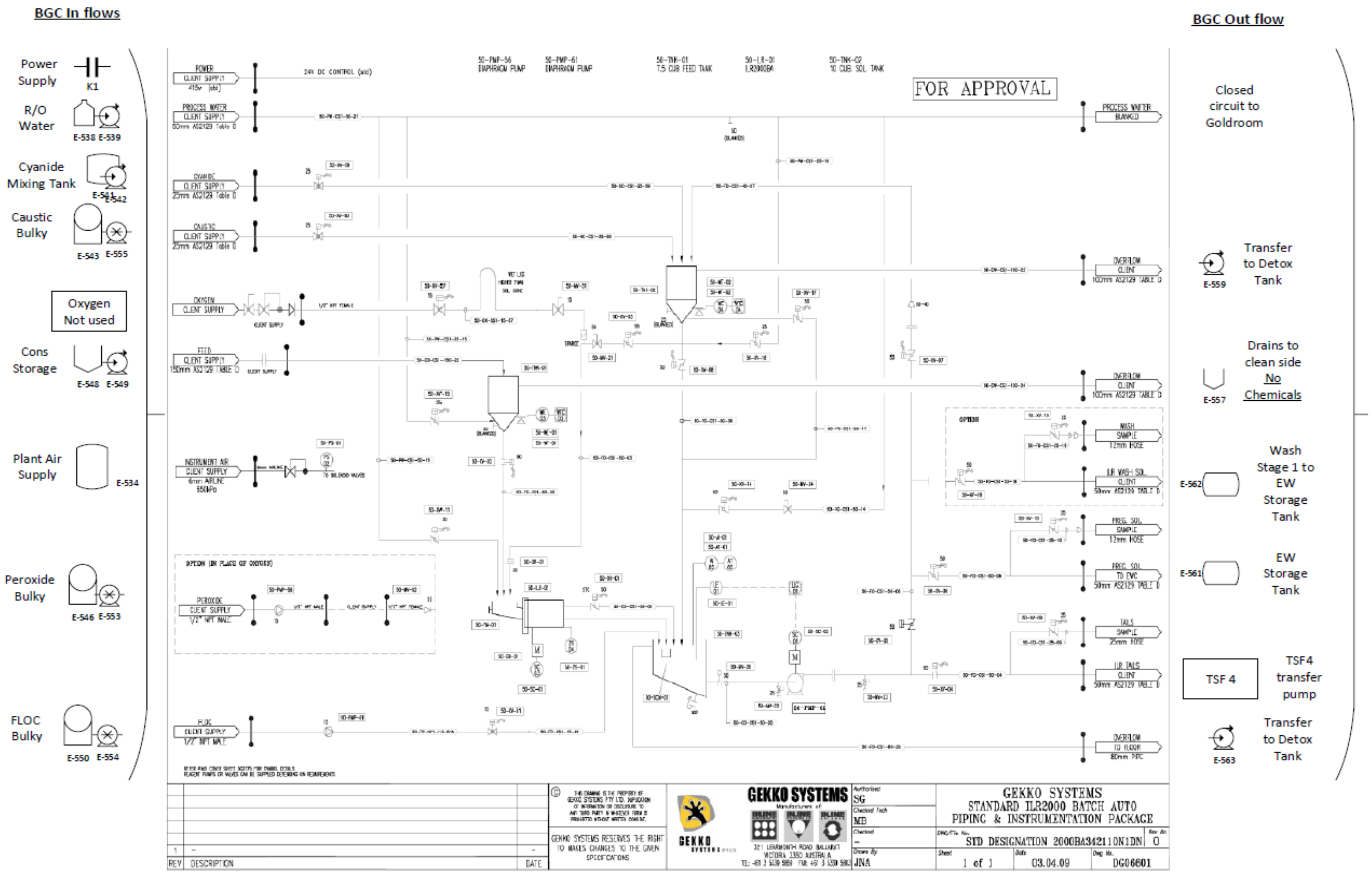


Figure 3-20: Inline Leach Reactor P&ID

3.5.3 Heap Leach

There are no heap leach facilities proposed as part of the scope of operations at the Portia Mine Site.

3.5.4 Processing Water Management

Overview

Water for processing and other forms of site usage will be sourced from dewatering of the open pit in the form of in-pit sumps. A pike lake has begun to develop within the Portia open pit whilst the Site has been in care and maintenance. As of July 2019, it is estimated that there is 200 ML of water within the pit. As such, inflows are conservatively estimated to be 30 L/s but could be lower (previous PEPR update 2016 indicated flows were as low as 20 L/s). Water for mining, processing and RO plant will be sourced from the Portia open pit with additional losses created by a lined evaporation pan on the OWD and evaporators on the TSFs. The addition of a new TSF cell (TSF-3) will also improve water management.

Site Water Management

BGC intends to evaporate all water deemed excess to site requirements. It is proposed that excess water will be provided to the local landowner for stock use. The reinjection system installed in 2015, does not provide adequate reliability and sufficient losses to meet requirements for pit drawdown and is not cost efficient. D&D Permits have not been renewed. If re-injection is to occur in the future, BGC will commence the process of relicensing the bores.

Water from the Pit will be discharged into the Pit dewatering dam (PDD). From there, a proportion of this water will be used for site dust suppression and for the Reverse Osmosis (RO) plant that will supply potable water for the infrastructure needs and also to the local landowner for stock use. The water is then pumped to the Raw Water Dam (RWD) and into the Plant.

During mining, any water accumulated in the Pit after periods of high rainfall or during mining of the ore zone will be pumped to the PDD and then distributed to either the Raw Water Dam for use in the processing plant or the OWD or TSF for evaporation.

To lower the water level in the Portia open pit to allow further mining, additional water needs to be disposed of above that lost in the tailings. BGC intend to lower the pit lake in approximately 200 days. The site water balance shows the losses predicted and amount of water that can be removed from the pit daily once the system is constructed.

Some water will be diverted from the PDD to the OWD evaporation area. Water will be diverted from the RWD initially and sent to evaporators on the TSF. Once sufficient water has built up on the TSF, the decant liquor will be recycled within the TSF and disposed of utilising mechanical evaporators (e.g. mechanical spray, pivot sprinklers or wobble tees).

Site Water Balance

During the entire operation, the project will have a positive water balance, meaning that water will be extracted at a greater rate than it will be used.

The predicted average raw water demand for the project during ore processing is approximately 4,001kL/d (made up of 3,541 kL of Pit water, rain inflows (97 kL) and ore moisture (363 kL/d). The Site water balance is detailed in Table 3-18 and is summarised as follows:

- process water - average consumption 2,032 kL/d (losses to tailings, oversize and run-off);
- potable water - average consumption 224 kL/d (generate 20 kL/day of drinking water and 200 kL/day for stock use);

- dust suppression and construction - average consumption 500 kL/d; and
- Additional evaporation losses of 1,245 kL/d.

Table 3-18 – Summary site balance for new water

Raw Water Balance Summary for Portia Project		
Site	Flow m^3/day	Flow m^3/day
Average condition	Operation	Post Closure
Inputs		
Dewatering / Pit Inflows	3,623	748
Rainfall	209	209
Ore Moisture	363	-
Total	**4,194**	**957**
Losses		
Tailings & other losses	2,226	97
Dust Suppression	500	-
Additional Evaporation	1,245	860 [3]
Potable and Cattle	224	-
Total	**4,001**	**957**

The closure water balance for the Site is detailed in Table 3-18 and Figure 3-26. The pit lake within the Portia open pit will reach a steady state with inflows in equilibrium with evaporation rates. The pit lake would rise to the approximately pre-mining level for groundwater (i.e. RL 23m) and be approximately 16 ha in area.

TSF-1, 2 and 3 will be store and release with small amount of seepage of 0.5 m3/day which is equivalent to natural infiltration rate of 1.1 x 10-2 m3/day[4] for the area or ~1% of rainfall. Therefore, any rain therefore will be mostly stored, transpired or evaporated.

Over the proposed operational period (August 2019 to Sept 2020) the summary of water flow rates are as follows:

- Average dewatering volumes are predicted to be 3,541 kL/day (ranging from 4,487 kL/d during summer to 2,827 kL/d in winter) for the period of ore mining until completion of processing.
- Average additional disposal volumes are 1,445 kL/day (ranging from 1,965 kL/d during summer to 1,097 kL/d in winter).

The additional losses are proposed to be obtained by sending 200 kL/d for stock use, on the OWD evaporation area (see Figure 3-21) and by using mechanical evaporators on the TSF (Figure 3-21). If the required losses are not being achieved by the use of the OWD evaporation area, the stock use or TSF evaporators; then additional evaporators would be put in service on the TSF.

[3] The closure "additional" evaporation is the losses from the 16 ha pit lake
[4] From Golder (2016b)

The Site water balance illustrating the average, summer and winter scenarios is shown in Table 3-19, and in Figure 3-23, Figure 3-24 and Figure 3-25.

Figure 3-21: Mechanical evaporator

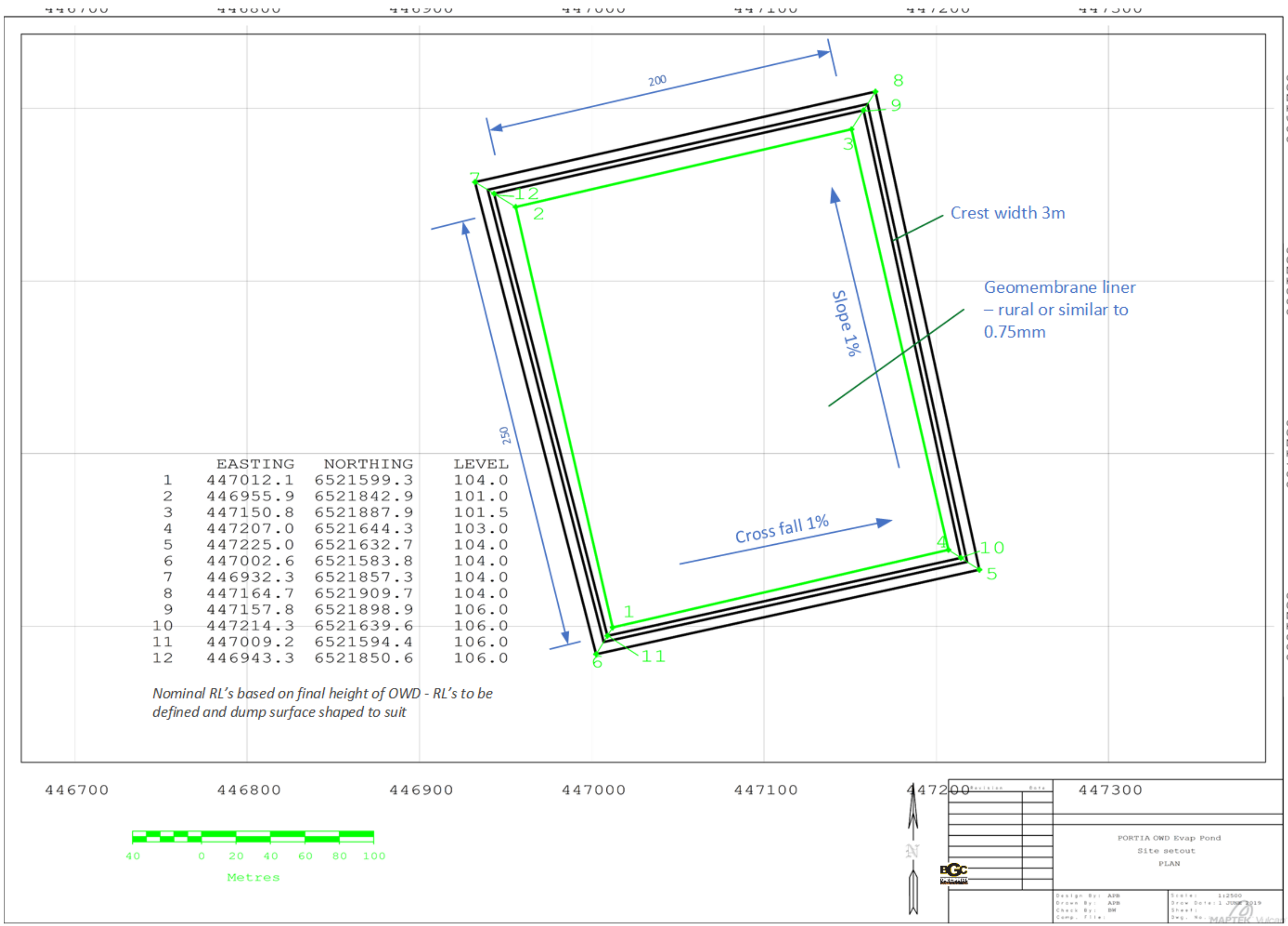


Figure 3-22 | Proposed OWD evaporation area

Table 3-19: Site Water Balance

Case	Average	Summer	Winter
Pit balance	**kL/day**	**kL/day**	**kL/day**
Pit Inflow	2600	2600	2600
Rainfall	100	100	100
Evaporation	200	300	100
Net Gain	**2500**	**2400**	**2600**
Plant and tailings Inflows			
Dewatering from Pit	3500	4500	2800
Rainfall	100	100	100
Ore moisture	400	400	400
Total Inflows	**4000**	**5000**	**3300**
Losses			
Dust Suppression	500	500	500
OWD evaporation surface	240	420	100
Potable	20	20	20
Cattle water	200	200	200
Tailings and other losses	2000	2500	1700
Additional Evaporation	1000	1300	800
Total Losses	**4000**	**5000**	**3300**
Pit Pond draw down	**1500**	**2600**	**700**

The pit lake of 200 ML will take most of the 2019/2020 spring and summer to empty. Given the approval timeframe (August – Sept 2019), it is most likely that the additional evaporation measures will not be fully required in the following winter as by then the pit inflows will be in balance with the outflows.

Schedule for activities

- August 2019;
  - Raise TSF-2 to final approved height;
  - Removal of tailings from TSF-2 complete (under current approval); and
  - Commence reduced rate processing with existing circuit into TSF-2.
  - Start expanded RO plant and stock water
  - Approval of PEPR
- August 2019 (On approval):
  - Commence construction of TSF3 and TSF-4; and
  - Make modifications to the process circuit including ILR install and commission.

- August/ September 2019 Commence processing (new circuit) into TSF-2, TSF3 and TSF4;
- August/ September 2019: Re-establish pit access;
- October 2019: Commencement of pre-strip activities; and
- November 2019: Construct OWD evaporation pond and put evaporators in service.

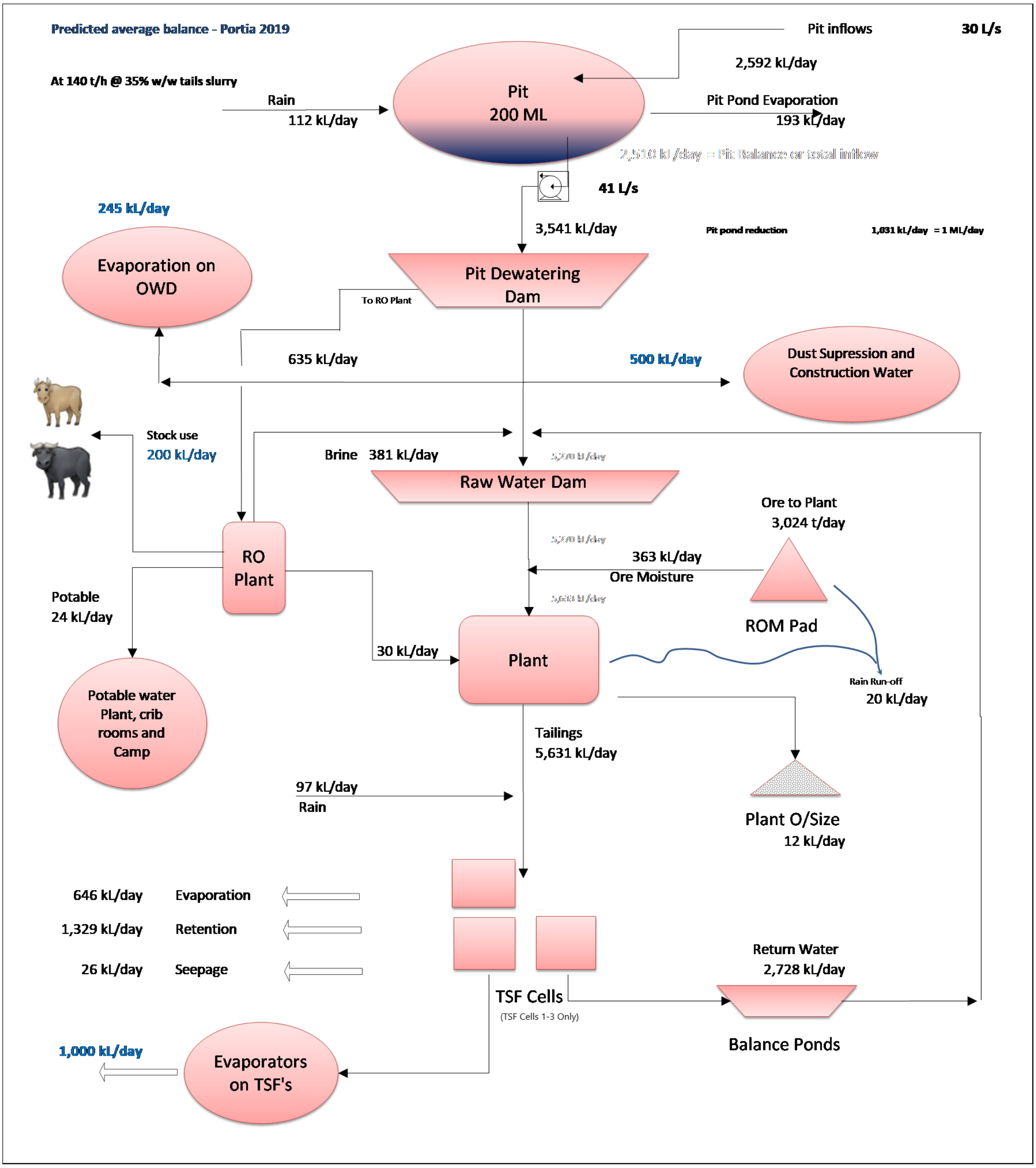


Figure 3-23 | Average operational site water balance

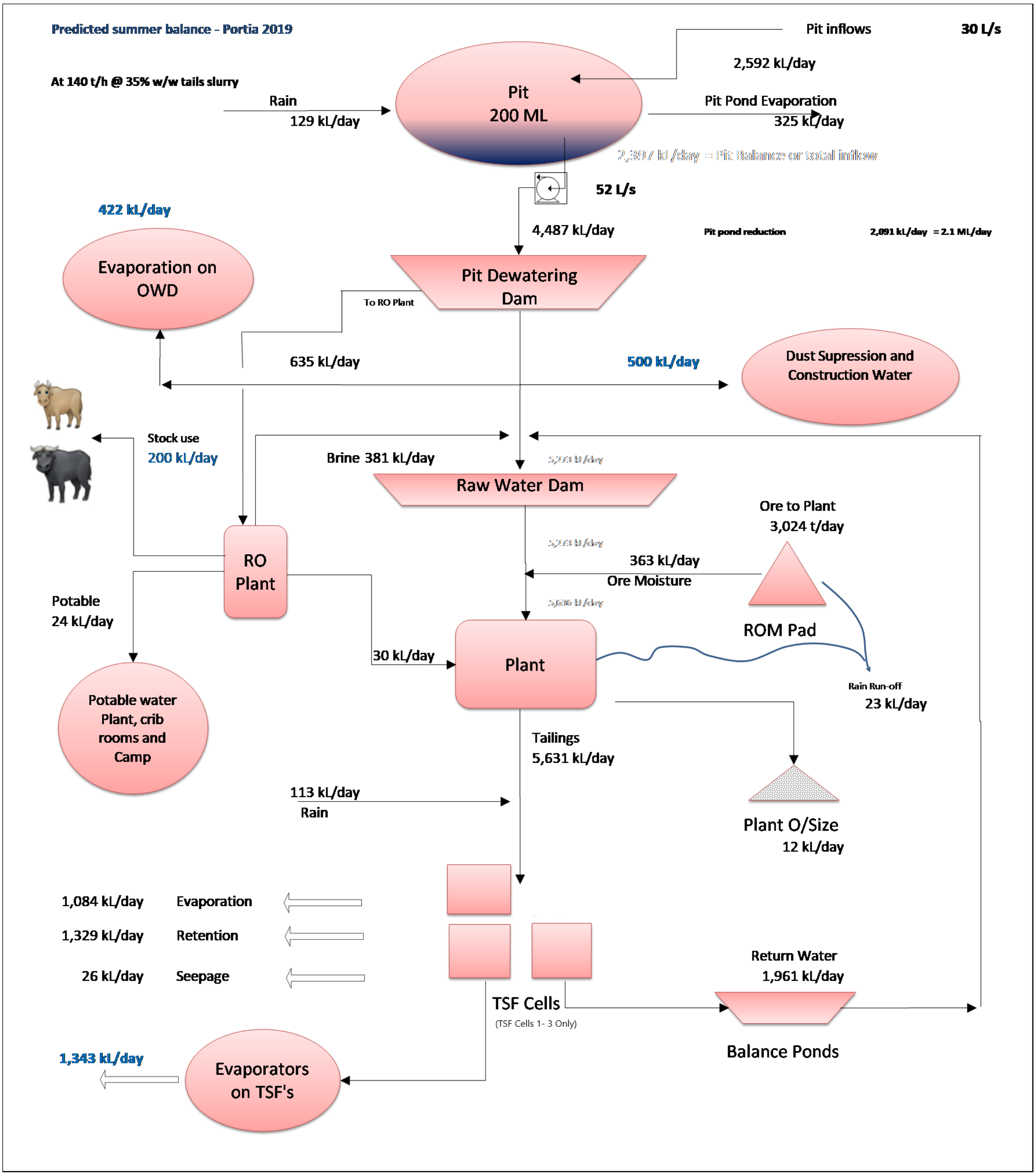


Figure 3-24 | Summer operational site water balance

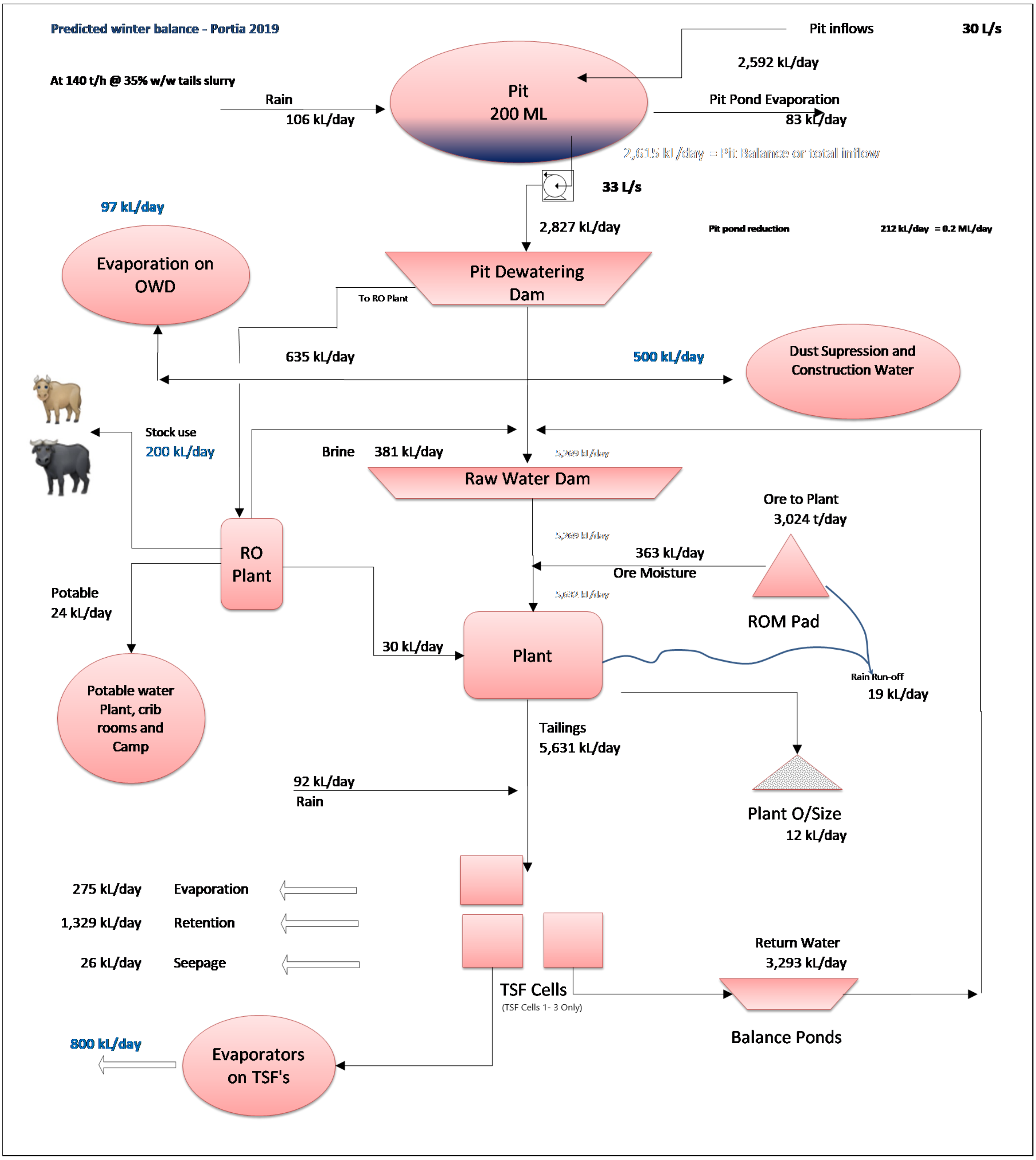


Figure 3-25 | Winter operational site water balance

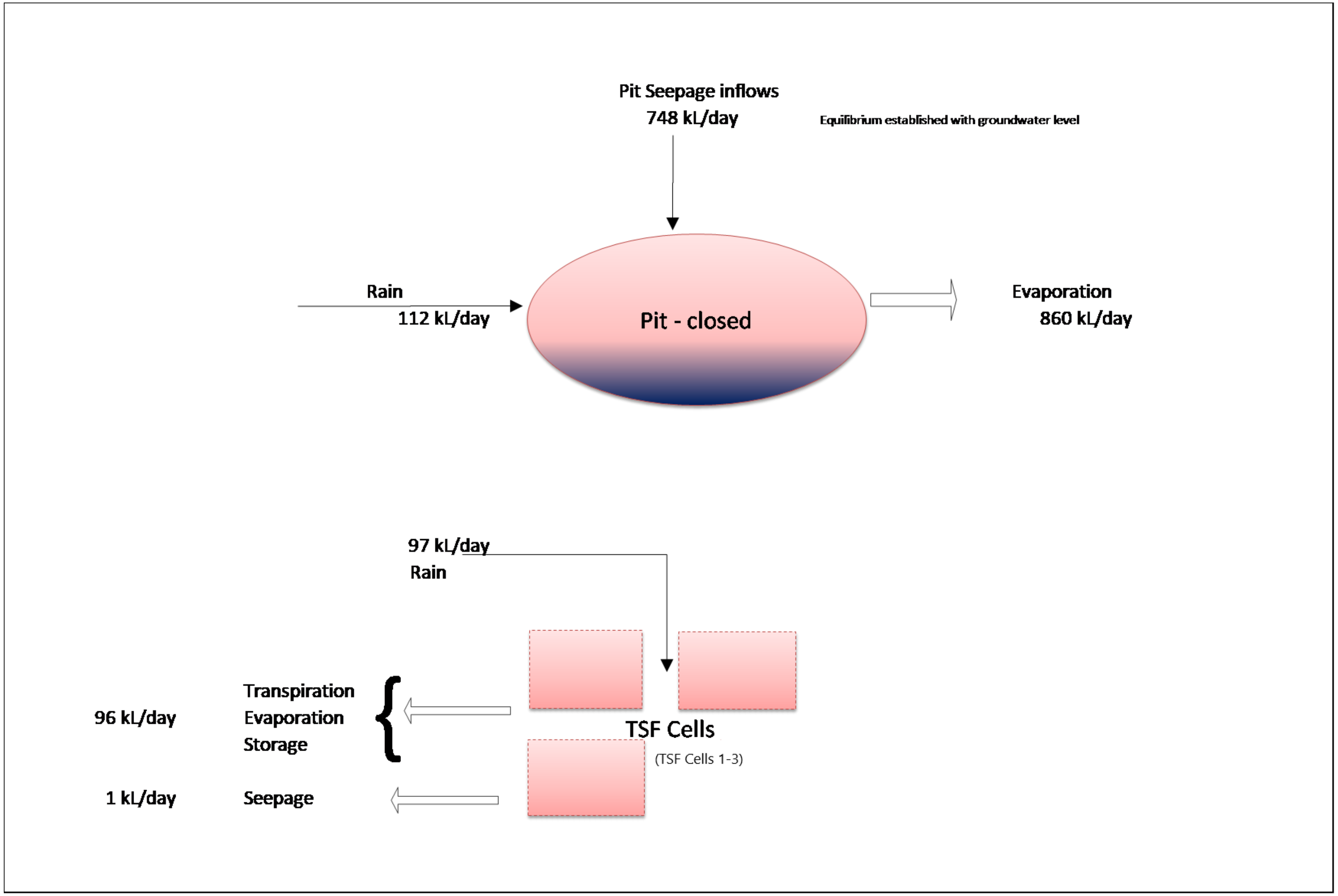


Figure 3-26 | Closure water balance

3.5.5 Site Water Management Contingency Plan

As described in Section 3.10.3 and shown in Figure 3-26, Benagerie Gold intends to dispose of all water deemed excess to site requirements. The losses are made up of:

- OWD evaporation;
- Stock use; and
- TSF Evaporators.

Previously, multiple scenarios were run given the uncertainty on the Plant throughput and pit inflows. The balances provided are worse case in that the pit inflow used at 30 L/s is conservative. The process plant will be mostly retreating tailings (80% of the flow) and is expected to repulp the materials at 40 to 50% Cw. Previously, the actual slurry solids concentrations obtained were less than desired at 15 to 20% due to the requirement to attrition the run of mine ore to break it down. Only about 15% new ore will be treated in the next 12 months. The result is that tailings densities will be higher at proposed 35% Cw.

OWD evaporation

As per Figure 2, the surface of the OWD will have a plastic liner (to limit seepage) over an area of 5 ha will have an average evaporation rate of 245 m3/day:

A = Area	*50,000 m^2*
E = Evaporation rate	*7.4 mm/day*
P = Pan factor	*0.7*
Rain rate per day	*0.32 $mm/m^2/day$*
R = Rain accumulated per day	*16 m^3/day*
Average losses per day	*$= (A \times E \times P/1000) – R$*
Average losses per day	*245 m^3/d*

Stock Water

It is proposed to supply the landowner 200 m3/d to the nearby Benagerie Dam or to a pump tank that the landowner will then pump around the property. The RO water is typically low in TDS so some brine will be re-added to make a stock suitable water of approximately 5,000 to 7,500 TDS. BGC have purchased and are installing a much larger RO plant to meet the requirements of the Plant (for the reagents), the Site camp and infrastructure and the stock use.

TSF mechanical evaporators

Initially two large evaporators will be situated on TSF-1 to promote water losses. Discussions with suppliers and previous experience suggest each unit can dispose of 40 m3/h. Given they will operate in daylight hours, an expected use is 10 hours and total of 800 m3/day. As stated, if the rate is not obtained, additional units may be put in service.

BGC will continue to monitor and review the site water balance as the reduction in level of the pit lake is critical to ongoing production. The measures noted above will be implemented and if additional evaporation losses are needed, further evaporation strategies will be deployed.

The re-establishment of the reinjection system is currently not planned but would form part of the contingency but with a longer time frame to implement that is needed to obtain approvals and upgrade the infrastructure.

3.5.6 Water Management Infrastructure

Process water is managed within four water storage ponds at the Portia Mine Site, the RWD, BP1 (previously referred to as PWD), PDD and BP2. Figure 3-27 details the locations of each of these ponds.

Please note that a description of the PDD can be found in Section 3.4.8 as it relates to dewatering infrastructure.

Raw Water Dam (RWD)

The flow of water to the RWD from the PDD is controlled daily by monitoring the flow requirements. The flow rates are measured by the inflow line meter.

The RWD measures approximately 10 m x 20 m at the base and 5.0 m deep and has dimensions at the inside crest of 40 m x 50 m. It has a total capacity to hold 4.7 ML. In maintaining an operating free board of 1.0 m, the live capacity of the RWD is 3.0 ML. This capacity provides approximately 2 days of storage for ore processing operations. The RWD has side slopes of 3H:1V and an embankment crest width of 1.0 m.

The RWD dam is lined with 1.0 mm HDPE geomembrane on a sand/clay base. The walls and floor of the PDD have been excavated neatly from solid material. All soft, yielding or other unsuitable material has been replaced with sound material and the subgrade compacted to provide a minimum of 95% compaction.

The geomembrane was laid on the clay foundation following specific working procedures and anchored into the ground utilizing a small 300 mm deep V- trench which was backfilled afterwards.

After placement, the geomembrane was inspected for evidence of holes, tears or defective seams. If these features are found to be present the liner shall be repaired in accordance with the manufacturer's specifications.

The location of the RWD can be seen in Figure 3-27. A plan and cross-section of the RWD is shown in Figure 3-29 and Figure 3-30.

Balance Pond 1 (BP1)

The BP1 (or PWD) holds excess water from pit dewatering activities. The location of the BP1 is adjacent to the existing TSF-1 (East) cell as shown in Figure 3-27. A plan and cross-section of the BP1 is shown in Figure 3-31 and Figure 3-32.

The location has been selected as it is close to the current plant and also potentially useful for future processing plant extensions and it is in a low-lying area.

The BP1 has been constructed with cut and fill construction to a depth at RL 67.0. The BP1 consists of a truncated inverted approximate pyramid and measures approximately 142 m x 137 m at the base and 5.0 m deep and has dimensions at the inside crest of approximately 165 m x 150 m. Whilst the BP1 was designed to have a live capacity of 85.0 ML (while maintaining an operational freeboard of 1.0 m), due to issues with its construction the actual live capacity is 48 ML. The BP1 has side slopes of 3H:1V and an embankment crest width of 4.0 m.

The banks and floor of the BP1 have been constructed with a 300 mm clay liner to the Zone 1 Engineered Fill construction method statement specific for the TSF cell embankments. This method has been shown to produce coefficients of permeability in the order of 10^{-9} to 10^{-10} m/s. The high clay content of the materials along with the work methods applied means that permeability similar to an HDPE liner can be achieved. The benefits of not using an HDPE liner include lower construction costs, lower ongoing maintenance costs and easier clean-up at closure (i.e. not needing to dispose of an HDPE liner). The seepage risk is considered to be low, based on previous work undertaken for the TSF cells by

Golder (see Golder, 2016b), however two additional seepage monitoring wells (S5 and S6) have been installed to monitor for lateral seepage to the east and north of the BP1. Monitoring has been added to the updated GMMP (see Appendix F6).

Balance Pond 2 (BP2)

In early 2018 it was identified that an additional large storage pond, BP2, was required to hold excess water from pit dewatering activities when the water balance is in surplus, and to supply contingency water resources for warmer (summer) months when processing demand is highest, and the water balance may be in a deficit. Together with the existing PWD (BP1) the Site will have the ability to hold a combined 110 ML of process water.

The BP2 has been constructed with cut and fill construction to a depth of approximately 10m to RL 60.0. The BP2 measures approximately 68 m x 36 m at the base and 10.0 m deep, with dimensions at the inside crest of approximately 175 m x 170 m. In maintaining an operating free board of 0.5 m, the maximum live capacity of BP2 is 62 ML. BP2 has side slopes of 3H:1V, an embankment crest width of 8.0 m and a wave table of 10.0 m.

The banks and floor of BP2 have been constructed with a 300 mm clay liner to the Zone 1 Engineered Fill construction method statement used for the TSF cell embankments, on zones of the floor or pond walls where sand is encountered. This method has been shown to produce coefficients of permeability in the order of 10-9 to 10-10 m/s. The seepage risk is deemed to be low, based on previous work undertaken for the TSF cells by Golder (see Golder, 2013 and 2016).

The location of BP2 is adjacent to the processing plant as shown in Figure 3-27. A plan and cross-section view of BP2 is shown in Figure 3-33 and Figure 3-34. The location has been selected as it is in a low-lying area and it is close to the current plant.

Both BP1 and BP2 are fitted with electric transfer pumps which are monitored daily and flow data recorded daily on the processing run sheet.

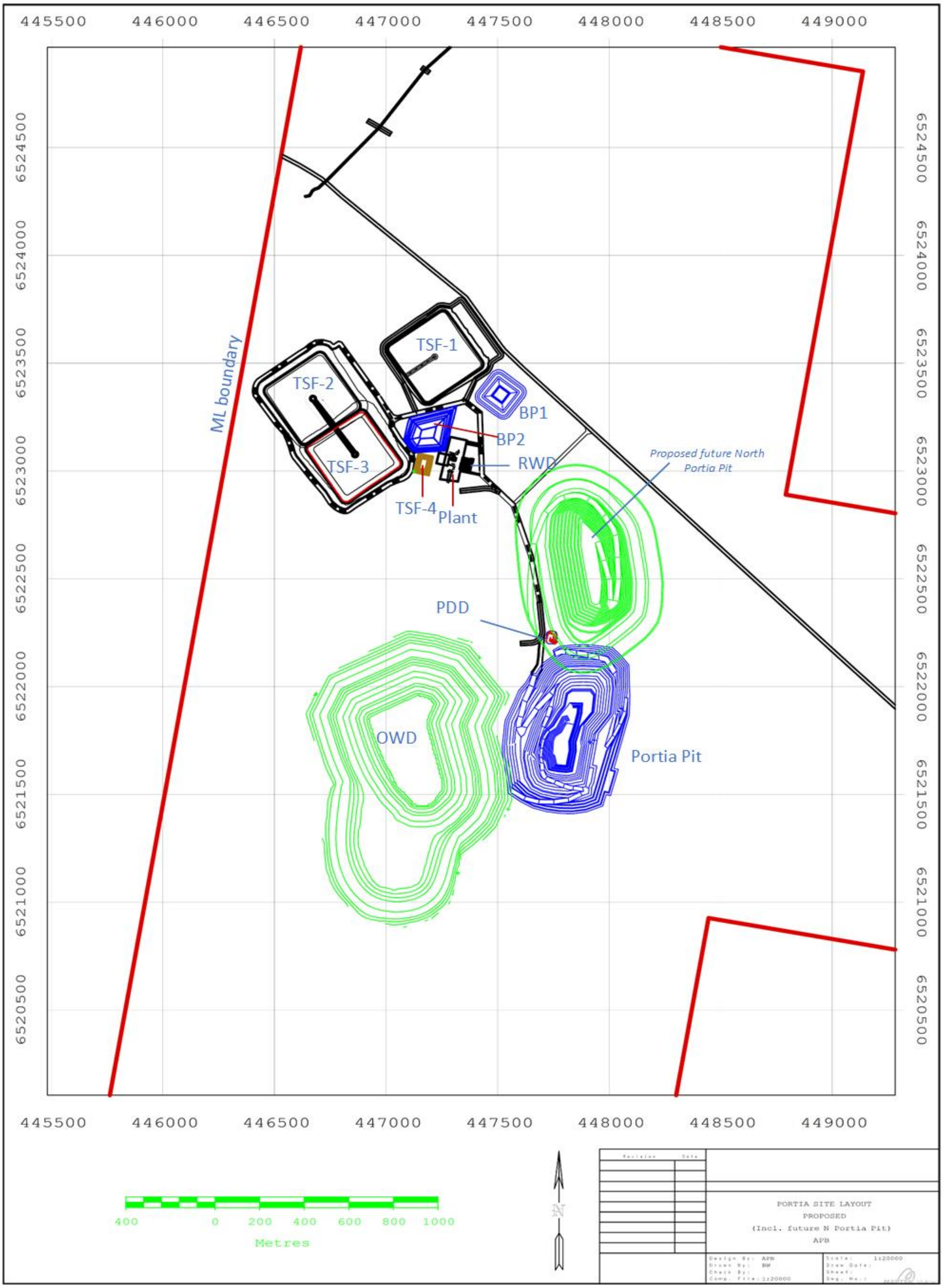


Figure 3-27 Location of Water Storage Dams

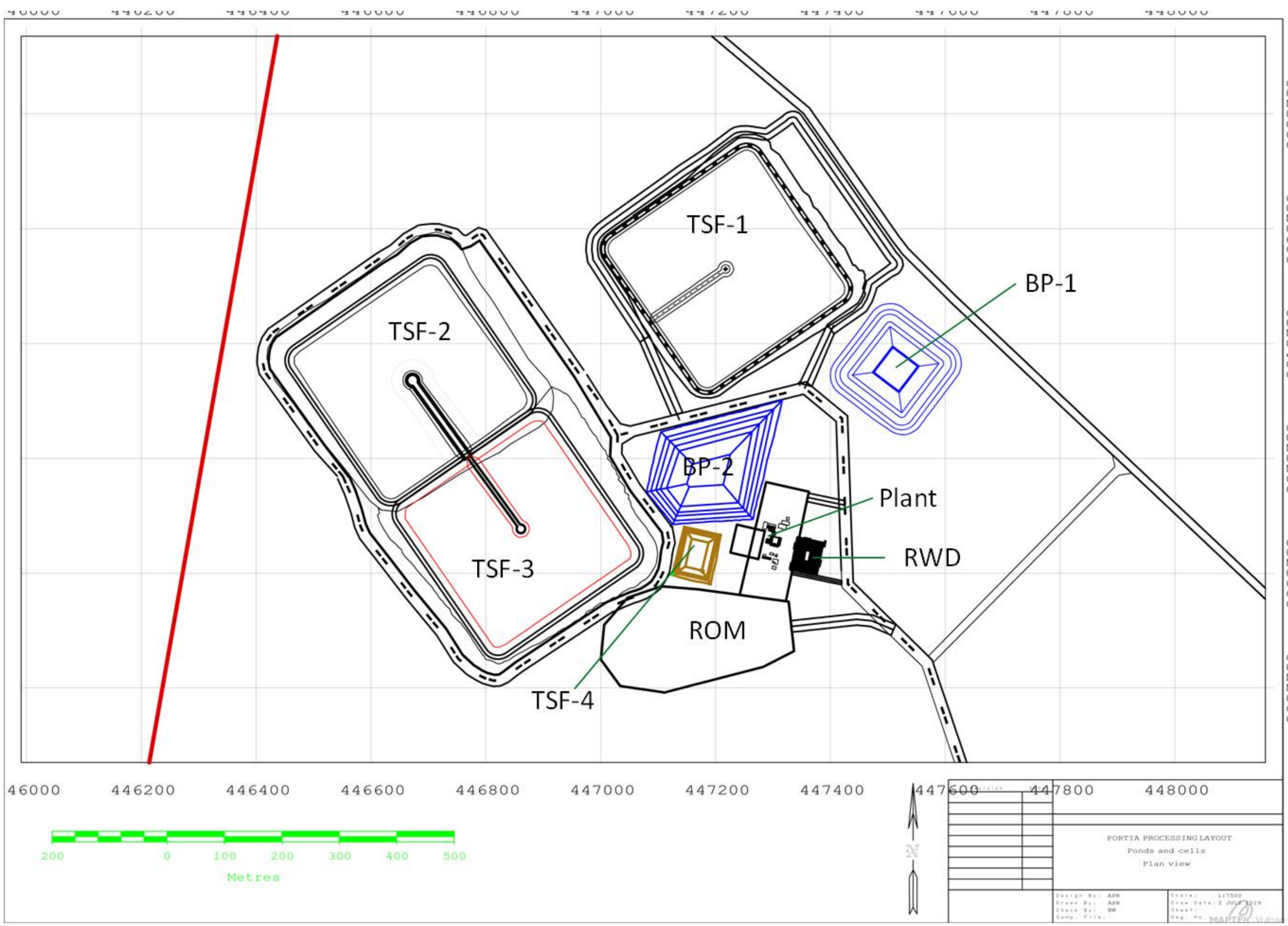
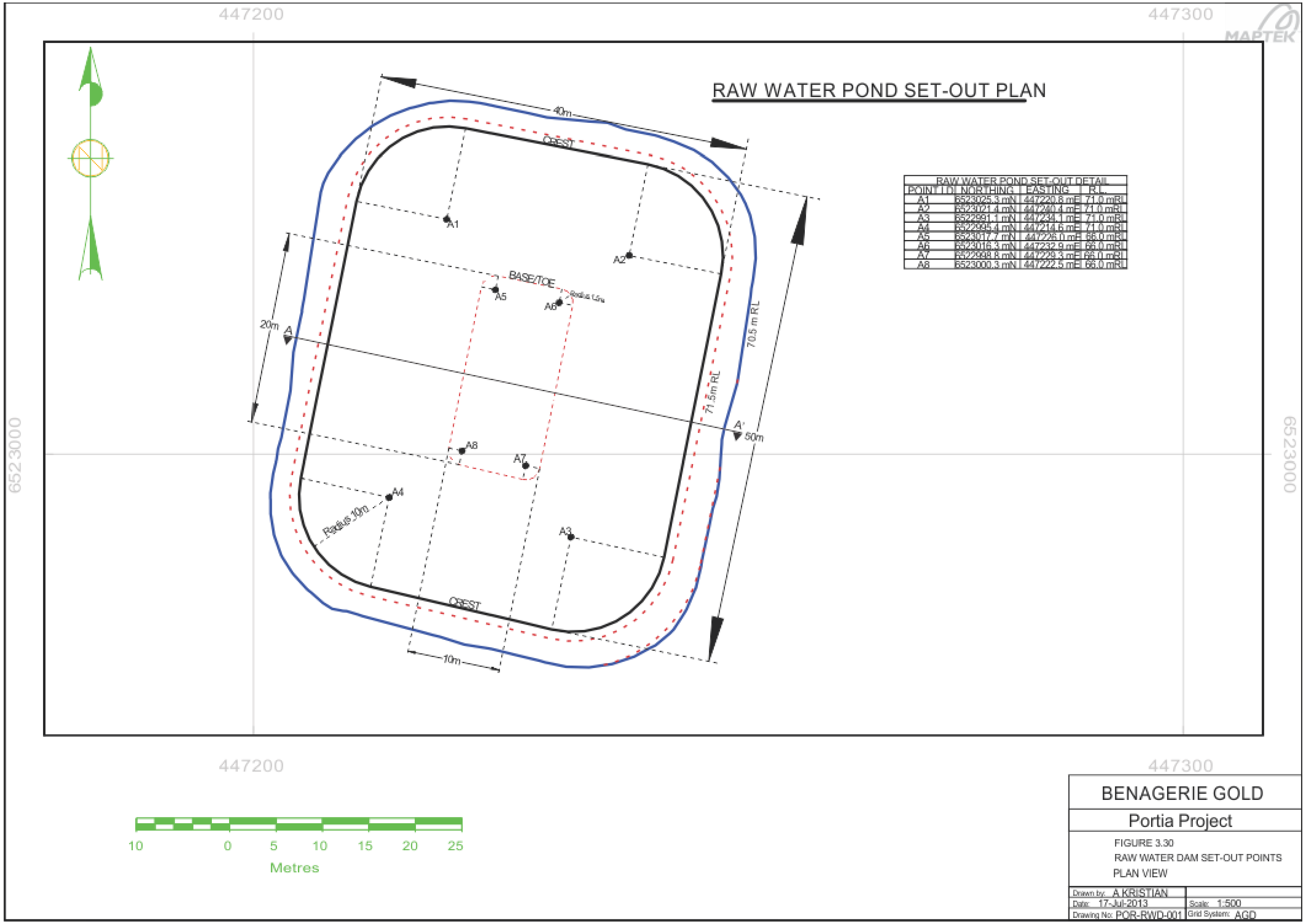


Figure 3-28| Processing area layout



RAW WATER POND SET-OUT DETAIL			
POINT ID	NORTHING	EASTING	R.L.
A1	6523025.3 mN	447220.8 mE	71.0 mRL
A2	6523021.4 mN	447240.4 mE	71.0 mRL
A3	6522991.1 mN	447234.1 mE	71.0 mRL
A4	6522995.4 mN	447214.6 mE	71.0 mRL
A5	6523017.7 mN	447226.0 mE	66.0 mRL
A6	6523016.3 mN	447232.9 mE	66.0 mRL
A7	6522998.8 mN	447229.3 mE	66.0 mRL
A8	6523000.3 mN	447222.5 mE	66.0 mRL

Figure 3-29 Plan View Raw Water Dam

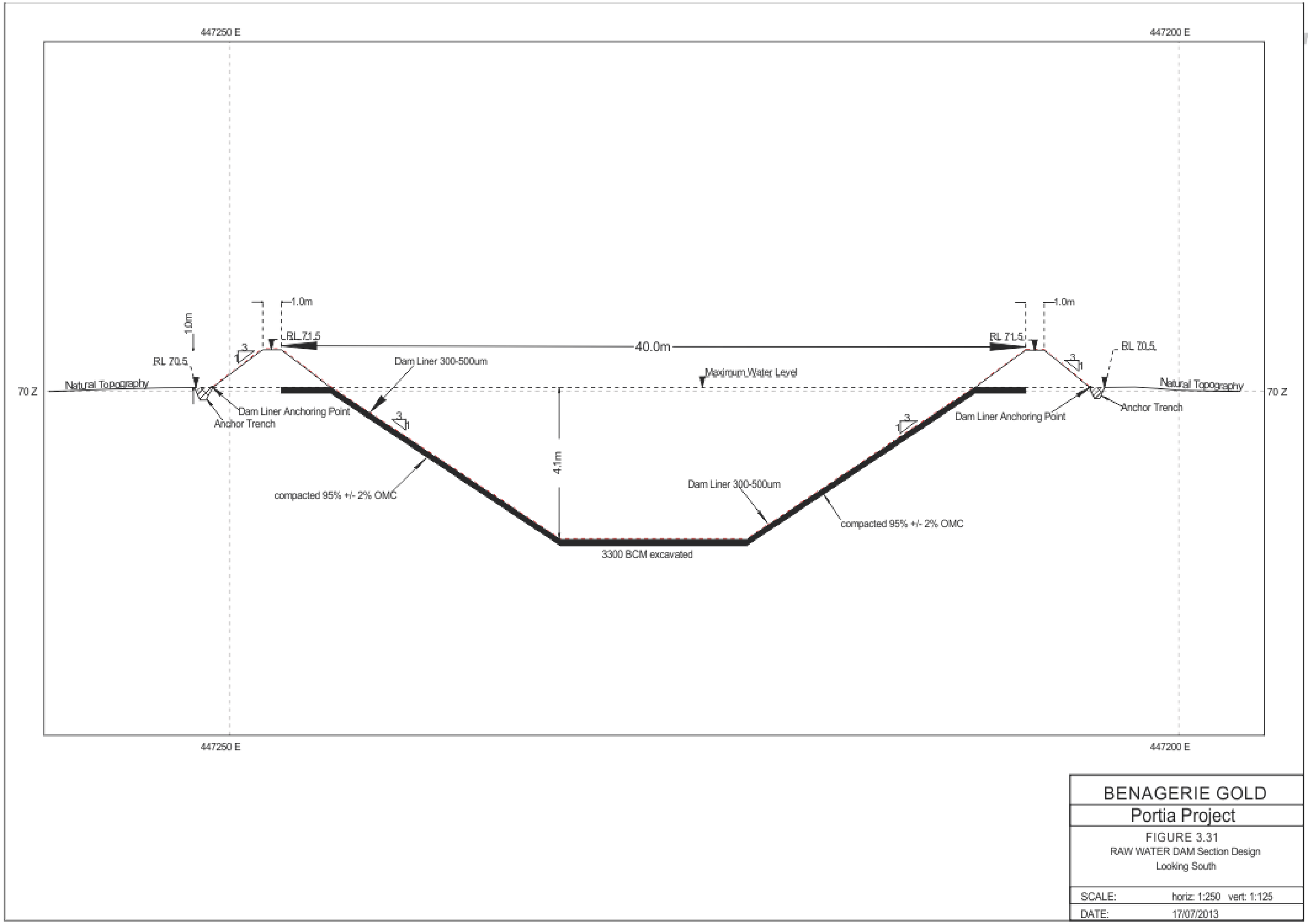


Figure 3-30 Cross-Section Looking South of Raw Water Dam (Design)

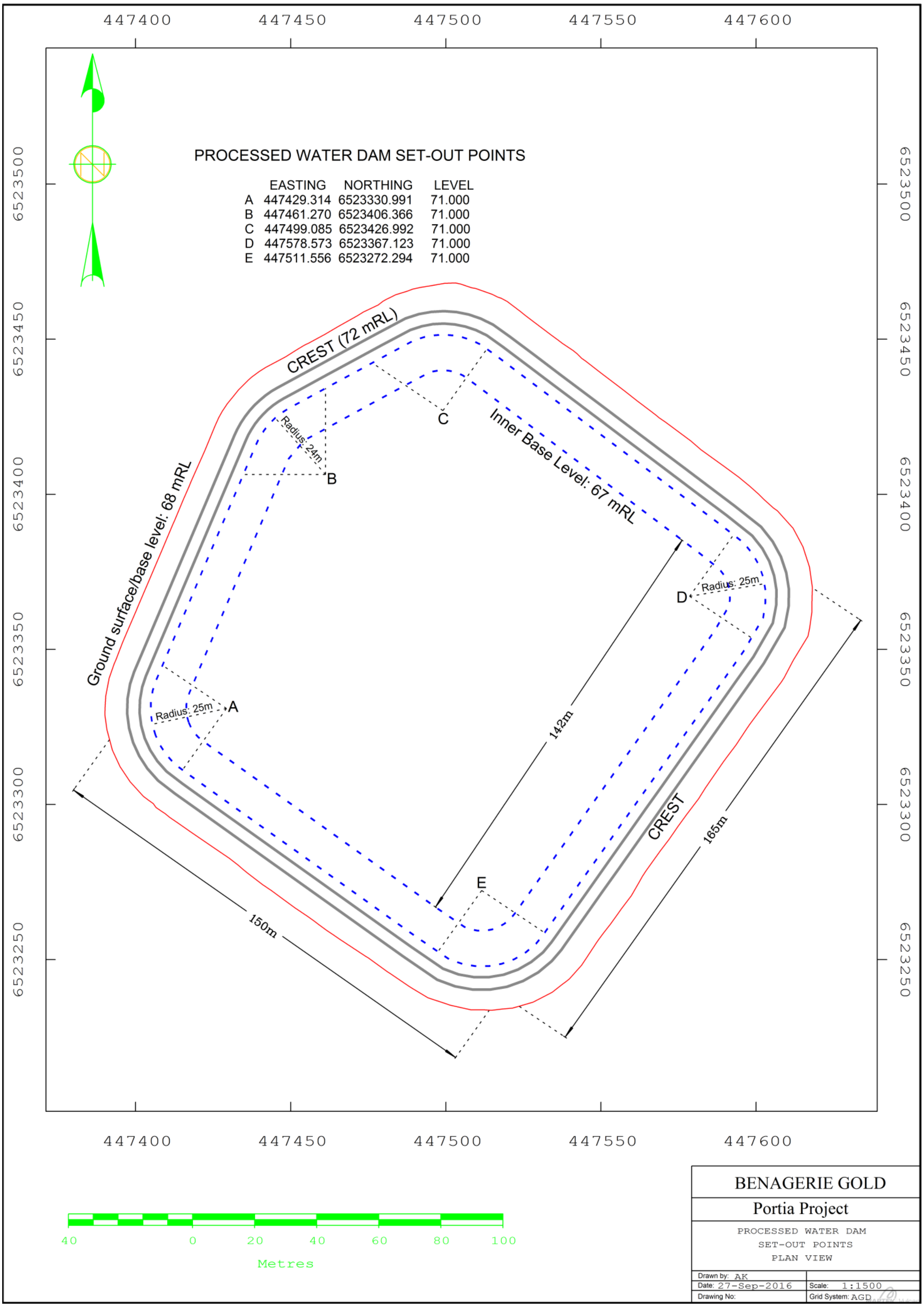


Figure 3-31 Plan View of Balance Pond 1 (previously Process Water Dam) (Design)

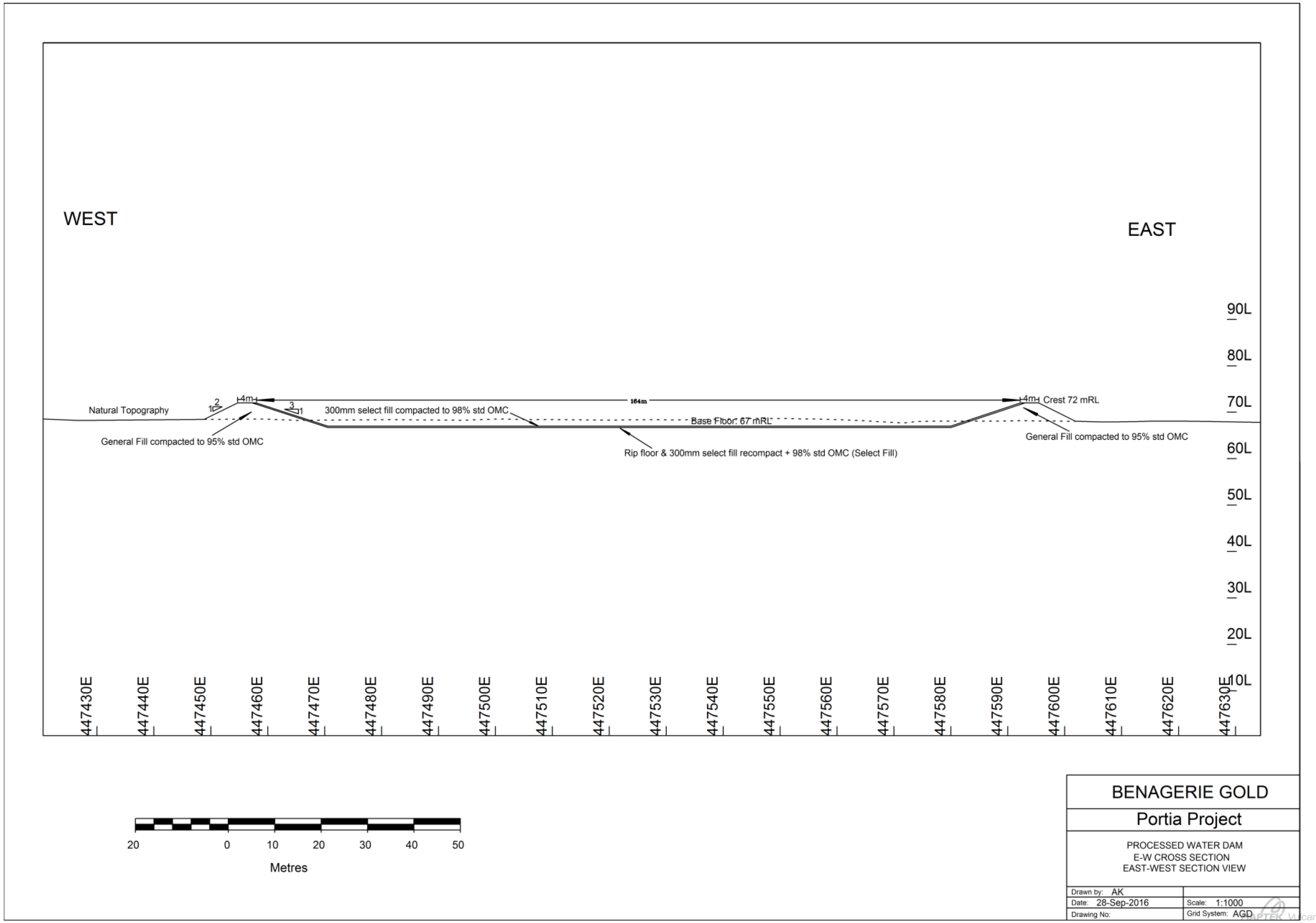
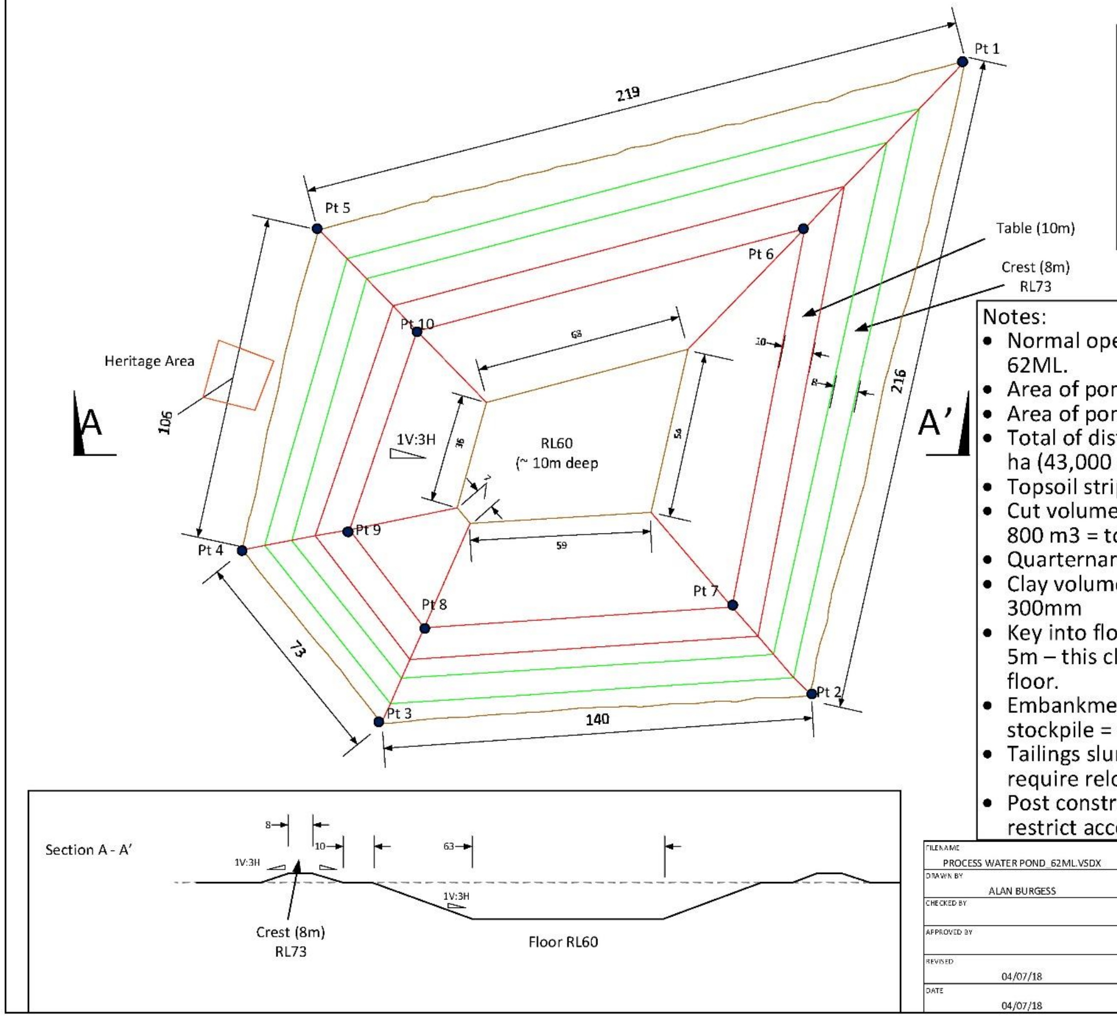


Figure 3-32 Cross-Section Looking North of Balance Pond 1 (previously Process Water Dam (Design))

BALANCE POND # 2 - 62ML



	EASTING	NORTHING	LEVEL
Pt1	447,315	6,523,302	69
Pt2	447,265	6,523,095	71
Pt3	447,125	6,523,085	71
Pt4	447,080	6,523,142	71
Pt5	447,105	6,523,246	69
Pt6	447,264	6,523,246	70
Pt7	447,240	6,523,123	71
Pt8	447,139	6,523,116	71
Pt9	447,115	6,523,148	71
Pt10	447,137	6,523,213	69

Notes:
- Normal operating dam is to RL69.0 and contains 62ML.
- Area of pond =1.3ha
- Area of pond + embankments = 3.5 ha (35,000 m2)
- Total of disturbance allowing for external roads = 4.3 ha (43,000 m2)
- Topsoil stripping = 6,500 m3 at 150mm
- Cut volume = 80,000 m3 + 300mm over cut inside 800 m3 = total of 80,800 m3 cut
- Quarternary clay to stockpile = 26,000 m3
- Clay volume to lay and compact in floor ~ 800 m3 at 300mm
- Key into floor along centreline of crest ~400mm by 5m – this clay ~ 1,000m3 to goto stockpile for use in floor.
- Embankments will hold 32,000m^3 therefore cut to stockpile = 48,800 m^3
- Tailings slurry lines and decant return line will require relocation
- Post construction the pond will need fencing to restrict access to stock and other fauna

FILENAME	PROCESS WATER POND_62ML.VSDX
DRAWN BY	ALAN BURGESS
CHECKED BY	
APPROVED BY	
REVISED	04/07/18
DATE	04/07/18

BTM SOLUTIONS PTY LTD

DESCRIPTION: BALANCE POND2 – 62ML

SIZE	FSCM NO	DWG NO	REV
A3		POR-DWG-1002	1
SCALE 1:1250		SHEET 2 OF 3	

Figure 3-33 Plan View of Balance Pond 2 (Design)

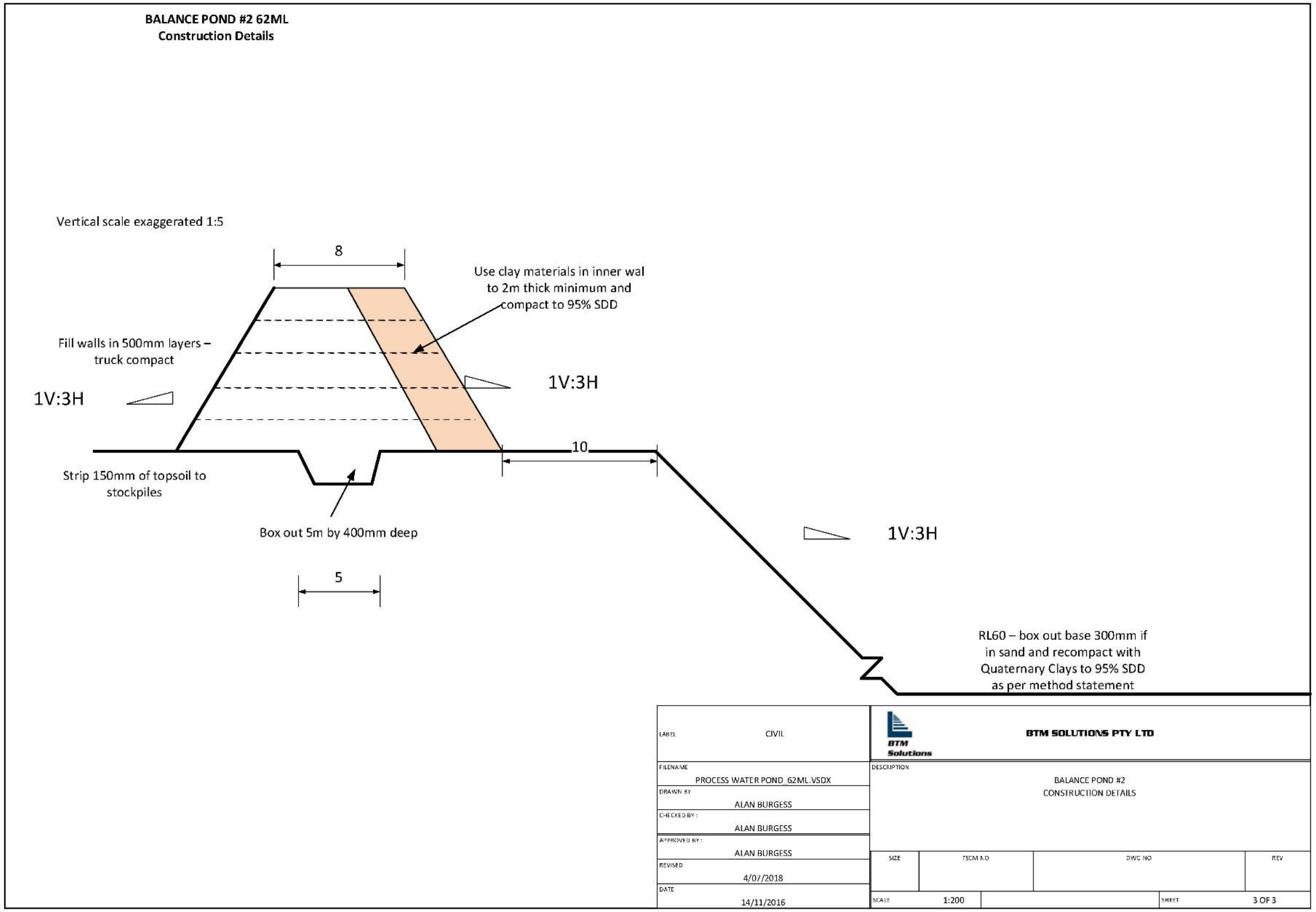


Figure 3-34 Cross-Section of Balance Pond 2 (Design)

3.5.7 Types of Mobile Equipment

Mobile equipment includes the items listed in Table 3-12 and Table 3-13. The processing infrastructure described in Section 3.4.7, i.e. the scrubber, Knelson concentrator, vibrating tables and gold room, although removable, are considered to be fixed plant.

3.5.8 Conveyors and Pipelines

There are no conveyors and pipelines that have not been described in Section 3.3.2 as part of the scope of operations at the Portia Mine Site.

Any additional pipelines will be run within the existing service corridors with the exception of the polyline feeding the cyanide cell. This line will be double skinned and buried to prevent damage and mitigate against leakage.

1100m of 280-300mm return line to the processing plant from TSF-1 for wet mining activities. New pipelines for TSF-3 will be installed for decant and tailings discharge.

3.5.9 Hours of Operation

A 24-hour working roster will be used for all processing operations.

3.5.10 Care and Maintenance

Please refer to Section 3.4.12 Care and Maintenance, which details the care and maintenance strategy for the operation.

3.5.11 Rehabilitation Strategies and Timing

Rehabilitation is described in detail in the closure section (Section 7). Due to the small scale of the operation, progressive rehabilitation measures will be limited to the rehabilitation of access and ancillary tracks not used during operations (operational period).

The following rehabilitation strategies are proposed:

- Remove all buildings (including processing plant office), power supply lines, tanks, chemicals, waste materials (in accordance with the Waste Management Plan), disconnect and terminate all services.
- Break up and remove any concrete footings and dispose to the open pit.
- Deep ripping (up to 300 mm depth) will occur for all compacted areas (hardstand and trafficked areas).
- Visual salt crust build-up will be removed.
- Remaining water in water storage dams (RWD, PWD (BP1) and BP2) would be either evaporated off or returned to one of the open pit voids.
- Cut the HDPE liner of the RWD and bury.
- Infill water storage dams and retention structures.
- Where required any disturbed land will be shallow ripped (up to 100 mm) and contoured to be consistent with the pre-mining ground surface.
- Topsoil placed on previously disturbed areas.

- The area will be seeded.

Rehabilitation for the Portia Mine Site will occur in two stages, this is discussed in more detail in Section 7 Mine Closure.

3.6 Wastes

3.6.1 Overburden and Waste Rock

Overburden and waste rock is deposited into an overburden waste dump (OWD) which has been constructed adjacent to the Portia open pit (refer to Figure 3-1). It has been designed to hold approximately 1.0 bcm of mined overburden and will cover an area of approximately 114.10 ha when complete (including ancillary features such as roads and water collection structures).

BGC engaged Mining One (2016e) to carry out a stability assessment of the OWD, with geotechnical stability being assessed by Mining One and erosional stability being carried out by Landloch Pty Ltd (Landloch), a specialist soil science consultancy. The results of this assessment are presented in the Mining One (2016e) report which is provided in Appendix B8. Specific and detailed testing was carried out for this assessment, both for geotechnical properties and for soil properties to be used in the erosional stability assessment. Relevant findings from the Mining One (2016e) report are summarised in the sub-sections below.

Details of an earlier assessment of the geotechnical stability of the OWD conducted by Rocktest in 2012 are provided in Appendix B2. This assessment used preliminary estimates of material properties from an early phase of investigations. The OWD design presented in the original PEPR (PEPR2014/090) used the results of Rocktest (2012b).

OWD Original Design and As-Built

The original OWD design was up to 35.5 m high, with its maximum height in the north where the topography is lowest. The original OWD design comprised two lifts, the first up to 20.5 m high (top at 89 m RL), and the second up to 15 m high (top at 104 m RL). The design overall slope angle is 14.6° to 14.9°.

The original OWD design was modified by BGC during the detailed design phase prior to Project commencement to accommodate topographic variations within the lower 20 m lift. The modified design was not geotechnically assessed, although it used some of the Rocktest (2012b) design parameters. It is noted that the 'as-built' overall slope angle and height are less than those recommended by Rocktest. These are the critical aspects of the dump geometry which ensured that the FOS would be greater than was derived by Rocktest (2012b).

The current 'as-built' OWD is completed to the original design limits in the south, with remaining capacity in the north. There is an approximately 40 m offset from the Dusky Hopping Mouse exclusion zone to the north.

The south-eastern toe of the current OWD is approximately 100 m from the Benagerie Gold defined mineral exclusion zone. A 100 m distance was maintained by Benagerie Gold to provide space for the abandonment bund at closure.

Field density tests show that the construction methods in use to build the OWD are achieving high levels of compaction, in excess of 90% of maximum dry density (MDD), which achieves the highest practical level of geotechnical stability.

Dumped swell factors of around 10% are being achieved, compared with 30% for the original design. It is clear from the swell factor being achieved, and the field density tests, that the construction methods currently in use are achieving high degrees of compaction that will ensure the maximum possible geotechnical stability (Mining One, 2016e). It is recommended that the same dumping and construction methods should continue to be used to achieve similar compactions, field densities and swell factors.

Laboratory testing of overburden materials was carried out in a NATA registered laboratory, with samples being remoulded and compacted at similar, or slightly lower (more conservative) densities than are being achieved at the Site. Results of the testing were used in a geotechnical stability assessment, which showed that the current 'as-built' OWD more than meets acceptance criteria for geotechnical stability.

OWD Landform Design Assessment

Landloch was engaged to assess the suitability of the proposed closure cover system (nominally 150 mm topsoil with revegetation) to achieve long term erosion stability. The landform study included:

- Characterisation of chemical and physical properties of topsoil(s) and waste to identify any constraints to both stability and site revegetation. A range of samples of topsoil and waste were sourced from the site and were tested for chemical and physical properties in a NATA registered laboratory;

- Selection of key materials for erodibility measurement;

- Laboratory measurement of erodibility of topsoil and waste using simulated rainfall and overland flows; and

- Numerical modelling using Water Erosion Prediction Project (WEPP) software to assess erosion potential, and to determine stable slope profiles.

The Landloch work used runoff, erosion and landform evolution modelling to identify landform options that would erode at rates low enough to provide acceptable long-term stability. Effectively, the landforms are planned to be consistent with *tolerable* rates of soil loss, which was originally defined as "*the maximum rate of soil erosion that will permit a high level of crop productivity to be sustained economically and indefinitely.*" That definition has since been extended to consider rangeland situations.

In considering batter slope stability, the WEPP model was used to consider runoff and erosion from a range of batter profile options to identify profiles that would deliver acceptable erosion rates for long-term sustainability of rangeland vegetation.

The WEPP model was run for a 100-year synthetic climate sequence based on rainfall data from Bureau of Meteorology stations close to the Portia Mine Site. The 100-year sequence used gives a good representation of long-term average erosion rates for periods greatly in excess of 100 years (Mining One, 2016e). Use of longer records including highly infrequent larger rainfall events has been found to give little change in the 100-year average erosion rate (Mining One, 2016e). Effectively, whether using a 10,000 year file or a 100-year file, the long term erosion rate predicted is little different.

Single extreme events (e.g. 1 in 1,000 year ARI events) are only considered in WEPP simulations where there is potential for the large event to cause failure of some key element of the landform – such as overtopping of a structure, or removal of some protective layer. In the case of the Portia Mine Site, there is no risk that extreme events will cause 'failure' of the concave profiles designed (Mining One, 2016e). Therefore, simulations aimed to define batter slopes such that long-term erosion rates were low enough for the soil to be sustainable over long periods, with small rates of erosion being balanced by soil profile development (leaching of salts, increases in organic matter and nutrients, etc.).

For slopes having a linear profile (constant gradient), simulations show erosion rates increasing rapidly downslope as runoff volumes increase and rill erosion is initiated. Predicted erosion rates are greatly in excess of the target levels required for long-term stability for bare linear slopes. For vegetated linear slopes, erosion rates reach undesirable levels even for the lower gradient options (less than 10%).

Concave slopes achieve better erosion control, by having an upper steeper slope where there is less flow, gradually reducing to a flatter lower slope where there is greater flow and run-off. Concave slope profiles were determined for 20 m, 15 m and 10 m high slopes that will maintain erosion below tolerable levels when vegetated.

The erosion assessment highlighted that there are two key risks to OWD erosional stability:

1. Erosion of the outer batter slopes, as the materials tested are highly erodible. Erosion simulations of batter slope profiles have been used to develop concave profiles to minimise that risk. Further mitigating controls are outlined below; and

2. Tunnel erosion, which is a risk because the clay wastes are swelling and largely strongly saline and sodic, and there is potential for runoff ponding at points on the landform to enter cracks and form tunnels at depth. Those tunnels could trigger gully erosion if allowed to develop.

Risks are to be mitigated by:

1. Controlling discharge of runoff into upper and lower batters by using crest bunds;

2. Minimising tunnel erosion by minimising concentration of flows and ponding of runoff;

3. Constraining surface ripping to a maximum depth of 100 mm; and

4. Establishing a vegetation cover to maintain longer-term erosion stability.

OWD Water Balance Assessment

Landloch was engaged to assess likely water movement through the rehabilitated OWD landform to consider whether the proposed 'store and release' type of cover system is appropriate and effective.

The water balance assessment utilised HYDRUS, a 1D water and solute balance model which has been widely calibrated and validated using data collected from numerous sites across Australia and internationally. Waste and soil properties were determined by laboratory testing, as mentioned in the landform assessment.

The simulations show that some deep drainage will occur below the 2 m deep profile modelled.

The net downward movement of water is essential at the Portia Mine Site, to ensure that soluble salts in topsoils and wastes move downward, rather than moving upward to salinise the soil surface. With time, the leaching of salts in the surface layers will reduce potential impacts of clay waste salinity on vegetation growth. Several of the clay wastes are clearly saline, with salinity levels high enough to impact on plant vigour and sustainability. Simulations clearly show downward movement of salts and resultant modification of salinity profiles, confirming that the cover layer will not salinise over time, and should remain sustainable with respect to supporting plant growth.

The rate of net downward movement of water is much higher than would be found, for example, under a vigorous woodland on a cracking clay soil in southern Queensland with high rates of transpiration and high water storage capacity in the soil. However, the rate is slow enough that wetting up of the OWD to 'field capacity' or 'drained upper limit' is likely to take hundreds of years. With changes in soil salinity profiles, it is possible that plant roots will be able to exploit more of the 'soil profile' and water use by vegetation may actually reduce the rate of deep drainage in the longer term.

OWD Revised Design

An initial concept design was prepared, using the concave profiles derived from the landform assessment. The initial design was to re-profile the existing OWD to achieve erosion stability and was therefore constrained to some extent in having to conform with the current OWD height and location. The design used a 20 m high concave lower profile and a 15 m high concave upper profile, with a 15 m berm in between, as recommended by Landloch.

A southern extension design was prepared, to meet additional capacity requirements of the proposed pit extensions. The height and location of the extension were guided by:

- Preferred area: from the southern extension concept design, which extended the dump to the south in the preferred area but used the slope design profile shown in Figure 2 of Mining One (2016e) and preferably to lie outside the mineral exclusion zone; and

- Preferred height: corresponding with the current OWD design first lift of 89 m RL.

The planned southern extension utilised the 20 m high concave profile recommended by Landloch as a single lift up to 89 m RL. The OWD extension toe intersects topography that ranges in elevation from 70.4 to 73.0 m RL, resulting in faces ranging from 16.0 to 18.6 m high. The upper part of the 20 m high profile was used and was truncated as necessary at the lowermost part where the profile intersected the topography.

The initial OWD design and the southern extension were integrated into an OWD final design with the following attributes:

- OWD final design total capacity: 14.1 million bcm;

- OWD final design total footprint area: 938,936 m^2; and

- OWD final design total surface area: 944,168 m^2

The OWD final design is depicted in design drawings accompanying the Mining One (2016e) report (see Appendix B8). The revised OWD final design prior to topsoil placement is presented in plan view Figure 3-35 and cross-sections Figure 3-36 and Figure 3-37. The OWD final design for closure is presented in Section 7 (Figure 7-15 to Figure 7-17 inclusive).

Geotechnical Assessment

The OWD final design was assessed for geotechnical stability by Mining One. It is noted that the overall slope angle is much less than the original OWD design and was expected to be geotechnically more stable. This was verified with the worst-case scenario: a combination of elevated transient pore pressures within the dump due to rainfall and the design earthquake, resulting in a factor of safety that greatly exceeds the acceptance criteria.

Because the height and location of the revised OWD design was constrained by the 'as-built' OWD and the concave profiles extend well beyond the current 'as-built' OWD toe, the revised OWD design encroaches partly within the defined mineral exclusion zone. A solution was assessed which would involve constructing the OWD, then mining the pit through the OWD where it would form a face of compacted waste only 1-2 m high, which is geotechnically insignificant. The abandonment bund would then be positioned on the lower flanks of the OWD.

A geotechnical stability assessment was carried out to determine the abandonment bund stand-off distance, given that the OWD places a load on the surface that changes the geotechnical stability of the pit and bund. A stand-off distance of 120 m was determined, which accounts for the long term (worst case) flooded pit conditions.

Future OWD Extensions

Based on the recommendations of Mining One (2016e), future extensions of the OWD may be designed and constructed by BGC using the following parameters:

1. Same or similar material types, comprising the overburden cover sequence of Namba and Eyre materials that is being mined in the Portia open pit, and is known to extend to the south and north;

2. OWD final profile to be formed of the concave or linear profiles recommended by Landloch and described in this report;

3. Minimising risk of tunnel erosion by preventing concentration of ponding and minimising flow concentration;

4. Surface ripping to a maximum depth of 100 mm;

5. Same or similar cover system design that would target the establishment of vegetation cover with 10% canopy and up to 30% surface (litter and basal area);

6. If a second lift is required:

   a) Maximum elevation of 104 RL, and nominal maximum height of 34 m but allowing for local topographic variations, up to 36 m at the northern end;

   b) Maximum single lift height of 20 m;

   c) Minimum berm width between lifts of 15 m;

   d) Lateral bunding on berms, as depicted in the design drawings accompanying this report; and

   e) Although not mandatory, a practical configuration is a lower lift up to 89 RL using the 20 m concave profile, a 15 m berm with bund, and an upper lift up to 104 RL using the 15 m profile, as depicted in the design drawings.

A further independent review may be required if any of the following were to occur:

1. Significant change to the material being stored in the OWD, i.e. originating from a different geological profile;

2. Significant change in the cover system and/or proposed methods of rehabilitation;

3. Significant erosion were to occur, whether it be surface or tunnel erosion; and

4. Any change is required of the maximum overall OWD height, maximum lift height, or profile slope angles as specified above.

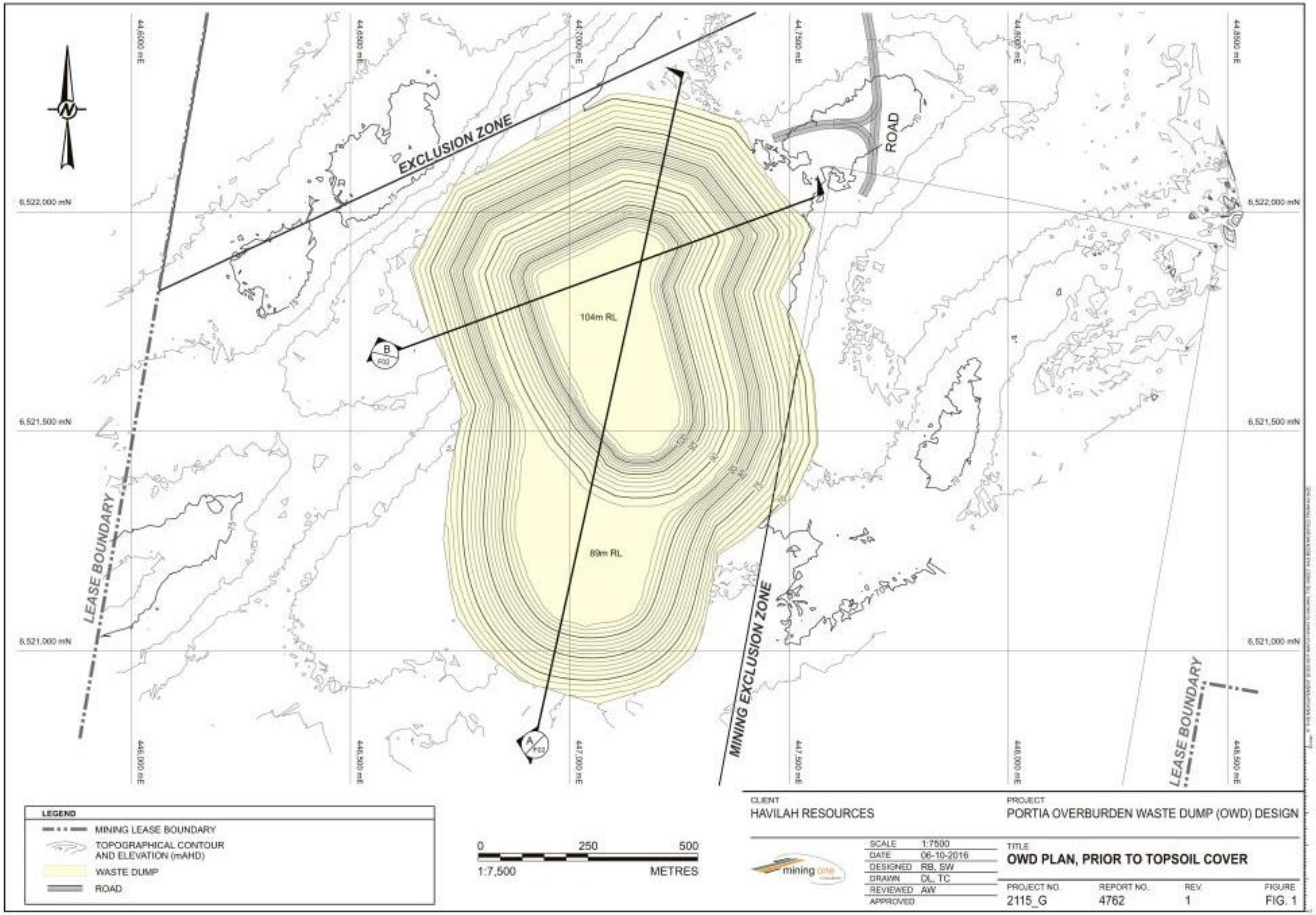


Figure 3-35: OWD Final Design Plan View – Prior to Topsoil Cover

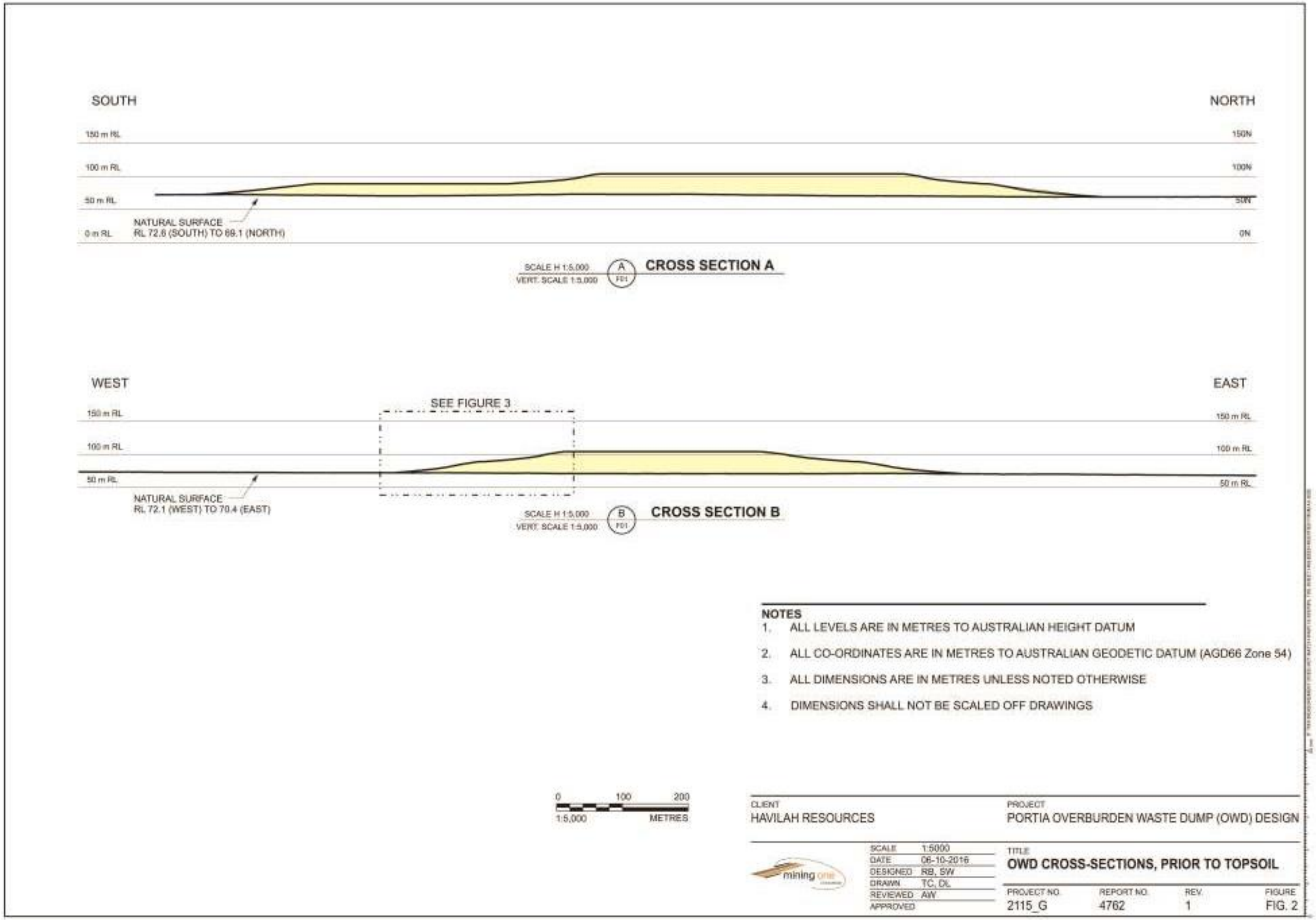


Figure 3-36: OWD Final Design Cross-Sections – Prior to Topsoil Cover

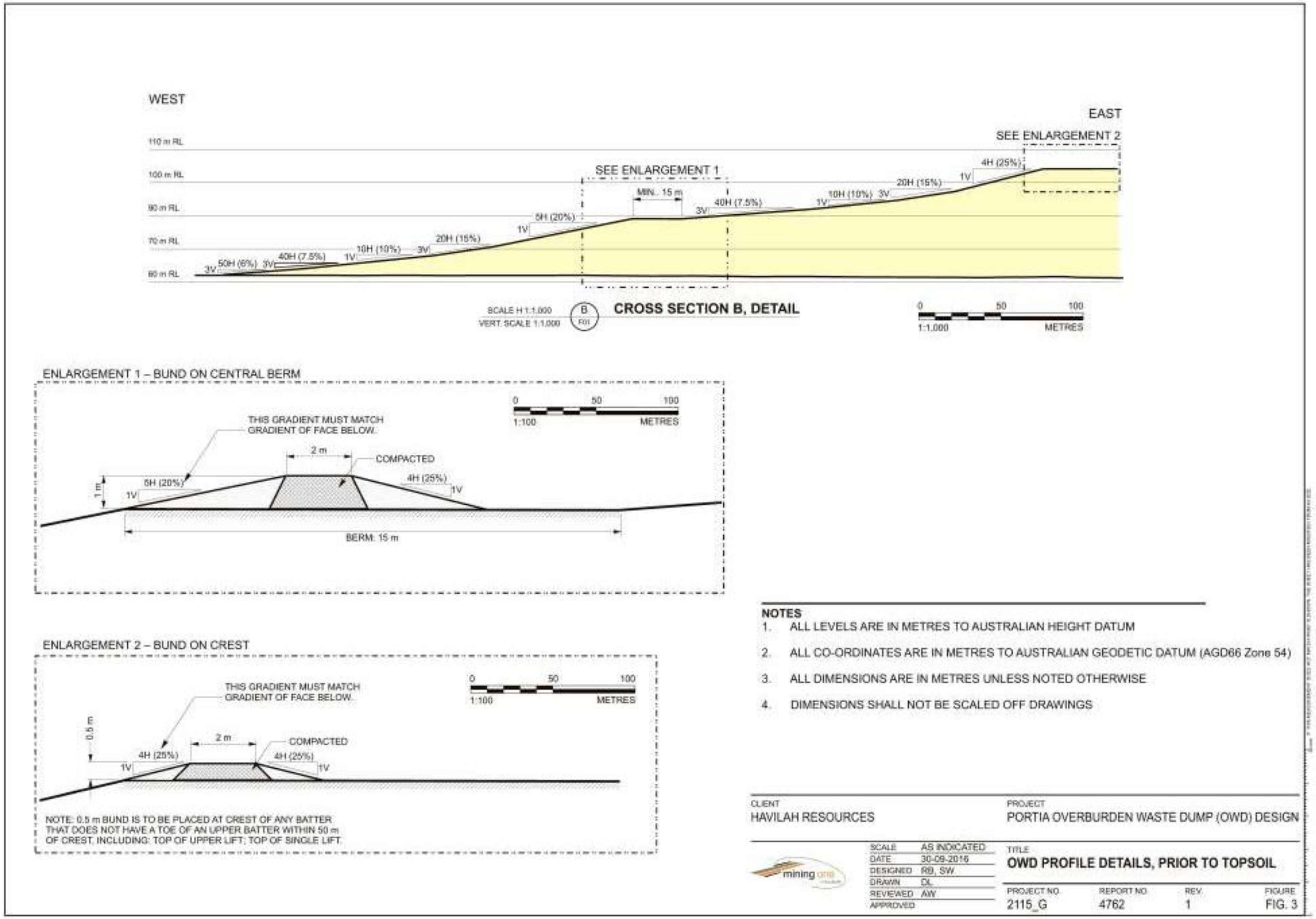


Figure 3-37: OWD Final Design Profile Details – Prior to Topsoil Cover

Ore and Waste Rock Classification (Portia Open Pit)

Where metallic sulfide minerals such as pyrite and pyrrhotite are present either in ore or waste materials, there is the possibility that oxidation may lead to Acid and Metalliferous Drainage (AMD). The generation of acid (H+) occurs typically when sulfide minerals are exposed to both oxygen (from air) and water. Sulfide oxidation produces sulfuric acid and an orange precipitate (typically ferric hydroxide). Acid generation and AMD may result in adverse impacts to the receiving environment and particularly to ecological receptors present at the Site, hence the need to identify and manage potentially acid forming (PAF) materials appropriately during the Project.

Ore and waste rock characterisation of the Portia open pit material was undertaken during preparation of the MLP. Representative samples of the different ore types and the overburden waste material within the Portia Deposit were selected and submitted for analysis to enable appropriate classification of the selected waste and ore rock types by AMD criteria.

AMD studies were undertaken using the following geochemical static tests by the ALS Laboratory Group:

1. **Acid Base Account (ABA):** The ABA evaluates the balance between acid generation processes (via oxidation of sulfide minerals) and acid neutralising processes and it involves determining the maximum potential acidity (derived from % total sulfur) and the inherent acid neutralising capacity (ANC). Two measures of the ABA are calculated, the Net Acid Producing Potential (NAPP) and the ANC/MPA Ratio (MPA is maximum potential acidity). NAPP testing is used as a screening test to qualitatively determine the acid generating potential based upon acid base accounting. Generally, very close to zero or negative NAPP values for samples indicate that the sample may have sufficient ANC to prevent acid generation. Conversely, positive NAPP results indicate the material may be acid generating. The ANC/MPA ratio provides an indication of the relative margin of safety for neutralising acid generation within material and generally ranges between 1.0 and 3.

2. **Net Acid Generation (NAG) Test:** NAG testing estimates acid generation through a direct measure of the amount of acid generated. A pH after reaction (NAG pH) of less than 4.5 indicates that the sample is net acid generating.

Geochemical classification criteria adopted based upon NAPP and NAG test data are shown in Table 3-20 below.

Table 3-20: Acid forming Potential Classification Criteria

Primary Geochemical Material Type	Final NAG pH	Static NAG Value (kg H_2SO_4/t)	NAPP (kg H_2SO_4/t)
Potentially Acid Forming (PAF)	< 4.5	> 5	Positive
Potentially Acid Forming - Low Capacity (PAF-LC)	≤ 4.5	≤ 5	Positive
Non-Acid Forming (NAF)	≥ 4.5	≤ 0.1	< 0.5
Acid Consuming Material (ACM)	≥ 4.5	< 0.1	< -100
Uncertain (UC-NAF)	≥ 4.5	< 0.1	Positive
Uncertain (UC-PAF)	< 4.5	> 0.1	Negative

Taken from *Leading Practice Sustainable Development Program for the Mining Industry – Managing Acid and Metalliferous Drainage (2007)*, but with a modification of PAF-LC ≤ 10 to PAF-LC ≤ 5.

Laboratory results were compared with the classification criteria set out in Table 3-20. The acid forming potential results are shown in Table 3-21. The results indicate that the overburden waste material is likely to be non-acid forming (NAF). One sample (PT_1) from the central portion of the overburden sequence has been classified with an uncertain non-acid forming (UC-NAF) status due to the positive NAPP measurement. Based upon a typical geochemical plot shown in Figure 3-38, this material is likely to be NAF, because of the low NAG measurement and pH value significantly greater than 4.5.

Assay results for the high-grade ore found within the light grey clay Tertiary age sediments of the Eyre Clays indicate this material is likely to be NAF.

Assay results for the graphitic metasediments in the bedrock indicate this material is likely to be NAF.

Assay results for the footwall abietite units in the bedrock indicate that it is likely to be PAF and would require management strategies to minimise potential acidification impacts. However, there are currently no plans to mine any of this material as it sits below the ore zone (base of open pit).

Table 3-21: Summary of Acid Forming Potential Results

Sample ID	Geological Description	Material Classification	NAG (kg H_2SO_4/t)	ANC (kg H_2SO_4/t)	MPA / ANC Ratio	NAPP (kg H_2SO_4/t)	pH	Category
PT_1	Namba Fm	Overburden	<0.1	17.1	0.08	185	10.5	Uncertain (NAF)
PT_2	Namba Fm	Overburden	<0.1	6.9	2	-3.6	6.8	NAF
PT_3	Namba Fm	Overburden	<0.1	3.9	1.1	<0.5	6.5	NAF
PT_4	Namba Fm	Overburden	<0.1	6.1	1.5	-2.1	6.2	NAF
PT_818	Eyre Fm	Ore	<0.1	3.9	1.4	-1.1	5.8	NAF
PT_822	Eyre Fm	Ore	<0.1	1.2	1.0	<0.5	5.7	NAF

PT_843	Graphitic pelite	Ore	<0.1	<0.5	0.03	15.9	6.0	Uncertain (NAF)
PT_863	Graphitic pelite	Ore	<0.1	1.9	1.24	<0.5	6.1	NAF
PT_872	Footwall albitite	Footwall waste	39.9	0.8	0.01	55.8	2.5	PAF
PT_888	Footwall albitite	Footwall waste	113	<0.5	<0	170	2.1	PAF

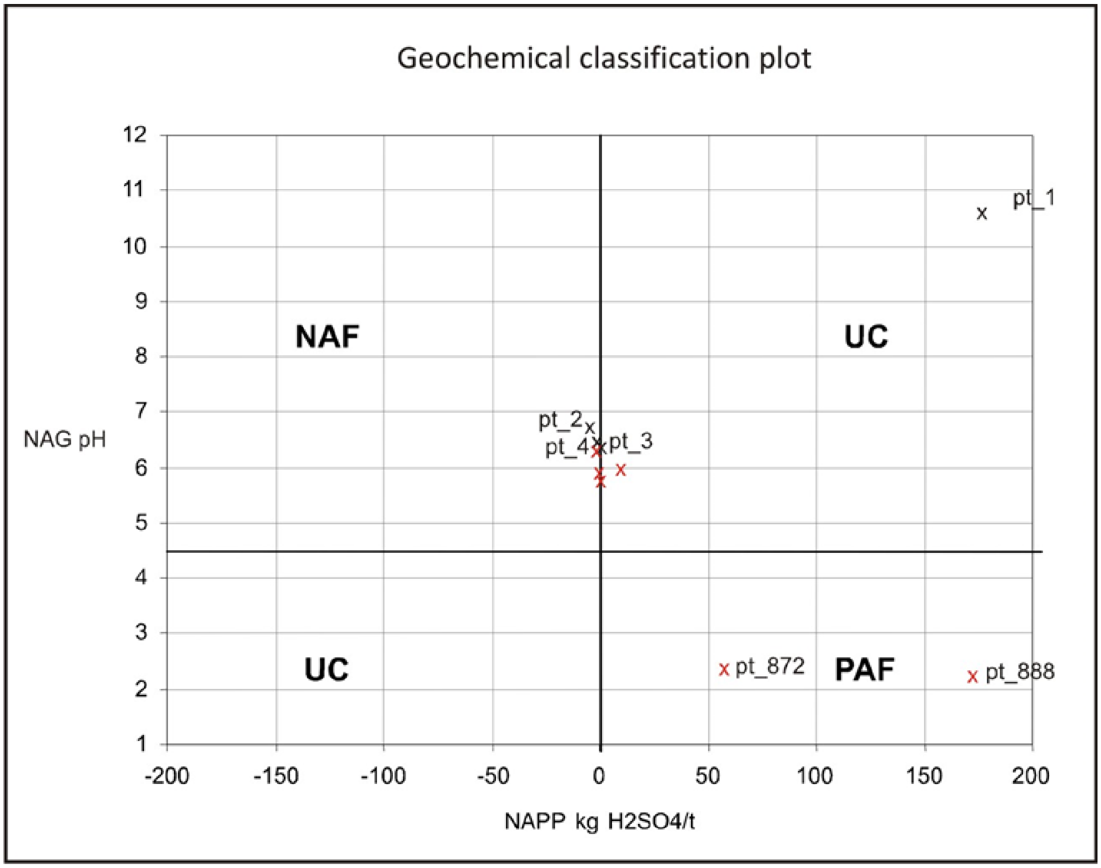


Figure 3-38: Geochemical Classification Plot

Since the approval of the first PEPR for the Portia Mine Site, further onsite test work has been undertaken to confirm the classification of ore and waste rock (as described above) within the Portia open pit. This included the collection of field pH and peroxide pH from samples taken within both the Namba Formation and Eyre Formation.

These two tests are useful indicators for PAF classification for the following reasons:

- **Field pH (pHF):** Will indicate if the material is acidic (or not) in its current state.
- **Peroxide pH (pH_{FOX}):** Will indicate if the material has the potential to be acidic (or not). This is because peroxide is an oxidant which will force any sulfide present within the material to oxidise, and thereby turns the sulfide to sulfate.

During the period June 2015 to September 2016, 80 samples (labelled PTAMD001 to PTAMD080), 77 which were collected with the Namba Formation (34 of which were also sent to ALS Laboratory to confirm the results) and a further 3 within the Eyre Formation (1 of which was also sent to ALS Laboratory). All of these samples confirmed the classification of NAF for both formations and present no AMD risk. Results from the monitoring are summarised in the table provided in Appendix E1. Samples were collected by BGC geologists from the Portia open pit at RLs varying between approximately -6 and 66 m AHD.

At least one sample per month was tested at ALS Laboratory as a check of the BGC field testing results. Analytical results from ALS Laboratory show that there has been a favourable comparison with the BGC test results, as evidenced by the low relative percentage difference (RPD) values.

The results of this test work have been provided to DEM.

Procedures for the management of PAF materials (if identified) are outlined in the approved procedure *PAF Materials Management Procedure* (Reference No. POR-PRO-ENV-002). A risk-based approach has been applied to the development of this procedure and the current level of detail is considered to be commensurate with the current low level of risk posed.

Given that PAF materials are not expected to be encountered under the current mine plan (i.e. the expected volume of PAF material is zero), a detailed encapsulation design is not considered warranted at this point in time. Should the mine plan change such that PAF materials are expected to be encountered (i.e. pit floor deeper than planned -20 m RL), then a review of the *PAF Materials Management Procedure* shall be undertaken immediately, in consultation with the DEM.

3.6.2 Tailings Storage Facilities

Overview

Waste previously generated from the gravity separation plant was discharged into two TSF cells, TSF-1 (previously called TSF East) and TSF-2 (previously called TSF West). These two TSF cells are approximately 10 ha each in size, with embankments 3.3 m high and are located to the north of the processing plant as shown in Figure 3-40. The locations of the two cells were selected based on the Site topography and with the objectives of having a large enough footprint to allow the tailings to dry and consolidate to a defined closure timeframe and to reduce the volume of material required to construct the perimeter embankments.

Construction of the TSF-1 and TSF-2 cells were completed in October 2015 and tailings deposition commenced on 20 April 2016. The original design was reviewed by Golder (Appendix D2) in April 2016 based on processing plant modifications, ‘as-built’ TSF basin modifications and a lower expected tailings slurry density. The results of this work are detailed in a report provided in Appendix D2. The two cells (TSF-1 and TSF-2) have an approximate footprint of 300 m x 300 m and height of ~2.0 m on TSF-1 and ~2.5m on TSF.

In 2016 Golder were engaged by BGC to undertake further design changes to the TSF cells to accommodation additional tailings generated from the processing plant. Golder were engaged in 2016 to undertake design of raises to the TSF to accommodate up to approximately 1 Mt (~800,000 m3) of tailings as well as noting variations from the original design implemented during construction. The updated design report is included as Appendix D4. Approval for an additional raise design of approximately 1 m on TSF-1and 2.1 m on TSF-2 will be required to accommodate the expected additional 200,000 tonnes of tailings above the 1 Mt design of Golder (2016b).

In 2019, Golders were further engaged to undertake design changes for the expansion of the TSF to reprocess approximately 620,000 t of tailings currently stored with the TSF-1 and 2 and to store new tailings from processing of ore from expansions to the current Portia open pit, which is anticipated to generate up to 200,000 t of gold ore (Appendix D5). TSF-1TSF-2TSF-3TSF-4 Planned Process Plant and tailings system changes for this expansion include:

- Raise TSF-2 to its current approved final height of RL74.3;
- Construction of a new third 10 ha gravity tailings cells TSF-3 with new pipeline;
- Construction of a small clay and HDPE lined cell TSF-4 to hold the detoxed cyanide residual and separate small pipeline;
- Recovery and retreatment of the tailings from TSF-2 through the current and modified circuit into TSF-3 and TSF-4. The proposed method is to create cells within the TSF and recover tailings, allowing deposition into the emptied cell. The method is shown in Figure 3-42;
- Retreatment of the tailings from TSF-1 through the modified circuit discharging into TSF-2 and 3;
- Additional decant return line from the cells to the plant;
- Modifications to the circuit include:
  - Adding an additional cyclone bank to treat gravity concentrates;
  - Additional Wilfley tables to clean up and produce more gravity concentrates
  - Addition of a small cyanide leach reactor for leaching concentrates from the gravity circuit. This will include additional gold recovery equipment such as elution columns and electrowinning cells;
  - Associated tanks and pumps;
  - Reagent tanks and pumps;
  - A detoxification plant to neutralise the reactor residual cyanide

TSF-3 will be constructed sourcing quaternary materials from the floor of TSF3 (~1m deep) and overburden material from the pit expansion. The initial embankment elevation of TSF – 3 will be 76.0m with a final elevation design of RL 77.5.

The final raise of the embankment to RL 72.8m will bring the capacity of TSF-1 to ~550,000 tonnes. TSF – 2 will be raised to the current approved height of RL 74.3 in July 2019 for a final storage capacity of ~550,000 tonnes. The final embankment level of TSF – 3 to an elevation of RL 77.5m will give the capacity of TSF-3 to up to ~350,000 to 400,000 tonnes. TSF-4 will have a total capacity of 7,700 tonnes. Total tonnes capacity of the combined four cells is ~1,659,600 tonnes. A summary of proposed estimated stored quantities is shown in

Table 3-22.

Table 3-22: Final Tailings Storage Capacity

Stage	Duration (months)	Total (months)	TSF 1	TSF 2	TSF 3	TSF 4	Cumulative TSF 1 to 3	Notes
Current conditions	0	0	420,000	200,000	0	0	620,000	TSF-1 is full
Stage 1	3.3	3.3	420,000	40,000	200,000	420	660,000	Raise TSF-2 to RL 74.3 m. Construct TSF-3. Mine TSF-2 in sectors until empty (to ROM); 40,000 tonnes new ore processed,
Stage 2	7.2	10.5	0	380,000	380,000	1,336	760,000	Mine out TSF-1 and complete 1 m raise; additional 100,000 tonnes of new ore into TSF-2 and TSF-3
Stage 3	1	11.5	20,000	400,000	400,000	1,463	820,000	Process additional 60,000 tonnes new ore to all cells
Proposed final RL (m)	-	-	72.8	74.8	77.5	72	-	-
Designed Capacity at final RL	-	-	553,200	553,200	553,200	7,700	1,659,600	-

Estimated tailings tonnage resulting from the reprocessing of tailings, fresh ore from the cutback and ruminant mining and stockpiled ore is ~910,000 (Table 3-23). It is anticipated that the additional storage capacity will be utilised in future mining operations with the commencement of Phase II – North Portia.

Table 3-23: Ore Reserve/ Resource Tonnage

Resource	Tonnage
Reprocessing of Tails TSF – 1	~440,000
Reprocessing of Tails TSF – 1	~180,000
Portia Pit Cutback and ruminant mining	100,000
Stockpile ore (ROM)	40,000
Eyre Formation ore (ROM)	100,000
Total Resource	910,000

Construction

Floor consolidation of TSF-1 and TSF-2 will be undertaken once tails have been removed and prior to the deposition of re-processed tailings. The trial removal and reprocessing of 20,000 tonnes of tails from TSF – 2 was approved in 2018 and completed in June 2019. Compaction testing was undertaken in TSF-2 where ~20,000 tonnes of tailings had been removed by CivilTest in July 2019. Compaction results confirmed the successful re-compaction of the cell floor and had achieved compaction ratios of between 98 – 110.5% (Appendix D6). Compaction procedures will also be applied in the construction of TSF – 3.

Figure 3-39: Compaction of the Trial Section of TSF-2 after Removal of Tailings Material

As with TSF -1 and 2, TSF -3 will be constructed to a 300m x 300m (9ha) footprint. Embankment raises will be constructed in a manner consistent with previous raise in TSF-1 and TSF- 2 with an external slope of 3H:1V and an internal slope of 2H:V using clayey soils as described in the 2019 *Golder's Tailings Storage Facility Expansion Update* (Appendix D5). TSF-3 will be situated to the south of TSF-2 as shown in Figure 3-41.

TSF-4 will be constructed to within a small 50 m × 50 m footprint at the internal toe. The embankment slopes will be constructed to 3H:1V for both upstream and downstream. The cell will have a low permeability clay liner overlain by a HDPE geomembrane liner to reduce the risk of seepage. TSF-4 will be situated the east of TSF-3 as shown in Figure 3-41.

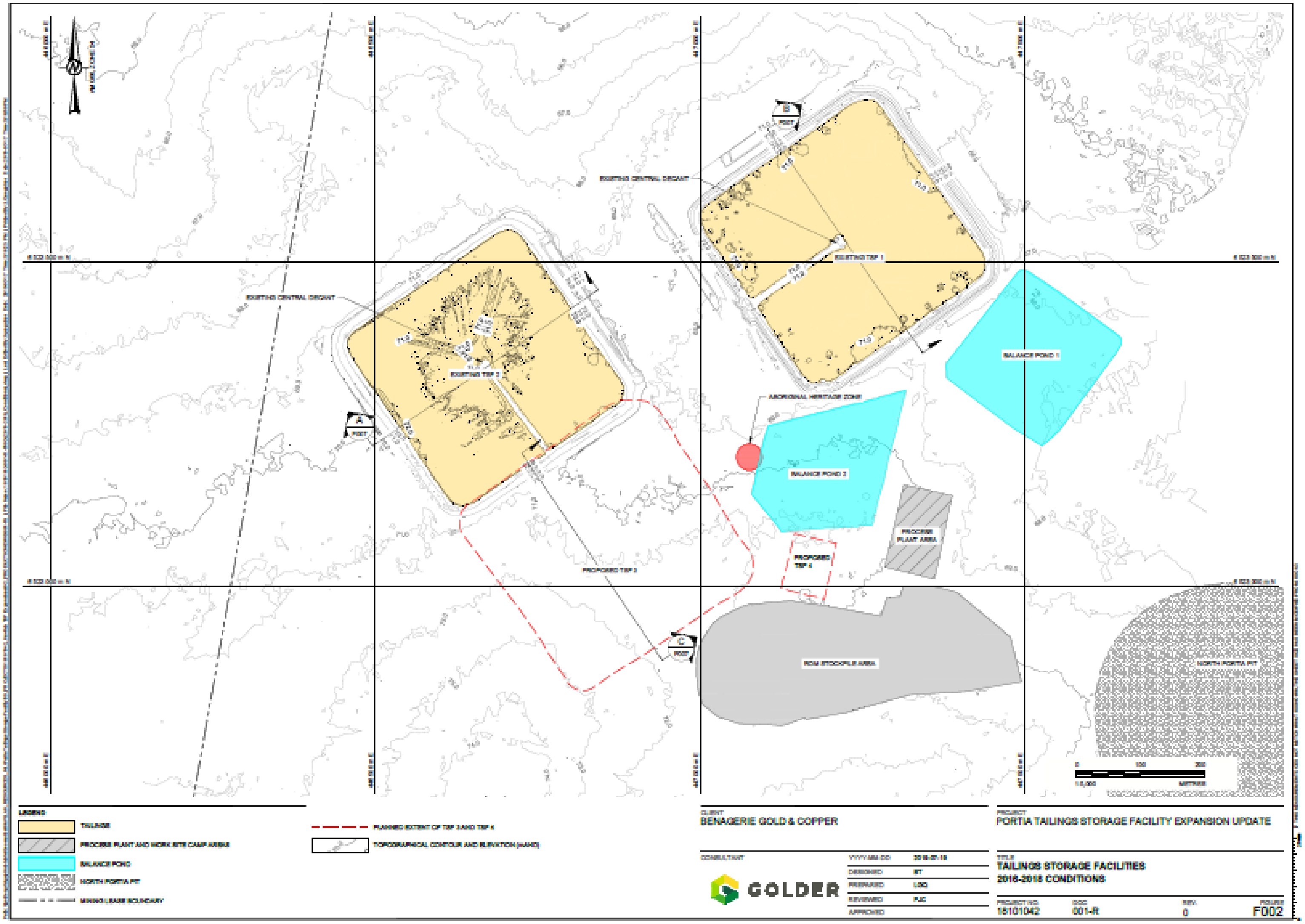


Figure 3-40: TSF-2016-2018 Conditions

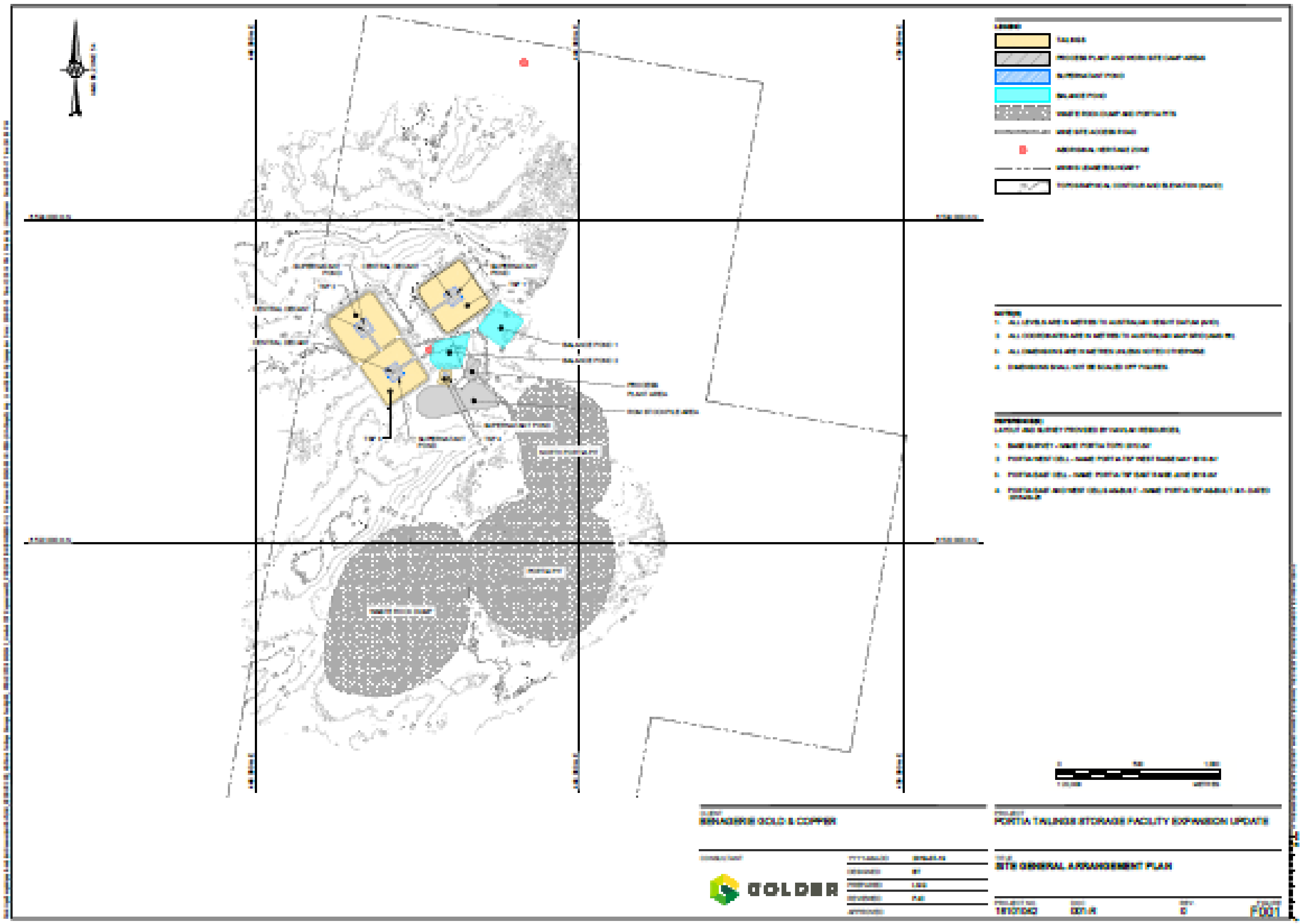


Figure 3-41: TSF General Arrangement Plan

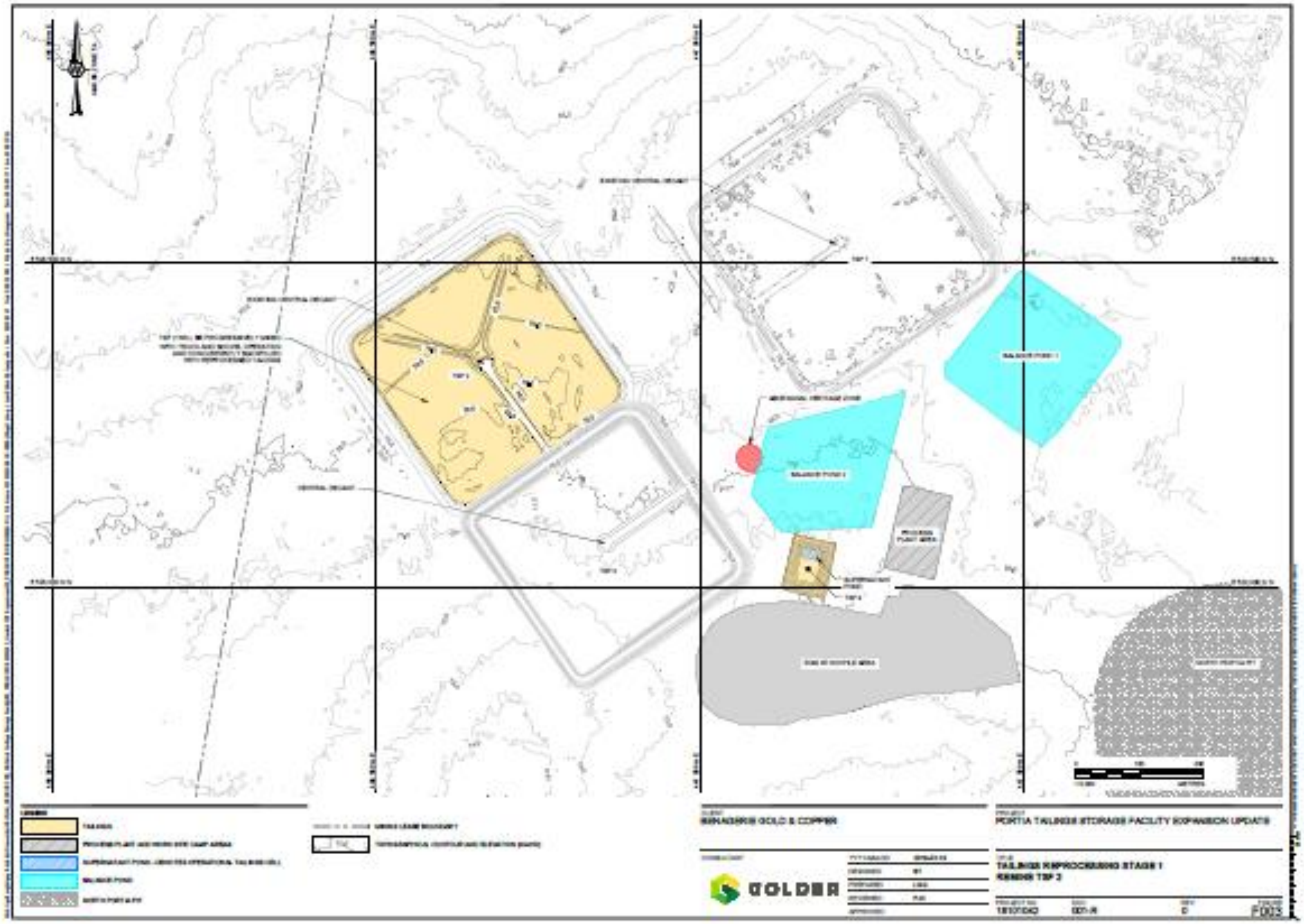


Figure 3-42: TSF-2 Reprocessing Stage 1.

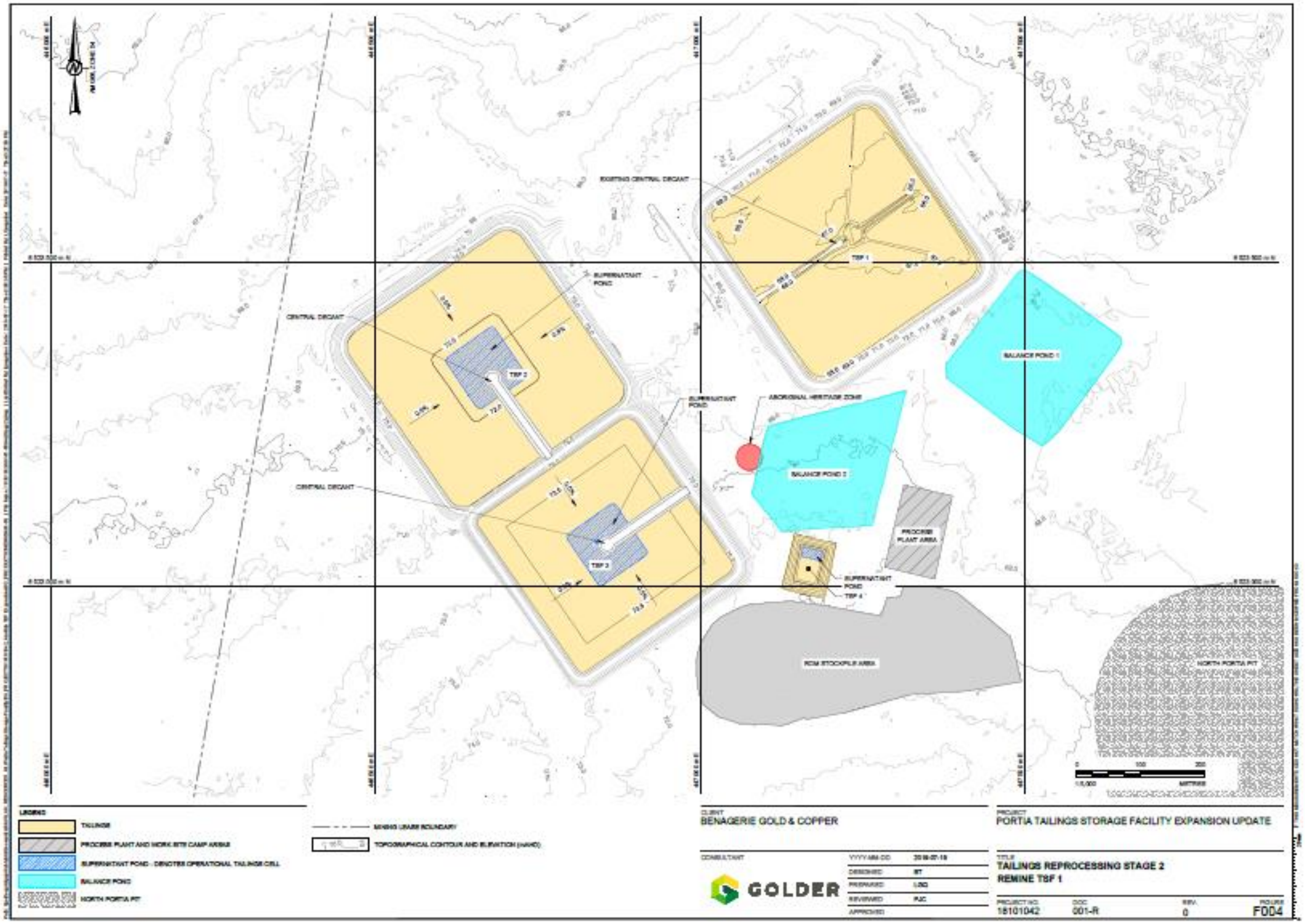


Figure 3-43: TSF-1 Reprocessing Stage 2.

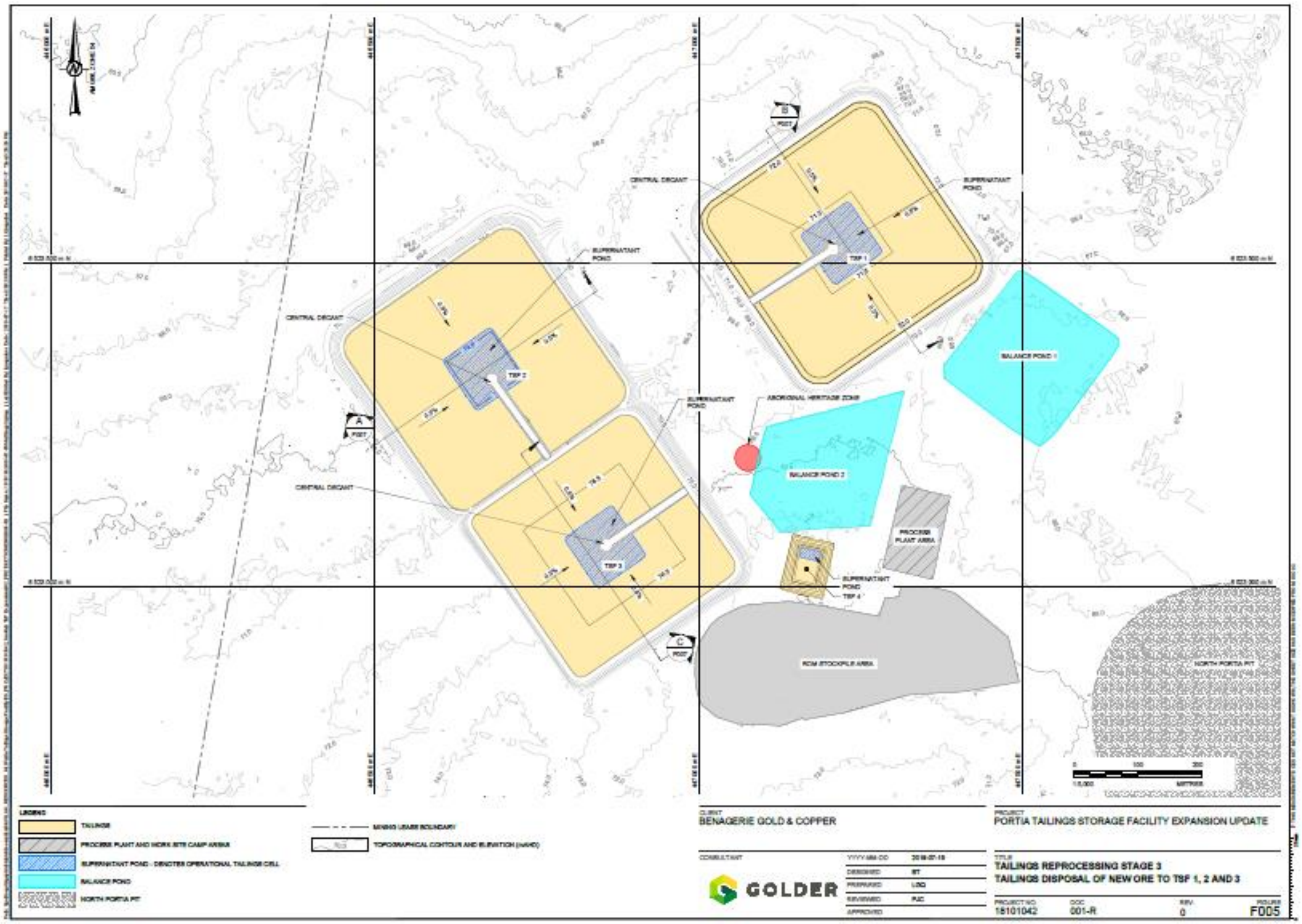


Figure 3-44: Tailings Storage Facility Stage 3 -Tailings Deposition.

Geochemistry and Geotechnical

Completed geotechnical investigations were conducted in 2013, 2017, 2018 and 2019 by Golder's (*Portia Gold Mine Geotechnical Investigation for the Tailing Storage Facility Expansion*, (Appendix D – Tailings Storage Facility Studies) and used to develop a geological model of the area where the TSFs are situated. Investigations have been aimed to identify seepage causes and the permeable sand layer which occurs on site. A summary of the subsurface profile based on geotechnical investigations is presented in Table 3-24.

Table 3-24: Summary of subsurface profile based on geotechnical investigations.

Depth Interval Range		Material Description
From (m)	To (m)	
0.00	0.05	TOPSOIL: Silty Clayey SAND, fine to medium grained, orange brown / red brown, low plasticity clay
0.05	2.00	Clayey Calcareous SAND, fine to medium grained, orange brown / red brown, low to medium plasticity clay, trace fine to coarse grained sub-rounded to sub - angular calcrete gravel **or** Calcareous SAND, fine to medium grained, orange brown / red brown, with low plasticity clay, trace fine to coarse grained sub-rounded to sub -angular calcrete gravel
0.8	2.10	Clayey Calcareous SAND, fine to medium grained, orange brown / red brown, low to medium plasticity clay, trace fine to coarse grained sub-rounded to sub - angular calcrete gravel
0.8	4.00	Mixture of SOIL and NODULAR GYPSUM Approx. 80- 50% Soil; Calcareous CLAY, medium to high plasticity, mottled grey and brown, with fine to coarse grained sub-rounded to sub-angular calcrete gravel, trace fine to coarse grained sand Approx. 20-50% Nodular GYPSUM; fine to coarse grained angular to sub-angular gravel sized material

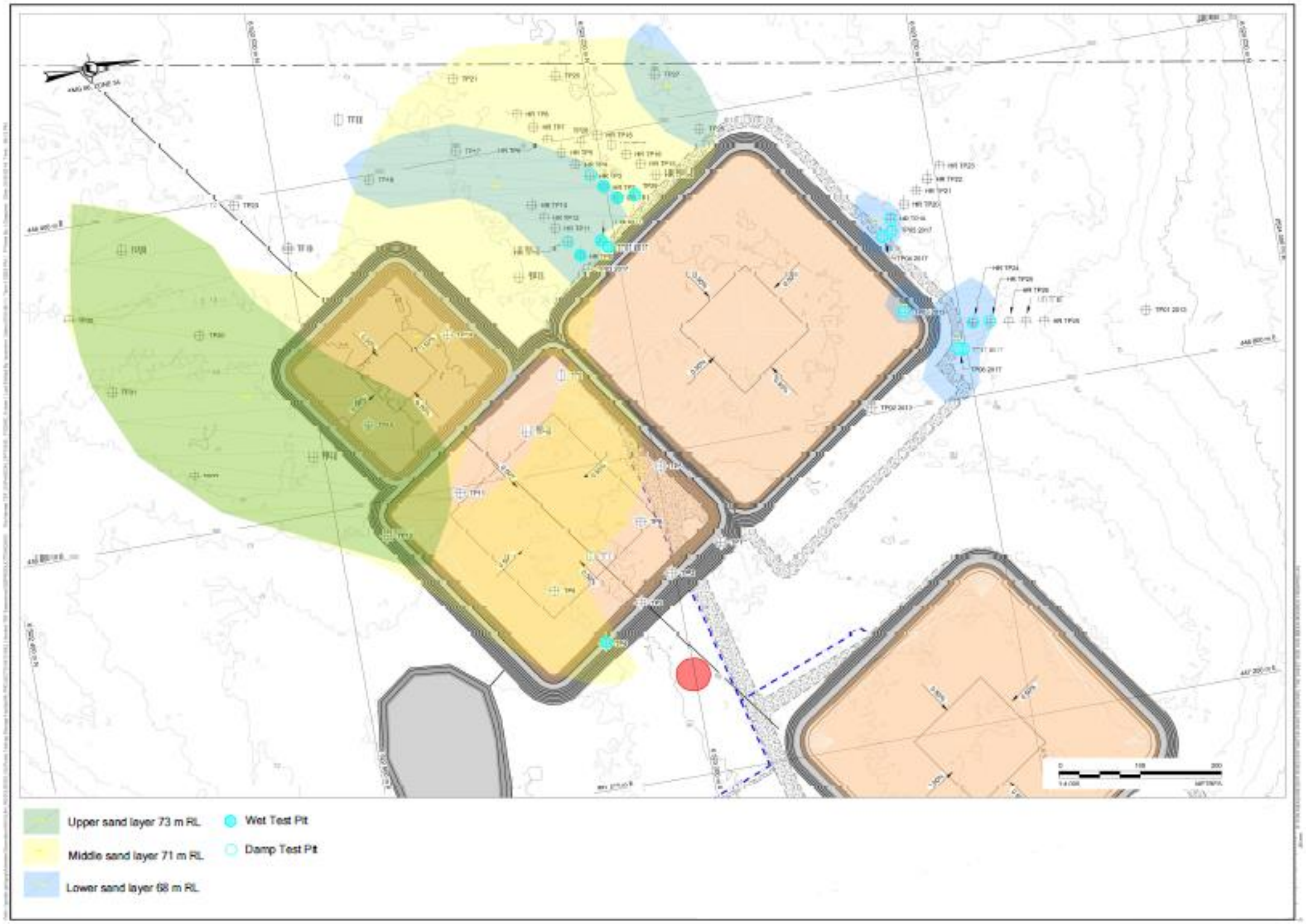


Figure 3-45: Geotechnical assessment plan

Note: Plan is for geotechnical assessment only. The layout design of TSF-3 and 4 is not current. The updated design is reflected in the set of figures located in the Golder's report (Appendix D5).

Method and Rate of Disposal

Waste material generated from the gravity separation wet plant will be transported and discharged into the TSF cells from the plant approximately 500m to the northwest, via a pipeline, at approximately 30-40% w/w solids concentration.

The tailings delivery line for the gravity tailings comprises a 250NB PN8 HDPE white pipeline from the pumps. A new valve station will be built close to the Plant and split flow between the new TSF-3 cell or to TSF1 and 2. Close to TSF-1, the delivery line is split to direct slurry to either TSF-1 and TSF-2 to form the eastern cell (TSF-1) and western TSF-2 tailings distribution lines. The cell ring main distribution lines on all three cells comprises 225 mm OD HDPE white pipeline and has reducing tee pieces (90 mm) and up to 8 spigots per sector located at 25 m centres to allow tailings discharge from the line. Lay-flat hose run out and down the embankment batter slope and allow the tailings to be discharged at the toe and not erode the embankment.

An independent DN110 HDPE line will distribute slurry along a lined trace to the new TSF-4 cell. The system will be batch operated once every one to two days.

Deposition of tailings occurring between each operational cell (TSF1-3) will occur in thin layers within the cells to allow time for drying and consolidation. This will allow for a trafficable tailings beach with a few months of cessation of deposition. Tailings deposition will be managed to control the pond at the central decant in each cell. Keeping water away from the embankments will limit seepage and lower the risk of geotechnical instability. The embankments are low height and have flat downstream slopes to have a low risk of geotechnical instability. The embankment design incorporates an engineered upstream zone to form a low permeability barrier to manage the risk of lateral seepage. Tailings will be deposited in each cell to maintain an operational freeboard of 0.3 m. Maintaining this freeboard will reduce the risk of overtopping in the case of a storm event and obviate the need for a spillway.

Tailings deposition on TSF-1- 3 will be rotated around the perimeter of each cell, in accordance with the *Portia TSF Operations and Surveillance Manual*, 2019, (Appendix F5). This will control the pond location around the central decant. Tailings deposition will also be rotated regularly to place the tailings in thin layers and allow time for drying and consolidation.

Tailings will be discharged from spigots placed around the perimeter embankment, spaced approximately 32 m apart. Indicative spigot locations are shown in Figure 3-46. The exact number and location of the spigots will need to be further refined during the course of operations, as required to maintain the position of the decant pond around the central decant and maximise the storage capacity of the TSF. The spigot discharge will incorporate a sacrificial slotted dropper pipe to limit embankment erosion.

Deposition of tailings occurs in zoned sections, equal to approximately one half of each side embankment of the cell. At the maximum deposition rate, tailings deposition would occur in a zone for approximately two days before moving to the next zone. Deposition is planned to continue around one cell until one full rotation has been completed after approximately 16 days. At this time, deposition will be diverted to the other cell to allow the tailings in the initial cell to dry and consolidate.

The cyanide leach circuit will batch operated to produce a small flow of nominally 4 t/d at 20% Cw (20 m3/d) slurry or approximately less than 0.02 % of the total production throughput of 3,300 t/d that will have the cyanide neutralised (detoxed) and sent to the lined TSF-4 cell.

The batch operated TSF-4 cell will have 4 spigots and will use only one at a time. The flow will be moved to a new spigot each day and then return to the start after 4 days.

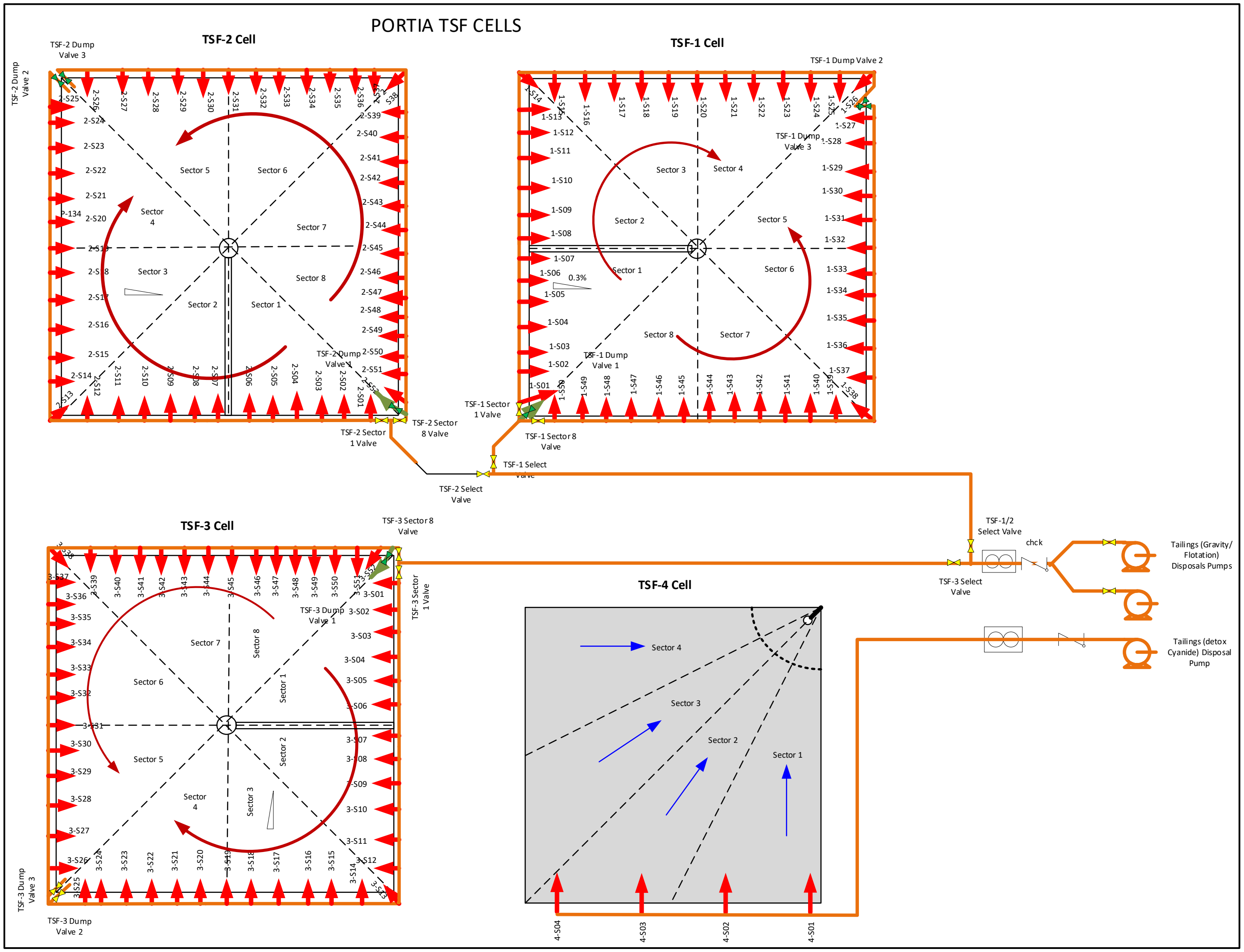


Figure 3-46: P&ID schematic of the existing and proposed tailings storage cells showing valving

Table 3-25: Tailings dry tonnes deposited

Year FY July to June	Dry tonnes deposited TSF-1 (t)	Dry tonnes deposited TSF-2 (t)	Dry tonnes total (t)	Cw%	Water recovered (m^3)
FY16	9145	5586	14731	17%	52,748
FY17	151,162	129,400	280,562	18.2%	757,438
FY18	255,171	65,883	321,054	16.5%	1,233,955
FY19[5]	75,501	0	75,501	8%	192,158[6]
FY20 June/July	20,000[7]		20,000	15%	105,000
TOTAL	510,979	200,869	711,848		2,236,299
Reconciliation	**420,000**	**200,869**	**620,869**		

The indicated tonnage to date is ~200,000 tonnes in the TSF-2 cell and ~ 510,000 tonnes by end of July in the TSF-1 cell. (Note: ~20,000 tonnes have been removed from TSF-2 under the approved trial reprocessing activity reducing the current TSF-2 tonnage to ~180,000). Using dry SG of 1.1 in the TSF-2 cell reconciles well. However, the current capacity of the TSF-1 cell is ~ 365,000 m3. Using the value of 510,000 tonnes calculates to a dry SG of 1.38. This is not realistic and using lab data and reconciling for oversize and recirculating loads on the belt weigher suggest that there is up to a 20% error in reported flows to the TSF. TSF-1 will have better consolidation with up to a thickness of 4m of tails so 1.15 SG has been adopted giving an estimated total tonnage in TSF-1 of 420,000 tonnes and TSF-2 of 200,000 tonnes. This number and the dry SG will be reconciled again when cell is emptied.

[5] As of end of May 2019.
[6] Records incomplete.
[7] Estimated until TSF-1 at capacity.

Table 3-26: Deposition records per sector (to end July 2019)

TSF-1 cell	**Sector**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Year Total**
FY16					2,424	3,552	2,036	1,133	9,145
FY17	21,078	16,702	16,674	15,601	21,837	25,919	22,857	12,464	153,132
FY18	43,617	38,560	23,972	32,764	29,590	33,269	31,051	22,189	255,011
FY19	9,643	9,800	9,077	9,676	13,435	9,577	6,523	7,771	75,502
Total	**74,338**	**65,062**	**49,722**	**58,041**	**67,286**	**72,317**	**62,467**	**43,557**	**492,791**
Adjustment	-10,980	-9,610	-7,344	-8,573	-9,939	-10,682	-9,227	-6,434	-72,790
Revised Total	**63,357**	**55,451**	**42,377**	**49,468**	**57,348**	**61,635**	**53,240**	**37,123**	**420,000**
TSF-2 cell	**Sector**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Year Total**
FY16			415		1,419	2,724	1,028	436	6,022
FY17	14,609	19,781	17,073	20,630	14,028	18,044	10,319	14,480	128,964
FY18	2,885	3,103	6,134	11,322	11,303	13,886	9,120	8,130	65,883
FY19	0	0	0	0	0	0	0	0	-
Total	**17,494**	**22,884**	**23,622**	**31,952**	**26,751**	**34,653**	**20,467**	**23,046**	**200,869**

TSF1 will reach capacity in August 2019 and the deposition of tailings will recommence into the retreated sectors of TSF-2 once it has been remined and recompacted to 98% standard maximum dry density. Once the construction of TSF3 has been completed, tailings will commence to normal cyclic operation between TSF2 and TSF3. TSF1 will be wet mined, and recompacted once empty for future tails deposition.

It is expected that tailings from the gravity circuit will achieve higher density than the current tailings stream. The main feed to the circuit coming from the retreated tailings is expected to be repulped at approximately 40% w/w, while the ore feed will be subject to lower densities to achieve liberation of the gold. The small detoxed cyanide residue flow would be at ~ 20% w/w. and deposited into TSF4. It is expected that the expected final solids concentration of the gravity tailings will be approximately 35% w/w.

The TSF designs are based around achieving a design density of 35% w/w. It is noted that historically densities have not achieved this target however, changes to the circuit will result in greater densities than previously achieved.

The modified plant will be fed with tailings/ finely crushed ore mix at a ratio of 80%/20%. A conservative solids concentration w/w of Cw of 40% has been used based on trials undertaken to date.

BGC has modified the plant as follows:

• Finely crushed ore combined with tailings as the feed stream

• Reduction of spray bar water volume on trommel

• Banks of riffles used defined by feed rate. Lower feed will drop riffle banks off that reduces water consumption.

• Cyclones will now gravity feed to Knelsons so no addition dilution water to the feed bin

• Flushing water to Knelsons is 30 m3/h each (a reduction)

• Tabling gold will only be used for coarse riffle gold treatment (5%) and water used is recirculating to the ILS to minimise makeup water

Scenario 1 – High grade Ore only

During high grade ore campaigns, the throughput will be reduced to 50t/h and Cw% will be reduced due to limits of the pumps to 35%. Only one Knelson is necessary under this scenario.

Table 27: Tailings Density Scenario 1 at 50 t/h and Cw 35% & 1 x Knelsons

Tailings final Cw%	%	29%
Decant Return	m3/day	1,852
Decant Return	34%	63-70%

Returns are less as more water is evaporated on the beach.

Scenario 2 – Tailings and low-med grade – 2 x Knelsons

During normal treatment, the throughput will be ~ 140 t/h and Cw% of 40% will be achieved easily. Both Knelsons will be used or 60m3/h of fluidising water to the circuit. The retreated tailings do not require the sme amount of dilution water to break the clays down as the material is in a loosely consolidated state from the previous treatment.

Table 28: Tailings Density Scenario 2 at 140 t/h and Cw 40% & 2 x Knelsons

Tailings final Cw%	%	34%
Decant Return	m3/day	4,229
Decant Return	%	65-72%

The Decant return value is total off the beach. Downstream flows will be directed to the to the evaporators on the tails beach as well as the plant and balance ponds.

Note that in both cases, the return is based on one TSF in operation. The reality is that evaporation continues on all three TSF's reducing the overall water inventory. The third cell will increase available evaporative area allowing flexibility in managing water inventory.

The modelling undertaken by Golders in their design report used the value of 35% Cw. This equates to the normal treatment throughput rates noted above.

As an additional contingency measure, should targeted densities of 35% w/w not be achieved, a tails thickener will be installed at the plant.

TSF cells have been designed to contain the 1:100 year annual exceedance probability (AEP) 72-hour storm event at all times and a spillway is not included. A 300mm dry freeboard will be retained at all times. The 'Very Low' ANCOLD (2012) consequence category remains unchanged from the original design (Golder, 2013).

The existing process circuit is a gravity separation circuit. Due to the fine particle size of the saprolite ore, the process upgrade includes the installation of a small cyanide leaching circuit to improve the recovery of the gold from gravity concentrates. The cyanide leach residual will be treated through a detoxification circuit and pumped to the new TSF-4 cell. This small cell is designed to store the detoxified cyanide residual and evaporate most of the liquor used to transport the slurry. As noted, the expected treatment rate of concentrates is nominally 2-4 tonne or 2m3 day with 20m3 solution per day) and therefore presents minimal change to impacts on receptors. Cyanide levels will be less than 50ppm WAD.

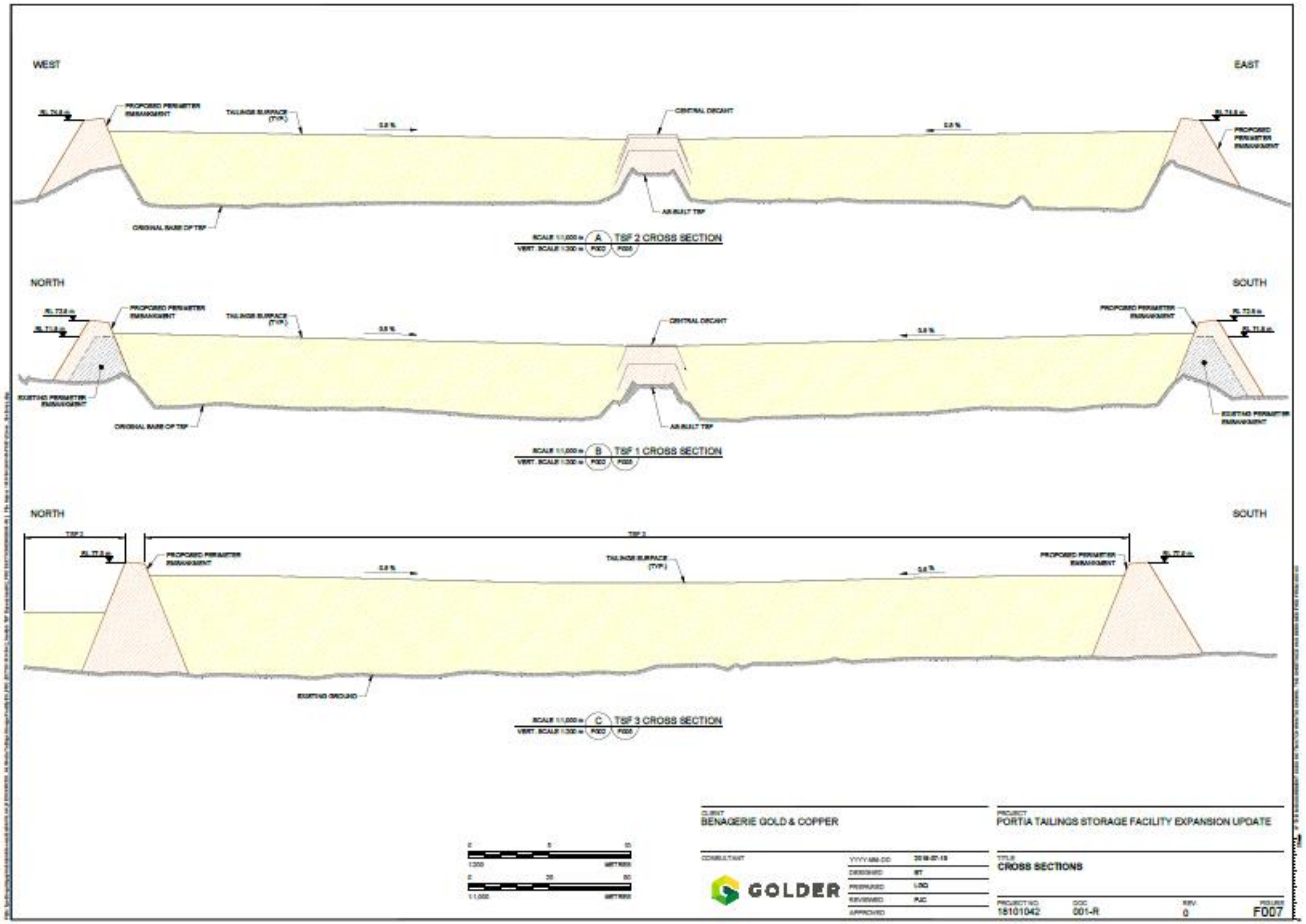


Figure 3-47: TSF-3 Cross section design

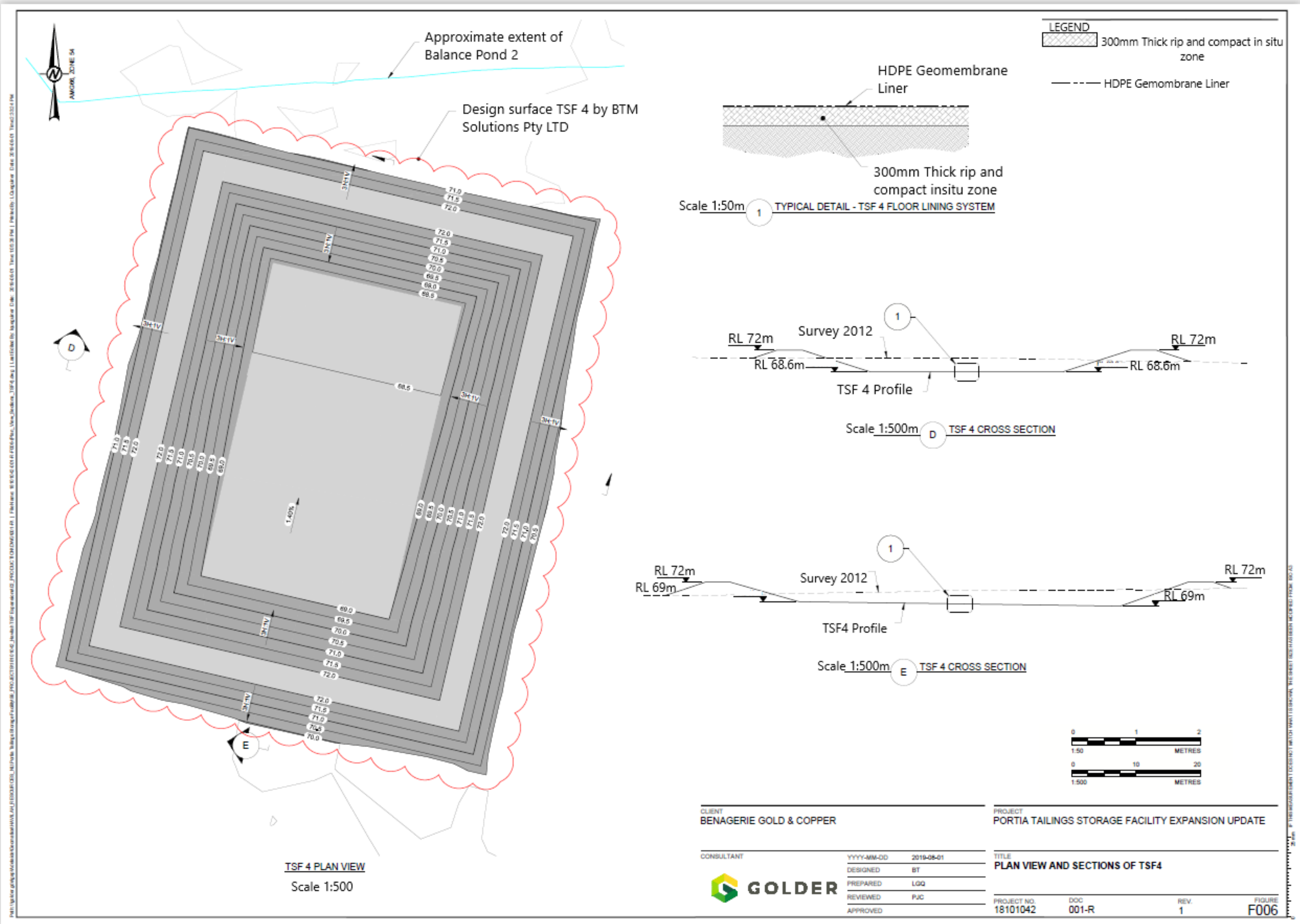


Figure 3-48: TSF-4 Plan view and sections

Placement and Encapsulation of Hazardous Waste Material (Including PAF)

Where metallic sulfide minerals such as pyrite and pyrrhotite are present either in ore or waste materials, there is the possibility that oxidation may lead to Acid and Metalliferous Drainage (AMD). The generation of acid (H+) occurs typically when sulfide minerals are exposed to both oxygen (from air) and water. Sulfide oxidation produces sulfuric acid and an orange precipitate (typically ferric hydroxide). Acid generation and AMD may result in adverse impacts to the receiving environment and particularly to ecological receptors present at the Site, hence the need to identify and manage potentially acid forming (PAF) materials appropriately during the Project. There is no PAF material expected to be present within this current plan.

Ore and waste rock characterisation of the Portia open pit material was undertaken during preparation of the MLP. Representative samples of the different ore types and the overburden waste material within the Portia Deposit were selected and submitted for analysis to enable appropriate classification of the selected waste and ore rock types by AMD criteria. Assay results indicate that the overburden waste material is likely to be non-acid forming (NAF). See Section 3.6.1 for detail.

Stabilisation and Erosion Control

During the operational phase, daily inspections of the TFS are conducted with any evidence of erosion being reported to DEM in the monthly TSFs Reports. The inspections note any cracking or other features, such as seepage, embankment erosion or scour (caused by tailings deposition or rainfall runoff) or any other obvious changes or problems. Any problems are reported to the Plant Manager. See Table 3-29 for Erosion Control Actions.

Table 3-29: Erosion Control Actions

Identify (Surveillance Action)	Investigate (Consulting Action)	Respond (Maintenance Action)
CREST		
Ruts along crest	NA	Re-grade and re-compact crest to original elevation with a slope towards the upstream crest edge. Provide surface resistance to rutting by adding gravel.
Longitudinal/Transverse cracks	A qualified geotechnical engineer should determine the cause and recommend methods to repair cracks that are deeper than surface/drying cracks and/or likely to impact on the structural stability.	Excavate and backfill affected area with compacted clay to prevent erosion and seepage. Monitor area for future movement.
Low area	A qualified geotechnical engineer should determine the cause and recommend method to repair and prevent reoccurrence.	Re-grade the crest to the original design.
Sinkhole	A qualified geotechnical engineer should determine the cause and recommend method to repair.	As directed by the engineer.
DOWNSTREAM FACE		
Longitudinal cracks	A qualified geotechnical engineer must determine the cause of the cracks and recommend a course of action.	Drying cracks should be sealed.

Identify (Surveillance Action)	Investigate (Consulting Action)	Respond (Maintenance Action)
Slump or slide	Initiate the **Emergency notification procedure** (Section 8.3). A qualified geotechnical engineer must determine the cause and recommend a course of action.	Cease tailings deposition and draw down the decant pond.
Seepage	A qualified geotechnical engineer should assess the situation and recommend a course of action. Initiate the **Emergency notification procedure** (Section 8.3) **if** seepage evolves into free water flow (piping) and volume increases or if dirty water is present.	Examine outflow for 'dirty' water (cloudy, sediments present). Advise environmental representative for chemical analysis. Monitor flow and draw down the decant pond if seepage flows increase. Contain seepage. **Consultant to advise but possible buttress and drainage required as an immediate response**
Cave in/Collapse	Initiate the **Emergency notification procedure** (Section 8.3) A qualified geotechnical engineer must investigate and determine the cause and recommend a course of action.	If embankment slump, cease deposition into the cell and remove as much water as possible off the cell. Survey and monitor the area for change.
Erosion	NA	Re-grade slope and provide adequate slope protection.
DOWNSTREAM TOE		
Seepage water	A qualified geotechnical engineer should evaluate the situation and recommend a course of action. Initiate the **Emergency notification procedure** (Section 8.3 if flow is constant or free water or if dirty water is present.	Examine outflow for 'dirty' water (cloudy, sediments present). Monitor flow.
Standing water or water flowing from embankment	Initiate the **Emergency notification procedure** (Section 8.3) procedure if flow volume increases or if dirty water is present.	Provide adequate drainage to a containment area to prevent ponding. Identify seepage path. Contain seepage. Examine outflow for 'dirty' water (cloudy, sediments present). Advise environmental representative for chemical analysis. Monitor flow and draw down the decant pond if seepage flows increase. **Consultant to advise but possible buttress and drainage required as an immediate response**
UPSTREAM FACE		
Breaching and Scarps (erosion)	NA	Re-grade the upstream slope to the original design grade. Provide adequate slope protection.
Cracks and slide or slump	A qualified Geotechnical engineer should determine the cause and recommend a course of action.	Cease tailings deposition and drawn down the decant pond.

Identify (Surveillance Action)	Investigate (Consulting Action)	Respond (Maintenance Action)
PIPELINE CORRIDORS		
Eroded corridor	NA	Repair with fill. Provide adequate erosion protection. Re-grade the corridor if necessary.
Blocked corridor from run-off erosion	NA	Remove the blockage and prevent future blockage.
GROUNDWATER WELLS		
Water in piezometer	Take a water level reading and also sample and test with conductivity meter.	Depending on reading and if subsequent readings show same or increasing levels. Refer to Section 7.4.4 for further details.

Surface Runoff

Surface water runoff control on disturbed areas will be conducted in accordance with Portia Tailings Storage Facility Operations and Surveillance Manual (Appendix F5). TSF cells have been designed to contain the 1:100 year annual exceedance probability (AEP) 72-hour storm event at all times and a spillway is not included. A 300mm dry freeboard will be retained at all times.

Surface water run-off from other disturbed areas round the TSF include from external embankment walls and the existing roads around the TSF. These areas are graded to ensure no sediment run-off occurs as a result of water run-off from disturbed areas around the TSF.

Seepage

Seepage was first detected at the external toe of TSF West cell 23rd March 2017. This was investigated by Golder Associates 4th April 2017. Test pits indicated lenses of coarse sand that were saturated with seepage water (salinity noted). This is documented in the Golder Associates technical memorandum "Portia TSF Site Inspection - West Cell Seepage" (Ref No. 1774844-003-M-Rev1, dated 26 April 2017).

Additional monitoring wells were installed on the TSF West embankment in May 2017 to understand the seepage flows under the embankment. The sand lenses located about 2m below the surface were deemed to be the main conduit of seepage water. The upper embankment was dry. The monitoring wells are measured monthly as part of the TSF monitoring bore inspections (Figure 3-49).

Seepage control measures have commenced with the treatment and recompacting of TSF-2 cell floor. The floor was scarified to 150mm and compacted with test results confirming compliance to WMS 98% standard. Additional seepage measures to be implemented include the retreatment and recompaction of the TSF-1 cell floor, the installation of seepage interception drains (as discussed in Strategies for Containment of Seepage). Additionally, changes with water management within the processing plant are expected to deliver higher density tails. With the implementation of these strategies, it is not anticipated that there will be an increase in groundwater levels or TDS levels in the TSF monitoring network. However, should groundwater monitoring identify an increase in groundwater levels or TDS, engineering strategies will be implemented to halt and reduce any increase observed. This will include the installation of a tails thickener within the processing plant.

An updated seepage assessment was made by Golder Associates (2019) and presented in Tailings Storage Facility Expansion Update (Appendix D7). A previous seepage investigation report conducted by Golder (2013) (AppendixD1) attributed the transport of the seepage from the cell to a sand layer approximately 2 m below the surface. In the original construction of TSF-1 and TSF-2 the cell floors were not compacted and relied on the clays occurring within the cell. In some areas within both cells, the clays were not present. The strategy to rip, scarify and place additional Quaternary clay layer over the floor in all three cells will result in reduced seepage rates due to the low permeability floors. The presence of the compacted clay layer in all cell floors reduces seepage and presents the seepage value as low, less than 1 L/s.

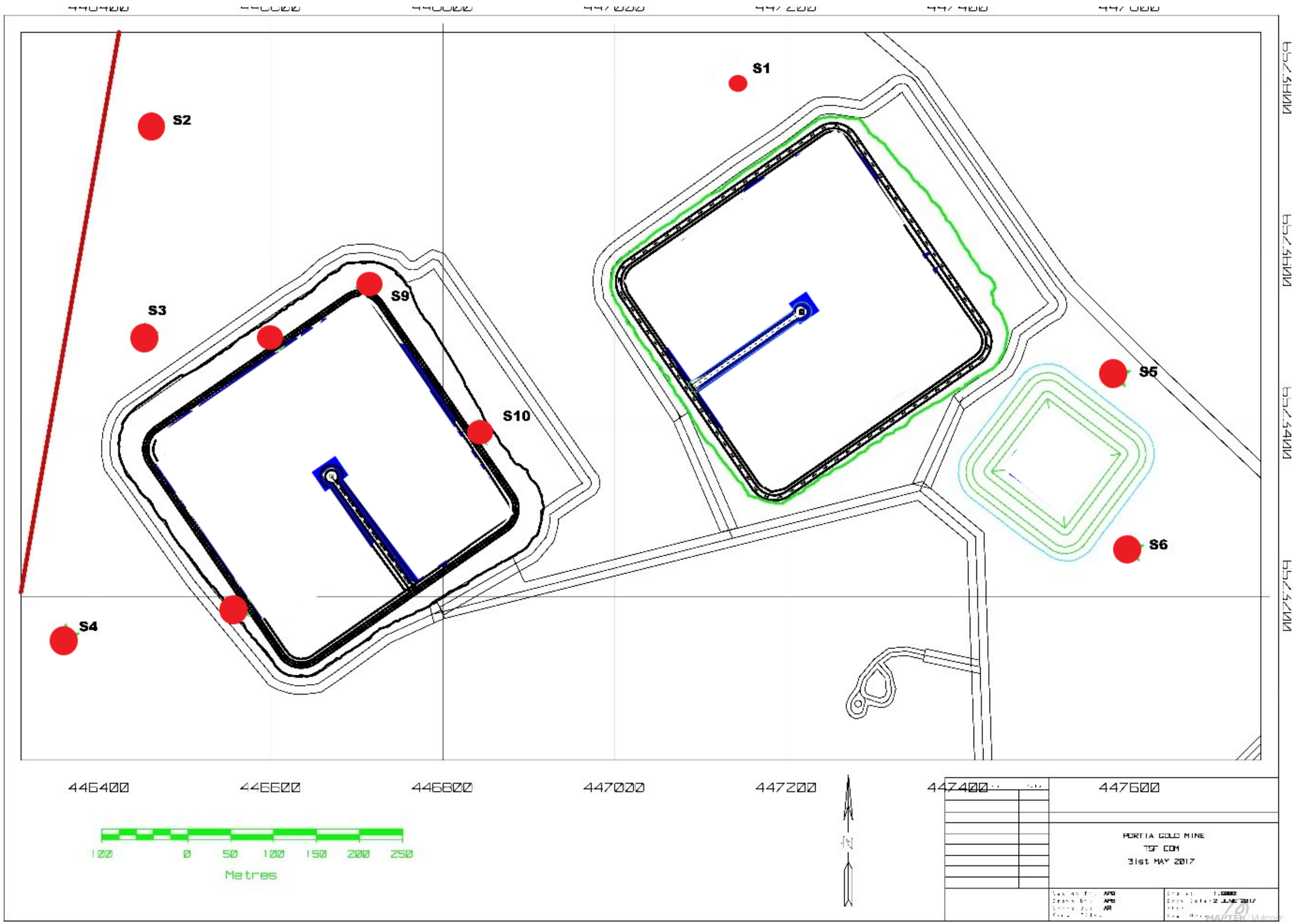


Figure 3-49: Shallow monitoring well locations (lateral seepage monitoring) around the TSF cells

The seepage along the cells has not changed in flow or extent significantly (July 2019); but neither has it diminished. BGC is planning the installation of capture toe drains along the western extents of both cells and the seepage collected will be pumped back onto the cells.

An updated seepage assessment was undertaken by Golder's (2019) and the key outcomes of the seepage modelling are summarised below:

- The seepage analyses have been carried out assuming that TSF-3 will have a 300 mm thick bottom layer of compacted clayey soil, with a hydraulic conductivity of 1 × 10-9 m/s, representing the proposed ground improvement.

- The presence of the compacted clay layer reduces seepage, hence this value is low, less than 1 L/s.

- Seepage emanating from TSF-3 is unlikely to increase groundwater level due to deposition of tailings. The modelling also indicates that seepage is not expected to daylight onto the ground surface.

Lateral Seepage

Lateral seepage continues to be evident and has expanded beyond the TSF boundary fence around both cells. BGC proposes to install mitigating controls to capture toe seepage. Interception toe drains will be located around the facilities. The interception drains are proposed to be constructed around each of the TSF cells and the balance pond where surface seepage is evident. Captured water will be directed to sumps on each side and returned to the TSF cells, reducing surface expression and seepage expanding beyond the trench location.

Seepage has been identified to predominantly occur only where an intermediate sand layer was present at approximately 2 m below ground surface. The interception drains will be placed where the known sand layer is evident by surface expression as shown in Figure 3-50 below.

Figure 3-50: Seepage on the northern side of TSF1 encroaching onto Topsoil Stockpile

Drains will be constructed to a depth of 1 m and 3 m wide. A maximum of 2,500 m of interception trench will be installed around TSF-1, TSF-2 and the balance pond 1 as shown in Figure 3-51. Sumps will be backfilled with imported drainage gravel. An estimated 5,650 m3 of clayey material will be removed during the process and stockpiled in Quaternary clay stockpiles.

The base of the trench will include a longitudinal grade to direct flows to a sump with dimensions of about 4 m × 4 m × 1 m. The location of the sumps is shown in Figure 3-52. Collected water will then be pumped to the relevant cell corresponding to the sump.

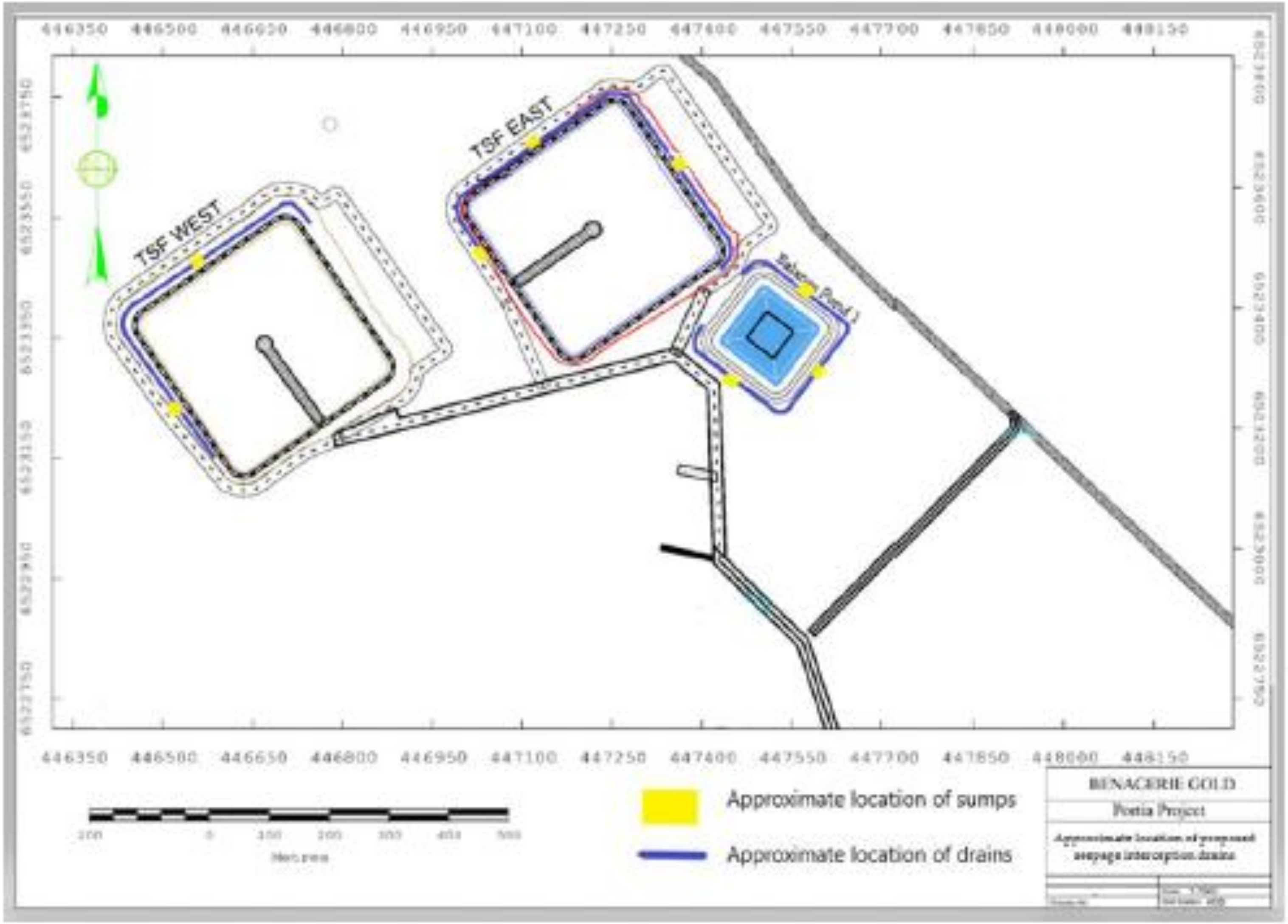


Figure 3-51: Proposed location of Seepage Interception Drains

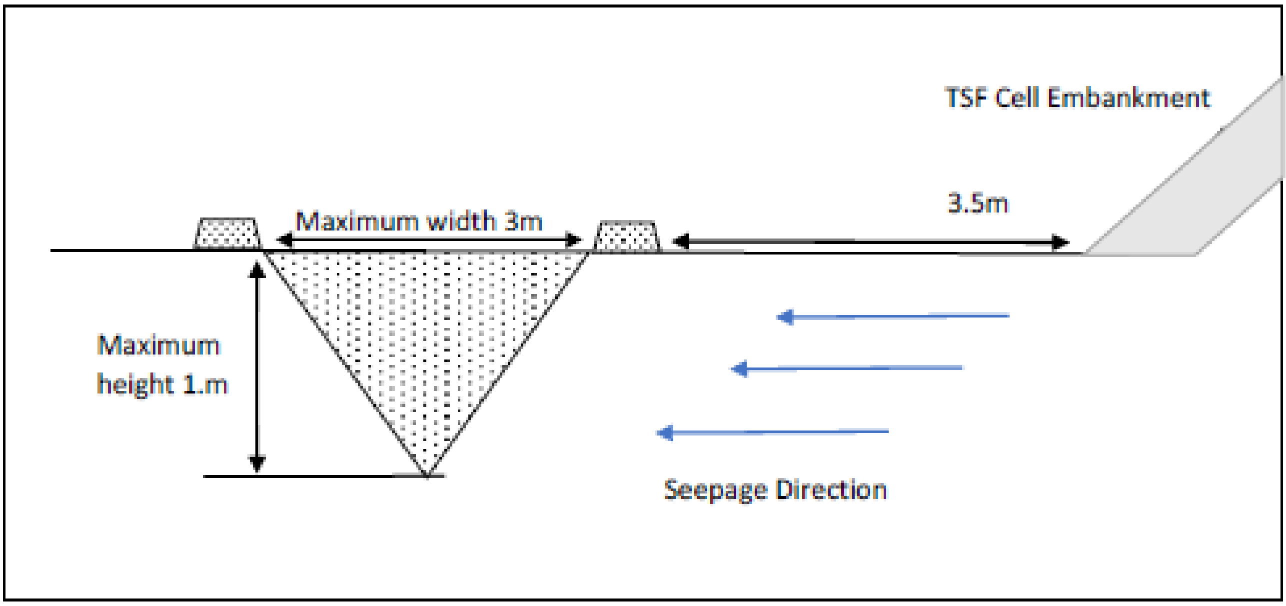


Figure 3-52: Cross-section of Seepage Interception Drain

<u>Strategies for Containment of Seepage</u>

Strategies for containing seepage include:

- On the completion of tailings removal of TSF-1 and TSF-2, retreat floor the cell floor by scarifying to 150mm and recompacting to WMS 98% standard;
- Construction of TSF-3 to include the treatment of the cell floor by scarifying to 150mm and compacting to WMS 98% standard;
- Construction of TSF-4 to include the treatment of the cell floor by scarifying to 150mm, compacting to WMS 98% standard and further sealed with a HDPE liner;
- Construction of seepage interceptions drains around TSF-1, TSF-2 and BP1.

<u>Assessment of Post-Completion Chemical and Physical Stability</u>

Additional to earlier assessments conducted on TSF1 and TSF2, a stability assessment has been undertaken for TSF-3, based on static and post-seismic conditions and using a section that crosses east-west over TSF-3. The target factor of safety (FoS) values for both analyses conditions were adopted based on recommendations from the ANCOLD (2012) guidelines.

Details and figures of the stability assessment can be seen in Appendix D5, and the results are presented in Table 3-30.

Table 3-30: Stability assessment results as Factors of Safety

Base condition	Target FoS	Modelled FoS	Assessment
Static	1.5	2.0	Acceptable
Post-seismic	1.1	2.0	Acceptable

The post-closure profile of the TSFs will include a 'store and release' style cover on the tailings surface. This profile along with this type of cover will likely inhibit the build-up of long-term moisture in the structure. Post-closure instability or geotechnical failure is considered less likely than during operation and overall a very low

An audit by a suitably qualified and experienced independent expert, prior to Lease surrender, will be undertaken to determine that the chemical and physical stability of the TSF and that TSF has been constructed and rehabilitated as per this document.

An additional audit, conducted by a suitably qualified and experienced independent expert, prior to Lease surrender, will also be undertaken to determine that Domains 1 to 3 have been revegetated in accordance with the sustainable closure strategies defined in Section 7.0.

Source, Pathway and Ultimate Fate of Potential Mobile Contaminants

Potential contaminants identified from processing wastes are limited to the tailings stream. Water discharged will be recovered from the decant system and returned back to the raw water dam.

Contaminants contained in the cyanide residue include Sodium Cyanide Solution (10%), Hydrogen Peroxide (40%), Copper Sulphate (dry) and Caustic Soda (40%) as well as small quantities of flocculant agent (eg Magnafloc®) and leach accelerant (eg GoldiLOX®). Further details on Cyanide leach and gold recovery reagents are listed in Section 3.5.2, Table 3-17.

These contaminants will be confined to the cyanide leach circuit which incorporates a ILR 2000 leach reactor, an electrowinning circuit (with one electrowinning cell) and a pregnant solution recycle tank. Gold is electrowinned onto stainless steel mesh and high pressure cleaned and conventionally smelted without the use of acid digestion. The ILR circuit uses nominally 17 m3/d of raw water produced from the RO plant. The ILR uses cyanide and caustic soda for pH control to dissolve fine gold particles taken from the Knelson circuit.

Once the electrowinning process is complete, the baron solution is recycled to the ILR (40%) and what remains is sent to the detox circuit for cyanide destruction. One detoxification has been completed the solution is transferred to the cyanide cell (TSF-4) for storage and evaporation. The detox process will also incorporate the use of hydrogen peroxide as part of the primary neutralisation phase. Cyanide will be deconstructed to levels of less than 50 ppm, in line with the International Cyanide Management Code.

Transfers of the solution to the TSF-4 will be via approximately 200m of double lined pipeline. The 7,500m^3 cyanide cell will be compacted clay lined and further lined with HDPE liner to eliminate potential transfer of contaminants to outside the cell.

Other potential contaminants include small amounts of Picric Acid and Silver Nitrate for laboratory titration testing. Waste from both Picric Acid and Silver Nitrate will be stored in a 200L HDPE chemical drum for collection from a licenced waste disposal company at a rate of approximately 1 litre per month.

Water Balance of TSF

The decant system returns water from the gravity cells to the Balance Ponds and then Raw Water Dam from where water will be pumped directly back to the plant for reuse as process water.

The decant system in the TSF cells comprises a diesel generated electric pump located on the decant finger. The decant weir-box (Figure 3-44) has weir plates that allow clean water to flow over into the pump sump. These may have to be adjusted as needed if water level falls or tailings encroach.

The decant fingers are built 1 m above the projected tailings beach based on the original predicted beach slope of 0.5%. If a significant rainfall event threatens the pump generator, it should be pulled up the decant finger until made safe.

The location of the decant pond that develops, will be controlled by the tailings discharge sequence. The process of tailings deposition is aimed at ensuring that the pond that develops within the TSF is pushed towards the decant system.

A preliminary water balance estimate has been prepared based on the inflows and outflows that would be expected during the operational life of the TSF. The assessment was considered on a monthly basis for a year operation. The assessment is based on the assumptions listed below:

- An average tailings particle density of 2.68 t/m3;
- A deposition rate of 140 tph and slurry density of 35% solids by mass;
- An averaged value was used for seepage and was estimated as outlined in the seepage assessment information above;
- Average annual and monthly rainfall records and pan evaporation rates are based on those for the Cockburn weather station;
- Evaporation coefficients of (when tailings are being deposited):
    - 0.7 over the active pond (conservatively assumed to be 30% of total beach area to account for periods where rainfall increases the pond size);
    - 0.6 over the wet beach area (60% of total beach area);
    - 0.5 over the inactive drying beach (10% of total beach area).

The results of the water balance values for TSFs 1 to 3 are shown in

Table 3-22. The water balance is developed for a single cell – i.e. that only one cell will be in use at any one time. Whilst there may be times during which water is being decanted from two cells at once as deposition switches from one cell to another, this is expected to short duration and has not been included in this water balance.

Based on a solids concentration of 35% w/w, the return water could be potentially up to 70% of the total water reporting to the TSF, which is in the order of 40 to 50 L/s. The seepage through the base of the TSF is expected to be less than 1 L/s, noting the intention to compact the basin of the cells.

Water inflow from TSF-4 was estimated to be less 1% of that for the other cells, hence this small amount of water would not impact the total water balance in Table 3-31 below.

Table 3-31: Water Balance

Inflows			Outflows		
Inflow Components	Inflow (m^3/year)	Percent Total	Outflow Components	Outflow (m^3/year)	Percent Total
Process Water	2,049,840	99%	Evaporation	138,942	7%
Rainfall	11,743	1%	Seepage	3,154	0.2%
			Reinstated Interstitial Water	482,552	23%
			Decant Return	1,436,936	70%
Total	**2,061583**	**100%**	**Total**	**2,061,583**	**100%**

3.6.3 Other Processing Wastes

Waste material generated from the gravity separation wet plant will be discharged into the TSF. The TSF currently comprises two cells, TSF-1 and TSF-2 located to the north of the pit and OWD, with a third cell (TSF-3) and fourth cyanide cell (TSF-4) proposed to be constructed as shown on the general Site layout in Figure 3-44**.**

Processing wastes will be limited to the tailings stream, as the only other discharges are the recovered water that is to be returned to the RWD and the recovered gold.

Sodium Cyanide, small volumes of picric acid (chemical formula $(O_2N)_3C_6H_2OH$), Hydrogen Peroxide (H2O2), Copper Sulphate (CuSO4) and Caustic Soda (NaOH) are proposed for use on site as well as a flocculant agent (eg Magnafloc®) and leach accelerant (eg GoldiLOX®).

Chemicals to be used in the beneficiation of processing of ore are:

- Anti-scalent for use in the RO plant;
- Sodium cyanide solution (10-20%) for ILR;
- Caustic Soda 40% w/w for pH control in ILR – FF as for Cn;
- Flocculant for ILR for anti frother – FF as for Cn;
- Hydrogen Peroxide oxidiser for cyanide destruction 40% w/w– FF as for Cn;
- Copper sulphate for detox circuit (dry) – FF as for Cn;
- Picric Acid for laboratory titration testing – FF goes into spent container and stored for appropriate removal (1Ltr per month); and
- Silver Nitrate for laboratory titration testing – FF goes into spent container and stored for appropriate removal (1Ltr per month).

Anti-Scalent

The first anti-scalent (POSM 352T) will be used in the reverse osmosis plant and will be discharged into the TSF. The anti-scalent is a phosphonate which will be applied to the incoming raw water at a dosage rate of 10.34 mg/L (approximately 0.52 litres per day). The second anti-scalent (MST 5052) will be added to the Knelson Concentrator fluidizing water to inhibit scale formation in the Knelson Concentrator (thus reducing the gold recovery capacity of these units). An expected dosage of approximately 1 mL/minute (approximately 1.44 litres per day) is required to be added to the Knelson water feed.

Toxicological assessments for both anti-scalents were provided by the product manufacturers in Material Safety Data Sheets (MSDSs) and are summarised below.

At the intended dosage rates, the anti-scalents are:

- not classified as harmful to aquatic invertebrates;
- not classified as harmful to fish;
- not harmful to birds; and
- not harmful to mammals.

Furthermore, the anti-scalent POSM 352T will be converted to orthophosphate and carbon dioxide through either bio-degradation or photo degradation and therefore poses no long-term environmental risk.

Sodium Cyanide

Sodium Cyanide is proposed to be used at Portia Gold Mine for gold processing at a concentration of 20% strength. Sodium cyanide is a raw material used for dissolving gold particles into soluble form and has been safely used for many years in the mining industry. It can however present a significant hazard if not managed correctly. BGC's Cyanide Management Plan (CMP) outlines information, policies and procedures that forms part of the Portia Gold Mine management system for the chemical.

Cyanide management principles include:

- Ensure Portia Gold Mine is socially and environmentally responsible;
- Protect the environment, people, visitors and the community;
- Meet or exceed best industry practice.

To be able to purchase and store cyanide, Portia Gold Mine will maintain and comply with a Licence to Possess Regulation 25 Poisons - Cyanide issued by SA Health and the Environmental Protection License 47223 issued under the Environmental Authorisation under Part 6 of the Environmental Protection Act 1993.

Sodium cyanide solid is classified as hazardous according to Australian WHS Regulations and for physicochemical hazards and specified as dangerous in the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code), 7th Edition. It is regulated dangerous goods as Class 6.1 Toxic hence its transport, storage, use and disposal must be carefully managed.

It is estimated that a maximum of 10 tonnes of Cyanide will be stored on Site at any one time away from incompatible materials. This total includes a 8m3 (8,000L) fit for purpose tank to be used for storage and mixing.

A detoxification unit incorporated in the inline leach reactor for solids and separate detoxification tank will deconstruct cyanide levels to below the acceptable level of <50ppm.

Any waste liquid waste resulting from the use of sodium cyanide will be diverted back to the detoxification unit it for destruction. Any physical waste from cyanide packaging will be burnt on site.

Picric Acid

Picric Acid is an organic compound that is classified as both toxic and explosive (Class 4.1). It is estimated that a maximum of 4 litres will be stored on Site at any one time in 2 x 2 litre containers. The containers will be stored securely in the Lab located within the processing plant compound. Although no special requirements are listed for the storage of picric acid, bottles will be stored away from any ignition source and handled in well ventilated areas. Workers involved in its use will be appropriately trained and provided with the necessary safety equipment (including PPE and engineering controls).

Any empty picric acid bottles (a maximum of 2 x 2 litre bottles) will be disposed of in the site land fill in accordance with the Landfill Environment Management Plan.

Hydrogen Peroxide

Hydrogen Peroxide is proposed to be used at a concentration of 60%. Hydrogen Peroxide is water with an extra oxygen molecule and breaks down into oxygen and water. It is produced by both animal and plant cells and is formed naturally in the environment by sunlight acting on water. Hydrogen Peroxide is commonly used as an oxidant in ore leaching, concentrate preparation and Cyanide effluent treatment.

Hydrogen Peroxide is an oxidising agent (Class 5.1), corrosive (8) and a Scheduled Poison (S6). It is estimated that a maximum of 6,000L will be stored on Site at any one time in 1,000L IBCs (bulkies). The containers will be stored in a secured chemical storage designated area within the processing plant. Containers will be stored away from incompatible materials. Workers involved in its use will be appropriately trained and provided with the necessary safety equipment (including PPE and engineering controls).

The empty Hydrogen Peroxide reusable bulkies will be triple rinsed and reused on site as concentrate containers.

Copper Sulphate

Copper Sulphate is an inorganic compound which is highly soluble in water and therefore is easy to distribute in the environment. copper sulphate exists mainly in the surface soil and tends to bind organic matter.

Copper Sulphate is classified as Dangerous Goods and a Scheduled Poison (S6). It is estimated that a maximum of 40kg will be stored on Site at any one time in 2 x 20kg bags. The containers will be stored in a secured chemical storage designated area within the processing plant. Containers will be stored away from incompatible materials including nitromethane, finely powdered metals, steel, hydrazine, hydroxylamine, magnesium, air. Workers involved in its use will be appropriately trained and provided with the necessary safety equipment (including PPE and engineering controls).

Any waste from the use of Copper Sulphate on site will be stored within an approved vessel for collection by an appropriately EPA licensed contractor (e.g. Cleanaway) on an approximately quarterly basis. If required, the IBCs will be transported to Adelaide for treatment and disposal.

Sodium Hydroxide (Caustic Soda)

Sodium Hydroxide is a Corrosive (Class 8) and a Scheduled Poison (S6). It is estimated that a maximum of 6 tonnes will be used and stored on Site at any one time. It will be stored in a secured chemical storage designated area within the processing plant. Containers will be stored away from incompatible materials. Workers involved in its application will be appropriately trained and provided with the necessary safety equipment (including PPE and engineering controls).

Any waste from the use of Copper Sulphate on site will be stored within an approved vessel for collection by an appropriately EPA licensed contractor (e.g. Cleanaway) on an approximately quarterly basis. If required, the IBCs will be transported to Adelaide for treatment and disposal.

Reagents

Reagents are proposed to be used on site include flocculant agents (eg Magnafloc®) and leach accelerants (eg GoldiLOX®). These are proposed to be used in small quantities only with a maximum of 5,000Ls of flocculant and a maximum 1 tonne of leach aid. The transport, storage and use of reagents will be in accordance with manufacturer's instructions. Workers involved in its application will be appropriately trained and provided with the necessary safety equipment (including PPE and engineering controls).

Any waste resulting from the use of reagents will be stored within the product IBC or other approved vessel for collection by an appropriately EPA licensed contractor (e.g. Cleanaway) on an approximately quarterly basis. The IBC will be transported to Adelaide for treatment and disposal. Costs will depend on the final concentrations of metals within the waste solution which will be analysed.

BGC currently holds SA EPA Licence 47223 for prescribed activities 2(9) Mineral Works and 3(3) Waste or Recycling Depot under the *Environment Protection Act 1993* (SA) ('EP Act').

The need for a Dangerous Substances Storage Licence under the *Dangerous Substances (General) Regulations 2017 (SA)* has been investigated and is not necessary given the small volume of substance proposed for storage, taking account also of other substances stored at the Site.

3.6.4 Industrial and Commercial Wastes

Solid waste materials (e.g. batteries, 200 L drums, scrap metal) are collected for recycling. Recyclable waste is periodically removed from Site by either BGC or a licensed contractor and disposed of at an appropriately licensed waste facility, in accordance with the relevant state EPA requirements (NSW or SA) dependent on disposal location.

Empty drums are stored sealed and in a bunded area. Returnable drums are sent to the vendor, and damaged drums sent to a licensed scrap metal dealer.

Used tyres are removed from Site and recycled.

All putrescible and non-recyclable waste material generated during operations is disposed of in a small approved SA EPA licensed landfill on Site. Refer to the Landfill Environmental Management Plan (Appendix F4) for further details concerning the Landfill design and operation.

Hydrocarbons and Oily Wastes are managed by the following means:

- implementation of appropriate storage and handling procedures in accordance with AS1940 – *The storage and handling of flammable and combustible liquids*;
- segregation of hydrocarbon materials and waste products from storm water runoff and other water;

- the actioning of hydrocarbon spill response procedures; and
- environmentally acceptable disposal and/or recycling of captured hydrocarbons.

Hydrocarbons are managed to minimise the potential risk of spills and the area of contamination should a spill occur. Management practices are based upon the SA EPA *Guidelines for Bunding and Spill Management* (2007) and include:

- use of self-bunded pallets for all 200 L drum storage areas;
- drums in use being placed on spill capturing platforms (secondary containment);
- effective maintenance of all valves and piping systems; and
- implementation of regular inspection and monitoring programs pertaining to the storage and handling of flammable and combustible liquids and facilities on Site.

Accidental spillages of hydrocarbon materials will be managed in general accordance with the SA EPA *Guidelines for Environmental Management of on-site remediation* (2008). Remediation will occur as soon as practical after a spill event has been identified. Minor spills (e.g. less than 20 L) will be managed by the placement of absorbent material and/or excavation and removal of contaminated soils. Minor contaminated soil volumes will either be disposed of at an EPA approved facility (NSW or SA) or bioremediated using landfarming techniques on-Site. Larger hydrocarbon spills will be assessed on a case by case basis for remediation and disposal requirements and may necessitate expert independent advice and management (e.g. Site contamination and remediation expert).

The Mine Manager will ensure that spills and leaks of contaminants are recorded in the contaminant spill register and those greater than 20 L are reported to DEM's Principal Mining Regulator within 24 hours of occurrence. Records are kept to show that spills (if any) have been remediated to an appropriate EPA standard within 48 hours of the spill, or longer time as agreed with DEM's Principal Mining Regulator.

Waste oil and other hydrocarbon wastes collected are removed from the Site for recycling/disposal by a licensed waste contractor.

A small Reverse Osmosis (RO) plant is located within the plant area and supplies the operation and infrastructure with necessary fresh water requirements. It produces brine reject water at a rate of approximately 0.6 L/s. This reject water is discharged to the raw water dam and disposed of into the TSF cells. This unit will be decommissioned once the second, larger unit is on line.

A second, larger RO plant is proposed to be installed during the Q3-Q4 of 2019 within the processing plant area. This plant will receive a total flow of 160 m^3 within a 24-hr period. This will produce a total of 64 m^3 of potable water for use within the plant (30 m^3), camp (20 m^3) with potentially an excess of 14 m^3 being distributed to the landholder for stock purposes.

Sewage generated at the Site ablutions and wash facilities is disposed of by small grey water disposal systems (septic tanks and soakage trenches). The capacity of these systems matches the requirements for the mine and processing ablutions. Grey water disposal systems are located at the main Site office ablutions and at the processing plant ablutions.

An "Enviroflow" waste water treatment unit is installed at the camp which services washing, shower and toilets. This waste water treatment system is designed to discharge treated water at a Class B quality. A small amount of this water can be used for campsite landscaping amenity whilst the remaining water is diverted to the evaporation irrigation area where it is evaporated off. The waste water treatment plant (WWTP) will not discharge treated sewage of a quantity exceeding a peak loading capacity of more than 1000 persons per day to land that is not in a water protection area. As such, no EPA approvals for the waste water treatment plant are required under the *Environmental Protection Act 1993*. The WWTP is located 100 metres away from the nearest campsite building locations.

The construction and operation of all sewage systems on Site is in accordance with SA Health requirements. The establishment of all plumbing requirements needed to service the Site has been completed by appropriately licensed Plumbers.

Landfill

S&G Environmental Consulting Pty Ltd (S&G) were originally commissioned to develop a *Landfill Environment Management Plan* (LEMP) for the Portia Mine Site in accordance with the requirements of the EPA Guidelines *Environmental Management of Landfill Facilities (Municipal Solid Waste and Commercial and Industrial General Waste)* (EPA, 2007). The LEMP has since been amended by BGC to better reflect operational conditions and updates to the PEPR since the commencement of operations. This LEMP for the Project can be found in Appendix F4 and is summarised below.

Putrescible and non-recyclable wastes are disposed of to an on-Site landfill facility. The majority of these wastes originate from the accommodation camp.

The landfill is situated approximately 500 m south of the accommodation camp as shown in Figure 3-1. The landfill has been constructed to specifications outlined in the LEMP (see Appendix F4), however was built on a larger scale (approximately 50 x 50 m footprint) to accommodate up to approximately 1,800 m^3 of putrescible and non-recyclable wastes. The intention was to give additional capacity should the Project life be extended in future. This larger landfill still meets the landfill classification of SB as the landfill capacity remains small (less than 26,000 tonnes) and the LEMP and current management controls therefore remain appropriate.

A survey pickup of the landfill volume on 26 June 2019 shows that approximately 412 m^3 of waste had been stored in the landfill since the commencement of mining operations in March 2015. This accounts for decomposition and compaction of the wastes during that time period. This equates to an estimated 8 m^3 of waste per month on average being stored in the landfill. The remaining capacity in the landfill as at 26 June 2019 was therefore approximately 1,800 – 412 m^3 = 1,388 m^3. Assuming an average waste generation rate of 8 m^3 per month, the landfill therefore has sufficient capacity for at least another 173.5 months or 14 years. This will need to be reviewed in future if the waste generation figures change (e.g. larger camp). This will need to be reviewed in future if the waste generation figures change (e.g. larger camp).

The landfill volume is therefore sufficient for the disposal of the estimated putrescible and non-recyclable wastes plus regular soil capping whilst also allowing at least 600 mm of subsoil and 100 mm of topsoil to be placed over the landfill for closure and rehabilitation purposes.

Management of Waste Types

The types of waste generated at the Site generally fall into one of the following categories:

- recyclables or salvageables (including drinking bottles and cans, cardboard, scrap metals, tyres and batteries);
- solid wastes (including general 'hard' wastes and 'putrescible' wastes);
- liquid wastes (including waste oils, coolants and other chemical wastes);
- septic wastes (from amenities); and
- contaminated soils (from spills).

The proposed management strategy for each of the waste categories is described in Table 3-32

Table 3-32: Management Strategies for Waste Categories

Type	Sub-Type	Management Strategies
Recyclables or Salvageables	Drinking Bottles & Cans	Recyclable (deposit) drinking bottles (glass and plastic) and aluminium cans are collected at the offices and crib rooms and placed into either 'wheelie' bins or 'bulka bags'. The bottles and cans will be collected as required by BGC and taken off-Site to a recycling depot in Broken Hill.
	Cardboard	Cardboard generation at the Site is mainly from packaging materials used for transporting parts and products to the Site. Waste cardboard and limited volumes of paper will be collected for disposal. When required, these will either be taken off-Site to Broken Hill or Adelaide for recycling at an appropriately licensed facility or disposed of via incineration, depending on volumes and fire risk conditions. In some instances, cardboard may be used during Emergency Response Team exercises.
	Scrap Metals	Scrap metal generation at the Site generally comprises empty metal drums and containers, scrap metal from construction and general scrap metal from the maintenance workshops. Scrap metals will be collected on-Site at the maintenance workshops and removed from Site as required and taken to Broken Hill or Adelaide for recycling at a scrap metal merchant. Re-useable steel drums will be recycled or sent back to the supplier.
	Tyres	Some of the large earthmoving (heavy fleet) tyres may be re-used on Site for traffic management (e.g. at road intersections and for road barriers). All surplus large earthmoving, light vehicle and truck tyres are collected on-Site at the maintenance workshops. When required, these are taken off-Site to Broken Hill or Adelaide for shredding and recycling at an appropriately licensed facility.
	Batteries	Waste battery generation at the Site is mainly from vehicles and occasionally electronic equipment. Waste batteries will be collected on bunded pallets adjacent to the maintenance workshops. When required, these will be removed from Site and taken to Broken Hill or Adelaide for recycling at an appropriately licensed facility.
	Pallets	Timber and plastic pallets are collected for reuse near the maintenance workshops. Re-useable pallets are sent back to the supplier. Those pallets that are un-useable or damaged will be disposed of as hard waste. In some instances, pallets may be used during Emergency Response Team exercises.
Solid Wastes	Soft Waste	Soft wastes or 'putrescibles' including food scraps, hand towels and general kitchen and office wastes will be collected in small bins provided in the crib rooms, Site offices and accommodation camp buildings. The majority of these wastes will originate from the accommodation camp. Additionally, soft wastes will be collected outside of these areas in small bins located in areas where food and drinks are generally consumed. These small bins are emptied into the on-Site landfill facility on a periodic basis as required.
	Hard Waste	Hard wastes which are non-recyclable, including plastics (other than deposit drinking containers), concrete, rubber (other than tyres) and packing materials will be collected in lidded skip bins marked as 'general waste' located at various locations around Site. The skips will be emptied into the on-Site landfill facility on a periodic basis as required. A more detailed explanation of the management of each hard waste stream is given below. • **Aerosol Cans:** Aerosol cans (including paints, lubricants and insect repellants) will be de-pressurised (emptied) prior to disposal and placed in with hard waste, collected in the skips located around the Site.

Type	Sub-Type	Management Strategies
		• **Air and Oil Filters:** Used air and oil filters will be separated from hard waste and stored appropriately until collection by an EPA licensed contractor for disposal in either Broken Hill or Adelaide at an appropriately licensed facility. • **Oily Rags:** Oily rags are generated in the maintenance workshops and at the fuel farm. These rags will be collected as hard waste in the skips located around the Site. • **Plastics (other than Drinking Bottles):** Plastics generated at the Site other than deposit drinking bottles (such as plastic drums and plastic pallet wrapping) are included with hard waste and collected in the skips located around the Site. • **Concrete and Masonry:** Waste concrete and masonry are generated occasionally on Site, primarily from construction activities. These are disposed of with hard waste, collected in the skips located around the Site. • **Organics:** Small amounts of organic food waste (including fruit, vegetables, etc.) are disposed of as soft waste. Larger organic material, such as bushes and branches, are infrequently generated at the Site as a result of approved vegetation clearing activities. Due to the sparse vegetative cover in the Project area, these usually remain in stockpiled or spread topsoils where they undergo decomposition naturally over time. They may also occasionally be 'chipped' to provide mulch cover for landscaping and / or rehabilitation activities on Site.
Hazardous Liquid Wastes		Hazardous liquid wastes including waste oils, degreasers and coolants are primarily generated at the Site from maintenance activities on plant and vehicles. These are collected in sealed and labelled 205 L (44 gallon) drums or Intermediate Bulk Containers (IBCs) located at the maintenance workshop facilities. The drums and IBCs are stored on appropriately bunded and sealed areas in accordance with the SA EPA Guidelines for Bunding and spill management (June 2007) and the Australian Standard AS 1940 The Storage and Handling of Flammable and Combustible Liquids. The waste liquids are removed from Site as required by an appropriately EPA licensed contractor and taken to Broken Hill or Adelaide for cleaning and recycling at a licensed facility.
Septic Wastes		Sewage generated at the Site ablutions and wash facilities is disposed of by small grey water disposal systems (septic tanks and soakage trenches). The capacity of these systems matches the requirements for the mine and processing ablutions. Grey water disposal systems are located at the main Site office ablutions and at the processing plant ablutions. An "Enviroflow" waste water treatment unit is installed at the camp which services washing, shower and toilets. This waste water treatment system is designed to discharge treated water at a Class B quality. A small amount of this water can be used for campsite landscaping amenity whilst the remaining water is diverted to the evaporation irrigation area where it is evaporated off. The waste water treatment plant (WWTP) will not discharge treated sewage of a quantity exceeding a peak loading capacity of more than 1000 persons per day to land that is not in a water protection area. As such, no EPA approvals for the waste water treatment plant are required under the *Environmental Protection Act 1993*. The WWTP is located 100 metres away from the nearest campsite building locations. The construction and operation of all sewage systems on Site is in accordance with SA Health requirements, as outlined in SA Health approval references WWI-164/16 and WWI-125/16. The establishment of all plumbing requirements needed to service the Site has been completed by appropriately licensed plumbers.
Contaminated Soils		Accidental spillages of hydrocarbon materials will be managed in general accordance with the SA EPA Guidelines for Environmental Management of on-site remediation (2008). Remediation will occur as soon as practical after a spill event has been identified. Minor spills (e.g. less than 20 L) will be managed by the placement of absorbent material and/or excavation and removal of contaminated soils. Minor contaminated soil volumes will either be treated on-Site using bioremediation or be disposed of off-Site at an EPA approved facility (NSW or SA). Larger hydrocarbon spills will be assessed on a case by case basis for

Type	Sub-Type	Management Strategies
		remediation and disposal requirements and may necessitate expert independent advice and management (e.g. Site contamination and remediation expert).

Landfill Design and Construction

The landfill design consists of an excavation of approximately 50 m x 50 m to a depth of around 2.5 m, with the floor consisting of compacted (to a minimum dry density ratio of 95% relative to standard compaction as per *Australian Standard AS 1289 5.1.1.*) Quaternary sand clay layer of at least 150 mm depth (with a permeability of around 1×10^{-8} m/s). The floor is graded to a sump, allowing the collection and evaporation of leachate and stormwater run-off (see Figure 3-53 and Figure 3-54).

The landfill design has wall slopes of approximately 1V:3H and a maximum depth of 2.5 m, giving a low risk to slope stability of the landfill during operation as well as ensuring the final waste filling height shall be a minimum of 500 mm below ground level.

Leachate Management

The landfill leachate collection system is designed to protect groundwater from the impacts of leachate. This is achieved by constructing a compacted clay landfill liner that prevents the vertical seepage of leachate and grading the subgrade to allow the collection and removal of leachate as it is generated. The subgrade for the landfill has a smooth surface of compacted clay, with at least a 2% grade to a leachate collection sump (also constructed from compacted clay). This compacted clay base forms the surface for the drainage of leachate and waste placement. Upon completion of compaction activities, the surface was proof-rolled in order to assess the presence of any areas that may have required subgrade improvement, such as areas of differential settlement or voids which may adversely affect the leachate drainage system.

The leachate and stormwater collection sump is sized conservatively to allow for stormwater generated from rainfall collected within the facility to be stored and either removed to the TSF or left in-situ for removal via evaporation, depending on the volume of collected.

Stormwater Management

The landfill is situated to minimise stormwater run-off into the facility and is constructed with a perimeter stormwater cut-off drain to direct stormwater around the landfill cell, keeping it separate from landfill leachate and minimising the volume of leachate requiring management within the landfill itself. The landfill excavation has volume sufficient for the temporary storage of a 1-in-100 year AEP rainfall event without overtopping of the facility.

Erosion of landfill infrastructure will be minimised by limiting the amount of vegetation disturbance within the landfill compound, rehabilitating inactive areas as soon as practicable, installing sediment controls such as diversion drains and bunds around the excavated capping material stockpiles and the implementation of temporary erosion control measures such as mulch on rehabilitated surfaces prior to the establishment of vegetation.

Landfill Gas Management

The US EPA LandGEM model was used to estimate the likely evolution of methane from the landfill for the 10 years post-closure. The model default factors were modified in accordance with the Australian National Pollutant Inventory (NPI) Emission Estimation Technique Manual for Municipal Solid Waste Landfills (Version 2, NPI, 2010). The results of this analysis are summarised in Table 3-33.

The generation of around 1 m^3 per day of methane is considered not to represent an explosion or asphyxiation risk to human health and safety based on the short facility life and the lack of nearby receivers post-closure, and further management and/or mitigation of the gas via gas capture and treatment would likely be cost prohibitive.

Table 3-33: Landfill Methane Generation by Year Following Closure

Year	Methane Generation (m^3/year)
1	424
2	400
3	377
4	356
5	336
6	317
7	299
8	282
9	266
10	51

Dust, Odour and Noise Management

Dust may be generated during construction and operation of the landfill, generally from areas of land disturbance, vehicle traffic and stockpiles. Process water derived from mine dewatering can be used for dust suppression as necessary.

The noise from activities associated with the landfill is limited to vehicles unloading waste and waste capping and compaction activities. These are unlikely to generate a disturbance beyond that associated with the surface mining activities and are not considered to require specific management measures.

The regular capping of the putrescible wastes within the landfill, together with the small volume of landfill gas expected to be generated and the remote location of the facility are likely to adequately mitigate any potential for significant odour emissions.

Pest and Litter Management

A 1.8 m high wire mesh fence has been constructed around the perimeter of the landfill facility with lockable gates allowing vehicle access. The gates are nominally closed at all times the landfill is inactive, thus restricting larger pest fauna access to the landfill (e.g. foxes, wild dogs and cats). Additionally, baiting or trapping may be undertaken from time-to-time as necessary to eradicate pests from the facility.

The fence also has a secondary function, limiting the spread of litter from the facility, although the primary control mechanism for the management of litter would be the regular capping and compaction of the waste mass.

Closure and Rehabilitation (Capping and Final Landform)

All landfill surface infrastructure including fences, gates and unused stockpiles will be removed. An engineered cap of at least 600 mm of Quaternary clays will be placed above a 300 mm thick interim fill cover that is deposited on top of the compacted waste materials. The engineered cap will be blended into the surrounding land. This layer will be compacted and will provide a layer designed to shed any rainfall / surface water, minimising infiltration and avoiding the build-up of leachate within the facility. This will be topped with at least 100 mm of topsoil to allow for revegetation using endemic native species (shrubs) with a rooting depth sufficiently shallow to avoid roots penetrating the cap, negatively influencing its ability to mitigate rainfall infiltration.

The landfill cap will be proud of the natural land surface and will be mildly sloped to promote the run-off of surface water. Initially, temporary sediment control measures such as mulch or hay bales may be used to mitigate the potential for erosion prior to the establishment of vegetation. With time, it is expected that the landfill mass will compact with the decomposition and compression of the putrescible waste, ultimately leaving a vegetated landfill cap that approximates the local topography and is suitable for the resumption of pastoral activities.

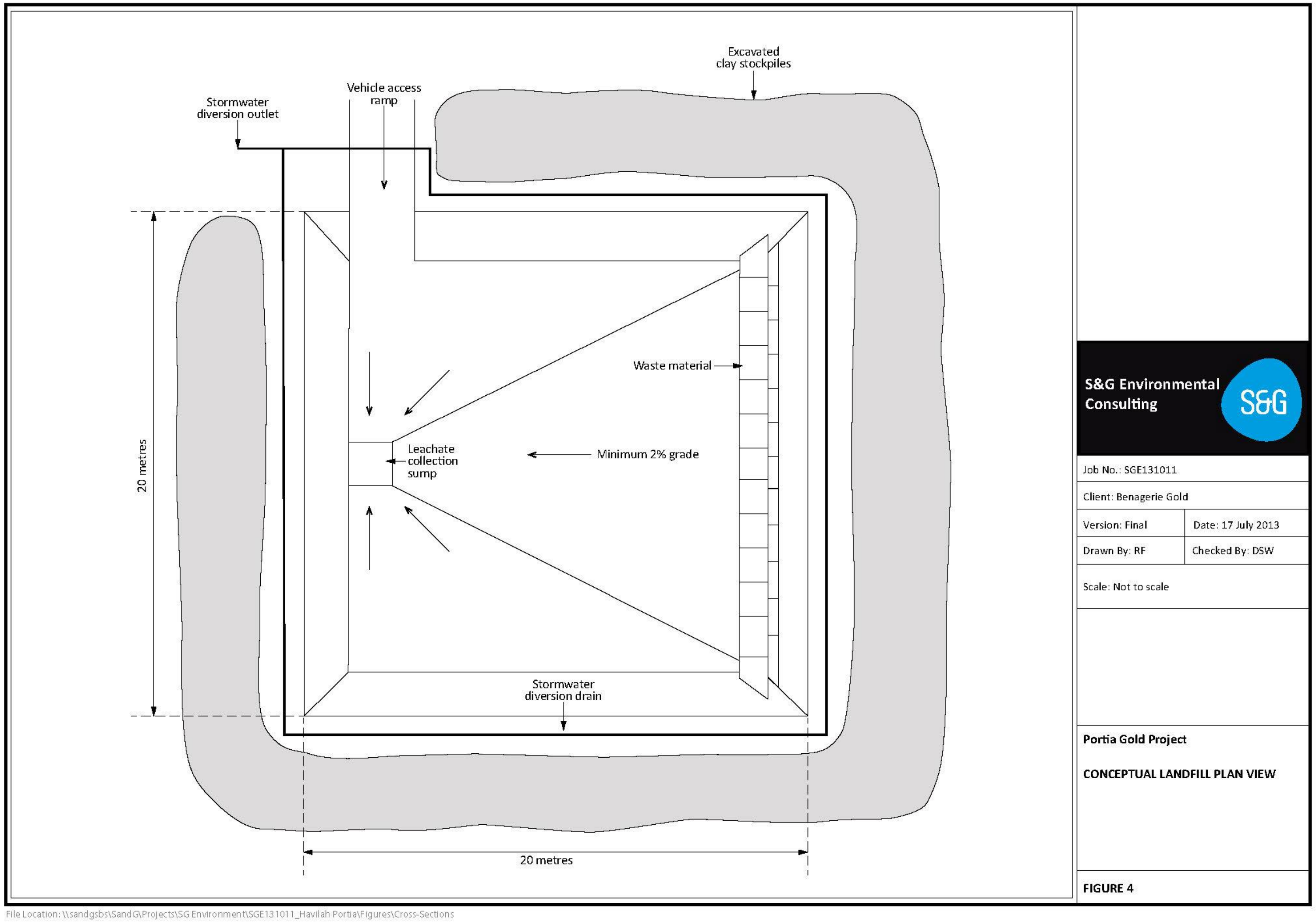


Figure 3-53: Plan View of the Landfill Design (Not to Scale)

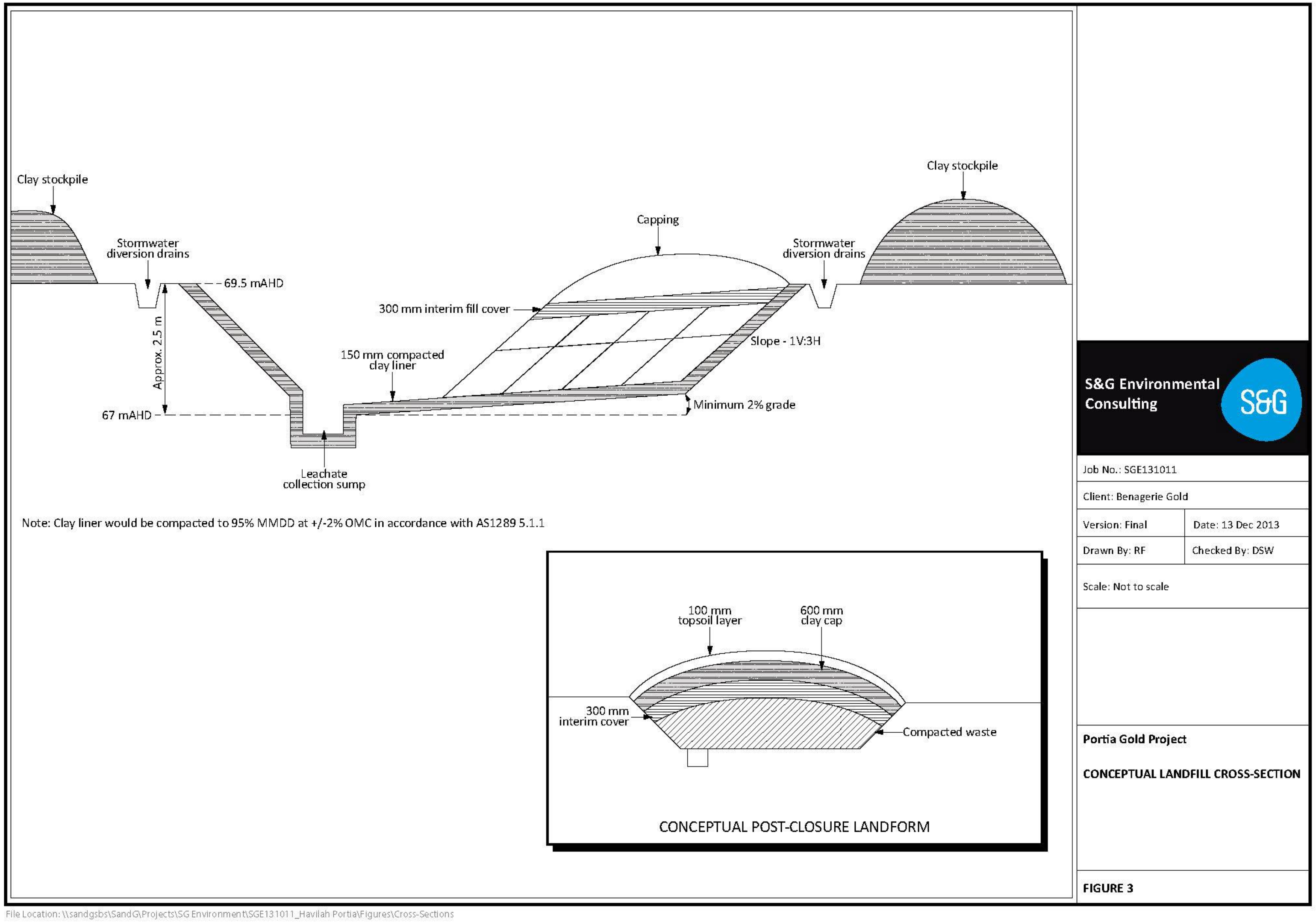


Figure 3-54: Conceptual Landfill Cross-Section (Not to Scale)

3.6.5 Care and Maintenance

Please refer to 3.4.12 Care and Maintenance, which details the care and maintenance strategy for the operation.

3.6.6 Rehabilitation Strategies and Timing

Rehabilitation is described in detail in the closure section (Section 7). Due to the small scale of the operation, progressive rehabilitation measures will be limited to the rehabilitation of access and ancillary tracks not used during operations (operational period).

The following rehabilitation strategies are proposed:

- Place overburden waste material in lifts using 777 dump trucks (or similar).
- Push out waste material to approximately 1.5 m thickness using D10 bulldozer (or similar).
- Compaction (95%) achieved by repeated dump truck passes over waste material, with compaction testing performed for each 5 m lift.
- Upon reaching finished design height in an area, smooth / trim sides and top surfaces of the OWD to achieve design batter slope angles and gradients (see Figure 3-55).
- Construct crest bunds and cross-bunding as shown in the design.
- Survey to record finished profile of the OWD landform prior to topsoil placement.
- Place topsoil on top and sides of the OWD to a depth of approximately 150 mm.
- Shallow rip (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.
- Survey to record finished rehabilitated profile of the OWD to ensure even distribution of topsoil across the landform.
- At completion of the rehabilitated OWD landform, fill in related stormwater drains and retention structures to the OWD.
- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas) including haulage roads and the internal road network around the OWD (as required).
- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the open pit.
- Grade windrows back over tracks or cleared areas.
- Seed all disturbed areas with local native grasses and shrubs.

Rehabilitation for the Portia Mine Site will occur in two stages, this is discussed in more detail in Section 7 Mine Closure.

Closure and Rehabilitation (Capping and Final Landform)

The closure design for the OWD is shown in Figure 7-15 to Figure 7-17 of the Portia *Mine Closure and Completion Plan* (see Section 7.17).

The final OWD design uses a 20 m high concave lower profile and a 15 m high concave upper profile, with a 15 m berm in between, as recommended by Landloch in Mining One (2016e) (see Appendix B8). The southern extension of the OWD utilises the 20 m high concave profile recommended by Landloch as a single lift up to 89 m RL.

During clearing and grubbing of the OWD footprint, topsoil has been / will be stored in low height stockpiles around the perimeter of the OWD, away from areas that might be subject to erosion. At closure, this topsoil will be placed as the final cover over the OWD surface.

The cover material of the closure landform will be constructed with low grades and follow a similar profile to the final waste surface. The cover profile will consist of nominally 150 mm of topsoil, as shown in the closure cover Figure 3-55. The external walls of the OWD will be sheeted with topsoil and shallow ripped on the contour to promote natural regeneration of native vegetation species.

Landloch was engaged to assess the suitability of the proposed closure cover system (nominally 150 mm topsoil with revegetation) to achieve long term erosion stability. To mitigate the risks associated with erosional stability, the following control and management strategies will be used:

1 Controlling discharge of runoff into upper and lower batters by using crest bunds;

2 Minimising tunnel erosion by minimising concentration of flows and ponding of runoff;

3 Constraining surface ripping to a maximum depth of 100 mm; and

4 Establishing a vegetation cover to maintain longer-term erosion stability.

These control and management strategies are summarised below and detailed further in the Mining One (2016e) report:

1. Control of discharge of runoff onto upper and lower batters by using crest bunds

The final OWD design assumes that there will not be uncontrolled discharges of runoff onto upper or lower batter slopes. To accommodate this, all level surfaces (waste dump tops and benches between batter slopes) must be level and be able to store both incident rainfall and any run-on from upslope areas.

Crest bunds are required to control surface water on the dump top to ensure water does not discharge from the top to the adjoining batter. Equally, a crest bund is required to be constructed on the top of the lower batter to protect it from runoff that discharges to the bench separating the two batters.

Further controls to assist in the management of water on the dump top include cross-bunding. These bunds are used to compartmentalise the dump top and minimise lateral movement of water, and should typically contain an area no larger than 5 ha.

Crest bunds must remain functional in the long term. Therefore, they must be constructed with great care, ensuring they are built to design. They will be constructed with the following properties:

- 1.0 m high at the crest of the 15 m wide bench between upper and lower batters and at the crest of the single lift when the toe of the upper lift is within 50 m;
- 0.5 m high at the crest of all remaining batters that don't require the 1.0 m high bund; i.e. the uppermost crest at 104 RL, and the crest of the southern extension where the toe of the upper lift is more than 50 m away;
- Thoroughly compacted (in a manner similar to that used to construct tailings dam walls) and constructed of stable material;

- Have their outer face continuous with the outer batter profile (i.e. same gradient);
- Have their outer face with the same surface treatments applied to it as the batter itself;
- Have a width across the top of the bund of at least 2 m; and
- Have their inner batter face sloping gradually inwards at a gradient of 1V:4H.

The gentle gradient of the inward facing batter will encourage any water that ponds on the dump top to pond well away from the outer batter slope, thereby minimising the potential for any slumping to reach the outer batter slope and cause a failure.

Where cross-bunding is used, it should have the following properties:

- 0.3 m high;
- Thoroughly compacted and constructed of stable material;
- Covered with topsoil in the same way as the rest of the landform;
- Have a width across the top of the bund of at least 1 m; and
- Have batter slope gradients of 1V:10H.

2. Minimising tunnel erosion by minimising concentration of flows and ponding of runoff

A key driver in the development of tunnel erosion is the concentration and ponding of runoff at some point. Therefore, a key aim for OWD construction is to minimise flow concentration. The cross bunds are important in reducing concentration, as is the requirement that the waste dump tops should be constructed level with sufficient surface roughness to hold rainfall excess in place.

For complex dump tops, it may be possible to create several level areas that are separated by bunding at the changes in elevation.

3. Constraining surface ripping to a maximum depth of 100 mm

Because the underlying clay waste is saline and sodic, deep ripping that mixes the waste with the overlying topsoil is highly undesirable.

Although surface ripping will undoubtedly be used to create some surface roughness as part of seeding operations, the ripping depth should be no deeper than 100 mm.

4. Establishing a vegetation cover to maintain longer-term erosion stability

For long-term erosion stability of the OWD, achievement of a vegetation cover with 10% canopy and up to 30% surface (litter and basal area) cover is desirable.

Given that the underlying clay waste is saline, consideration will be given to planting relatively salt-tolerant species. Also, as vegetation growth is important, measures to reduce grazing of the OWD following vegetation establishment will also be considered.

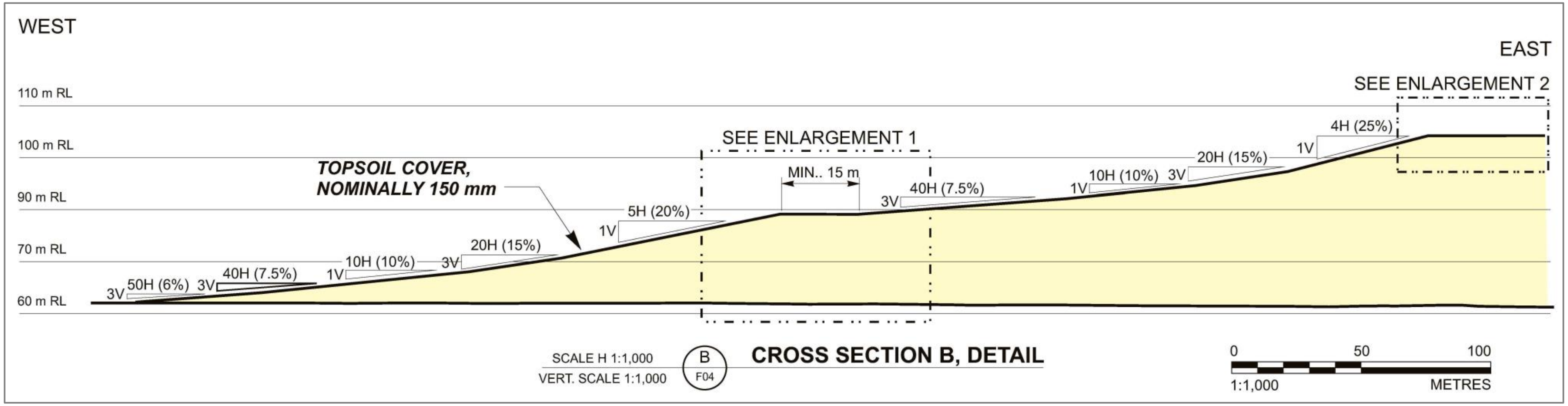


Figure 3-55: OWD Closure Cover Profile Detail

3.7 Supporting Infrastructure

Supporting Site infrastructure includes:

- offices for administration, management and technical staff;
- workshops for routine servicing and maintenance of the processing plant as well as mobile equipment. Site workshops are temporary constructions. Workshops and laydown yards have been levelled, sheeted where necessary with suitable road base and cross-graded with drainage installed to control storm water run-off and erosion;
- the laydown area and ‘Go-bay’ for mobile equipment are located adjacent to the workshop and fuel bay. The laydown area has been levelled, sheeted where necessary with appropriate material and cross graded to control storm water run-off and erosion;
- car parking areas for light vehicles located adjacent to the main Site offices, camp and processing plant;
- a small fully-catered accommodation complex;
- ablutions facilities adjacent to the main Site offices and processing plant;
- a dedicated first aid post located in the main Site offices;
- internal haul roads;
- a water disposal re-injection well field;
- pit dewatering and water management infrastructure;
- a TSF (comprised of four cells);
- a process plant area;
- a small landfill for disposal of non-recyclable and putrescible waste; and
- potable water supplied by a reverse osmosis plant.

Supporting Site infrastructure is shown in Figure 3-1.

3.7.1 Access

Access to the Portia Mine Site is via the unsealed public road from the Barrier Highway to Mulyungarie, followed by station track to Site. The location of the access route is shown in Figure 3-56. As shown in Figure 3-1, the access track from the east splits into two tracks near the Site, with one track passing directly through the centre of the Site (adjacent the pit, processing facility and through the Dusky hopping-mouse exclusion zone), whereas the other track passes to the north of these features. The access track passing through the centre of the Site provides restricted access to nearby monitoring locations and wells and access for the pastoralist around the Site to the southern end of the pastoral block.

The entrance to the Site from the access road has been appropriately sign posted to notify the public that unauthorised access to the Site is not permitted.

An access agreement has been negotiated with the property landholder.

A five-strand fence has been constructed around the perimeter of the campsite irrigation area to preclude interactions between stock and Project personnel.

No airport or airstrips are planned as part of the Site operations.

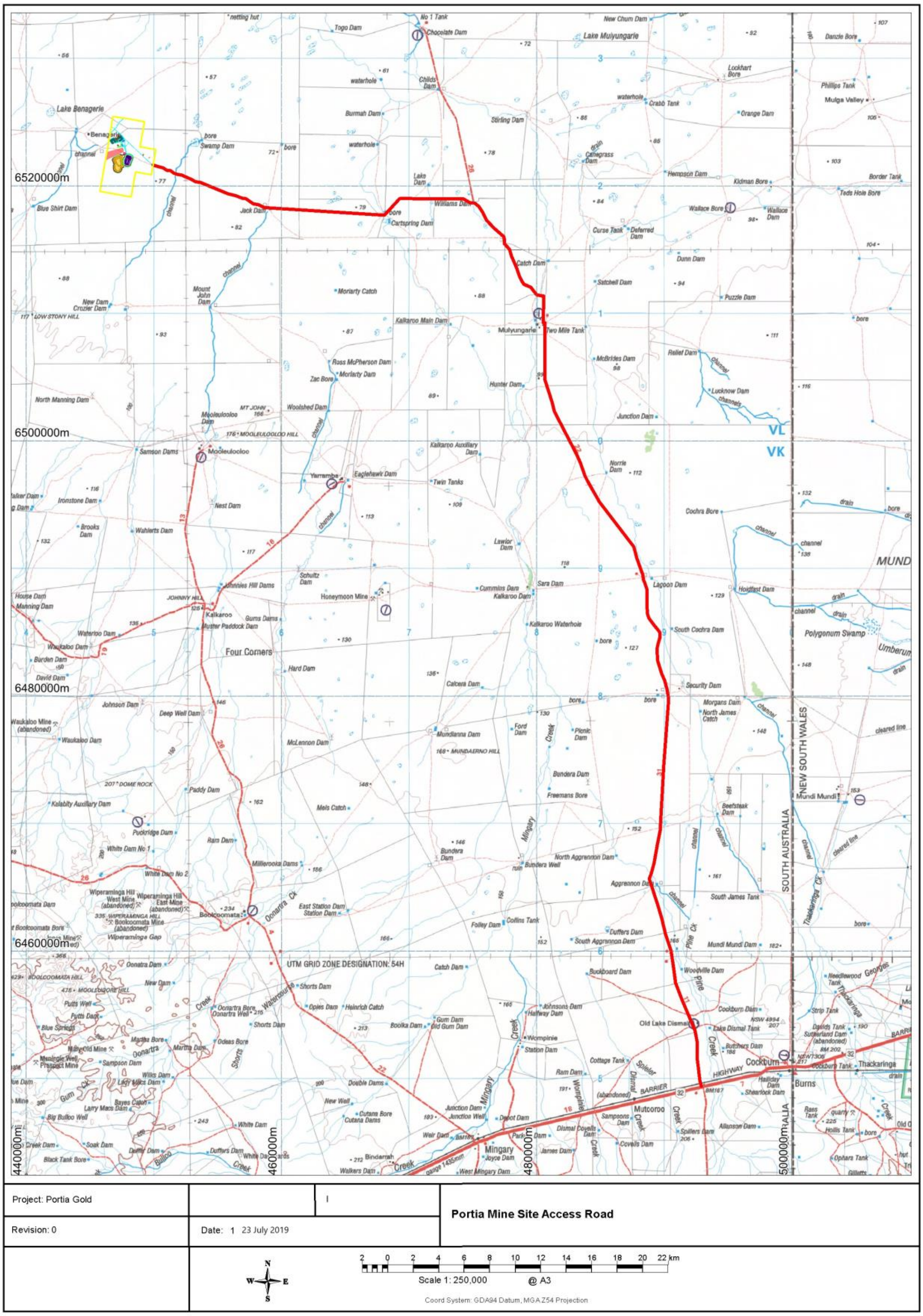


Figure 3-56: Portia Mine Site Access Road

3.7.2 Accommodation and Offices

A camp to accommodate approximately 90 people has been constructed near the main access road. The camp incorporates catering and recreational facilities and has a waste water treatment plant.

Offices and crib rooms are prefabricated buildings, also placed on blocks. Gold bars (when produced) are stored in a safe located within the Gold Room prior to despatch to the refiner for refining and sale.

The Site is supplied with potable water produced by reverse osmosis from a portion of the water available from mine dewatering.

Potable water resource line routes to office buildings and the campsite consist of small above ground pipelines. Pipelines are routed around claypans and local depressions as necessary to prevent hydrological disruption during rainfall events.

A series of one-way valves has been placed in the pipeline at strategic locations to limit draining of pipes in the event of pipeline failure or maintenance needs if necessary.

The main office complex includes an emergency first aid post, including a bed, stretcher and an RFDS medical chest. At least one person trained in first aid is available at all times when the mine is operating.

On-Site communications are by UHF radio. Off-Site internet communications are via satellite. A 3G telephone system has been installed at the Site to provide off-Site communication services.

Campsite

The camp site covers a total area of approximately 5.45 ha and comprises of a 3.1 ha irrigation area and a 2.35 ha area containing the balance of the infrastructure pertaining to the camp. It is typical of a modern small mining camp and consists of a number of prefabricated building components and related infrastructure which includes:

- 21 units of 4 bedrooms and 1 unit of 6 bedrooms, each with an ensuite;
- kitchen (12 m x 3 m) and mess complex (19 m x 12 m), including cool rooms and storage suitable for catering purposes;
- laundry (12 m x 3 m);
- separate ablution block (6 m x 3 m);
- office / visitor reception (12 m x 3 m);
- recreation room (12 m x 6 m);
- small Hydrocarbon storage area (used for power generation);
- Enviroflow septic waste management system;
- irrigation area for Class B treated water; and
- outdoor undercover area.

The area chosen for the camp is generally flat and adjacent to the main Site access road.

Topsoil has been left intact over much of the proposed campsite area in order to preserve the existing soil structure and native vegetation as much as possible. Trees have been left undisturbed. Topsoil has been removed systematically from locations within the proposed work area where infrastructure has been established and windrowed for later re-use during rehabilitation activities.

The layout is efficient in terms of the total camp size and for connection of services, including water, sewage and electricity. The prefabricated buildings are placed on dry laid blocks, precluding the need for concrete footings or any permanent fixtures. All buildings are connected by either concrete or gravel pathways. The general layout of the campsite and related infrastructure is shown in Figure 3-57. The actual constructed campsite may have minor differences to the layout shown at any point in time.

An Enviroflow septic waste management system is set up and maintained in accordance with the manufacturer's specifications.

Two independent generator sets and an associated bunded diesel fuel tank are used to supply power generation requirements at the camp.

The entire camp is designed such that it can be easily removed and the site fully rehabilitated in an efficient manner upon Lease surrender.

To enable safe management and control of traffic flow into and out of the campsite, the camp entrance road is at least 7.5 m wide, has a carriageway width of at least 3.75 m and a 1.5 m shoulder on either side of each road. The road ways have been cleared of topsoil and formed and compacted with appropriate drainage cross fall installed. The camp entrance road may be subsequently sheeted with road base so as to provide a durable surface during wet weather and to minimise excessive dust at the camp in dry times if required.

Due to the nature of the terrain and vegetation, it has not been necessary to undertake any major earthworks in order to construct the camp. The campsite area is dominated by low sandy rises and shallow depressions with sandy loam soils, all dominated by low bluebush, saltbush and bindii. Trees (black oak) have been identified during a survey of the Site and have been avoided during planning to avoid unnecessary disturbance to this plant life during construction activities. No hardstand areas have been constructed within the drip line of any existing trees.

To limit unauthorised access during construction, the entrance road to the campsite has been appropriately sign posted to notify the public that unauthorised access to the Site is not permitted.

Vehicle parking is provided adjacent to the camp entrance road in front of the camp site.

Project: Portia Gold	Author: AW	Reviewed: CG	Campsite General Layout
Revision: 0	Date: 18/10/2016		
	Scale 1 : 500 @ A3		
	Coord System : GDA94 Datum, MGA Z54 Projection		

Figure 3-57: Campsite General Layout Plan

Campsite Car Parking Area

Vehicles are not permitted in the camp area, other than for delivery of fuel, general supplies and the removal of waste or during emergency situations. A small carpark area for light vehicles is installed in front of the Camp and adjacent to the office. The location of the carparking area is shown in Figure 3-57. The parking area has been cleared of topsoil, formed and compacted with appropriate drainage cross fall and may be subsequently sheeted with roadbase aggregate in order to provide a durable surface during wet weather if needed. Personnel are bussed in and out of the camp to reduce traffic on the access roads and also to limit the need for additional vegetation clearance for camp car parking.

Waste Water Treatment Plant (WWTP)

The WWTP is an Enviroflow deployable sewage treatment plant designed for small camps. The unit provides secondary treatment to achieve class B final effluent water quality suitable for evaporation irrigation. The minimum expected final effluent quality for the plant is:

- *E. coli* of zero MPN (Most Probable Number)[8];
- BOD (median) <50 mg/L;
- Suspended Solids (median) <40 mg/L;
- TDS (median) <1000 mg/L; and
- pH of 6.0-8.5.

The WWTP is small in footprint and required no major civil work prior to its installation. The Enviroflow treatment process consists of the following stages and processes:

- Delivery of influent via pumpwell and maceration pump to a balance tank for flow equalisation;
- A primary tank for sedimentation, digestion and storage of solid matter;
- An aeration compartment for biological degradation of organic matter;
- A clarifier for further removal of residual suspended solids; and
- A final effluent tank for disinfection and storage of treated water.

The WWTP has been installed and will be maintained in accordance with the manufacturer's instructions.

Evaporation Irrigation Area

Treated water from the WWTP is pumped to an evaporation irrigation area where it is discharged via a series of low pressure micro-sprinklers and discharge lines onto the ground for evaporation and some take up by the existing vegetation. The irrigation area is 3.1 ha in total area. The irrigation area is approximately 150 m wide and 180 m long, identical dimensions to the current evaporation irrigation area which exists at the White Dam Project.

The evaporation irrigation area has not been cleared of vegetation other than for a fenceline/fire break as shown in Figure 3-58. Based on the experience gained from the White Dam Project, the levels of phosphorous and nutrient

[8] Note that previously *E. coli* (median) was measured in terms of cfu/100 mL. *E. coli* is now more commonly determined by Australian laboratories in terms of MNP (Most Probable Number).

loadings which Class B water contains had no effect on existing similar vegetation as is found to occur at Portia. Based on this experience and the similar vegetative associations which occur, the affects to native vegetation in the irrigation area caused by the discharge of Class B quality treated water within it are unlikely to cause any adverse impacts to existing vegetation. The general arrangement drawing of the campsite irrigation area is shown in Figure 3-58.

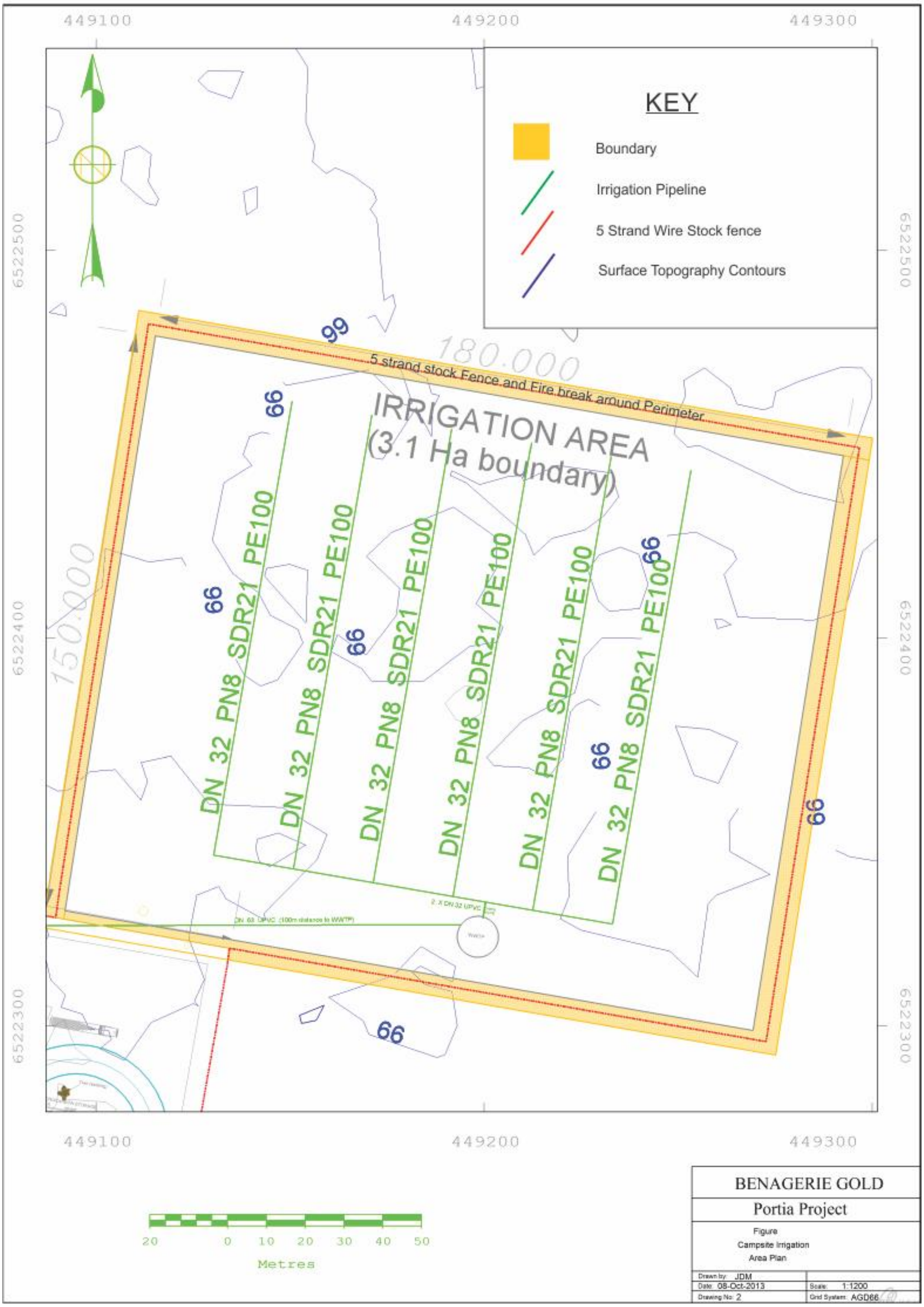


Figure 3-58: General Layout Plan of the Campsite Evaporation Irrigation Area (Design)

3.7.3 Reinjection Wellfield

Reinjection into the Shylock Paleochannel wellfield occurred at the Site during the period of late April 2015 to late January 2016. During this period, reinjection occurred at average monthly rates of up to 12 L/s (1.0 ML/d). Reinjection was recommenced during mid October 2016 and ceased in early 2018. The reinjection wellfield was used to support water management at the Site to give capacity to store water underground within the paleochannel during times of excess water (i.e. winter) and then abstract the water during periods of water shortages (i.e. during summer).

There are eight wells within the re-injection wellfield which are capable of managing approximately 11 L./s of water. These wells were previously operated under the conditions of 1.8

Water that is found to be excess to site requirements will now be disposed of via alternative water management strategies such as BP1, BP2, TSF cells and mechanical evaporation devices such as wobble tees.

The existing layout of the re-injection well field is shown in Figure 3-59.

As the reinjection wellfield will not be used for the scope of this PEPR minimal information has been supplied within the Section on the wellfield. For further information please refer to Appendix C2, C3 and C5. Please note that abstraction from the wellfield is permissible but also not currently planned as part of daily operations. As the Site is not within a Prescribed Wells Area no water licence is required for abstraction.

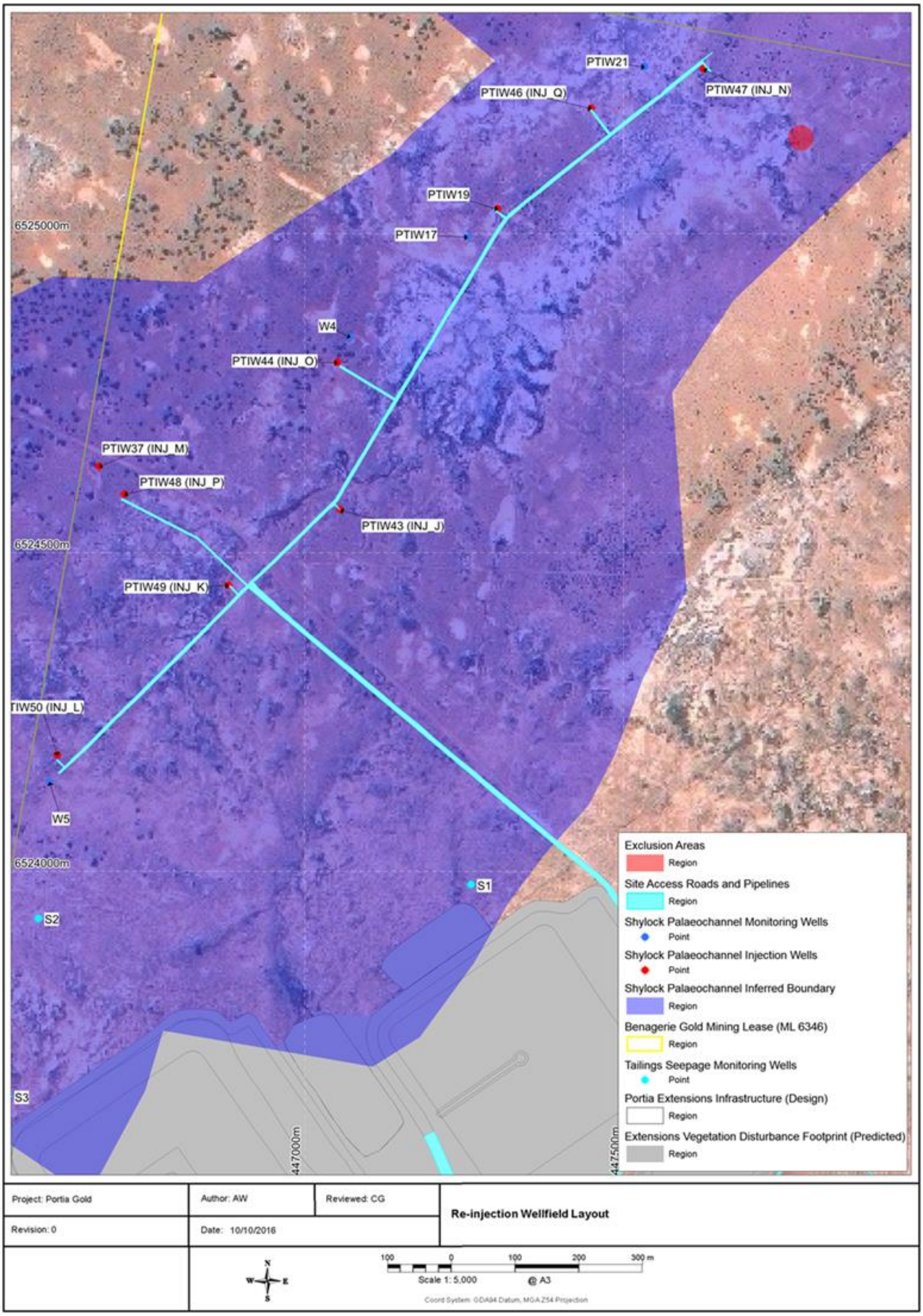


Figure 3-59: Plan view of the re-injection well field layout

Well Construction

All injection wells are cased using nominal 150 mm Class 9 PVC Casing. Casing was pressure cemented in place to the surface in accordance with National Well Drilling Standards. Sand screens were installed with a nominal aperture size of 0.8 to 0.9 mm and wells have end caps installed.

Well Headworks

A schematic of the proposed headwork design for each injection well is shown in Figure 3-60. This headwork design is suitable for applications containing low flow injections and similar head pressures.

Water enters each of the wells via a PN12 50 mm HDPE Poly pipe and valve from an offtake from the Main reinjection delivery line from the PDD. The pipeline to each well head is supported and stabilized utilizing a galvanized A-frame support and is tied to the ground with a star dropper and strap. This will prevent the risk of injury to personnel from an unplanned failure of a pipe fitting at the well.

A 50 mm electronic Turbine flow meter is installed to enable both Flow rate and Total Batch volumes to be recorded at each injection well.

A 50 mm diameter Inline Pressure Reducing Valve is located at each well head to maintain pressure at or below the prescribed maximum pressure head of 590 kPa (including an estimated 5 m component of well loss) at each injection well head. A 12 mm diameter Pressure gauge capable of reading pressures up to 750 kPa is installed at each well head to verify and record pressure at the top of the well head.

A ball valve is installed in order to manually regulate and isolate the flow of water to each well if necessary for maintenance or management requirements. At each well head, a 50 mm diameter one-way Air Valve is installed to enable air to escape during normal operation of the wells. The entire well head is bolted to each well casing utilizing typical Table D flanges with a minimum pressure rating of PN16. A PN16 T-piece is utilized at the headwork to provide added rigidity and strength and enable wells to be quickly and easily redeveloped in the event that well clogging becomes problematic.

The downhole injection pipe is secured to the Poly Flange base of each well head using a typical stainless steel BSP threaded Pipe Socket. The injection pipe consists of threaded 50 mm HDPE poly pipe installed to a depth of approximately 60 m below ground level. Typically, the pipe sits at a depth of around 38 m below the standing water level. This minimizes air entrainment and reduces the likelihood of well screens clogging up during operation and allows for this pipe to be utilized for airlift redevelopment of the wells if necessary. The injection pipe diameter has also been calculated to ensure that the velocity of the injectant entering each injection well will not introduce air entrainment.

At each well, the well casing extends approximately 200 mm above ground level and the head works extend a further 700 mm (approx.) above this. The casing above the ground has a cemented apron footing approximately 200 mm thick at the centre and 1.5 m in length and width which will provide secure anchorage for the well casing during operation at the anticipated flow rates and pressure.

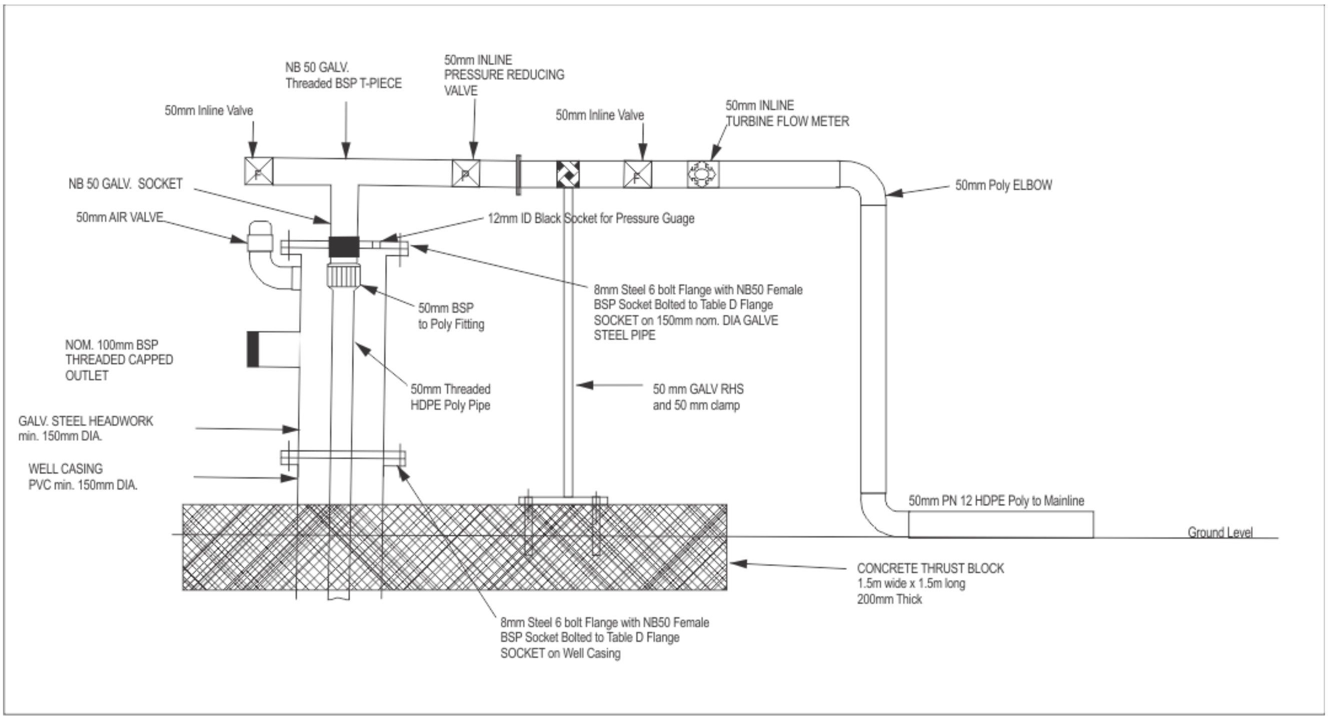


Figure 3-60: Schematic Reinjection Well Headwork Design (Not To Scale)

Process Control

Water is delivered from pit dewatering (wells and sumps) into two 42,000 L sealed poly water tanks where it is delivered to the Booster Pump System (BPS). The tanks were found to be a necessary inclusion to prevent algal blooms arising and clogging of the filtration system. Water not pumped by the BPS overflows into the PDD for use by water carts.

The BPS delivers water, at a set (but adjustable) pressure through a custom-built filtration skid. It delivers this water via a 180 mm diameter PN12.5 pipeline to the re-injection wellfield where it is pumped underground into the existing Shylock Palaeochannel sand aquifer. Up to 16 L/s can be disposed of into the well field and the plant raw water dam on an as needs basis only via a hand opened butterfly valve located at the dam outlet. A single stage filtration process has been employed utilising readily available, industrial application water filtration technology. The filtration system comprises of 8 skid mounted bag filters capable of capturing all sediment down to 1 micron in size. The system comprises of a manifold of filters and valving operating in parallel which enables the individual elements of the filtration system to be changed without interruption to the flow of water to the reinjection well field. Differential pressure of water going into and out of the filtration skid is continuously monitored to ensure that an exceedance of pressure above the manufacturers pressure rating does not occur which may otherwise cause a failure of the bag filtration system and subsequent clogging of the reinjection wells.

As described above, in line pressure reducing valves installed at each re-injection well head regulate well head pressures to ensure that the maximum prescribed pressure limit of 590 KPa (60 m) of head pressure (measured at the top of each well head) is not exceeded during injection of water into each well. Along with these engineering controls, pressure and flow measurements are recorded daily by on Site personnel to monitor the performance of each injection well and make adjustments to flows if necessary to maintain flow rates in accordance with the prescribed reinjection disposal schedule.

Baseline Groundwater Levels

Baseline groundwater levels (SWL in m BTOC) were recorded, prior to the commencement of all pumping and reinjection activities, in monitoring wells W1A, W2A, W3A (model calibration wells), PTIW17, PTIW21, W4 and W5 (Shylock

Palaeochannel monitoring wells) and in Shylock Palaeochannel reinjection wells PTIW19, PTIW43, PTIW44, PTIW46, PTIW48 and PTIW49. The baseline measurements are shown in Table 3-34.

Table 3-34: Baseline groundwater level measurements in monitoring and Shylock Palaeochannel wells

Well ID	Date	SWL (m BTOC)
W1A	2/10/2014	27.42
W2A	2/10/2014	25.13
W3A	3/10/2014	27.22
PTIW17	6/05/2013	22.00
PTIW21	6/05/2013	22.00
W4	1/02/2015	20.63
W5	1/02/2015	25.54
PTIW19	16/12/2014	22.33
PTIW43 (INJ_J)	16/12/2014	22.43
PTIW44 (INJ_O)	16/12/2014	21.44
PTIW46 (INJ_Q)	16/12/2014	21.00
PTIW48 (INJ_P)	1/02/2015	22.74
PTIW49 (INJ_K)	1/02/2015	23.06

Groundwater Quality

Groundwater quality samples were collected from the source water (nine wells around the Portia open pit) and the receiving aquifer (six wells within the Shylock Paleochannel). Samples were analysed by a National Association of Testing Authority (NATA) accredited laboratory (ALS Laboratory).

Samples were anlaysed for physio-chemical properties and dissolved metals prior to the commencement of reinjection activities (i.e. baseline measurements).

Results of the water quality for physio-chemical properties of the waters are detailed in Table 3-35, whilst dissolved metals concentrations are detailed in Table 3-36.

Table 3-35: Physio-chemical properties of Source (Mine) and Receiving (Palaeochannel) waters

			Source / Injectant (Mine) Water Quality Results									Receiving (Palaeochannel) Water Quality Results				
Well Name			**TJ1**	**PTDW1**	**JAREDS BORE**	**TJ5**	**TJ8**	**PTDW6**	**PTDW4**	**PTDW3**	**WB1**	**PTIW17**	**PTIW19**	**INJ_J**	**INJ_K**	**INJ_M**
Sample Date			**2/1/14**	**2/1/14**	**18/6/14**	**2/1/14**	**2/1/14**	**2/1/14**	**2/1/14**	**2/1/14**	**27/5/13**	**6/5/13**	**27/5/13**	**13/4/14**	**12/4/14**	**13/4/14**
Analyte	**Unit**	**LOR**														
pH Value	pH Unit	*0.01*	8.02	8.04	7.27	8	7.78	8.1	8.43	8.07	6.88	7.31	6.88	7.78	7.74	7.54
Electrical Conductivity @ 25°C	µS/cm	*1*	23,100	22,200	21,700	21,500	22,000	21,800	23,800	24,100	-	31,000	-	28,100	29,900	33,700
Total Dissolved Solids @180°C	mg/L	*10*	14,200	12,300	13,300	13,100	13,300	13,900	15,400	13,500	14,480	19,800	21,000	18,800	19,600	23,500
Hydroxide Alkalinity as $CaCO_3$	mg/L	*1*	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	*1*	<1	<1	<1	<1	<1	<1	11	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	*1*	216	158	146	168	132	269	315	152	148	159	151	159	151	159
Total Alkalinity as $CaCO_3$	mg/L	*1*	216	158	146	168	132	269	326	152	148	159	151	159	151	159
Sulfate as SO_4^- Turbidimetric	mg/L	*1*	1,660	1,810	1,720	1,750	1,770	1,870	1,740	1,850	1,660	2,340	2,150	2,000	2,180	2,480
Chloride	mg/L	*1*	7,030	6,840	6,950	6,380	6,530	7,170	7,210	7,350	6,330	10,300	10,300	8,890	9,660	10,900
Calcium	mg/L	*1*	566	538	470	485	456	518	576	541	460	740	650	636	660	767
Magnesium	mg/L	*1*	269	303	291	283	299	328	359	324	305	499	469	420	451	523
Sodium	mg/L	*1*	4,220	3,820	3,810	3,500	3,700	4,020	4,510	4,080	3,740	5,980	5,920	5,180	5,700	6,600
Potassium	mg/L	*1*	28	25	23	23	22	20	26	26	33	-	46	50	43	46
Total Anions	meq/L	*0.01*	237	234	235	220	224	246	246	249	216	-	338	296	321	362
Total Cations	meq/L	*0.01*	235	218	214	200	209	228	255	232	212	-	330	293	319	370
Ionic Balance	%	*0.01*	0.54	3.37	4.71	4.64	3.44	3.88	1.78	3.56	1.06	-	1.3	0.47	0.29	0.98

Table 3-36: Dissolved metal concentrations of Source (Mine) and Receiving (Palaeochannel) waters

			Source / Injectant (Mine) Water Quality Results									Receiving (Palaeochannel) Water Quality Results					
Well Name			TJ1	PTDW1	JAREDS BORE	TJ5	TJ8	PTDW6	PTDW4	PTDW3	WB1	PTIW17	PTIW19	INJ_J	INJ_K	INJ_M	INJ_L
Sample Date			2/01/14	2/01/14	18/06/14	2/01/14	2/01/14	2/01/14	2/01/14	2/01/14	27/05/13	6/05/13	27/05/13	13/04/14	12/04/14	13/04/14	10/05/14
Analyte	Unit	LOR															
Arsenic	mg/L	*0.001*	0.114	0.124	0.276	0.786	1.49	0.031	0.152	0.134	0.546	0.082	0.137	0.057	0.019	0.009	0.037
Barium	mg/L	*0.001*	-	-	-	-	-	-	-	-	0.023	-	0.023	-	-	-	-
Beryllium	mg/L	*0.001*	-	-	-	-	-	-	-	-	<0.001	-	<.001	-	-	-	-
Cadmium	mg/L	*0.0001*	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002	<0.0001	<0.0001	<0.0001
Cobalt	mg/L	*0.001*	-	-	-	-	-	-	-	-	0.001	-	0.002	-	-	-	
Chromium	mg/L	*0.001*	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<.001	<0.001	0.001	0.002	0.001
Copper	mg/L	*0.001*	0.004	0.005	0.004	0.024	0.004	0.004	0.004	0.004	0.004	0.006	0.006	0.026	0.006	0.008	0.003
Nickel	mg/L	*0.001*	<0.001	<0.001	0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.003
Lead	mg/L	*0.001*	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.008	<0.001	<0.001	<0.001	<0.001
Vanadium	mg/L	*0.01*	-	-	-	-	-	-	-	-	<.01	-	<.01	-	-	-	
Zinc	mg/L	*0.005*	0.007	<0.005	<.005	0.012	<0.005	<0.005	<0.005	0.009	<0.005	0.08	0.048	0.056	0.014	0.007	0.024
Iron	mg/L	*0.05*	-	-	-	-	-	-	-	-	0.16	-	0.99	-	-	-	-
Manganese	mg/L	*0.001*	0.393	0.799	0.341	0.531	0.273	0.951	0.556	0.54	0.377	1.59	1.78	1.48	1.4	2.47	1.69
Mercury	mg/L	*0.0001*	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

3.7.4 Public Services and Utilities used by the Operation

Access to the Site is from the Barrier Highway by public road to Mulyungarie Station and then via station tracks (Figure 3-56). Due to the anticipated limited vehicle movements and the remote location, vegetation and screening is not considered necessary. In addition, due to the short period of operation and very low rainfall and high evaporation, it is unlikely that screening vegetation would be successfully established during the period of operation.

To limit unauthorised access, the entrance to the Site from the access road at Mulyungarie Station has been appropriately sign-posted to notify the public that unauthorised access to the Site is not permitted.

The track passing through the centre of the Site provides restricted access to nearby monitoring locations and wells and access for the pastoralist around the site to the southern end of the pastoral block.

3.7.5 Visual Screening

Do to the remoteness of the operation no visual screening using plants has been undertaken at the operation or camp facilities. Where possible existing native vegetation has been retained.

3.7.6 Fuel and Chemical Storage

All chemicals used at the Site are stored in accordance with guidance provided in the SA EPA *Guidelines for Bunding and spill management* (updated August 2012). Flammable and combustible materials are stored in accordance with *Australian Standard 1940: The Storage and Handling of Flammable and Combustible Liquids*.

The main hydrocarbon storage area consists of three double-bunded (self-bunded) diesel storage tanks located adjacent to the main workshops. Temporary on-Site chemical storages, such as drums and smaller containers, are stored on 'spill containment pallets'. Temporary bunding arrangements ensure that there is only localised contamination in the event of a spill. The storage of Cyanide will be in a 20ft sea container within a locked, secure compound located within the current processing plant footprint. The gates of the solid storage area will be locked when cyanide is not being removed or delivered or when it is unattended.

A spill response kit (containing absorbent padding and other spill containment items) is available at the hydrocarbon storage area and easily accessible to personnel during refuelling operations. Additional spill response kits (containing sodium hypochlorite solution) will be made available at the processing plant. Site personnel are suitably trained in spill response procedures and familiar with use of the spill kits. The contents of spill kits are checked and replaced as needed from time to time. All chemical storages, bunds and spill containment pallets on Site are routinely inspected to ensure maintenance of their integrity.

3.7.7 Site Security

There is one access to the Portia Mine Site via the access road from the Barrier Highway. All visitors are required to report to the camp administration office where onsite personnel are responsible for:

- Check-in and out of all visitors and staff;
- Inductions;
- Being the central contract point for onsite security; and
- Ensuring Site specific safety information is provided.

No unauthorised personnel will be allowed to access the Site. Signage has been appropriately sign posted to notify the public that unauthorised access is not permitted.

3.7.8 Stormwater, Silt Control and Drainage

Dirty Water Stream Management

A minor amount of 'dirty water' is generated on the Site. Dirty water streams consist of:

- Ore processing water;
- Leachate from the Landfill collection sump; and
- Run-off from in-pit sumps and collection sumps associated with the, the ROM Pad, overburden waste dump and office and mining laydown area.

All dirty water streams report to the raw water dam where they will be used by the processing plant once the plant is in operation. To this end, if significant water accumulates, this water will be pumped to the RWD for use in processing. Runoff generated within the pit can be pumped to the RWD for use in processing, with surplus water being pumped to either the reinjection well field, the large process water dam or the TSF cells depending on operational requirements.

Run-off and Sediment Control Structures

Erosion control strategies for the OWD were detailed in Section 3.6. In addition to run-off and erosion control strategies on the OWD itself, surface water collection trenches, bunds and sumps will be installed around the OWD, ROM Pad, the Office and mining hardstand area, the TSF and within the landfill. Spoon drains or toe drains are nominally 2 m wide by 300 mm deep and bunds are constructed to enable surface water to drain to local low points adjacent to each structure. Small sumps, approximately 1 m deep are constructed at the end of each drain to allow suspended sediment to settle. The sumps are designed to capture surface run-off and benign sediment loadings caused by run-off during heavy rainfall. Accordingly, the surface water collection sumps are not lined.

All surface runoff control measures implemented for the Site were designed using the 1 in 10-year, 72 hour average recurrence interval (ARI) for the Site of 88 mm. This recurrence interval is considered appropriate for the current short LoM.

Due to the flat topography, large surface water inflows to the Site are not expected to occur. The abandonment bund will preclude surface water runoff from entering the pit. This is augmented during operation, by a low bund constructed on the haul road at the entrance to the pit to prevent water funnelling into the open pit via the ramp entrance as well as safety bund placed approximately 10 metres away from the crest of the pit.

A map showing surface runoff controls (design) is presented as Figure 3-61.

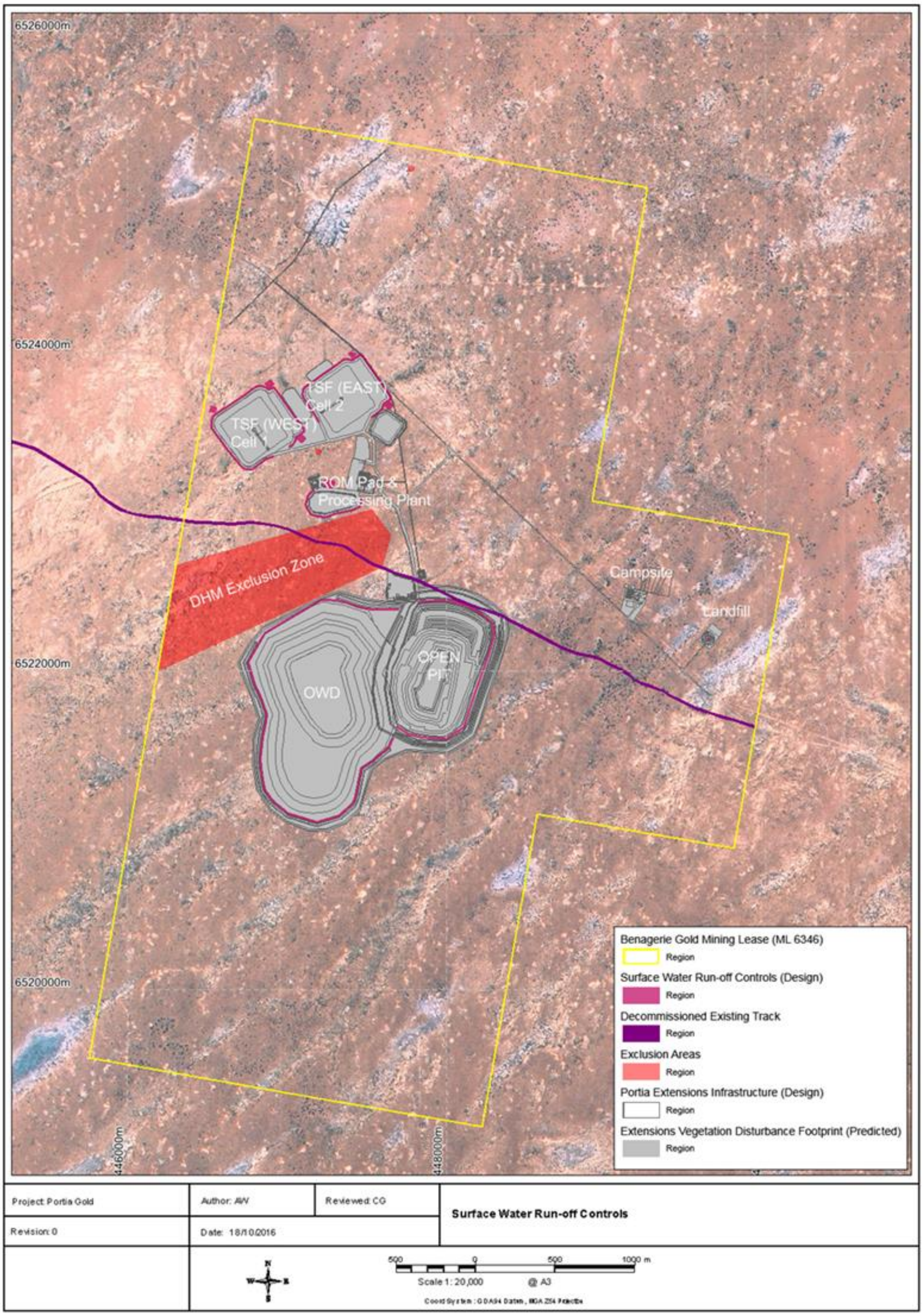


Figure 3-61: Surface run-off control structures (design)

3.7.9 Care and Maintenance

Please refer to The current roster for mining is 24hours per day (two shifts), 7 days per week. Processing is also 24 hours per day (two shifts), 7 days per week. This may be revised as necessary to suit the mining and processing plan.

Care and Maintenance 0, which details the care and maintenance strategy for the operation.

3.7.10 Rehabilitation Strategies and Timing

Rehabilitation is described in detail in the closure section (Section 7). Due to the small scale of the operation, progressive rehabilitation measures will be limited to the rehabilitation of access and ancillary tracks not used during operations (operational period).

The following rehabilitation strategies are proposed:

- Remove all buildings infrastructure, waste materials (in accordance with the Waste Management Plan), disconnect and terminate all services;
- Remove pumps, pipelines and power supply lines (to reinjection well field);
- Cap and decommission all wells, including re-injection, dewatering and monitoring wells, in accordance with DEW requirements;
- **Break up and remove any concrete footings and dispose to the Portia open pit;**
- Deep ripping (up to 300 mm depth) will occur for all compacted areas (hardstand and trafficked areas);
- Visual salt crust build-up will be removed;
- Grade windrows back over tracks or cleared areas;
- Reshape or profile individual areas as necessary to blend in with the surrounding environment and reduce erosion potential;
- Topsoil placed on previously disturbed areas;
- Where required any disturbed land will be shallow ripped (up to 100 mm) and contoured to be consistent with the pre-mining ground surface;
- Fill in related stormwater drains and retention structures;

Rehabilitation for the Portia Mine Site will occur in two stages, this is discussed in more detail in Section 7 Mine Closure.

3.8 Vegetation Clearance

3.8.1 Description of Vegetation Clearance

Under the previous version of the PEPR (version 4.2 2016) approval was granted for the disturbance of up to 372.2 ha of land on the Portia Mine Lease, which is being offset by an on-ground Significant Environmental Benefit (SEB) offset area on Kalkaroo station in accordance with the Native Vegetation Management Plan (Appendix F1) endorsed by the Native Vegetation Council (NVC) of South Australia. The Kalkaroo Station is owned and operated by Kalkaroo Pastoral

Company, a wholly owned subsidiary of Havilah. Kalkaroo Station (Lease Number PE 2278) was purchased from Uranium One Australia Pty Ltd by Havilah in late 2014.

The disturbance of 372.2 ha of land on the ML required an offset of 965.9 ha of land to be managed within the SEB, however Kalkaroo Pastoral Company managed a SEB offset area that is approximately 3,232 ha (32.32 km2), more than three times greater than that required. The reasons for this were to facilitate achieving an environmental benefit at a larger scale across the station, while also allowing for credits for future projects should they be required.

A review of the SEB offset calculation was undertaken by Ecological Australia (2019) using methods required the *Native Vegetation Regulations 2017.* Previous clearance as per the PEPR approval (2016 version 4.2) associated with the development of the Portia Mine Site required an initial offset of 5,089.61 SEB credits (approximately 21.13% of the Kalkaroo SEB offset site). The activity proposed in this PEPR requires an additional 20.77ha of clearance which requires an additional 803.97 SEB credits. The Kalkaroo SEB Offset area was determined to currently contain a total of 24,081.59 SEB credits.

Details of the calculations for the previously approved SEB requirements under the *Native Vegetation Regulations 2003* are provided in Table 3-37.

Table 3-37 Previous approvals as per PEPR 2016

Area	Area of Disturbance (ha)	Initial SEB Ratio	Initial SEB Offset Area (without Onsite Restoration) (ha)	Area to be Restored (ha)	SEB Offset Area (with Onsite Restoration Reductions (i.e. 50% Reduction for areas to be Restored) (ha)
Portia Open Pit	110.75	4:1	443.00	0	443.00
Other Areas	261.45	4:1	1045.80	261.45	522.90
Total	**372.20**	**4:1**	**1,488.80**	**261.45**	**965.90**

Table 3-38: Reviewed clearance areas under the scope of the PEPR 2016

Area	Area of Disturbance (ha)	Initial SEB Ratio	Initial SEB Offset Area (without Onsite Restoration) (ha)	Area to be Restored (ha)	SEB Offset Area (with Onsite Restoration Reductions (i.e. 50% Reduction for areas to be Restored) (ha)
Portia Open Pit	65.83	4:1	263.32	0	263.32
Other Areas	215.74	4:1	862.96	215.74	431.48
Total	**281.57**		**1,126.28**	**215.74**	**694.8**

Whilst 372.2 ha were approved for native vegetation disturbance on Site, the most recent reconcile of disturbance demonstrated that only 281.57 ha has been cleared onsite (see **Error! Reference source not found.**).

As part of the PEPR 2019 (this document) proposed activities minimal further native vegetation clearance will be required including:

- Approximately 16.98 ha associated with the construction of TSF-3 and TSF-4 (including roads);
- Approximately 3.8 ha associated with the construction of BP2 (including roads, this disturbance was approved to occur under existing credits through an approved Notification of Change assessment in 2018); and

As such the native vegetation clearance to occur on Site over the next 12 months associated with this PEPR will be 20.78 ha, bringing the site total vegetation clearance to 302.35 ha.

The SEB offset requirements for this 20.78 ha of clearance will continue to be managed through the Kalkaroo Offset area. As Havilah no longer own the ML relating to Portia Mine Site, it is planned that this will be achieved through a Third-Party Provider (Kalkaroo Pastoral Company) committing to the protection of land on behalf of BGC for Portia Mine Site disturbance, which is permissible under Section 25C of the *Native Vegetation Act 1991* (SA) ('Native Vegetation Act'). This will be managed through a Management Agreement between Havilah (Kalkaroo Pastoral Company) and the Minister and will be binding on any future owners or occupiers of the land.

3.8.2 Kalkaroo SEB Offset Area

Kalkaroo Station is located in the northeast pastoral region of South Australia and is located within the South Australian Arid Lands Natural Resources Management Board (SAAL NRMB) region, approximately 10 km south of the vermin proof fence (the 'dog fence'). It occurs within the Northern Olary Plains Biological Region (Playfair and Robinson, 1997). Based on the Interim Biogeographic Regionalism for Australia, it is located in the Strzelecki Desert, Western Dunefields sub-region within the Simpson Strzelecki Dunefields Bioregion (Commonwealth of Australia, 2014). The major features of the bioregion include dunefields, sand plains and salt lakes.

According to Laut *et al.* (1977), the Site is within the Benagerie environmental association, which is characterised by a broad plain on sand and calcrete partially overlain by dunes, with sporadic floodout areas. Typical vegetation cover varies from low open woodlands and low Atriplex (saltbush) and Maireana (bluebush) shrublands on the plains, to tall shrubland and low woodland on the dunes (KBR, 2011).

Vegetation communities surveyed to date (Badman, 2008a and KBR, 2011) were considered to be disturbed, and in some areas, degraded to severely degraded. All have been and continue to be grazed by domestic herbivores (sheep and cattle), European rabbits, house mice and native herbivores.

Further information relating to the recent assessment of the ML and the Kalkaroo SEB Offset Area can be found in Appendix A7.

3.9 Mine Completion

3.9.1 Description of Mine Site at Completion

On completion of the operations, remnant landforms at the Portia Mine Site will be limited to the open pit void (Portia), the abandonment bund, the rehabilitated TSF cells (TSF-1, 2, 3 and 4) and the rehabilitated OWD. The offices, camp, workshop, access roads, water storage dams (BP1, BP2, RWD), water collection systems, landfill and processing areas will all have been removed and or levelled, covered with topsoil and revegetated (ripped and seeded). The TSF cells will be allowed to dry out prior to infilling with stored capping material (overburden) and covered with topsoil and then seeded. Tube stock for trees will not be planted during mine rehabilitation as the soils and rainfall in the region generally does not support larger vegetation. Trees and larger shrubs will also not be used in the rehabilitation of the TSF cells due to the increase risk of capping layer failure.

The Portia open pit will remain a net groundwater sink with ongoing loss of groundwater evaporation. The groundwater in the pit will become increasingly saline as the salts are left to concentrate. As the pit lake salinity increases less soluble salts such as carbonate minerals will begin to precipitate and settle to the base of the pit. The saline lake will eventually reach saturation with salt (NaCL at around 360 g/L TDS) and that that point NaCl salts will begin to crystallise and settle to the base of the open pit. Given ambient TDS values are >12,000 mg/L, an additional increase in salinity or TDS will not change the environmental value (beneficial use) of the groundwater resource, currently limited to industrial use.

The water levels will continue to rise within the pit void reaching a steady state after approximately 10 years. Steady-state drawdown is approximately 8 m below the initial standing water level or 43 m below the groundwater surface.

As discussed in this PEPR there will be no PAF material mined or excavated as part of the Portia open pit or reprocessing of tailings material. As such there is no ongoing requirement to manage or monitor PAF at mine completion.

There will be no surface water infrastructure remaining at mine completion.

Disturbed land, where possible, will be shaped to resemble the pre-mining natural contours of the landscape.

Post mining land use will revert back to pastoral use with the exclusion of the open pit void and the land within the abandonment bund. Ongoing consultation with the pastoral lease holder of Mulyungarie Station as well as the land owner (the Crown) will be required in the lead up to closure to understand stakeholder requirements.

An agreement will be developed, with the pastoral lease holder which outlines the handover process (if any) of any remaining infrastructure such as groundwater wells and roads that the landholder may wish to use following Lease relinquishment. It is understood that if any infrastructure is agreed to remain on the land that its use by the pastoral lease holder may be subject to further approvals and agreement to the infrastructure remaining from the Crown.

Rehabilitation is described in detail in the *Mine Closure and Completion Plan* (Section 7). Progressive rehabilitation measures will include the rehabilitation of access and ancillary tracks not used during operations (operational period), followed by two stages of rehabilitation upon completion of Portia open pit mining. These are:

1) **Stage 1:** The drying out and filling in of the TSF cells, the covering and rehabilitation of the OWD, the infilling and levelling of the water storage dams and the completion of the abandonment bund.

2) **Stage 2:** The removal of the camp, office and workshop facilities, the infilling of the landfill followed by topsoil placement and revegetation.

Concerning stage 1, overburden will be used where required to infill structures, the faces of the OWD and TSF cells will be battered and sculpted to designs, stockpiled topsoil will be spread over disturbed areas and lightly scarified or shallow ripped. Locally sourced seed stock will be spread to facilitate revegetation.

Plans, cross-sections and figures can be found in the *Mine Closure and Completion Plan* (Section 7).

3.9.2 Rehabilitation Liability Estimate

A review of the rehabilitation liability estimate has been undertaken as part of this PEPR review process. The rehabilitation liability has been estimated using the South Australian Mine Rehabilitation Liability Calculator Tool version 4.20 as provided by DEM. The rehabilitation liability estimate is based on the assumption that a third-party contractor is required to undertake the rehabilitation and decommissioning works in an instance where BGC are unable to meet their rehabilitation and decommissioning obligations. The liability does not take into account revenue from re-sale of items from the Site.

The estimated rehabilitation liability for the new scope of the Portia Mine Site (this PEPR) is $3,230,552.00. This estimate will be reviewed in consultation with DEM during the formal assessment process.

A summary of the history of the estimated rehabilitation liability costs for the Portia Mine Site are summarised in Table 3-39.

Table 3-39 Portia Mine Site Rehabilitation Liability Estimate History

Version	Estimated Rehabilitation Liability
2014 PEPR (version 3.4)	$1,833,00.00
2016 PEPR (version 4.2)	$2,445,042.00
2019 PEPR (version 5.0)	$3,230,552.00

BGC maintains a financial security in the form of a bond with the South Australian Government in accordance with Section 62 of the Mining Act for the Portia Mine Site. An unconditional bank guarantee of $1,954,000.00 was provided to the South Australian Minister for Mineral Resources and Energy on 9 February 2015, prior to the commencement of the Project.

3.10 Resource Inputs

3.10.1 Workforce

Approximately 45 full time personnel are directly employed at Portia. The operation also has additional technical support provided by consulting specialists in key fields of environmental management, mining engineering, geotechnical engineering, processing and metallurgy.

A summary of personnel required during mining and processing operations is presented as Table 3-40. It should be noted that this is indicative only and subject to regular change depending on the requirements of the mining and processing plan.

The majority of on-Site personnel have been recruited from either nearby settlements, Broken Hill, Adelaide or the northern towns of South Australia.

Table 3-40: Personnel Summary

DEPARTMENTS	SHIFT 1	SHIFT 2	TOTAL
PROCESSING AREA			
Project Manager (Processing)	1		1
Plant Manager	1		1
Plant Supervisor	1	1	2
Plant Operator / Maintenance	2	2	4
Metallurgist / Goldroom Supervisor	1		1
Goldroom Operator	3		3
Loader Operator	1	1	2
SUB TOTAL EMPLOYED	***10***	***4***	***14***
MINING AREA			
Mine Manager	1		1
Mine Surveyor	1		1
Mining Engineer	1		1
Production Manager	1		1
Camp/Administration Manager	1		1
Safety/Training/Environmental Advisors	2		2
Excavator Operator	3	3	6
Truck Operator	2	2	4
Water Truck Operator	1	1	2
All-rounder (Grader/dozer)	2	2	4
Workshop Manager	1	1	2
Fitters	1	1	2
Servicemen	1	1	2
SUB TOTAL EMPLOYED	***18***	***11***	***29***
CATERING & ACCOMMODATION			
Cooks, Cleaners and Camp Maintenance	1	1	
SUB TOTAL EMPLOYED	***1***	***1***	***2***
SITE TOTAL	***28***	***16***	***45***

3.10.2 Energy Sources

Portable diesel generator sets are used to supply power to the Mine Site operations, infrastructure, gold room and camp. Power is supplied via 415V and 240V.

Generator sets required to supply the process plant and offices are located within the general infrastructure layout, whilst generator sets required for the camp are located within the hydrocarbon storage area. Fuel is supplied from a self-bunded diesel fuel tank.

Predicted power requirements for the operation are estimated to be 660 kW. A breakdown of the estimated power requirements is shown in Table 3-41.

Predicted power requirements for the camp during its operation will be 270 kW and this operational design criteria has been used in the basis of design of the proposed campsite and the quantity of diesel necessary to be stored at the campsite. The Camp has no LPG facilities and therefore will not require the use of LPG fuel.

Table 3-41: Predicted Site Power Requirements

Infrastructure	Power (kW)
Processing Plant	455
Site offices and Ablutions	20
Workshop and Pump Delivery	33
Dewatering wells	29
Camp	270
Total	**807**

The fuels needed for the operation are presented in Table 3-42.

Table 3-42: Expected Fuel Usage and Storage Volumes

Reagent	Annual Use	Stored Mass or Volume
Diesel (kL)	4,400	170
Oils (L)	5,000	1,600

There is limited scope for energy efficiency gains due to the fact that there are no other practical sources for more than 95% of energy required other than diesel generators. Solar hot water services will be used where practicable. There are no zero emissions energy or carbon offsets proposed to be used at the Portia Mine Site.

3.10.3 Water Sources

Water from in pit sumps is discharged into the PDD and used on-Site for mining, processing, dust suppression and for the RO plant that supplies potable water for the Project. Water deemed excess to Site requirements will be evaporated by a lined evaporation pan on the waste dump and evaporators on the TSF's and/or provided to the local landowner for stock use. The reinjection system installed in 2015, does not provide adequate reliability and sufficient losses to meet requirements for pit drawdown and is not cost efficient. D&D Permits have not been renewed. If re-injection is to occur in the future, BGC will commence the process of relicensing the bores.

During ore processing, the majority of water from the PDD is expected to be diverted to the RWD and to either BP1 or BP2 (when required) for use by the processing plant.

As a contingency measure, water may also be extracted from the re-injection wellfield and delivered directly to the RWD for use in processing. The use of this wellfield is subject to further approval through DEW through a Drain and Discharge permit. It is not planned to use the wellfield for the scope of this PEPR.

During mining, any water ponding within in-pit sumps after periods of high rainfall or from inflows encountered during mining will be pumped directly to the PDD and either sent to the RWD. BP1 or BP2 for use in processing.

There is no water discharged to the environment at the Portia Mine Site. The discharge of water would only occur in exceptional circumstances and would be agreed to with DEM prior to disposal.

4 DESCRIPTION OF POTENTIAL BENEFITS

This Section describes the benefits of the Portia Mine Site in terms of its social, economic and environmental effects.

4.1 Social Benefits

The surrounding pastoral station residents, while being self-contained and resilient people, exist in a remote and sometimes lonely environment. BGC strive to use the services of the surrounding station personnel and offer jobs to local people as a priority.

BGC has been well supported by the local population in these endeavours.

BGC will continue our active involvement with the local residents and engage them both in awareness of operations as well as offering employment wherever possible. This can help improve their social interaction and create a new flux of activity and development in the area. Remembering that the local permanent population is less than 10 people, mining at the Portia Mine Site will have a significant helpful impact on the local people and a positive effect in the Broken Hill region.

With the vagaries of the rural industry, employment is sometimes low in remuneration and sporadic. There is an excellent skill pool of staff on the rural properties and they are generally well suited to mining activities if they so desire. Several local people are employed in at the Portia Mine Site and the majority of BGC's employees are from the nearby Broken Hill region.

Mining activities strive to integrate and co-operate at all levels with pastoral activities.

BGC staff are currently driven by light vehicle to Site from Broken Hill at the beginning of each rostered working period and similarly driven by light vehicle back to Broken Hill at the end of each rostered working period. Management personnel from BGC travel to and from Site by either light aircraft or light vehicle.

As part of the NTMA, BGC has undertaken to train and employ aboriginal people who are willing to travel and work at the Portia Mine Site. Where skilled workers are not readily available, training will be offered to bring skill levels to those required. The jobs offered will assist in reducing unemployment in the northern areas of South Australia and adjacent Broken Hill.

Local communities will directly benefit via employment and increased prosperity. Since the Project area is remote from the communities, other infrastructure spin-offs, such as power, water, medical facilities will be of minimal impact.

4.2 Economic Benefits

4.2.1 Flow-on Economic Benefits

The Portia Mine Site will continue to and has made a large financial contribution to the local economy. Small settlements at Yunta, Olary and Cockburn, not to mention the major settlements of Broken Hill and Peterborough receive the benefits of the cash influx from the operational and investment expenditure. At the time of the ML application this was approximated to be of the order of $20 million per annum in salaries and related outgoings alone. Many services like fuel supply, engineering and electrical services will be supplied by local firms.

4.2.2 Royalty

BGC will continue to pay royalties to the South Australian Government at the prescribed rate in accordance with the Mining Act. This is based on the original production estimate of 53,200 ounces of gold and should generate a royalty of approximately $2.83 million, assuming 95% recovery and an average gold price of A$1,600 per ounce.

It should also be noted that the extensions to the north and south of the Portia open pit and the reprocessing of tailings material will contribute further to royalties paid to the South Australian Government.

No land on the ML has been acquired as part of the Project, but a Lease and compensation arrangement has been entered into with the local pastoralist, as part of the access agreement.

4.3 Environmental Benefits

Detailed study and monitoring of the environment during the pre-mining, operational and post closure phases will provide new observational data and also record the local meteorological inputs. In particular, new information will be obtained about the hydrogeological systems and flora and fauna species present in the area.

During operations Site personnel will have the opportunity to work on targeted weed control measures in the area, focussing on the control of recognised problem weed species, such as Noogoora burr, Bathurst burr and other high threat species and the prevention of their spread during the life of the Project. Site personnel will also be able to work on the control of pest faunal species in the area including rabbits, foxes and wild dogs, known to have a substantial impact on native flora and fauna species.

5 STAKEHOLDER CONSULTATION

This Section summarises the consultation that has taken place with stakeholders during the preparation of the ML application, during preparation and various updates of the PEPR and during operations to date.

5.1 Consultation Program Objectives

The primary goals of BGC's consultation program are to:

- achieve mutual understanding between BGC and its stakeholders; and
- ensure the smooth and efficient development and operation of the Portia Mine Site.

The specific objectives that will allow these goals to be met include:

- stakeholders are involved in the impact assessment and permitting process;
- stakeholders are well informed about the Project and its potential impacts;
- issues or concerns are addressed as early as possible;
- the appropriate regulatory requirements are met; and
- positive stakeholder relationships are established and maintained throughout the Project life (i.e. from permitting through to construction, operations and closure phases).

These objectives are being met by the establishment of a consultation framework and program that is supported by relevant technical investigations throughout Project development. A feature of the program is, and will continue to be, BGC's willingness to ensure that the focus is on consultation, i.e. a two-way communication process that involves both talking and listening, rather than simply information dissemination. The consultation program associated with the Project is therefore consistent with BGC's corporate consultation program, which is based on the principles of communication, transparency, collaboration, inclusiveness and integrity.

5.2 Stakeholder Analysis

A list of key stakeholders has been identified and additional stakeholders may be added as the mine progresses.

Stakeholders with an interest in the Portia Mine Site include:

- The 'local' community which comprises pastoralists on a number of properties (i.e. Mooleulooloo, Mulyungarie, Yarramba, Kalkaroo, Boolcoomatta and Strathearn pastoral leases).
- The Adnyamathanha and Wilyakali Peoples as recognised Native Title Claimants (in relation to the Mine Site).
- South Australian Aboriginal Affairs and Reconciliation (AAR).
- Commonwealth Department of the Environment and Energy (DoEE).
- South Australian Department for Environment and Water (DEW).
- South Australian Native Vegetation Council (NVC).

- South Australian Pastoral Board.
- South Australian Department for Mining and Energy (DEM).
- South Australian Department of Planning, Transport and Infrastructure (DPTI).
- South Australian Arid Lands Natural Resources Management Board (SAAL NRMB).
- South Australian Environmental Protection Authority (EPA).
- South Australian Department of Health (SA Health)
- SafeWork SA.
- Boss Uranium Pty Ltd (as a user of the Mulyungarie Road).
- ‘Peripheral’ communities, i.e. communities that are located near the Project area and may or may not be affected by the Project in some way, e.g. through increased employment opportunities. These comprise the townships of Yunta, Olary, and Cockburn, and the city of Broken Hill (the source of most staff).
- Cockburn Progress Association.
- ‘Other’ communities, i.e. communities that are distant from the Project area and that may still be affected by the Project in some way. These include Aboriginal communities of the Southern region and the cities of Port Pirie and Adelaide.
- Media (regional, state and national).
- General public (particularly within South Australia).
- Mining industry, e.g. other mineral explorers or producers in the area, South Australian Chamber of Mines and Energy (SACOME) and the Minerals Council of Australia (MCA).

5.3 Consultation Undertaken

An effective, ongoing consultation program involving BGC, State Government, ‘local’ residents and communities, indigenous groups and other stakeholders is essential to the successful development of the Project. Consultation has commenced with key interest groups during planning and permitting phases and will continue during the remaining Project construction and operational phases through to mine closure and Lease surrender.

Consultation study focusses on liaison with key state and Australian government agencies and with pastoral leaseholders.

Since the early consultation undertaken during development of the MLP and PEPR, consultation has expanded to include a broader range of organisations and individuals.

Appendix H details key consultation events that have occurred to date. It should be noted that the table in Appendix H is by no means an exhaustive list and does not aim to detail each and every consultation event undertaken (e.g. every phone call, email, meeting, etc.). Rather it provides details of the key consultation events undertaken where important Project issues were discussed and outcomes or actions agreed.

5.4 Ongoing Consultation Process

The consultation program is ongoing and will continue throughout the life of the Project to ensure due consideration of all Project-related opportunities and concerns. BGC's approach to ongoing consultation is outlined in Table 5-1.

Table 5-1: Planned Ongoing Consultation

Stakeholder	Planned Consultation Process
Local Pastoralists	Provide regular briefings on work programs (as required). Provide information sessions on the impacts of the operations and the outcomes (as required). Regular and ongoing consultation during construction and operations.
Federal, State and Local Government Authorities	Establish contact with other key stakeholders as new issues arise. Supply latest information on the Project activities through planned information sessions (as required). Identify and respond to key issues and concerns of all stakeholders during the assessment phase. Prepare and consult with relevant stakeholders regarding updates to the operations and PEPR.
Local Community	Include newspaper advertisements, web page and mail out to key stakeholder communities with contact details so that business and employment opportunities within the nearby surrounding communities of Olary, Yunta, Broken Hill and Cockburn can be identified and any comments can be directed to the appropriate person for response.
Native Title Claimants	Abide by the terms and conditions contained within the NTMA.

5.5 On-going Communication

Consultation and communication does not end with Project approval and BGC is committed to providing information on its performance throughout all phases of the Project. To this end, Project staff will compile relevant information from monitoring and management programs and reports regularly. These reports will be clearly written and illustrated (where appropriate) to aid understanding.

Statutory reports will continue to be submitted to relevant authorities at intervals determined during the approval process. Currently, BGC submits quarterly and Annual Compliance Reports (ACR) to DEM in accordance with the Lease conditions and agreed *Tenement Compliance Plan* (TCP) for the Project.

The ACRs are publicly available documents which report on the following information:

- a summary of the major mining activities undertaken in the reporting period and proposed activities for the following reporting period;

- a summary of environmental management and rehabilitation activities for the reporting period and proposed activities for the following reporting period;
- a summary of consultation undertaken in the reporting period, and of complaints (if any) received from third parties and actions taken by BGC to resolve these;
- a statement of compliance with the outcomes under the Lease conditions and the approved PEPR for the reporting period;
- a statement of action taken to rectify any non-compliance, detected either by DEM inspections or BGC's monitoring, and to prevent recurrence;
- a statement on the effectiveness of any previously undertaken action to rectify non-compliance;
- any new environmental hazards detected during the reporting period that were not previously documented to DEM (e.g. at the time the PEPR was approved); and
- environmental incidents that have occurred and how these incidents were managed and resolved.

5.6 Process for Managing Complaints

BGC is committed to effectively managing complaints raised by various stakeholders if and when they occur during the life of the Portia Mine Site. BGC will respond in a timely manner to all communications received through its consultation and communication program. A register of all communications with stakeholders is maintained by the operation.

6 ENVIRONMENTAL, SOCIAL AND ECONOMIC ASPECTS

This Section summarises those activities that have the potential to impact on aspects of the natural environment, society, culture or the economy and outlines the proposed management objectives, actions and commitments by BGC to mitigate the identified adverse impacts. BGC has reviewed and updated the information in this Section based on operational changes which have occurred since Project commencement.

6.1 Environmental Risk Assessment Approach

Aspects of the environment which may be impacted by the proposed activities of the Project were identified in the original PEPR and include the following:

- Adjacent land use;
- Aboriginal and European Heritage;
- Native fauna;
- Native vegetation;
- Weeds and pests (feral animals);
- Soil;
- Groundwater and hydrology;
- Waste disposal and hazardous substances; and
- Air quality, odour and noise.

The potential impacts associated with each environmental aspect are detailed in the following sub-sections. An environmental risk assessment (ERA) has been undertaken for each potential impact event and results are presented in the following sub-sections, along with the definition of outcomes, measurement criteria, leading indicator criteria and monitoring actions.

The ERA process provides a structure in which the environmental consequences of activities can be considered when developing and formulating projects. As a result, the potential impacts are identified, minimised and managed in a cost-effective manner. The impacts considered are broad ranging and include both on and off-Site impacts as well as direct and indirect impacts.

The original approach to the ERA was developed based on the risk assessment process detailed in the DEM (then DSD) *Guidelines for miners: preparation of a Mining Lease Proposal or Mining and Rehabilitation Program (MARP) in South Australia*, MG2, Version 4.11 (DSD, 2011). This is considered to still be aligned to the updated process detailed in the DEM (then DSD) *Preparation of a program for environment protection and rehabilitation (PEPR) for metallic and industrial minerals (excluding coal and uranium) in South Australia*, MG2b (DEM, 2018).

For each potential impact event, likelihood and consequence ratings have been applied using the five-point scales summarised below.

Qualitative measures of **likelihood**:

- *Almost certain* – will occur, is of a continuous nature, or the likelihood is unknown.
- *Likely* – will probably occur.
- *Possible* – could occur.
- *Unlikely* – could occur, but is not expected to do so.
- *Rare* – has almost never occurred in similar operations but conceivably could occur.

Qualitative measures of **consequence**:

- *Insignificant* – possible impacts but without noticeable consequence.
- *Minor* – very local consequence but with no significant long-term changes.
- *Moderate* – significant local changes but can be alleviated or rehabilitated.
- *Major* – substantial and significant changes, only partially able to be alleviated or rehabilitated.
- *Catastrophic* – extreme permanent changes to social or natural environment, deaths or widespread health and economic effects on public, major public outrage or unknown consequences.

The risk associated with any particular potential impact event has then been defined according to the following risk matrix (Table 6-1) that uses the likelihood and consequence ratings defined above.

Table 6-1: Risk Matrix

			Likelihood of Consequences				
			E	**D**	**C**	**B**	**A**
			Rare	**Unlikely**	**Possible**	**Likely**	**Almost Certain**
Severity of Consequence	**5**	**Insignificant**	Low	Low	Low	Moderate	High
	4	**Minor**	Low	Low	Moderate	High	High
	3	**Moderate**	Moderate	Moderate	High	High	Extreme
	2	**Major**	High	High	Extreme	Extreme	Extreme
	1	**Catastrophic**	High	Extreme	Extreme	Extreme	Extreme

6.2 Adjacent Land Use

6.2.1 Context

Environment

The Portia Mine Site is located on Mulyungarie Station, approximately 105 km to the north west of Cockburn and approximately 110 km (direct) or 190 km (by road and track) to the north west of Broken Hill. Rainfall is typically less than 200 mm per year, whilst evaporation is about 2,800 mm per year.

Due to the arid climate, limited topsoil and nutrient availability and generally saline groundwater present, agricultural land use is generally restricted to grazing of domestic herbivores (sheep and cattle).

Stakeholders

DEM (as the regulator for mining developments) has stated that there are to be no adverse impacts to adjacent land use. Consultation with the pastoral Lease Holder of Mulyungarie Station, Mutooroo Pastoral Company, has occured throughout the life of the project. Initially concerns were expressed concerning potential impacts on local stock water supplies and the introduction of weeds. Loss of stock grazing areas was not expressed a major concern, acknowledging that this would be dealt with under a compensation arrangement. The Lease Holder will continue to be consulted as the project progresses.

The residents of Cockburn were also consulted in the early stages and supportive of the Project (partly due to the potential benefits for local employment and business).

Industry

The nearest industry, other than pastoral, occurs at the Honeymoon Uranium Mine Site (~40 km south east) and the Oban ISR (In Situ Recovery) Site (~40 km north east).

6.2.2 Applicable Legislation and Standards

Impacts to adjacent land use associated with mining are regulated by the Mining Act.

6.2.3 Potential Impact Event

Site activities may adversely impact adjacent land use.

The mining of the Portia deposit has the potential to adversely impact adjacent land uses by:

- damage to water resource infrastructure;
- damage to stock fencing and gates;
- degradation of station access tracks by vehicle use;
- stock losses due to collision with vehicles;
- stock losses by poisoning/ingestion of chemicals; and
- impacts to water resources and soil quality from cyanide.

Failure to protect adjacent land uses may result in:

- loss of stock, and therefore financial losses to the landholder.

6.2.4 Control and Management Strategies

The potential for impacts to adjacent land uses can be reduced by the implementation of the following control strategies:

- ensuring that all personnel working at the Portia Mine Site undergo appropriate awareness training with respect to stock and related infrastructure;

- avoiding disturbance to stock fencing, gates and water resource infrastructure;
- repairing/replacing any items of infrastructure that may be removed or damaged by activities associated with the operation;
- limiting vehicle speeds to those that significantly reduce the potential for collision with livestock or infrastructure;
- grading and repairing access tracks shared with pastoral activities;
- rehabilitating disturbed areas (in consultation with the pastoral landholder) as soon as practicable following the completion of mining;
- ensuring that all activities onsite occur in compliance with the Cyanide Management Plan;
- ensuring that all fuels and any chemicals are stored securely and appropriately; and
- maintaining an ongoing consultation program with adjacent landholders.

Cyanide control and management strategies to negate the potential for adverse impacts to the environment include:

- the incorporation of a detoxification circuit in the process to ensure any cyanide residue reporting to TSF4 is <50ppm WAD;
- TSF4 (cyanide cell) will be clay and HDPE lined to eliminate the potential for seepage;
- TSF4 will be fenced to stop stock and wildlife entering the cell;
- Transfer of cyanide residue to the TSF4 will be via a double piped line to reduce risk of leakage;
- The release of hydrogen cyanide will be controlled by maintaining high pH via addition of liquid Caustic soda. A a manual pH check will also be carried out prior to mixing each batch in the cyanide mixing tank and adjusted for pH control prior to the mix.; and
- Safe Work Procedures and specific Emergency Procedures have been developed in relation to cyanide and personnel are trained in these procedures.

6.2.5 Likelihood and Severity of Consequences

The inherent risk of adverse impacts to adjacent land use occurring due to mining at the Portia Mine Site is considered low.

Control measures are in place to further reduce the potential for such impacts to occur.

6.2.6 Risk Levels

The results of the risk assessment for adjacent land use are presented in Table 6-2.

Table 6-2 Risk Assessment – Adjacent Land Use

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Loss of stock, financial losses to the landholder	Possible	Minor	Control measures as outlined above	Rare	Minor	Low	Yes

6.2.7 Justification for Risk Acceptance

From the above risk assessment, it would appear that the most significant risks from adverse impacts to adjacent land use are possible stock and financial losses. Given the control measures proposed, it is expected that the residual risk of adverse impacts occurring will be low.

6.2.8 Outcome

No adverse impacts to adjacent land use.

6.2.9 Outcome Measurement Criteria

See Table 6-18.

6.2.10 Monitoring Program

The Mine Manager will maintain an incident/ complaints register for the Portia ML area and access tracks to record all incidents and complaints. It will include details of the following:

- the date and time of the complaint, stock loss, or damage;
- details of the complaint, loss or damage;
- records of discussion with the landholder relating to the complaint, loss or damage;
- an assessment of the validity of the claim;
- the identification of the persons or processes leading to the complaint;
- reason(s) for the actions leading to the complaint, loss or damage;
- remedial measures actioned;
- communications with the landholder (date, time, means of communication);
- landholder response; and
- outcomes / landholder satisfaction.

The register will be reviewed monthly and results will be presented in Site management reports prepared by the Mine Manager. The review will report against the control and management strategies as outlined in Section 6.2.4 and will include the identification of possible improvement measures (i.e. procedural changes) to reduce impacts to adjacent land use if complaints, stock losses or damage to infrastructure occur.

Results will also be presented in the close out report for the operation.

6.3 Aboriginal and European Heritage

6.3.1 Context

Environment

The Portia Mine Site is located in the southern Strzelecki Desert, approximately 10 km from the nearest ephemeral watercourse, and over 60 km distant from permanent water sources such as the mound springs in Lake Frome and springs and seeps in the Barrier and Olary Ranges. The nearest quarries and resource centres are also likely to be in these ranges.

With regard to Aboriginal heritage, proximity to water resources is generally considered the primary factor determining the location of Aboriginal occupation. On major creek-lines and rivers, archaeological sites often indicate the presence of more permanent or repeated occupation. Resource rich zones such as quarries can also contain evidence of complex and long-term occupation sites. Further from permanent water, sites are generally smaller, less complex and can be the result of one-off or episodic occupation. Sites near ephemeral water sources can be generated by single event occupation or multiple (seasonal, flood episodic) occupation.

The Portia ML area is subject to a registered native title application made by the Adnyamathanha People (Adnyamathna No.1, filed 15/01/1999, Federal Court No. SAD 6001/1998, Tribunal File No. SC 1999/001). As a result, BGC entered into a NTMA with the Adnyamathanha People pursuant to Part 9B of the Mining Act which was entered into PIRSA's (now DEM's) register on 10 October 2008. It has been determined that native title exists in parts of the Adnyamathanha No. 1 determination area on 30/03/2009, 25/02/2014 and 08/12/2015.

Since the granting of a ML for the region a second native title application has been made in the region by the Wilyakali People (Wilyakali #2, filed 25/11/2015, Federal Court No. SAD 417/2015, Tribunal File No. SC 2015/003). BGC will continue to engage with both the Adnyamathanha and Wilyakali Peoples in regards to matters at the Portia Mine Site.

Heritage surveys have been conducted with representative of the traditional owners of the area prior to land disturbance occurring. During these surveys where sites were identified to be of significant cultural value they have been registered in the heritage database and the area sectioned off.

With respect to European heritage, the area has been subject to pastoralism since around the mid eighteen hundreds with wire fencing introduced shortly afterwards. Extensive use was made of storage drains by an early pastoralist, Edwin Crozer. He deepened water courses that flowed to Lake Frome, to form long dams. Other European heritage items could include pastoral tracks, old gates, farm and other machinery, windmills and tanks.

Stakeholders

DEM (as the regulator for mining developments) has stated that there is to be no disturbance to Aboriginal or European artefacts or sites of significance unless prior approval is obtained under relevant legislation.

The Aboriginal Affairs and Reconciliation division of DEM generally advises that an activity must be authorised by the Minister if the activity is likely to damage, disturb or interfere with a site or object of significance.

Industry

The nearest industry, other than pastoral, occurs at the Honeymoon Uranium Mine Site (~40 km south east) and the Oban ISR Site (~40 km north east).

6.3.2 Applicable Legislation and Standards

Legislation relevant to activities at Portia includes the *Aboriginal Heritage Act 1988*, the *Heritage Places Act 1993* and the Mining Act.

6.3.3 Potential Impact Event

Mining at the Portia Mine Site has the potential to disturb Aboriginal and European heritage artefacts or sites of significance.

Disturbance to Aboriginal or European artefacts or sites of significance could occur by:

- earthworks associated with construction of site infrastructure; and
- construction of access roads and tracks.

Failure to protect Aboriginal and European heritage artefacts or sites of significance may result in:

- disturbance to or destruction of Aboriginal or European artefacts or sites of significance.

6.3.4 Control and Management Strategies

The potential for disturbance to Aboriginal or European artefacts or sites of significance can be reduced by the implementation of the following control strategies:

- fencing off the known sites on the ML;
- providing training to contractors and staff working at the Site, enabling them to recognise sites of significance prior to disturbance;
- halting work in any area in which Aboriginal artefacts or sites are identified and where disturbance of them may occur due to mining related operations, followed by contact with appropriate authorities for advice on how to proceed; and
- adhering to the requirements of relevant legislation at all times during the period of operations and rehabilitation.

6.3.5 Likelihood and Severity of Consequences

The inherent risk of disturbance to Aboriginal or European artefacts or sites of significance at the Portia Mine Site is considered low.

Control measures are in place to further reduce the potential for such impacts to occur.

6.3.6 Risk Levels

The results of the risk assessment for adverse impacts to adjacent land use are presented in Table 6-3.

Table 6-3 Risk Assessment – Aboriginal and European Heritage

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Disturbance to or destruction of Aboriginal or European artefacts or sites of significance	Possible	Moderate	Control measures as outlined above	Rare	Minor	Low	Yes

6.3.7 Justification for Risk Acceptance

From the above risk assessment, it would appear that the most significant risk disturbance to or destruction of Aboriginal or European artefacts or sites of significance is during the construction stage (overburden stripping and construction of accommodation and office facilities, roads, ROM pad, OWD, TSF cells, etc.). Given the control measures proposed and minimal further construction that is proposed, it is expected that the residual risk of disturbance will be low.

6.3.8 Outcome/Objective

No disturbance to or destruction of Aboriginal or European artefacts or sites of significance unless prior approval under the *Aboriginal Heritage Act 1988* is obtained

6.3.9 Measurement Criteria

See Table 6-18.

6.3.10 Monitoring Program

Should any evidence of Aboriginal artefacts or heritage be identified on Site, the relevant authorities will be notified in accordance with the *Aboriginal and Heritage Act 1988*.

In addition, an incident register will be kept by the Mine Manager and entries made of Aboriginal or European artefacts or sites of significance discovered at the Portia Mine Site.

This register is to record the following information:

- the date and time of the discovery;
- who made the discovery;
- a description of what was discovered, the means of discovery (e.g., backhoe, exposure due to wind erosion);
- discovery site location (GPS coordinates);
- a description of the physical features of the area in the near vicinity of the discovery;
- details of any damage caused to the discovery;
- the Mine Manager's written acknowledgement of the discovery;

- actions taken to preclude access and additional disturbance to the discovery;
- notification measures;
- instructions obtained from the relevant authorities; and
- final outcomes.

Procedures followed post discovery are to be recorded and outcomes documented, including:

- where the measuring (monitoring) will occur;
- how it is to be measured (monitored);
- the frequency of monitoring; and
- documentation, record keeping and data management.

The register will be reviewed monthly and results will be presented in monthly Site management reports prepared by the Mine Manager. The review will include the identification of procedural changes (if needed) to reduce or preclude damage to sites of heritage significance.

Results will be presented in the close out report for the operation.

6.4 Native Fauna

6.4.1 Context

Environment

Environmental databases up to 2008 indicate that 111 bird species have been recorded within a 50 km radius of the Portia Mine Site and nine mammal species were recorded within the same area. There is a low frequency and diversity of small terrestrial mammals recorded for the wider region which reduces even further within a 5 km search of the Site with only three species being recorded, one of which was introduced. Thirty reptile and one amphibian species have been recorded for the wider region. Only six reptile and one amphibian species have been identified to occur within a 5 km radius of the site.

More recent surveys of the Site in 2011 confirmed that there are more species present in the Site than database records indicate, but the majority of animal species are relatively common and do not have a formal conservation status.

Other than one example of a Dusky hopping-mouse (observed during a boom period for the species), no fauna species listed under the EPBC Act have been reported within a 5 km radius of the ML.

Species such as grey falcon and letter-winged kite will continue to occur in the region following above average rainfall and good seasonal conditions. During drought years the species are not likely to be present. Plains-wanderer has not been recorded in the ML area or adjacent areas and limited suitable habitat for this species occurs in the Site. The Project is considered to be low risk for each of these bird species.

Stakeholders

Stakeholders who may have concern over potential impacts of mining operations on native fauna abundance or diversity include the SAAL NRMB and local community or environmental groups, however no such concerns were communicated with respect to the mining area during consultation.

DEM, as the regulator for mining developments, has stated a requirement that there is to be no net adverse impacts to native fauna abundance or diversity in the Lease area and in adjacent areas.

Industry

The nearest industry, other than pastoral, occurs at the Honeymoon Mine Site (~40 km south east) and the Oban ISR site (~40 km north east).

6.4.2 Applicable Legislation and Standards

Legislation relating to mining activities and fauna includes the South Australian Mining Act, the EP Act the Native Vegetation Act and the Commonwealth EPBC Act. These acts provide mechanisms for the preservation of abundance and diversity of native fauna.

6.4.3 Potential Impact Event

Operations impact native fauna abundance or diversity in the lease area and in adjacent areas.

The proposed project has the potential to impact native fauna abundance and diversity by:

- the clearance of vegetation (habitat);
- death or injury by collision with vehicles;
- effects to avifauna by their drowning or consumption of fluids from the RWD, PDD, BP (1&2) and the TSF (1,2 &3);
- effects to fauna from the consumption of cyanide residue from TSF4;
- the introduction and proliferation of feral animal populations; and
- uncontrolled fires.

Failure to effectively control impacts to native fauna abundance and diversity may result in:

- permanent reduction in native fauna abundance and diversity.

6.4.4 Control and Management Strategies

Impacts to native fauna abundance and diversity can be significantly reduced by the implementation of the following control strategies:

- minimizing the areas of clearance and disturbance to reduce habitat loss;
- restricting vehicle access to designated roads and tracks to reduce habitat loss;
- restricting vehicle speeds to reduce the potential for collisions with fauna;
- progressively rehabilitating disturbed areas where possible to restore habitat;

- establishing and maintaining a fire break between infrastructure and vegetation or ground with a high fuel load;
- installing and maintaining fire extinguishers and control systems (including alarms);
- restricting access to the TSF through appropriate fencing; and
- ensuring cyanide residue is deconstructed to <50ppm WADCN prior to deposition into TSF-4.

6.4.5 Likelihood and Severity of Consequences

The inherent risk of adverse impacts to native fauna abundance and diversity in the ML area and in adjacent areas is considered low.

Control measures are in place to further reduce the potential for such impacts to occur.

6.4.6 Risk Levels

The results of the risk assessment for adverse impacts to native fauna are presented in Table 6-4.

Table 6-4 Risk Assessment - Native Fauna

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Clearance of vegetation	Likely	Minor	Control measures as outlined above	Rare	Insignificant	Low	Yes
Death or injury by collision with vehicles	Possible	Minor	Control measures as outlined above	Rare	Insignificant	Low	Yes
Consumption by avifauna of fluids from the TSF and raw water dams	Likely	Minor	Control measures as outlined above	Rare	Minor	Low	Yes
Concentration of residual cyanide within TSF 4 is above 50 ppm resulting in injury or death to fauna	Likely	Significant	Control measures as outlined above	Rare	Minor	Low	Yes
The introduction and proliferation of feral animals	Possible	Minor	Control measures as outlined above	Rare	Minor	Low	Yes
Uncontrolled fires	Unlikely	Minor	Control measures as outlined above	Rare	Minor	Low	Yes

6.4.7 Justification for Risk Acceptance

From the above risk assessment, it would appear that the most significant risk of adverse impacts to native fauna is through extended drought over which the mining operators have no control and through land clearance and loss of habitat. Given the abundance of similar vegetation and habitat nearby and measures to rehabilitate the Site on completion of activities, it is expected that the residual risk of permanent impacts to the abundance and diversity of native fauna will be low.

As a consequence of this assessment, the possibility for adverse impacts to native fauna abundance and diversity in the Lease area and in adjacent areas will be monitored.

6.4.8 Outcome/Objective

No net adverse impacts from the site operations (including fire) on native fauna abundance or diversity in the Lease area and in adjacent areas

6.4.9 Measurement Criteria

See Table 6-18.

6.4.10 Monitoring Program

The Mine Manager will maintain an incident register for the Portia ML area and access tracks, to record all fauna trappings, injuries and deaths. It will record the date, time and location of the discovery of trapped, injured or deceased fauna, the person who made the discovery, the condition and fate of the animal and release location (if applicable). The register will be reviewed monthly and results will be presented in monthly site management reports prepared by the Mine Manager. The review will include the identification of any procedural changes required. The results will also be taken into consideration by the fauna consultant when preparing the fauna survey closure report for the Project.

Native fauna abundance and diversity will be measured by a suitably qualified and experienced independent professional using standardised fauna monitoring techniques (e.g. trapping, active searching and bird surveys) generally consistent with methods conducted during baseline fauna surveys (KBR, 2011).

A fauna survey report is to be prepared by the professional and the results of the survey are to be compared with the results from the baseline survey (KBR, 2011). Differences in species abundance and diversity are to be assessed and a discussion of the significance of the results provided.

It is noted that some of the original KBR (2011) fauna monitoring locations may be impacted by the southern extension to the OWD and the northern extension to the Portia open pit. If the monitoring locations have been impacted at the time of the fauna monitoring survey, then a suitably qualified and experienced independent professional will make assessment on where the most appropriate survey locations should be prior to the survey. New fauna survey locations may be established at points radiating outwards from the existing footprint at those locations. The homogeneity of the Portia Mine Site vegetation community structure (see Badman Environmental, 2008 and KBR, 2011) allows for a large variation in site length without significant change to monitoring structures.

6.5 Native Vegetation

6.5.1 Context

Environment

The Portia Mine Site is located on the plains of the Lake Frome Basin and is within the Broken Hill Complex Bioregion (Neagle, 2003). Vegetation of the area is dominated by low shrublands of *Maireana astrotricha* (Low Bluebush) on the plains, with areas of *Atriplex vesicaria* (Bladder Saltbush) and *Maireana astrotricha* on low dunes. There are some isolated stands of *Casuarina pauper* (Black Oak) low woodlands.

Other less common vegetation types are tall shrublands on sandplains and *Eragrostis australasica* (Cane-grass) in swampy areas.

No vegetation species listed as threatened under either the Commonwealth EPBC Act or the South Australian National Parks and Wildlife Act were recorded at the Portia Mine Site during surveys to date.

Stakeholders

Stakeholders who may have concern over potential impacts of mining operations on native flora abundance or diversity include the SAAL NRMB and the NVC as part of DEW as well as local community or environmental groups. Local landholders may also be concerned about the loss of native vegetation, particularly palatable species for stock. However, no concerns were formally expressed by the local landholder or residents of Cockburn during the MLP public consultation period.

DEM (as the regulator for mining developments) has stated that there is to be no permanent loss of abundance or diversity on or off the Lease through vegetation clearance, dust / contaminant deposition or other means unless prior approval under relevant legislation is obtained.

Industry

The nearest industry, other than pastoral, occurs at the Honeymoon Mine Site (~40 km south east) and the Oban ISR site (~40 km north east).

6.5.2 Applicable Legislation and Standards

Legislation that applies to vegetation and mining includes the South Australian Mining Act, the EP Act, the Native Vegetation Act and the Commonwealth EPBC Act. These Acts provide mechanisms for the preservation of abundance and diversity of native flora.

6.5.3 Potential Impact Event

Land clearance, dust or contaminant deposition or other damage to native vegetation leads to a permanent loss of vegetation abundance or diversity.

The proposed development has the potential to impact vegetation abundance or diversity by:

- the clearance of vegetation;
- vegetation health impacts due to dust / contaminant deposition;
- mining related fires; and
- reduction in native flora abundance and diversity.

As detailed in the *Native Vegetation Management Plan* (refer Appendix F1), up to 244 ha of vegetation is approved for disturbance or clearance for operations at the Portia Mine Site (refer to Section 3.8).

This area includes clearance for the Portia and North Portia open pits (Phase II), water storage dams, OWD, ROM pad, the TSF cells (TSF-1, 2, 3 and 4), roads, campsite, office and laydown area, landfill area and the processing plant.

Failure to effectively control impacts to vegetation may result in:

- a permanent reduction in native flora abundance and diversity.

6.5.4 Control and Management Strategies

Impacts to native flora can be significantly reduced by the implementation of the following control strategies:

- minimizing the areas of clearance and disturbance;

- implementing a native vegetation clearance permit process, where all clearances are pre-approved by the Mine Manger or delegate;
- the use of dust suppression measures (e.g. water cart) during periods of significant dust generation to reduce dust effects to vegetation;
- containing contaminants (e.g. fuel, reagents) within fully bunded sections of the Site to preclude spills impacting vegetation;
- ensuring evaporators on the TSF and the OWD are not in use during high wind conditions that threaten the carry of fine water mist more than 150m;
- restricting vehicle speeds to reduce the potential for dust generation;
- revegetating disturbed areas as soon as practicable on completion of operations in that particular area;
- siting infrastructure in a manner that reduces vegetation disturbance; and
- reducing the potential for uncontrolled fires.

A *Native Vegetation Management Plan* for the Project is presented as Appendix F1.

6.5.5 Likelihood and Severity of Consequences

The inherent risk of permanent loss of abundance or diversity of native flora in the ML area and in adjacent areas due to activities associated with mining operations is considered moderate but will be reduced by the control measures stated above.

6.5.6 Risk Levels

The results of the risk assessment for adverse impacts to native fauna are presented in Table 6-5.

Table 6-5 Risk Assessment - Native Vegetation

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Vegetation clearance	Likely	Minor	Control measures as outlined above	Unlikely	Minor	Low	Yes
Vegetation health impacts due to dust/ contaminant deposition	Possible	Minor	Control measures as outlined above	Unlikely	Minor	Low	Yes
Mining related fires	Unlikely	Minor	Control measures as outlined above	Rare	Insignificant	Low	Yes

6.5.7 Justification for Risk Acceptance

From the above risk assessment, it would appear that the most significant risk events to adverse impacts to vegetation abundance or diversity are through land clearance, dust/ contaminant deposition and possibly through uncontrolled fires. Given the control measures proposed, it is expected that residual risk of impacts to the abundance and diversity of native vegetation will be low. Rehabilitation at closure will also reduce the impact on abundance and diversity of native vegetation.

As a consequence of this analysis, native vegetation in the Lease area and in adjacent areas will be monitored for adverse impacts to abundance and diversity.

6.5.8 Outcome/Objective

No permanent loss of abundance or diversity to native vegetation on or off the Lease area through clearance, dust / contaminant deposition, fire or other damage unless prior approval under the Native Vegetation Act is obtained.

6.5.9 Measurement Criteria

See Table 6-18.

6.5.10 Leading Indicator Criteria

See Table 6-18.

6.5.11 Monitoring Program

Native vegetation abundance and diversity will be measured by a suitably qualified and experienced independent professional using standardised flora monitoring techniques (e.g. line transects and photo points) generally consistent with methods conducted during the initial monitoring survey conducted by EBS (2015).

A vegetation survey report is to be prepared by the professional and the results are to be compared with the results from the baseline survey (Badman, 2008a) and with the results of successive monitoring surveys. Differences in species abundance and diversity are to be assessed and a discussion of the significance of results provided.

All Portia vegetation monitoring sites (PM1 to PM5) were established by EBS in 2015 (see Appendix A3) with the intent that expansion of the existing Project footprint would not corrupt data collected in the period prior. Each 'PM' monitoring site consists of five transects located along a straight line that radiates outwards from the existing footprint. Each transect has an interval distance of 150 m giving an overall individual site length of 750 m. In the event of a change in infrastructure footprint, any given site can simply be removed from its current location and added to the end of the existing site. This serves the purpose of having consistent distances, enabling utilisation of pre and post change data based on distance from operational areas. The homogeneity of the Portia vegetation community structure (see Badman Environmental, 2008 and KBR, 2011) allows for a large variation in site length without significant change to monitoring structures.

Vegetation monitoring sites were also located so as to remove any variability in grazing impacts, with the nearest permanent watering point being located at a distance of greater than 2 km.

It could be considered that adaptation of the transect sites may add further weight to any observed monitoring trends in the early part of surveys. If observed trends translate to transects which become closer in proximity to infrastructure footprints as the Project expands, it gives very strong evidence as to any recorded impacts that may occur.

A record is to be kept of the area disturbed by the operation to ensure compliance. Records are to be kept of applications and approvals for additional vegetation clearance.

Measurement of native vegetation clearance will be undertaken using a combination of GIS software, ground surveys/ pickups and/ or aerial surveys of the mine operational areas.

The Mine Manager will maintain an incident register for the Portia ML area of any unauthorised vegetation clearances, including uncontrolled fires on or off the Lease due to site operations. The register will be reviewed monthly and results will be presented in monthly site management reports prepared by the Mine Manager. The review will include the identification of any procedural changes required.

An incident register is to be kept and entries made of damage to vegetation due to fire. It will document details of the following:

- the date and time of the fire;
- the location of the fire;
- its cause;
- how it was brought under control; and
- damage resulting from it, including areas / infrastructure burnt.

A *Native Vegetation Management Plan* for the operation is presented as Appendix F1.

BGC will continue to offset the clearance of native vegetation associated with the Project via the Kalkaroo SEB offset area.

6.6 Weeds and Pests (Feral Animals)

6.6.1 Context

Environment

Land use in the vicinity of the Portia Mine Site is pastoral, predominantly cattle grazing. This activity is likely to have been carried out for over 70 years, with stock and vehicles traversing the Site on many occasions in that period. Such activities have led to colonisation by feral animals including rabbits, foxes, feral cats, goats and mice as well as the introduction of weeds including wild turnip (*Brassica tournefortii*), Ward's weed (*Carrichtera annua*) and Arabian grass (*Schismus barbatus*).

Stakeholders

Stakeholders who may have concern over potential impacts of mining operations on weeds and pests include the SAAL NRMB and the NVC as part of DEW as well as local community or environmental groups.

DEM (in its role as a regulator for new mining developments) has stated that there is to be no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the Lease area compared to adjoining land.

Industry

The nearest industry, other than pastoral, occurs at the Honeymoon Mine Site (~40 km south east) and the Oban ISR site (~40 km north east).

6.6.2 Applicable Legislation and Standards

Legislation relating to weeds and feral animals includes the South Australian Mining Act, the EP Act, the Native Vegetation Act, the NRM Act and also the Commonwealth EPBC Act.

6.6.3 Potential Impact Event

Activities associated with mining at the Portia Mine Site lead to the introduction of new weeds, plant pathogens or pests (including feral animals), and / or increases in abundance of existing weed or pest species in the Lease area.

The Project has the potential to introduce new weeds and feral animals or increase existing weed and feral animal populations on or near the Site. The main mechanisms for this to occur would be via:

- new weed species being carried on to the Site and nearby areas by vehicles;
- the increased growth or population of existing pest species (flora and fauna) due to the availability of putrescible waste at the landfill; and
- the introduction of new weed or animal species as domestic plants or pets by personnel working on site.

Failure to effectively control weed and feral animal populations may result in:

- damage to flora and habitat, reduction in indigenous fauna populations.

6.6.4 Control and Management Strategies

The impact of weeds, plant pathogens and feral animals can be significantly reduced by the implementation of the following control strategies:

- minimizing the areas of clearance and disturbance to provide less opportunity for seed growth;
- the banning of domestic pets and plants from Site;
- adhering to waste management policies including the deposition of all putrescible wastes in secured bins for disposal within the landfill facility in accordance with the *Landfill Environmental Management Plan*;
- the regular capping of the landfill to limit the amount of exposed material;
- the spraying or removal of weeds and pest plants when identified; and
- the use of control measures against feral animals.

6.6.5 Likelihood and Severity of Consequences

It is possible that weed and feral animal numbers could increase both on Site and in nearby areas due to activities associated mining operations. Control measures will be used to minimize weed, plant pathogen and feral animal impacts. Due to the significant distance between the mine and the nearest residence, it is unlikely that residents will be affected by weed and feral animal populations or control measures at the Site. Due to restrictions to Site access, risks to the public will be low.

6.6.6 Risk Levels

The results of the risk assessment for weeds and feral animals are presented in Table 6-6.

Table 6-6 Risk Assessment - Weeds and Pests (Feral Animals)

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Damage to flora and habitat, reduction in indigenous fauna populations	possible	Minor	Control measures as outlined	Rare	Minor	Low	Yes

6.6.7 Justification for Risk Acceptance

From the above risk assessment, it would appear that the most significant risk events from weed and feral animals are the potential reduction in loss of flora abundance or diversity and a reduction in indigenous fauna populations or diversity. Given the control measures proposed, it is expected that the residual risk will be low.

As a consequence of this assessment, weeds and feral animals will be monitored for abundance and diversity changes.

6.6.8 Outcome/Objective

No introduction of new species of weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the Lease area compared to adjoining land.

6.6.9 Measurement Criteria

See Table 6-18.

6.6.10 Leading Indicator Criteria

See Table 6-18.

6.6.11 Monitoring Program

The Mine Manager will maintain an incident register of any new weeds (including declared weeds), plant pathogens or pests (including feral animals) identified by site personnel, including management actions undertaken. The register will be reviewed monthly and results will be presented in monthly site management reports prepared by the Mine Manager. The review will include the identification of any procedural changes required.

A log is to be maintained of feral animals observed on the ML or in the vicinity of the Site during the period of operations. The log is to also include eradication and control measures employed until Lease surrender.

This log will include details of the following:

- dates and times of observation;
- observation location;
- the name of the observer;
- species identified (scientific or common name);
- description of observed species (number of animals, condition, activity observed);
- the Mine Manager's written acknowledgement of the observation; and
- actions taken (e.g. observation only, eradication).

A log is also to be maintained of weed infestation and measures used up to the time of Lease surrender.

This log will include details of the following:

- dates and times of observation;
- observation location;
- the name of the observer;
- species identified (scientific or common name);
- description of observed species (number of specimens, area of infestation, vigour);

- the Mine Manager's written acknowledgement of the observation; and
- actions taken (e.g. observation only, eradication, method of eradication).

Native vegetation abundance and diversity will be measured by a suitably qualified and experienced independent professional using standardised flora monitoring techniques (e.g. point location monitoring) generally consistent with methods conducted during the initial monitoring survey conducted by EBS (2015).

A vegetation survey report is to be prepared by the professional and the results are to be compared with the results from the baseline survey (Badman, 2008a) and with the results of successive monitoring surveys. Differences in weed species abundance and diversity are to be assessed and a discussion of the significance of results provided.

Native fauna abundance and diversity will also be measured by a suitably qualified and experienced independent professional using standardised fauna monitoring techniques (e.g. trapping and active searching) generally consistent with methods conducted during baseline surveys (KBR, 2011).

A fauna survey report is to be prepared by the professional and the results of the survey are to be compared with the results from the baseline survey (KBR, 2011). Differences in pest species abundance and diversity are to be assessed and a discussion of the significance of results provided.

6.7 Soils

6.7.1 Context

Environment

The Portia Mine Site is located in the Northern Olary Plains. These plains extend for many tens of kilometres and includes gently sloping alluvial plains, ephemeral watercourses (none within about 10 km), and dune fields, particularly further north. Soils in the vicinity of the Portia Site include:

- Dune sands;
- Red brown clays in swales and low lying areas; and
- Red brown clays in clay pans.

Stakeholders

DEM (in its role as a regulator for new mining developments) has stated that soils affected by mining activities are to be suitable for return to pastoral use. No concerns were expressed by the local landholder or residents of Cockburn during the consultation period.

Industry

The nearest industry, other than pastoral, occurs at the Honeymoon Mine Site (~40 km south east) and the Oban ISR site (~40 km north east).

6.7.2 Applicable Legislation and Standards

Legislation relating to soils and soil management includes the Mining Act and associated guidance documents, the EP Act, the NRM Act and the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM).

6.7.3 Potential Impact Event

Soils affected by Site activities are not suitable for return to pastoral use.

The Project has the potential to impact soils by the following means:

- the clearance of vegetation leading to soil erosion and loss;
- contaminated surface runoff from stockpiles ponding and contaminating soils;
- fuel and chemical spills contaminating soils;
- overburden and mine wastes not being properly disposed of;
- topsoil not being appropriately stockpiled (e.g. causing compaction);
- compaction of soil from vehicle movements;
- leachate contaminating the immediate local environment to the landfill;
- lateral seepage from the TSF surfacing and affecting local soils;
- inadequate TSF freeboard and / or water being stored against internal wall of embankments for significant periods leading to an increased risk of overtopping, embankment erosion and potential for slope failure.
- Accidental spill of picric acid and silver nitrate during transportation, storage or use results in contamination of soils;
- Accidental spill of Magnafloc®, Sodium Cyanide (NaCN), Hydrogen Peroxide (H_2O_2), Sodium Hydroxide (NaOH), GoldiLOX (leach accelerant), and/or Copper Sulphate during transportation, storage or use results in contamination of soils;
- Accidental spill of cyanide during transportation, storage or use results in contamination of soils; and
- Overtopping of the cyanide cell (TSF 4) results in contamination of soils.

Failure to effectively control impacts to soils may result in:

- loss of pastoral viability of the land.

6.7.4 Control and Management Strategies

Impacts to soils can be significantly reduced by the implementation of the following control strategies:

- minimizing the areas of clearance and disturbance to minimize the potential for soil erosion;
- stockpiling topsoil for use in rehabilitation in mounds or heaps less than 2 m high (as described in Section 3.4.5);
- the use of dust suppression measures (e.g. water cart) to reduce soil erosion;
- bunds built around all stockpiles to prevent erosion and sedimentation of nearby land during rain events;
- design and construction of all sediment catch drains, bunds and sumps as described in Section 3.7.8;
- containing chemicals and hazardous substances (e.g. fuels, lubricants) within bunded areas;

- maintaining a 1.0 m operational freeboard in the BP1, BP2, PDD and RWD;
- the storage of overburden in accordance with the design as described in Section 3.6.1;
- accidental spillages of hydrocarbon materials to be managed in general accordance with the SA EPA *Guidelines for Environmental Management of on-site remediation* (2008);
- remediation of contaminated soils to occur as soon as practical after a spill event has been identified;
- minor spills (e.g. less than 20 L) to be managed by the placement of absorbent material and/or excavation and removal of contaminated soils, with disposal at an EPA approved facility (NSW or SA).
- larger hydrocarbon spills to be assessed on a case by case basis for remediation and disposal requirements and may necessitate expert independent advice and management (e.g. Site contamination and remediation expert);
- construction of the TSF in accordance with construction design as summarised in Section 3.6.2 and Appendix D1 and D4;
- construction of seepage interception drains around TSF1, TSF2 and BP1;
- operation of the Landfill facility in accordance with the *Landfill Environmental Management Plan*, (refer to Appendix F4);
- operation of the TSF in accordance with the *TSF Operations and Surveillance Manual* (refer to Appendix F5); and
- ensuring all water pipelines are bunded to contain saline water leakage. All pipe welds are to be carried out using a certified and competent person.

A *Topsoil Management Plan* has been developed for the Project (refer to Appendix F2).

6.7.5 Likelihood and Severity of Consequences

The inherent risk of impacts to soils during the period of operation is low and will be further reduced by the control measures stated above.

Seepage modelling was completed for the TSF by Golder in 2013 and 2016. The results of the modelling can be found in Appendix D1 and D4.

The original design has been reviewed by Golder (2016a, 2016b and 2019) based on processing plant modifications, 'as built' TSF basin modifications, revised production schedule, and revised tailings slurry density, remining of tails and construction of additional cells (TSF3 and TSF4). Results of the work are summarised in detail earlier in Section 3.6.2.

Results of the Golder (2016b) assessment show that the average seepage rate during deposition was 0.01 m^3/day through the base of the TSF cell. The phreatic surface for the seepage model remained within the tailings and localised saturation is indicated directly beneath the TSF. This localised saturation dissipates rapidly after deposition ceases and the pond is removed from the surface of the TSF.

Seepage through the perimeter embankments is not indicated to occur during operations or closure under normal operating conditions. However, seepage into the embankment was indicated during storm events that were simulated, both before and after the inclusion of the cover material. This is likely due to the extent of the storm pond covering the entire facility and touching the embankment faces. The maximum seepage rate through the embankment occurred during 'storm 1', which was prior to cover material being applied to the facility. The seepage rate thorough the embankment during this event was modelled as 0.15 m^3/day, extending less than 2 m into the embankment.

Lateral seepage was also investigated by modelling a 1 m deep pond against the embankment for a period of 40 days, without any tailings (to imitate the TSF prior to deposition with water inside). The results of the seepage modelling indicate that the extent of the lateral seepage is unlikely to extend more than 50 m beyond the toe of the embankment, under the scenario of water retention in the TSF cells for 40 days. The modelling also indicates that seepage is not expected to daylight onto the ground surface. This indicates a low risk of lateral seepage extending beyond the Lease boundary due to ponding at the embankment for a period of 40 days.

The results of the Golder (2016b) seepage assessment did not demonstrate mounding in the underlying groundwater, which can be attributed to the relatively low permeability of the natural surface, the depth of the groundwater (approximately 30 m below ground level) and the relatively short operating period for the TSF.

The risk of landfill leachate impacting soils and causing loss of pastoral viability is considered low due to the insignificant volumes of leachate likely to be generated, the management of this leachate (by regular removal on accumulation) and that the landfill excavation has volume sufficient for the temporary storage of a 1-in-100 year AEP rainfall event without overtopping of the facility.

6.7.6 Risk Levels

The results of the risk assessment for adverse impacts to soils are presented in Table 6-7.

Table 6-7 Risk Assessment - Soils

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Loss of pastoral viability of the land	Possible	Minor	Control measures as outlined above	Unlikely	Minor	Low	Yes
Accidental spill of picric acid and silver nitrate during transportation, storage or use results in contamination of soils	Possible	Minor	Control measures as outlined above	Unlikely	Minor	Low	Yes
Accidental spill of Magnafloc®, Sodium Cyanide (NaCN), Hydrogen Peroxide (H_2O_2), Sodium Hydroxide (NaOH), GoldiLOX (leach accelerant), and/or Copper Sulphate during transportation, storage or use results in contamination of soils	Possible	Minor	Control measures as outlined above	Unlikely	Minor	Low	Yes
Accidental spill of cyanide during transportation, storage or use results in contamination of soils	Possible	Minor	Control measures as outlined above	Unlikely	Minor	Low	Yes

Overtopping of the cyanide cell (TSF 4) results in contamination of soils	Possible	Minor	Control measures as outlined above	Unlikely	Minor	Low	Yes

6.7.7 Justification for Risk Acceptance

From the above risk assessment, it would appear that the most significant risk events for adverse impacts to soils are the potential loss of pastoral viability.

As a consequence of this assessment, soils in the Lease area will be monitored for adverse impacts.

6.7.8 Outcome/Objective

Soil affected by mining activities is suitable for return to pre-mining (pastoral) use.

The TSF is physically stable.

6.7.9 Measurement Criteria

See Table 6-18.

6.7.10 Leading Indicator Criteria

See Table 6-18.

6.7.11 Monitoring Program

All spills and leaks of contaminants will be recorded by the Mine Manager in the contaminant spill register, including remedial actions undertaken. Spills greater than 20 L identified in the contaminant spill register and reported to DEM's Principal Mining Regulator. The contaminant spill register is to include information on the following:

- the date and time that the spill was detected;
- who discovered the spill;
- spill location;
- spill material, spill volume, whether the spill/leak has ceased or is ongoing;
- cause of spill/leak;
- remedial measures;
- validation measures;
- measures to reduce the risk of a repeat occurrence;
- notification measures;
- instructions obtained from relevant authorities; and
- final outcomes.

Quarterly visual assessment of topsoil stockpiles is to include photographs and record keeping including signs of stockpile erosion, stability, effectiveness of perimeter bunds and/ or drains, pest activity and the presence and removal of weeds.

Standing water level (SWL) in piezometers S1 to S6 will be monitored and recorded weekly during operations using a calibrated water level meter. If water found to be present, then field TDS will also be monitored and recorded using a calibrated water quality meter.

Weekly visual inspections and monthly scans of the TSF decant ponds will be undertaken using the I-Site laser scanner to ensure that decant ponds are not stored at the internal wall of embankments for more than 7 days during normal operations. A freeboard of at least 0.5 m will be maintained during normal operations and it will be targeted that water is not to be stored against the embankment walls.

6.8 Groundwater and Hydrology

6.8.1 Context

Environment

The Portia Deposit occurs in sediments of the Eyre Formation, which is a Tertiary age unit of the Lake Eyre Basin, a sedimentary sequence that extends from about 80 kilometres south of Oban to the Northern Territory border and beyond.

At the Portia Mine Site, the Eyre Formation occurs at depths greater than 60 metres, being separated from the land surface by low permeability clayey sediments of the Namba Formation and recent surficial deposits. The Namba Formation also forms part of the Lake Eyre Basin sedimentary sequence and acts as a confining layer to the units below. Eromanga Basin sediments do not occur at the Portia Mine Site, as the Eyre Clays rest unconformably on Precambrian age basement rocks and are directly overlain by Namba Formation sediments.

The primary aquifer at the Portia Mine Site is the fractured basement rock aquifer. Historical and more recent drilling has confirmed that there is no perched aquifer system within the upper Namba and Eyre Formations.

Groundwater modelling was originally carried out by AGT (2014) and updated by AGT (2015), Aqueon (2016a, 2016b and 2016c) and WGA (2017). Full details are provided in Sections 3.4.1 and 3.7.3 and Appendix C.

The recent Aqueon (2016c) and WGA (2017) modelling results identify that pit sumping can effectively maintain the current rates of drawdown. The environmental impacts associated with the expansion do not change from those previously reported by AGT (2015) and Aqueon (2016a, 2016b and 2016c). The drawdown contours show impacts at the Shylock Palaeochannel of around 0.5 m consistent with the previous model predictions. The model domain is 10 km x 10 km and the nearest groundwater receptor (Zac's Bore, unit number 7034-40) is greater than 25 km to the south. At the boundaries of the model there is no drawdown influence and therefore it is unlikely that any existing users will be impacted.

Jareds Bore lies within the final pit void and was selected to represent the rising pit water level during the recovery phase. After taking into consideration all inflows and outflows the pit lake is predicted to recover to its maximum level of RL 23 m AHD approximately 20 years after dewatering operations cease. The recovery model will be reviewed again prior to mine closure, when observed drawdowns can be compared with predicted drawdowns and when extraction volumes are known.

The groundwater from the fractured bedrock aquifer is saline (TDS > 12,000 mg/L) and therefore will have limited value as a resource for stock or other agricultural pursuits. Although not modelled, in-pit salinity will increase due to evaporative effects. Given ambient TDS values are > 12,000 mg/L, an additional increase in salinity or TDS will not change the environmental value (beneficial use) of the groundwater resource, currently limited to industrial use (AGT, 2014).

The Aqueon (2016a) modelling also demonstrates the capacity of the Shylock Palaeochannel to support the contingency supply demand at the required 'worse case' rate (i.e. 18 L/s for 270 days). The modelling also shows that extraction from the Shylock Palaeochannel will not significantly alter the regional drawdown predictions, as benchmarked by the predicted 0.2 m at the Yarramba Palaeochannel (AGT, 2014). Furthermore, as the nearest groundwater receptor (Zac's Bore, unit number 7034-40) is located some 25 km to the south east of the pit, existing users will also not be impacted.

Seepage assessments conducted on the TSF by Golder (2013 and 2016) demonstrate that no impact is predicted to occur to the groundwater piezometric surface as a result of vertical seepage flows through the TSF.

Shylock Re-injection Well Field

At the re-injection well field, the stratigraphy of the channel consists of a surficial layer of Quaternary-Recent sands, underlain by soapy-plastic clay (+/- sand layers) of the Namba Formation, then silky-micaceous clay of the Eyre Formation, which grades into a basal Eyre (palaeo) sand package of medium (+/- coarse) to fine grained angular quartz sand with minor silt and clay. The Namba and Eyre clays extend from near surface to a depth of around 70 m below ground, followed by sand or clayey-sand lenses generally 6 m thick in the central channel (Eyre Sand), followed by highly weathered basement (saprolite) at 73 to 76 m below ground level.

The Shylock Palaeochannel sand aquifer is about 450 to 650 m wide and the palaeo-sands range in thickness from about 5 to 8 m (average 6 metres), pinching out to <1 m at the edge. The palaeo-sands are overlain by approximately 70 m of clay. Pre-mining depth to groundwater was approximately 22 m BGL or about 38 m AHD.

Groundwater quality is poor with TDS of the source (mine) water ranging from approximately 12,000 to 15,000 mg/L, compared to 18,000 to 23,500 mg/L at the Shylock Palaeochannel. This demonstrates that water captured from the open pit is generally of better quality than the receiving aquifer. Predominantly due to the high salinity/ TDS, there are no existing users which source groundwater from this aquifer system.

Comparison of major ion chemistry between the source and receiving waters using a Piper Trilinear Diagram was completed (see Section 3.7.3). As detailed in Table 3-35 and Table 3-36, the groundwater from the pit and the Shylock sand aquifer are of the same type. From a geochemical perspective, multi element analysis of sand samples from the Shylock Palaeochannel demonstrate the Palaeochannel sands as predominantly clean, with low concentration of secondary pyrite or sulfidic material (Total sulphur values of less than 0.05%). This indicates a low risk of trace metal mobilisation during the introduction of injectant and supports the conclusion that the injection of pit disposal water will not have any adverse effects on the groundwater quality of the Palaeochannel.

Dissolved arsenic concentrations measured in the Shylock Palaeochannel wells ranged between 0.009 and 0.137 mg/L (Table 3-36). Dissolved arsenic concentration ranged between 0.191 and 0.277 mg/L for sampled pit water (Jared's Bore) during the re-injection trial and sampling and analysis of back-flush water (post injection) showed major and trace chemistries consistent with the source injectant (refer to Appendix C3).

The dissolved arsenic concentration of the other pit wells tested (TJ-1, TJ-5, TJ-8, WB1 and PTDW1, PTDW3, PTDW4 and PTDW6, also ranged between 0.031 and 1.49 mg/L (average of 0.4 mg/L from 9 samples). Although the dissolved arsenic concentrations are higher at the pit than the receiving aquifer, the composite average concentration of the blended injectant is expected to be consistently below the Australia and New Zealand Environment and Conservation Council (ANZECC, 2000) trigger level (low risk) value of 0.5 mg/L for stock watering. All other dissolved metals shown in Table 3-36 were at concentrations lower than the Palaeochannel aquifer.

Additional baseline measurements taken from re-injection wells prior to re-injection activities, shown in Table 3-36, demonstrate that the dissolved arsenic range of Shylock Palaeochannel waters should be extended to 0.009 to 0.582 mg/L. Re-injection well PTIW43 (INJ_J) was sampled during airlift development on 16/12/2014 and the laboratory reported (ALS Laboratory) dissolved arsenic concentration was 0.582 mg/L, which exceeds the ANZECC (2000) trigger level (low risk) of 0.5 mg/L for stock watering.

There are no existing users which target the Shylock Palaeochannel which could be impacted by the re-injection or extraction activities should they recommence in future operations. The nearest industry to the Site, other than pastoral, occurs at the Honeymoon ISR Mine Site (~40 km south east) and the Oban ISR site (~40 km north east). The nearest known operational stock watering well (Zac's Bore) is over 25 km to the south.

Site Hydrology

There are no established water courses within approximately 10 km of the Portia Mine Siteand no significant drainage channels occur in the ML area, with primary drainages lying well to the north, south and east. In the immediate vicinity of the Portia Mine Site, the landscape is characterised by a series of low northeast trending dunes separated by flat interdune corridors. Denuded claypans between the dunes are common in these basins. At the Portia Mine Site, surface water typically occurs only after significant and intense rainfall events. Rainwater generally soaks into surficial soils and sands and may also accumulate on claypans prior to being evaporated.

Stakeholders

Stakeholders with an interest in groundwater in the area include local pastoralists, none of whom are known to extract groundwater within 25 km of the Site, DEW and the SA EPA as the regulators of groundwater resources in South Australia.

Stakeholders with an interest in surface hydrology in the area include local pastoralists, DEW and the SA EPA. Some stock watering dams have been constructed across the existing ephemeral drainage lines, the nearest of these drainage channels feeds Jacks Dam approximately 10 km to the east, Blue Shirt Dam, approximately 7 km to the west of Portia and Swamp Dam approximately 5 km north west , and are considered a significant distance away from the Project location.

Industry

The nearest industry, other than pastoral, occurs at the Honeymoon ISR site (~40 km south east) and the Oban ISR site (~40 km north east). The ISR operations at Honeymoon relate to Eyre Formation Palaeochannel facies (Yarramba Palaeochannel), whereas at Oban, the mineralisation occurs in a large 'blanket sand' facies of the Eyre Formation. Neither of these sedimentary facies of the Eyre Formation occur at Portia. As described above, the nearest known operational stock watering well (Zac's Bore) is some 25 km to the south.

6.8.2 Applicable Legislation and Standards

Relevant legislation and standards for groundwater include the Mining Act, the EP Act, the *Natural Resource Management Act 2004*, the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPM) and the *Environment Protection (Water Quality) Policy 2015*.

Benagerie Gold has developed a *Groundwater Monitoring and Management Plan* (GMMP) to support mining activities at the Portia Gold Mine. This GMMP provides detail of monitoring for groundwater affecting activities at Portia and incorporates impacts from the mine dewatering, aquifer reinjection/ extraction and tailings storage facility seepage. The GMMP is a requirement of a drainage and discharge (D&D) permit and in addition, will be used as an operational document to fulfil monitoring requirements under the approved PEPR. A copy of the GMMP is contained in Appendix F6.

6.8.3 Potential Impact Event

Mining operations at the Portia Mine Site adversely impact the quality and quantity of groundwater in the Eyre Formation available to existing users and the environmental values of the Yarramba Palaeochannel.

Groundwater could be impacted through the following:

- extracting water from pit sumping;
- supernatant water from the TSF leaking and infiltrating through the confining layer and contaminating groundwater resources;
- leachate from landfill contaminating the groundwater;
- Accidental spill of picric acid and silver nitrate during transportation, storage or use results in contamination to groundwater;
- Accidental spill of Magnafloc®, Sodium Cyanide (NaCN), Hydrogen Peroxide (H_2O_2), Sodium Hydroxide (NaOH), GoldiLOX (leach accelerant), and/or Copper Sulphate during transportation, storage or use results in contamination to groundwater; and

- Accidental spill of cyanide during transportation, storage or use results in contamination to groundwater.

Surface water could be impacted by:

- leachate from the landfill escaping to surrounding environment; and
- lateral seepage from the TSF surfacing and affecting local vegetation.

Failure to effectively control impacts to ground or surface water may result in:

- a reduction in the quality of groundwater available for existing (pastoral) users;
- a reduction in the quantity of groundwater for existing (pastoral) users; and
- leachate contaminating immediate local environment to the landfill.

6.8.4 Control and Management Strategies

The impact of mining operations on groundwater quality and quantity to existing users and environmental values of the Yarramba and Shylock Palaeochannels will be significantly reduced by implementing the following control and management strategies:

- segregating clean and dirty water streams on Site to prevent groundwater contamination (refer to Section 3.7.8);
- construction of the TSF in accordance with construction design summarised in Section 3.6.2 and Appendix D1, D4 and D5;
- construction of seepage interception drains around TSF1, TSF2 and BP1;
- construction and operation of the Landfill facility in accordance with the *Landfill Environmental Management Plan* (refer to Appendix F4);
- operation of the TSF in accordance with the *TSF Operations and Surveillance Manual* (refer to Appendix F5);
- managing stormwater run-off into the landfill by constructing a perimeter stormwater cut-off bund;
- maintaining operational freeboard of 1.0 m in the BP1, BP2, RWD and PDD;
- appropriate design of the landfill cell for the temporary storage of a 1:100 year AEP rainfall event without overtopping (refer to Appendix F4);
- appropriate design of the TSF cell to ensure ANCOLD free board design criteria are met (refer to Section 3.6.2); and
- monitoring of impacts on groundwater resources resulting from pit dewatering; and
- monitoring of impacts on groundwater resources resulting from MAR and wellfield operation when reinjection and well extraction activities are being undertaken.

6.8.5 Likelihood and Severity of Consequences

The inherent risk of operations negatively affecting the quality and quantity of ground or surface water for existing users and environmental values is low and will be further reduced by the implementation of the control strategies stated above.

6.8.6 Risk Levels

The results of the risk assessment for ground and surface water are presented in Table 6-8 Risk Assessment – Groundwater and Hydrology.

Table 6-8 Risk Assessment – Groundwater and Hydrology

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
A reduction in the quality of groundwater for existing pastoral users	Rare	Minor	No control measures needed	-	-	-	Yes
A reduction in the quantity of groundwater for existing pastoral users	Unlikely	Minor	Control measures as outlined above	Rare	Minor	Low	Yes
Impacts to environmental values of the Yarramba and Shylock Palaeochannel	Unlikely	Minor	Control measures as outlined above	Rare	Minor	Low	Yes
Leachate escape from landfill	Unlikely	Minor	Control measures as outlined above	Rare	Minor	Low	Yes
Accidental spill of picric acid and silver nitrate during transportation, storage or use results in contamination to groundwater	Unlikely	Minor	Control measures as outlined above	Rare	Minor	Low	Yes
Accidental spill of Magnafloc®, Sodium Cyanide (NaCN), Hydrogen Peroxide (H_2O_2), Sodium Hydroxide (NaOH), GoldiLOX (leach accelerant), and/or Copper Sulphate during transportation, storage or use results in contamination to groundwater	Unlikely	Minor	Control measures as outlined above	Rare	Minor	Low	Yes
Accidental spill of cyanide during transportation, storage or use results in contamination to groundwater	Unlikely	Minor	Control measures as outlined above	Rare	Minor	Low	Yes

6.8.7 Justification for Risk Acceptance

From the above risk assessment, it would appear that the most significant risk events for groundwater are a reduction in the quality and quantity of water available for existing pastoral users and possible impacts to environmental values of the Yarramba and Shylock Palaeochannels.

Given the considerable distance between the Portia Site and existing pastoral supply locations, the significant distance to the Yarramba Palaeochannel, the lack of hydraulic connection between the Eyre Formation on Site and the sediments in the Yarramba and Shylock Palaeochannels, as well as the control measures stated above, it is expected that impacts will be insignificant and the residual risk will be low.

6.8.8 Outcome/Objective

No adverse impact to the quality and quantity of groundwater to existing users.

No compromise to the environmental values of the Yarramba Palaeochannel groundwater.

No compromise to the environmental values of the Shylock Palaeochannel groundwater.

6.8.9 Measurement Criteria

See Table 6-18.

6.8.10 Leading Indicator Criteria

See Table 6-18.

6.8.11 Monitoring Program

Full details of the monitoring program are defined in the Groundwater Monitoring and Management Plan (see Appendix F6).

Leading indicators provide forewarning to potential over pressurisation of the Shylock Palaeochannel during re-injection activities. The first leading indicator for the Shylock Palaeochannel is 100 Kpa less than the calculated fracture pressure to indicate potential over-pressurisation of the Palaeochannel aquifer. Leading indicators related to drawdown will determine if the hydrogeological model used is overestimating or underestimating the amount of water in the aquifer. Leading indicators related to water quality (pH, TDS and arsenic) will ensure that the arsenic concentration of the injectant water remains below 0.5 mg/L and will not contaminate the receiving waters of the Paleochannel.

As described in Section 3.4.1, the Aqueon (2016c) review highlighted that a number of the constructed pit perimeter monitoring wells are unsuitable for ongoing use as calibration wells for a numerical groundwater model. This is either because the wells were screened across multiple formations or because they are influenced by the pumping of the pit dewatering wells and therefore calibration is very difficult due to significant perturbations each time the pumping wells are switched on and off. Many of the existing pit perimeter wells will also be abandoned or become inaccessible as the open pit footprint expands to the north and south.

Figure 6-1 presents locations of existing exploration holes (BEN0599, BEN603, BEN6703, BEN1070 and W6) that are considered suitable to be converted to monitoring wells for ongoing model calibration, as recommended by Aqueon (2016c). These holes have multiple casings and penetrate the fractured bedrock aquifer to depth. Monitoring of explorations holes BEN0599, BEN603, BEN6703, BEN1070 commenced in October, 2016 and had continued to be monitored on a fortnightly basis. Due to the consistency of the data collected from these wells, monitoring frequency will be altered from fortnightly to quarterly. The existing 'distal' monitoring wells (W1A, W2A, W3A and BEN605) are also pivotal for the ongoing calibration of the groundwater numerical model. Presently there are no monitoring wells on the western side of the open pit and the proposed W6 location is recommended to support future model calibration and validation.

Head impress (pressure) in wells at locations PTIW21, PTIW17 and W5 will be monitored monthly during re-injection at the well head to confirm aquifer pressure remains within the conservative fracture pressure limit for the overlying Namba Formation. A leading indicator pressure of 540 kPa at the top of each monitoring well head has been selected which is 85% of calculated fracture pressure (750 kPa or 75 m above initial standing water level).

Monitoring of the water quality of the injectant (mine water) from the pit dewatering dam on a monthly basis during re-injection activities for field parameters (EC / TDS and pH) and Arsenic (As) shows As concentration of the blended injectant is below 0.5 mg/L, confirmed by Laboratory dissolved As and Major ion testing of the injectant using an approved NATA registered laboratory on a quarterly basis.

In the event that re-injection wells are used for extraction, the above injection monitoring program will cease and the following extraction monitoring program is proposed.

At pumped extraction wells in the Shylock Palaeochannel (e.g. PTIW19, PTIW43, PTIW44, PTIW46, PTIW48 and PTIW49), Site personnel will monitor and record the following:

- Measure SWL once immediately prior to the commencement of extraction to establish appropriate pre-extraction water level;
- Measure SWL, field EC / TDS, field As, laboratory As and major ions once at the commencement of extraction;
- Measure SWL weekly during the first month of extraction;
- Measure SWL fortnightly from month two to month three of extraction;
- Measure SWL monthly from month four to cessation of extraction;
- Measure field EC / TDS, field As, laboratory As and major ions quarterly during extraction.
- Weekly extraction rates at each well; and
- Total cumulative extraction volumes from each well.

At monitoring wells in the Shylock Palaeochannel (PTIW17, PTIW21, W4 and W5) Site personnel to monitor and record the following:

- As far as reasonably practicable, measure SWL monthly for two months prior to the commencement of extraction.
- Measure SWL once at commencement of extraction.
- Measure SWL weekly during the first month of extraction.
- Measure SWL monthly from month two to cessation of extraction.

Further details of the groundwater monitoring program are detailed in the *Groundwater Monitoring and Management Plan* (Appendix F6) and Section 3.7.3. Groundwater monitoring locations are shown in Figure 6-1. The coordinates of the monitoring locations are presented in Appendix 1 of the updated GMMP (Appendix F6).

Piezometers S1, S2, S3, S4, S5 and S6 next to the TSF and PWD are to be monitored monthly for seepage by Site personnel to confirm field TDS values of captured water inside piezometers of no greater than 4,000 ppm.

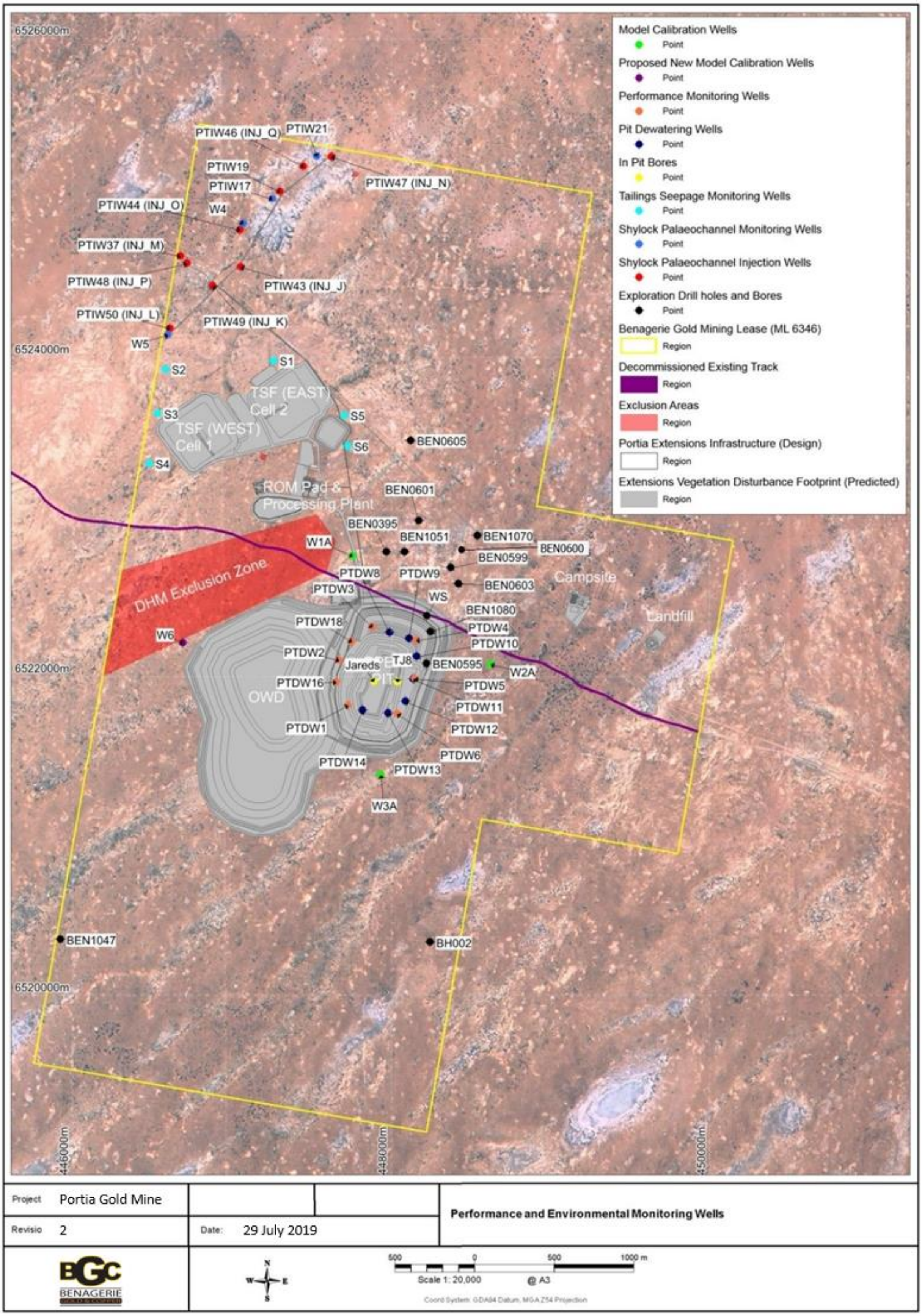


Figure 6-1: Performance and environmental monitoring well locations

6.9 Waste Disposal and Hazardous Substances

6.9.1 Context

Environment

The Portia Landfill Facility is located on Mulyungarie Station, approximately 105 km to the north west of Cockburn and approximately 110 km (direct) or 190 km (by road and track) to the north west of Broken Hill. Prior to its construction, there were no waste management facilities of any kind on Site. Soils on Site are shallow sands and clays and are underlain by about 60 m of low permeability Namba Formation clays.

Activities carried out on Site include the excavation of a pit, the construction of an OWD the recovery of gold through the processing plant, the deposition of tailings from that plant in a TSF and the construction and operation of a camp, office, workshop and administrative facilities. Potable water for Site use is obtained from two RO plant installed on Site.

Wastes generated by the operation include:

- industrial and domestic wastes such as waste oils, oil/fuel filters, soiled rags, worn out equipment (for example pumps), packaging wastes (refer to Section 3.6.4);
- small amounts of RO brine reject water and anti-scalent at very low dosage rates (refer to Section 3.6.4);
- sewerage and putrescible matter such as food wastes (refer to Section 3.6.4);
- mining wastes such as waste rock / overburden (refer to 3.6.1);
- tailings discharge from the processing plant (refer to Section 3.6); and
- small amounts of waste solution from the gold clean-up (nitric acid oxidation) procedure (refer to Section 3.6).

Stakeholders

DEM (in its role as a regulator for new mining developments) has stated that all domestic or industrial waste must be disposed of in accordance with EP Act requirements.

Other stakeholders who may have concern over potential impacts of domestic and industrial wastes include SA Health and the SA EPA.

Concerns have not been expressed by the local landholder or residents of Cockburn relating to waste.

The nearest industry, other than pastoral, occurs at the Honeymoon Mine Site (~40 km south east) and the Oban ISR site (~40 km north east).

6.9.2 Applicable Legislation and Standards

Relevant legislation and standards for waste disposal and hazardous substances include the Mining Act, the EP Act, *Dangerous Substances Act 1979* and the *Natural Resource Management Act 2004*.

BGC has developed a *Landfill Environmental Management Plan* (LEMP) to support mining activities at the Portia Mine Site. The LEMP provides detail of the design, construction, management and monitoring of the landfill facility. The LEMP is a requirement of an EPA licence for a landfill facility and in addition, will be used as an operational document to fulfil monitoring requirements under the approved PEPR. A copy of the LEMP is contained in Appendix F4.

6.9.3 Potential Impact Event

Discharge of domestic or industrial wastes contaminates land and soils on or off Site.

The types of waste generated at the Site generally fall into one of the following categories:

- recyclables (including drinking bottles and cans, cardboard, scrap metals, tyres and batteries);
- solid wastes (including general 'hard' wastes and 'putrescible' wastes);
- liquid wastes (including waste oils, coolants and other chemical wastes);
- septic wastes (from amenities);
- contaminated soils (from spills);
- mining wastes (including overburden / waste rock);
- processing wastes (including tailings); and
- RO plant waste (hyper-saline brine waste).

Failure to effectively control domestic or industrial wastes may result in:

- the generation of litter, reducing visual amenity;
- increases in feral animal populations; and
- contamination of land and soils.

6.9.4 Control and Management Strategies

The impact of industrial and domestic wastes can be significantly reduced by the implementation of the following control strategies:

- management of all wastes in accordance with the *Waste Management Plan* (refer to Appendix F3);
- placing all hard waste substances (putrescible and packaging) in appropriate bins and then disposing at an approved landfill facility in accordance with relevant state EPA requirements (NSW or SA);
- installing a 1.8 m high wire mesh fence and lockable gates around the perimeter of the landfill;
- maintaining septic waste systems in accordance with manufacturer and SA Health department requirements;
- collecting spent lubricants, fuels and other chemicals for disposal at an approved landfill facility in accordance with state EPA requirements (NSW or SA);
- the use of bunding (secondary containment) for all fuel and hazardous chemical storages;
- the construction of the OWD, TSF and landfill in accordance with design specifications;
- managing the landfill in accordance with the LEMP (refer to Appendix F4); and

- operation of the TSF in accordance with the *TSF Operations and Surveillance Manual* (refer to Appendix F5).

The following additional control strategies will apply specifically to the use of chemicals used in the beneficiation of ore processing to ensure worker health and safety is maintained and that applicable environmental outcomes are achieved:

- use of an internally approve procedures for cyanide handling including:
    - BGC SOP 085 Inline Leaching Procedure
    - BGC SOP 086 GEKKO Control Panel Procedure
    - BGC SOP 087 Cyanide First Aid Procedure
    - BGC SOP 088 Safe Handling and Use of Picric Procedure
    - BGC SOP 089 Cyanide Mixing Procedure
    - BGC SOP 090 Cyanide Clean Up of Cyanide Spills Procedure

- maintain and comply with a Licence to Possess Regulation 25 Poisons - Cyanide issued by SA Health and the Environmental Protection License 47223 issued under the Environmental Authorisation under Part 6 of the Environmental Protection Act 1993.
- transport of cyanide to the Site will be by the supplier, AGL on a contractual basis. AGL are one of the two suppliers of cyanide to the mining industry in Australia and are cyanide code compliant for production of cyanide.
- storage of cyanide in accordance with Australian Standards AS 3780-1994 '*The storage and handling of corrosive substances*' and AS 4326-1995 '*The storage and handling of oxidizing agents*' and the *Dangerous Substances Regulations 2002 (SA)*;
- cyanide to be stored in a secured, locked compound with 20ft sea container within the current processing plant footprint in accordance with *AS 4452:1997 - The storage and handling of toxic substances*;
- workers involved in its use to be appropriately trained and qualified, including training in incident response measures (e.g. spills and first aid);
- bunds around bulk cyanide storage areas shall be constructed from an impervious material and capable of containing a minimum of 120% of the capacity of the bulk storage tanks. Bunding shall be capable of containing liquid discharge from any tank rupture e.g. a spurt from a small hole that could flow over a bund built close into a tank;
- workers to be provided with the necessary PPE, including face shield or chemical googles, protective gloves, rubber boots, and Full face respirator with canister for HCN (Cyanide mask);
- eye wash and shower station to be provided in the immediate area of the procedure for first aid (eyes and skin);
- worker access to the location will be restricted during the process (e.g. signage, fencing, etc.);
- neutralising waste solution with carbonate (e.g. soda ash) prior to storage in an approved vessel; and

- collection and off-Site disposal by an appropriately EPA licensed contractor.

A *Waste Management Plan* for the operations has been developed to cover waste control and strategies more broadly across the Site (i.e. in addition to the landfill) and is presented as Appendix F3.

6.9.5 Likelihood and Severity of Consequences

The likelihood of waste being generated from Site activities is almost certain; further, waste will be generated for the duration of the active mining operation. Control measures will be used to minimize the effects of the generation of these wastes.

The likelihood of hazardous substances being discharged is low. Control measures will be used to further reduce risks.

Due to the significant distance between the mine and the nearest residence, it is unlikely that residents will be affected by waste generation and hazardous substances at this Site. Likewise, the Site is a restricted area, so public health and amenity are unlikely to be affected by hazardous substances and waste management during the mining and closure periods.

6.9.6 Risk Levels

The results of the risk assessment for industrial and domestic waste and hazardous substances are presented in Table 6-9.

Table 6-9 Risk Assessment - Waste Disposal and Hazardous Substances

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
The generation of litter	Almost certain	Minor	Waste collection and disposal measures as outlined above	Rare	Insignificant	Low	Yes
Increase in feral animal populations	Likely	Minor	Waste collection and disposal measures as outlined above	Rare	Insignificant	Low	Yes
Contamination of land and soils	Possible	Minor	Waste and hazardous substance control measures as outlined above	Rare	Minor	Low	Yes

6.9.7 Justification for Risk Acceptance

From the above risk assessment, it would appear that the most significant risk events from waste generation and hazardous substances are reduced visual amenity due to the generation of litter, increases in feral animal populations and contamination of soils. Given the control measures stated above, it is expected that impacts will be minor to insignificant and the residual risks are considered low.

As a consequence of this assessment, waste and hazardous substances will be monitored for occurrence and impacts to the environment.

6.9.8 Outcome/Objective

No contamination of land and soils either on or off site, from waste products and hazardous materials used in the mine operations.

6.9.9 Measurement Criteria

See Table 6-18.

6.9.10 Monitoring Program

Photo monitoring is to occur, on a quarterly basis, of areas adjacent to the office, refuelling and mine laydown area, the workshop, the accommodation area, the TSF cells, the OWD, the RWD, ROM pad and the gravity separation plant and the landfill during operations and into post closure. Photo monitoring locations are P1 through to P15 inclusive.

Records of waste disposal to EPA approved facilities will be retained and reviewed fortnightly for appropriateness and consistency.

Monitoring locations are shown in Figure 6-2 and the co-ordinates of monitoring locations are presented in Table 6-12.

6.10 Air quality, Odour and Noise

6.10.1 Context

The locality of the Site is sparsely populated and pre-mining was devoid of sources of industrial noise and noise associated with human habitation and movement.

It is also an area of low rainfall and high evaporation, resulting in vegetation being sparse. Overgrazing by native and introduced animals has led to soils becoming exposed, resulting in the generation of large amounts of dust in periods of strong winds. There were no pre-mining sources of airborne pollution on Site, apart from dust and emissions from mineral exploration activities.

Stakeholders

DEM (in its role as a regulator for new mining developments) has stated that air quality, dust and noise emissions must comply with the EP Act requirements. The SA EPA is also the regulator responsible for administering the requirements of the EP Act.

The landholder (Mutooroo Pastoral Company) has been consulted and was not concerned with noise or dust impacts related to the Project.

Industry

The nearest industry, other than pastoral, occurs at the Honeymoon Mine site (~40 km south east) and the Oban ISR site (~40 km north east).

6.10.2 Applicable Legislation and Standards

Relevant legislation and standards for air quality, odour and noise include the Mining Act, the EP Act and the *Natural Resource Management Act 2004*.

6.10.3 Potential Impact Event

The potential impacts associated with noise are related to disturbance to residences at the on-Site camp as well as offsite neighbours.

Site activities will produce noise from both fixed and mobile equipment. The major sources of noise associated with the operations have been identified as being:

- vehicles (including reversing alarms); and
- machinery (e.g. generators, loaders, haul trucks, excavators, processing and other ancillary equipment).

Natural dust levels at the Site are unknown, however levels are expected to be elevated due to the arid climate and pastoral activities.

The primary sources of dust generation from the operations are:

- clearing of vegetation for construction;
- construction activities;
- dumping of ore and waste material during mining and dam construction;
- loading operations;
- wind erosion from exposed surfaces (including stockpiles, overburden dumps and tailings dams); and
- traffic from mining activity.

6.10.4 Control and Management Strategies

Separation distances outlined in the SA EPA *Guidelines for separation distances* (December, 2007) have been used to ensure that impacts from noise have been appropriately considered during the planning phase. The campsite is located 1,000 metres from the Portia open pit and approximately 1,900 metres from the ore processing facilities.

For waste water treatment systems, the guideline separation distance is 100 m from the nearest dwelling for waste treatment plants under 1,000 person capacity. The designed waste treatment facility for the campsite is located at least 100 m away, thereby complying with this guideline.

The landfill is located approximately 500 m away from the campsite and away from the prevailing wind directions.

The impact to air quality can be significantly reduced by the implementation of the following control strategies:

- vehicles and equipment will be switched off when not in use and not left idling;
- the landfill facility will be managed in accordance with the LEMP and regular capping of putrescible waste will occur in accordance with the plan;
- the waste treatment plant shall be serviced and maintained in accordance with the manufacturers recommendations;
- monitoring energy consumption (e.g. diesel and electricity) and calculating greenhouse gas emissions;

- regular maintenance of machinery to ensure noise abatement devices are working effectively;
- minimising the amount of cleared and disturbed areas on the Site;
- daily inspections will be carried out regarding dust emissions;
- using a water truck to control fugitive dust emissions within construction areas, pits and on roads;
- where dust suppression using water is not effective, the use of chemical dust suppressants and/or wetting agents will be considered;
- limiting vehicle speed limits;
- recording and actioning of public complaints; and
- monitoring noise impacts by complaint. In the event of a complaint, additional management and mitigation measures may be introduced.

6.10.5 Likelihood and Severity of Consequences

No specific air quality data exists for the Project area. The National Pollution Inventory (NPI) for the region indicates relatively low nitrogen and phosphorous levels associated with agricultural activities. Air quality for the Project area is expected to be generally good given the lack of urban populations and industry in the region.

Emission sources are likely to include diesel combustion engines in stationary and mobile equipment. Emissions will be relatively constant for the life of the Project. The emission of combustion products such as carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and particulate matter will occur and has the potential to adversely impact local air quality, with subsequent adverse impacts to human health and amenity.

Greenhouse gas also generated as a result of burning diesel fuel and LPG at the Project will contribute CO_2 and N_2O emissions to the atmosphere with subsequent adverse impacts on human health on a regional scale.

Odorous emissions may occur from septic tank systems and the proposed landfill facility. These odours have the potential to adversely impact local air quality, with subsequent adverse impacts to human health and amenity.

The risk of operations negatively affecting the noise, odour and dust levels for existing users or temporary camp inhabitants is low and will be further reduced by the implementation of the control strategies stated above.

6.10.6 Risk Levels

The results of the risk assessment for air quality odour and noise are presented in Table 6-10.

Table 6-10 Risk Assessment - Air Quality, Odour and Noise

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Respiratory irritation to the workforce	Unlikely	Minor	As noted above	Rare	Minor	Low	Yes
Respiratory irritation to members of the public	Rare	Minor	As noted above	Rare	Minor	Low	Yes
Greenhouse Gas	Almost certain	Insignificant	As noted above	Almost certain	Insignificant	Moderate	Yes

6.10.7 Justification for Risk Acceptance

There are no viable alternatives to the use of diesel engines in the context of this project. The likelihood of greenhouse gas emissions to the atmosphere is therefore almost certain and the residual risk remains moderate.

Respiratory Irritation of Members of the Public and Workforce

The nearest homestead is located 20 kilometres to the south of the Site. Impacts associated with odour and atmospheric emissions on public health and amenity will be virtually impossible and the consequences insignificant due to the distance of the ML area to the homestead, and the general prevailing westerly wind direction negating any potential impacts giving an overall residual risk ranking of low.

Dust generated from mining and processing activities is likely to be localised to generally within 200-300 metres from the dust source. The Site accommodation village is located 1,000 m from the eastern edge of the Portia open pit and approximately 1,900 m from the ore processing and stockpiling areas. It is unlikely that respiratory irritation to members of the workforce will occur given the proposed control and management strategies in place and the location of infrastructure within the ML area. If they do occur, they will be localised and have minor, short term consequences giving this impact an overall residual risk rating of low.

Greenhouse Gas

The Portia Mine Site is a small operation compared with other mining operations and its contribution to State or National greenhouse gas emissions will be negligible. The Site is remote and thereby self-reliant in terms of generating on-Site electricity needs using diesel generators. Estimates of greenhouse gas emissions have been calculated for the ML area and are based on the Australian Greenhouse Office (AGO) *Factors and Methods Workbook* (AGO, December 2006). Calculations were completed using the AGO emissions calculator tool using the predicted annual fuel usage data for the Site required to generate power and energy for mining and processing (refer to Chapter 3, section 3.18 of this document).

The Project is estimated to liberate approximately 13,374 tonnes CO_2-e (carbon dioxide equivalent) annually. State contributions to annual greenhouse emissions for the 2005 year were estimated at 28.1 Mt CO_2-e. The Portia Mine Site therefore represents an increase in emissions of approximately 0.04% annually to the States greenhouse gas emissions. Emissions of greenhouse gases into the atmosphere are almost certain. The increased levels of greenhouse gas generated are considered to be insignificant when compared to current emissions on a State level thereby resulting in an overall moderate residual risk ranking for this impact.

The US EPA LandGEM model was used to estimate the likely evolution of methane from the landfill for the 10 years post-closure. The model default factors were modified in accordance with the Australian NPI *Emission Estimation Technique Manual for Municipal Solid Waste Landfills* (Version 2, NPI, 2010). The results of this analysis are summarised in Table 6-11.

Table 6-11: Landfill Methane Generation by Year Following Closure

Year	Methane Generation (m^3/year)
1	424
2	400
3	377
4	356
5	336
6	317
7	299
8	282
9	266
10	251

The generation of around 1 m^3 per day of methane is considered not to represent an explosion or asphyxiation risk to human health and safety based on the short facility life and the lack of nearby receivers post-closure, and further management and/or mitigation of the gas via gas capture and treatment would likely be cost prohibitive.

6.10.8 Outcome/Objective

No significant adverse impacts to amenity or health as a result of airborne emissions or noise.

6.10.9 Measurement Criteria

See Table 6-18.

6.10.10 Monitoring Program

An incident register is to be kept by the Mine Manager and entries made of complaints by Site personnel and members of the public. It will include details of the following:

- the date and time of the complaint;
- details of the complaint;
- records of discussion with the person making the complaint;
- an assessment of the validity of the claim; and

- remedial measures actioned.

The register will be reviewed monthly. The review will include the identification of possible improvement measures (i.e. procedural changes) to reduce impacts from air quality, noise and odour.

All complaints and the details of close out of these complaints will be presented in a statutory compliance report to DEM prepared by the Mine Manager.

Table 6-12: Monitoring Location Summary Table (Coordinates in AGD66, AMG Zone 54)

Monitoring Location ID	Location Description	Easting (AGD66)	Northing (AGD66)	Monitoring Element
		(m)	(m)	
P1	Camp	449,057	6,522,174	Photograph - vegetation, waste, soils
P2	Office	447,674	6,522,280	Photograph - vegetation, waste, soils
P3	Processing plant	447,260	6,523,055	Photograph - vegetation, waste, soils
P4	Workshop	447,646	6,522,359	Photograph - vegetation, waste, soils
P5	Refuelling area	447,510	6,522,404	Photograph - vegetation, waste, soils
P6	Go bay	447,605	6,522,278	Photograph - vegetation, waste, soils
P7	TSF	446,708	6,523,682	Photograph - vegetation, waste, soils
P8	ROM pad	447,299	6,522,842	Photograph - vegetation, waste, soils
P9	OWD	447,362	6,522,331	Photograph - vegetation, waste, soils
P10	Access road	448,071	6,522,218	Photograph - vegetation, waste, soils
P12	OWD	446,684	6,522,057	Photograph - vegetation, waste, soils
P13	OWD	446,962	6,521,232	Photograph - vegetation, waste, soils
P14	OWD	447,447	6,521,424	Photograph - vegetation, waste, soils
P15	Landfill	449,509	6,521,988	Photograph - vegetation, waste, soils

Table 6-13: Updated drawdown and water level predictions for model calibration wells (W1A, W2A and W3A) – dewatering operations (WGA, 2017)

Date	Model Calibration 'Distal' Wells					
	RSWL (m AHD)			Drawdown (m)		
	W1A	W2A	W3A	W1A	W2A	W3A
7/03/2016	29.5	33.2	27.8	12.7	12.8	15.3
15/03/2016	29.2	32.8	27.5	13.0	13.2	15.6
4/04/2016	27.9	31.5	26.2	14.3	14.5	16.9
25/04/2016	26.6	30.7	25.3	15.6	15.3	17.8
30/05/2016	25.9	30.2	24.6	16.3	15.8	18.5
28/06/2016	23.7	27.8	22.4	18.5	18.2	20.7
24/07/2016	21.7	26.2	20.5	20.5	19.8	22.6
25/08/2016	19.3	24.2	18.4	22.9	21.8	24.7
14/09/2016	17.2	22.2	15.5	25.0	23.8	27.6
30/10/2016	13.9	19.5	12.2	28.3	26.5	30.9
7/12/2016	12.4	18.3	10.9	29.8	27.7	32.2
5/03/2017	10.1	16.6	8.9	32.1	29.4	34.2
31/03/2017	9.4	15.8	7.9	32.8	30.2	35.2
3/05/2017	8.6	15.2	7.2	33.6	30.8	35.9
25/05/2017	8.2	14.9	6.8	34.0	31.1	36.3
3/07/2017	7.7	14.5	6.4	34.5	31.5	36.7
28/09/2017	6.7	13.8	5.7	35.5	32.2	37.4
31/10/2017	6.4	13.6	5.5	35.8	32.4	37.6
4/12/2017	3.8	10.7	2.5	38.4	35.3	40.6
5/01/2018	2.8	9.9	1.5	39.4	36.1	41.6
3/02/2018	2.2	9.4	0.9	40.0	36.6	42.2
1/03/2018	1.5	8.9	0.4	40.7	37.1	42.7
3/04/2018	1.1	8.5	0.0	41.1	37.5	43.1
27/04/2018	0.8	8.3	-0.3	41.4	37.7	43.4
28/05/2018	0.5	8.1	-0.5	41.7	37.9	43.6
4/07/2018	-0.3	7.4	-1.2	42.5	38.6	44.3
18/08/2018	-0.8	7.1	-1.5	43.0	38.9	44.6
21/09/2018	-1.0	6.9	-1.7	43.2	39.1	44.8
4/11/2018	-1.2	6.8	-1.9	43.4	39.2	45.0
31/12/2018	-1.6	6.5	-2.1	43.8	39.5	45.2

Notes:

[1] Model start date of dewatering (Day 1) is 23 March 2015

[2] Dewatering operations are assumed to finish at the end of December 2018

Table 6-14: Updated recovery water level predictions for model calibration wells (W1A, W2A and W3A) – closure (WGA, 2017)

Years Post Cessation of Dewatering	RSWL (m AHD)				Drawdown (m)		
	Jareds Bore	W1A	W2A	W3A	W1A	W2A	W3A
1	13.1	15.4	18.9	15.9	26.8	27.1	27.2
2	17.1	19.6	22.3	19.6	22.6	23.7	23.5
3	19.6	22.2	24.5	22.0	20.0	21.5	21.1
5	21.2	24.0	26.0	23.6	18.2	20.0	19.5
10	22.8	25.5	27.3	25.1	16.7	18.7	18.0

Notes:

[1] Model start date of recovery (Day 1) is end of December 2018

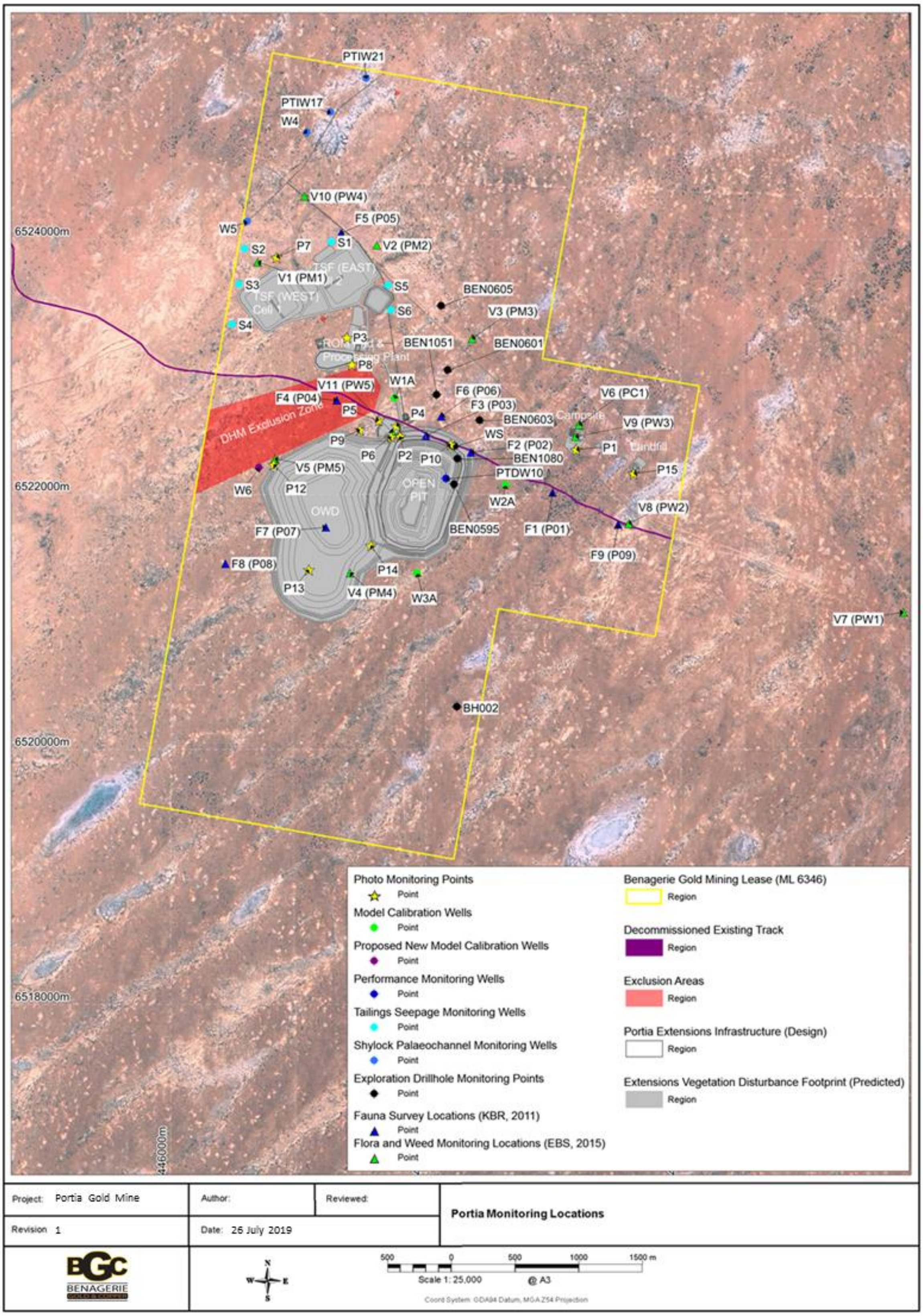


Figure 6-2: Monitoring Locations

6.11 Assessment of Changes to Operations

Where a change to existing operations or circumstances is identified, BGC will undertake an assessment of the significance level of the proposed change to determine if its within or out of scope of the approved PEPR. A notification of this assessment of change will be submitted to DEM for confirmation of whether the notification is sufficient, or whether a review of the PEPR is required pursuant to section 70C of the Mining Act.

As outlined in MG2b Minerals Regulatory Guidelines, a proposed change will be considered significant (i.e. Level 1, 2 or 3) if it:

- is inconsistent with the mining operations originally assessed when the lease was granted;
- has a negative impact on any lease condition;
- reduces the ability to achieve an outcome; and/or
- requires any modification to the approved outcomes or measurement criteria.

Where operational changes are deemed to be a Level 1, 2 or 3 they will require further discussions with DEM and/ or a PEPR review.

If the changes are considered minor in nature (Level 4) then they will not contravene lease or licence conditions, introduce new environmental impacts or require changes to approved outcomes and outcome measurement criteria.

BGC have undertaken self-assessments of proposed changes to the Portia Mine Site as required since commencement of the Project. These have resulted in amendments to previously approved PEPRs (PEPR2014/090 and PEPR2016/021). A summary of the minor changes (Level 4) that have occurred to date is provided in Table 6-15 below. The minor operational changes described in Table 6-15 have also been incorporated into this revised PEPR document where relevant.

Table 6-15: Portia Mine Site – Minor Change Notifications Summary

Minor Change Notification No.	Operational Change Description and Reference	Description of PEPR Changes	Forward Work Plan
1 PEPR2014/090	Pit abandonment bund redesign DPC Reference MO: 6935.002, ID No: A2440888, dated 8 July 2015	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	Visual monitoring and monthly photographs required to document stability.
2 PEPR2014/090	Disposal and evaporation of additional water into the TSF cells that is not able to be disposed of within the re-injection well field Reference MO: 6935.002, ID No: A2630222, dated 8 December 2015	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	Notification of commencement of disposal required, plus weekly summaries that include: • daily volumes and flow rates of water disposed into the TSF; and • photographs showing the effectiveness of the evaporation techniques and contour bunds where applicable.

Minor Change Notification No.	Operational Change Description and Reference	Description of PEPR Changes	Forward Work Plan
3 PEPR2014/090	Immediate storage of water within the TSF cells for processing plant commissioning Reference MO: 6935.002, ID No: A2685595, dated 3 February 2016	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	Management measures including: • Monitoring wells S1, S2, S3 and S4 for weekly seepage; • Conducting daily visual inspection of the TSF embankments for signs of seepage; • Ensuring water is not stored against any embankment wall for greater than 40 days; and • Ensuring water does not accumulate to a depth greater than 1 m against the upstream face of any perimeter embankment wall.
4 PEPR2014/090	Contingency water resources from the Shylock Palaeochannel re-injection well field for processing plant commissioning and operation Reference MO: 6935.002, ID No: A2716670, dated 9 March 2016	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	Monitoring of the re-injection wellfield during extraction activities, as detailed in Section 3.7.3.
5 PEPR2014/090	Tailings slurry density changed from 50% to 25-30% w/w solids in the TSF cells Reference MO: 6935.002, ID No: A2755450, dated 12 April 2016	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	Brief monthly written reports to DEM during the period of processing detailing the following information: • A copy of the daily inspection log sheets showing the information collected, including weekly seepage monitoring well inspections (S1 to S4). • A project to date (PTD) tailings tonnage deposited. • Solids volume estimate, based on monthly survey. • Solids in-situ density estimate, based on monthly survey and tonnes deposited. • Decant pond size estimate, as at the end of the month. • Water balance information for the TSF, including water return totals and a basic 'flow in flow out' balance with assumptions for evaporation and seepage. • Any TSF related incident reports and subsequent investigations (including any non-compliance issues such as water ponding against an embankment).

Minor Change Notification No.	Operational Change Description and Reference	Description of PEPR Changes	Forward Work Plan
6 PEPR2014/090	Nitric acid use to remove impurities from gold concentrate prior to smelting. Reference MO: 6935.002, ID No: A2849019, dated 15 June 2016 SA EPA letter dated 15/6/2016	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	• Comply with control measures as described in the MCN when the change is implemented. • Comply with conditions of existing EPA Licence No. 47223 and *Environmental Protection Act 1993* requirements regarding notification of environmental incidents to the SA EPA.
7 PEPR2014/090	Portia open pit design changes – southern and eastern walls. Reference MO: 6935.002, ID No: 2016D002831, dated 20 July 2016	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	• No additional approvals required to enable re-profiling of the southern and eastern walls of the open pit to an overall slope angle of 20 degrees down to RL 35.
8 (PEPR2014/090)	Portia open pit – southern and eastern wall cutbacks to the Abandonment Bund Reference MO: 6935.002, ID No: 2016D009346, dated 8 September 2016	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	• No additional approvals required to enable re-profiling of the southern and eastern walls of the open pit to an overall slope angle of 22 degrees resulting in a pit crest footprint extension of 30-40 m to the south and south-east.
9 (PEPR2014/090)	Portia OWD design changes – eastern dump area extensions Reference MO: 6935.002, ID No: 2016D015796, dated 27 October 2016	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	• No additional approvals required to enable commencement of placing overburden on the eastern side of the existing OWD facility.
10 (PEPR2014/090)	Process Water Dam construction Reference MO: 6935.002, ID No: 2016D019113, dated 23 November 2016	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	• No additional approvals required to enable construction of the PWD. • Upon completion of works, BGC to provide QA / QC records including: o Permeability testing – 1 test for the dam floor and 1 test for the embankments; and o Compaction testing – 1 test for the first compacted lift and 1 test for the last compacted lift, to be consistent with the TSF Zone 1 and 2 type material.
Updated PEPR Approved as PEPR2016/021			

Minor Change Notification No.	Operational Change Description and Reference	Description of PEPR Changes	Forward Work Plan
1 PEPR2016/021	Use of surcharge stockpiles for Portia TSF raise construction Reference MO: 6935.002, ID No: 2017D030939, dated 13 July 2017	No changes to approved Lease conditions, outcomes or outcome measurement criteria required	Upon completion of the TSF raise construction, BGC is to provide the as-constructed report to DEM containing the following laboratory testing: • *AS 1289 6.7.3: "Determination of the permeability of a soil – Constant head method using a flexible wall permeameter".* • *AS 1289 6.4.2: "Determination of the compressive strength of a soil – Compressive strength of a saturated specimen tested in undrained triaxial compression with measurement of pore water pressure".* BGC must also ensure that a sufficient stockpile of suitable material (i.e. Quaternary clay) will remain available to appropriately close the TSF as per the approved design.
2 (PEPR2016/021)	Construction of a new surface water dam, called Balance Pond 2. Reference MO 6935.002, ID No. 2018D029979, dated 17 July 2017	No changes to approved Lease conditions, outcomes or outcome measurement criteria required.	Upon completion BGC to provide an as built construction report demonstrating that the balance pond has been constructed and fenced in accordance with the design notes, and with QA/QC records including: ▪ Permeability testing – 1 test for the dam floor and 1 test for the embankments; and ▪ Compaction testing – 1 test for the first compacted lift and 1 test for the last compacted left to be consistent with the TSF zone 1 and 2 type material.

Minor Change Notification No.	Operational Change Description and Reference	Description of PEPR Changes	Forward Work Plan
3 (PEPR 2016/021)	Reprocessing of Portia tailings through existing gravity circuit Reference POR-MNC-003; dated 25 July 2018.	No changes to approved Lease conditions, outcomes or outcome measurement criteria required.	Approximately 20,000 tonnes of tailings will be excavated from TSF-2 for reprocessing – total tonnes reprocessed to align with capacity remaining in the TSF eastern cell (TSF-1) once all outstanding Portia ore has been processed. TSF capacity will be measured by survey and reported via the Monthly TSF Report. No further tailings will be deposited into TSF-2 until an approved plan is in place to remove and reprocess all Portia gravity tailings and the empty TSF structure is inspected and “refurbished”, as required, to meet the approved standards.

6.12 Uncertainty Assessment

This section summarises the significant uncertainties and assumptions identified throughout the PEPR. These are summerised in Table 6-16. A Forward Work Plan (FWP) has been developed which describes the current and future works to address the uncertainties and assumptions. Progress is reported on via the regulatory ACRs submitted to DEM for each reporting period.

Table 6-16: Uncertainties, Assumptions and Forward Work Plan

Uncertainty / Assumption	Current and Future Works (FWP)	Planned Date for Submission to DEM	Responsibility
TSF cells: tailings slurry density changes and decant pond size management	Brief monthly written reports to DEM during the period of processing detailing the following information: • Weekly seepage monitoring well inspections data (S1 to S10). • A project to date (PTD) tailings tonnage deposited. • Solids volume estimate, based on monthly survey. • Solids in-situ density estimate, based on monthly survey and tonnes deposited. • Decant pond size estimate, as at the end of the month. • Water balance information for the TSF, including water return totals and a basic 'flow in flow out' balance with assumptions for evaporation and seepage. • Any TSF related incident reports and subsequent investigations (including any non-compliance issues such as water ponding against an embankment).	Monthly during tailings deposition into the TSF	BGC – Processing/Environment
TSF cells: residual cyanide levels in the tailings	• Free cyanide monitoring (picric acid titrations) of both detoxified tailings and barren EW solution prior to deposition in TSF4 (daily); • WAD cyanide monitoring of the supernatant in TSF4 (daily) WAD and free cyanide monitoring of groundwater bores (3 monthly).	Ongoing during processing. Monthly during tailings deposition into the TSF	BGC – Processing/Environment
Open pit design: geotechnical stability	Further ongoing geotechnical assessments and review of pit design parameters to be undertaken as mining progresses.	Ongoing during mining. Comprehensive review of geotechnical model undertaken in June 2017 (see Appendix B10).	BGC - Geology

Uncertainty / Assumption	Current and Future Works (FWP)	Planned Date for Submission to DEM	Responsibility
Groundwater: validation and re-calibration of groundwater model (pre-closure)	The groundwater model will be reviewed again at least three months prior to mine closure, when observed drawdowns can be compared with predicted drawdowns and when extraction volumes are known. The recovery model and recovery predictions will be updated at this time.	Q3/Q4 2020 (approx. three months prior to closure)	BGC - Environment
Closure: post mine land use handover process	Prior to the commencement of mine closure activities, a private mutual agreement is to be finalised with the pastoral lease holder of Mulyungarie Station (Mutooroo Pastoral Company), outlining the mutually agreed expected roles, responsibilities and timeframes for handover of the Site, including ongoing responsibilities post ML relinquishment. The final agreement will be provided to DEM (confidential financial information removed) within 14 days of finalisation.	Q3/Q4 2020 (approx. three months prior to closure)	BGC - Management

6.13 Outcomes Summary

The Second Schedule of the ML offer (ML 6346, Reference No. T02606) states the agreed environmental outcomes for construction, operations and closure phases and is summarised in Table 6-17.

Table 6-17: Outcomes Defined in the Second Schedule of the Mining Lease Offer

No.	Second Schedule Conditions
Adjacent Land Use	
1	The Lessee must in constructing and operating the Lease, ensure that there are no adverse impacts to **adjacent land use**.
Aboriginal and European Heritage	
2	The Lessee must in constructing and operating the Lease, ensure that there is no disturbance to **Aboriginal or European artefacts or sites of significance** unless prior approval under the *Aboriginal Heritage Act 1988* is obtained.
Native Fauna	
3	The Lessee must in constructing and operating the Lease ensure that there are no net adverse impacts from the site operations (including fire) on **native fauna** abundance or diversity in the Lease area and in adjacent areas.
Native Vegetation	
4	The Lessee must in constructing and operating the Lease ensure no permanent loss of abundance or diversity to **native vegetation** on or off the Lease area through: a) clearance, b) dust/contaminant deposition, c) fire, d) other damage, unless prior approval under the *Native Vegetation Act 1991* is obtained.
Weeds and Pests (Feral Animals)	
5	The Lessee must in constructing and operating the Lease ensure no introduction of new species of **weeds, plant pathogens or pests** (including feral animals), nor increase in abundance of existing weed or pest species in the Lease area compared to adjoining land. Weeds are defined in this condition as any invasive plant that threatens native vegetation in the local area or any species recognised as invasive in SA.
Soil	
6	The Lessee must in constructing and operating the Lease ensure that the **soil** affected by mining activities is suitable for return to pre-mining use.
Groundwater and Hydrology	
7	The Lessee must in constructing and operating the Lease ensure that there is no adverse impact to the quality and quantity of **groundwater** caused by mining operations to existing users.
8	The Lessee must in constructing and operating the Lease ensure that there is no compromise* to the environmental values of the **Yarramba palaeochannel groundwater**.
Waste Disposal and Hazardous Substances	
9	The Lessee must in constructing and operating the Lease ensure that all **domestic or industrial waste** is disposed of in accordance with *Environment Protection Act 1993* requirements.
Mine Closure	
10	The Lessee must demonstrate to the satisfaction of the Director of Mines that the following mine closure outcomes (in so far as they may be affected by mining operations) are expected to be achieved and sustained after mine closure:
⍰	The external **visual amenity** of the Site is acceptable as determined by the Director of Mines in consultation with relevant interested parties.
⍰	The risks to the **health and safety of the public and fauna** are as low as reasonably practical.
⍰	**Ecosystem function and landscape function** is resilient and self-sustaining.
⍰	The Site is **physically stable**.
⍰	No compromise of the quality and quantity of **groundwater** to existing users.

No.	Second Schedule Conditions
⍰	All mine waste materials left onsite are **chemically and physically stable**.
⍰	Where practical, **pre-mining land use** is re-established.
Landholder Liaison	
11	The Lessee must ensure that the occupier of the land is fully advised of their program of activities, particularly in regard to the impact of operations on the land and rehabilitation progress.
Leading Indicators	
12	The PEPR must include additional leading indicator criteria for the following outcome: a) Ensure that there is no compromise to the environmental values* of the Yarramba palaeochannel groundwater.
Other Legislation	
13	The above environmental outcomes do not derogate from the operation of any other Acts that may be applicable to this operation including (but not limited to): *Aboriginal Heritage Act 1988* *Environment Protection Act 1993* *Native Vegetation Act 1991* *Natural resources Management Act 2004*

* Environmental Values will be defined according to: The environmental values recognised in *'ANZECC & ARMCANZ 2000. Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper No. 4, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra.'*

In addition to the outcomes stated in the Second Schedule of the ML offer (see Table 6-17), the following non-Lease based outcomes have also been developed and agreed as part of the risk assessment process presented in the PEPR:

Soil

- The TSF is physically stable.

Groundwater and Hydrology

- No compromise to the environmental values and water quantity of the Shylock Palaeochannel groundwater.
- No adverse impact to the quality of surface water.

Waste Disposal and Hazardous Substances

- There is to be no contamination of land and soils either on or off Site, from waste products and hazardous materials used in the mine operations.

Air Quality, Odour and Noise

- No significant adverse impacts to amenity of health as a result of airborne emissions or noise.

Post Mining Land Use

- At Lease relinquishment, the Mine Site is suitable for a return to the future land use identified in PEPR Section 7.16.

6.14 Outcome Measurement Criteria Summary

A summary of the outcome measurement criteria for each outcome (construction and operations phases) is presented in Table 6-18 below.

Table 6-18: Outcome Measurement Criteria (Construction and Operations) Breakdown Table

ID	Outcome	Outcome Measurement Criteria					Leading Indicator
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Frequency	Control or Baseline Data	
Adjacent Land Use							
PO_001	No adverse impacts to **adjacent land use**	The Mine Manager will maintain an incident/ complaints register for the Portia ML area and access tracks to record all incidents and complaints. It will record the date and time of the incident / complaint, a description of damage / losses, remedial actions to be taken and the date when the action has been completed.	Portia ML area and access tracks	All incidents or complaints are resolved or addressed to the satisfaction of the complainant or DEM within 7 days of the incident / complaint, or a longer time frame as agreed with DEM's Principal Mining Regulator.	As required following all incidents / complaints.	NA	Not required
Aboriginal and European Heritage							
PO_002	No disturbance to or destruction of **Aboriginal or European artefacts or sites of significance** unless prior approval under the *Aboriginal Heritage Act 1988* is obtained.	The Mine Manager will maintain an incident register for the Portia Mining Lease area. The register will record any disturbance to or destruction of Aboriginal or European artefacts or sites of significance.	Portia ML area	No disturbance to or destruction of Aboriginal or European artefacts or sites of significance unless prior approval is obtained. Mine records demonstrate that work ceased in the immediate area of the discovery of Aboriginal artefacts or sites, appropriate authorities were advised, and work recommenced only after authorization under the *Aboriginal Heritage Act 1998*.	During construction and operation of the mine, any disturbance of Aboriginal or European artefacts or sites of significance will be recorded. The register will be reviewed monthly and results will be presented in monthly site management reports prepared by the Mine Manager. The review will include the identification of any procedural changes required.	NA	Incident register will be reviewed monthly for unauthorised disturbance to Aboriginal or European artefacts or sites.
		Identified existing heritage sites which occur within close proximity to operational areas are to be fenced to protect against disturbance or destruction. These sites are to be included within the incident register and identified in Site Inductions to ensure employees are aware of the importance of these sites.	Portia ML operational areas	No disturbance to or destruction of identified Aboriginal or European artefacts or sites of significance within the operational area will occur as a result of operations.	As required / ongoing	NA	
Native Fauna							
PO_003	No net adverse impacts from the site operations (including fire) on **native fauna** abundance or diversity in the Lease area and in adjacent areas	The Mine Manager will maintain an incident register for the Portia ML area and access tracks, to record all fauna trappings, injuries and deaths. It will record the date, time and location of the discovery of trapped, injured or deceased fauna, the person who made the discovery, the condition and fate of the animal and release location (if applicable).	Portia ML area and access tracks.	Mine records will identify any consistency in data to enable management strategies to be identified and implemented to minimise any adverse impacts from the site operations on native fauna abundance or diversity in the Lease area and in adjacent areas.	As required following fauna trappings, injuries and deaths due to site operations. The register will be reviewed monthly and results will be presented in monthly site management reports prepared by the Mine Manager. The review will include the identification of any procedural changes required.	NA	Not required

ID	Outcome	Outcome Measurement Criteria					Leading Indicator
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Frequency	Control or Baseline Data	
		Native fauna abundance and diversity will be measured by a suitably qualified and experienced independent professional using standardised fauna monitoring techniques (e.g. trapping, active searching and bird surveys) generally consistent with methods conducted during baseline fauna surveys (KBR, 2011). A fauna survey report is to be prepared by the professional and the results of the survey are to be compared with the results from the baseline survey (KBR, 2011). Differences in species abundance and diversity are to be assessed and a discussion of the significance of results provided.	Fauna survey locations P01 to P09[9], as defined in KBR (2011), excluding locations which have been disturbed by the approved clearance footprint shown in Figure 3-1 (e.g. P07).	Fauna survey results to show no significant decrease in the abundancy or diversity of native fauna on the Lease in comparison with adjacent areas.	Survey conducted once prior to Lease surrender during either the autumn or spring season.	Baseline fauna survey conducted by KBR (2011) (see Appendix A2 of the PEPR).	Not required
		Abundance of the Dusky Hopping Mouse will be assessed by a suitably qualified and experienced independent professional using standardised fauna monitoring techniques generally consistent with methods conducted during the baseline fauna surveys (KBR, 2011). A fauna survey report is to be prepared by the professional and the results of the survey are to be compared with the results from the baseline survey (KBR, 2011). Differences in species abundance and diversity are to be assessed and a discussion of the significance of results provided.	Dusky Mouse Hopping Exclusion Zone	Survey results to show no significant decrease in the abundancy of the Dusky Hopping Mouse fauna on the Lease in comparison with adjacent areas.	Survey conducted once prior to Lease surrender during either the autumn or spring season.	Baseline fauna survey conducted by KBR (2011) (see Appendix A2 of the PEPR).	Not required
		The Mine Manager will ensure no disturbance is made to the Dusky Hopping Mouse Exclusion Zone by Site operations. Monthly inspections will be conducted with any disturbance to be recorded in a register maintained by the Mine Manger.		Monthly inspections to show no disturbance to the Dusky Hopping Mouse Exclusion Zone.	Monthly	Undisturbed Dusky Hopping Mouse Exclusion Zone.	Incident register will be reviewed monthly to show no disturbance having occurred within the Dusky Hopping Mouse Exclusion Zone.
		Batch testing of cyanide residue to verify WAD cyanide levels are <50ppm.	TSF4	No native fauna are adversely impacted by the quality of the decant pond on TSF 4.	Daily	NA	Free cyanide is less than 40 ppm WAD in decant pond water
Native Vegetation							
PO_004	No permanent loss of abundance or diversity to **native vegetation** on or off the Lease area through clearance, dust / contaminant deposition, fire or other damage unless prior approval under the *Native Vegetation Act 1991* is obtained	Native vegetation abundance and diversity measured by a suitably qualified and experienced independent professional using standardised flora monitoring techniques (e.g. line transects and photo points) generally consistent with methods conducted during the initial monitoring survey conducted by EBS (2015). A vegetation survey report is to be prepared by the professional and the results are to be compared with the results from the baseline survey (Badman, 2008a) and with the results of successive monitoring surveys. Differences in species abundance and diversity are to be assessed and a discussion of the significance of results provided.	Vegetation monitoring locations PM1 to PM5 and PC1, as defined in EBS (2015).	No permanent loss of abundance or diversity to native vegetation on or off the Lease area through clearance, dust / contaminant deposition, fire or other damage unless prior approval under the *Native Vegetation Act 1991* is obtained	Survey conducted once annually during either the autumn or spring season.	Baseline vegetation survey conducted by Badman (2008a) (see Appendix A1 of the PEPR) and initial vegetation monitoring survey conducted by EBS (2015) (see Appendix A3 of the PEPR).	Not required
		Measurement of native vegetation clearance using a combination of GIS software, ground surveys / pickups and / or aerial surveys of the mine operational areas.	Portia ML area disturbance footprint as shown in Figure 3-1.	Vegetation clearance (including that by dust / contaminant deposition, fire and other damage) does not extend beyond the approved clearance footprint shown in Figure 3-1 unless prior approval is obtained under the *Native Vegetation Act 1991*.	Monthly during site operations.	The approved clearance footprint shown in Figure 3-1 of the PEPR.	Not required

[9] Note P01 to P09 have been relabelled as F1 to F9 as shown in Table 6-12 and Figure 6-2 of the PEPR to avoid confusion with established photo monitoring points (P1 to P15).

ID	Outcome	Outcome Measurement Criteria					Leading Indicator
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Frequency	Control or Baseline Data	
		The Mine Manager will maintain an incident register for the Portia ML area of any unauthorised vegetation clearances, including uncontrolled fires on or off the Lease due to site operations. The register will be reviewed monthly and results will be presented in monthly site management reports prepared by the Mine Manager. The review will include the identification of any procedural changes required.	Portia ML area disturbance footprint as shown in Figure 3-1.	Vegetation clearance (including that by dust / contaminant deposition, fire and other damage) does not extend beyond the approved clearance footprint shown in Figure 3-1 unless prior approval is obtained under the *Native Vegetation Act 1991*..	The incident register will be reviewed monthly.	The approved clearance footprint shown in Figure 3-1 of the PEPR.	Incident register will be reviewed monthly for unauthorised vegetation clearance beyond the clearance footprint shown in Figure 3-1.
Weeds and Pests (Feral Animals)							
PO_005	No introduction of new species of **weeds, plant pathogens or pests (including feral animals)**, nor increase in abundance of existing weed or pest species in the Lease area compared to adjoining land.	The Mine Manager will maintain an incident register of any new weeds (including declared weeds), plant pathogens or pests (including feral animals) identified by site personnel, including management actions undertaken. The register will be reviewed monthly and results will be presented in monthly site management reports prepared by the Mine Manager. The review will include the identification of any procedural changes required.	Portia ML area	No new species of weeds, plant pathogens or pests (including feral animals) in the Lease area, when compared to baseline vegetation and fauna surveys conducted prior to the commencement of operations (Badman, 2008a and KBR, 2011).	The incident register will be reviewed quarterly.	List of weed and pest species identified in the baseline vegetation survey conducted by Badman (2008a) (see Appendix A1 of the PEPR) and the baseline fauna survey conducted by KBR (2011) (see Appendix A2 of the PEPR).	Incident register will be reviewed monthly to show no new weed or pest species in the Lease area.
		Native vegetation abundance and diversity measured by a suitably qualified and experienced independent professional using standardised flora monitoring techniques (e.g. point location monitoring) generally consistent with methods conducted during the initial monitoring survey conducted by EBS (2015). A vegetation survey report is to be prepared by the professional and the results are to be compared with the results from the baseline survey (Badman, 2008a) and with the results of successive monitoring surveys. Differences in weed species abundance and diversity are to be assessed and a discussion of the significance of results provided.	Weed monitoring locations PW1 to PW5, as defined in EBS (2015).	No new weeds or plant pathogens nor increase in abundance of existing weed species in the Lease area compared to adjoining land.	Survey conducted once annually during either the autumn or spring season.	Baseline vegetation survey conducted by Badman (2008a) (see Appendix A1 of the PEPR) and initial vegetation monitoring survey conducted by EBS (2015) (see Appendix A3 of the PEPR).	Not required
		Native fauna abundance and diversity measured by a suitably qualified and experienced independent professional using standardised fauna monitoring techniques (e.g. trapping and active searching) generally consistent with methods conducted during baseline surveys (KBR, 2011). A fauna survey report is to be prepared by the professional and the results of the survey are to be compared with the results from the baseline survey (KBR, 2011). Differences in pest species abundance and diversity are to be assessed and a discussion of the significance of results provided.	Portia Mining Lease area and in adjacent areas.	No new species of pests (including feral animals), nor increase in abundance of existing pest species in the Lease area compared to adjoining land.	Survey conducted once prior to Lease surrender during either the autumn or spring season.	Baseline fauna survey conducted by KBR (2011) (see Appendix A2 of the PEPR).	Not required
Soil							
PO_006	**Soil** affected by mining activities is suitable for return to pre-mining (pastoral) use.	All spills and leaks of contaminants recorded by the Mine Manager in the contaminant spill register, including remedial actions undertaken. Spills greater than 20 L identified in the contaminant spill register and reported to DEM's Principal Mining Regulator within 24 hours of occurrence.	Portia ML area.	Spills to be remediated to an appropriate EPA standard within 48 hours of the spill, or longer time frame as agreed with DEM's Principal Mining Regulator.	As required following all spills and leaks.	NA	Not required

ID	Outcome	Outcome Measurement Criteria					Leading Indicator
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Frequency	Control or Baseline Data	
		Visual assessment of topsoil stockpiles to include photographs and record keeping including signs of erosion, stability, effectiveness of perimeter bunds and / or drains, pest activity, vegetation establishment and the presence and removal of weeds.	Topsoil storage locations within the Portia ML area shown in Figure 3-1.	Stockpiled topsoil is being managed such that it is suitable for rehabilitation activities and returning the site to the future land use identified in Section 7.16.	Quarterly	NA	Not required
		Standing water level (SWL) in piezometers S1 to S6 monitored and recorded weekly during operations using a calibrated water level meter. If water found to be present, then monitor and record field TDS using a calibrated water quality meter.	Piezometers S1 to S6 shown in Figure 6-2.	Field TDS of water (if present) to be less than 4,000[10] mg/L, as defined by BTM Solutions (2016b) in the *TSF Operations and Surveillance Manual* (Appendix F5 of the PEPR). Soil adjacent to the TSF is suitable for return to the future land use identified in Section 7.16.	Weekly during operations.	NA	Free water present in any of piezometers S1 to S6.
		Monitoring of TSF decant pond area.	TSF decant ponds (TSF-1, TSF-2 and TSF-3).	Decant pond area within each cell not stored at the internal wall of embankments for more than 7 days to reduce the risk of lateral seepage breakout outside of the TSF. Decant pond size should not exceed 2 ha for a period longer than 4 weeks. Soil adjacent to the TSF is suitable for return to the future land use identified in Section 7.16.	Daily during TSF operation.	NA	TSF decant ponds reach the internal walls of embankments.
	The TSF is physically stable.	TSF decant pond freeboard	TSF decant ponds (TSF-1, 2, and 3).	A minimum 300 mm freeboard is maintained between tailings solids and the embankment crests. Decant pond area within each cell not stored at the internal wall of embankments for more than 7 days to minimise the risk of overtopping and to ensure the TSF remains physically stable.	Weekly during TSF operation.	NA	TSF freeboard becomes < 500 mm measured between tailings solids and embankment crests.
			TSF decant ponds (TSF-4).	A minimum 300 mm freeboard is maintained between tailings solids and the embankment crests.	Weekly during TSF operation.	NA	TSF freeboard becomes < 500 mm measured between tailings solids and embankment crests.
Groundwater and Hydrology							
PO_007	No adverse impact to the quality and quantity of **groundwater to existing users**.	Standing water level (SWL) measured using a water level meter (dipper) below fixed reference point (top of well casing). Drawdown in metres calculated by subtracting initial reading shown in Table 3-34 from SWL reading taken.	Monitoring wells W1A, W2A, W3A and BEN605 as shown in Figure 6-2.	Observed quarterly drawdown measurements in monitoring wells W1A, W2A and W3A do not exceed the following drawdown thresholds: • 43.8 m at W1A; • 39.5 m at W2A; and • 45.2 m at W3A. In any instance where a drawdown threshold is exceeded for more than two consecutive monitoring events, further investigation into the reason for the exceedance is required. Water levels only are collected for BEN605 (as it doesn't not have a modelled drawdown threshold).	Quarterly measurement of SWL.	NA	Observed drawdown in wells W1A, W2A and W3A exceeds the drawdown threshold for one reading.
		Monitoring of the water quality of the injectant (mine water) from the pit dewatering dam during re-injection. Field measurement of EC/TDS and pH using a calibrated water quality meter. Field Arsenic measured using a field arsenic test kit. Laboratory analysis of dissolved As and major ions by sampling and testing at a NATA accredited laboratory.	Pit Dewatering Dam during re-injection.	ANZECC / ARMCANZ (2000) water quality trigger value (low risk) for pH of 4 – 9 and Arsenic of 0.5 mg/L for stock watering. Field TDS target is below 20,500 mg/L, which was calculated by adding 20% to minimum recorded baseline TDS (Shylock Palaeochannel) of 17,100 mg/L (PTIW19).	Monthly: for field Arsenic, EC/TDS and pH Quarterly: Laboratory dissolved Arsenic and Major Ions	N/A	Field TDS of the blended injectant greater than 17,500 mg/L and / or pH falls outside of 4.5 – 8.5. Field Arsenic concentration of the blended injectant greater than 0.45 mg/L.

[10] TDS less than 4,000 mg/L is likely to be rain water infiltration. TDS greater than 4,000 mg/L is potentially from TSF seepage and further investigation is required.

ID	Outcome	Outcome Measurement Criteria					Leading Indicator
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Frequency	Control or Baseline Data	
		Under HDPE liner (1.8 – 2.0mm) seepage detection system. Detection tube will be dip checked weekly for free water water. Any free water detected will be tested for pH and free cyanide.	TSF 4	Any free water detected within the detection tube is tested and demonstrates that WAD cyanide levels were below 50 ppm and a pH below 8.5.	Weekly	NA	Any free water detected within the detection tube is tested and demonstrates that WAD cyanide levels were below 40 ppm and a pH below 8.0.
		WAD cyanide levels from the detox system	Detox unit	Prior to detox material being released into TSF 4 it is demonstrated that WAD cyanide levels were below 50 ppm.	Prior to each release into TSF 4	NA	Free cyanide is less than 40 ppm WAD in slurry and barren EW solution
		WAD Cyanide levels from the TSF 4 water quality	TSF 4	Water quality results demonstrate that WAD Cyanide is below 50 ppm.	Quarterly	NA	Free cyanide is less than 40 ppm WAD in decant pond water
		Water quality	Cyanide Monitoring Well 01 (CM01)	Water quality results demonstrate that WAD Cyanide is below 1 ppm	Quarterly	NA	Free cyanide is less than 0.5 ppm WAD in water samples from bores
PO_008	No compromise to the environmental values of the **Yarramba Palaeochannel groundwater**.	Standing water level (SWL) measured using a water level meter (dipper) below fixed reference point (top of well casing). Drawdown in metres calculated by subtracting initial reading shown in Table 3-34 from SWL reading taken.	Monitoring wells W1A, W2A and W3A as shown in Figure 6-2.	Observed quarterly drawdown measurements in monitoring wells W1A, W2A and W3A do not exceed the following drawdown thresholds: • 43.8 m at W1A; • 39.5 m at W2A; and • 45.2 at W3A. . In any instance where a drawdown threshold is exceeded for more than two consecutive monitoring events further investigation into the reason for the exceedance is required.	Quarterly measurement of SWL.	NA	Observed drawdown in wells W1A, W2A and W3A exceeds the drawdown threshold for one reading.
		Monitoring of the water quality of the injectant (mine water) from the pit dewatering dam during re-injection. Field measurement of EC/TDS and pH using a calibrated water quality meter. Field Arsenic measured using a field arsenic test kit. Laboratory analysis of dissolved As and major ions by sampling and testing at a NATA accredited laboratory.	Pit Dewatering Dam	ANZECC / ARMCANZ (2000) water quality trigger value (low risk) for pH of 4 – 9 and Arsenic of 0.5 mg/L for stock watering. Field TDS target of 20,500 mg/L was calculated by adding 20% to minimum recorded baseline TDS (Shylock Palaeochannel) of 17,100 mg/L (PTIW49).	Monthly: for field Arsenic, EC/TDS and pH Quarterly: Laboratory dissolved Arsenic and Major Ions	NA	Field TDS of the blended injectant greater than 17,500 mg/L and / or pH falls outside of 4.5 – 8.5. Field Arsenic concentration of the blended injectant greater than 0.45 mg/L.
PO_009	No compromise to the environmental values of the **Shylock Palaeochannel groundwater**.	Records taken of head impress (metres of head or kPa pressure) at the top of each well casing during re-injection.	PTIW17, PTIW21and W5 shown in Figure 6-2.	Impress head less than or equal to 540 kPa, which is equivalent to 85% of the fracture pressure level of the overlying confining bed above the aquifer, indicating that there is no failure of the aquitard (Namba Formation).	Monthly	NA	Impress head recorded at monitoring wells PTIW17, PTIW21 or W5 greater than or equal to 500 kPa.

ID	Outcome	Outcome Measurement Criteria					Leading Indicator
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Frequency	Control or Baseline Data	
		Monitoring of the water quality of the injectant (mine water) from the pit dewatering dam during re-injection. Field measurement of EC/TDS and pH using a calibrated water quality meter. Field Arsenic measured using a field arsenic test kit. Laboratory analysis of dissolved As and major ions by sampling and testing at a NATA accredited laboratory.	Pit Dewatering Dam	ANZECC / ARMCANZ (2000) water quality trigger value (low risk) for pH of 4 – 9 and Arsenic of 0.5 mg/L for stock watering. Field TDS target of 20,500 mg/L was calculated by adding 20% to minimum recorded baseline TDS (Shylock Palaeochannel) of 17,100 mg/L (PTIW49).	Monthly: for field Arsenic, EC/TDS and pH Quarterly: Laboratory dissolved Arsenic and Major Ions	NA	Field TDS of the blended injectant greater than 17,500 mg/L and / or pH falls outside of 4.5 – 8.5. Field Arsenic concentration of the blended injectant greater than 0.45 mg/L.
		Records of extraction volumes taken from flow meters installed on the head works of each re-injection well.	Re-injection wells which are used for extraction shown in Figure 3-59.	Total extraction rate less than or equal to 1,555 KL/day and total extraction duration less than or equal to 270 days.	Weekly	NA	Not required
PO_010	No adverse impact to the quality of **surface water**.	Visual monitoring of the landfill stormwater and leachate management system.	Landfill leachate and stormwater management system as detailed in the *Landfill Environmental Management Plan* (LEMP, Appendix F4 of the PEPR).	Landfill leachate and stormwater management systems (e.g. collection sumps, cut-off drains, bunds, sediment controls) are stable and functioning as designedin the *Landfill Environmental Management Plan* (Appendix F4), and that any stormwater collected within the landfill facility is captured and retained on the Lease.	During flow events (opportunistic) and quarterly.	NA	Not required
Waste Disposal and Hazardous Substances							
PO_011	No contamination of land and soils either on or off site, from **waste products and hazardous materials** used in the mine operations.	The occurrence of litter and the storage of industrial and domestic waste; measurement by geo-referenced photos.	Photo monitoring locations P1 to P15 as shown in Figure 6-2.	Photos show all litter and industrial waste securely stored in accordance with *Waste Management Plan* (Appendix F3 of the PEPR) in waste transfer areas.	Quarterly	NA	Not required
		The disposal of domestic and industrial wastes, measurement by checks of waste disposal records	Portia ML area.	Records show all waste is disposed of at appropriately licensed waste facilities in accordance with the relevant state EPA requirements (NSW or SA) dependent on disposal location.	Fortnightly	NA	Not required
Air Quality, Odour and Noise							
PO_012	No significant adverse impacts to amenity or health as a result of **airborne emissions or noise**.	Complaints register demonstrates that all complaints received regarding dust, odour and noise have been resolved within 5 working days. All complaints and details of close out will be reported in the annual statutory compliance report to DEM.	Location of complainants.	All complaints received regarding dust, odour and noise will be recorded in the complaints / incident register and closed out through contacting complainant, identifying the source (where possible) and providing feedback on actions taken within 5 working days.	As required following all incidents / complaints.	NA	Not required

7 MINE CLOSURE AND COMPLETION PLAN

This Section describes in detail the proposed rehabilitation and closure activities for the Project. This updated and detailed *Mine Closure and Completion Plan* builds on the mainly conceptual information provided in previous PEPRs.

Key to the success of the Project is the integration of rehabilitation and closure considerations into all stages of mine planning, decision making and the operational lifecycle. Health, safety, social, environmental, cultural and economic considerations need to be considered from exploration through to construction and operations through to closure and beyond.

Closure planning is initially conceptual and progressively becomes more detailed. The information presented in this plan will continue to be updated and refined (if required) as the Project develops and more detailed information becomes available. This may include, for example, updated information about the environment, modifications to the OWD and Portia open pit designs during mining, information about the success or otherwise of previous rehabilitation activities and ongoing discussions with regulators and other stakeholders.

7.1 Approach to Mine Closure

In addition to the relevant DEM guidelines for a PEPR, this plan takes into account current practices employed at other arid area mines in Australia. The plan follows the objectives and principles outlined in '*Strategic framework for mine closure* (2000)' developed by the Minerals Council of Australia (MCA) and the former Australian and New Zealand Minerals and Energy Council (now the Ministerial Council on Mineral and Petroleum Resources) and further developed in the '*Leading Practice Sustainable Development Program for the Mining Industry – Mine Closure and Completion* (2006)'.

The (general) objectives for closure are to:

- enable all stakeholders to have their interests considered;
- ensure that mine closure occurs in an orderly, cost-effective and timely manner;
- ensure that the cost of rehabilitation is adequately represented in company accounts and that the community is not left with the liability;
- ensure there is clear accountability, and adequate resources for rehabilitation;
- establish a set of indicators which will demonstrate the successful completion of rehabilitation; and
- reach a point where the company has met agreed completion criteria to the satisfaction of the regulating authority.

The plan includes progressive rehabilitation (where possible) to a stable condition consistent with prior land use (i.e. pastoral) as agreed with stakeholders (including the landowner).

This plan will ensure that the following standards are taken into account:

General economic standards

- That the community and future generations are left with no residual liability for site rehabilitation or maintenance.

- That any adverse economic effects are minimized.
- That provision is made for reasonable access for future mining (or reprocessing) of any remaining resource.

General social standards

- Effective ongoing community engagement.
- Closure minimizes the disruption/impact on the community.
- Future public health and safety are not compromised.

General environmental and rehabilitation standards

It is intended that rehabilitation and closure results in the return of disturbed land to "*a stable, productive and self-sustaining condition, after taking into account the beneficial pastoral uses of the Site and the surrounding land.*" This includes reference to:

- Physical, geochemical and ecological stability.
- The protection of the quality of the surrounding water resources.
- Risk of adverse effects to people, livestock, other fauna and the environment in general being reduced to a level acceptable to stakeholders.

It is also a goal that rehabilitation and closure leads to the Site being suitable for a sustainable post mining land use, which at Portia Mine Site will be pastoral.

Monitoring and reporting criteria for successful final rehabilitation have also been developed, including (where appropriate) reference to:

- appropriate mechanisms for formal 'sign-off' of rehabilitation as completed;
- Australian Standards as they apply at the time the rehabilitation is 'signed-off';
- comparative measures (for example reference photographs);
- agreed times for the proving of rehabilitation actions; and
- requirements under other legislation, e.g. *the* EP Act and the NRM Act.

The approach to mine closure adopted by BGC is also consistent with the approach to closure planning outlined in the International Council on Mining and Metals (ICMM) '*Planning for Integrated Mine Closure Toolkit*' (ICMM, 2008). The Integrated Mine Closure Planning Toolkit is intended to support an operation in achieving a post closure status that leaves behind an enduring positive legacy in the community.

Figure 7-1 below shows the closure planning process and how it develops throughout the mine life cycle. As shown in Figure 7-1, the Project is presently in its operational phase. Based on the current Project scope (Phase 1) operations at the Site will continue until Jun 2020. However, it is planned that further approvals will be obtained for North Portia Phase 2 and 3 which will result in operation at the Site continuing until 2024.

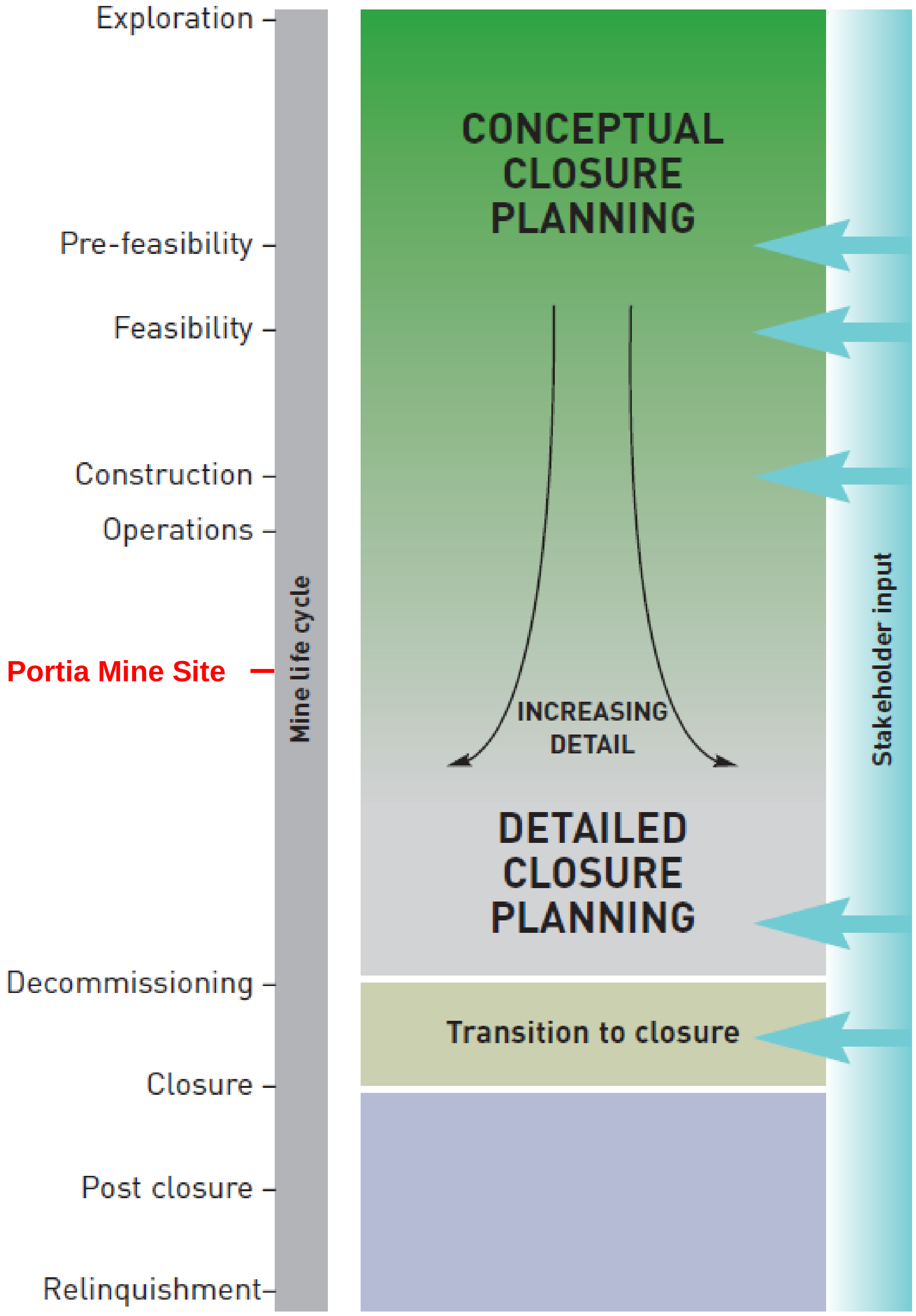


Figure 7-1: Closure Planning Process (adopted from Figure 1 of ICMM, 2008)

7.2 Context

The Portia Mine Site is located in the north east pastoral zone of South Australia and has been developed as a green field site, i.e. with no prior mining in the areas now occupied by the operation. The only activities carried out at this Site have been stock grazing and mineral exploration.

The area has been described as being in fair rather than good condition, primarily due to the impacts of heavy grazing by native animals and livestock. Public amenity is low and there are no unusual habitats, sites of significance or other items that are likely to make the area suitable for conservation. Agricultural productivity is described as very low, supporting only 12 sheep per square kilometre. The climate is hot and arid, with low rainfall and high evaporation. Surface topography is subdued, consisting of low sand dunes separated by clayey interdune corridors (flats). Vegetation is sparse; it consists of low shrublands of *Maireana astrotricha* (Low Bluebush) on the flats, with *Atriplex vesicaria* (Bladder Saltbush) and *Maireana astrotricha* on low dunes. There are some isolated stands of *Casuarina pauper* (Black Oak) low woodlands.

With regard to fauna, the Portia Mine Site and surrounds are species-poor, with the exception being reptiles, which have proven to be the group best adapted to the conditions. However, many of the populations of arid zone mammal and bird species have been and are threatened by anthropogenic influences, especially the impacts of introduced plants (weeds) and animals (pests). A few of the larger species, such as kangaroo, euro and emu, and some of the bird species have benefited by the introduction of permanent artificial watering points.

There are no established water courses within 10 km of the Site and no significant drainage channels occur in the ML area, with primary drainages lying well to the north, south and east. At the Site, surface water is present only after significant and intense rainfall events.

Groundwater resources at the Site are poor, with supplies of groundwater occurring in the underlying basement rocks. Well yields are generally low at < 5 L/s per well. Furthermore, the raw water is highly saline, with a TDS in excess of 12,000 mg/L, making it generally unsuitable for potable supply, irrigation and livestock use (~13,000 mg/L – upper limit for sheep).

7.3 Stakeholder Involvement and Issues

Stakeholder consultation carried out during exploration and development leading to this (and previous) PEPRs included one-on-one consultation with the pastoral lease holder on a number of occasions, consultation with traditional owners (ATLA), liaison with government agencies (DEM, EPA, DEW) and discussions with and information distribution to the residents of Cockburn and surrounds.

Key requirements raised by government agencies (EPA and DEM) in relation to closure environmental safeguards for the Project included:

- That the TSF structures are safe, physically and chemically stable and fit to the natural environment with a clearly defined closure timeframe. To this end, the TSF cells have been designed so as to provide a clear and defined closure timeframe.

- That salinization effects to soil have been suitably considered within the Projects closure plan by the company. To this end, seepage analysis studies were completed by Golder Associates (see Appendix D) for the TSF facility to demonstrate the efficacy of the design and quantify the risk to salinization of soils by seepage during and after operation as being low. The Site water holding dams will all be lined using either HDPE liners or low permeability clay liners in order to prevent seepage into the surrounding environment from these structures and a clear closure and rehabilitation strategy for all Site roads has been developed.

- Due to the remote location, low rainfall, uniformity of landscape, and significant distance from population centres, land use on completion of operations will revert to pastoral as agreed with the current pastoral lease holders of Mulyungarie Station.

7.4 Scope and Description of Closure Domains

The Portia Site has been divided into the following domains:

- Domain 1 – infrastructure areas;
- Domain 2 – TSFs, processing plant, ROM pad and associated infrastructure;
- Domain 3 – OWD; and
- Domain 4 – open pit (Portia).

These domains are shown in Figure 7-2 and are described in more detail over.

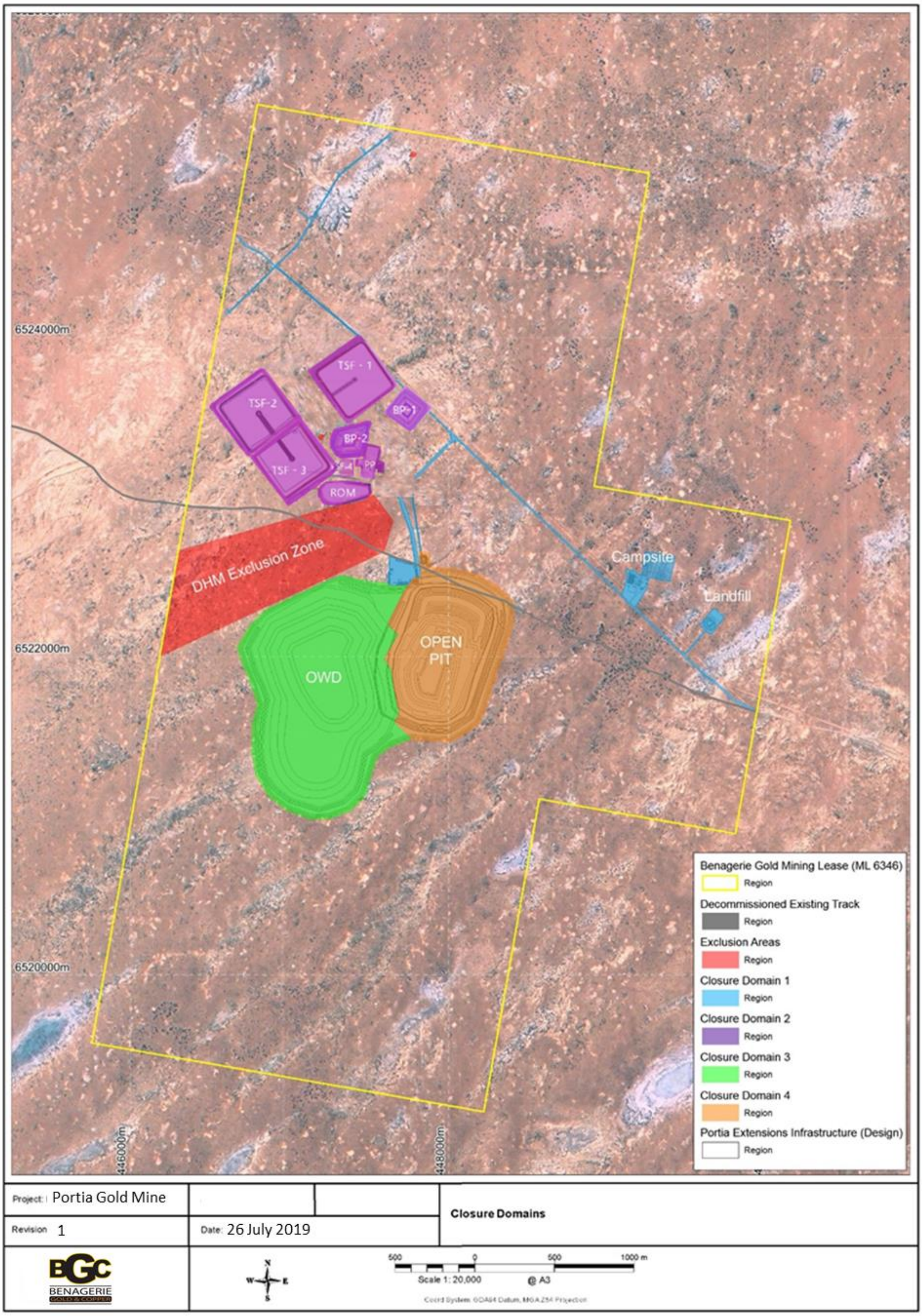


Figure 7-2: Plan View Showing Closure Domains

7.4.1 Domain 1 – Infrastructure Areas

This domain includes the campsite, landfill, re-injection well field, all monitoring wells, pipeline corridors, office and workshop areas, refuelling area, hardstand and laydown areas, haul roads, Site and camp roads (excluding roads defined within other domains and the main existing access track which remains at closure), fence lines and sewage and wastewater treatment plants (at camp and mine Site offices).

In these areas, the main changes to the land have been the stripping and stockpiling of topsoil, the placement of sheeting, the placement of buildings, the installation of tanks (e.g. fuel and septic), the construction of the landfill facility, the stockpiling of gravel, the construction of drains and run-off retention structures and the installation of wells and placement of pipes and cabling (e.g. power).

The total area of infrastructure requiring rehabilitation in Domain 1 is approximately 18 ha.

7.4.2 Domain 2 – TSFs, Processing Plant, ROM Pad and Associated Infrastructure

This domain includes the processing plant, the ROM pad, the TSFs and internal road network around the TSFs, the RWD, large BP1 and BP2, processing plant laydown areas and related surface water collection and retention systems, plus the capping surcharge stockpiles and topsoil stockpiles contained within this domain. Alterations to the land surface include topsoil stripping and stockpiling, the construction of the TSF cells, the excavation of the RWD, BP1 and BP2, the placement of road and pad sheeting, the placement of capping surcharge material adjacent to the TSF cells, the erection of processing plant infrastructure and pipelines to and around the TSF and the construction of drains and water retention structures.

The total area of infrastructure requiring rehabilitation in Domain 2 is approximately 84 ha.

7.4.3 Domain 3 – OWD

The OWD is constructed of overburden from the stripping of the top section of the Portia open pit and other non-economic intervals from deeper down. A shallow, lined evaporation cell will be constructed on top of the OWD measuring 200m x 250m. Upon completion, the HDPE liner will be lapped in from the sides and folded in. The shallow cell will be filled with general fill and Namba clays with the OWD then being covered with topsoil and seeded in. The perimeter access road, drainage collection systems and retention storages to manage runoff from the OWD are also included in this domain, as are topsoil stockpiles formed by clearance prior to OWD construction within the boundary of this domain.

The total area of infrastructure requiring rehabilitation within Domain 3 is 82 ha.

7.4.4 Domain 4 – Portia Open Pit

This domain includes the Portia open pit, the abandonment bund, the perimeter access track around the abandonment bund, the PDD and pit dewatering infrastructure, including, wells, pipelines and cables and temporary surface stockpiles including the topsoil stockpiles within the boundary of this domain. The Portia open pit itself will remain as a voids at closure and this covers an area of approximately 39.01 ha (crest footprint).

Allowing for the construction of the abandonment bund at closure, the total area of Domain 4 is 60 ha, including the crest safety bund and safety bund perimeter access road.

The footprints stated above for each domain include areas for stormwater runoff collection and retention structures. The total area of infrastructure footprint requiring rehabilitation for closure is approximately 244 ha.

7.4.5 Topsoil / Subsoil Management

As a precursor to rehabilitation, topsoil was stockpiled from all areas of disturbance at the commencement of mining and will be re-spread over areas that are to be rehabilitated upon mine closure. Topsoil will be spread over the final OWD and TSF landforms at a thickness of approximately 150 mm. Other infrastructure areas with lower or flat final gradients will have approximately 100-150 mm thickness of topsoil spread

During pre-stripping activities approximately 150 mm of top soil was removed from most areas, which is sufficient to adequately cover the disturbed areas, with a little extra available for additional rehabilitation if and when required. A reconciliation of estimated available topsoil volume (actual) versus estimated required topsoil volume for rehabilitation has been undertaken to ensure that sufficient topsoil material is available at closure for rehabilitation activities within each Domain (see *Topsoil Management Plan* in Appendix F2).

7.4.6 Topsoil / Subsoil Material Balances

A reconciliation of estimated available topsoil volume (actual) versus estimated required topsoil volume for rehabilitation has been undertaken to ensure that sufficient topsoil material is available at closure for rehabilitation activities within each Domain (see *Topsoil Management Plan* provided in Appendix F2). The reconciliation was undertaken using survey data current to 30 September 2016, when the majority of topsoil stripping activities (for the Portia open pit) had been completed. The reconciliation includes and additional 5,870m^3 stripped for BP2 and the proposed additional stripping of 13,060m^3 (13.06ha) for TSF 3, 600m^3 (0.6ha) for TSF 4 and 3,300m^3 (3.3ha) for road network expansion. The estimated available topsoil is expected to be at least 6% (or approximately 16,900m^3) greater than what is required for rehabilitation purposes across all Domains.

The volumes of subsoil materials required for closure will increase with the construction of TSF3 and TSF4s. As previously agreed with DEM, the surcharge stockpiles could be used to build the raises providing an alternate source of the required material remains available.

A total of 178,000 m3 is required for the closure of TSF-1-4 of the existing and proposed cells. 185,000m^3 of materials is currently available with additional volumes of ~ 60,000 m^3 to be recovered and stockpiled from the proposed cutback of the Portia Pit and ~120,000m3 from the construction of TSF3 and TSF4 leaving a surplus of 187,850m^3.

7.5 Potential Environmental, Economic and Social Impacts of Mine Closure

Potential environmental, economic and social impacts of mining operations that could remain after mine closure include:

- unacceptable visual amenity;
- risks to health and safety of the public and fauna;
- ecosystem function and landscape function is not resilient and self-sustaining;
- the Site is not physically stable;
- compromised quality and quantity of groundwater to existing users and compromise to the environmental values of the Yarramba Palaeochannel;
- mine waste materials left on Site are not chemically and physically stable; and

- pre-mining land use not being re-established.

A risk assessment for each impact event has been undertaken and is detailed in the following sub-sections.

7.6 Visual Amenity

7.6.1 Potential Impact Event

The external visual amenity of the Site does not meet acceptance by the Director of Mines.

This risk event relates to all domains.

7.6.2 Control and Management Strategies

Control and management strategies:

- The removal of all plant and equipment from the Site;
- The drying out, backfilling and covering of the TSF cells with topsoil;
- The backfilling of the water storage dams and topsoil placement;
- The placement of topsoil on the OWD;
- The infilling of all surface drainage infrastructure;
- The removal of the camp and septic wastewater system and topsoil placement;
- The capping of the landfill pit with 60 mm of clay and subsequent cover with 100 mm of topsoil;
- The decommissioning / abandonment of dewatering wells;
- The spraying and removal of weed species (if required) prior to Lease surrender;
- The establishment of vegetation on all previously disturbed land through seeding.

7.6.3 Likelihood and Severity of Consequences

It is possible that external visual amenity of the Site may not meet the approval of the Director of Mines. Control and management strategies will be used to improve the likelihood of the visual amenity closure outcome being met.

7.6.4 Risk Levels

Risk levels for visual amenity are presented in Table 7-1.

Table 7-1 Risk Assessment - Visual Amenity

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
External visual amenity of the Site may not meet approval	Likely	Minor	Control measures as outlined	Unlikely	Minor	Low	Yes

7.6.5 Justification for Risk Acceptance

From the above risk assessment, it would appear that residual risk to visual amenity is low, following the implementation of control and management strategies.

7.6.6 Outcome/Objective

The external visual amenity of the site is acceptable as determined by the Director of Mines in consultation with relevant interested parties.

7.6.7 Completion Criteria

The Mine Manager ensures photo monitoring at locations P1 to P15, inclusive, as shown in Figure 6-2 and listed in Table 6-12 at Lease surrender shows visual amenity that is acceptable to the Director of Mines and that all buildings, plant, temporary stockpiles and equipment are removed from the site.

7.7 Health and Safety

7.7.1 Potential Impact Event

Risks to the health and safety of the public and fauna remain after closure.

This risk event relates to all domains.

7.7.2 Control and Management Strategies

Control and management strategies:

- Completing the construction of the abandonment bund around the Portia open pit to preclude access.
- Backfilling the water storage dams.
- Removing any Site (perimeter) fencing unless otherwise requested by the landholder.
- Erecting signage warning of danger (open void).
- Ensuring good drying and consolidation of the tailings material within the TSF cells by following the methods outlined in (Golder, 2019). This will allow them to be trafficable within approximately 3 months from the

completion of deposition. This will be followed by the infilling of any remaining void, grading back the sides, placing topsoil and seeding.

- The remediation of chemical spill sites in accordance with EPA requirements.

7.7.3 Likelihood and Severity of Consequences

It is possible that risks to the health and safety of the public and fauna could remain after closure; however, the control and management strategies stated above will reduce these risks.

7.7.4 Risk Levels

Risk levels for health and safety of the public and fauna are presented in Table 7-2.

Table 7-2 Risk Assessment - Health and Safety

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Risks to the health and safety of the public and fauna remain after closure	Unlikely	Major	Control measures as outlined	Unlikely	Minor	Low	Yes

7.7.5 Justification for Risk Acceptance

From the above risk assessment, it would appear that the residual risk to the health and safety of the public and fauna will be low, following implementation of the control and management strategies.

7.7.6 Outcome/Objective

The risks to the health and safety of the public and fauna are as low as reasonably practical.

7.7.7 Completion Criteria

Audit carried out by a suitably qualified and experienced independent expert, prior to Lease surrender verifies that:

1. Construction of the TSF cells has occurred in accordance with the construction design as summarised in Appendix D4 and D5.

2. The TSF was operated as per design in accordance with the *Portia TSF Operations and Surveillance Manual* (Appendix F5).

3. The tailings beaches in the TSF cells are appropriately dried out and trafficable in order to undertake progressive rehabilitation activities and have been capped and rehabilitated as shown in Figure 7-11 and Figure 7-12 and described in Appendix F7.

4. The PDD, RWD, BP1 and BP2 are backfilled and capped with topsoil and seeded.

An independent geotechnical expert certifies prior to Lease surrender that the pit abandonment bund (including a barrier across the entrance to the pit) has been located at least 10 m outside the long term stable pit wall collapse area, is at least 5 m wide (at the base) and at least 2 m high (at the crest), with side slopes of nominally 1V:2H and a crest width of at least 2 m and that is has been constructed with a core of locally won clay.

A site audit report to the satisfaction of DEM carried out by a suitably qualified and experienced independent expert immediately prior to Lease surrender shows that:

1. Warning signage is in place every 400 m along the abandonment bund adequately secured to posts.

2. All fencing has been removed, unless a written agreement to accept ongoing liability for maintenance is received from the pastoralist.

3. The long term risks to the health and safety of the public and fauna on closure remains as low as reasonably practical through the siting and construction of a safe, stable abandonment bund outside of the identified zone of potential instability of the pit and which has been verified by an independent geotechnical expert prior to Lease surrender.

7.8 Ecosystem and Landscape Function

7.8.1 Potential Impact Event

Ecosystem function and landscape function is not resilient and self-sustaining.

This relates to closure Domains 1, 2 and 3.

7.8.2 Control and Management Strategies

Control and management strategies:

- Topsoil profiles within the ML are thin as evidenced in test pit logs (see Golder TSF design report, Appendix D1). The topsoils are usually less than 100 mm with subsoils up to another 300 mm thick. The disturbed areas of the Site (with exception of the Portia open pit) will be rehabilitated with a layer of growth medium nominally 150 mm thick, with additional nutrients and seed base added to encourage growth. The rationale is to establish an equivalent soil profile to the surrounding landscape with the desired outcome being equal to or an improvement over the local environment if possible.

- With regard to the TSF cells, the amelioration cover layer will comprise subsoil made up of a minimum 350 mm layer of surface Quaternary materials with growth medium of approximately 150 mm of topsoil. This layer is therefore analogous (albeit slightly thicker) to the typical soil profile as noted above in the test pit logs.

- Management of soil resources, especially the placement of topsoil on disturbed areas.

- Completion of suitable earthworks to assist both active and passive revegetation, including shallow ripping to break up compacted areas and scarifying to promote the accumulation of nutrients, water and seeds in the furrows created.

- The successful stabilisation and revegetation of disturbed areas (except the Portia open pit).

- The removal of all putrescible and non-recyclable wastes and disposal in an EPA approved facility on Site.

- Capping of the landfill facility and subsequent rehabilitation in accordance with the *Landfill Environmental Management Plan.*

- The spraying or removal of declared weeds species if persisting prior to Lease surrender.

- Control of feral animals on and in the vicinity of the Site (if required) prior to Lease surrender.

- Potential control measures for over-abundant large native herbivores and domestic livestock (if adversely affecting revegetation success). This may include fencing off Stage 1 rehabilitation activities to reduce grazing pressure.

- Monitoring of rehabilitation success using standardised Landscape Function Analysis (LFA) monitoring methods (refer Section 7.13).

7.8.3 Likelihood and Severity of Consequences

It is possible that ecosystem and landscape function is not resilient and self-sustaining. Control and management strategies will be used to improve the likelihood of achieving the ecosystem and landscape function closure outcomes.

7.8.4 Risk Levels

Risk levels for ecosystem and landscape function are presented in Table 7-3.

Table 7-3 Risk Assessment - Ecosystem and Landscape Function

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Ecosystem and landscape function is not resilient and self-sustaining after Site closure	Likely	Minor	Control measures as outlined	Unlikely	Minor	Low	Yes

7.8.5 Justification for Risk Acceptance

From the above risk assessment, it would appear that residual risk to ecosystem and landscape function will be low, following the implementation of the control and management strategies.

7.8.6 Outcome/Objective

Ecosystem function and landscape function is resilient and self-sustaining.

7.8.7 Completion Criteria

Annual assessment until Lease surrender of rehabilitation success and ecosystem / landscape function, measured using standardised LFA monitoring techniques at proposed monitoring sites in Domains 1 to 3, as agreed with the Director of Mines prior to mine closure, conducted by a suitably qualified and experienced professional, demonstrates the self-sustainability (success) of rehabilitated areas, when compared to baseline monitoring conducted at the completion of rehabilitation works.

7.9 Physical Stability

7.9.1 Potential Impact Event

The Site is not physically stable.

This relates to all domains.

7.9.2 Control and Management Strategies

Control and management strategies:

- The placement of topsoil on disturbed areas.
- Specifically, for the OWD:
    - Controlling discharge of runoff into upper and lower batters by using crest bunds;
    - Minimising tunnel erosion by minimising concentration of flows and ponding of runoff;
    - Constraining surface ripping to a maximum depth of 100 mm; and
    - Seeding in order to establish a vegetation cover to maintain longer-term erosion stability.
- The successful revegetation of all disturbed areas (except the Portia open pit) with locally derived seed stock.
- The construction of the pit abandonment bund at a distance from the pit crest that precludes it from collapsing into the pit if the pit walls collapse (i.e. outside the pit wall collapse radius).
- Operation of the TSF cells in accordance with the *TSF Operations and Surveillance Manual* (refer to Appendix F5).
- With regard to the TSF cells, the structures will be built to design as per the guidelines (ANCOLD, 2012) that will mitigate the risk of failure from post closure overtopping, seismic risks or storm erosion.

7.9.3 Likelihood and Severity of Consequences

It is possible that the Site or parts of it may remain physically unstable. Control and management strategies will be used to improve stability and manage risk.

7.9.4 Risk Levels

Risk levels for physical stability of the Site are presented in Table 7-4.

Table 7-4 Risk Assessment - Physical Stability

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
The Site is not physically stable	Likely	Minor	Control measures as outlined	Unlikely	Minor	Low	Yes

7.9.5 Justification for Risk Acceptance

From the above risk assessment, it would appear that the residual risk to physical stability will be low, following implementation of the control and management strategies.

7.9.6 Outcome/Objective

The Site is physically stable.

7.9.7 Completion Criteria

An audit by a suitably qualified and experienced independent expert, prior to Lease surrender, shows that the OWD and TSF have been constructed and rehabilitated as per Sections 3.6.1 (OWD) and 3.6.2(TSF), and also in accordance with Figure 7-15 – Figure 7-17 (OWD) and Figure 7-11 and Figure 7-12 (TSF).

An additional audit, conducted by a suitably qualified and experienced independent expert, prior to Lease surrender, shows that Domains 1 to 3 have been revegetated in accordance with the sustainable closure strategies defined in Section 7.15.

7.10 Groundwater

7.10.1 Potential Impact Event

Compromise in quality and quantity of groundwater to existing users.

This does not relate to domains on Site, but to potential off-Site impacts.

7.10.2 Control and Management Strategies

The nearest known groundwater use sites (Honeymoon Uranium Mine Site and Zac's Bore) are situated to the south, outside the modelled area and as shown by the updated drawdown contours, the cone of depression remains a significant distance from the model boundaries when drawdown is at its greatest. Hence, drawdown at Honeymoon Uranium Mine and Zac's Bore due to pumping activities at the Portia Mine Site during operation and on closure is modelled to be effectively zero.

Seepage assessments conducted on the TSF by Golder (2013 and 2016b) demonstrate that no impact is predicted to occur to the groundwater piezometric surface as a result of vertical seepage flows through the TSF (refer to Appendix D1, D4 and D5).

At the reinjection wellfield, there are no existing users which target the Shylock Palaeochannel which could be impacted by the proposed reinjection or extraction scheme (when its operating). Groundwater quality in the Palaeochannel is poor, with TDS ranging from approximately 18,000 to 23,500 mg/L. This is above the ANZECC (2000) guideline value for stock watering (~13,000 mg/L – upper limit for sheep) and as such there are no existing users which source groundwater from this aquifer system. Major ion chemistry of the pit disposal water and the groundwater obtained from the Shylock Palaeochannel shows that both samples belong to the same water type, with the pit water being of lower TSD (12,000 to 15,000 mg/L) than the groundwater within the Shylock Palaeochannel. Hydrochemical analysis of the pit disposal water and the groundwater obtained from the Shylock Palaeochannel shows that with the exception of Arsenic, all other dissolved metals were at concentrations in the pit groundwater lower than the Palaeochannel aquifer. Although the arsenic concentrations are generally higher at the pit than the receiving aquifer, the composite average concentration of the blended injectant is expected to be consistently below the ANZECC (2000) guideline limit of 0.5 mg/L (refer Appendix C3).

On closure of Domain 4, as detailed in Section 6.8.1, the Portia open pit will remain as a groundwater sink in the long term. Jareds Bore lies within the final Portia open pit void and was selected to represent the rising pit water level during the recovery phase of groundwater modelling (see Aqueon, 2016c). After taking into consideration all inflows and outflows the pit lake is predicted to recover to its maximum level of RL 25 m AHD approximately 2,000 days (~5.5 years) after dewatering operations cease. The recovery model will be reviewed again prior to mine closure, when observed drawdowns can be compared with predicted drawdowns and when extraction volumes are known.

The groundwater from the fractured bedrock aquifer is saline (TDS > 12,000 mg/L) and therefore will have limited value as a resource for stock or other agricultural pursuits. Although not modelled, in-pit salinity will increase due to evaporative effects. Given ambient TDS values are > 12,000 mg/L, an additional increase in salinity or TDS will not change the environmental value (beneficial use) of the groundwater resource, currently limited to industrial use (AGT, 2014).

No PAF material is known to occur within the walls of the Portia open pit and no PAF material is planned to be mined within the pit using the current design to the -20 m RL. Furthermore, the filling of the pit void with water replicates the naturally occurring conditions by re-creating anaerobic conditions with approximately 40 m of water above the base of pit that will prevent oxidation of any sulfidic minerals that may be inadvertently exposed on the pit floor. This will ensure acid forming conditions do not exist upon pit closure. The likelihood of acid generation occurring within the pit on closure would be very rare given the context described.

7.10.3 Likelihood and Severity of Consequences

The risk of operations negatively impacting the quality and quantity of groundwater for existing users and environmental values of the Shylock and Yarramba Palaeochannels after mining has ceased is very low.

7.10.4 Risk Levels

The results of the risk assessment for groundwater are presented in Table 7-5.

Table 7-5: Risk Assessment - Groundwater

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
The reduction in the quality and quantity of groundwater for existing pastoral users	Rare	Minor	Control measures as outlined above	Virtually impossible	Minor	Low	Yes
Impacts to environmental values of the Yarramba and Shylock Palaeochannels	Rare	Minor	Control measures as outlined above	Virtually impossible	Minor	Low	Yes
TSF seepage impacting off-Site receptors	Rare	Minor	Control measures as outlined above	Virtually impossible	Minor	Low	Yes

7.10.5 Justification for Risk Acceptance

From the above risk assessment and control and management strategies presented through modelling results, it would appear that the residual risks to the quality and quantity of water available for existing pastoral users and possible impacts to environmental values of the Yarramba and Shylock Palaeochannels are very low.

7.10.6 Outcome/Objective

No compromise in the quality and quantity of groundwater to existing users.

No compromise to the environmental values of the Yarramba Palaeochannel groundwater.

No compromise to the environmental values and water quantity of the Shylock Palaeochannel groundwater.

7.10.7 Completion Criteria

Basement Rock Aquifer and Yarramba Palaeochannel

Following the cessation of all groundwater pumping and re-injection activities, the Mine Manager will ensure that standing water level (SWL) measurements recorded by site staff in monitoring wells W1A, W2A and W3A and BEN605 (shown in Figure 6-2) are compared with recovery model predictions, shown in Table 6-14. SWL will be recorded in wells W1A, W2A and W3A and BEN605 monthly for the first six months after cessation of groundwater extraction. Thereafter SWL will be measured bi-monthly for the next six months, six monthly for the next two years and thereafter annually until Lease surrender.

The monitoring data is to be reviewed annually and reported in the statutory Compliance Report to DEM.

The numerical groundwater model will be reviewed and updated by a suitably qualified and experienced independent professional at least three months prior to mine closure to confirm the time for full recovery to predicted post-mining groundwater levels and to establish updated model predictions for wells W1A, W2A and W3A and BEN605. Updated predictions will be presented to DEM.

The Mine Manager will provide records to demonstrate that monitoring of the water quality of the injectant (mine water) from the PDD was undertaken on a monthly basis during re-injection for field parameters EC/TDS, pH and Arsenic (As), showing that field TDS was below 20,500 mg/L, pH was in the range 4 – 9 and As concentration of the blended injectant was below 0.5 mg/L, confirmed by Laboratory dissolved As and major ion testing of the injectant using a NATA accredited laboratory on a quarterly basis.

The Exploration Manager provides an audit prior to Lease surrender demonstrating that each exploration drill hole on the Mining Lease has been rehabilitated in accordance with Information Sheet M21, '*Mineral exploration drillholes - General specifications for construction and backfilling*' within 6 months of being drilled.

Shylock Palaeochannel

Following the cessation of all groundwater pumping and reinjection activities, the Mine Manager will ensure that standing water level (SWL) measurements recorded by site staff in monitoring wells PTIW17, PTIW21, W4 and W5 (shown in Figure 6-2) are compared with recovery model predictions. SWL will be recorded in wells PTIW17, PTIW21, W4 and W5 monthly for the first six months after cessation of groundwater extraction. Thereafter SWL will be measured bi-monthly for the next six months, six monthly for the next two years and thereafter annually until Lease surrender.

The monitoring data is to be reviewed annually and reported in the statutory Compliance Report to DEM.

The numerical groundwater model will be reviewed and updated by a suitably qualified and experienced independent professional at least three prior to mine closure to confirm the time for full recovery to predicted post-mining groundwater levels and to establish updated model predictions for wells PTIW17, PTIW21, W4 and W5. Updated predictions will be presented to DEM.

During the three month period prior to the cessation of all groundwater pumping and reinjection activities, the Mine Manager will ensure that monthly monitoring (three discrete events) of extraction wells used in the Shylock Palaeochannel is undertaken for field parameters EC/TDS and pH and laboratory analysis of EC/TDS, pH, dissolved Arsenic and major ions using a NATA accredited laboratory, to demonstrate that EC/TDS, pH, dissolved As and major ion chemistry is comparable (within ± 30%) of baseline water chemistry collected prior to the commencement of operations, presented in Table 3-35 and Table 3-36. If final water chemistry is not within ± 30% of baseline water chemistry then the significance will be reviewed and reported on by suitably qualified and experienced independent professional.

7.11 Mine Waste Materials

7.11.1 Potential Impact Event

Mine waste materials left on Site are not chemically and physically stable.

This relates to Domain 1 (infrastructure areas), Domain 2 (TSF) and Domain 3 (OWD).

Waste material generated from the gravity separation wet plant are discharged directly into the tailings storage facility (TSF) comprising of two existing cells, TSF1 and TSF2 and on proposed cell (TSF3). Processing wastes will be limited to the tailings stream, as the only other discharges are the recovered water that is to be returned to the raw water dam and the recovered gold.

Chemical waste from the beneficiation of processing of ore will be deposited directly into the HDPE lined cell (TSF4). This includes the destructed residue of sodium cyanide, caustic soda, hydrogen peroxide, copper sulphate and flocculant. Minor dosages of anti-scalent and minor volumes of picric acid used for laboratory titration testing will also be used.

Overburden and un-mineralised materials are to be used in the construction of the abandonment bund, with the remainder being trucked to the OWD. Any PAF materials (if present) will be encapsulated within the OWD and then covered by topsoil.

All disturbed areas will be covered with available topsoil and seeded to successfully revegetate disturbed areas to prevent erosion.

7.11.2 Control and Management Strategies

Control and management strategies:

- Encapsulating PAF materials within the OWD if these are encountered (note: no PAF materials are planned to be mined under the current mine plan).
- Drying tailings materials then backfilling the TSF cells (TSFs 1, 2 and 3).
- The HDPE liner of TSF-4 will be lapped in from the sides and folded in. Backfilling of the cell with general fill and Namba clays to form a final shedding landform.
- A Quaternary capping layer will be placed for all cells TSF-1 to 4 in a layer 350mm.
- Covering disturbed areas with topsoil and seeding with locally derived seedstock.
- Remediating chemical spill sites of spills greater than 20 L to meet EPA standards.

Note: The shedding cover design was selected for the capping of TSF4 to minimize the potential for post closure seepage. This design will minimise the ingress of rainwater and therefore minimise seepage into the tails mass. The tails mass will be benign with only low levels of residual cyanide but the reduction in water pooling on the surface will reduce the capillary rise of containments from the detox tailings. This design was recommended by Golder's Associates (2019) and further supported by ATC Williams, independent reviewers (2019).

7.11.3 Outcome/Objective

All mine waste materials left on Site are chemically and physically stable.

7.11.4 Completion Criteria

This outcome will also be measured by the physical stability criteria (refer Section 7.9).

The Mine Manager will review the mine operations contaminant spill register to demonstrate all chemical spills greater than 20 L have been rehabilitated to meet EPA standard, and there is no residual contamination due to spills.

7.12 Post Mining Land Use

7.12.1 Potential Impact Event

At Lease relinquishment, the Site is not suitable for a return to pastoral land use.

This relates to Domain 1 (infrastructure areas), Domain 2 (TSF) and Domain 3 (OWD).

7.12.2 Control and Management Strategies

Control and management strategies:

- Prior to the commencement of mine closure activities, finalise a private mutual agreement with the pastoral lease holder of Mulyungarie Station (Mutooroo Pastoral Company), outlining the mutually agreed expected roles, responsibilities and timeframes for handover of the Site, including ongoing responsibilities post ML relinquishment.
- Prior to commencement of mine closure activities have determined agreed expected roles, responsibilities, timeframes for handover of the Site, including ongoing responsibilities post ML relinquishment with the Crown.
- Removal of all plant and equipment from the Site at closure, unless otherwise agreed with the pastoral lease holder and the Crown.
- Rehabilitation of all Domains as described in Section 7.15.
- The decommissioning / abandonment of Project groundwater wells, unless otherwise required by the lease holder and the Crown.
- Removing any Site (perimeter) fencing, unless otherwise required by the lease holder and the Crown.
- Completion of the abandonment bund around the pit to preclude access.
- Erecting signage warning of danger (open void).
- Prior to ML relinquishment, a meeting is to be held with the lease holder to handover responsibility for any remaining infrastructure (if any) and for the resumption of pastoral activities across the ML area to begin.
- Administrative measures to control any future development of the Site post completion (if required) will be agreed with DEM prior to relinquishment, e.g. the use of caveats on the Pastoral Lease.

7.12.3 Outcome/Objective

At Lease relinquishment, the Mine Site is suitable for a return to the future land use identified in PEPR Section 7.16.

7.12.4 Completion Criteria

An audit by a suitably qualified and experienced independent expert, prior to Lease surrender, shows that Domains 1 to 3 have been rehabilitated in accordance with strategies described in Section 7.15, that decommissioning of infrastructure has not created site contamination requiring remediation and the land has been returned to a condition suitable for a return to the future land use identified in Section 7.16.

7.13 Landscape Rehabilitation Monitoring Program

Landscape rehabilitation monitoring is a tool used to assess the rehabilitation performance and to inform rehabilitation implementation and management practices of the need for change.

More specifically for the Portia Project, the results of the rehabilitation monitoring program will be one of the primary mechanisms by which DEM and other government departments, including DEW and the EPA, will determine the rehabilitation success (or otherwise) of the Project and the appropriate time for Lease relinquishment.

7.13.1 Monitoring Objective

The monitoring objective for rehabilitation at the Portia Mine Site is to provide evidence that the landscape is stable, with nutrient cycling and vegetation indices equal to or above those of the control transects within the analogue sites.

7.13.2 Monitoring Methodology

Guidelines

DEM is not prescriptive regarding the rehabilitation monitoring program to be employed, but rather provides guidance requiring that whatever program is utilised is based on scientific evidence and is capable of proving that the rehabilitated landscape is self-sustaining. DEM employs a risk-based approach and the rehabilitation monitoring protocol for smaller sites, such as bore/drill holes and turkeys nest dams, can be tailored accordingly and need not employ a complex protocol due to the associated lower risk. This presents the opportunity to employ different monitoring protocols based upon risk analysis.

DEM have produced two guidelines on the use of the Landscape Function Analysis methodology as follows:

- *Guidelines for data entry and reporting of landscape function analysis*, Minerals Regulatory Guidelines MG19, Version 1.0, dated August 2013; and

- Field guide for landscape function analysis for environmental monitoring and assessment, Minerals Regulatory Guidelines MG21, dated 2013.

BGC currently proposes to implement LFA (or a modified LFA method), to guide the planning, design, implementation and performance monitoring of Site rehabilitation, in response to DEM's perceived preference for the LFA method.

Landscape Function Analysis (LFA)

Tongway and Hindley (2004) developed the LFA method also known as Ecosystem Function Analysis (EFA) as the CSIRO's principal method for mine rehabilitation assessment within the arid zone. LFA is an indicator-based monitoring procedure that evaluates soil surface processes to examine how well a landscape is working as a biophysical system in relation to disturbance or rehabilitation. The development of LFA as a rehabilitation monitoring methodology specifically for the arid zone makes it particularly suited to the Portia Site.

LFA monitoring methods comprise assessing a suite of parameters at different landscape positions on each site, namely on flats, slopes and in troughs. Repeated edaphic (soil properties) and biological measurements are taken over time for various parameters that indicate changes in ecosystem function as rehabilitation proceeds. The goal of rehabilitation is to achieve a self-sustaining landscape. A self-sustaining ecosystem would not need further additions of nutrients, seed, water or other management inputs. A conceptual critical threshold value is shown in the model presented in Figure 7-3, which represents the index value for self-sustainability. This threshold is derived from the study of analogue sites, that is, sites that represent the ecosystem in an undisturbed state. These analogue sites represent the end point for rehabilitation of the mine Site or disturbed area.

The response of a rehabilitated area over time can be measured as an indicator curve. Ideally this curve would resemble *curve A*, Figure 7-3, and would demonstrate that the rehabilitation approach is working. This type of response starts slowly and then increases rapidly before developing at a slower rate as an equilibrium point is approached.

An ecosystem below the threshold range is vulnerable to events that have a negative impact like storms or fire. The longer an ecosystem is below this threshold represented by *curve B*, Figure 7-3, the greater the risk that it will not achieve ecosystem sustainability. *Curve C*, represents an ecosystem that has been regularly disturbed (e.g. periodic fire) and therefore remains unstable. Once an ecosystem has passed the critical threshold it is considered to have the capacity to recover from negative impacts.

The shape of the indicator curve measured over time can be utilised to predict ecosystem function. For example, Tongway and Hindley (2004) suggest that like a metaphorical traffic light, *curve A* (green light) – no problems identified; *curve B* (amber light) – potential problems identified which need a closer look and *curve C* (red light) – problem identified which needs attention.

To determine the indicator curve, samples would be obtained from specific points along fixed transects, which facilitates repeat and comparable surveys. In this manner monitoring could be utilised to predict whether or not the ecosystem was 'on course' to become self-sustaining or whether corrective actions were required.

The CSIRO LFA method, as detailed by Tongway and Hindley (2004), would be used to inform the monitoring program design, however some modification to this method is likely needed to address the Site-specific variables at Portia.

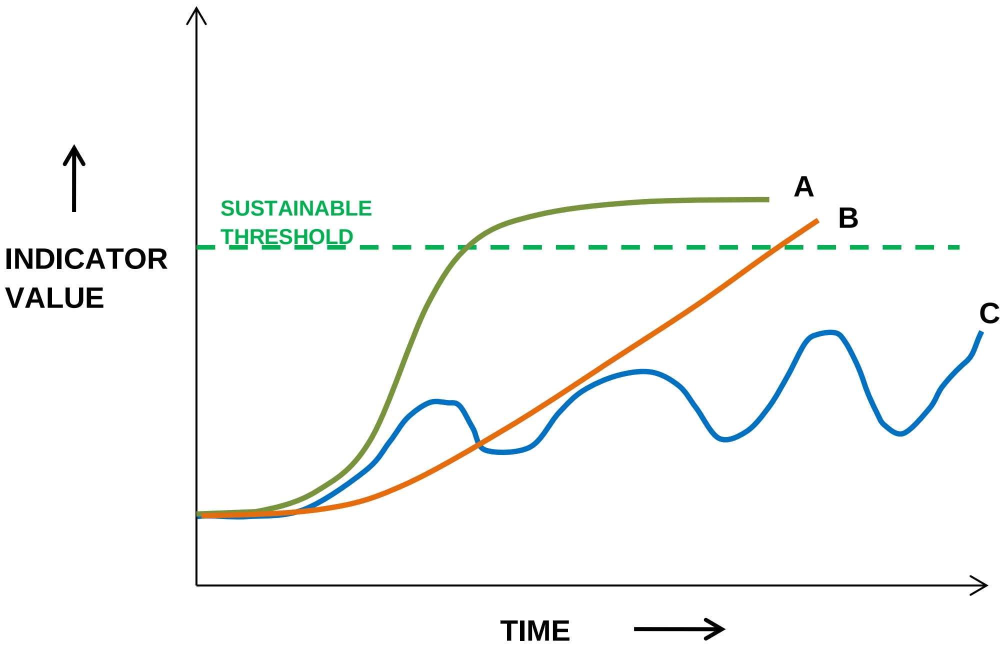


Figure 7-3: Landscape Function Analysis – Differing Responses (Adapted from Tongway and Hindley, 2004)

LFA is typically conducted as an annual monitoring event. The results of the LFA monitoring and recommendations will be discussed in the Compliance Reports presented to DEM following mine closure.

The Portia Mine Site occurs on a pastoral lease and as such the entire ML is subject to grazing pressure. Analogue sites would be chosen which are as close as possible to the rehabilitated areas so that the same climatic and environmental conditions existed at both sites to the extent possible. The analogue site(s) may therefore be subject to approximately the same grazing pressure as the rehabilitated site(s). Fencing however may be erected to exclude stock from rehabilitation areas.

The LFA monitoring program to be initiated on mine closure is detailed in Table 7-6.

7.14 Closure Outcome Measurement Criteria Summary

A summary of the outcome measurement criteria for each closure outcome is presented in Table 7-6.

Table 7-6: Outcome Measurement Criteria (Closure) Summary

ID	Outcome	Outcome Measurement Criteria					Leading Indicator Criteria
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Measurement Frequency	Control or Baseline Data	
Visual Amenity							
PO_013	Mining Lease condition: The external **visual amenity** of the site is acceptable as determined by the Director of Mines in consultation with relevant interested parties.	Visual amenity measured by geo-referenced photos.	Photo monitoring locations P1 to P15 as shown in Figure 6-2 and listed in Table 6-12.	Visual amenity that is acceptable to the Director of Mines and that all buildings, plant, temporary stockpiles and equipment are removed from the site.	Once, prior to Lease surrender.	NA	NA
Health and Safety							
PO_014	Mining Lease condition: The risks to the **health and safety** of the public and fauna are as low as reasonably practical.	1. Verification by reporting and inspection during construction of the TSF cells. 2. Monthly verification by reporting and inspection during operation of the TSF cells. 3. Verification by inspection and reporting prior to and on completion of capping and rehabilitating the TSF cells. 4. Verification by reporting on completion of backfilling and rehabilitation.	TSF cells TSF cells TSF cells RWD,PDD, BP1 and BP2	Audit carried out by a suitably qualified and experienced independent expert, prior to Lease surrender verifies that: 1. Construction of the tailings storage facility has occurred in accordance with the construction design as summarised Appendix D4 and D5. 2. The TSF was operated as per design in accordance with the *Portia TSF Operations and Surveillance* Manual, (Appendix F5). 3. The tailings beaches in the TSF cells are appropriately dried out and trafficable in order to undertake progressive rehabilitation activities and have been capped and rehabilitated as shown in Figure 7-11 and Figure 7-12 and described in Appendix F7. 4. The PDD, RWD, BP1 and BP2 are backfilled and capped with topsoil.	Immediately post construction of TSF. Monthly during TSF operation. Once, prior to Lease surrender Once, prior to Lease surrender	NA NA NA NA	NA
		A site audit report to the satisfaction of DEM by an independent geotechnical expert.	Pit Abandonment Bund	Pit abandonment bund (including a barrier across the entrance to the pit) has been located at least 10 m outside the long-term stable pit wall collapse area, is at least 5 m wide (at the base) and at least 2 m high (at the crest), with side slopes of nominally 1V:2H and a crest width of at least 2 m and constructed with a core of locally won clay.	Immediately prior to Lease surrender.	NA	NA

ID	Outcome	Outcome Measurement Criteria					Leading Indicator Criteria
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Measurement Frequency	Control or Baseline Data	
		A site audit report to the satisfaction of DEM by a suitably qualified and experienced independent expert.	Pit Abandonment Bund	1. Warning signage is in place every 400 m along the abandonment bund adequately secured to posts. 2. All fencing has been removed, unless a written agreement to accept ongoing liability for maintenance is received from the pastoralist. 3. The long term risks to the health and safety of the public and fauna on closure remains as low as reasonably practical through the siting and construction of a safe, stable abandonment bund outside of the identified zone of potential instability of the pit and which has been verified by an independent geotechnical expert prior to Lease surrender.	Immediately prior to Lease surrender.	NA	NA
Ecosystem and Landscape Function							
PO_015	Mining Lease condition: **Ecosystem function and landscape function** is resilient and self-sustaining.	<u>LFA Survey Indices:</u> • Stability index • Infiltration index • Nutrient cycling • Patch proportion <u>Survey Specifications:</u> • 50 meter transects • Plains: In line with prevailing wind direction • Slopes: Aligned with the maximum slope.	<u>Impact Sites:</u> Domain 1: Infrastructure areas: • 1 x Accommodation Camp (Plains) Domain 2: TSF, Processing Plant, ROM & associated infrastructure: • 1 x TSF West (Slope) • 1 x TSF East (Crest/Plains) • 1 x Processing Plant (Plains) • 1 x ROM (Plains) Domain 3: OWD: • 1 x Northern batter (Slope) • 1 x Western/Southern batter (Slope) • 1 x OWD top (Plains) <u>Analogue Sites:</u> • 2 x Sandy-clay plains (on-Site) • 2 x low to mid-range slope 10-18º (off-Site)	Representative test sites within rehabilitated areas have achieved, or by trends may be confidently predicted to reach and pass LFA critical sustainability thresholds. LFA critical sustainability thresholds indicate that a resilient, self-sustaining ecosystem and landscape function is present and the pre-mining ecosystem and landscape function will ultimately be achieved. LFA critical sustainability thresholds = LFA indices have all met or exceeded 60% of the mean analogue site's value and are maintained for three consecutive monitoring rounds.	Annual surveys, post mine rehabilitation at both Analogue and Impact sites. Surveys will be undertaken at the same time each year, during either the autumn or spring season, until sustainably threshold values can be demonstrated.	Analogue sites.	NA
Physical Stability							

ID	Outcome	Outcome Measurement Criteria					Leading Indicator Criteria
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Measurement Frequency	Control or Baseline Data	
PO_016	The site is **physically stable**.	Technical report demonstrates that the OWD and TSF have been constructed as per Section 3.6, and also in accordance with Figure 7-15 – Figure 7-17 (OWD) and Figure 7-11 and Figure 7-12 (TSF).	OWD and TSF	Audit report verifies the OWD and TSF have been constructed and rehabilitated as per design.	Immediately prior to Lease surrender.	NA	NA
		Technical report demonstrates that all domains have been revegetated.	Domains 1 to 3 within the Portia ML area	Audit report verifies that Domains 1 to 3 have been revegetated in accordance with the closure strategies defined in Section 7.15.	Immediately prior to Lease surrender.	NA	NA
Groundwater							
PO_017	Mining Lease condition: No compromise in the quality and quantity of **groundwater to existing users** and no compromise to the environmental values of the **Yarramba Palaeochannel groundwater**.	Standing water level (SWL) measured using a water level meter (dipper) below fixed reference point (top of well casing). Drawdown in metres calculated by subtracting initial reading shown in Table 3-34 from SWL reading taken. Numerical groundwater modelling to verify calibration and establish long term recovery scenario.	Monitoring wells W1A, W2A and W3A and BEN605 as shown in Figure 6-2.	SWL measurements compared with recovery model predictions. The numerical groundwater model will be reviewed and updated by a suitably qualified and experienced independent professional prior to mine closure to confirm the time for full recovery to predicted post-mining groundwater levels and to establish updated model predictions for wells W1A, W2A, W3A and BEN605. Updated predictions will be presented to DEM.	Following the cessation of all groundwater pumping and re-injection activities, SWL will be recorded in W1A, W2A, W3A and BEN605 monthly for the first six months. Thereafter SWL will be measured bi-monthly for the next six months, six monthly for the next two years and thereafter annually until Lease surrender.	NA	NA
		Provision of mine records of monthly field measurements of EC/TDS, pH and field Arsenic and laboratory dissolved Arsenic recorded during re-injection activities.	PDD	ANZECC / ARMCANZ (2000) water quality trigger value (low risk) for pH of 4 – 9 and Arsenic of 0.5 mg/L for stock watering. Field TDS of 20,500 mg/L calculated by adding 20% to minimum recorded baseline TDS (Shylock Palaeochannel) of 17,100 mg/L (PTIW49).	Provision of mine records (monthly observations), prior to Lease surrender.	NA	NA
		The rehabilitation status of each drill hole by audit and reporting, including photographs and inspection notes.	Portia ML area	Each exploration drill hole on the Mining Lease has been rehabilitated in accordance with Information Sheet M21, '*Mineral exploration drillholes - General specifications for construction and backfilling*' within 6 months of being drilled.	Once, prior to Lease surrender	NA	NA

ID	Outcome	Outcome Measurement Criteria					Leading Indicator Criteria
		What will be measured and form (method) of measurement	Location(s)	Outcome Achievement	Measurement Frequency	Control or Baseline Data	
PO_018	No compromise to the environmental values and water quantity of the **Shylock Palaeochannel system**.	Standing water level (SWL) measured using a water level meter (dipper) below fixed reference point (top of well casing). Drawdown in metres calculated by subtracting initial reading shown in Table 3-34 from SWL reading taken. Numerical groundwater modelling to verify calibration and establish long term recovery scenario.	Monitoring wells PTIW17, PTIW21, W4 and W5 as shown in Figure 6-2.	SWL measurements compared with recovery model predictions. The numerical groundwater model will be reviewed and updated by a suitably qualified and experienced independent professional at least three months prior to mine closure to confirm the time for full recovery to predicted post-mining groundwater levels and to establish updated model predictions for wells PTIW17, PTIW21, W4 and W5. Updated predictions will be presented to DEM.	Following the cessation of all groundwater pumping and re-injection activities, SWL will be recorded in PTIW17, PTIW21, W4 and W5 monthly for the first six months. Thereafter SWL will be measured bi-monthly for the next six months, six monthly for the next two years and thereafter annually until Lease surrender. The monitoring data is to be reviewed annually and reported in the statutory compliance report to DPC.	NA	NA
		Field measurement of EC/TDS and pH using a calibrated water quality meter. Laboratory analysis of EC/TDS, pH, dissolved As and major ions by sampling and testing at a NATA accredited laboratory.	Re-injection wells used for extraction shown in Figure 3-59 (selection of PTIW19, PTIW43, PTIW44, PTIW46, PTIW48 and PTIW49, as confirmed with DPC prior to sampling).	EC/TDS, pH and major ion chemistry is within ± 30% of baseline water chemistry collected prior to the commencement of operations, presented in Table 3-35. If final water chemistry is not within ± 30% of baseline water chemistry then the significance will be reviewed and reported on by a suitably qualified and experienced independent professional.	Monthly monitoring (three discrete events) conducted during the three month period prior to the cessation of all groundwater pumping and re-injection activities.	Shylock Palaeochannel baseline well chemistry data presented in Table 3-35.	NA
Mine Waste Materials							
PO_019	Mining Lease condition: All **mine waste materials** left on site are chemically and physically stable.	Physical stability will be measured by the physical stability criteria. Refer to physical stability criteria.	Refer to physical stability criteria.	Refer to physical stability criteria.	Refer to physical stability criteria.	Refer to physical stability criteria.	NA
		The contaminant spill register will be reviewed to demonstrate that all chemical spills greater than 20 L have been rehabilitated to EPA standards.	Portia ML area.	All spills have been remediated to an appropriate EPA standard (refer to EPA Guideline *Environmental Management of On-Site Remediation*).	Once, prior to Lease surrender	NA	NA
Post Mining Land Use							
PO_020	At Lease relinquishment, the mine site is suitable for a **return to the future land use identified in PEPR Section 7.16**.	Independent audit demonstrates that other than Domain 4, the site is suitable for a return to the future land use identified in Section 7.16.	Portia ML area.	Domains 1 to 3 have been rehabilitated in accordance with strategies described in Section 7.15, decommissioning of infrastructure has not created site contamination requiring remediation and the land has been returned to a condition suitable for the future land use identified in Section 7.16.	Once, prior to Lease surrender	NA	NA

7.15 Sustainable Closure Strategies (Control Measures)

The following closure strategies (control measures) are proposed for each domain:

Domain 1: Supporting Site Infrastructure

- Remove all buildings (including camp and office), power supply lines, tanks, chemicals, waste water treatment systems, waste materials (in accordance with the *Waste Management Plan*), disconnect and terminate all services, fuel tanks and non-permanent bunding (e.g. fuel tank bunding) and fencing.
- Remove pumps, pipelines and power supply lines (to reinjection wellfield).
- Cap and decommission all wells, including re-injection, dewatering and monitoring wells, in accordance with DEW requirements.
- Break up and remove any concrete footings and dispose to the Portia open pit.
- Remove landfill surface infrastructure, including fences, gates and unused stockpiles.
- Cap the landfill and compact the capping layer.
- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas), including roads (but excluding the existing main access road).
- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the Portia open pit.
- Grade windrows back over tracks or cleared areas.
- Reshape or profile individual areas if necessary to blend in with surrounding areas and reduce erosion potential. Shallow ripping (up to 100 mm depth) in a direction that is perpendicular to the direction of surface water flow (i.e. across slope) to minimise the potential for erosion during large rainfall events.
- Fill in related stormwater drains and retention structures.
- Place topsoil over all disturbed areas and shallow rip (up to 100 mm depth) to create a ‘crest and trough’ profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.
- Seed all disturbed areas with local native grasses and shrubs.

Domain 2: TSFs, Processing Plant, ROM Pad and Associated Infrastructure

For the TSF cells:

- Remove all tailings delivery pipelines and return water (decant) infrastructure from the TSF cells.
- Allow tailings cells to dry and consolidate. It is expected that some TSF rehabilitation works can commence between 2 months and 1 year of deposition ceasing. TSF cells will be progressively covered and decommissioned over a two-year period following the completion of deposition.
- Lap in and fold the sides in the HDPE liner in TSF4 and fill with general fill and Namba clays to form the shedding landform. This shedding landform will be covered with a puncture resistant geomembrane liner (LLDPE or equivalent).

- Survey to record finished profile of the TSF cells prior to commencing rehabilitation earthworks.
- Audit (and reporting) carried out by a suitably qualified and experienced independent expert prior to placement of capping materials, to confirm that the TSF cells are appropriately dried out and trafficable in order to commence progressive rehabilitation earthworks.
- Place Quaternary overburden materials.
- Push out Quaternary overburden materials to a minimum thickness of 350 mm to follow a similar profile to the ultimate tailings beach and achieve design gradients.
- The Quaternary material will be moved out onto the edge of the TSF and then pushed out. The materials should not be compacted but loosely packed to provide suitable storage porosity for water retention.
- Survey to record finished profile of the Quaternary material prior to topsoil placement.
- Place topsoil materials and spread to a depth of approximately 150 mm.
- Level sides and top surfaces.
- Shallow rip topsoil profile (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.
- Survey to record finished rehabilitated profile of the TSF cells to ensure even distribution of topsoil across the landform.
- At completion of the rehabilitated TSF landforms, fill in related stormwater drains and retention structures to the TSF.
- Deep rip all compacted areas (hardstand and trafficked areas), including haulage roads and the internal road network (as required).
- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the open pit.
- Grade windrows back over tracks or cleared areas.
- Audit (and reporting) carried out by a suitably qualified and experienced independent expert to confirm that the TSF cells have been rehabilitated and closed in accordance with the design and are suitable for return to the future land use as defined in PEPR Section 7.16.
- Seed all disturbed areas with local native grasses and shrubs.

For other Infrastructure areas:

- Remove all buildings (including processing plant office), power supply lines, tanks, chemical storage units, waste water treatment systems, waste materials (in accordance with the *Waste Management Plan*), disconnect and terminate all services, fuel tanks and non-permanent bunding (e.g. fuel tank bunding) and fencing.
- Break up and remove any concrete footings and dispose to the Portia open pit.
- Remove any remaining material stockpiled on the ROM pad to the Portia open pit.

- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas), including haulage roads and the internal road network contained within Domain 2.

- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the Portia open pit.

- Grade windrows back over tracks or cleared areas.

- Remaining water in water storage dams (RWD, BP1 and BP2) to either be evaporated off (if small volumes present) or returned to the Portia open pit void.

- Once RWD is empty, cut HDPE liner and bury.

- Infill the RWD, BP1 and BP2 using Quaternary materials and reshape/profile the footprint areas to existing topography.

- Fill in related stormwater drains and retention structures.

- Place topsoil over all disturbed areas and shallow rip (up to 100 mm depth) to create a ‘crest and trough’ profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.

- Seed all disturbed areas with local native grasses and shrubs.

Domain 3: OWD

- Lap in and fold the sides in the HDPE liner in the evaporation area and fill with general fill and Namba clays.
- Removal all associated pipe work.
- Smooth / trim sides and top surfaces of the OWD to achieve design batter slope angles and gradients.

- Construct crest bunds and cross-bunding as shown in the design.

- Survey to record finished profile of the OWD landform prior to topsoil placement.

- Place topsoil on top and sides of the OWD to a depth of approximately 150 mm.

- Shallow rip (up to 100 mm depth) to create a ‘crest and trough’ profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.

- Survey to record finished rehabilitated profile of the OWD to ensure even distribution of topsoil across the landform.

- At completion of the rehabilitated OWD landform, fill in related stormwater drains and retention structures to the OWD.

- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas) including haulage roads and the internal road network around the OWD (as required).

- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the open pit.

- Grade windrows back over tracks or cleared areas.

- Seed all disturbed areas with local native grasses and shrubs.

Domain 4: Portia Open Pit

- Remove any remaining stockpiles of gravel and construction materials and dispose of within the Portia open pit.
- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas), including haulage roads and the internal road network contained within Domain 4.
- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the open pit.
- Remove pumps, discharge lines and power supply lines.
- Abandon / decommission all wells in accordance with DEW requirements.
- Remaining water in PDD to either be evaporated off (if small volumes present), re-injected into the Shylock Palaeochannel prior to decommissioning or returned to the open pit void.
- Once PDD is empty, cut HDPE liner and bury.
- Infill the PDD using quaternary material and reshape/profile the footprint areas to existing topography.
- Fill in related stormwater drains and retention structures.
- Allow Portia open pit walls to collapse to post mining angle of repose.
- Complete the abandonment bund.
- Ensure abandonment bund has not been breached.
- Grade windrows back over tracks or cleared areas.
- Place topsoil on disturbed surfaces which have been stripped of topsoil contained within Domain 4, except the Portia open pit and all areas inside of the abandonment bund. Shallow rip (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.
- Seed all disturbed areas with local native grasses and shrubs except the pit.
- Install warning signage.

Rehabilitation is to occur in two stages.

Stage 1 rehabilitation activities for **Domain 1** are to include:

- Remove all buildings, excluding the camp, office associated power supply lines and infrastructure and the landfill.
- Remove pumps, pipelines and power supply lines (to reinjection well field).
- Cap and decommission all wells, including re-injection, dewatering and monitoring wells, in accordance with DEW requirements.
- Break up and remove any concrete footings and dispose to the Portia open pit.

- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas), including roads (but excluding the existing main access road).
- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the open pit.
- Grade windrows back over tracks or cleared areas.
- Reshape or profile individual areas if necessary to blend in with surrounding areas and reduce erosion potential. Shallow ripping (up to 100 mm depth) in a direction that is perpendicular to the direction of surface water flow (i.e. across slope) to minimise the potential for erosion during large rainfall events.
- Fill in related stormwater drains and retention structures.
- Place topsoil over all disturbed areas and shallow rip (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.
- Seed all disturbed areas with local native grasses and shrubs.

Stage 1 rehabilitation activities for **Domain 2** will include:

For TSFs 1 - 3:

- Remove all tailings delivery pipelines and return water (decant) infrastructure from the TSF cells.
- Allow tailings cells to dry and consolidate. It is expected that some TSF rehabilitation works can commence between 2 months and 1 year of deposition ceasing.
- Survey to record finished profile of the TSF cells prior to commencing rehabilitation earthworks.
- Audit (and reporting) carried out by a suitably qualified and experienced independent expert prior to placement of capping materials, to confirm that the TSF cells are appropriately dried out and trafficable in order to commence progressive rehabilitation earthworks.
- Place Quaternary overburden materials.
- Push out Quaternary overburden materials to a minimum thickness of 350 mm to follow a similar profile to the ultimate tailings beach and achieve design gradients.
- The Quaternary material will be moved out onto the edge of the TSF and then pushed out. The materials should not be compacted but loosely packed to provide suitable storage porosity for water retention.
- Survey to record finished profile of the Quaternary material prior to topsoil placement.
- Place topsoil materials and spread to a depth of approximately 150 mm.
- Level sides and top surfaces.
- Shallow rip topsoil profile (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.
- Survey to record finished rehabilitated profile of the TSF cells to ensure even distribution of topsoil across the landform.

- At completion of the rehabilitated TSF landforms, fill in related stormwater drains and retention structures to the TSF.
- Deep rip all compacted areas (hardstand and trafficked areas), including haulage roads and the internal road network (as required).
- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the open pit.
- Grade windrows back over tracks or cleared areas.
- Audit (and reporting) carried out by a suitably qualified and experienced independent expert to confirm that the TSF cells have been rehabilitated and closed in accordance with the design and are suitable for return to the future land use as defined in PEPR Section 7.16.
- Seed all disturbed areas with local native grasses and shrubs.

For TSF 4:

- As above with the additional steps:
  - lapping over the excess HDPE from the embankments
  - placement of general fill (non-Quaternary or Namba materials) in a shedding landform such that seepage of rain water into the tailings will be minimised.
  - general fill to be covered with a 1.0 mm puncture resistant geomembrane liner (LLDPE or similar)
  - capped with 350mm of Quaternary sandy clays
  - overlain with 150mm of topsoil.

This will provide a seepage barrier and limit inflows of water for at least 10 years that will allow the residual trace cyanide to dissipate.

For other Infrastructure areas:

- Break up and remove any concrete footings and dispose to the open pit.
- Remove any remaining material stockpiled on the ROM pad to the open pit.
- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas), including haulage roads and the internal road network contained within Domain 2.
- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the open pit.
- Grade windrows back over tracks or cleared areas.
- Remaining water in water storage dams (RWD, PWD and BP2) to either be evaporated off (if small volumes present) or returned to the open pit void.
- Once RWD is empty, cut HDPE liner and bury.

- Infill the RWD, PWD and BP2 using Quaternary materials and reshape/profile the footprint areas to existing topography.

- Fill in related stormwater drains and retention structures.

- Place topsoil over all disturbed areas and shallow rip (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.

- Seed all disturbed areas with local native grasses and shrubs.

Stage 1 rehabilitation activities for **Domain 3** will include:

- Lap in and fold the sides in the HDPE liner in the evaporation area and fill with general fill and Namba clays.
- Removal all associated pipe work.
- Smooth / trim sides and top surfaces of the OWD to achieve design batter slope angles and gradients.

- Construct crest bunds and cross-bunding as shown in the design.

- Survey to record finished profile of the OWD landform prior to topsoil placement.

- Place topsoil on top and sides of the OWD to a depth of approximately 150 mm.

- Shallow rip (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.

- Survey to record finished rehabilitated profile of the OWD to ensure even distribution of topsoil across the landform.

- At completion of the rehabilitated OWD landform, fill in related stormwater drains and retention structures to the OWD.

- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas) including haulage roads and the internal road network around the OWD (as required).

- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the open pit.

- Grade windrows back over tracks or cleared areas.

- Seed all disturbed areas with local native grasses and shrubs.

Stage 1 rehabilitation activities for **Domain 4** will include:

- Remove any remaining stockpiles of gravel and construction materials and dispose of within the Portia open pit.

- Deep rip (up to 300 mm depth) all compacted areas (hardstand and trafficked areas), including haulage roads and the internal road network contained within Domain 4.

- Scrape off any visual salt crust build up on trafficked areas, including roads and dispose to the Portia open pit.

- Remove pumps, discharge lines and power supply lines.

- Abandon / decommission all wells in accordance with DEW requirements.

- Remaining water in PDD to either be evaporated off (if small volumes present), re-injected into the Shylock Palaeochannel prior to decommissioning or returned to the open pit void.
- Once PDD is empty, cut HDPE liner and bury.
- Infill the PDD using quaternary material and reshape/profile the footprint areas to existing topography.
- Fill in related stormwater drains and retention structures.
- Allow pit walls to collapse to post mining angle of repose.
- Complete the abandonment bund.
- Ensure abandonment bund has not been breached.
- Grade windrows back over tracks or cleared areas.
- Place topsoil on disturbed surfaces which have been stripped of topsoil contained within Domain 4, except the Portia open pit and all areas inside of the abandonment bund. Shallow rip (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.
- Seed all disturbed areas with local native grasses and shrubs except the pit.
- Install warning signage.

Stage 2 rehabilitation activities for **all Domains** are to include:

- Remove all buildings (e.g. camp, office), pipework, power supply lines, septic tanks, fuel tanks, fencing and non-permanent bunding (e.g. fuel tanks).
- Remove landfill surface infrastructure, including fences, gates and unused stockpiles.
- Cap the landfill and compact the capping layer.
- Fill in any related and remaining stormwater drains and retention structures (e.g. office, camp, landfill).
- Deep rip (up to 300 mm depth) remaining compacted hardstand and trafficked areas.
- Grade remaining windrows back over existing tracks or cleared areas.
- Place topsoil on remaining disturbed surfaces and shallow rip (up to 100 mm depth) to create a 'crest and trough' profile across the land surface, where nutrients, water and seeds will collect over time to promote vegetation growth.

Seed all remaining disturbed areas with local native grasses and shrubs. Control measures for over-abundant large native herbivores and domestic livestock may be implemented if monitoring shows that these are adversely affecting revegetation success. This may include fencing off rehabilitation areas to reduce grazing pressure. Stage 2 rehabilitation will also include ongoing maintenance and restoration of areas rehabilitated in Stage 1 as required. These stages are presented in Figure 7-4.

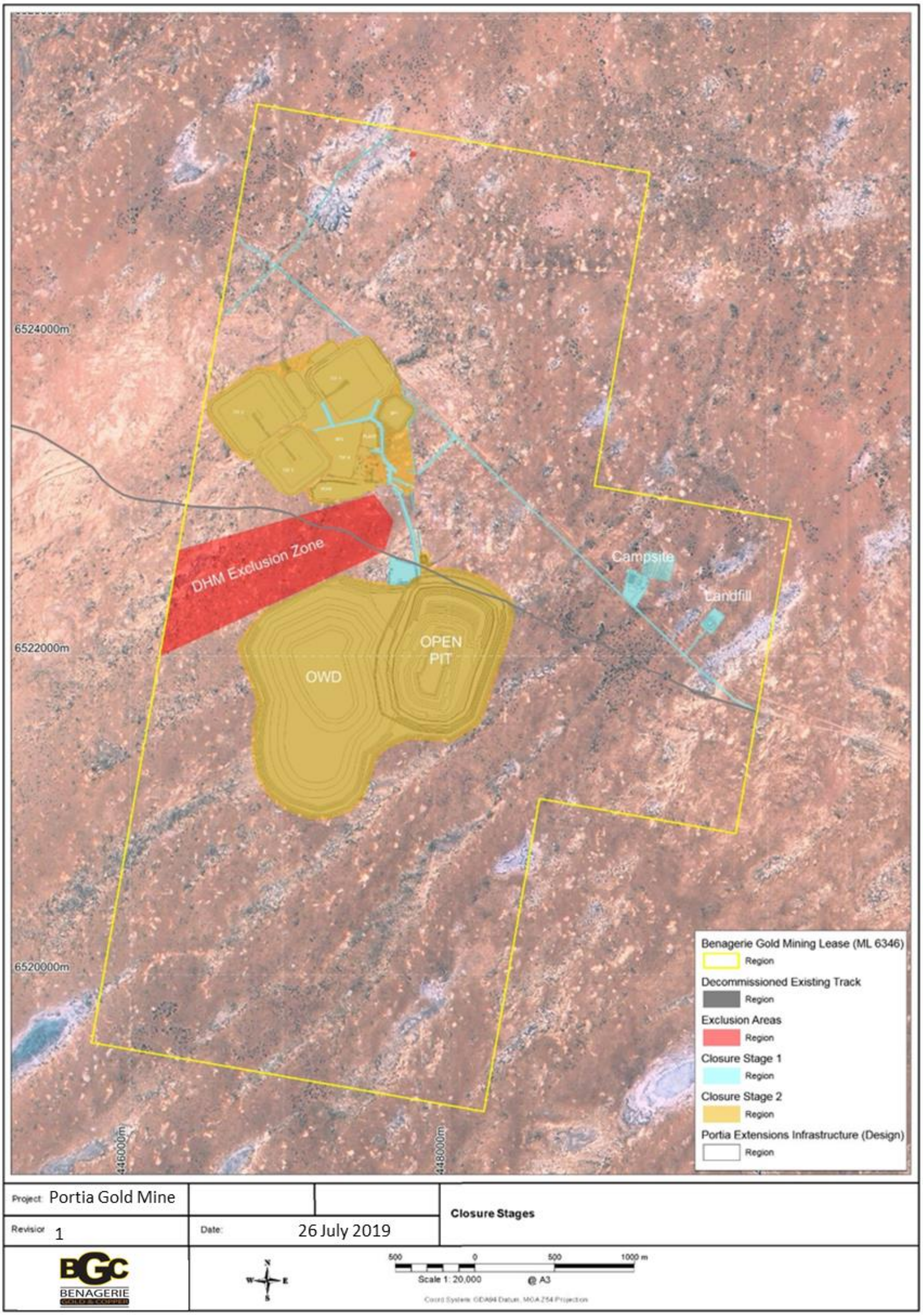


Figure 7-4: Plan view showing rehabilitation stages

7.16 Mine Completion Land Use Handover Process

On completion of the operations, remnant landforms at the Portia Mine Site will be limited to the Portia open pit void, the abandonment bund, the rehabilitated TSF cell (TSF-1, 2, 3 and 4) landforms and the rehabilitated OWD landform. The Site offices, accommodation camp, workshop, access roads, PDD, RWD, BP1, BP2, water collection systems, landfill and processing areas will all have been removed, backfilled and or levelled, covered with topsoil and rehabilitated.

Following completion of progressive rehabilitation activities, monitoring will commence as described in Section 7.13 across rehabilitated areas within Domains 1, 2 and 3.

Post mining land use will revert back to pastoral use with the exclusion of the open pit void and abandonment bund areas. Consultation will continue to be undertaken with the landholder prior to mine closure activities Control and management strategies for the achievement of the post mining land use were described in Section 7.12.

temporary stock fencing may need to be installed around rehabilitated areas if grazing from domestic herbivores is found to adversely impact upon the success of vegetation re-establishment in those areas during the early stages following rehabilitation (i.e. first six months). Such stock fencing (if installed) will not be designed to exclude native herbivores (such as kangaroos) or introduced pest species (such as rabbits) as such fencing would be prohibitively expensive and may not achieve the desired outcomes. The intention of such fencing is also not to restrict access by the public, as the abandonment bund and warning signage will serve this purpose at closure.

A private mutual agreement will be finalised with the pastoral lease holder of Mulyungarie Station (Mutooroo Pastoral Company) prior to the commencement of mine closure activities, expected to commence in late 2020. The final agreement will be provided to DEM (confidential financial information removed) within 14 days of finalisation. BGC will consult thoroughly with Mutooroo Pastoral Company to ensure that this agreement outlines the mutually agreed expected roles, responsibilities and timeframes for handover of the Site, including ongoing responsibilities post ML relinquishment. This agreement will outline the handover process (if any) for any remaining infrastructure such as groundwater wells and roads that the landholder may wish to use following ML relinquishment.

It is acknowledged that vegetation may take a number of years to successfully re-establish and is highly rainfall dependent. Therefore, rehabilitation monitoring will be based on demonstrating the rehabilitated landforms are stable and self-sustaining, utilising the LFA monitoring technique, rather than by monitoring total vegetation cover. Following the successful demonstration of closure OMC, a Completion Report will be prepared and submitted to DEM with the intention of ML relinquishment. Prior to relinquishment, a meeting will be held with the owners of Mutooroo Pastoral Company to handover responsibility for any remaining infrastructure (if any) and for the resumption of pastoral activities across the ML area to begin. The remnant landforms will be identified at this meeting and the results of the rehabilitation monitoring program discussed. This meeting will be documented and may also involve representatives from DEM (as required). Administrative measures to control any future development of the Site post completion will be agreed with DEM prior to relinquishment. Following successful ML relinquishment and this handover process, pastoral activities can resume across the agreed areas.

The pastoral lease holder will be reminded of the presence of the Portia open pit void at relinquishment. The height of the abandonment bund and the gradient of its outside slope will be sufficient to provide a visual indication of the presence of a feature beyond. Signage noting 'Danger Deep Excavation' or similar wording will be placed on posts at appropriate spacing around the outside of the bund at not greater than 400 m centres to warn workers and the public of the safety risk.

7.17 Closure Plan Maps and Sections

Plans and sections depicting the Site layout on completion of Mining and Processing and on completion of closure and rehabilitation have been included to show the intended final landforms resulting from mining and rehabilitation at the Portia Mine Site. These plans and sections are shown from Figure 7-5 through to Figure 7-17 inclusive.

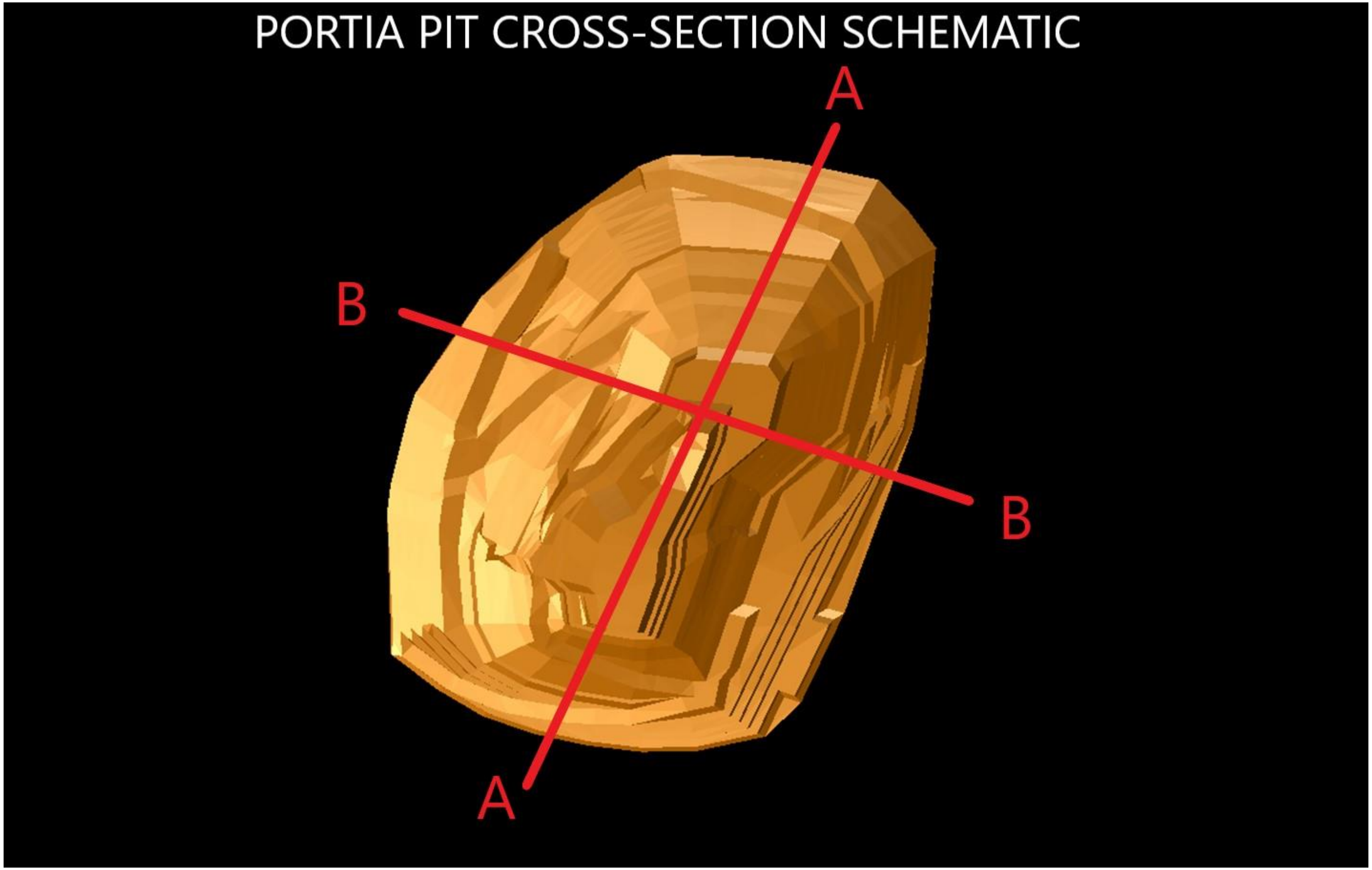


Figure 7-5: Open pit (Updated Design) Cross-Section Schematic Viewed from North

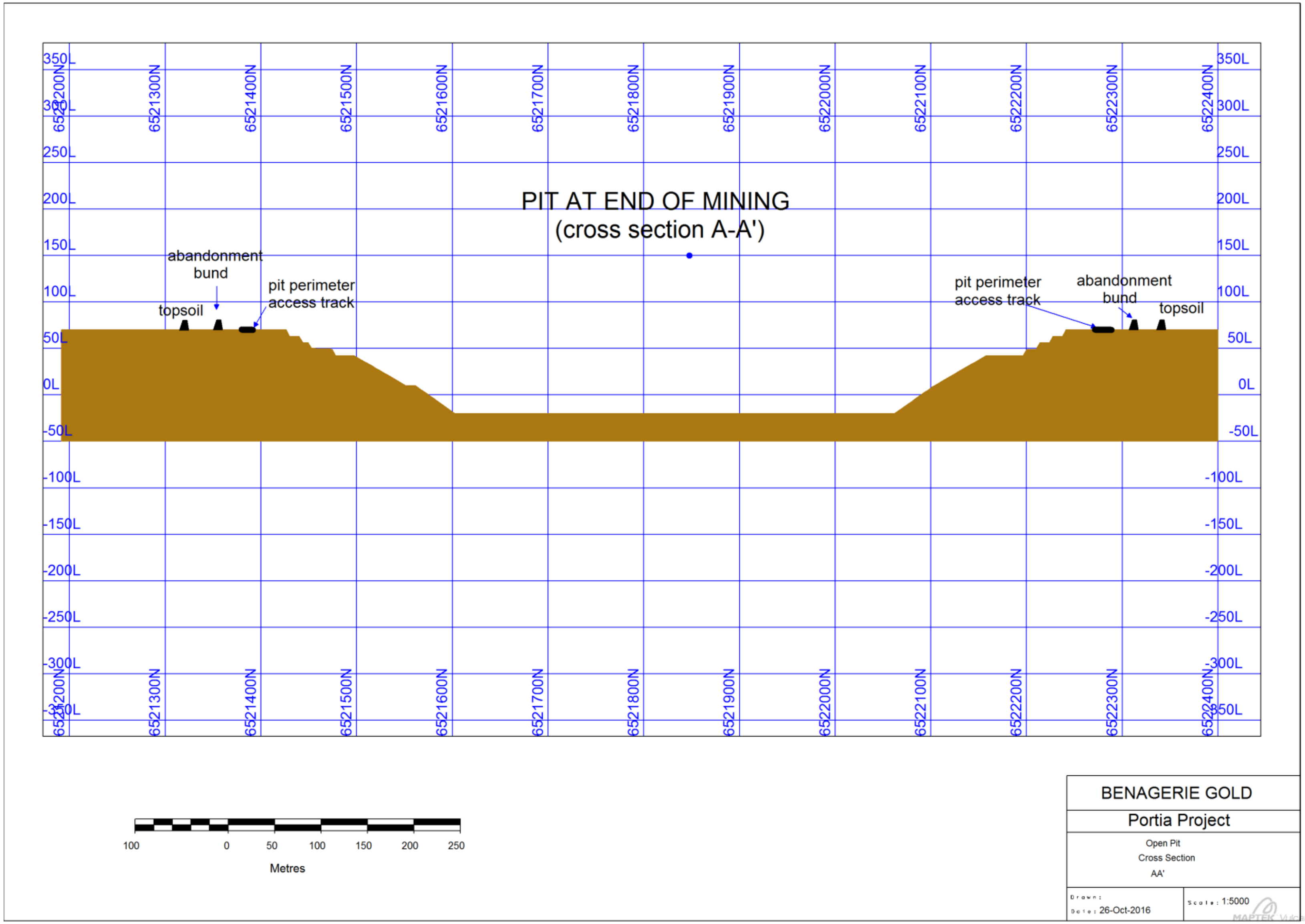


Figure 7-6: Cross-section A-A' of Portia Open Pit at End of Mining

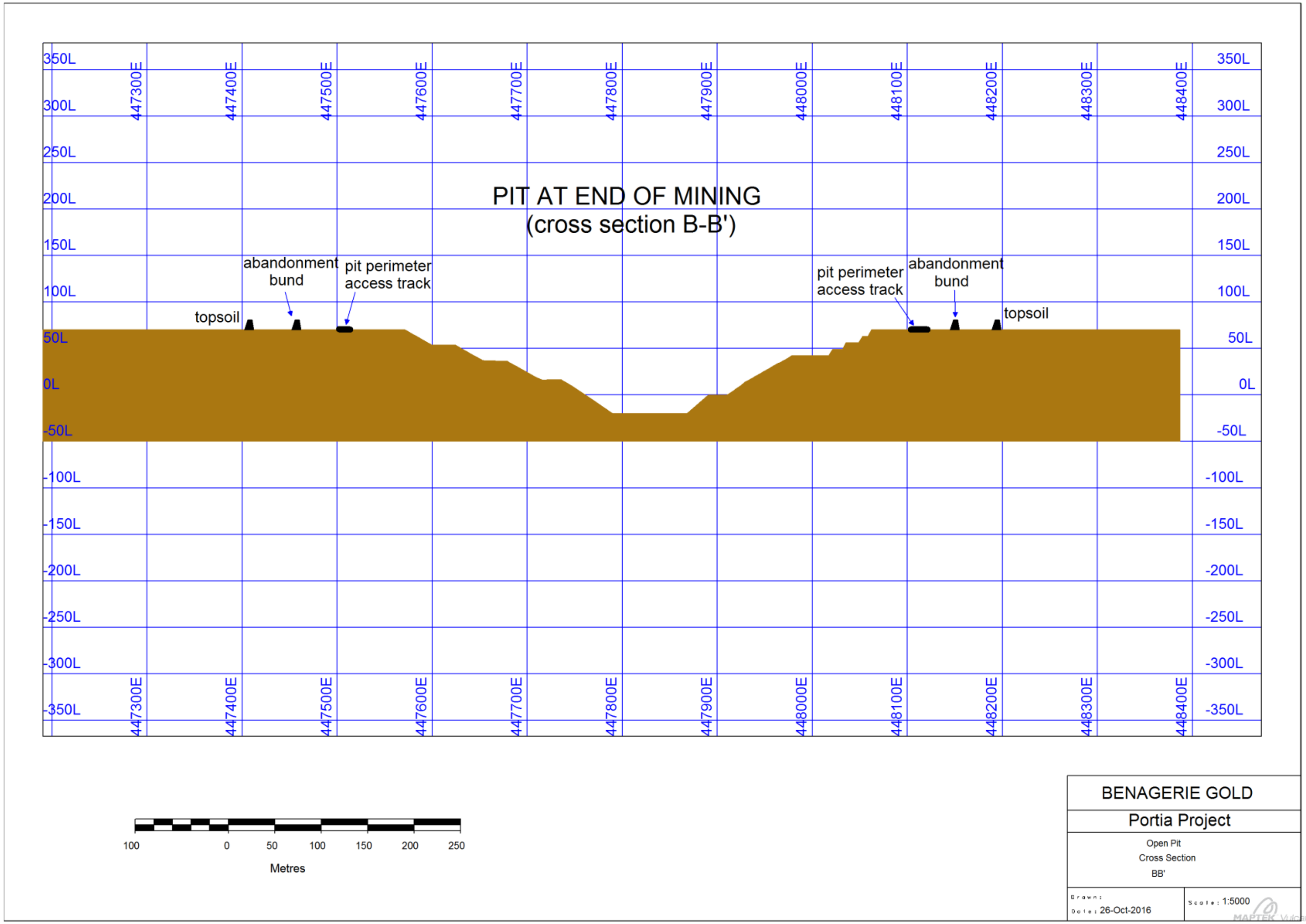


Figure 7-7: Cross-section B-B' of Portia Open Pit at End of Mining

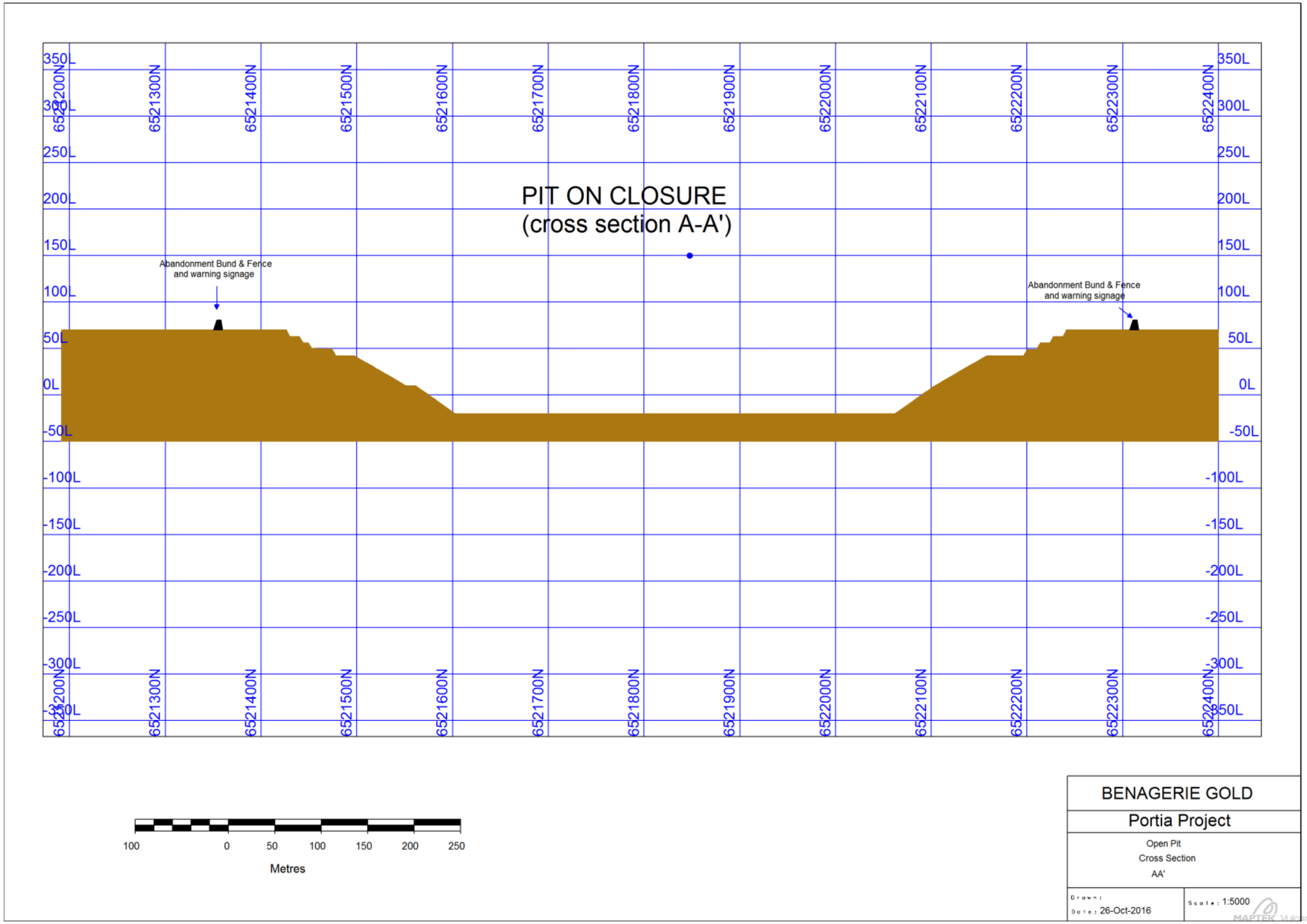


Figure 7-8: Cross-section A-A' of Portia Open Pit on Closure

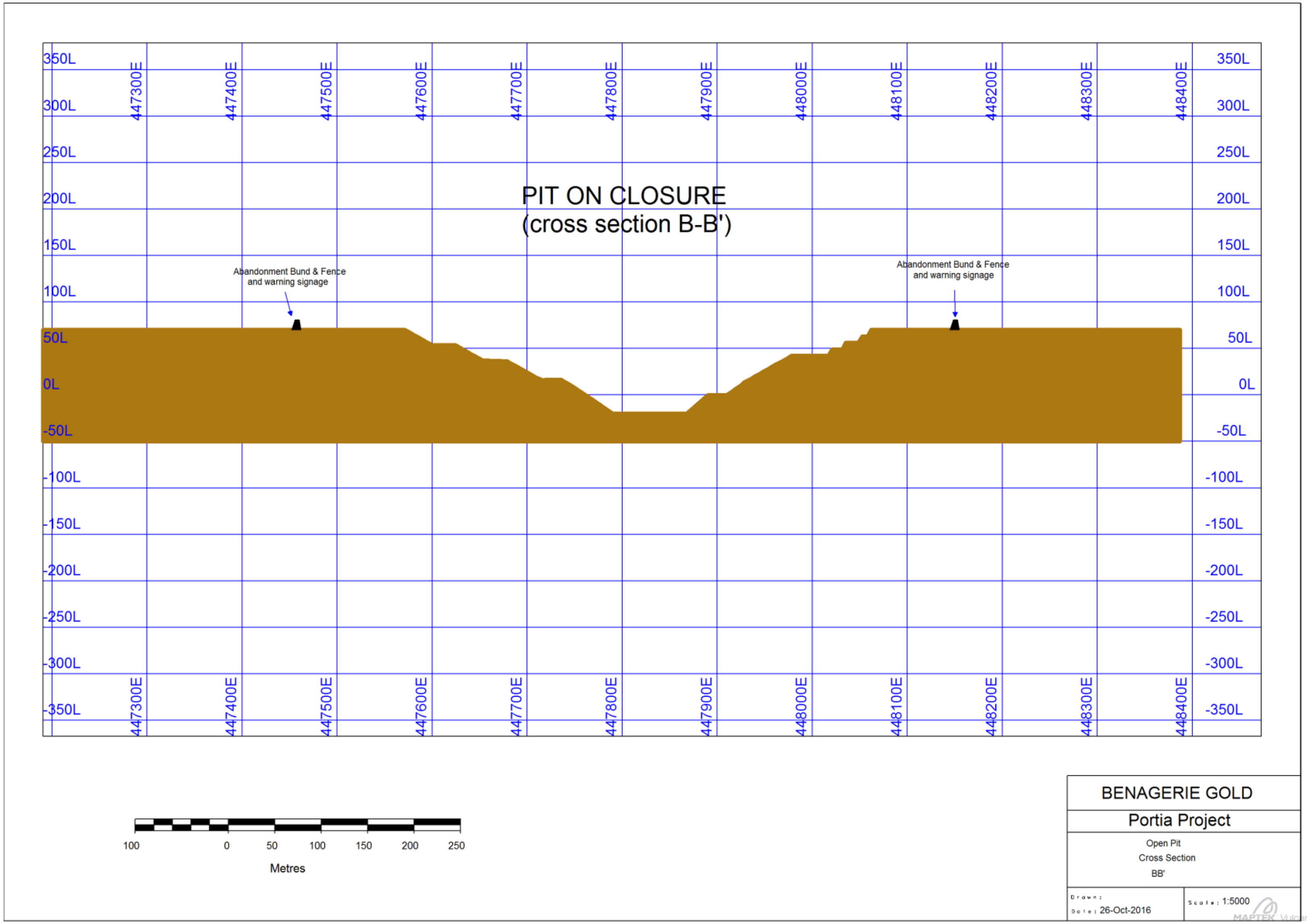


Figure 7-9: Cross-section B-B' of Portia Open Pit on Closure

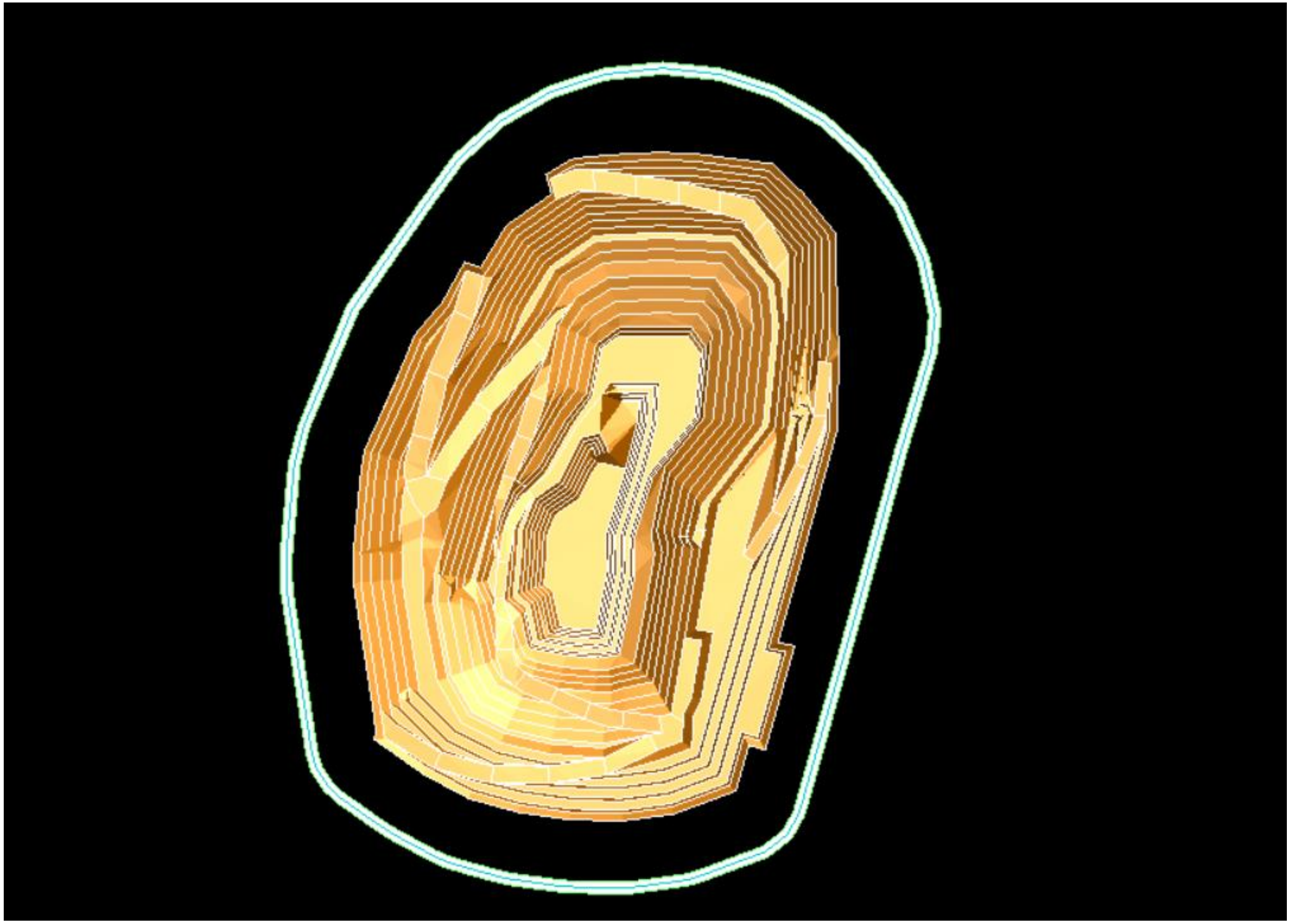


Figure 7-10: Schematic of Abandonment Bund at Closure

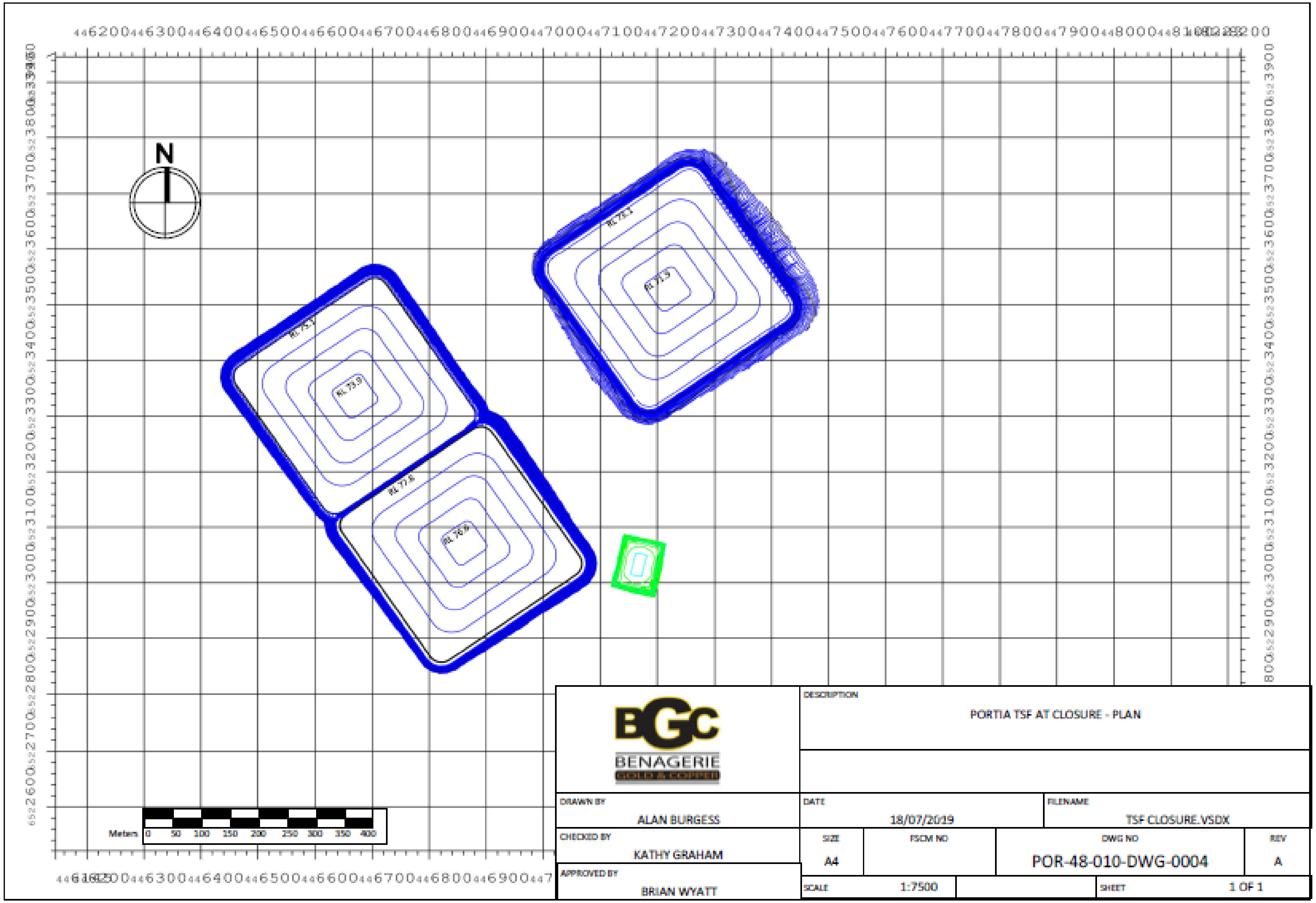


Figure 7-11: TSF final design plan view – with topsoil cover

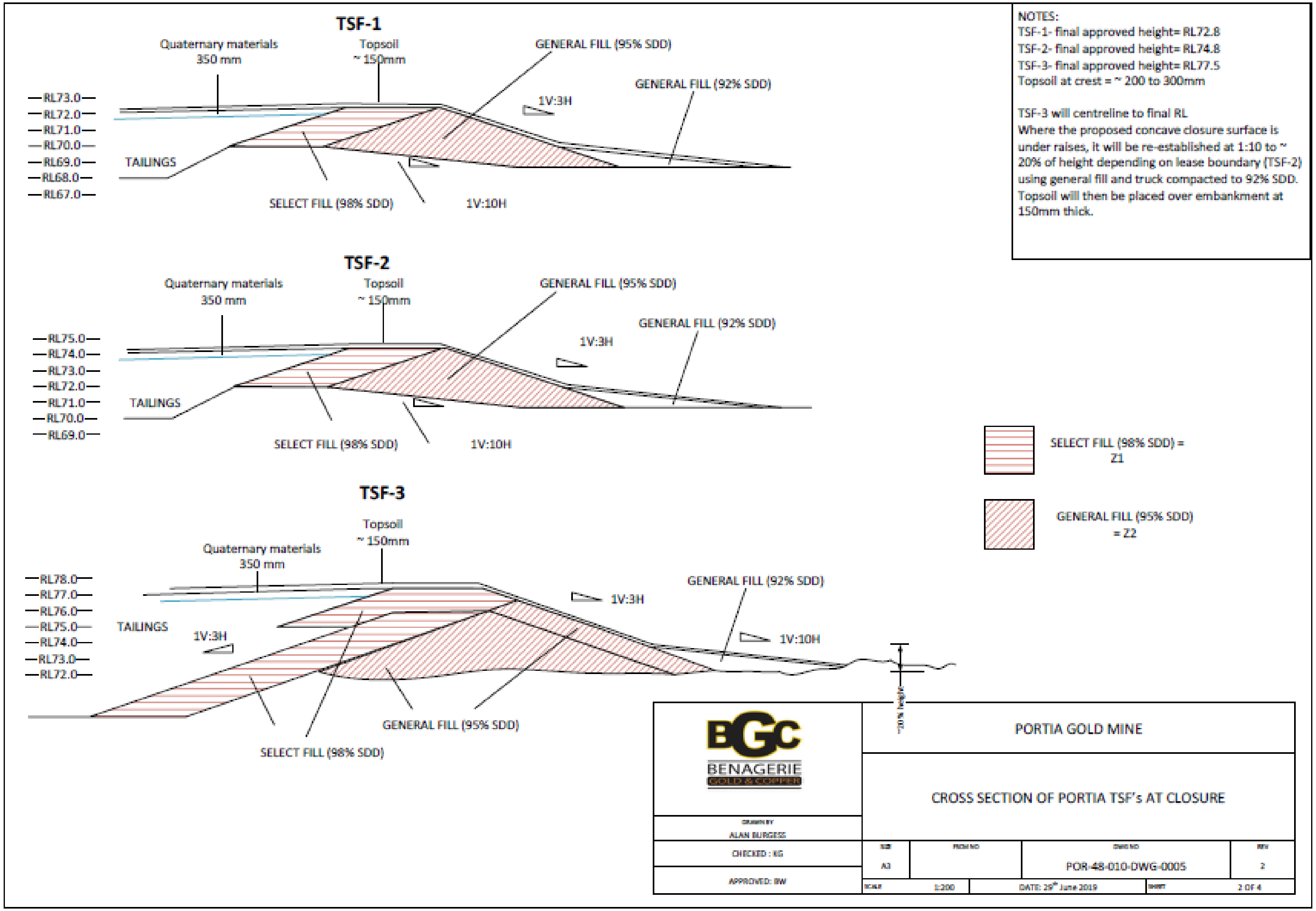
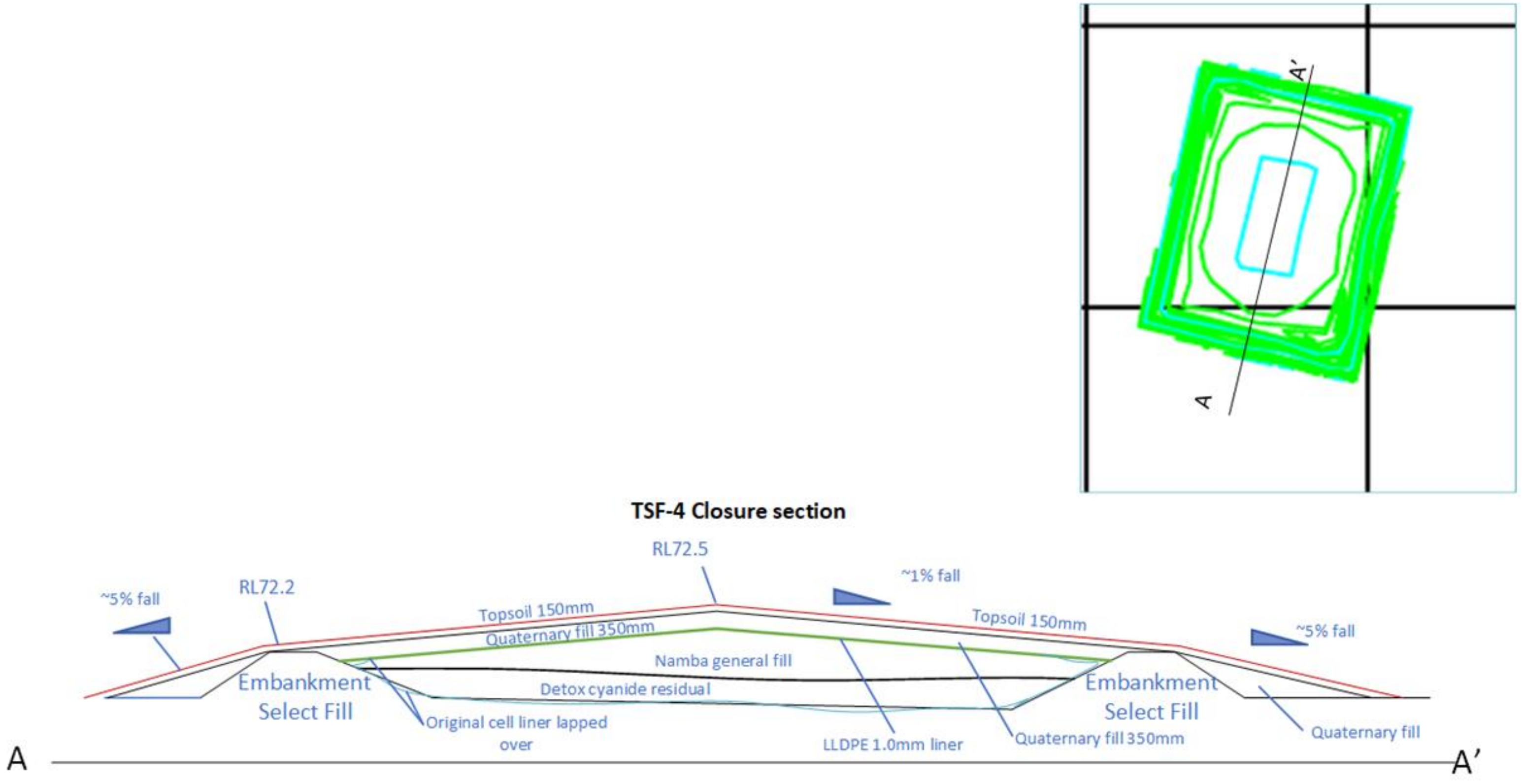


Figure 7-12: TSF Final Design Cross-Sections (TSF-1, 2 and 3)



BGC BENAGERIE GOLD & COPPER	PORTIA GOLD MINE			
	TITLE: CLOSURE CROSS SECTION – TSF4			
DRAWN BY ALAN BURGESS				
CHECKED BY KG	SIZE A3	FSCM NO	DWG NO POR-48-010-DWG-0006	REV 0
APPROVED BY BW	SCALE 1:500		SHEET 3 OF 4	

Figure 7-13: TSF-4 Final Design Cross-Section

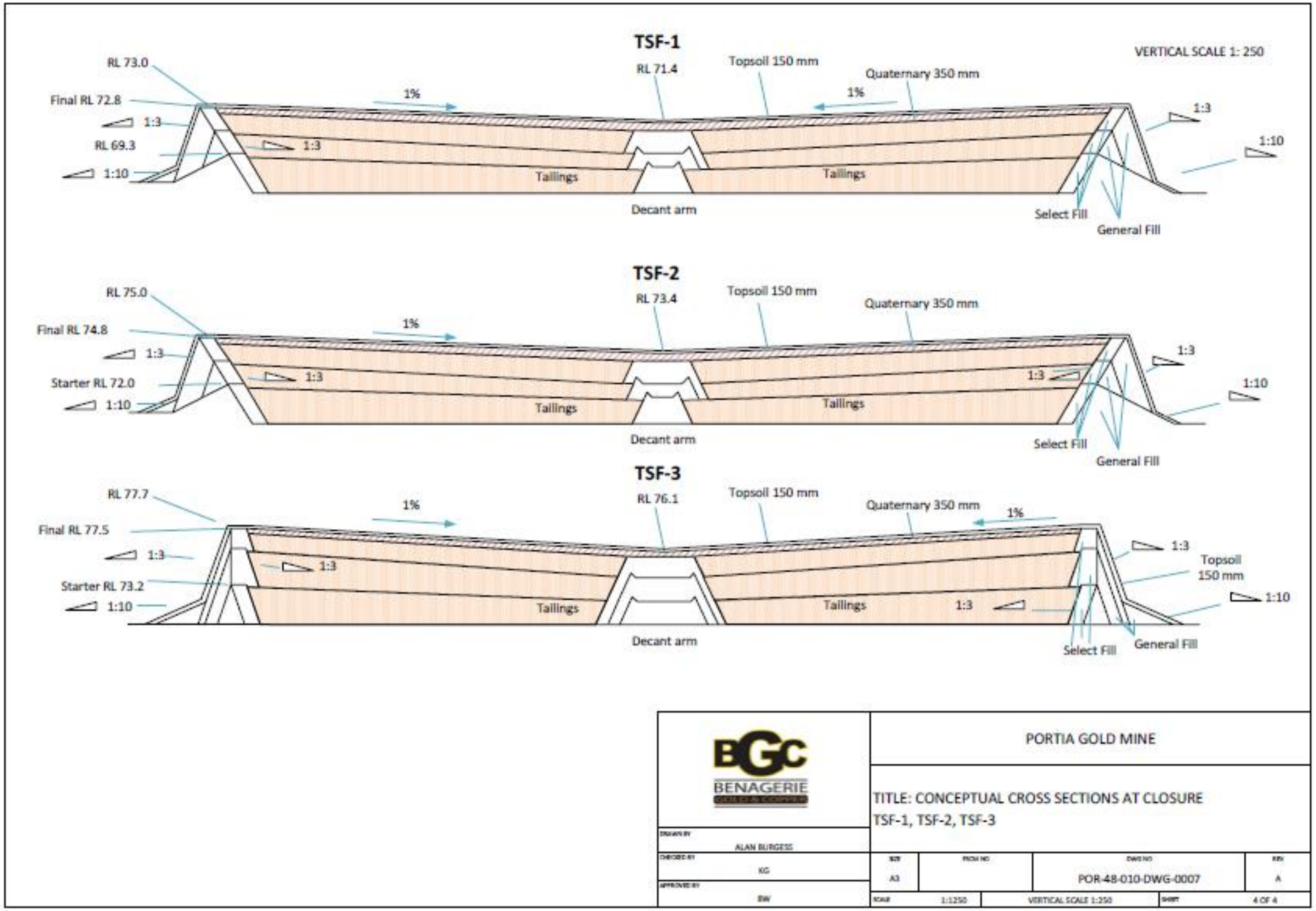


Figure 7-14: TSF-1, 2 and 3 Closure Cross-Sections

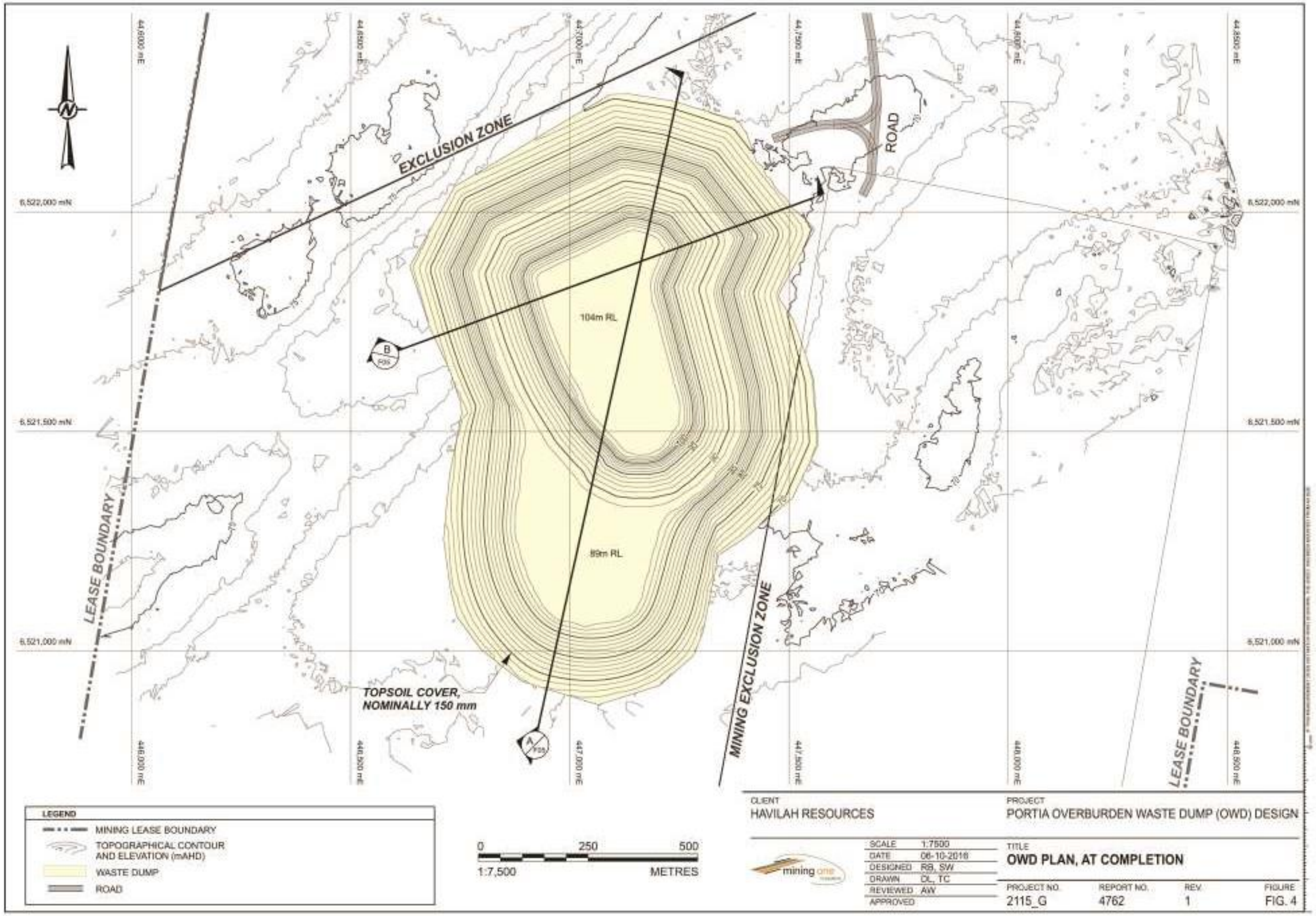


Figure 7-15: OWD final design plan view – with topsoil cover

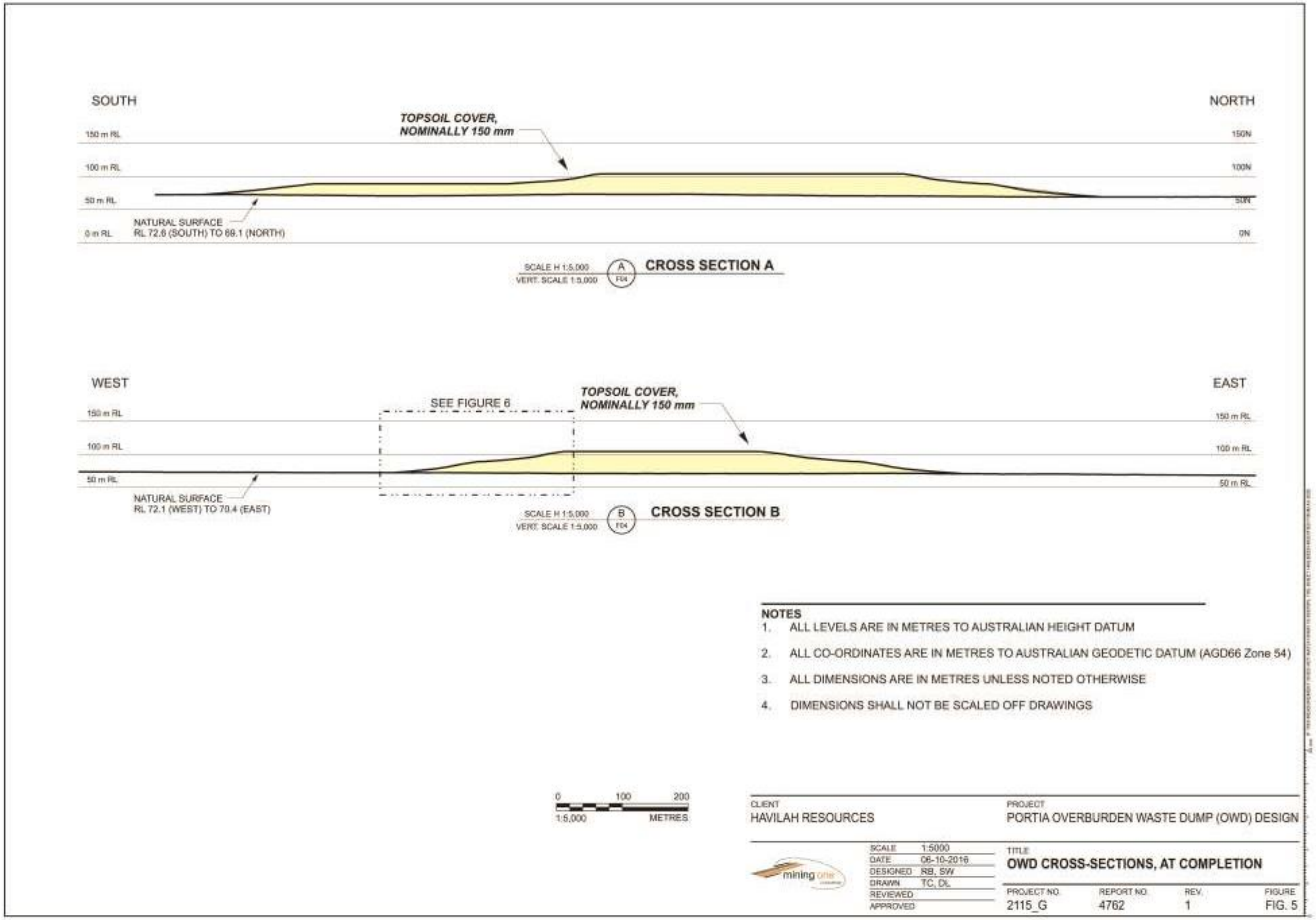


Figure 7-16: OWD final design cross-sections – with topsoil cover

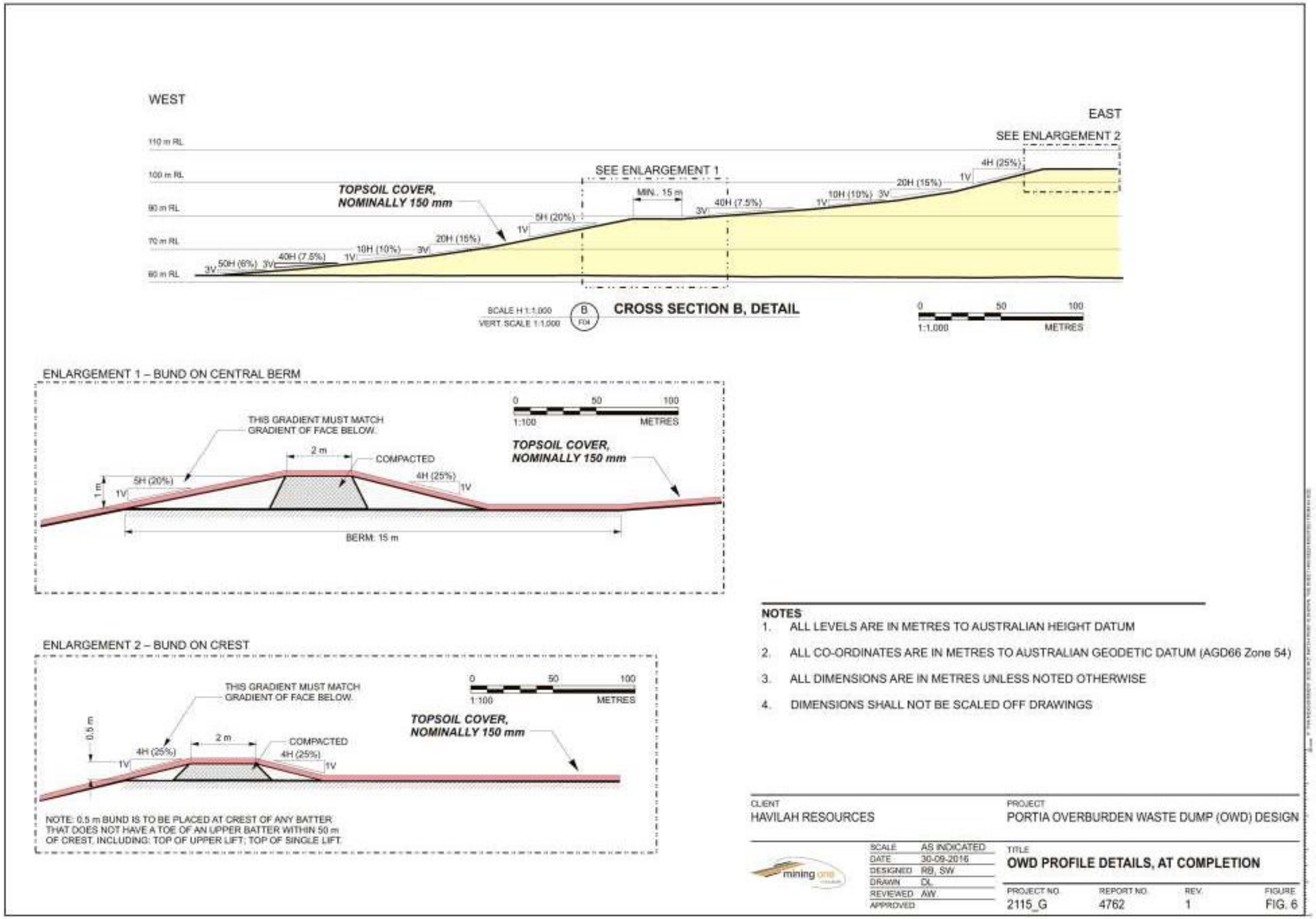


Figure 7-17: OWD final design profile details – with topsoil cover

7.18 Completion Risk Assessment

Closure risks may include:

- sudden closure of the mine due to unforeseen market changes;
- unsuccessful rehabilitation; and
- climatic impacts.

Risk assessments for each are presented below.

7.18.1 Potential Impact Event: the mine is closed due to unforeseen market changes

Control and Management Strategies

The bond payment will cover all anticipated rehabilitation costs in the event of premature mine closure and company insolvency.

Likelihood and Severity of Consequences

It is possible that mining operations could cease before mining has been completed due to changes in market (i.e. the gold price). Risks to closure will, however be reduced by the control measure stated above.

Risk Levels

Risk levels for closure of the mine due to market changes are presented in Table 7-7.

Table 7-7 Risk Assessment – Closure of Mine due to Market Changes

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Closure of the mine due to market changes	Unlikely	Major	Control measures as outlined above	Unlikely	Minor	Low	Yes

Justification for Risk Acceptance

From the risk assessment above, market changes will not affect the effective outcome of closure, as the bond will cover all anticipated closure costs.

7.18.2 Potential Impact Event: unsuccessful rehabilitation activities

Control and Management Strategies

- Best practice procedures will be employed in the rehabilitation work to prevent this from occurring.
- A contingency sum has been allocated to cover for additional remedial activities.

Likelihood and Severity of Consequences

It is possible that rehabilitation activities may not achieve the required closure outcomes. Risks to closure will, however be reduced by the control measure stated above.

Risk Levels

Risk levels for closure of the mine due to poor management of rehabilitation are presented in Table 7-8.

Table 7-8 Risk Assessment - Unsuccessful Rehabilitation Activities

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Poor management of rehabilitation	Unlikely	Minor	Control measures as outlined above	Unlikely	Minor	Low	Yes

Justification for Risk Acceptance

From the risk assessment above, poor management of rehabilitation will not affect closure, as a contingency is budgeted to cover ongoing monitoring and any additional remedial activities.

7.18.3 Potential Impact Event: climatic impacts

Control and Management Strategies

Successive dry seasons or droughts will delay the revegetation process. BGC's ongoing monitoring will determine what remedial actions are required. Costs are provided for in the contingency budget.

Likelihood and Severity of Consequences

It is possible that negative climatic impacts could impact rehabilitation of the Site, both through drought and flood. Risks to closure will, however be reduced by the control measure stated above.

Risk Levels

Risk levels for closure of the mine due to climatic impacts are presented in Table 7-9.

Table 7-9 Risk Assessment – Climatic Impacts

Risk Event	Risk Prior to Implementation of Controls		Primary Control Measures	Residual Risk After Implementation of Controls		Level of Risk	ALARP
	Likelihood	Consequence		Likelihood	Consequence		
Climatic impacts	Possible	Minor	Control measures as outlined above	Rare	Minor	Low	Yes

<u>Justification for Risk Acceptance</u>

From the risk assessment above, climate impacts will not affect the closure outcome, as the contingency budget will be used to cover costs associated with all required remedial works.

7.19 Mine Closure Schedule

The indicative mine closure activity schedule for Site closure is based upon completion of rehabilitation in accordance with the closure strategy plan outlined in Section 7.15 is illustrated in Table 7-10 over.

It assumes that all Stage 1 rehabilitation activities will be completed within 2 years of the cessation of operations. The rehabilitation schedule critical path lies on the closure of Domain 2 which contains the TSF cells. The design and operation methodology of the TSF will enable closure works of this facility to be commenced within the first year of the rehabilitation schedule and completed within the second year of rehabilitation.

Closure and rehabilitation activities will be coordinated by BGC, using in-house staff and contractors / consultants as required. Benagerie Gold and Copper's Mining Executive will be responsible for the successful implementation of the closure strategy. It is acknowledged that vegetation may take a number of years to successfully re-establish. Monitoring and maintenance (as required) will be carried out until Lease surrender. BGC, as the Lease holder, will provide oversight of the rehabilitation, monitoring and maintenance activities including final peer review and submission of all statutory Compliance Reports to government departments, including the final Closure Report.

Table 7-10: Indicative mine closure activity schedule

Closure Activity Schedule		Month (Year 1)												Subsequent Years			
		1	2	3	4	5	6	7	8	9	10	11	12	2	3	4	5
Stage 1																	
Domain 1 - Supporting Site Infrastructure																	
1.1	Remove pumps, pipelines and power supply lines (to re-injection well field)																
1.2	Cap and abandon all wells																
1.3	Break up and remove any concrete footings and dispose																
1.4	Deep rip all compacted areas (excluding the existing main access road)																
1.5	Scrape off any visual salt crust build up on trafficked areas and dispose																
1.6	Grade windrows back over tracks or cleared areas																
1.7	Reshape or profile individual areas																
1.8	Fill in related stormwater drains and retention structures																
1.9	Place topsoil over all disturbed areas and shallow rip																
1.10	Seed all disturbed areas with local native grasses and shrubs.																
Domain 2 - TSF cells and Process Plant Infrastructure																	
2.1	Remove all tailings delivery pipelines and decant infrastructure																
2.2	Allow tailings cells to dry and consolidate																
2.3	Survey to record finished profile																
2.4	Audit (and reporting) to confirm TSF cells are appropriately dried out																
2.5	Place Quaternary overburden materials (progressive rehabilitation)																
2.6	Survey to record finished profile prior to topsoil placement																
2.7	Place topsoil materials																
2.8	Level sides and top surfaces																
2.9	Shallow rip topsoil profile																
2.10	Survey to record finished rehabilitated profile																
2.11	Fill in related stormwater drains and retention structures																
2.12	Break up and remove any concrete footings and dispose																
2.13	Remove any remaining material stockpiled on the ROM pad to the open pit																
2.14	Remove water in RWD and PWD, cut HDPE liner and bury																
2.15	Empty SSD and dispose of any remaining slimes to the open pit																
2.16	Infill the RWD, PWD & SSD and reshape/profile																

Closure Activity Schedule		Month (Year 1)												Subsequent Years			
		1	2	3	4	5	6	7	8	9	10	11	12	2	3	4	5
2.17	Deep rip all compacted areas					■											
2.18	Scrape off any visual salt crust build up on trafficked areas and dispose					■											
2.19	Grade windrows back over tracks or cleared areas					■											
2.20	Seed all disturbed areas with local native grasses and shrubs						■							■			
Domain 3 - OWD																	
3.1	Smooth / trim sides and top surfaces of the OWD to achieve design	■	■	■													
3.2	Construct crest bunds and cross-bunding			■	■												
3.3	Survey to record finished profile prior to topsoil placement				■												
3.4	Place topsoil on top and sides of the OWD					■	■										
3.5	Shallow rip topsoil profile						■										
3.6	Survey to record finished rehabilitated profile of the OWD						■										
3.7	Fill in related stormwater drains and retention structures							■									
3.8	Deep rip all compacted areas								■								
3.9	Scrape off any visual salt crust build up on trafficked areas and dispose								■								
3.10	Grade windrows back over tracks or cleared areas								■								
3.11	Seed all disturbed areas with local native grasses and shrubs									■							
Domain 4 - Pit and Pit Dewatering Infrastructure																	
4.1	Remove any remaining stockpiles and dispose in open pit	■															
4.2	Deep rip all compacted areas	■															
4.3	Scrape off any visual salt crust build up on trafficked areas and dispose	■															
4.4	Remove pumps, discharge lines and power supply lines	■															
4.5	Abandon / decommission all wells		■														
4.6	Empty water in PDD, cut liner and bury	■	■	■													
4.7	Infill the PDD and reshape/profile				■												
4.8	Fill in related stormwater drains and retention structures				■												
4.9	Allow pit walls to collapse to post mining angle of repose	■	■	■	■												
4.10	Complete the abandonment bund				■	■	■										
4.11	Grade windrows back over tracks or cleared areas						■										
4.12	Place topsoil on disturbed surfaces, except open pit and abandonment bund						■	■									
4.13	Shallow rip topsoil profile							■									
4.14	Seed all disturbed areas with local native grasses and shrubs								■								
4.15	Install warning signage									■							

Closure Activity Schedule		Month (Year 1)												Subsequent Years			
		1	2	3	4	5	6	7	8	9	10	11	12	2	3	4	5
Stage 2																	
All Domains																	
5.1	Remove buildings and disconnect and terminate all services																
5.2	Remove landfill surface infrastructure, including fences, gates, etc.																
5.3	Cap the landfill and compact the capping layer																
5.4	Deep rip all compacted areas (excluding the existing main access road)																
5.5	Scrape off any visual salt crust build up on trafficked areas and dispose																
5.6	Grade windrows back over tracks or cleared areas																
5.7	Reshape or profile individual areas																
5.8	Fill in related stormwater drains and retention structures																
5.9	Place topsoil over all disturbed areas and shallow rip																
5.10	Seed all disturbed areas with local native grasses and shrubs																
Ongoing maintenance and monitoring																	
Lease relinquishment																	

8 MANAGEMENT SYSTEMS AND CAPABILITY

8.1 General

This Section outlines the management systems and capabilities of the mine owner (Lease holder) BGC as they relate to the Portia Mine Site. As the mine operator and owner, BGC is responsible for ensuring that operations at the Portia Mine Site are conducted in accordance with the requirements of the *SA Mines and Works Inspection Act 1920* and the *SA Work Health and Safety Act 2012*. All workers at the Portia Mine Site, including BGC personnel and contractors, are required to work under the BGC management systems. A registered Mine Manager has been directly appointed by BGC for the Portia Mine.

BGC are responsible for ensuring their activities are undertaken in accordance with the requirements of this PEPR and other environmental authorisations held (e.g. EPA Licences).

A *Mine Safety Management Plan* (MSMP) and supporting documents specific to the Portia Mine Site were submitted to DEM for review and acceptance prior to commencement of operations. An *Environmental Management Plan* (EMP) specific to the Portia Mine Site was also submitted to DEM at this time. Both plans will be continuously updated to reflect the status of current operations.

The MSMP details the safety management system adopted by BGC including how the specific health and safety requirements under the SA legislation are achieved. The EMP details the environmental management approach adopted for the Site to achieve the environmental outcomes as defined in the PEPR.

Representatives from DEM, SafeWork SA, SA Health and SA EPA have visited the Portia Mine Site on numerous occasions during operations to date.

8.2 Commitment and Leadership

8.2.1 Benagerie Gold and Copper

BGCs common principles ensure its operations and activities are conducted in a manner that:

- protects the natural environment, public safety and amenity;
- complies with regulatory requirements and with relevant legislation; and
- achieves agreed environmental and social outcomes.

BGC is committed to ensuring a safe workplace and efficient operation of the Project and has provided appropriate resources, including training, to implement the MSMP and EMP requirements.

BGC has established corporate principles and a number of policies that have been adopted and define how the Project operations should be conducted. These HSE procedures are built on the environment and safety policies and the set of guiding principles described above.

A registered Mine Manager has been appointed for the Portia Mine. This person is supported by personnel responsible for HSE management under the direction of the BGC Project Directors.

BGC has established good working relationships with all of the key stakeholders for the Project and the local community and consultation has been ongoing with these groups throughout the Project from planning through to construction and operations.

8.3 Policies and Objectives

8.3.1 Benagerie Gold and Copper

All workers at the Portia Mine Site, including BGC personnel and contractors, are required to work under the BGC management systems. BGC policies and procedures relevant to the Project were contained in the MSMP and EMP provided to DEM in both electronic and hard copy format prior to the commencement of operations. BGC's *Environment Policy* and *Occupational Health and Safety Policy* are provided below for reference. These policies are reviewed and amended as appropriate from time to time by senior management team to maintain consistency with company goals and objectives.

BGC's HSE program provides a solid framework for all aspects of safety and environmental management at Portia.

This system works on a continuous improvement model and focuses on risk management and is closely monitored by the senior management team. BGC reports monthly on its HSE performance, compliance aspects and on any incidents that required investigation. BGC also undertakes safety meetings, workplace inspections and internal audits or reviews.

BGC has developed emergency response programs that include information system recovery, emergency response management and call centre requirements.

In line with industry requirements and best practices, BGC has developed an *Emergency Response Plan* which includes a General Contacts Directory for the Portia operations. This plan draws on existing emergency response capabilities at Broken Hill (e.g. Flying Doctor).

Environment Policy

BGC (the 'Company') is committed to ensuring that all its operations and activities are conducted in a manner that minimises impacts on the environment.

The Company recognises that its operations have an environmental impact and has adopted an approach of proactively managing activities and adopting techniques which minimise environmental harm. The Company also recognises the rights of others in the environment.

To achieve our commitment BGC:

- Minimises adverse environmental impacts through the use of integrated management procedures and planning.
- Monitors, reviews, audits and assesses its operations with a view to continual improvement of environmental performance.
- As a minimum, complies with all relevant legislation, regulations and Codes of Practice.
- Implements procedures for establishing and reviewing environmental objectives and targets
- Recognises the responsibilities of all employees, including contractors, to work in an appropriate manner, and provides training and resources to ensure tasks are properly performed.
- Prevents pollution.
- Has a minimum practical disturbance approach to mining and rehabilitates disturbed areas to a pre-determined land use.

- Communicates with stakeholders about the Company environmental performance and has relevant information publicly available.

Commitment to the environment is a team commitment involving co-operation and consultation between employees, contractors and stakeholders.

Occupational Health and Safety Policy

BGC (the 'Company') is committed to ensuring that all its operations are conducted in a manner that does not adversely impact on the health or safety of any person.

The Company Directors and management consider that there is no more important factor in the undertaking of anyone's job than prevention of injury or ill health to any person.

The Company is committed to ensuring a safe and healthy working environment for all personnel / contractors at all of its work locations and operations.

The complete elimination of injuries is our ultimate goal. We strongly believe that all accidents are preventable and that a 'Zero Accident' target is achievable.

To achieve these commitments, BGC will:

- Involve all personnel / contractors in health and safety programs and actively taking steps to control hazards.
- Ensure the establishment of occupational health and safety committees and recognise their effectiveness in preventing accidents.
- Continually improve performance to reduce work related injury and illness through measurable objectives and targets.
- Maintain rehabilitation programs for employees in the event of an injury or illness occurring, or in the event of personal or family loss.
- Comply with all relevant legislation, regulations and codes of practice and endeavour to exceed compliance.
- Ensure that all personnel / contractors are aware of this policy; are appropriately trained to undertake their duties; understand their responsibilities in the application of this policy.
- Integrate management of occupational health and safety as a central part of the Company Management System.

Commitment to safety is a team commitment involving managers, supervisors, sub-contractors, suppliers and employees working together through consultation and co-operation.

8.4 Organisation, Resources and Documentation

The following resources have been made available to ensure that BGC fulfils their responsibilities for the Project:

- **Mining Executive**, reporting to the Managing Director, overall responsibility for the successful operation of the mining, haulage and processing aspects of the Project, ensuring that the Project is appropriately resourced and that all requirements are met in relation to HSE legislation and reporting.

- **Registered Mine Manager**, reporting to the Mining Executive, directly responsible for ensuring all compliance conditions of the Mining Lease, PEPR and other permits / authorisations are met. Also responsible for the HSE and financial performance of the operations.

- **Mining Manager,** reporting to the Mine Manager, directly responsible for the oversight of all mining related activities.

- **Exploration Manager**, reporting to the Mine Manager, directly responsible for leading and operating the exploration activities on the ML in order to discover and further define existing mineral resources.

- **Production Manager**, reporting to the Mine Manager, responsible for ensuring the successful design, procurement, construction, operation and management of the gold processing plant and TSF.

- **Mining Superintendent**, reporting to the Mining Manager, directly responsible for the successful operation of the mining and haulage aspects of the operations, including appropriate resourcing and maintenance of plant and equipment.

- **Environmental Compliance Manager**, reporting to the Mine Manager, directly responsible for ensuring BGC meets compliance conditions of the PEPR and other permits / authorisations as well as all requirements pertaining to relevant environmental legislation.

- **CMC Operations,** reporting to the Mine Manager, directly responsible for providing corporate and logistical assistance to operations.

- **WHS / Training Officer**, reporting to CMC Operations, directly responsible for ensuring that all staff are appropriately trained for the tasks they perform on Site and appropriately inducted into the specific WHSE policies and procedures applying at the Site. They are also responsible for ensuring that BGC meets all requirements in relation to WHSE legislation.

- **Workshop Manager**, reporting to the Mine Manager, directly responsible for ensuring the efficient management of the Workshop, including appropriate resourcing of all maintenance tasks for plant and equipment.

- **Camp Manager**, reporting to the Mine Manager, directly responsible for ensuring the successful operation of the accommodation and amenities facilities.

A copy of the PEPR is to be kept on Site at all times for reference.

The existing organisational structure for the Portia Project is presented Figure 8-1, which details the roles mentioned above as well as further roles which will report to the management team. The organisational structure and resources will be reviewed regularly to ensure that it has the capacity for meeting regulatory and corporate requirements.

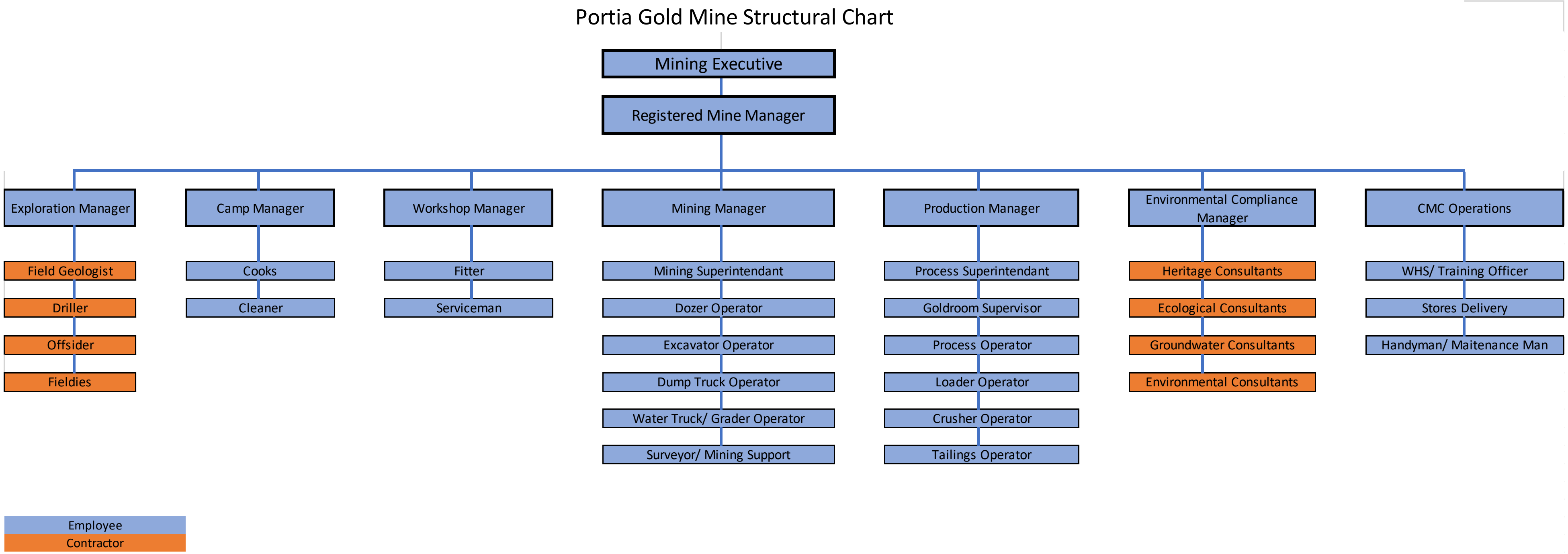


Figure 8-1: Portia Project Organisation Chart

8.4.1 Induction and Documentation

All employees, contractors and visitors to the Site will undergo a formal comprehensive general Site induction prior to entry to ensure that personnel have the appropriate knowledge and training related to health and safety, environmental and community relations documentation and objectives. The induction process is interactive, led by BGC Site Management and addresses the following information:

- Site occupational health and safety policies, plans, procedures and forms;
- Site environmental management and community relations policies, plans, procedures and forms;
- Site cultural heritage policies, plans, procedures and forms;
- Personnel responsibilities and legal obligations;
- Hazard and incident reporting and management;
- Vehicle safety and Site traffic rules;
- Emergency response plan and procedures;
- Site security;
- Drug and alcohol and fitness-for-work policies; and
- Other Site requirements.

Site inductions for visitors are less comprehensive than for full-time personnel, however visitors to Site will be escorted at all times by a fully-inducted and approved person. At completion of the general Site induction, personnel are required to successfully complete an induction workbook to determine that they have understood the requirements of the induction. Personnel visiting the Site less frequently (i.e. contractors, consultants and visitors) will be required to undertake a refresher induction if they have not visited the Site within six months of their last induction.

In addition to the general Site induction, all personnel working in the open pit are required to undertake a ground control management induction to ensure that they have the appropriate knowledge and understanding of health and safety risks relating to the open pit.

8.5 Risk Evaluation and Management

8.6 Planning

BGC's management system for the Portia Mine Site includes policies, standard operating procedures (SOPs), management plans and forms. BGC policies and SOPs are designed to ensure that risks are identified, assessed and managed effectively. In particular, the following has been implemented at the Portia Mine Site:

- Preliminary hazard analyses to identify risks.
- Documentation of risks in a register.
- Action or continuous improvement plans that identify:

  - controls to be implemented;
  - the person responsible for the control of the risk;
  - the due date for control measures to be completed; and
  - a schedule to review and assess effectiveness of the risk control measures.
- Training of employees in risk management techniques.

BGC operates under an Integrated Management System (IMS) that encompasses the following:

- *Quality Management System* in accordance with ISO 9001:2008;
- *Occupational Health and Safety System* in accordance with AS/NZS 4801; and
- *Environmental Management System* in accordance with AS/NZS ISO 14001:2004.

This management system also incorporates Human Resources and Industrial Relations policies and procedures. This system works on a continuous improvement model; it focuses on risk management and is closely monitored by senior management.

All staff and contractors working on the Project are encouraged and expected to participate in the identification and management of health, safety and environmental risks. This includes the reporting of near misses, safety hazards and incidents to Site Management. An Incident Register has been established for the Project to document reported incidents, investigate root causes and develop corrective actions with assigned responsibilities. Specific incidents related to the environment (e.g. chemical spills, fauna strikes, etc.) are reported to DEM in the Compliance Reports. Major environmental incidents will be reported to the SA EPA as soon as possible after the incident. Safety incidents are also reported to SafeWork SA and DEM as required by legislation.

This PEPR has been developed to address the environmental, closure and rehabilitation risks specifically associated with the Project. The PEPR will be reviewed regularly throughout operations to ensure that risks are adequately identified and managed in a manner that is consistent with current knowledge, regulatory requirements and currently accepted industry practices.

DEM expect major items of plant or equipment be reviewed at least once every five years. As activities at the Portia Mine Site have not reached or exceeded five years, no reviews have been conducted to date.

BGC employs a full-time maintenance team responsible for the maintenance of all plant, equipment, infrastructure and other facilities on Site. All pieces of plant / equipment are checked for serviceability prior to entering the Site and records of these checks are entered into the maintenance logs kept with each piece of plant / equipment.

8.6.1 Environmental Management Plans

A number of Site-specific environmental management plans have been developed as part of the PEPR to ensure that Portia staff and contractors undertake activities in a way that ensures compliance with Lease conditions and the environmental and closure outcomes agreed in the PEPR. These include:

- *Native Vegetation Management Plan* (refer Appendix F1);
- *Topsoil Management Plan* (refer Appendix F2);

- *Waste Management Plan* (refer Appendix F3);
- *Landfill Environmental Management Plan* (refer Appendix F4);
- *Groundwater Monitoring and Management Plan* (refer Appendix F6);
- *Potentially Acid Forming Materials Management Plan;*;
- *Mine Closure and Completion Plan* (refer Section 7).

For those areas of the environment where a greater level of detail was deemed necessary, separate plans and procedures have been developed and these are reviewed and amended from time to time by BGC to ensure compliance is maintained.

8.6.2 Emergency Management Plans

A Site-specific *Emergency Response Plan* has been developed to provide reference information and guidance to managers, supervisors, employees, contractors and visitors in the event of an emergency. The key areas covered in this plan are:

- Key internal and external contact details, including office, mobile, UHF radio and Occupational / Senior first aiders;
- Site personnel responsibilities;
- Actions on alert signal (where applicable);
- General Site emergency procedures, including but not limited to:
    - Fire
    - Bomb threat
    - Structural damage
    - Chemical emergency
    - Power outage / failure
    - Water / leakage / flood incident
    - Medical emergency
    - Rescue and recovery of personnel and machinery;
    - Fire prevention strategies; and
    - Site emergency map detailing muster point location.

Emergency management responsibilities for the Site are held by BGC. Workers and visitors to the Site are inducted into the requirements of these plans during general site inductions. These plans along with the inductions and training ensure that the appropriate systems are in place to take action to minimise the effect of an incident should it occur.

8.7 Implementation, Recording and Monitoring

Mining at the Portia Mine Site requires adherence to internal environmental management protocols, government guidelines and legislative requirements. To achieve compliance, BGC follow a set of environmental management procedures for the operation based on; operating experience at other open cut mines, current industry best practice, the requirements of South Australian legislation and the requirements stated in this PEPR. This includes reference to the Mining Act, the NRM Act, the EP Act and Lease Conditions (outcomes) provided for the Site.

Procedures adopted include monitoring protocols, data storage and management processes, quality assurance programs (to provide confidence in the integrity of collected data including internal audit review of the data obtained) and the development and implementation of environmental improvement measures arising from the review of monitoring data.

Reporting and disclosure to government agencies is in accordance with relevant Acts and guidance documentation (including the PEPR).

Compliance is monitored by the Mining Executive, Mine Manager and the Environmental Compliance Manager. A compliance register is maintained and this is reviewed and updated regularly throughout the reporting year. Non-compliances and proposed corrective actions are communicated to Site management and other staff and contractors as required. Compliance (or non-compliance) against the Lease Conditions and agreed environmental outcomes is currently reported annually to DEM in the Compliance Reports.

As mentioned previously, an Incident Register has been established for the Project to document all reported incidents, to investigate root causes and develop corrective actions with assigned responsibilities. Specific incidents related to the environment (e.g. chemical spills, fauna strikes, etc.) are also reported to DEM in the Compliance Reports.

Monitoring requirements for the Project are set out in this PEPR, with operational monitoring detailed in Section 6 and closure and rehabilitation monitoring detailed in Section 7.

8.8 Audit and Review

Regular compliance inspections (formal and informal) are undertaken throughout the reporting year in order to monitor, audit and assess compliance against Lease conditions and the agreed environmental outcomes in the PEPR. Records of inspections are kept electronically, and results discussed in the Compliance Reports.

Environmental policies, plans, procedures and forms are reviewed annually and updated as required. Following an environmental incident where policies, plans, procedures and forms are found to be deficient, they will be reviewed and updated to reflect the updated level of knowledge. Any updates to environmental documentation will be communicated to personnel and contractors during toolbox meetings and / or Site inductions.

BGC has developed monitoring programs that enable changes or trends to be identified. Data is reviewed monthly and internal reports are prepared with respect to HSE performance, compliance and on any incidents that require investigation.

The need for corrective action will be considered in light of inspections and audits or in the unlikely event that impacts reach an unacceptable level. Alternatively, the monitoring programs may indicate that certain risks are not significant, and resources may be channelled to other areas.

8.9 Previous Experience of the Operator

8.9.1 Benagerie Gold and Copper

BGC is a young company comprising of a team of experienced, multidisciplinary personal. BGC is 100% owned by Consolidated Broken Hill Holdings (CBHH). Consolidated Mining and Civil (CMC), under the umbrella of CBHH employ over 500 employees, sub-contractors and contractors and have been involved in the Portia operations since its inception as the Operator. Personnel employed by CMC have wide ranging practical experience in the successful management of mining operations gained throughout Australia and particularly within the wider Broken Hill region. BGC personnel are supported by the CMC Group senior management team, including the following personnel:

- Managing Director with over 40 years of relevant industry experience;
- General Manager with over 20 years of relevant industry experience;
- Commercial and Business Development Manager with over 10 years of relevant industry experience;
- Business Manager with over 4 years of relevant industry experience;
- Business and Project Manager with over 35 years of relevant industry experience;
- Accountant with over 25 years of relevant industry experience;
- Human Resources Manager with over 10 years of relevant industry experience; and
- Transport Manager with over 40 years of relevant industry experience.

CBHH finalised the sale purchase agreement of the Portia Gold Mine in May 2019 from Havilah Resources. BGC continues to maintain a close working relationship with Havilah Resources.

Mr Bran Wyatt is BGC's Mining Executive and has more than 36 years' experience in the Australian mining industry. Mr Wyatt has held various senior roles throughout his career spanning General Manager (GM) Operations, GM Processing, and Head of Occupational Health & Safety. Most recently, Mr Wyatt was Director and GM with Baralaba Coal Mine. He has held previous senior roles across metalliferous mining include GM of Regis Resources, Millennium Minerals and Lady Annie Copper Mine. Prior to this, Mr Wyatt was engaged for 20 years in operational management and mine start-ups positions. The earlier projects were focused on front-line management and hands on operations roles. Mr Wyatt's expertise is focused on most aspects of gold, copper and coal mining disciplines.

BGC has recently appointed Ian Carroll as BGC's Registered Mine Manager/Mining Engineer. Mr Carroll joins the BGC team with over 32 year's operational experience on mine sites with the time split between 20 years in Open Pit Mining and 12 years Underground Mining Experience. Mr Carroll is highly experienced in the mining and processing of gold, silver, (CIL and CIP), copper (SX-EW), manganese (Heavy Media) and nickel (Floatation). He has highly developed skills in mining management, drilling and blasting, mine planning and design, scheduling, budgeting, equipment selection, cost reduction.

8.10 Lease Conditions

The Mining Lease (ML 6346) conditions for the Project are contained in Appendix J. To demonstrate where Lease conditions have been addressed in the PEPR, BGC has provided cross-references for specific Sections in the PEPR against each condition, as detailed in Table 8-1.

Table 8-1: ML 6346 Conditions and PEPR Section References

Lease Condition		PEPR Reference
FIRST SCHEDULE		
1	Mining operations authorised by this Lease must only be for the recovery of gold.	Section 3
2	The Lessee must notify the Minister immediately: 2.1 if the Lessee is subject to any form of Insolvency Administration; 2.2 if a mortgagee enters into possession of any of the Lessee's assets or property in the State or appoints an agent to enter into possession on its behalf; 2.3 if there occurs any material adverse change in the financial condition or stability of the Lessee which could reasonably result in the Lessee being unable to perform its obligations under this Lease; 2.4 if the Lessee becomes deregistered by the Australian Securities and Investment Commission;	Acknowledged however not specifically addressed in the PEPR
3	The Lessee must not commence or undertake any mining operations of the land until a Mining and Rehabilitation Program (MARP[11]) has been approved by the Minister and a bond has been paid in accordance with Section 62 of the *Mining Act 1971*.	Sections 1 and 7
4	The Lessee must prepare a MARP that complies with the requirements of guidelines approved by the Director of Mines and include environmental outcomes and criteria that are developed in consultation with relevant stakeholders.	Section 6
5	The criteria included in the MARP must demonstrate clear and unambiguous achievement of the environmental and mine closure outcomes specified in Schedule 2 by: • Including the specific parameters to be measured and monitored by the Lessee • Specifying the locations that the parameters will be measured, or how these locations will be determined • Clearly stating the acceptable values for demonstrating achievement of the outcome, with consideration of any inherent errors of measurement • Specifying the frequency of monitoring by the Lessee • Identifying what background or control data are to be used or specify how it will be acquired (if necessary).	Sections 6 and 7
6	The Lessee must implement and comply with the approved MARP.	Acknowledged however not specifically addressed in the PEPR
7	The Lessee must review the MARP on request of the Director of Mines within a time specified in the request and submit the revised MARP for approval to the Director of Mines.	Acknowledged however not specifically addressed in the PEPR
8	The Lessee agrees to the approved MARP being made available for public inspection.	Acknowledged however not specifically addressed in the PEPR
9	The Lessee must provide information as requested by and to the satisfaction of the Director of Mines, on the Lessee's capability and competence to comply with the requirements of the *Mining Act 1971*, the conditions of this Lease, and the MARP in accordance with approved guidelines or as otherwise specified by the Director of Mines.	Section 8
10	The Lessee must provide to the Director of Mines a Mining and Rehabilitation Compliance Report (MARCR[12]) on operations carried out on the Lease and compliance with the approved MARP. The MARCR must be submitted every year, within 2 months after the anniversary of the date the Lease was granted, or at some other time agreed with the Director of Mines. The Lessee agrees to the MARCR being made available for public inspection.	Acknowledged

[11] Now known as the 'Program for Environment Protection and Rehabilitation' (PEPR)
[12] Now known as a 'Compliance Report'

Lease Condition		PEPR Reference
11	The Lessee must, if requested by the Director of Mines, undertake an independent audit of achievement of the environmental outcomes in the MARP, by an independent expert approved by the Director of Mines and submit the audit to the Director of Mines. The Lessee agrees to the audit being made available for public inspection.	Acknowledged however not specifically addressed in the PEPR
12	At least 3 months prior to Lease relinquishment or expiry, the Lessee must provide to the Minister a Mine Completion report prepared in consultation with the landowner and in accordance with guidelines approved by the Director of Mines, which demonstrates achievement of the closure criteria as specified in the current MARP.	Acknowledged however not specifically addressed in the PEPR
13	The Lessee must, prior to commencing operations under this Lease and for the duration of the Lease maintain public liability insurance to cover all operations under the Lease (including sudden and accidental pollution) in the name of the Lessee for a sum not less than $20 million or such greater sum as specified by the Director of Mines, and make such amendments to the terms and conditions of the insurance as the Director of Mines may require. A copy of the cover note of certificate of currency for the insurance must be provided to the Director of Mines upon request. If requested by the Director of Mines, the Lessee must engage an independent and reputable risk assessor to prepare a risk assessment report detailing the public liability risks arising out of the conduct of operations on the Lease, and recommending the level of amount of public liability cover (in respect of any one occurrence) that should be effected and maintained by the Lessee. In preparing the risk assessment report, the assessor must consult with the landowner and the Director of Mines. In specifying the level of insurance required, the Director of Mines accepts no liability for the completeness, adequacy of the sum insured, the limit of liability, the scoped coverage, the conditions or exclusions of the insurance in respect of how the Lessee may or may not respond to any loss, damage or liability.	Acknowledged however not specifically addressed in the PEPR
14	The Lessee must report any non-compliances with these conditions and approved MARP to the Director of Mines. A verbal notification must be provided within 24 hours, after the Lessee becomes aware of the non-compliance. A written report must be provided within 3 calendar days or such time period as approved by the Director of Mines.	Acknowledged however not specifically addressed in the PEPR
15	In requesting a review of the bond required under the *Mining Act 1971* the Minister may request that written quotes from an independent third party approved by the Minister are obtained by the Lessee for the cost of rehabilitating the site to the requirements specified in the approved MARP. The Lessee must meet all the charges and costs in obtaining and maintaining the Bond.	Acknowledged however not specifically addressed in the PEPR
SECOND SCHEDULE		
1	***Adjacent Land Use*** The Lessee must in constructing and operating the Lease, ensure that there are no adverse impacts to adjacent land use.	Section 6.2
2	***Aboriginal and European Heritage*** The Lessee must in constructing and operating the Lease, ensure that there is no disturbance to Aboriginal or European artefacts or sites of significance unless prior approval under the *Aboriginal Heritage Act 1988* is obtained.	Section 6.3
3	***Native Fauna*** The Lessee must in constructing and operating the Lease ensure that there are no net adverse impacts from the site operations (including fire) on native fauna abundance or diversity in the Lease area and in adjacent areas.	Section 6.4

<table>
<tr><th colspan="2">Lease Condition</th><th>PEPR Reference</th></tr>
<tr><td>4</td><td>Native Vegetation
The Lessee must in constructing and operating the Lease ensure no permanent loss of abundance or diversity to native vegetation on or off the Lease area through:
a) clearance,
b) dust/contaminant deposition,
c) fire,
d) other damage,
unless prior approval under the Native Vegetation Act 1991 is obtained.</td><td>Section 6.5</td></tr>
<tr><td>5</td><td>Weeds and Pests (Feral Animals)
The Lessee must in constructing and operating the Lease ensure no introduction of new species of weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the Lease area compared to adjoining land.

Weeds are defined in this condition as any invasive plant that threatens native vegetation in the local area or any species recognised as invasive in SA.</td><td>Section 6.6</td></tr>
<tr><td>6</td><td>Soil
The Lessee must in constructing and operating the Lease ensure that the soil affected by mining activities is suitable for return to pre-mining use.</td><td>Section 6.7</td></tr>
<tr><td>7</td><td>Groundwater and Hydrology
The Lessee must in constructing and operating the Lease ensure that there is no adverse impact to the quality and quantity of groundwater caused by mining operations to existing users.</td><td>Section 6.8</td></tr>
<tr><td>8</td><td>The Lessee must in constructing and operating the Lease ensure that there is no compromise to the environmental values[13] of the Yarramba palaeochannel groundwater.</td><td>Section 6.8</td></tr>
<tr><td>9</td><td>Waste Disposal and Hazardous Substances
The Lessee must in constructing and operating the Lease ensure that all domestic or industrial waste is disposed of in accordance with Environment Protection Act 1993 requirements.</td><td>Section 6.9</td></tr>
<tr><td>10</td><td>Mine Closure
The Lessee must demonstrate to the satisfaction of the Director of Mines that the following mine closure outcomes (in so far as they may be affected by mining operations) are expected to be achieved and sustained after mine closure:
• The external visual amenity of the Site is acceptable as determined by the Director of Mines in consultation with relevant interested parties.
• The risks to the health and safety of the public and fauna are as low as reasonably practical.
• Ecosystem function and landscape function is resilient and self-sustaining.
• The Site is physically stable.
• No compromise of the quality and quantity of groundwater to existing users.
• All mine waste materials left onsite are chemically and physically stable.
• Where practical, pre-mining land use is re-established.</td><td>Section 7</td></tr>
<tr><td>11</td><td>Landholder Liaison
The Lessee must ensure that the occupier of the land is fully advised of their program of activities, particularly in regard to the impact of operations on the land and rehabilitation progress.</td><td>Sections 5 and 6.2</td></tr>
</table>

[13] Environmental Values will be defined according to: The environmental values recognised in *'ANZECC & ARMCANZ 2000. Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper No. 4, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra.'*

Lease Condition		PEPR Reference
12	***Leading Indicators*** The MARP must include additional leading indicator criteria for the following outcome: a) Ensure that there is no compromise to the environmental values of the Yarramba palaeochannel groundwater.	Sections 6.8 and 7.10
13	The above environmental outcomes do not derogate from the operation of any other Acts that may be applicable to this operation including (but not limited to): • *Aboriginal Heritage Act 1988* • *Environment Protection Act 1993* • *Native Vegetation Act 1991* • *Natural resources Management Act 2004*	Acknowledged

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