Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Works Approval Amendment

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6051/2017/1
Works Approval Holder	Pilgangoora Operations Pty Ltd
ACN	616 560 395
File Number	DER2017/000317
Premises	Pilgangoora Lithium-Tantalum Project Mining Tenement M45/1256 and L45/147 MARBLE BAR WA 6760
Date of Report	18 October 2019
Status of Report	Final

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1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
AACR ACN	Annual Audit Compliance Report Australian Company Number
AER	Annual Environment Report
ANZECC Guidelines	Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australia and New Zealand Environment and Conservation Council and the Agriculture and Resource Management Council of Australia and New Zealand. Paper No. 4. Canberra. 2000. (ANZECC/ARMCANZ, 2000). accessed at http://www.agriculture.gov.au/water/quality/nwqms
Application	The inclusion of all applications, including revised applications and additional information provided in Works Approval Holder responses to requests for information between 15 November 2017 and 5 June 2018.
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
Decision Report	refers to this document.
Delegated Officer Department	an officer under section 20 of the EP Act. means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental Protection Act 1986* along with other legislation.
Effluent	means treated sewage
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)

EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
Existing Licence	The Licence issued under Part V, Division 3 of the EP Act and in force prior to the commencement of, and during this Review
Influent	means un-treated sewage
Works Approval Holder	Pilgangoora Operations Pty Ltd
m^3	cubic metres
Minister	the Minister responsible for the EP Act and associated regulations
MS	Ministerial Statement
mtpa	million tonnes per annum
MW	Mega watt
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Primary Activities	as defined in Schedule 2 of the Revised Licence
Revised Licence	the amended Licence issued under Part V, Division 3 of the EP Act following the finalisation of this Review.
Risk Event	As described in *Guidance Statement: Risk Assessment*
RO	Reverse Osmosis
tpa	tonnes per annum
TMF 1	Tailings Management Facility Cell 1
TMF 2	Tailings Management Facility Cell 2
UDR	*Environmental Protection (Unauthorised Discharges) Regulations 2004* (WA)
µg/L	micrograms per litre
WWTP	Wastewater treatment plant

2. Purpose and scope of assessment

Works Approval W6051/2017/1 was first issued on 28 September 2017, followed by a Department of Water and Environmental Regulation (DWER) initiated administrative amendment issued on 6 November 2017. The second amendment was significant (detailed below) and was issued on 27 June 2018. The Works Approval was transferred on 16 October 2018 and the commissioning periods extended by Amendment Notice on 25 February 2019.

Table 2 provides a log of the issued instruments since 28 September 2017.

The 27 June 2018 amendment authorised:

- The staged (1A and 1B) construction of TMF 1 and associated pipeline infrastructure and decant return to the process dam via submersible pumps located in the central decant tower structure.
- TMF 2 construction staging to mirror TMF 1, being Cell 2 Stage 1A to RL 185.3 m and Cell 2 Stage 1B to RL 189.3 m.
- Facility construction to allow for an increase to the throughput of the WWTP and expansion of the irrigation field
- Change to the Prescribed Premises category for the WWTP from Category 85 to 54
- Relocation of the putrescible and inert landfill facility to a new waste dump location within the West Dump
- Installation and mobilisation of a 1,000,000tpa mobile crushing and screening plant and associated storm water infrastructure
- Change to constructed location of the Category 52 Power Station and Category 73 Fuel Farm locations
- Inclusion of L45/147 tenure within the Prescribed Premises boundary.

Works Approval Holder Transfer

On 6 August 2018 PML implemented an internal restructure, pursuant to which all assets relating to the Pilgangoora Lithium – Tantalum Project were transferred to, or otherwise issued to the wholly-owned subsidiary, Pilgangoora Operations Pty Ltd (POPL). In September 2018 the works approval was transferred from PML to POPL (Works Approval Holder).

POPL was registered via Australian Securities & Investments Commission (ASIC) on 21 December 2016 and has been deemed to be a fit and competent operator. No records of the following have been found by DWER:

- Infringement notices or environmental field notices;
- Closure notices, stop work orders or environmental protection notices (although on 18 May 2018, DWER advised ‘that in order to comply with their WA they should cease work on Cell 1’;
- Investigation reports or prosecution outcomes;
- Non-compliance history with controlled waste obligations and payment of fees;
- Parliamentary questions or briefing notes that the Department has had to respond to in relation to the applicant;
- History of complaints received about the applicant or any other activities they have been involved with; and
- Past history of being unable to meet their financial obligations, for example unpaid licencing fees, current or past insolvency and bankruptcy proceedings.

PML has a non-compliant history with regards to meeting works approval or licence obligations, as they have previously been deemed non-compliant with this works approval, including:

- Construction and/or installation of TMF1, as opposed to TMF2, which resulted in DWER advising 'that in order to comply with their WA they should cease work on Cell 1' on 18 May 2018;
- Alteration of the location of the Category 52 power station and Category 73 fuel farm locations, including an extension of the Prescribed Premises boundary to include L45/417;
- Use of unauthorised landfill;
- Commissioning the WWTP over the specified timeframe; and
- Not providing groundwater monitoring data by the specified timeframe.

These matters have been investigated in line with DWER's Compliance and Enforcement Policy.

It should be noted, the Works Approval Holder has taken numerous improvement actions to ensure that a recurrence of non-compliance actions is prevented, including investing in information management systems and online software; such as a new compliance system, new human resources system and an obligations register.

Stage 1 and Stage 2 Amendment

This amendment includes amendments for minor modifications to Stage 1 and for the construction of Stage 2 infrastructure.

Stage 1 minor modifications include:

- Modifying the proposed design capacity of the process plant sediment pond;
- Removal of PWB004 and PWB005 groundwater monitoring bores, however groundwater monitoring has been removed from the Works Approval as this is now covered under the operating Licence L9056/2017/1;
- Reusing RO brine water for dust suppression;
- Modifying the monitoring frequency of TMF groundwater monitoring bores, however, groundwater monitoring has been removed from the Works Approval as it is covered under the operating Licence L9056/2017/1;
- Modifying the original raw water ponds (turkeys nests) to a Raw Water Tank; and
- Including a second cell to the Process Water Pond as there were issues with the process pond pumps bogging due to the pump inlets being close to the process plant outflow into the pond.

Stage 2 approval to construct (with commissioning and time limited operations):

- Second ore processing train alongside the existing approved train, which increases category 5 from 2 Mtpa to 5 Mpta;
- Additional generator sets and replacement of existing sets at the Power Station resulting in category 52 increase up to 36 MW;
- Additional fuel and chemical storage facilities increase category 73 up to 1,476 kL (fuel) and 60 kL (chemical storage); and
- Additional of a temporary 150 m^3/day Wastewater Treatment Plant (WWTP) alongside the existing WWTP with an increase category 54 up to 27 5m^3/day to cater for workforce during construction of Stage 2.

It also incorporates the following:

- Update of the construction, commissioning and time limited operations conditions as per

DWER's Guideline: Industry Regulation Guide to Licensing June 2019; and

- Removal of previous conditions 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19 and 20 as this information has been provided and/or commissioning periods for this infrastructure is now completed and is operated under the Licence L9056/2017/1.

Table 2: Instruments issued for the Premises since 28 September 2017

Instrument	Issued	Description
W6051/2017/1	28/09/2017	Original approval to construct: • Category 5: max. 2mtpa capacity Processing Plant including Tailings Management Facility (TMF) Cell 2, Stage 1 only to 13.3m RL and tailings pipeline infrastructure; • Category 52: 15.7 MW (plus 2.2 MW standby) capacity Power Station; • Category 64: 100 tpa capacity putrescible and inert landfill facility; • Category 70: Crushing and Screening Facility, limited to 50,000 tpa during construction; • Category 73: 1,036 m^3 in aggregate Bulk fuel and chemical storage; and • Category 85: 50 m^3/day throughput Wastewater Treatment Plant (WWTP).
W6051/2017/1	06/11/2017	Amendment 1 – DWER initiated amendment of Condition 6 to authorise the commissioning of the Process Plant and Power Station for a period no longer than 2 months
W6051/2017/1	27/06/2018	Amendment 2 – This amendment allows the following: Approval to construct: • TMF Cell 1 Stage 1 (TMF 1), stages 1A and 1B; • TMF Cell 2 Stage 1 (TMF 2), in stages 1A and 1B; • Modifications of the existing WWTP to allow for an increase in throughput (from 100 to 125m^3/day) and associated irrigation field expansion; • Category 64 landfill within the West Waste Dump; • Mobile crushing and screening plant (max capacity 1,000,000 tpa) for ore production Amendment to: • Change Prescribed Premises Category 5 to allow for the construction of a facility that allows for an increased processing throughput of (max) 1 Mtpa, taking the Premises total processing capacity to 3 Mtpa. • Change Prescribed Premises Category 85 to Category 54 to allow for the increased throughput and discharge from the WWTP • Add a new landfill location within the Premises. • Prescribed premises boundary to include L45/147 tenure. • Alter the location of the Category 52 power station and Category 73 fuel farm locations.
W6051/2017/1	16/10/2018	Transfer from Pilbara Minerals Limited to Pilgangoora Operations Pty Ltd On 6 August 2018, Pilbara Minerals Limited implemented an internal restructure with assets (mining tenements, contracts, plant, equipment, permits and licenses) relating to the Pilgangoora Lithium-Tantalum Project transferred to Pilgangoora Operations Pty Ltd
W6051/2017/1	25/02/2019	Amendment 3 - Extension of commissioning periods in Condition 8 and Condition 9 for the Processing Plant, Power Station, Landfill, Mobile Crushing and Screening Plants, Bulk Diesel Fuel Facility, TMF Cells and WWTP.
W6051/2017/1	18/10/2019	Amendments for minor modifications and Stage 1 and for the construction of Stage 2 infrastructure. Stage 1 minor modifications include: • Modifying the proposed design capacity of the process plant sediment pond; • Removal of PWB004 and PWB005 groundwater monitoring bores. Groundwater monitoring has been removed from the Works Approval as it is covered by the site's operating Licence L9056/2017/1;

		• Reusing RO brine water for dust suppression; • Modifying the frequency of TMF groundwater monitoring bores. Groundwater monitoring has been removed from the Works Approval as it is covered by the site's operating Licence L9056/2017/1 ; • Modifying the original raw water ponds (turkeys nests) to a Raw Water Tank; and • Including a second cell to the Process Water Pond as there were issues with the process pond pumps bogging due to the pump inlets being close to the process plant outflow into the pond. Stage 2 approval to construct: • Second ore processing train alongside the existing approved train, which increases category 5 from 2 Mtpa to 5 Mpta; • Additional generator sets and replacement of existing sets at the Power Station resulting in category 52 increase up to 36 MW; • Additional fuel and chemical storage facilities increase category 73 up to 1,476 kL (fuel) and 60 kL (chemical storage); and • Additional of a temporary 150 m^3/day Wastewater Treatment Plant alongside the existing WWTP with an increase category 54 up to 27 5m^3/day to cater for workforce during construction of Stage 2. It also incorporates the following: • Update of the construction, commissioning and time limited operations conditions as per DWER's *Guideline: Industry Regulation Guide to Licensing June 2019*; and • Removal of previous conditions 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19 and 20 as this information has been provided and/or commissioning periods for this infrastructure is now completed and is operated under the Licence L9056/2017/1.

2.1 Application details

Table 3 lists the documents submitted during the assessment process.

Table 3: Documents and information submitted during the assessment process

Document/information description	Date received
Application form and supporting documentation (dated 7 November 2017) for relocation of putrescible and inert landfill and construction of TMF 1 and TMF 3.	15 November 2017
Revised application supporting documentation omitting TMF 3	5 December 2017
Revised application information to include a (up to) 1,000,000tpa capacity mobile crushing and screening plant	19 December 2017
Additional application for an amendment to increase throughput of WWTP (to 125m^3/day capacity) and irrigation field expansion	5 February 2018
Works Approval Holder response to request for additional information (180205_response to CEO3009_17_1)	5 February 2018
Additional information regarding expansion of the waste water irrigation field	26 February 2018
Works Approval Holder response to request for additional information with WWTP size, confirmation of new landfill location within West Waste Dump, bore feeding the RO treatment system, amendment of 6 figures used in the original works approval to reflect current information and applications.	5 April 2018
Works Approval Holder letter notification to the CEO regarding the commencement of TMF 1 construction.	5 April 2018

Additional information regarding the constructed location of the Category 52 Power Station and Category 73 Fuel Farm locations within L45/147 tenure, approximately 100m from the location demonstrated in the original Works Approval.	18 April 2018
Works Approval Holder provision of water quality results for bores listed under Condition 5 of the Works Approval. Additional application for an amendment to amend the Category 52 Power Station and Category 73 Fuel Farm locations within L45/147 tenure and add L45/147 tenure to the Prescribed Premises boundary.	23 April 2018 30 April 2018
W6051/2017/1 – (Partial) TMF Engineering Report detailing some information regarding construction of TMF 1 and alterations to construction staging of the TMF.	11 May 2018
Additional information regarding the power station general arrangement, oily water separators, waste oil storage and sediment pond/basin locations	14 May 2018
Updated information regarding the Reverse Osmosis Plants throughput resulting on the manning increase (and associated water throughput) at the camp.	5 June 2018
Application for Transfer from Pilbara Minerals Limited to Pilgangoora Operations Pty Ltd	17 August 2018
Completion Report for Oily Water Separator Completion Report for Oily Water Separator at the Truck washdown bay	5 April 2018 19 November 2018
Completion Report for the Power Station: Re: Applicant Notification – W6051/2017/1 – Request for Further Information Completion Report for the WWTP: W6051/2017-1 Pilgangoora Lithium Project - WWTP Completion Report	18 April 2018 30 May 2018
Completion Report for the Process Plant: W6051/2017/1 - Process Plant Completion Report	8 June 2018
Completion for TMF1: Pilbara Minerals - Pilgangoora Operations - TMF 1 completion report PILBARA MINERALS LIMITED, Pilgangoora Lithium-Tantalum Project, Western Australia, Tailings Management Facility, Cell 1 Stage 1A, Construction Report	5 July 2018 July 2018
Completion Report for W6051/2017/1 Condition 16 and 17: W6051/2017/1 - Condition 16 and 17 report	27 July 2018
Completion Report for W6051/2017/1 Condition 18: Pilgangoora Operations - W6051/2017/1 - Condition 18 Report	27 August 2018
Completion Reports for the Process Water Pond: Completion Report - Pilgangoora Operations Process pond	5 February 2019
Application for Amendment “Pilbara Minerals, Works Approval Amendment Supporting Document, Pilgangoora Lithium-Tantalum Project Stage 2 dated September 2018	19 October 2018
Email: RE: W6051/2017/1 - Amendment to Works Approval	1 November 2019

Email: RE: APPLICANT NOTIFICATION - W6051/2017/1 - APPLICATION FOR AN AMENDMENT TO WORKS APPROVAL - REQUEST FOR FURTHER INFORMATION	13 December 2018
Pilgangoora Lithium-Tantalum Project, W6051/2017/1, REPORT, Works Approval Condition 2	14 February 2019
W6051/2017/1 – Condition 19 and 20 Monitoring Data	14 February 2019

3. Background

The prescribed activities of the project are all located on Mining Tenement M45/1256 and L45/417 (Power station and fuel farm), approximately 90 km south-southeast of the town of Port Hedland and 30 km northeast of the Wodgina Mine. The site is located on Wallareenya Station pastoral lease, an active cattle grazing station. Figure 1 displays the Project Overview, tenure and the location of the Project from the Great Northern Highway and Figure 2 the Project Site Plan.

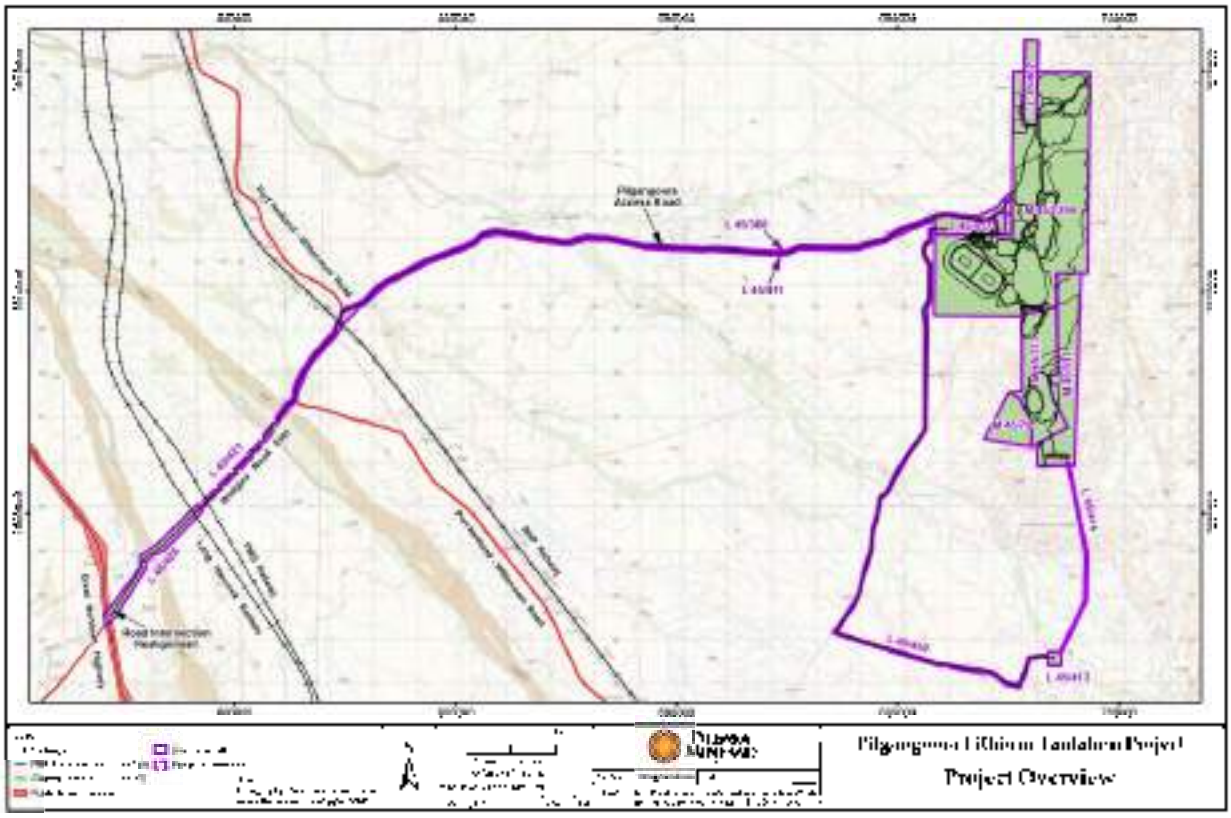

Figure 1: Project Overview

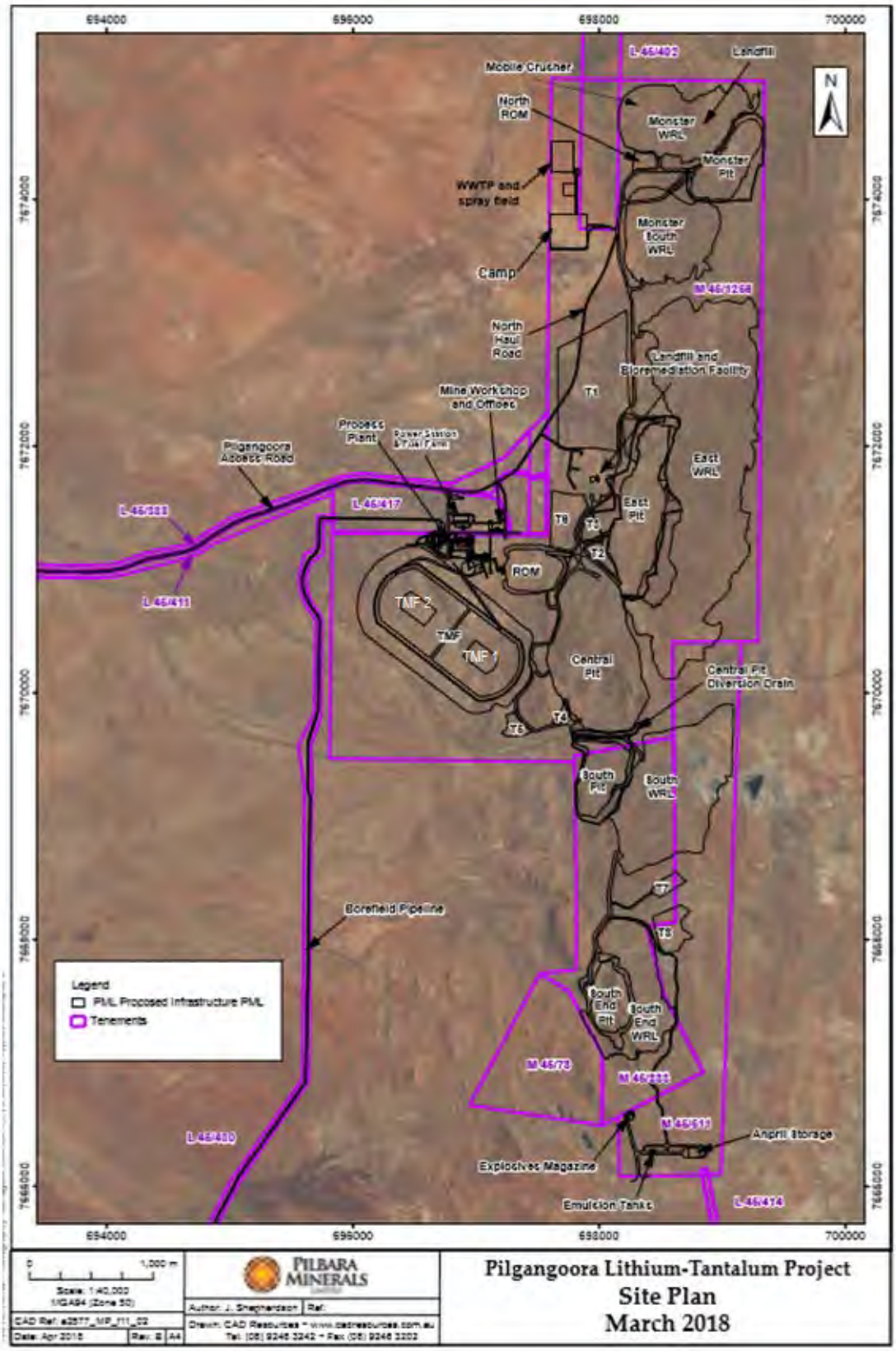

Figure 2: Project Site Plan

Works Approval W6051/2017/1 issued on 28 September 2017 approved the construction of infrastructure for the following prescribed activities in Table 4:

Table 4: Prescribed Premises Categories

Category	Description	Approved Premises production or design capacity or throughput
5	Processing or beneficiation of metallic or non-metallic ore	2,000,000 tonnes per annum
52	Electric power generation	15.7 MW plus 2.2 MW standby
64	Putrescible landfill	100 tonnes per annum
70	Screening etc. of material	50 000 tonnes per annum during construction
73	Bulk storage of chemicals	1036 m^3 in aggregate
85	Sewage facility	50 m^3/day

No change to these categories or capacities occurred in the November 2017 amendment of the works approval.

The works approval amendment (Amendment 2) granted on 27 June 2018 related to primary activities and emissions from these activities within the Premises for the Categories defined in Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations). Table 5 lists the prescribed premises categories that were authorised under that amendment decision.

Table 5: Proposed (design or throughput capacity) changes

Category	Current design or throughput capacity	Proposed design or throughput capacity	Description of proposed amendment
5	Approved throughput of 2,000,000 tonnes per annum	3,000,000 tonnes per annum (comprising: 2,000,000 tonnes per annum for fixed processing plant and 1,000,000 tonnes per annum for mobile crushing and screening plant)	The Works Approval Holder proposes to operate a mobile crushing and screening plant which has a design capacity of 300 tonnes per hour with a throughput of up to 1 mtpa within mining tenement M45/1256. Application seeks approval to construct TMF 1 adjacent to the already approved TMF 2 within mining tenement M45/1256. Modification of TMF 1 and TMF 2 construction stages due to mine waste availability for construction.
54	-	Design and throughput capacity of 125 m^3/day	Category 85 changed to category 54 due to increased design and production capacity of 125 m^3/day.
64	100 tpa	100 tpa (no change)	Change of location of landfill from Monster Waste Dump to West Waste Dump. This includes a bioremediation facility. The original location within Monster Waste Dump is to be retained for future use.
85	Design capacity of 100 m^3/day. Approved throughput of 50 m^3/day	*(Category removed and replaced by Category 54, see above)*	Category 85 changed to category 54 due to increased design and production capacity of 125 m^3/day.
52	15.7 MW (plus 2.2 MW standby)	15.7 MW (plus 2.2 MW standby) (No change)	Change to location due to incorrect construction location outside the Premises boundary.

73	1,036 m^3 in aggregate	1,036 m^3 in aggregate (No change)	Change to location due to incorrect construction location outside the Premises boundary.

3.1 Exclusions to the premises

The Works Approval Holder will also be constructing the following infrastructure which is not within the scope of this assessment:

- Bioremediation facility - as the facility will not receive liquid waste from other Premises, it does not trigger category 61 under the EP Regulations. The Works Approval Holder should note that the discharge of hydrocarbons to the environment is an unauthorised discharge under the *Environmental Protection (Unauthorised Discharges) Regulations 2004* and the facility should be constructed and operated to comply with the Assessment and management of contaminated sites and the National Environment Protection (*Assessment of Site Contamination*) Measure 1999 (ASC NEPM);
- Concrete batching plant - the plant will produce approximately 8,000-10,000m^3 for construction purposes over the anticipated 35 week construction period. All concrete manufactured within the prescribed premises boundary will be utilised within that boundary and not used off-site. This batching plant will be removed on completion of construction activities. This activity is not regulated by DWER as it does not trigger category 77 under the EP Regulations, as the material is not being taken offsite;
- TMF exclusions - The supporting documentation (PML, 2017a) contains information on the entire TMF however the Works Approval Holder has only requested approval to construct and implement works associated with TMF1 and TMF 2, Stages 1A and 1B only. The Works Approval Holder has indicated that in future TMF construction stages (Stage 2 TMF [Cell 3]), the diversion of Pilgangoora Creek, via construction of a diversion berm will be required. It is understood that the construction of this diversion berm will not be required until some 20 years into mine operation life. As such, given that further site geotechnical assessment and engineering design is required for TMF 3 and the Pilgangoora Creek diversion, the construction of TMF 3 and associated Pilgangoora Creek diversion is not authorised or included within the scope of this assessment;
- Treatment of raw water within reverse osmosis (RO) plants – two RO plants will be installed and operated on site; one at the camp and one at the processing plant.

  Camp RO Plant

  The Camp RO Plant is to be supplied using raw water from production bore PWB005.

  The camp RO plant will have an estimated throughput/ production capacity of 16.5 63.8 ML/annum (0.0638 GL/annum) (based on 640 man effective manning rate including camp use and ablutions, kitchen and washing facilities [note 640 manning rate, with 500 rooms includes roster and room rotations]). The volume of waste water is 50% of raw water input. As such, volume of waste water is equal to produced water (0.0319 GL/annum).

  The waste brine from the camp RO plant will be sent to the irrigation tank at the WWTP and mixed with treated effluent prior to discharge to the sprayfield. The maximum TDS (mg/L) of the (final) effluent stream that is sent to the spray irrigation field for disposal will be 4,000 mg/L and reused in dust suppression.

  Processing Plant RO Plant

  The Processing Plant RO Plant is to be supplied using raw water from production bore PWB005.

  The processing plant RO plant will have an estimated throughput of 18.2 ML/annum (0.0182 GL/annum) and the waste brine (estimated 0.0091 GL/annum) will be recirculated back into the process plant for use within the plant process.

The combined total throughput of both the RO plants is 0.082GL/annum, less than the category 85B prescribed premise throughput of 0.50GL or more per year.

The throughput (volume) from the RO plants will not be included in this assessment. However, due to the site water (quality) information provided by the Works Approval Holder and the potential for site contamination by the RO brine, the emissions have been assessed within this Report.

- Wastewater treatment at the mine office, workshop and plant complexes – these areas will be serviced by septic tanks and leach drains for the treatment of wastewater. It is anticipated that the treatment capacities of these wastewater facilities will not exceed requirements for category 85. The Works Approval Holder has advised that approvals will be obtained prior to construction for these septic systems from the Department of Health and the Shire of East Pilbara;
- Pit dewatering infrastructure and in-pit sumps – dewatering discharge from the in-pit sumps will be directed to a Raw Water Tank and used for dust suppression across the site. As all abstracted water will be used on site, and not discharged to the environment for the purpose of accessing ore for mining purposes, category 6 is deemed not to be triggered. Predicted abstraction rates for pit dewatering are as follows (Table 6):

Table 6: Predicted pit dewatering rates in tonnes

Type	Location	Method	Average Simulated Abstraction Rate (tonnes/year)						
			Year 1-4	Year 5-8	Year 9-12	Year 13-16	Year 16-20	Year 21-24	Year 25-28
Dewatering	Monster	Sump	63,072	31,536	63,072	63,072	63,072	63,072	63,072
	Eastern	Sump	63,072	63,072	157,680	220,752	189,216	220,752	283,824
	Central	Bores	189,216	189,216	126,144	63,072	-	-	-
		Sump	63,072	94,608	189,216	220,752	220,752	220,752	346,896
	Southern	Sump	-	31,536	63,072	63,072	94,608	94,608	157,680
	South	Sump	<31,536	31,536	63,072	63,072	63,072	63,072	126,144
		Total	**409,968**	**441,504**	**662,256**	**693,792**	**630,720**	**630,720**	**977,616**

Note: predicted dewatering rates for years 28-35 years (to end of expected mine life) not provided by the Works Approval Holder at the time of assessment.

- Haul roads and access roads;
- 500 person accommodation village (640 manning rate on roster rotation) (not including the WWTP);
- Borrow pits and stockpiles;
- Workshops and offices;
- Plant stores;
- Laboratory;
- Laydown area; and
- Borefield.

4. Overview of Premises

4.1 Operational aspects – this amendment

4.1.1 Processing Plant

Stage 1

The final preparation (dressing) of the tantalite concentrate is currently conducted offsite by a contractor. An onsite tantalite dressing facility will be incorporated to allow the final product to be prepared and packaged in drums onsite for direct sale, with 31 tonnes per day of finished tantalite product expected to be produced.

The facility will be incorporated to the tail end of the gravity separation circuit of the Stage 1 processing train, which currently produces the tantalite concentrate. It is located within a concrete floored, enclosed shed, with dust extraction system.

It is a dry process and uses a screening and magnetic separation process. The circuit uses air tables to separate the product based on size. Magnets are then used to remove magnetic impurities. Wastes are sent to the TMF (all wastes from this circuit do not contain any radioactive materials). The product is then transported in sealed 60 gallon drums in seacontainters on trucks to the Port Hedland Port.

The final product is classified as Dangerous Goods Class 7 – Category 1 Radioactive Material. The Radiation Management Plan will be updated accordingly and re-submitted to the safety branch of DMIRS for approval.

Stage 2

A second processing plant train is proposed alongside the original Stage 1 processing train to increase the capacity of the project from 2 Mtpa to 5 Mtpa. Stage 1 and Stage 2 infrastructure will share the primary and secondary crushers, but from there the process stream will split and be processed separately between the two trains.

The Stage 2 processing train will include:

- A larger High-Pressure Grinding Roller (HPGR) unit with a double deck screen;
- An increased capacity of the Heavy Metals Separator (HMS) components;
- A larger ball mill;
- A larger thickener tank; and
- An increased spodumene handling circuit capacity.

The increased throughput of the combined Stage 1 and Stage 2 process plant trains will increase the rate of tailings discharged to the TMF from 1.68 Mtpa to 4.25 Mtpa.

4.1.2 Stage 2 Power Station

This will include the addition of seven 2,500 kVA generators (total 17,500 kVA), increasing the total power production of the project to 32.5 MW. Three of the generators are to be located within the existing Stage 1 power station building and the other four generators will be housed in this building, but in a new extended area of the building.

The trailer-mounted self-contained gas supply will be increased from 350 m^3 to 560 m^3 to ensure that all generators have an 18-hour supply of gas.

4.1.3 Stage 2 Fuel and Chemical Storage

To cater for the increase fuel demands of Stage 2, an additional 440kL of diesel storage is required and will consist of:

- 1 x 110kL self-bunded diesel tank for mining fleet, stored at the mining contractors yard; and

- 3 x 110kL self-bunded diesel tanks added to the existing fuel farm.

4.1.4 Stage 2 WWTP

A temporary construction WWTP is required for the workforce during Stage 2 works. This is to be located adjacent to the existing Stage 1 permanent WWTP and consists of:

- 1 x Sequence Batch Reactor (SBR) with less than 150 m^3/day treatment capacity;
- 1 x 200 kL Balance tank fitted with high level alarm wired to visual strobe light and sounder to alert of overflows;
- 1 x 200 kL Treated effluent / Irrigation tank fitted with high level alarm;
- 1 x 50kL sludge thickening tank;
- WWTP containerized with external tanks;
- Flow meters to be installed at influent inlet point and effluent egress point;
- The WWTP will be constructed to meet the following water quality emission standards:
  - Biochemical Oxygen Demand <20mg/L;
  - Total Suspended Solids <30mg/L;
  - Total Nitrogen <30mg/L;
  - Total Phosphorus <7.5mg/L;
  - Chlorine Residual >0.2-2mg/L;
  - pH 6.5-8.5;
  - E.coli <1000cfu/100mL;
- Stock exclusion fence surrounding entire WWTP facility;
- Stock exclusion fence comprising star picket, 3 strand wire and corner strainer posts surrounding entire irrigation area;
- Internal berm installed inside the fence line from excess soil to prevent surface water runoff from the irrigation area;
- Operational pipework constructed using HDPE with minimum pressure rating (PN) of 12.5;
- Total minimum spray area of 2.63 hectares (note that the Stage 2 WWTP will discharge treated effluent to the 2.63 ha and the existing 3.04 ha irrigation areas to meeting the WQPN 22 loading rates;
- Minimum of 26 irrigation sprinklers; and
- Irrigation area boundary coordinates shown in Table 7:

Table 7: Irrigation are boundary coordinates

Easting	Northing
697800,	7674337
698031,	7674337
698031	7674218
697842	7674218
697842	7674250
697800	7674250

4.2 Operational aspects – Amendment 2 - 27 June 2018

4.2.1 Mobile crushing and screening plant

A ROM, crushing and stockpiling area will be constructed adjacent to the Monster Pit in previously disturbed areas. A Striker mobile crushing and screening plant is to be mobilized to site. Figure 2 depicts the initial mobile plant location within mining tenement M45/1256 (in Monster WRL).

The mobile plant has a design capacity of 300 tonnes per hour with a nominated throughput of up to 1,000,000 tonnes per annum. The mobile plant consists of crushing, screening and stacker units. Rock containing ore and waste from the mining areas will be crushed and screened through this facility. This additional throughput will increase the approved Premises capacity from 2 Mtpa to 3 Mtpa of ore processing capacity.

The stacker will have a reach of 24 m and will create stockpiles up to 9 m in height. The crusher will produce a final product between 55-65 mm.

The mobile crusher will be equipped with a dust suppression system, and additional dust suppression will be undertaken on associated stockpiles using water carts as required. No specific details of the dust suppression system on the mobile crushing and screening plant have been provided. The plant is to be located in cleared areas and no residential receptors or priority/threatened flora are located in close proximity to the crushing and screening plant.

Storm water management for the mobile crushing and screening plant is to follow the management measures as committed to in the (GRM, 2016) Surface Water Management Plan. These comprise but are not limited to surface grading, diversion drains, bunds, launders, sumps and pumps.

A Category 70 screening facility sizing rock and material (including borrow) on site for construction purposes has been previously approved (under the original works approval). There are no changes to this Category 70 facility as part of this amendment.

4.2.2 TMF 1 – Cell 1 Stage 1

The Works Approval Holder seeks approval to construct TMF Cell 1 via staged methodology (ATC Williams, 2018), being Stage 1A (185.3m RL) and Stage 1B (189.3m RL), hereafter named TMF 1 to the final height of 189.3m RL (Figure 3 and Figure 4). The location of TMF 1 is on the northeastern side of Pilgangoora Creek and west of the Central (mine) Pit.

Table 8 summarises the following information.

Embankment

The TMF 1 Stage 1A embankment is to be a maximum of 9.3 m high/ RL 185.3m, with an upstream low permeability face (Zone 1) and sand filter zone (Zone 2) placed against waste rock bulk fill (Zones 4A and 4B). Zone 1 is to be 4 m in width to facilitate safe construction access for machinery. The final TMF 1 embankment (Stage 1B) is to be a maximum of 13.3m high/ RL 189.3 m.

TMF 1 (Stage 1) will an initial capacity of 1.9 million tonnes with a storage area of 19.9 ha (ATC Williams, 2016, 115275.01R02 Rev 0).

The TMF 1 starter embankments will be constructed primarily from pre-strip mine waste rock materials with a low permeability upstream zone being formed from clayey sand materials excavated from the vicinity of the TMF footprint. A sandy filter zone will separate the low-permeability zone from the waste rock zone. The initial low permeability zone will be constructed from clayey material present within the TMF footprint. Subsequent (future) raises of this zone will utilise proximal beach tailings. Tailings deposition will switch between cells at each extension of the upstream liner; facilitating drying and strength gain on the fallow cell before the

next construction stage (Note: these future raises outside TMF 1 Stage 1B will require Part V EP Act approval).

In-situ density testing for Zone 1 and 2 TMF 1 materials will constitute the following:

- Determination of field density in accordance with AS 1289 Method 5.8.1 (AS 1289.5.8.1 – 2007).
- Compaction control testing using the Hilf (Rapid) Method in accordance with AS 1289 Method 5.7.1 (AS 1289.5.7.1 - 2006).
- The ratio of field density to compaction control testing shall be 1:1.

Foundation preparation of TMF 1 will include excavation of a cut off trench to a depth of 1.5 m and width of 3.0 m through the superficial materials. This will be backfilled with compacted clayey sand material to minimise potential for lateral seepage beneath the embankments. Cut off trench installation will require to be completed immediately following foundation preparation and prior to commencement of waste rock placement.

The base materials reviewed for the entire TMF 1 and TMF 2 (combined footprint) have a range of hydraulic conductivities from 7.45 x 10^{-6} m/s (foundation – extremely weathered calcrete) to 3.32 x 10^{-7} m/s (depending foundation – extremely weathered mica schist) on the base materials (ACTW, 2016). Vertical seepage from TMF 1 is anticipated to be 1000 m^3/day (ACTW, 2016) as is the vertical seepage for TMF 2.

Impoundment area

Clayey gravel, sandy gravel and clayey sand materials, typically less than 1 m thick were identified throughout the TMF impoundment area and are considered suitable for low permeability construction material. Clayey fines content typically ranged from 15% to 35% and laboratory permeability was less than 1 x 10-^{8} m/s. Geochemically, the tailings and associated decant water are considered benign based on laboratory analyses conducted by Graeme Campbell and Associates and supplemented by testing of the sample of tailings received by ATCW. Decant water is expected by the Works Approval Holder to be of similar quality to groundwater.

The Works Approval Holder has advised that design and construction methods include measures to minimise the potential for direct hydraulic connection occurring between the decant ponds and groundwater. This is to reduce the likelihood of a phreatic surface intersecting the perimeter embankments, but also limit vertical seepage. However, these design and construction methods were not specifically itemized within the application documentation with the exception of the following:

Compaction: In situ permeability tests conducted in the TMF area during the geotechnical investigation indicated relatively low permeability in the weathered rock mass (< 7 x 10^{-6} m/s). Laboratory permeability tests have indicated that the superficial clayey soils are of very low permeability when compacted to 95% maximum modified dry density (MMDD). To reduce vertical seepage beneath the operational decant ponds, at least 300 mm of the clayey in-situ soils will be left in the floor of the TMF and proof compacted to form an in-situ low permeability barrier to vertical seepage. The results indicate calculated permeability between 1 x 10^{-6} m/s and 47 x 10^{-6} m/s for the superficial soils, calcrete and fractured upper surface of the rock mass, and between 0.6 x 10^{-6} m/s and 10 x 10^{-6} m/s for the general rock mass.

Foundation preparation: will include excavation of a cut off trench to a depth of 1.5 m and width of 3.0 m through the superficial materials. This will be backfilled with compacted clayey sand material to minimise potential for lateral seepage beneath the embankments.

Underdrainage

Underdrainage is to be constructed at the low point of the Cell 1 Stage 1A perimeter (northern corner) to minimize water accumulation. Underdrainage pipe will be pre-slotted and is likely to comprise of:

- "HDPE PE100 PN16 DN200 mm,
- PVC-U PN16 DN200, or
- SRP Rocla Plastream DN225" (115275.04 SP01 Rev0)

This pipe will be placed in the existing natural drainage line and should extend 60 m towards the upstream side of the embankment and will be covered by 0.5 m of gravel material which will be extended until the gravel packing meets the natural ground surface. (115275.04 SP01 Rev0, Detail 4, drawing 115275.04-007).

Tailings deposition

An overall tailings density of 1.4 t/m^3 has been adopted for design purposes.

Tailings are designed to be discharged from the perimeter embankment as thickened slurry consisting of 65% to 68% solids. The discharge methodology differs between TMF 1 and TMF 2. TMF 1 tailings deposition will be via multiple spigot discharge (ring main) on a cyclic (rotating) basis (ATC Williams, 2018). TMF 2 tailings deposition will be through a single rotating spigot creating a concave tailings surface within which a decant pond will develop at the centre of the cell (ATC Williams, 2016, 115275.01R02 Rev 0).

Decant

There will be a central decant system decant access causeway with a decant tower comprising of 2.8 metre wide concrete base footing and 8 slot 1800 diameter x 89 wall x 1220 high rings. Decant will be recovered via submersible pumps located within the decant tower.

The decant access causeways will be raised by the application of waste rock on both sides of the causeway.

TMF Pipelines

Pipelines to TMF 1 will be fitted with pressure transmitters at both ends of the pipeline with alarms to indicate variation in flow pressure. The tailings delivery line from the process plant to the TSF and the return water line to be situated above ground within bunds with spill catch pits that have 12 hours of containment.

Stormwater retention

TMF 1 has been designed with several water storage contingencies that include storm water capacity to contain a 1 % AEP 72 hour duration storm event, a total freeboard of 500 mm and operational freeboard of 300 mm.

Surface water interfaces with TMF 1

The southern face of Cell 1 and 2 will be rock armoured to provide protection against flooding of Pilgangoora Creek. Surface water drainage will be installed to divert runoff from the north-eastern side of the entire TMF (TMF 1 and TMF 2 combined) around the eastern side to Pilgangoora Creek.

To minimise surface water run-off into TMF 1 and external ponding at topographic lows created by embankment construction, excavation of two sections of diversion drain and one low point drainage trench is required. The trench excavations are between 130 m and 230 m in length and will be located at the south eastern edge of the TMF area.

Table 8: TMF design criteria and specifications

	TMF 1 Stage 1A	TMF 1 Stage 1B	TMF 2 Stage 1A	TMF 2 Stage 1B
Type	Integrated waste landform			
Footprint	19.9 ha		20.5 ha	
Height	9.3m (RL 185.3 m)	13.3 m (RL 189.3m)	9.3m (RL 185.3 m)	13.3 m (RL 189.3m)
Storage capacity	1.9 Mt		2.7 Mt	
	Storage for 35.1 Mt of tailings and 29.4 Mm^3 of waste rock (over a period of 21 years at 2 Mtpa ore throughput). Rate of 1.68 Mtpa, operated for about 21 years.			
Stormwater storage	1:100 AEP, 72 hr run-off superimposed on normal operating pond plus 0.5 m total freeboard.		1:100 AEP, 72 hr run-off superimposed on normal operating pond plus 0.5 m total freeboard.	
Tailings Density	Thickened slurry consisting of 65% to 68% solids concentration Settling to a stored density of 1.4 t/m^3		52% to 68% solids concentration Settling to a stored density of 1.2 - 1.4t/m^3	
Pipelines	Audible alarms fitted to record pressure changes fitted to all pipelines and monitored in the control room.			
Tailings Deposition Method	Multiple rotating spiggots (ring main) on a cyclic (rotating) basis		Perimeter discharge via single rotating spigot to create a concave tailings surface within which a decant pond will develop at the centre of the cell	
	Deposition of tailings will alternate between Cell 1 and Cell 2 up to year 21 of plant operation			
Permeability	Not less than 0.3m clay material Impoundment area proof compacted to between 1 x 10^{-6} m/s and 47 x 10^{-6} m/s Facility will be unlined	Impoundment area permeability dependent on the tailings settling density from within TMF 1 Stage 1A	Permeability ranges across the embankments zones from 1 x 10^{-8} to 3.32 x 10^{-7} m/s Maximum hydraulic conductivity at the base (impoundment area) of the TMF has been measured at 7.45 x 10^{-6} m/s in extremely weathered granite Facility will be unlined	Impoundment area permeability dependent on the tailings settling density from within TMF 2 Stage 1A
Embankment Zone construction	Width of Zone 1 to 4 m to facilitate safe construction access for machinery.			
Water Management	Central decant system decant	Addition of concrete rings to an	Central decant system decant	Addition of concrete rings to an

	TMF 1 Stage 1A	TMF 1 Stage 1B	TMF 2 Stage 1A	TMF 2 Stage 1B
System	access causeway, decant comprising of 2.8m wide concrete base footing and 8 slot 1800 dia x 89 wall x 1220 high rings	adequate height for decant management post decant causeway raise	access causeway, decant comprising of 2.8m wide concrete base footing and 8 slot 1800 dia x 89 wall x 1220 high rings	adequate height for decant management post decant causeway raise
	Decant removed via submersible pumps within decant tower			
	Cut off trench will be constructed through the surficial deposits on the upstream side of the starter embankments and extended around the full TMF perimeter Underdrainage is to be provided at the low point of the Cell 1 Stage 1A perimeter (northern corner) to minimize water accumulation. Underdrainage pipe will be pre-slotted and is likely to comprise of: • "HDPE PE100 PN16 DN200 mm, • PVC-U PN16 DN200, or • SRP Rocla Plastream DN225" (115275.04 SP01 Rev0) This pipe will be placed in the existing drainage line and should extend 60 m towards the upstream side of the embankment and will be covered by 0.5 m of gravel material which will be		Cut off trench will be constructed through the surficial deposits on the upstream side of the starter embankments and extended around the full TMF perimeter.	

	TMF 1 Stage 1A	TMF 1 Stage 1B	TMF 2 Stage 1A	TMF 2 Stage 1B
	extended 1 m to the sides of the pipe (115275.04 SP01 Rev0).			
Monitoring bores	Six groundwater monitoring bores installed around the perimeter of the TMF (TMF TMFMB01- TMFMB06). If there is a rise in groundwater level in any monitoring bore to 5 mbgl, the Works Approval Holder commits to installing recovery bores (or trenches) to collect seepage and return the seepage water to the TMF decant pond. A network of 10 monitoring bores installed at the Premises to provide background data, and, allow the assessment of groundwater during operations.			
Monitoring of porewater in embankment	Four Vibrating Wire Piezometers (VWP) will be installed in the embankment foundation	Four Standpipe Piezometers to be installed (Total of 8 Piezometers installed)	Four VWP will be installed in the embankment foundation	Six Standpipe Piezometers to be installed (Total of 10 Piezometers installed)
Earthquake Loading	Operating: Operating Basis Earthquake[1] Final Landform: Maximum Design Earthquake[1] Post Closure: Maximum Credible Earthquake [1]			
Tailings monitoring parameters (Works Approval Holder controls)	Feed rate Slurry densities pH TDS and Electrical Conductivity (analyses at a laboratory) Radiation levels (Th and U)			

1 ATC Williams, 2016

Tailings Characterization

Original Leachate testing was undertaken on the waste materials using “static testing” and “kinetic testing” using humidity cells. The conclusion of this report is that the waste materials are “inert with near-zero risk for water quality impacts when left in a free-draining state.” Furthermore, the report states that “in terms of drinking-water quality, the leachates are essentially potable” (Campbell and Associates Pty Ltd, September 2016).

This report suggests that static testing was undertaken in an appropriate manner, however, there are a number of factors that may limit the usefulness of the results. These include:

Duration of kinetic testing

The kinetic testing was only undertaken for a six week period whereas this testing is required to be undertaken for a minimum of twenty-weeks and may be required to exceed one year for some materials (Maest et al., 2005).

Heterogeneity and surface area effect

Rare-element pegmatite ore bodies are extremely coarse-grained and typically contain a large suite of minerals that have a highly heterogeneous distribution within the ore body (Bradley et al., 2010). Therefore, it is important that sufficient samples are collected and tested to assess

the geochemistry of these materials, and kinetic testing must consider the available surface area of the material so that results can be scaled up from the laboratory to field scale (Maest et al, 2005).

Furthermore, the geochemical testing has not considered the possibility that tailings materials could be the subject to biologically-enhanced weathering. This type of weathering is caused by a range of fungal communities and microorganisms in the soil profile that produce organic acids to leach nutrients (particularly potassium and phosphorus).

LEAF 1313 testing at other sites with a similar ore body have indicated tailings leachate containing fluoride, lithium and thallium at levels of environmental concern.

Conditions 1 and 2 of Works Approval W6051/2017/1, therefore, required additional tailings leachate testing using the USEPA LEAF 1313 testing methodology (Conditions 1 and 2 Report and Radionuclides Characterisation, February 2019). The results of this testing were referred to Contaminated Sites Branch who have confirmed that the tests were carried out appropriately and the leachate is unlikely to cause significant environmental impacts. These conditions are removed as part of this Works Approval amendment.

4.2.3 TMF 2 – Cell 2 Stage 1

The Works Approval Holder obtained approval to construct TMF 2 in September 2017, to a final RL of 189.3m. The Works Approval Holder has requested that in order to balance TMF construction with the initially available supply of mine waste, the construction program for TMF 2 requires modification to incorporate two phases; namely TMF 2 Stage 1A and 1B. TMF 2 Stage 1A involves initial construction to a height of 4 m below the final TMF 2 Stage 1B crest elevation; such that the construction sequence is:

- Cell 2 Stage 1A to RL 185.3 m
- Cell 2 Stage 1B to RL 189.3 m

A minor variation to the original design is the increase in width of Zone 1 from 3 m to 4 m to facilitate safe construction access for machinery. Table 6 outlines the TMF design criteria and specifications for the construction stages of TMF1 and TMF2.

4.2.4 Waste Water Treatment Plant

The Works Approval Holder proposes to increase the throughput of the WWTP from 100 m^3/day to 125 m^3/day. The increased throughput changes the Category of the WWTP from Category 85 to Category 54.

The increased capacity will be enabled by only minimal modifications (details not supplied) to the existing plant. Due to the increase in capacity, an expansion of the irrigation field is to be undertaken to receive the additional treated effluent which also includes RO Brine waste.

Brine from the RO process is to be sent to the irrigation tank at the WWTP and mixed with treated effluent prior to discharge to the spray field. The maximum TDS (mg/L) of the (final, including the RO Brine) effluent stream that is sent to the spray irrigation field for disposal will be 4,000 mg/L.

The Works Approval Holder proposed to increase the irrigation field from 3.03 ha to 4.72 ha. The coordinates of the existing spray field and extension are provided in Table 9. Figure 5 depicts the location of the WWTP within mining tenement M45/1256.

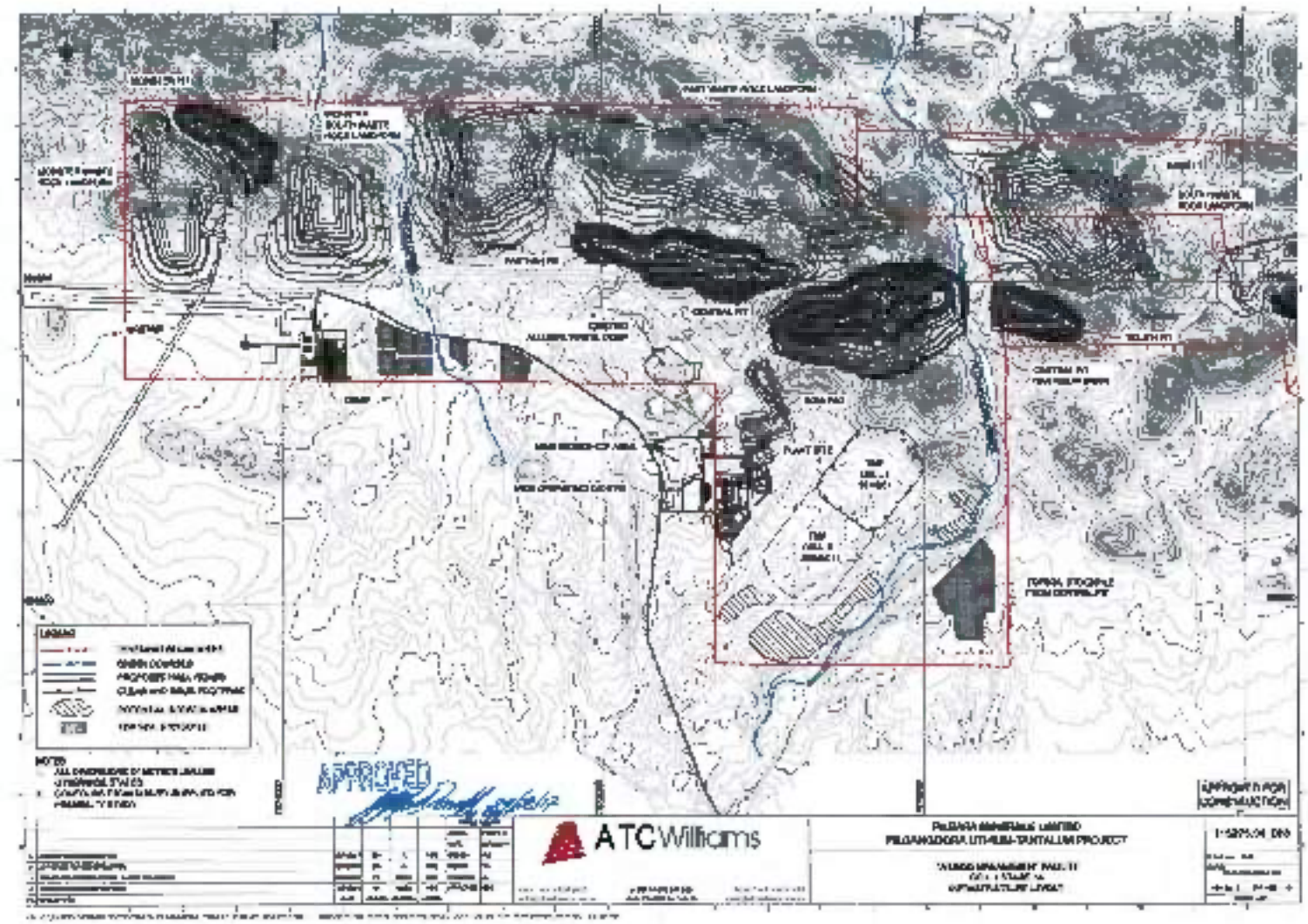

Figure 3: TMF Stage 1 footprint and location of other site infrastructure.

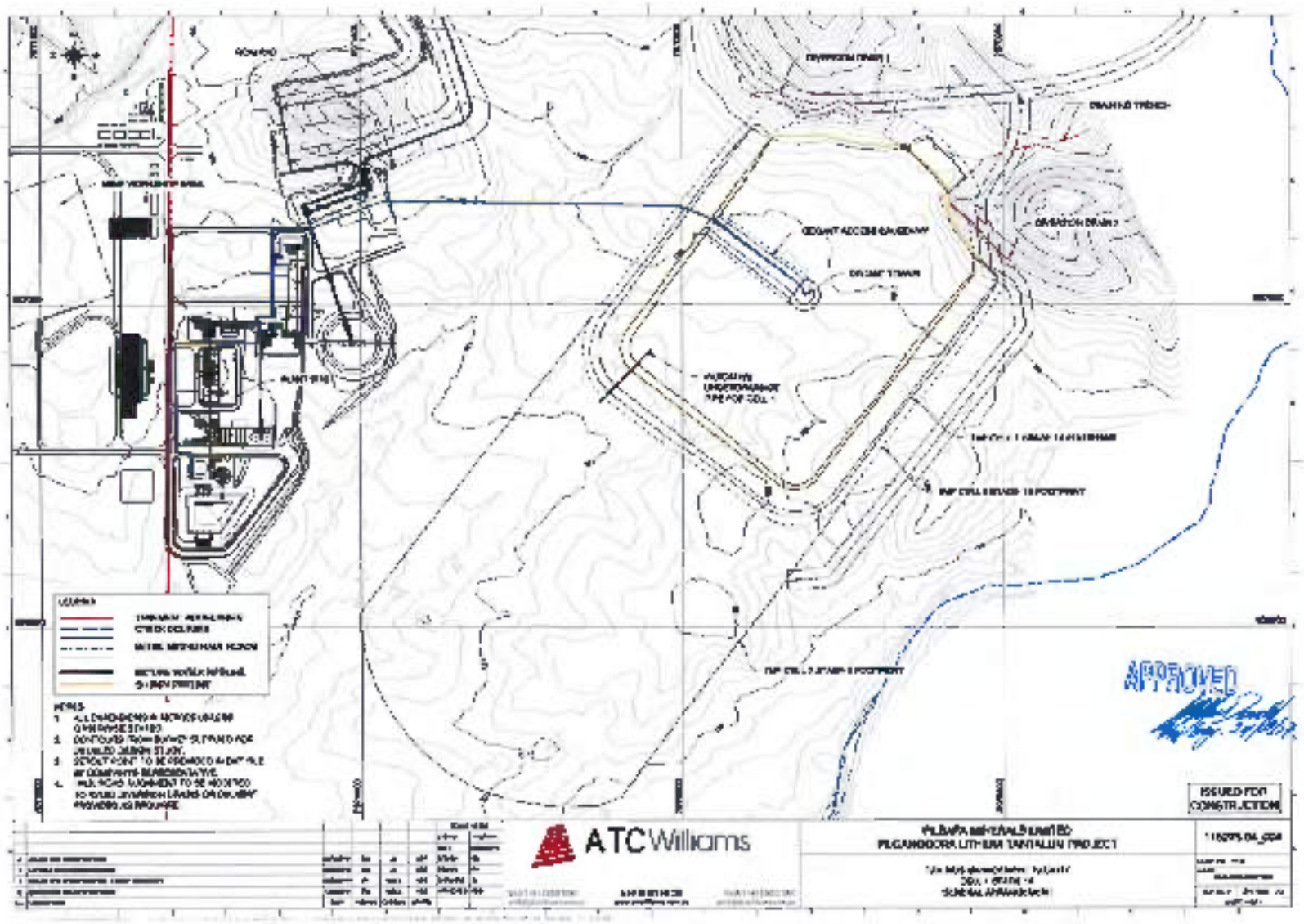

Figure 4: TMF Stage 1 A general arrangement.

Table 9: Coordinates for the existing and proposed extension to the irrigation field

Spray field section	Coordinates	
Existing spray field (3.03 ha)	697606.0 mE 76743779.9 mN	697795.5 mE 7674377.9 mN
	697606.2 mE 7674217.7 mN	697795.7 mE 7674217.9 mN
Proposed extension (1.69 ha)	697606.0 mE 7674467.3 mN	697795.5 mE 7674467.3 mN
	697606.0 mE 76743779.9 mN	697795.5 mE 7674377.9 mN

The WWTP is designed to achieve the following water quality standards:

- Biochemical Oxygen Demand <20mg/L
- Total Suspended Solids <30mg/L
- Total Nitrogen <30mg/L
- Total Phosphorus <7.5mg/L
- Chlorine Residual >0.2-2mg/L
- pH 6.5-8.5
- E.coli <1000cfu/100mL

The Works Approval Holder has provided nutrient loading calculations in accordance with Water Quality Protection Note 22. According to these calculations, the expected nutrient loading is 72.5 kg/ha/yr for phosphorus and 290 kg/ha/yr for nitrogen (PML, February 2018).

The Works Approval Holder has selected the lowest vulnerability category soils (D) from Table 2 of WQPN 22 due to the types of soils (high loam content) and due to the proximity of the irrigation field to the Northern Creek (between 250m and 500 m).

DWER notes that there appears to be a watercourse approximately 120 m west of the irrigation field as depicted in Figure 3 and Figure 5.

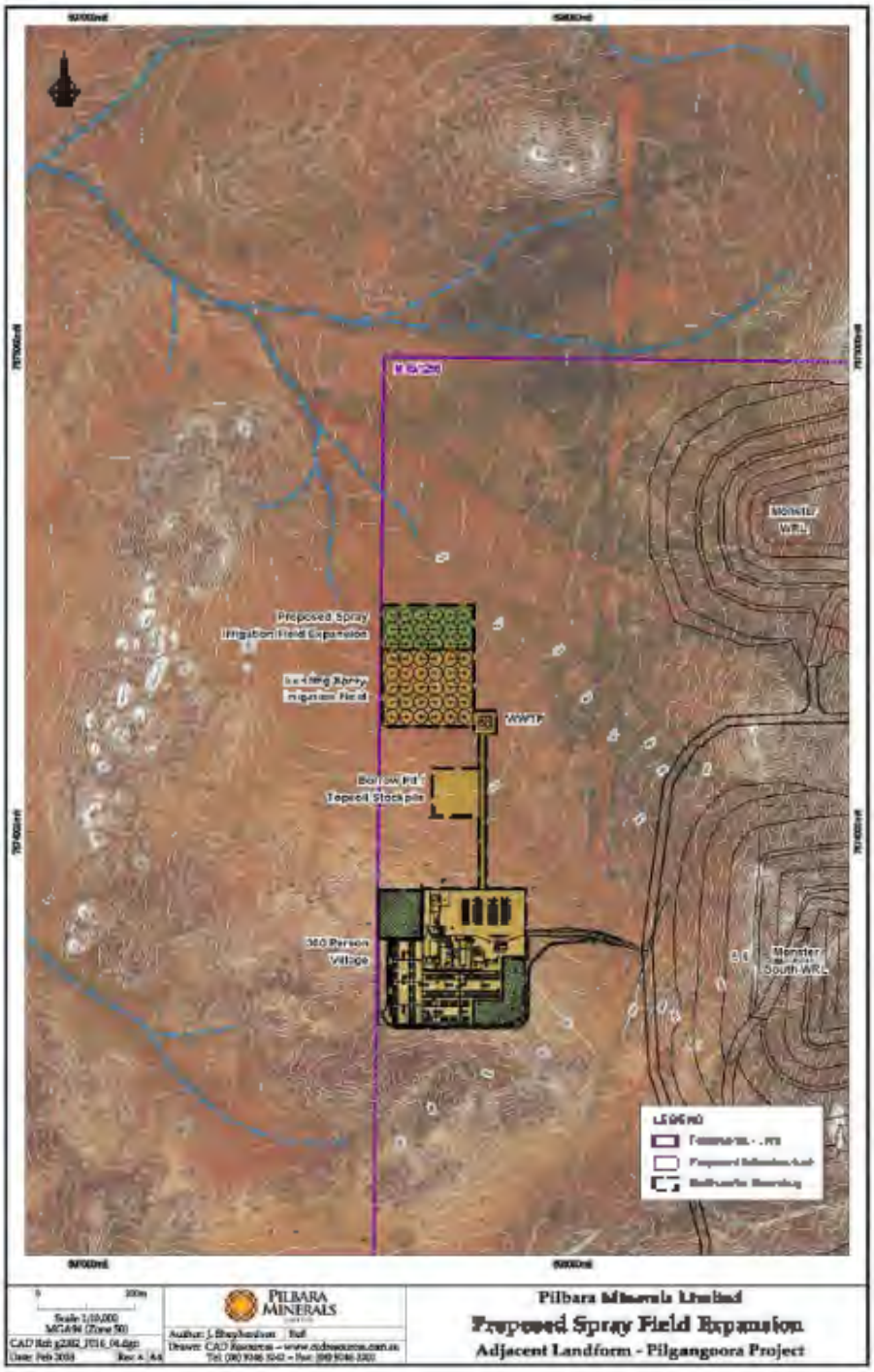

Figure 5: WWTP location and irrigation field expansion

4.2.5 RO Processes on site

The Works Approval Holder has advised that raw water for RO treatment for the accommodation camp is to be sourced from production bore PWB005. With the increase in the manning rate and WWTP throughput at the camp, the volumes of raw water requiring RO treatment have increased.

The Works Approval Holder has advised that water treated through the RO process for use at the accommodation camp will have contaminants from the source groundwater removed such that it will reach potable water quality and meet the Australian Drinking Water Guideline requirements.

The camp RO plant will have an estimated throughput of 63.8 ML/annum (based on 640 man effective manning rate including camp use and ablutions, kitchen and washing facilities). The waste brine from this RO plant will be sent to the irrigation tank at the WWTP and mixed with treated effluent prior to discharge to the sprayfield. The maximum TDS (mg/L) of the (final) effluent stream (including RO Brine) that is sent to the WWTP spray irrigation field for disposal will be < 1000 mg/L.

Information on contaminant removal from the RO plant, (such as detail from the RO plant supplier) into the RO brine waste is unknown.

Brine from the RO at the processing plant is to be sent to the process water dam and mixed with dewatering effluent prior to onsite use for dust suppression purposes or recirculated back into the process plant for use within the plant process. The concentration of contaminants in the RO brine is unknown and will depend on the performance of the RO plant and the quality of the feed water. The processing plant RO plant will have an estimated throughput of 18.2 ML/annum.

The combined total throughput of the RO plants is 0.081 GL/annum and the volume of waste water production is 50% of raw water input (i.e.: 0.0405 GL of RO waste to be produced per annum).

4.2.6 Inert and Putrescible landfill

The Works Approval Holder proposes to construct an inert and putrescible landfill within the West Waste Dump (Figure 2). The landfill (location) already approved to be constructed in the Monster Waste Dump is to be retained for future use.

The landfill will consist of trenches. The number and dimension of trenches to be constructed as the waste rock dump progresses has not been provided by the Works Approval Holder.

A maximum of 100 tonnes per annual period of waste is to be disposed. The waste types proposed to be disposed consist of:

- Inert Waste Type 1
- Inert Waste Type 2
- Contaminated solid waste meeting waste acceptance criteria specified for class I or II landfills
- Putrescible Waste

The landfill is to be surrounded by an earthen bund at least 2 m tall on three sides to minimise wind-blown rubbish as well as to prevent surface water runoff entering the trench.

The landfill will be constructed and managed in accordance with the *Environmental Protection (Rural Landfill) Regulations 2002*.

Weekly inspections will be undertaken of the landfill and any rubbish in the surrounding area will be collected at least on a monthly basis.

The contaminated solid waste will be any hydrocarbon contaminated solid waste that has undergone bioremediation at the onsite bioremediation facility which is to be constructed adjacent to the landfill facility within the West Waste Dump (Figure 2). It will initially consist of an approximate 20 m x 20 m prepared pad surrounded by 0.5 m bund walls and divided into two cells. Additional cells will be added as required. Hydrocarbon-contaminated soil will be placed in the cells, progressively filling them from the rear. When a cell is full it will be closed, the material will be spread to an even thickness of approximately 300 mm and scarified, then bioremediation treatment will commence. This will involve application of a commercially available bioremediation solution containing hydrocarbon-consuming bacteria. Periodic application of water and additional scarification will be undertaken as required. Composite sampling of treated cells will be undertaken at three-monthly intervals. Hydrocarbon levels will be compared to the Class 1 Landfill criteria listed in Landfill Waste Classification and Waste Definitions 1996 (As amended December 2009) (DEC 2009).

Target hydrocarbon levels are:

C6 – C9 2800 mg/kg
C16 – C35 450 mg/kg

When these levels have been achieved the material will be removed for disposal within the West or Monster waste dumps.

4.2.7 Electric Power Generation (Power Station)

This facility was assessed and approved to be constructed within M45/1256

This facility was assessed and approved under Part V of the EP Act in September 2017 to be constructed within M45/1256. The M45/1256 tenure boundary was assessed and approved as the Prescribed Premises boundary.

In April 2018 it was identified that the Power Station had not been constructed in its approved location but had been constructed on Pilbara Minerals Limited tenure, Miscellaneous Licence L45/147. L45/147 is situated immediately north of the western portion of M45/1256. The Category 52 Power Station has been constructed approximately 100m away from the (original) approved location. The works approval Holder stated on 18 April 2018 that the power station has been constructed in accordance with the requirements of Schedule 3 (Table 3) of the original Works Approval with the exception of the diesel generators that were intended to supply power to the power station. The Works Approval Holder had installed 10 x diesel generators with capacities ranging from 1300 kVA to 3100 kVA in place of the originally proposed 16 x 1400 kVA diesel generators. The Works Approval Holder advised that the reconfiguration of genset sizing was a requirement of the availability of units for purchase within the timeframe of construction. The Works Approval Holder also advised that the installed fewer generators with higher load capacities are expected to have fuel consumption and emissions similar to original estimates.

This facility was assessed and approved under Part V of the EP Act in September 2017 to be constructed within M45/1256. The M45/1256 tenure boundary was assessed and approved as the Prescribed Premises boundary.

In April 2018 it was identified that the Fuel Farm had not been constructed in the location it had been approved for but had been constructed on Pilbara Minerals Limited tenure, Miscellaneous Licence L45/147. L45/147 is situated immediately north of the western portion of M45/1256. The Category 73 bulk fuel facility has been constructed approximately 100m away from the (original) approved location. The works approval Holder confirmed on 18 April 2018 that the Fuel Farm has been constructed in accordance with the requirements of Schedule 3 (Table 3) of the original Works Approval.

4.2.8 Bulk storage of chemicals and treatment of hydrocarbon contaminated water (Fuel Farm)

In the issue of the original Works Approval in September 2017, DWER had incorrectly stated within the Decision Report that the bulk chemical capacity within the Premises was 1,032 m^3 in aggregate. This value was supposed to read 1,036m^3 in aggregate. The risks for the storage of this volume of bulk chemicals (diesel) at the higher capacity were assessed at the time and as such, DWER consider that the risk profile between 1,032m^3 and 1,036m^3 has not altered. The correct value has now been clarified/updated in this Report and the Works Approval.

Photograph 1 – Construction location of the Power Station and Bulk Fuel Storage area on L45/417

4.3 Operational aspects - previously approved for construction (Original Works Approval)

4.3.1 Processing Plant

Ore is fed through three stages of crushing, multiple screening processes, dense media separation, high pressure grinding, gravity concentrators, cyclones, cleaner spirals, cleaner scavenger spirals, low intensity magnetic separation, hydrocylones, ball, flotation, mill and concentrate thickener to produce lithium and tantalum concentrate (Figure 6), which is to be transported by road to Port Hedland.

Crushing and Dry Screening

A front end loader will feed ore to the crushing plant via the Run of Mine (ROM) bin to commence primary then secondary crushing of the ore. The ore is then screened and oversized ore is re-crushed to achieve the desired size for stockpiling prior to tertiary crushing.

A reinforced tunnel sits centrally under the stockpile and houses the four vibrating feeders which are open to the stockpile located above the feeders. Ore will be withdrawn from the coarse ore stockpile via the vibratory feeders. The vibrating feeders transport crushed ore from the stockpile above, through the passive slot feeders and onto a conveyor at a tertiary crusher feed conveyor at nominal rate of 270t/h.

High Pressure Grinding Rolls (HPGR)

Tertiary crushing of the dry ore is conducted using a High Pressure Grinding Roller (HPGR). The grinding elements of the HPGR are two counter-rotating rolls, between which the material is crushed. One roll is designed as a fixed roll and the other one as a floating roll.

Screening

The - 3.35mm HPGR screen (undersize) is diverted to the Heavy Media Separator (HMS) Stage 1 Feed Preparation screen which screens the ore particles into plus 0.5 and minus 0.5mm

streams. The minus 0.5mm particles are pumped from the screed underflow hopper to the spiral gravity circuit to recover tantalum minerals.

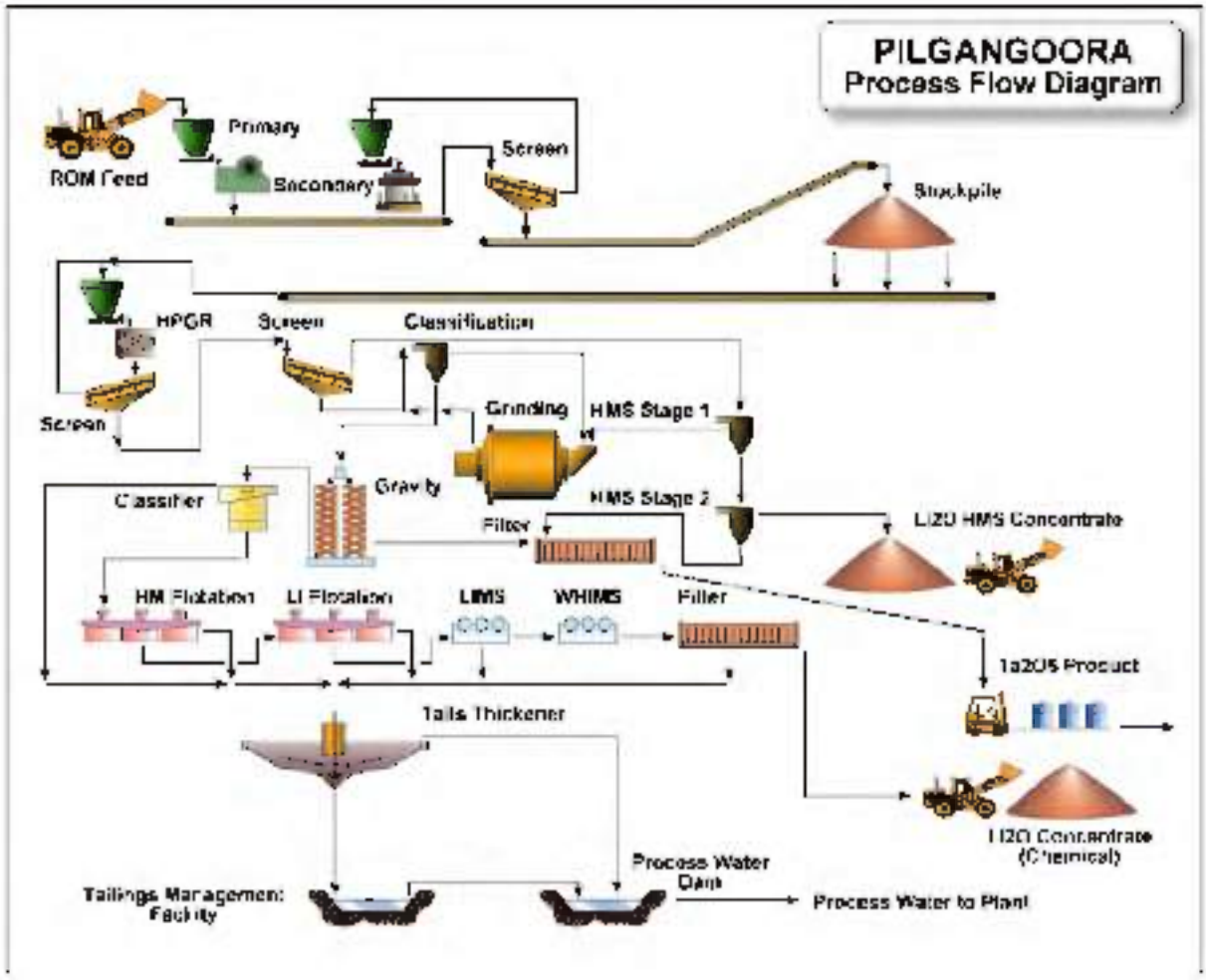

Figure 6: Process flow diagram

The process plant area general layout has been provided in Figure 7.

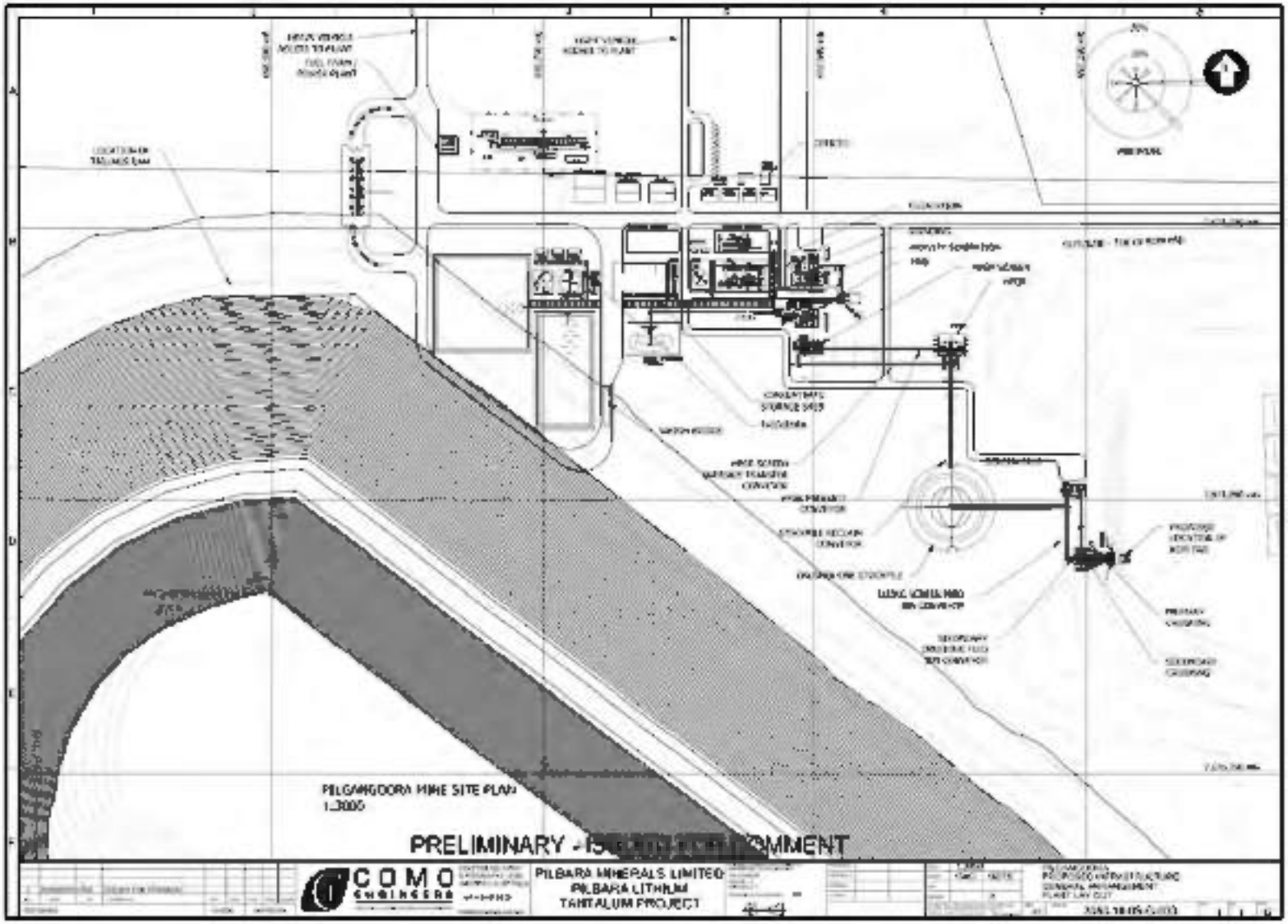

Figure 7: Process plant area general layout

Milling and Flotation

The + 0.5mm particles are re-pulped with ferrosilicon slurry and pumped through 4 x 300mm HMS Stage 1 Cyclones. The cyclones separate the particles into light particles (floats), nominally with a specific gravity <2.9, and heavy particles (sinks), nominally having a specific gravity >2.9. The heavy particles contain substantially liberated spodumene particles and tantalum minerals (and other heavy minerals present in the ore).

These Stage 1 floats containing partially liberated spodumene particles and waste minerals are conveyed to the grinding mill, whereas the sinks are transferred to the Stage 2 HMS Circuit. The Stage 1 sinks are re-pulped with a higher density mix of ferrosilicon slurry than used in Stage 1 and are passed through a single 250mm HMS cyclone. The floats from this cyclone, with a nominal specific gravity between 2.9 and 3.3 contain the majority of spodumene minerals (approximately 15tph) and the sinks contain the tantalum (and other heavy minerals) at a rate of approximately 0.5tph.

Each floats and sinks stream is thoroughly washed on the respective product screens to recover ferrosilicon for re-use in the circuit. New ferrosilicon is intermittently added to the circuit to replenish any losses.

The gravity tails (from the spiral circuit) are classified via a cluster of Primary Hydrocyclones, the underflow contains coarse particles which then report to the ball mill feed for further size reduction. The primary hydrocyclone overflow has a P80 (point or particle size that is 80% finer in the overflow) of 106µm and proceeds to the flotation circuit after intensive conditioning with sodium lignosulphonate, and desliming by cyclones. The slimes report to the tailings thickener and the rest of the slurry (cyclone underflow) reports to flotation.

The HMS Stage 1 Floats and HMS Stage 2 Sinks streams are also fed to the ball mill to liberate and enable recovery (after further size reduction) of additional spodumene and tantalum minerals contained within these streams. After intensive conditioning and desliming, the flotation feed is first conditioned with sodium silicate solution and adjusted to pH 8 with sodium hydroxide prior to the addition of the flotation collector. The slurry passes through the first bank of Rougher Flotation cells after which additional collector is added and then further flotation recovery takes place in a second bank of Rougher flotation cells. The tails from the 1st Cleaner cells proceeds to Cleaner Scavenger flotation cells to recover additional spodumene, after which the Cleaner Scavenger tails are pumped to the tailings thickener.

Concentrators

The HMS Stage 1 Feed Preparation screen undersize material contains valuable tantalum minerals which are recoverable using conventional wet spiral concentrators. Accordingly, this is pumped to banks of Rougher Spirals which are designed to recover the maximum amount of heavy minerals into a low grade concentrate. The Rougher Spiral concentrate is then pumped to a bank of Cleaner Spirals which recover a high grade concentrate at lower recovery rates. The Cleaner Tails then returns to a bank of Cleaner Scavenger Spirals which scavenges heavy minerals from the Cleaner Tails into a lower grade concentrate which returns to the Cleaner Spirals to recover these minerals.

The concentrate from the Cleaner Spirals is passed through a Low Intensity Magnetic Separator to remove iron contaminants from the concentrate.

The flotation Spodumene (concentrate) stream is attritioned and then processed via magnetic separation to remove contaminant iron (grinding media and iron staining) after which it is pumped to the Spodumene Concentrate thickener where it is thickened to approximately 70% w/w solids prior to being pumped to a pressure filter.

Final Product Processing

The tantalum concentrate is then processed over Rougher and Cleaner wet shaking tables to upgrade the tantalite into a concentrate of approximately 25% Ta_2O_5. This is packaged into bulka-bags and shipped off site for sale or further upgrading.

Following pumping from the pumped to the Spodumene Concentrate thickener, the pressure filter dewaters the Spodumene concentrate to less than 7% moisture, after which it is stacked on the Spodumene Flotation Concentrate stockpile within the concentrate storage shed prior to transport off site.

Fines Tailings Handling

The tailings stream comprises the deslime cyclone overflow, the flotation tailings and minor process streams. Excess water from the thickening process is delivered to the process water pond for recycling through the processing plant.

Tailings Management Facility – Cell 2 Stage 1 only

Tailings will be pumped to the tailings thickener where flocculent is added and the slurry thickened to 52-68% w/w solids before disposal via a ring of spigots to the integrated waste landform TMF.

Tailings are proposed to be discharged from the perimeter embankment. The discharge will be operated through a single rotating spigot creating a concave tailings surface within which a decant pond will be developed at the centre of the cells. The spigot interval will be approximately 24 m (two pipe lengths).

Deposition of tailings and natural ground slope/surface will form a tailings beach sloping to a central decant water pond within Cell 2. This water will be recovered from the decant area by a submersible pump and will be transferred to the process water pond for reuse in the Process Plant. The Works Approval Holder has advised that recovery of decant water from Cell 2 will be from concrete ring decant towers accessed via causeways from the northern side of the cells. The decant access causeways will be raised employing a “top hat” method of construction, whereby waste rock is placed on both sides of the causeway.

The outer slopes of the developing landform will be constructed to 1v:2.5H (22˚) and graded to a final landform batter of 15˚towards the latter years of operation.

There will be a low permeability inner embankment and an outer waste rock shoulder that encompass a sand filter zone. The low permeability material will be sourced from the TMF impoundment area and borrow locations close to Pilgangoora Creek.

The design of the facility has not included a liner and the maximum hydraulic conductivity at the base of the TMF has been measured at 1.45×10^{-6} in extremely weathered granite. Mounding (from seepage) causing direct hydraulic connection between the saturated tailings and the underlying groundwater is likely to occur beneath the TMF given the moderate permeability of the TMF base and the shallow depth of groundwater (~9 to 11 mbgl).

A cut off trench will be constructed on the upstream side of the TMF and around the perimeter.

Audible alarms that register modifications in pressure will be fitted to all pipelines and monitored in the control room.

The Application states that the tailings are benign and that decant water quality is comparable to groundwater quality.

Cell 2 stage 1 will be constructed to a maximum height of RL189.3 m with a storage capacity of 2.7 Mt (one year storage) and impoundment area of 19.9 ha. The design criteria of the TMF are presented in Table 6.

The Geochemical Characterisation report provided with the application presented findings of static leach testing of floatation tailings from the site. Acid-formation potential of the samples was determined by total sulfur analysis, and Acid-Neutralising Capacity (ANC) tests. The findings showed that the geochemical profile of the tailings provide sufficient ANC to indicate that the risk of acidic leachate formation from the tailings is low. Both the Tailings Management Feasibility Study and the Geochemical Characterisation report provided for the assessment both showed similar results with regards to the risk to groundwater from the tailings decant and tailings leachate should seepage occur from the TMF. It is noted that the chemical conditions of tailings decant water may alter over time as the chemical conditions in the TMF may vary over time due to consolidation of the tailings mass and evaporation from the tailings surface increasing chemical concentrations.

4.3.2 Electric Power Generation

A dual fuel natural gas/diesel power plant consisting of 16 x 1400 kVA generators and a Compressed Natural Gas (CNG) daughter station is proposed to be constructed at the Premises. The capacity provided to power all facilities for the Premises will be 15.7 MW, with 2.2 MW standby. Initially three diesel-fired generators will be used to power the village.

The Power Station will operate on diesel generators during the commissioning period, with the diesel trucked to the Premises during the first five years. The CNG supply will be trucked to site as trailer mounted self-contained 350m^3 gas in bullet type vessels. A permanent natural gas supply may be installed in the future and diesel supply would then be used as backup.

The generators will be operated at 75-100% capacity and monitored via the control system based on fuel consumption and routine emissions sampling. Optimal fuel burn has been identified for these gensets as being between 80 and 90%. Stack sampling locations will comply with Australian Standard AS4323.1 Stationary source emissions. Table 10 outlines the expected air quality concentrations emitted from the stacks as provided by the Works Approval Holder.

Table 10: Expected air quality concentrations emitted from the stacks

Test Criteria	Emission Limits	Standard of Concentration (Group 6)[1]
Diesel emissions		
NO_x	Less than 2880 ppm	N.A. (system capacity less than 30 MW)
CO	Less than 1060 ppm	N.A. (not listed)[2]
Particulates	Less than 55 ppm	Less than 50 mg/m^3
SO_2	Less than 28 ppm	N.A. (not listed) [2]
Non-Methane Hydrocarbons (NMHC)	Less than 110 ppm	N.A. (not listed) [2]
Volatile Organic Compounds	Less than 6.48 g/min	N.A. (using standard fuel) [2]

Gas Emissions		
NO_x	NOx Less than 189 ppm	N.A. (system capacity less than 30 MW)
CO	CO Less than 623 ppm	N.A. (not listed) [2]
Particulates	NA	Less than 50 mg/m^3
SO_2	Less than 565 ppm	N.A. (not listed) [2]
NMHC	Less than 141.88 g/min	N.A. (using standard fuel) [2]

1 Based on NSW Protection of the Environment Operations (Clean Air) Regulation 2010 (Division 2, Clause 32).

2. Based on NSW Protection of the Environment Operations (Clean Air) Regulation 2010 (Schedule 3, Electricity Generation).

4.3.3 Class II putrescible and inert landfill site

The 100 tpa putrescible and inert (Category 64) landfill will be incorporated within the Monster South Waste Rock Landform (WRL). Putrescible and industrial waste will be segregated and disposed of in separate trenches.
Each landfill trench will be excavated to a maximum depth of 4m. This will provide at least 8-10m of separation from the estimated natural groundwater table, which is 12-15m below surface level in the low-lying areas. The size of the tipping face will not be larger than 30 metres in length or more than 2 metres above ground level in height.

The Works Approval Holder has advised that the landfill will be surrounded by an earthen bund created by the material excavated for the waste disposal trench. The bund will be at least 2m tall on three sides and will minimise wind blown rubbish as well as prevent surface water runoff entering the trench.

The Works Approval Holder has advised that the landfill will not be fenced however; there will be appropriate infrastructure in place around the active mining areas (combination of fencing and bunding) to exclude stock from the entire mining operation. No firebreak will be constructed around the landfill due to the moving and advancing faces of the Monster South WRD. 10mm of clean fill will be applied at least weekly, to ensure that the waste is completely covered and that no waste is exposed.

Unserviceable tyres shall be transported to a designated area within the approved waste rock dump disturbance footprint. They shall be stacked appropriately and periodically buried in accordance with Regulation 14(2) of the EP Regs. Where possible, PML will remove tyres offsite for recycling to reduce the volume of waste to landfill. Some larger tyres will be utilised as road direction/separation markers on haul roads. These will be removed at closure and buried.

4.3.4 Mobile crushing and screening plant (construction purposes only)

At the commencement of construction, crushed rock for aggregate in concrete batching and other requirements (roads, hardstand areas, etc) will be sourced from existing quarries off-site and transported to the Project.
As suitable rock is exposed by stripping of overburden from the site open pits, suitable benign waste rock will become the source for the crushing and screening plant for aggregate production.
A maximum of 50,000m^3 of rock will pass through this mobile unit. This mobile plant will be removed on completion of construction activities.

4.3.5 Bulk storage of chemicals and treatment of hydrocarbon contaminated water

Diesel fuel will be delivered by road trains and stored in above ground self-bunded fuel storage tanks within the bulk fuel facility area (fuel farm).

A bunded concrete pad with a drain will be constructed at the tanks for both fast-fill (haul packs) and light vehicle refuelling. The pad will also be the location for refuelling the tanks from fuel tanker road trains. The drain from this bunded concrete pad drains from below the refuelling grates and the self-bunded tank sumps to a local sump. The local sump contents are then pumped to the Power Station oil - water separator (diesel fuel farm).

There will be two oil - water separators operational on site (to enable wastewater reuse or for dust suppression). One is designated for the truck wash and will be located at the workshop. The second will be located at the power station in the diesel fuel farm area. Both oil-water separators will treat hydrocarbon waste to a maximum total petroleum hydrocarbon (TPH) concentration of <15mg/L which will be monitored monthly. The treated oily water from both oil - water separator systems will be pumped to a holding tank, collected by truck and unloaded into the vehicle wash water area / sump or dust suppression Raw Water Tank.

Equipment wash down areas will be contained on an impervious pad, such as reinforced concrete or plastic liner (for temporary facilities), with a perimeter kerb or bund wall.
Wash down pads will drain to a collector sump which will then transfer wastewater to an oil-water separator for treatment.

Washdown from hardstand areas (e.g. workshop area floors) will be directed to the truck wash oil-water separator for treatment. Collected sludge will be removed from the settling sump and transported to the bioremediation pad on-site.

Coolants, lubrication and hydraulic oils for servicing the mobile fleet will be stored within workshop, maintenance and reagent areas. All fuel storage and dispensing facilities will be constructed and managed in accordance with the '*Australian Standard for Storage and Handling of Flammable and Combustible Liquids*' (AS 1940-2004). All of these materials will be stored on drip trays or within steel or concrete bunded areas.

The site will contain two secondary containment systems by way of sedimentation traps, one at the processing plant area and a second at the mining contractor's area. Hydrocarbon and chemical waste not contained in large stormwater events will be captured in either sediment trap systems. Both sediment trap systems overflow to natural tributaries. These sediment basins will be inspected as required, and before known significant rainfall events to ensure they are capable of functioning to remove sediment during high-rainfall events. PML will establish surface water monitoring sites, prior to the construction of the basin structures which will include sites upstream and downstream of the (entire) operation.

4.3.6 Sewage facility

The WWTP is a Moving Bed Bioreactor system designed to treat up to 100 m^3 of effluent per day, however is not anticipated to operate at this output level. The WWTP will treat sewage from the 300 person village. The WWTP will come to the Premises fully assembled; factory tested and water treatment cultures generated off site with the suppliers having commissioned it ready for operations.

Throughput is based on the 300 room camp at full occupancy with an input rate of 250 litres per person per day (taking into account camp ablutions, kitchen and washing facilities, as well as ablutions at the mine site) for a maximum output of 75 m^3 per day expected.

Tanks will be fitted with high levels alarms wired to alert of overflows, and a flow meter will be operational between the WWTP outflow point and the spray field to record the WWTP output flow rate. There is 2 days (tank volume) storage available, should the camp be at maximum capacity and the WWTP require fixing.

Sludge will be stored in a Sludge Thickening Tank and removed offsite by mobile tanker.

Treated sewage mixed with brine from the Camp Reverse Osmosis (RO) plant will be discharged via a HDPE pipeline PN12.5 to a 3.04ha spray irrigation area containing 30 irrigation impact sprinkler heads. The spray field will be located north of the village. The expected effluent discharge quality is shown in Table 11.

The depth to groundwater within the vicinity of the WWTP area (and spray field) is approximately 15m. This has been measured from the closest bore. This facility will be fully fenced.

The design details for the Accommodation Camp WWTP are as follows:

- 1 x Moving Bed Bio Reactor -0100-C-X-X-X with less than 100 m^3/day treatment capacity.
- 5 x PSPS-02-2-X-C-X-X
- 1 x 50 kL Balance tank fitted with high level alarm wired to visual strobe light and sounder to alert of overflows
- 1 x 50 kL Treated effluent / Irrigation tank fitted with high level alarm
- 1 x Irrigation pump skid
- 1 x sludge thickening tank
- WWTP containerized with external pump skids and tanks
- Flow meters to be installed at influent inlet point and effluent egress point
- The WWTP will be constructed to meet the following water quality emission standards:
    - Biochemical Oxygen Demand <20mg/L
    - Total Suspended Solids <30mg/L
    - Total Nitrogen <30mg/L
    - Total Phosphorus <7.5mg/L
    - Chlorine Residual >0.2-2mg/L
    - pH 6.5-8.5
    - *E.coli* <1000cfu/100mL
- Stock exclusion fence surrounding entire WWTP facility
- Tie-in with Camp RO brine stream at the treated effluent irrigation tank

Table 11: WWTP Manufacturer Design Details

Influent Quality	Type	Domestic strength sewage
	Temperature	25 – 30°C
	pH	6.5 - 8.5
	BOD	150 – 500 mg/L
	TSS	150 - 400 mg/L
	T-N	< 50 mg/L
	T-P	< 15 mg/L
	TDS	< 1,000 mg/L
Product Quality	Risk Level	Low (Class C)
	BOD	< 20 mg/L
	TSS	< 30 mg/L
	pH	6.5 - 8.5
	T-N	< 40 mg/L
	T-P	< 10 mg/L
	E Coli	< 1,000 CFU/100 mL
	Free Chlorine	0.2 - 2 mg/L
Plant Capacity	100m³ per day	
Assembly	Containerised MBBR, with external pump skids and tanks	
MAK Model No	1x MBBR-0100-C-X-X-X 5 x PSPS 02 2 X C X X 1x 50 kL Balance Tank 1x 50 kL Treated Effluent/Irrigation Tank 1x Irrigation Pump Skid	

4.4 All Infrastructure

The Pilgangoora facility infrastructure, as it relates to Categories 5, 52, 54, 64, 70 and 73 activities, is detailed in Table 12 and with reference to the proposed site layout (Figure 2).

Table 12: Pilgangoora facility Category 5, 12, 52, 64, 70, 73 and 54 infrastructure

	Infrastructure
	Prescribed Activity Category 5
Lithium and tantalum bearing ore is to be processed to produce lithium and tantalum-niobium concentrate fines for the chemical and technical grade markets. Tailings will be thickened and disposed of to an integrated waste landform TMF.	
1	Processing Plant designed to process 2 Mtpa, beneficiating run-of-mine ore to a 6% lithium concentrates fines and a tantalum-niobium concentrate fines: •Concrete pad bunded with containment capacity equivalent to 110% of the capacity of all tanks; •Electric sump pumps; •Primary/Secondary/Tertiary crushers; •Wet screener; •Two stages of Dense Media Separation; •Wet spiral concentrators; •Four vibrating feeders; •High Pressure Grinding Roll; •Stage 1 Feed Preparation screener; •Four Stage 1 Cyclones;

	Infrastructure
	• Grinding Mill; • One Stage 2 Cyclone; • Wet spiral concentrators; • Cleaner spirals; • Cleaner scavenger spirals; • Low intensity magnetic separator; • Rougher and cleaner wet shaking tables; • Primary hydrocyclones; • Floatation circuit; • Tailings thickener; • Ball mill; • Spodumene concentrate thickener; • Pressure filter; • Spray/ sprinkler systems; and • Stockpiles
2	Tailings Management Facility: • Cell 2, Stages 1A and 1B; • Minimum crest width of 40m; • Waste landform type facility; • Central decant water pond; • Associated pumps/piping with pressure transmitters
3	Control System
4	Process water pond consisting of two cells lined with minimum 1.8 mm thick HDPE liner
5	Sedimentation pond
6	Chemical storage within the workshop area: • Concrete bunded area containing plinths for the location of isotainers, mixing tanks and storage tanks located within the processing plant area; • Transfer pumps/pipelines fitted with pressure transmitters; • Isotainers will contain the following liquids: • 28kL Sodium hydroxide (50% w/w) (33m^3 per month) • 28kL Sodium silicate (43% w/w) (26m^3 per month) • 28kL Flotinor 7179 (as supplied) (300m3/month) • 1000L IBC sulphuric acid (98% w/w) (estimate 20m^3/ month, if required) • 50m^3 sodium lignosulphonate mixing tank (25% w/v sodium lignosulphonate) • 50m^3 sodium lignosulphonate solution storage tank (25% w/v sodium lignosulphonate). • Dry reagents stored in a storage shed: • Sodium lignosulphonate (1000kg bags) (40 tonnes per month) • Magnafloc 333 flocculant (3 tonnes per month) • Ferrosilican in bulka-bags (35 tonnes per month)
7	Mobile Crushing and Screening Facility: • Design capacity of 300 tonnes per hour with a nominated throughput of up to 1,000,000 tonnes per

	Infrastructure
	annum. • Consists of crushing, screening and stacker units. • Equipped with a dust suppression system.
8	Stage 2 Processing Plant: • Capable of processing 3 Million tonnes per annum (Mtpa) • Primary/Secondary/Tertiary crushers • Wet screener • Two stages of Dense Media Separation • Wet spiral concentrators • Four vibrating feeders • High Pressure Grinding Roll • Stage 1 Feed Preparation screener • Four Stage 1 Cyclones • Grinding Mill • One Stage 2 Cyclone • Wet spiral concentrators • Cleaner spirals • Low intensity magnetic separator • Rougher wet shaking tables • Primary hydrocyclones • Flotation circuit • Tailings thickener • Ball mill • Spodumene concentrate thickener • Pressure filter • Tantalite dressing facility • Spray/ sprinkler systems in crushing circuit • Plant to be constructed on a concrete pad and concrete bunded with a containment capacity equivalent to 110% of the capacity of largest tank • Electric sump pumps installed in the concrete flooring to collect and pump any spilled material back into the process stream • Pipelines fitted with pressure transmitters at both ends of pipelines with alarms to indicate variation in flow pressure Isotainers, mixing tanks and storage tanks will be located on a concrete bunded area with plinths within the Processing Plant area • Spray/sprinkler systems installed at the crusher conveyor transfer points
	Prescribed Activity Category 52
Dual fuel natural gas/diesel power plant of 153.7 MW and 2.9 MW standby	
1	7 x 2500 kVA, 2 x 1300 kVA and 1 x 3100 KvA generators giving a capacity of 23,200 kVA. Particulate Matter (PM) QSK78-G9: 0.1 g/bhp-h or 0.46 g/min QSV91G: n/a HSK78G: n/a VOC QSK78-G9: 0.14 g/bhp-h or 6.48 g/min

	Infrastructure QSV91G: 3.04 g/bhp-h or 141.88 g/min HSK78G: 2.7 g/bhp-h or 126.09 g/min Data offered for QSK 78 Diesel Genset, data is based on Tier-1 Emissions. FROM A111380 ('n/a' means the concentration is insignificant and hence not measured)
2	Compressed natural gas daughter station
3	Control System to monitor efficiency of the system
4	Trailer mounted self-contained 350 m^3 gas in bullet type vessels (18 hour supply of gas)
7	Oil tanks within concrete bunded areas
8	Waste oil storage tank
9	Used oil contaminated parts fully enclosed metal bin storage
10	Oily water separator
11	Sedimentation pond
12	Stage 2 Bulk Fuel Storage: • A total of 440 KL (m^3) diesel storage capacity comprising: o 110 kilolitre (kL) (3 x 110kL) self bunded diesel tanks for mining fleet, stored at the mining contractors yard; and o 110 kL (1 x 110kL) sekf bunded diesel tank added to the existing fuel farm • 330 kL (3 x 110kL) self bunded diesel tanks for the power station
13	Stage 2 diesel generators at power station: • 7 x 2500 kVA generators giving a capacity of 17,500 kVA, increasing total power output to 32.5MW • The trailer-mounted self-contained gas supply will be increased from 350 m^3 to 560 m^3 to ensure that all generators have an 18-hour supply of gas
	Prescribed Activity Category 64
Putrescible and inert 100 tpa landfill facilities incorporated within the Monster South Waste Rock Landform (WRL), or West Waste Dump includes the disposal of unserviceable tyres.	
1	Putrescible and inert segregated trenches to maximum depth of 4m bgl.
2	Each cell rock- bunded to prevent wind-blown rubbish from escaping across site
	Prescribed Activity Category 70
Crushing and screening of rock material is required for aggregate, sheeting and stemming material for blasting. Up to a maximum of 50,000 tonnes is anticipated to go through the facility during construction. This mobile plant will be removed on completion of construction activities.	
1	One mobile crushing plant
	Prescribed Activity Category 73
Above ground self bunded fuel storage tanks to a total capacity of 1,036 m^3 of diesel (in aggregate)	
1	440 kL (4 x 110kL) self bunded diesel tanks for mining fleet, located at the mining contractors yard
2	26 kL (1 x 26kL) self bunded diesel tank for camp diesel supply, located at the camp
3	550 kL (5 x 110kL) self bunded diesel tanks for power plant, located at the bulk fuel facility.

	Infrastructure
4	20kL (1 x 20kL, the “day tank”) for the power station will be located in a concrete bund at the bulk fuel facility.
	Prescribed Activity Category 54
Moving sequence batch reactor (SBR) less than 125 m^3/day treatment capacity WWTP, fully assembled and factory tested prior to site arrival	
1	Sequence Batch Reactor treatment facility
2	Five packaged sewage pump stations
3	200 kL Balance Tank
4	300 kL Treated Effluent/Irrigation Tank
5	Associated tanks and equipment
3	High level alarms wired to visual strobe light and sounder to alert of overflows
6	Sludge thickening tank
7	WWTP inlet and outlet flow meters
8	3.04ha spray irrigation area with 30 irrigation impact sprinkler heads and HDPE pipeline PN12.5, expanded to add an additional 1.69 ha and 18 additional impact sprinkler heads. Total irrigation area 4.73ha with 48 sprinkler heads
9	Three strand perimeter fencing around the spray irrigation area and extension
10	Capacity for two and a half days of contingency storage at full camp occupancy in the event of WWTP malfunction
11	Stage 2 Temporary Construction WWTP: • 1 x Sequence Batch Reactor (SBR) with less than 150 m^3/day treatment capacity. • 1 x 200 kL Balance tank fitted with high level alarm wired to visual strobe light and sounder to alert of overflows • 1 x 200 kL Treated effluent / Irrigation tank fitted with high level alarm • 1 x 50kL sludge thickening tank • WWTP containerized with external tanks • Flow meters to be installed at influent inlet point and effluent egress point • The WWTP will be constructed to meet the following water quality emission standards: o Biochemical Oxygen Demand <20mg/L o Total Suspended Solids <30mg/L o Total Nitrogen <30mg/L o Total Phosphorus <7.5mg/L o Chlorine Residual >0.2-2mg/L o pH 6.5-8.5 o *E.coli* <1000cfu/100mL • Stock exclusion fence surrounding entire WWTP facility
12	Stage 2 Temporary Construction WWTP Spray Irrigation Area: • Stock exclusion fence comprising star picket, 3 strand wire and corner strainer posts surrounding entire irrigation area • Internal berm installed inside the fence line from excess soil to prevent surface water runoff from the irrigation area • Operational pipework constructed using HDPE with minimum pressure rating (PN) of 12.5 • Total minimum spray area of 2.63 hectares

<table>
<tr><td></td><td>Infrastructure
Minimum of 26 irrigation sprinklers
Irrigation area boundary coordinates:
<table>
<tr><th>Easting</th><th>Northing</th></tr>
<tr><td>697800,</td><td>7674337</td></tr>
<tr><td>698031,</td><td>7674337</td></tr>
<tr><td>698031</td><td>7674218</td></tr>
<tr><td>697842</td><td>7674218</td></tr>
<tr><td>697842</td><td>7674250</td></tr>
<tr><td>697800</td><td>7674250</td></tr>
</table></td></tr>
<tr><td></td><td>Other activities</td></tr>
<tr><td>1</td><td>Office</td></tr>
<tr><td>2</td><td>Workshop and laydown areas</td></tr>
<tr><td>3</td><td>Laboratory</td></tr>
<tr><td>4

5

6</td><td>Plant complexes

A 500 person accommodation village and associated infrastructure

2 Reverse Osmosis Plants: 1 to facilitate the accommodation camp and 1 to facilitate the Process Plant with a combined throughput of less than 0.50GL or more per year</td></tr>
</table>

5. Legislative context

The following Table 13 outlines the known legislative context for this project in relation to this works approval amendment.

Table 13: Pilgangoora Project Legislative context

Legislation	Number	Subsidiary	Approval
Mining Act (WA) 1978	Mining Proposal (with Closure Plan) (Reg ID 63791) 9 May 2017	PML	Pilgangoora Lithium Tantalum Project - Version 3 on M 4500333; M 4500078; M 4501256; M 4500511; L 4500388; L 4500413; L 4500414
	Mining Proposal amendment (Revised) (Reg ID 68032) 22 August 2017		Pilgangoora Lithium-Tantalum Project, Version 4 on M 4501256; M 4500333; M 4500511; M 4500078; L 4500388; L 4500413; L 4500414; L 4500417. (NB: the Closure Plan did not change between Versions 3 and 4).
	Mining Proposal (Reg ID 70524) 28 February 2018.		This Mining Proposal approval includes TMF cell 1 and TMF cell 2. Fixed plant crushing and screening of ore material has been approved however, mobile crushing and screening is yet to be approved. The proposed increase in the disturbance footprint for the spray irrigation field expansion is currently approved under the Mining Act. The current Mining Proposal does not include a landfill in either the Monster Waste Dump (already approved under W6051/2017/1) or the proposed landfill within the West Waste Dump. Department of Mines, Industry Regulation and Safety (DMIRS) does not have any concerns with any aspect

			of the proposed works approval amendment (DMIRS, 2018).
Granted under section 51E of the EP Act	Clearing Permit CPS 7449-1 23 March 2017	PML	Clearing limited to 1,217 ha on Mining Lease 45/78, Mining Lease 45/333, Mining Lease 45/511, Mining Lease 45/1256, Miscellaneous Licence 45/388, Miscellaneous Licence 45/413, Miscellaneous Licence 45/414
	Clearing Permit amendment CPS 7449-2 3 August 2017		Clearing limited to 1,330 ha on Mining Lease 45/78, Mining Lease 45/333, Mining Lease 45/511, Mining Lease 45/1256, Miscellaneous Licence 45/388, Miscellaneous Licence 45/413, Miscellaneous Licence 45/414, Miscellaneous Licence 45/417
Rights in Water and Irrigation Act 1914	GWL183594 (2)	PML	The annual entitlement for the licence is 1,000,000kL from Southern Borefield on L45/413. This water is for dust suppression and processing. This lease is outside the current approved Premises boundary of Mining Tenement M45/1256.
	GWL183354 (1) 3 March 2017)	PML	The annual entitlement for the licence is 1,250,000 kL from bores located across the mining tenements M45/78, M45/333, M45/511 and M45/1256 for dust suppression, earthworks and construction, camp requirements and road construction purposes. This licence expired on 2 March 2018, however PML applied for a renewal of this licence on 14 February 2018. This licence remains valid until the next version of the licence has been issued by DWER.

5.1 Part IV of the EP Act

The Works Approval Holder stated that the project has not been referred to Part IV of the EP Act for assessment under s38 of the EP Act as the Premises was not considered to have a significant impact on the environment.

5.2 Other relevant approvals

5.2.1 Radiation management

In Western Australia the primary legislation relating to radiation management is the *Radiation Safety Act 1975* and subsidiary legislation. In general, mining operations are mandated to comply with the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Code of Practice & Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing – Radiation Protection Series No. 9 (the Code).

Within the Code it is stated that the International Atomic Energy Agency (IAEA, RS-G-1.7) sets exclusion levels for naturally occurring radioactivity in bulk materials at 1 Becquerel per gram (Bq/g) head-of-chain activity for the uranium and thorium decay chain radionuclides. The activity concentration of 1 Bq/g is currently the internationally-accepted level for defining the scope of regulation for naturally occurring materials containing uranium or thorium.

The Works Approval Holder advised that as part of the tailings test work, a subsample of tailings was assayed by ALS in June 2016. Thorium and Uranium concentrations were 2.6 mg/kg and 3.2 mg/kg respectively. At these concentrations, the combined activity concentration of Thorium and Uranium is approximately 0.05 Bq/g which is an order of magnitude lower than the internationally adopted radiation management trigger value of 1 Bq/g.

Transport of radioactive material in Western Australia is legislated by the *Radiation Safety*

(Transport of Radioactive Substances) Regulations 2002, made under the *Radiation Safety Act 1975*. The regulations commit Western Australia to regulating the transport of radioactive materials as per the requirements of the ARPANSA Code of Practice for the Safe Transport of Radioactive Material – Radiation Protection Series No. 2 (Transport Code). Under the Transport Code (Section IV, Table 1. *Basic Radionuclide Values)* the exemption limit for materials or ores containing natural uranium and thorium is 1 (1×10^0) Bq/g head-of-chain. However, under an additional clause, paragraph 107(e) of the Transport Code states, "natural material and ores containing naturally occurring radionuclides that are either in their natural state, or have been processed only for purposes other than for the extraction of the radionuclides, and that are not intended to be processed for use of these radionuclides, provided that the activity concentration of the material does not exceed 10 times the values specified in para. 401(b), or calculated in accordance with paras 402-406".

Based on the additional clause, paragraph 107(e) of the Transport Code, the limit for transport of materials or ores containing natural uranium and thorium is 10 Bq/g head-of-chain.

Due to the overall low uranium and thorium level details as provided in the Works Approval Holder's supporting documentation, the requirements of the Code "are not applicable" to the Premises. "It is not anticipated that any pre-operational baseline or radiation management actions is needed".

Radiation Management Plan

DMIRS has required the Works Approval Holder to have a Radiation Management Plan for the site in accordance with the requirements of the regulation 16.7 of the *Western Australian Mines Safety and Inspection Regulations 1995.*

The current version of this plan is dated November 2017, however, is in need of an update as it states that no elevations of radionuclides are present. Elevations of Gross Alpha, with increasing trends, have been noted in both the wastewater and groundwater, which exceed the trigger level of 0.5 Bq/L as listed in the ANZECC/ARMCANZ, water quality guidelines. This data is required to be monitored as per the operating Licence L9056/2017/1 for wastewater and groundwater data.

DWER has advised DMIRS of this data with a formal advice request on 23 January 2019 to advise of any concerns or recommendations as a result of this data. DMIRS provided a response with recommendations for Radionuclides Characterisation which has been provided by the Applicant and detailed in Section 5.2.2.

5.2.2 Conditions 1 and 2 Report from Works Approval W6051/2017/1 and Radionuclides Characterisation

Conditions 1 and 2 Report

The Applicant provided the Conditions 1 and 2 Report to DWER which addressed:

- Additional tailings leachate testing using USEPA LEAF test 1313 and ASLP testing methodology;
- Information on the radial extent of the cone of depression around pit dewatering infrastructure to determine whether TMF1 is within the dewatering capture zone. Information must include dewatering contours on a local scale to determine if the footprint of TMF1 is within the capture zone. Drawdown contours must be provided on a map at 50m, 10m, 5m and 1m intervals;
- A seepage model for TMF1 and TMF2 for the life of mine which must:
    - Estimate the total seepage magnitude;
    - Shows seepage flow direction from TMF1 and TMF2;
    - Includes a site specific risk assessment for seepage from TMF1 and TMF2, identifying potential pathways and impacts on receptors including potential impacts to the hyporheic zone of Pilgangoora Creek; and

- Any additional controls required to manage seepage in the event that testing undertaken in indicates that contaminants are at levels of environmental concern.

Radionuclides Characterisation

Previous Conditions 19 and 20 of the Works Approval W6051/2017/1 required regular wastewater and groundwater monitoring, including Gross Alpha, Gross Beta, Radium 226 and Radium 228. Results have shown some samples exceed the Gross Alpha screening level of 0.5 Bq/L within the ANZECC/ARMCANZ Livestock Watering Guidelines. Contaminated Sites Branch and DMIRS, Regional Inspector of Mines, Mines Safety Directorate were consulted and a request for further information provided to Pilgangoora Operations Pty Ltd. The request included the alpha-emitting nuclides concentrations be provided, that are contributing to these elevations in Gross Alpha. A risk assessment was also requested to be conducted to identify the sources of and receptors for the radionuclides. In situations where groundwater containing elevated Gross Alpha levels is located near sensitive receptors, additional water quality investigations are required to identify which particular radionuclides have elevated concentrations and to more fully evaluate the magnitude of the risk they pose to receptors.

Contaminated Sites Technical Advice

The report was forwarded to Contaminated Sites Branch for technical advice. The advice received documented the following:

- The short-term leaching tests have been carried out appropriately, and the conclusion that leachate from these materials is unlikely to cause significant environmental impacts during the life of the mine is generally supported;
- The predicted extent and depth of the cone-of-depression of the water table predicted by numerical modelling is likely to be valid based on an assessment of mine-dewatering using simplified analytical solutions;
- The modelling of seepage from the TSF has been undertaken in an appropriate manner using a suitable finite-element modelling code, and the conclusions of the modelling are supported as are the proposed control measures to further reduce the seepage risk from the facility;
- The proposed groundwater monitoring program is supported;
- It is likely that the combined effects of mine-dewatering and the deposition of mine-wastes in surface repositories have contributed to increased concentrations of uranium in groundwater at the Pilgangoora mine site; and
- It is likely that the leaching of uranium from host rocks under oxidising conditions is the source of the elevated gross-alpha levels measured in groundwater in the area.

Key findings:

1. **The Conditions 1 and 2 report and Radionuclides Characterisation, which included DMIRS advice, was referred to Contaminated Sites Branch and deemed appropriate.**
2. **Conditions 1 and 2 have, therefore, been removed from the works approval as the requirements have been met.**
3. **A reduction in frequency of monitoring from fortnightly has been endorsed as suitable by Contaminated Sites Branch.**

5.2.3 Planning approvals

No planning approvals have been obtained for the project at the time of application submission. The Works Approval Holder will apply to the Shire of East Pilbara for wastewater disposal

approval and for septic tanks with leach drains under the *Health Act 1911*.

5.2.4 Department of Jobs, Tourism, Science and Innovation

This project has not been listed as having an Agreement Act administered by the department.

5.2.5 *Environment Protection and Biodiversity Conservation Act 1999* (Cth)

The Project was not referred to the Commonwealth Department of Environment and Energy.

5.3 Part V of the EP Act

5.3.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations.

The guidance statements which inform this assessment are:

- *Guidance Statement: Regulatory Principles (July 2015)*
- *Guidance Statement: Setting Conditions (October 2015)*
- *Guidance Statement: Decision Making (February 2017)*
- *Guidance Statement: Risk Assessments (February 2017)*
- *Guidance Statement: Environmental Siting (November 2016)*

5.3.2 Works approval and licence history

Table 2 outlines the works approval and licence history for the premises.

5.3.3 Clearing

The clearing of native vegetation is not approved under the Issued Works Approval. Refer to Table 11 for information on known clearing approvals for this project.

6. Consultation

6.1 Recent consultation

Consultation with DMIRS and DWER's CSB has recently occurred as noted in Section 5.2.

The Department of Health was also advised on 9 April 2019 of the Gross Alpha levels in groundwater at the site that are likely to be of natural origin in the Pilgangoora area because of the presence of naturally-radioactive pegmatites in the area.

6.2 Previous consultation

A letter of referral was sent to the DMIRS on 27 February 2018 requesting advice on this works approval amendment. The following comments were received from DMIRS on 16 March 2018 regarding the amendment application:

- Approvals under the *Mining Act 1978* have been obtained for M45/1256, and associated tenements, under Mining Proposal Registration ID 70524, approved 28 February 2018.
- The footprint and geotechnical design of TMF 1 has been approved by the Resources Safety Division and the Environmental Compliance Branch of DMIRS. No concerns with this amendment relating to TMF 1 were raised.
- Fixed plant crushing and screening of ore material has been approved for M45/1256,

however, mobile crushing and screening has not been approved under the *Mining Act 1978*. DMIRS noted that this change can be managed via the 2016 Mining Proposal Guidelines *"Proforma for Notification of Minor Changes to a Mining Proposal".*

- No issues were raised in relation to the expansion of the Category 54 WWTP and associated spray field.
- The current Mining Proposal does not include a landfill in either the Monster Waste Dump or the West Waste Dump. Additionally, the "West Waste Dump" has not been approved by DMIRS, and the (DMIRS) approved site layout differs to that presented in the PML letter (to DWER) dated 19 December 2017. DMIRS has no concerns with the proposed works approval amendment for an additional landfill area, but this will require clarification from PML as to the discrepancies between site plans, as well as management of this change via the 2016 Mining Proposal Guidelines *"Proforma for Notification of Minor Changes to a Mining Proposal".*

6.3 Original consultation

The Application was advertised in the West Australian on 26 June 2017 for a comment period ending on 17 July 2017. A letter inviting comment was sent to the Shire of East Pilbara on 26 June 2017. No comments were received from the Shire of East Pilbara.

A letter of referral was sent to the Department of Parks and Wildlife (now Department of Biodiversity, Conservation and Attractions [DBCA]), Department of Water (DoW), DMP (now Department of Mines, Industry Regulation and Safety [DMIRS]) and an external party on 26 June 2017. The comments received are outlined below.

The following comments were received from DMIRS on 11 July 2017 (DMP, 2017) regarding the Application:

- DMIRS recently approved a Mining Proposal and Mine Closure Plan (REG ID 63791) on M45/1256.
- The Mining Proposal and associated Mine Closure Plan were referred to the Department of Water (DoW) who provided comments on the proposal and raised no significant concerns with the activities as proposed, or management strategies as suggested.
- As part of the assessment process, the TSF (TMF) design was again submitted to DMP's Resources Safety Division for assessment. No significant issues were raised in relation to the geotechnical design of the facility.

The following comments were received from DWER – Land Use Planning/Approvals (Water), on 11 July 2017 (DWER Water, 2017) regarding the Application:

- Regulatory Services (Water) recently reviewed the mine proposal and mine closure plan (MPMCP) for the Pilbara Minerals Pilgangoora project (REG ID63791) and provided comment to the former DMP. The region has also received a groundwater licence and supporting groundwater operating strategy (GWOS) for the project, and this is currently under assessment (*at the time of submission of these comments)*.
- Comments were provided for the assessment of *Category 05 - Processing or beneficiation of metallic or non-metallic ore.*
- The departments' review of the proposed groundwater monitoring, impact management measures and contingency plans presented in the GWOS found them to be reasonable and acceptable, and well designed to protect other users; potential groundwater dependent ecosystems (GDEs); and the nearby Breccia borefield.
- The GWOS has a more detailed monitoring program than was presented in the (*Part V*) application supporting document (*for this assessment*), and also includes five regional monitoring bores (ISCB, Strelley1, Strelley2, GDE_Mon_1 and GDE_Mon_2) to assess

mine related drawdown. Regulatory Services (Water) suggested that it may be useful for these additional monitoring bores to be referenced in the Part V assessment for this project.

- PML and adjacent landholders Altura Mining / Altura Lithium Operations Pty Ltd have collaboratively/ collectively:
    - Approached Strelley Station to access existing monitoring bores Strelley1 and Strelley2 to facilitate early detection of any potential impacts to the groundwater environment, and if required, install further monitoring bores east of Pilbara Mineral's operation.
    - Approached Wallareenya Station with respect to groundwater monitoring and data sharing.
    - Agreed to install two additional monitoring bores on the northern bank of Chinnamon Creek, GDE_Mon_1 and GDE_Mon_2 to facilitate early detection of potential impact to the GDE associated with Chinnamon Creek, and also Mineral Resource's Breccia Borefield.

The DBCA responded on 3 July 2017 (DBCA, 2017). Noting the *Wildlife Conservation and Land Management Act 1984* and the *Wildlife Conservation Act 1950,* the department did not have comment to add in relation to the proposal.

7. Location and siting

7.1 Siting context

The project is located on mining tenement M45/1256 on Wallareenya Pastoral Station, located approximately 90 km south-southeast of the town of Port Hedland and 30 km northeast of the Wodgina Mine in the Pilbara Region (Figure 8). The site is located on Wallareenya Station pastoral lease, an active cattle grazing station and cattle are anticipated to occur within the mining operations area during the life of the Project.

The workforce for the Premises will be accommodated on site, with the accommodation village location presented in Figure 2. In accordance with the DWER Guidance Statement: Risk Assessments, the Camp is not considered a sensitive receptor for the purposes of this assessment.

Altura Lithium Operations Pty Ltd (mine) is located approximately 3km southwest of the Premises. The accommodation facility for the (Altura) Pilgangoora Lithium Project is not within Altura's Premises and has not been considered as a sensitive receptor within this assessment due to the extended distance this accommodation facility is away from the Premises.

Figure 8. Regional Location

7.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 14.

Table 14: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Residential Premises	Wallareenya Homestead more than 30 km north of the Premises. Indee Station more than 30 km northwest of the Premises. South Hedland more than 75 km north of the Premises.
Altura Lithium Operations Pty Ltd Accommodation Camp (ex-Roy Hill Infrastructure Rail Construction Camp 2)	More than 20 km from the Premises.
Wodgina Mine Camp	More than 30 km southwest of the Premises.
Industrial receptors	Altura Pilgangoora Project adjacent tenements (M45/1230 and M45/1231) approximately 3 km southwest of the Premises Wodgina Mine 60 km southwest of the Premises

7.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems are shown in Table 15. Table 15 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting.*

Table 15: Environmental values

Specified ecosystems - Biological component	Distance from the Premises
Threatened/Priority Flora	*No threatened or priority flora has been identified using publicly available GIS datasets.* A study conducted by MMWC Environmental has identified the presence of *"one species listed as Threatened Flora under the Wildlife Conservation Act 1050 (WA) is considered as Possible to occur in the survey area: Pityrodia sp. Marble Bar" (MMWC Environmental, July 2016).* There are no Declared Rare Flora within the Premises. The Works Approval Holders's database search indicated 16 species of Threatened and Priority listed flora occur within the vicinity of the project. Priority species *Heliotropium muticum* was recorded during the July 2016 survey conducted by the Works Approval Holder.
Threatened/Priority Fauna	Conservation significant species have been recorded in the survey area. These include the Rainbow Bee-eater listed under the EPBC Act, the Pilbara Leaf-nosed bat listed under the EPBC Act and the Western Pebble-mouse listed under the Wildlife Conservation Act 1950 (WA) (360 Environmental, July 2016) . Threatened species Pityrodia sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) is considered possible to occur in the survey area.
Threatened Ecological Communities and Priority Ecological Communities	There are no Threatened Ecological Communities or Priority Ecological Communities within or in a 30 km radius of the Premises

Groundwater Dependent Ecosystems	The nearest significant GDE (i.e. a GDE with moderate or higher potential for interaction with subsurface groundwater) to the Pilgangoora project, as identified in the GDE Atlas, is the Chinnamon Creek system (GRM, 2017). The Chinnamon Creek system is classified as having moderate potential for interaction. This ecosystem is located approximately 2 km south of project (and 3 km south of any dewatering activities).
Department of Biodiversity, Conservation and Attractions - Managed Lands and Waters	Mungaroona Range Nature Reserve boundary is located approximately 82 km south-west of the Premises
Public Drinking Water Sources Area (PDWSA)	There are no PDWSA within the Premises.
RAMSAR wetland	No RAMSAR wetlands within 30 km radius of the Premises

7.4 Surface water

The project is located within the eastern portion of the Turner River catchment (within the Port Hedland Coast Basin) to the west of the watershed with the Strelley River (within the De Grey River Basin).

Two primary drainage lines dissect the Premises, with the Houston Creek flowing from east to west through the northern half of M45/1256 and the Pilgangoora Creek (the larger of the two drainage lines) flowing from east to west near the southern boundary of M45/1256 (Figure 3). Both of the two primary drainage lines intersect approximately 4km west of M45/1256, reporting to Chinnamon Creek about 11km west of the Project site before discharging into the Turner River some 13km to the north-west. None of the rivers or creeks in the immediate vicinity of the Project site are perennial and only carry runoff following significant rainfall events (Significant Env, 2016).

A surface water study was undertaken by Groundwater Resource Management (GRM) in 2016 to determine the risks associated with the then proposed locations of mine site infrastructure. The study found that the camp, spray field and nearby abandoned airstrip are situated within the small Northern Creek catchment. The area has a negligible upstream catchment area and is not considered to be at any significant risk of flooding (GRM, 2017, Attachment 2). Northern Creeks' upper reaches are located between 250 m and 500 m to the north-west of the spray field. Northern Creek flows for short durations following rainfall events with extremely variable flow rates (GRM, 2017), which is typical of minor creek lines in the region. Northern Creek flows into Chinnamon Creek approximately 6.5 km south-west of the WWTP spray field. There are no permanent or semi-permanent pools between the Premises and prior to Chinnamon Creek.

7.5 Groundwater

The groundwater licence (GWL183354 (1)) for the project indicates that the Project is located above and is abstracting from the Pilbara fractured rock aquifer.

The hydrogeology of the area is characterised by an easterly draining system, with the groundwater divide immediately to the west of the Project. Alluvial cover is typically thin or absent in the area and mostly confined to the creek beds and minor drainage systems. The weathering profile in the region is also thin, typically less than 20m in depth (GRM,2016).

Groundwater occurrences in the area predominantly occur as fractured bedrock aquifers, whereby permeability in the natural rock is enhanced by fracturing, dissolution and chemical weathering. Away from the fractures permeability in the bedrock is low.

Groundwater levels along the deposits typically range between 170-190mRL. Groundwater flow direction is towards the west, away from the groundwater divide and locally towards Pilgangoora Creek.

In the geotechnical investigations conducted by ATC Williams (ATC Williams 2017a) groundwater was not encountered in any of the test pits but was intersected in each of the boreholes at the TMF site location (and two boreholes at the plant site) between depths of 9.75 m and 13.7 m bgl. Inferred groundwater elevation ranges from RL 159.4 m to 166.2 m in this area with an inferred hydraulic gradient of approximately 1:250 towards the North West.

Groundwater salinities in the area are typically fresh to slightly brackish, ranging from about 600 to 3,000mg/L Total Dissolved Solids (TDS) This low salinity groundwater is typical of areas most affected by direct rainfall recharge, e.g. near catchment divides and within shallow alluvium. Higher salinity groundwater typically occurs lower down in catchments and possibly also within deeper fractured rock aquifers (GRM, 2016).

The distances to surface and groundwater sources are shown in Table 16.

Table 16: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental Value
Major watercourses/water bodies	Pilgangoora Creek located in close proximity (southwest) to TMF 1 and TMF 2 (Figure 3). Northern Creek located approximately 125 m from the expanded irrigation field Houston Creek crosses the premises boundary near the east pit. Other unnamed ephemeral creeks systems are located on the Premises.	Water is used for livestock watering and industrial use.
Groundwater Groundwater is considered fresh to slightly brackish (600 – 3,000 mg/L TDS)	Depth to groundwater is approximately 9.5 metres below ground level. There are no known operational stock watering bores within 5 km of the project. The nearest known operational stock watering bore is on Strelley Station, approximately 45 km east of the project. The WIR data shows there are 27 registered bores within 5 km of the project tenements. The WIR data identified the following bores within 5 km of the project: • Two bores are located to the east of the project (ISDB and ISCB) associated with the disused Lynas Find mine. It is understood these bores are no longer in operation. • Two bores to the west of the project (ISCWB and Coffins Bore), located within the Altura Mining tenement. Bore ISCWB was also installed for the Lynas Find mine and according to the database is of unknown type, although a site observation indicates the bore is a currently un-used production bore. Coffin Bore (which is locally called Coppin Bore) is listed as a domestic bore and discussions with Altura Mining indicate the bore has been decommissioned. The remaining 23 bores are all located along Chinnamon Creek, targeting a known high yielding fractured rock aquifer in the region. These bores are at least 2 km from the Pilgangoora project and include Mineral Resource's Breccia Borefield.	

7.5.1 Monitoring of ambient groundwater

Works Approval W6051/2017/1 contained the following conditions regarding ambient groundwater monitoring:

Condition 15 required a report providing all baseline water quality sampled for the groundwater monitoring bores listed in Schedule 1 of the Works Approval.

Condition 16 required a report be submitted containing groudwater monitoring results from the following bores:

- TMFMB01;
- TMFMB02;
- PWB005;
- PMB001;
- PMB002; and
- PWB004.

Condition 17 required that the following groundwater monitoring bores be constructed that are in the vicinity of TMF1:

- TMFMB3: 697575E 7669675N;
- TMFMB4: 696457E 7670088N;
- TMFMB5: 695880E 7670579N;
- TMFMB6: 696165E 7669570N; and
- New shallow (50m) monitoring bore adjacent to PWB004: 696609E 7670135N.

Condition 18 required that the results from the bores constructed via condition 17 be provided in a report.

Conditions 15, 16, 17 and 18 have been removed from the works approval as the requirements have been met.

The Works Approval Holder has required the removal of two groundwater bores, PWB004 and PWB005, as these are production (pumping) bores, not monitoring bores. PWB004 has been replaced by PWBMB004 and PWB005 has been replaced by PMB005. Groundwater monitoring has been removed from the Works Approval as it is now covered under the operating Licence L9056/2017/1.

Groundwater Chemistry

The Works Approval Holder provided groundwater quality information from bores sampled across the project area in early April 2018. The locations of the groundwater monitoring bores are shown in Figure 9. Some bores were not able to be sampled due to access issues at the time of sampling. This information is combined with data presented in the original (September 2017) Decision Report and is shown in Table 17. A comparison of data against ANZECC/ARMCANZ, 2000 Livestock watering guidelines trigger exceedance and ANZECC/ARMCANZ, 2000 Freshwater guidelines 95% protection limit exceedance is also provided within Table 17 for the purpose of risk assessment review.

The average water depth of the bores able to be sampled across the project area was 13.8mbgl. Groundwater was observed to be fresh to brackish with EC values ranging from 714 - 2350 µS/cm, while TDS ranged from 472 - 2,120 mg/L. pH values observed across the project area ranged from 7.59 - 7.99. These results infer that pH is slightly basic and water quality (TDS) is fresh to slightly brackish.

With the exception of elevated levels of Aluminium in PMB009 and PMB010, Fluoride in PMB002 and sulphate in PB5, all baseline water quality levels provided by the Works Approval Holder are below the recommended levels for livestock drinking water ANZECC/ARMCANZ, 2000 Livestock watering guidelines health trigger exceedance values. Aluminium, Cadmium, Copper, Boron, Nickel, Zinc and Chromium displayed water quality values higher than ANZECC/ARMCANZ, 2000 Freshwater guidelines 95% protection value for freshwater ecosystems. More groundwater monitoring data is available within DWER records, but was too extensive to provide in this report.

Gross Alpha elevations over the ANZECC/ARMCANZ, 2000 trigger values for radioactive contaminants in irrigation water guidelines are shown in Table 18 for TMFMB01.

Table 17: Groundwater monitoring summary

Analyte	Units	ANZECC Livestock (mg/L)	ANZECC Freshwater (mg/L)	PWB001 [3]	PWB002 [3]	PWB004 [11]	PWB005 [11]	PB5 [3]	PMB001 [11]	PMB002 [4]	PMB003 [4]	PMB004 [3]	PMB005 [4]	PMB006 [4]	PMB007 [4]	PMB008 [3]	PMB009 [3]	PMB010 [3]	TMFMB01 [4]	TMFMB02 [4]	TMFMB03 [10]	TMFMB04 [10]	TMFMB05 [10]	TMFMB06 [10]	New shallow bore near [illegible]	SWB1 [3]	MRLPB3 [3]	SBM01 [3]	SBM03 [3]
pH	pH Units	NE	6 to 9	8.3	8.4	8.1	7.9	8.2	8	7.84	7.71	7.99	7.72	7.71	7.68	7.59	7.74	7.79	7.9	7.77	8	7.9	7.9	8.1	8	7.66	8.52	7.24	7.28
Conductivity	@ 25 C µS/cm	NE	NE	1600	2500	/	/	4700	/	2350	1360	2180	1560	1100	970	1330	783	898	714	1460	/	/	/	/	/	2230	1450	685	547
Total Dissolved Solids	mg/L	5000	NE	950	1500	/	/	3500	/	1360	996	2120	1060	736	640	868	581	653	472	1090	/	/	/	/	/	1610	925	502	450
Bicarbonate Alkalinity as HCO_3	mg/L	NE	NE	580	610	/	/	470	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Carbonate Alkalinity as CO_3	mg/L	NE	NE	2	8	/	/	<1	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Total Alkalinity as $CaCO_3$	mg/L	NE	NE	480	510	390	470	380	430	494	437	423	393	412	478	518	338	321	367	407	360	390	280	470	330	450	340	303	228
Total Hardness by Calculation	mg $CaCO_3$/L	NE	NE	510	500	/	/	2,000	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Fluoride by ISE	mg/L	2	NE	0.8	2.1	/	/	0.3	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Fluoride by PC Titrator	mg/L	2	NE	/	/	0.3	1.4	/	**0.7**	2.2	0.8	0.6	1.4	0.6	0.7	0.4	0.2	0.4	0.6	0.6	0.5	0.2	0.3	0.5	0.3	0.7	0.2	0.3	0.3
Gross Alpha	Bq/L																				0.3	0.27	0.55	0.706	0.476				
Gross Bets	Bq/L																				0.08	0.081	0.088	<0.07	0.135				
Nitrite, NO_2 as NO_2	mg/L	30	NE	<0.2	0.8	<0.2	<0.2	/	<0.2	/	/	/	/	/	/	/	/	/	/	/	0.6	<0.2	<0.2	<0.2	<0.2	/	/	/	/
Nitrate, NO_3 as NO_3	mg/L	400	NE	11	34	2.9	3.9	100	10	/	/	/	/	/	/	/	/	/	/	/	3.6	4.3	<0.2	3.2	0.2	/	/	/	/
Sulfate, SO_4	mg/L	1000	NE	58	170	45	100	1300	92	135	50	421	67	36	19	42	85	66	32	68	140	31	16	64	50	205	133	48	44
Aluminum, Al	mg/L	5	0.055	0.007	0.037	0.017	0.025	/	0.25	0.02	0.83	0.001	0.09	0.06	0.04	0.36	7.6	5.55	0.13	0.02	<0.005	<0.005	0.009	0.009	0.006	0.04	0.02	0.27	3.88
Antimony, Sb	mg/L	NE	ID	<0.001	<0.001			/		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	/	/	/	/	/	<0.001	<0.001	<0.001	<0.001
Arsenic, As	mg/L	0.5	0.013 As V, 0.024 AsIII	0.027	0.016	0.014	0.26	/	0.023	0.023	0.02	0.034	0.018	0.0002	0.038	0.044	0.003	0.003	0.001	0.008	0.005	0.004	0.002	0.009	0.005	0.068	<0.001	0.004	0.012
Barium, Ba	mg/L	NE	NE	0.029	0.066	/	/	/	/	0.069	0.089	0.099	0.039	0.226	0.016	0.024	0.319	0.16	0.137	0.154	/	/	/	/	/	0.025	0.001	0.108	0.057

Bismuth, Bi	mg/L	NE	ID	<0.001	<0.001	<0.001	<0.001	/	<0.001	/	/	/	/	/	/	/	/	/	/	/	<0.001	<0.001	<0.001	<0.001	<0.001	/	/	/	/
Boron, B	mg/L	5	0.37	0.6	1.10	/	/	/	/	0.79	0.36	0.64	0.44	0.17	0.32	0.5	0.35	0.4	0.24	0.79	/	/	/	/	/	0.83	0.48	0.22	0.21
Cadmium, Cd	mg/L	0.01	0.0002	<0.0001	<0.00001	0.0001	0.0002	/	0.0001	<0.00001	0.0003	0.003	0.002	<0.00001	<0.00001	<0.00001	0.001	<0.00001	<0.00001	0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.00001	<0.0001	<0.0001	<0.0001
Calcium, Ca	mg/L	1000	NE	59	61	80	70	71	62	57	90	106	73	100	65	56	74	62	52	94	75	82	65	39	73	26	6	39	29
Chloride, Cl	mg/L	NE	NE	230	410	220	350	690	240	440	240	504	314	141	78	193	55	119	45	321	320	190	35	190	230	530	301	76	63
Chromium, Cr^{VI}	mg/L	1	0.001 Cr^{VI}	<0.001	<0.001	<0.004	<0.004	/	<0.004	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.006	0.31	0.024	<0.001	0.002	<0.004	<0.004	<0.004	<0.004	<0.004	0.008	<0.001	0.002	0.032
Cobalt, Co	mg/L	1	ID	<0.001	<0.001	<0.001	<0.001	/	0.001	<0.001	0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.007	0.005	0.002	<0.001	0.002	<0.001	0.001	<0.001	0.002	0.039	<0.001	0.004	0.003
Copper, Cu	mg/L	1	0.0014	0.001	0.002	0.02	0.009	/	0.002	<0.001	0.002	0.004	<0.001	<0.001	<0.001	0.002	0.016	0.012	0.001	0.001	<0.001	0.002	<0.001	0.002	<0.001	0.003	<0.001	0.002	0.004
Iron, Fe	mg/L	ID	ID	0.01	0.011	0.02	0.029	0.02	0.19	<0.05	0.87	<0.05	0.12	0.74	<0.05	0.35	8.01	6.11	0.49	<0.05	<0.005	<0.005	0.014	<0.005	<0.005	0.05	1.1	0.56	5.64
Potassium, K	mg/L	NE	NE	1.6	4.1	1.7	1.3	6.1	1.7	3	3	4	1	2	<1	1	11	10	11	4	8	1.8	3.9	2.7	8	14	7	5	4
Lead, Pb	mg/L	0.1	0.0034	<0.001	<0.001	0.005	<0.001	/	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Lithium, Li	mg/L	NE	NE	1.70	1.10	0.36	0.62	/	1.1	/	/	/	/	/	/	/	/	/	/	/	1.1	0.2	0.0	0.3	0.3	/	/	/	/
Magnesium, Mg	mg/L	ND	ND	88	85	100	100	440	95	95	102	225	104	79	83	107	41	45	33	105	100	89	25	62	79	148	110	58	43
Manganese, Mn	mg/L	NT	NE	0.025	0.037	0.0	0.001	0.006	0.036	/	/	/	/	/	/	/	/	/	/	/	0.29	0.002	0.49	0.017	0.74	/	/	/	/
Mercury, Hg	Mg/L	0.02	0.006 (inorganic)	/	/	<0.000005	<0.000005	/	<0.000005	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.000005	<0.000005	<0.000005	<0.000005	<0.0000005	<0.0001	<0.00001	<0.0001	<0.0001	<0.0001
Molybdenum, Mo	mg/L	0.15	ID	0.003	0.01	0.001	0.003	/	0.007	0.005	0.001	<0.001	0.002	0.003	<0.001	<0.001	0.006	0.006	0.019	0.003	0.01	<0.001	0.006	0.006	0.008	0.001	<0.001	0.002	0.001
Nickel, Ni	mg/L	1	0.011	0.001	0.002	0.005	0.002	/	0.002	<0.001	<0.001	0.003	<0.001	0.001	<0.001	0.004	0.015	0.013	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.002	0.002	<0.001	0.017	0.024
Niobium, Nb	mg/L	NE	NE	<0.005	<0.005	<0.005	<0.005	/	<0.005	/	/	/	/	/	/	/	/	/	/	/	<0.005	<0.005	<0.005	<0.005	<0.005	/	/	/	/
Total N	mg/L	NE	NE	/	/	0.72	0.96	/	2.4	4.2	1.7	23.3	2.1	0.5	1.2	1.1	0.2	0.3	0.3	1.1	1.6	0.98	0.11	0.8	0.22	1.6	0.2	0.2	<0.1
Total P	mg/L	NE	NE	/	/	0.03	<0.02	/	0.03	<0.01	0.04	<0.05	0.01	0.08	<0.01	0.03	0.08	0.11	0.06	0.02	0.3	0.03	0.04	0.09	0.08	0.02	<0.01	0.06	0.04
Phosphorus, P	mg/L	NE	NE	<0.05	0.32	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Radium-226	Bq/L	5	NE	0.075	<0.043			/		/	/	/	/	/	/	/	/	/	/	/						/	/	/	/
Radium-228	Bq/L	2	NE	<0.099	0.048			/		/	/	/	/	/	/	/	/	/	/	/						/	/	/	/
Selenium, Se	mg/L	0.02	0.011	0.004	0.011	0.002	0.003	/	0.003	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.002	<0.001	<0.001	0.003	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Silica,	mg/L	NE	NE	/	/	26	24	0.081	28	/	/	/	/	/	/	/	/	/	/	/	19	25	14	22	17	/	/	/	/

Soluble																											
Sodium, Na	mg/L	NE	NE	160	370	67	230	330	130	299	85	179	147	69	79	111	74	102	86	133	150	44	34	190	50	295	173	60	68
Thallium, Tl	mg/L	NE	ID	<0.001	<0.001	<0.001	/	/	<0.001	/	/	/	/	/	/	/	/	/	/	/	<0.001	<0.001	<0.001	<0.001	<0.001	/	/	/	/
Thorium, Th	mg/L	NE	ID	<0.001	0.001	<0.001	<0.001	/	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Tin, Sn	mg/L	NE	ID	<0.001	0.001	<0.001	<0.001	/	<0.001	<0.01	0.003	<0.001	0.003	0.004	0.005	0.004	0.011	0.108	0.003	0.001	<0.001	0.004	0.015	0.009	<0.001	0.002	0.058	0.058	0.038
Uranium, U	mg/L	0.2	ID	0.006	0.007	0.005	0.005	/	0.005	0.006	0.004	0.004	0.006	0.016	0.002	0.002	0.01	0.025	0.03	0.013	0.008	0.004	0.015	0.01	0.01	0.002	<0.001	0.008	0.001
Vanadium, V	mg/L	ND	ID	0.11	0.096	/	/	/		0.13	0.03	0.05	0.07	<0.01	0.08	0.09	0.02	0.02	<0.01	0.03	/	/	/	/	/	0.02	<0.01	<0.01	<0.01
Zinc, Zn -	mg/L	20	0.008	<0.005	<0.005	0.110	0.21	/	0.006	<0.005	<0.005	0.041	<0.005	<0.005	<0.005	0.013	0.019	0.03	0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	0.022

1. The following codes are from ANZECC/ARMCANZ, 2000 Livestock watering criteria:
   ND = Not determined. Insufficient background data to calculate.
   NT = Not sufficiently toxic
   NE = Not established
2. Sampled in 2017
3. Sampled 28/3/18
4. Sampled 4/4/18
5. ID = Insufficient data to derive a reliable trigger value ANZECC/ARMCANZ, 2000 Freshwater guidelines.
6. / = not analysed, no data provided
7. Note: Rubidium not tested for in analytical suites
8. Red highlight indicates ANZECC/ARMCANZ, 2000 Livestock watering guidelines, health trigger exceedance values exceeded
9. Purple highlight indicates ANZECC/ARMCANZ, 2000 Freshwater guidelines 95% protection guideline value for freshwater ecosystems exceeded
10. Sampled 14/8/18
11. Sampled July 2018

Accessibility for sampling: No Sample provided for PMB001 previous to July 2018 (too deep +40m), MRLMB3 and MRLMB4 not accessible at the time of sampling (April 2018), SBM02 was blocked.

Table 18: Radionuclide groundwater monitoring at TMFMB01

	TMFMB01							
	18/07/18	**31/07/18**	**14/08/18**	**29/08/18**	**12/09/18**	**25/09/18**	**10/10/18**	**24/10/18**
Gross Alpha	1.77	1.70	2.18	1.79	3.04	2.42	3.78	3.19
Gross Beta	0.08	0.08	0.08	0.07	0.26	0.13	<0.390	<0.330
Radium 226	0.07	0.05	0.05	0.03	0.05	0.05	-	-
Radium 228	<0.140	0.04	<0.130	<0.100	<0.130	<0.095	-	-

1. - = not analysed, no data provided

2. Red highlight indicates ANZECC/ARMCANZ, Trigger values for radioactive contaminants for irrigation water exceeded.

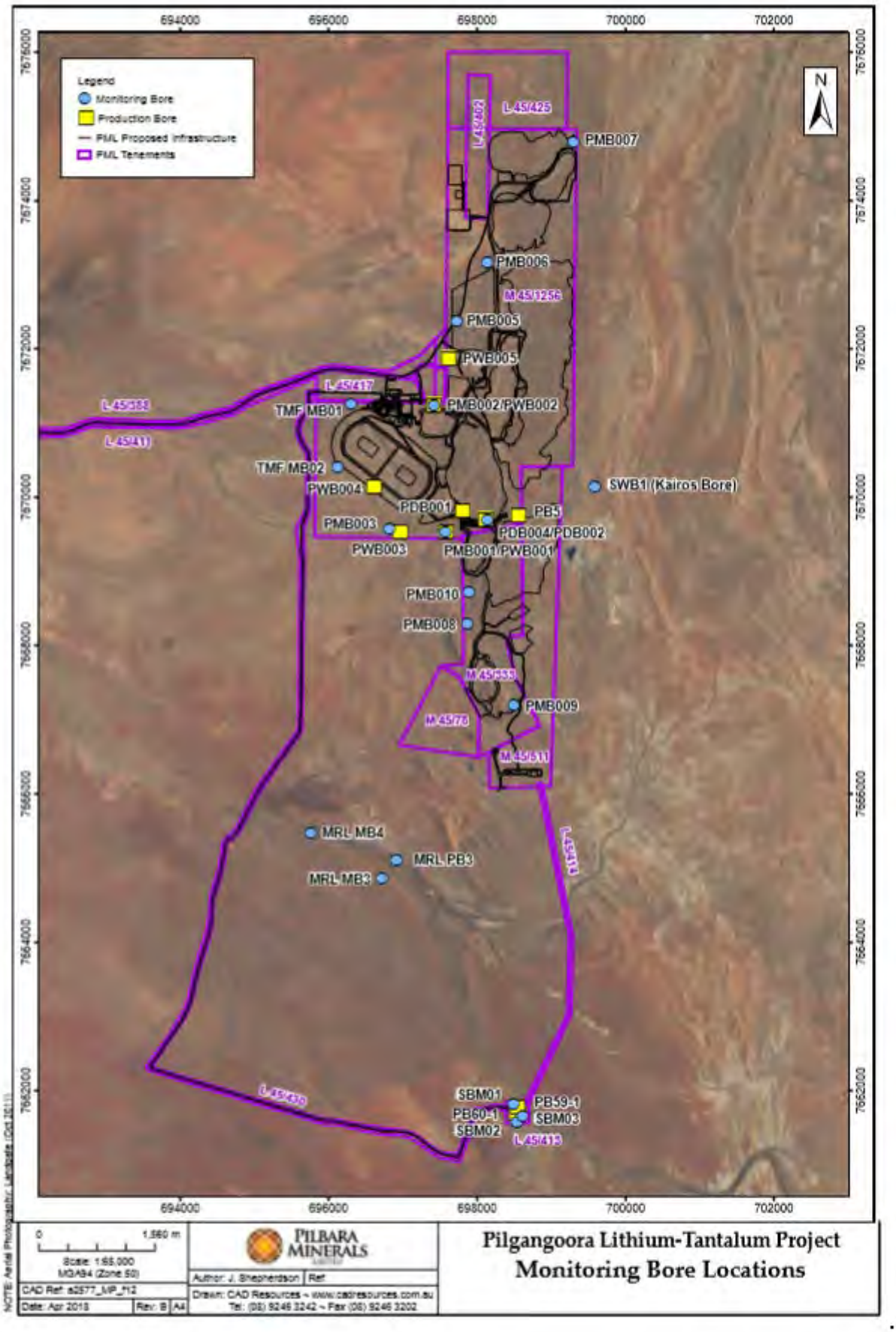

Figure 9: Current Monitoring Bore Locations

7.5.2 Modelling of TMF seepage

Condition 2 of the Works Approval W6051/2017/1 required a seepage model for TMF1 and TMF2 be provided that:

- Estimates the total seepage magnitude;
- Shows seepage flow direction from TMF1 and TMF2;
- Includes a site specific risk assessment for seepage from TMF1 and TMF2, identifying potential pathways and impacts on receptors including potential impacts to the hyporheic zone of Pilgangoora Creek; and
- Any additional controls required to manage seepage in the event that testing undertaken indicates that contaminants are at levels of environmental concern.

Two scenarios were modelled:

- Scenario 1 uses extremely low rock permeability, forcing seepage to propagate laterally and thus groundwater intersects Pilgangoora Creek by year 6 at very low rates; and
- Scenario 2 uses measured rock permeability from geotechnical investigations and this higher permeability allows seepage to propagate vertically, remaining at 40 metres below the creek level, thus not impacting on Pilgangoora Creek.

The outcome will likely be somewhere between these two scenarios, with mine dewatering activities influencing the seepage. An average of the two models results in groundwater remaining approximately 20 metres below the creek level.

Contaminated Sites Branch verified that the modelling of seepage from the TMFs has been undertaken in an appropriate manner using a suitable finite-element modelling code, and the conclusions of the modelling are supported as are the proposed control measures to further reduce the seepage risk from the facility.

7.6 RO System Brine and WWTP effluent

Fortnightly monitoring of RO brine and RO brine mixed with WWTP effluent had been required under Works Approval W6051/2017/1. The results are provided in Table 19 below. It should be noted that elevations in fluoride and Gross Alpha are present above the ANZECC/ARMCANZ, 2000 guidelines, Short-term trigger values for irrigation. DWER's Contaminated Sites Regulation Branch has stated that there is unlikely to be significant impacts on vegetation and soil fauna from the use of water that contains about 2.9 mg/L of fluoride as this concentration is only marginally above the short-term irrigation value of 2 mg/L. It is likely that the ongoing use of water with this fluoride concentration will cause concentrations of this anion to progressively increase in groundwater beneath the site due to the effects of evaporative concentration and due to physical and chemical processes that will allow fluoride to have high mobility soils beneath the irrigation area.

It should be noted that the original commitment was for TDS of irrigation water to meet <1,000mg/L, however, this has been elevated so 4,000mg/L has been used in line with the Livestock drinking water guidelines. The brine water will also be mixed with raw water and used in dust suppression.

Table 19: Camp RO Brine and WWTP Discharge Data

	RO Brine									RO brine and WWTP effluent								
Parameter (mg/L)	31/07/18	14/08/18	29/08/18	12/09/18	25/09/18	10/10/18	24/10/18	07/11/18	21/11/18	31/07/18	14/08/18	29/08/18	12/09/18	25/09/18	10/10/18	24/10/18	07/11/18	21/11/18	Trigger[1]
Volume	-	797	1010	918	497	828	705	793	465	1974	882	1483	1527	997	1233	912	1189	1508	-
TDS	2100	3000	2900	2700	3300	1700	3200	3000	2400	700	1700	2100	1300	1500	1200	1200	2100	2200	<1,000
TSS	-	-	-	-	-	-	-	-	-	11	6	28	34	6	-	-	-	-	<30
E.coli	-	-	-	-	-	-	-	-	-	<10	<1	<1	<1	22	-	-	-	-	<1,000
pH (pH units)	8	8.1	8.1	8.3	8.1	8.1	8.3	8	8.3	8.1	8.2	8.2	8.2	8.2	8.2	8.2	8.1	8.3	6.5-8.5
BOD	-	-	-	-	-	-	-	-	-	13	<5	13	13	10	<5	<5	<5	<5	<20
Total P	0.13	0.09	1	0.12	0.45	0.05	0.04	0.09	0.06	0.55	0.46	1.2	2	0.61	0.68	0.66	0.74	1.1	<7.5
Total N	5.5	6.6	4.9	2.6	6.9	3.2	6.6	5.6	4.5	44	22	10	14	7.6	6.3	9.7	15	7.8	<30
Al	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.079	0.066	0.17	0.12	0.086	0.094	0.11	0.069	0.057	<20
As	0.041	0.058	0.058	0.05	0.054	0.032	0.058	0.058	0.042	0.005	0.032	0.039	0.021	0.022	0.017	0.019	0.036	0.039	<2.0
Bi	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Br	4.2	4.8	3.8	4	5	2.4	5.4	4.8	3.9	5.4	1.9	2.6	1.5	1.8	1.4	1.4	2.6	3.5	-
Cd	0.0003	0.0002	0.0003	0.0002	0.0003	0.0002	<0.0001	0.0003	0.0002	<0.0001	<0.0002	<0.0001	0.0001	0.0001	<0.0001	<0.0001	0.0002	0.0002	<0.05
Cs	0.033	0.058	0.053	0.052	0.064	0.030	0.060	0.062	0.045	0.009	0.030	0.040	0.023	0.026	0.018	0.020	0.037	0.04	-
Ca	120	170	160	150	170	96	130	170	130	25	94	110	66	74	56	69	110	120	-
Total hardness as $CaCO_3$	1000	1400	1500	1300	1500	880	1500	1500	1200	180	770	1000	550	640	500	570	940	1000	-
Cl	610	980	820	850	1100	570	1100	1100	820	280	660	820	420	540	380	500	720	760	-
Cr	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<1
Co	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.1
Cu	0.017	0.007	0.006	0.006	0.006	0.004	0.001	0.007	0.004	0.010	0.017	0.024	0.015	0.007	0.006	0.011	0.023	0.002	<5
F	2.8	3.8	3.8	3.2	3.9	2.2	3.5	4.1	2.9	0.6	2.1	2.9	1.4	1.7	1.2	1.3	2.6	2.7	<2
Gross Beta	0.077	0.122	0.177	0.206	0.095	0.066	0.058	0.068	-	<0.063	0.077	0.050	0.071	-	0.059	0.045	0.096	-	0.5
Gross Alpha	0.443	0.714	0.783	0.829	1.190	0.387	0.728	1.230	-	0.044	0.325	0.224	0.161	-	0.159	0.145	0.144	-	0.5
Cr^{6+}	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.019	<0.004	<0.004	<0.004	<0.004	<0.004	0.026	0.025	<0.004	<1
Fe	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.071	0.006	0.008	0.015	0.026	0.009	0.024	0.0042	<0.005	<10
Pb	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<5
Li	1.4	2.0	1.8	1.4	1.9	1.1	2.0	1.9	1.4	0.24	0.86	1.60	0.59	0.84	0.66	0.72	1.20	1.30	<2.5
Mg	180	240	250	230	270	150	290	260	210	30	130	180	94	110	87	96	160	180	-

Mn	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.015	0.01	0.004	0.014	0.017	0.013	0.013	0.012	0.004	<10
Hg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.002
Ni	0.008	0.003	0.003	0.003	0.003	0.002	0.003	0.003	0.002	0.006	0.006	0.008	0.006	0.006	0.006	0.001	0.006	0.003	<2
Nb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
K	2.2	3.1	3.1	2.7	2.5	1.8	3.7	3.3	2.5	12	8.1	5.3	9.7	8.9	7.8	10	7.0	3.9	-
Rb	0.012	0.021	0.020	0.018	0.022	0.011	0.022	0.022	0.016	0.016	0.019	0.02	0.018	0.019	0.015	0.020	0.021	0.017	-
Se	0.006	0.007	0.009	0.007	0.008	0.005	0.009	0.008	0.007	0.001	0.004	0.006	0.003	0.003	0.003	0.003	0.005	0.006	<0.05
Radium 226	0.024	0.038	0.028	0.034	<0.44	-	-	-	-	<0.051	<0.059	0.055	<0.056	-	-	-	-	-	5
Radium 228	<0.120	<0.098	<0.130	0.077	<0.095	-	-	-	-	<0.150	<0.110	0.053	<0.170	-	-	-	-	-	2
Si	45	66	54	48	55	30	58	56	42	29	40	20	30	39	18	18	33	36	-
Na	370	610	570	470	600	340	590	590	470	170	310	470	250	300	230	270	390	430	-
SO_4	190	270	270	260	300	180	300	320	260	44	140	200	110	140	100	120	200	240	-
Ta	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
Tl	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
U	0.011	0.014	0.014	0.014	0.015	0.008	0.013	0.015	0.011	0.001	0.007	0.010	0.006	0.007	0.004	0.004	0.009	0.010	<0.1
Zn	0.021	0.010	0.008	0.009	0.010	0.006	<0.005	0.007	0.006	0.035	0.041	0.021	0.031	<0.001	0.050	0.028	0.063	0.007	<5

Note 1: Derived from the ANZECC/ARMCANZ, 2000 guidelines, Short-term trigger values for irrigation

7.7 Geology and Soils

7.7.1 Site Overview

The project is within the East Strelley Greenstone Belt of the Archean North Pilbara Craton, in the western part of the well exposed East Pilbara Granite Greenstone Terrane.

The region is underlain by Archean rocks comprising volcanic, sedimentary, mafic and ultramafic rocks. The mineralised zones contain varying amounts of lepidolite (lithium rich mica), spodumene (primary lithium ore), tantalite (primary tantalum ore), cassiterite (tin ore) and minor tapiolite (niobium and tantalum ore).

DWER's GIS dataset (Northcote, 1960-68) identifies soils within the Premises as being under the following classifications:

Oc63 - Pediplains on granite; more dissected than unit Oc62 and usually occurring as a zone flanking the main stream courses: chief soils are hard alkaline red soils (Dr2.33) and (Dr2.43). There are more areas of (Um5.11) soils on calcrete (kunkar) than in unit Oc62 and some (Uc5.11) and (Uc1.22) soils occur along creeks.

Gf1 - Steep ranges on basic lavas along with dolomites, tuff, banded iron formations, and dolerite dykes, with some narrow valley plains and high-level gently undulating areas of limited extent. The soils are generally shallow and stony and there are large areas without soil cover: chief soils are brown loams (Um6.23) along with significant areas of earthy loam (Um5.51) soils. (Dr2.33) soils occur on lower slopes with (Uf6.71) and (Ug5.37) soils on valley floors.

7.7.2 TMF area

Geotechnical investigations were conducted by ATC Williams (ATC Williams 2017a). The following information was presented in their 2017 report (115275.03R02).

Superficial deposits

Superficial deposits in the TMF area typically comprised very dense, fine to coarse, red brown or brown sandy clayey gravel with occasional cobbles to depths of less than 1 m. At Pilgangoora Creek, geotechnical investigations (ATC Williams 2017a) encountered clayey gravel to 3.3 m depth.

Adjacent to minor drainage lines, medium dense to very dense, fine to coarse, red brown or pale brown or orange brown clayey sand was also identified to shallow depths (<1 m).

Medium dense to dense, fine and medium, brown or pale red brown and white silty sand was encountered in TP12-TMF (Figure 10) and TP13-TMF between 0.0 m and 0.8 m bgl.

Low plasticity, fine to coarse, red brown clayey sand was encountered in TP22-TMF between 0.0 m and 0.5 m bgl.

In –situ permeability testing of the superficial soils permeability was calculated at between 1 x 10^{-6} m/s and 47 x 10^{-6} m/s (ATC Williams, 2017a).

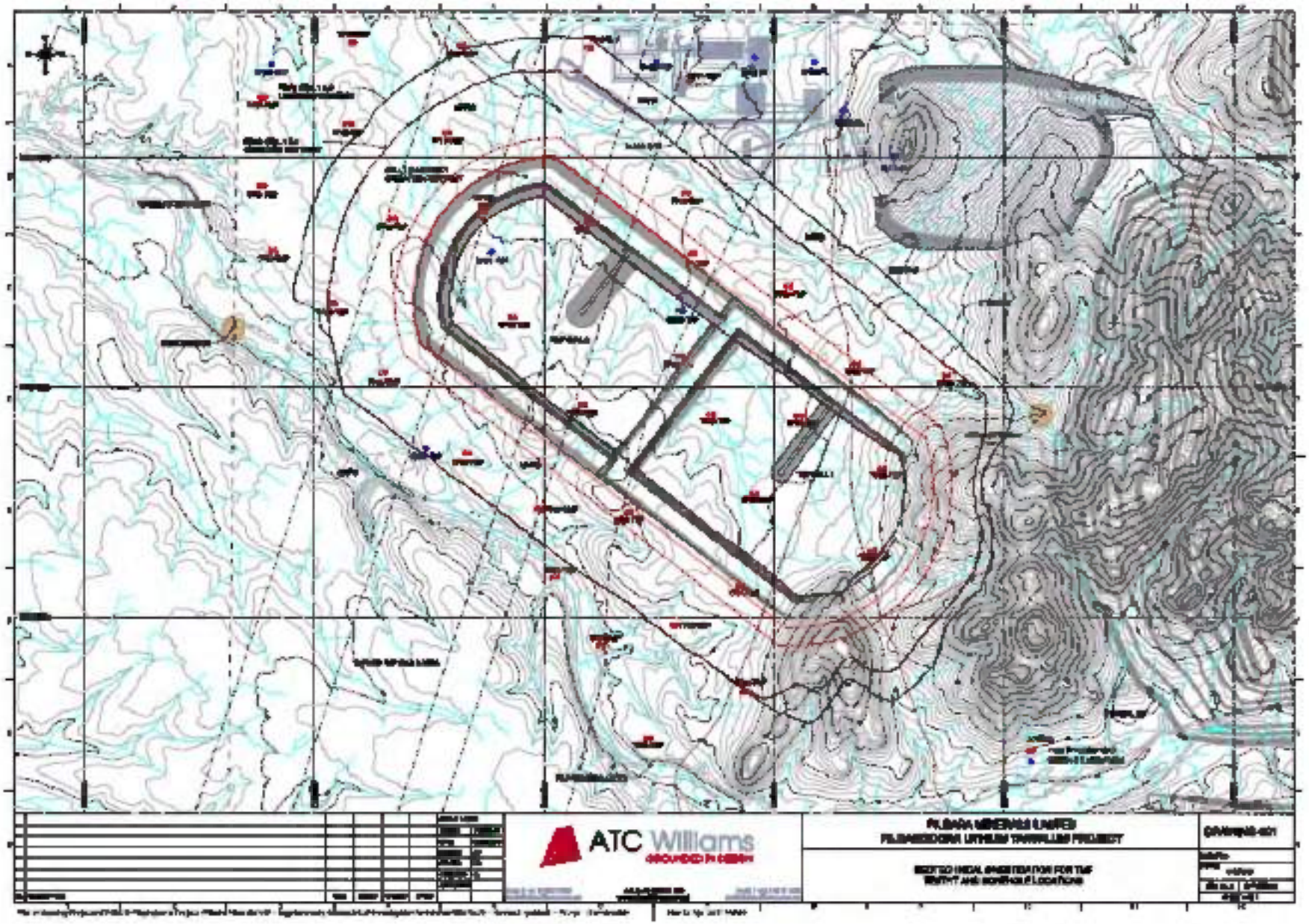

Figure 10: Overview of Geotechnical Investigation Locations (ATC Williams 2017a)

Calcrete

ATC Williams (2017 a) identified that calcrete was exposed at the ground surface or sub-cropped at shallow depth over significant areas of the TMF site (inclusive of TMF1 and TMF 2). The calcrete was typically nodular and cemented, extremely to moderately weathered, very low to medium strength, white or pale grey white. Thin partings of red brown clay were encountered in the calcrete at TP08-TMF.

The upper exposure of the calcrete was typically cemented to a depth of 500 mm.

In –situ permeability testing of the calcrete (and fractured upper surface) of the rock mass was calculated at between 0.6 x 10^{-6} m/s and 10 x 10^{-6} m/s within the TMF area.

Rock

BH01-TMF and BH01-TMF are located inside TMF2 impoundment area. There were no boreholes drilled during the ATC Williams 2017a investigations within TMF 1 impoundment area.

The predominant rock type identified in the western part of the TMF area (TMF2) was extremely to highly weathered, white pale grey granite of very low and low strength. Locally, thin pegmatite dykes are visible in outcrop and were intersected in three of the test pits. Thin intrusive pegmatite layers between 0.4 m to 0.6 m thick were also encountered in BH05-TMF (west of TMF 2 embankment, adjacent to Pilgangoora Creek) between 12.4 m and 13.6 m bgl. The layers were typically highly weathered, pale grey; fine to coarse grained and foliated.

At BH01-TMF (inside TMF 2 impoundment area) and BH04-TMF (outside and northwest of TMF 2), the granite rock mass was generally extremely weathered, with pale yellow brown discolouration and was of very low to low strength. At BH01-TMF (inside TMF 2 impoundment area), the rock was highly fractured above 2.0 m depth.

Mafic rocks are present in the eastern part of the TMF site, predominantly comprising metabasalt. Dolerite (or basalt) dykes with an inferred trend to the NNE were also intersected in the western part of the TMF area. Where encountered, the mafic rocks were typically highly weathered and of medium or high strength.

A granite/dolerite contact was intersected in BH03-TMF (under the Process Water Dam area) at 0.5 m depth and thin dolerite dykes were penetrated at BH04-TMF (2.2 m thick) and BH05-TMF (west of TMF 2 embankment, adjacent to Pilgangoora Creek) (0.8 m thick).

Mica schist was identified in the central site area in BH02-TMF (inside TMF 2 impoundment area), BH05-TMF and TP36-TMF (within Pilgangoora Creekline). The schist was typically extremely to highly weathered, pale grey / pale red brown and discontinuity surfaces had a soapy texture. The rock was of very low strength. Open and silty sand infilled joints had developed along the foliation in the upper 2 m to 3 m but tight discontinuities were observed thereafter.

A localised bed of conglomerate was encountered in TP07-TMF (outside and northwest of TMF 2) between 0.7 m and 1.3 m bgl. It was highly weathered, medium strength, red brown with purple and yellow with fine and medium gravel sized, sub-rounded clasts. The conglomerate bed was also identified in BH04-TMF (outside and northwest of TMF 2) where it was 3 m thick, contained partings of pale red brown clayey sand and overlay basalt /dolerite.

Occasional quartz veins outcrop in the TMF area, and a shallow sub-crop was encountered at the base of TP02-TMF (outside, west of TMF 2) at 1.1 m depth. A discrete quartzite layer was also encountered in BH04-TMF (outside and northwest of TMF 2) between 6.3 and 7.2 m bgl.

7.7.3 WWTP Spray field

No site-specific geological information was provided for the WWTP spray field area.

A soil survey of the project area was conducted in 2016, with one sampling location in the vicinity

of the camp and spray field. The spray field is located within the Macroy Land System, described as “comprising stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands”. The soils in the area of the spray field are red sandy loam with fine gravel throughout. Photograph 2 shows the soil typical of the area (Significant Environmental Services 2016). The high loam content of the soil places it in the “Fine grained soils” category as defined by Table 1 of WQPN 22.

Photograph 2: Soil sample location near the spray field.

8. Risk assessment

8.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Tables 17 and 18.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 20 and Table 21 below.

Table 20: Identification of emissions, pathway and receptors during construction

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction and the mobilisation and positioning of infrastructure	Vehicle movements on unsealed access roads	Noise	No residences or other sensitive receptors in close proximity	Air / wind dispersion	None expected	No	There are no residential receptors located within 30 km from the Premises.
		Dust			None expected	No	There are no residential receptors located within 30 km from the Premises.
	Construction of new buildings, plant and infrastructure	Noise	No residences or other sensitive receptors in close proximity	Air / wind dispersion	None expected	No	There are no residential receptors located within 30 km from the Premises.
		Dust			None expected	No	There are no residential receptors located within 30 km from the Premises.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Dust Suppression Including Stage 2 Processing Train	Use of water containing elevated levels of aluminium, arsenic, copper, chromium, zinc, boron, lithium and nitrate on roads, stockpiles and infrastructure	Elevated levels of aluminium, arsenic, copper, chromium, zinc, boron, lithium and nitrate into the environment	Localised environment receiving runoff and road-side vegetation	Accumulation through soil profile	Accumulation of aluminium, arsenic, copper, chromium, zinc, boron, lithium and nitrate in the localised environment	Yes	The use of groundwater for dust suppression purposes was not risk assessed for the original works approval. Based on the provision of additional information on groundwater quality from the area, since the original (2017) assessment of the project, the risk of impact from accumulation of metals and non-metals in the environment is deemed to be required. See detailed risk assessment in section 8.4.

Table 21: Identification of emissions, pathway and receptors during operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Raw Water Tank and Process Water Pond	Storage of water	Raw water and process water	Soil, groundwater and vegetation	Direct discharge	Contamination to soil and groundwater and negative impacts to vegetation	Yes	See detailed risk assessment in Section 8.10.
All infrastructure	Use of site infrastructure	Contaminated stormwater	Soil, groundwater and vegetation	Direct discharge	Contamination to soil and groundwater and negative impacts to vegetation	Yes	See detailed risk assessment in Section 8.9.
Operation of Processing Trains	Use of processing infrastructure	Dust	No residences or other sensitive receptors in close proximity	Air / wind dispersion	None expected	No	There are no residential receptors located within 30 km from the Premises. The majority of the process is a wet process and spray/sprinkler systems are to be implemented in the crushing circuit and crusher conveyor transfer points.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Noise	No residences or other sensitive receptors in proximity	Air / wind dispersion	Amenity	No	There are no residential receptors located within 30 km from the Premises.
Tantalite Dressing Facility	A dry process and uses a screening and magnetic separation process. The circuit uses air tables to separate the product based on size. Magnets are then used to remove magnetic impurities. Wastes are sent to the TMF.	Dust	No residences or other sensitive receptors in close proximity	Air / wind dispersion	None expected	No	The facility will be incorporated to the tail end of the gravity separation circuit of the Stage 1 processing train, which currently produces the tantalite concentrate. It is located within a concrete floored, enclosed shed, with dust extraction system.
		Noise	No residences or other sensitive receptors in proximity	Air / wind dispersion	Amenity	No	There are no residential receptors located within 30 km from the Premises.
Operation of power station **Including Stage 2 Power Station**	Operation of power station at new location within L45/147 tenure, approximately 100m from the location demonstrated in the original Works Approval	Air emissions of nitrogen oxides, sulfur oxides, carbon monoxide and volatile organic compounds	No residences or other sensitive receptors in proximity	Air / wind dispersion	Health and amenity	No	No sensitive receptors present at the constructed location within L45/147. The Delegated Officer considers 5km to be a sufficient separation distance for emissions generated by power stations and the risks for this facility were adequately assessed in the original assessment (as amended November 2017). Stage 2 generators are an extension of Stage 1 and conforms to all the requirements of the existing Stage 1 storage.
		Noise	No residences or other sensitive receptors in proximity	Air / wind dispersion	Amenity	No	No sensitive receptors present at the constructed location within L45/147.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Operation of fuel farm **Including Stage 2 Fuel and chemical storage**	Storage and use of hydrocarbons	Spills and breach of containment	Soil and vegetation adjacent to areas of spill or breach	Direct discharges to land	Soil contamination inhibiting vegetation growth and survival and health impacts to fauna	No	The Delegated Officer considers that the risks from spills and leaks of hydrocarbons and chemicals within the Premises facility were adequately assessed in the original assessment (as amended November 2017). Stage 2 conforms to all the requirements of the existing Stage 1 storage.
Dust Suppression	Use of water containing elevated levels of aluminium, arsenic, copper, chromium, zinc, boron, lithium and nitrate on roads, stockpiles and infrastructure	Elevated levels of aluminium, arsenic, copper, chromium, zinc, boron, lithium and nitrate into the environment	Localised environment receiving runoff and road-side vegetation	Accumulation through soil profile	Accumulation of aluminium, arsenic, copper, chromium, zinc, boron, lithium and nitrate in the localised environment	No	The use of groundwater for dust suppression purposes was not risk assessed for the original works approval. During operation, use of waste water (in this case dewatering water and RO Brine) is considered (according to DoW Water in Mining Guideline [DoW, 2013]) to be for consumptive use and not a discharge. As such, this specific activity is not to be further risk assessed or subject to licence conditions, however any impact (such as vegetation death or broader ecosystem impacts from pollution) on potential receptors (vegetation and localised environment receiving runoff) may be considered an unauthorised discharge under the EP Act or broader EP Act provisions. See detailed risk assessment in Section 8.4.
TMF 1	Tailings surface	Dust	No residences in proximity, vegetation including riparian vegetation adjacent to mine areas	Air / wind dispersion	Potential suppression of photosynthetic and respiratory functions	No	Tailings dust could contain elevated levels of metals. The material is enriched in lithium, thallium, bismuth and tantalum (Campbell and Associates, September 2016). Noting that the slurry consists of approximately 60% solids to 40% water and that there are no residences or priority flora within the vicinity of the premises, the risk is considered to be ***low***.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	Tailings pipeline	Rupture of pipeline causing tailings discharge to land	Vegetation adjacent to tailings pipeline alignment. On site surface water systems	Direct discharge	Soil contamination inhibiting vegetation growth and survival	Yes	See detailed risk assessment in Section 8.11.
	Overtopping of tailings	Tailings discharge to land	Vegetation adjacent to TMF 1. On site surface water systems	Direct discharge	Soil contamination inhibiting vegetation growth and survival	Yes	See detailed risk assessment in Section 8.11.
	Seepage	Leachate to groundwater	Underlying groundwater and Pilgangoora Creek system.	Infiltration to groundwater Hydraulic connection between groundwater and the Pilgangoora Creek	Groundwater mounding Groundwater contamination and surface water contamination	Yes	See detailed risk assessment in section 8.5.
TMF 2 - reassessment	Seepage	Leachate to groundwater	Underlying groundwater and Pilgangoora Creek system.	Infiltration to groundwater Hydraulic connection between groundwater and the Pilgangoora Creek	Groundwater mounding Groundwater contamination and surface water contamination	Yes	Based on the provision of additional information on groundwater quality, geology and modelling since the original (2017) assessment of TMF 2, the risk of impact from seepage on the environment is deemed to require reassessment. See detailed risk assessment in section 8.6.
Processing and ore using a mobile crushing and screening plant	Processing of material	Dust	No residences in proximity, the initial location of the processing plant is adjacent to the monster pit in already disturbed areas	Air / wind dispersion	Potential suppression of photosynthetic and respiratory functions.	No	The closest residential receptor is located more than 30 km from the Premises. The industrial receptor of Altura Mine Site is located more than 5 kms from the initial mobile plant site. The initial plant location is within already disturbed areas. The risk of dust from the mobile crushing and screening plant has been determined as ***low***.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Noise	No residences or other sensitive receptors in proximity		None expected	No	The closest residential receptor is located more than 30 km from the Premises. The industrial receptor of Altura Mine Site is located more than 5 kms from the initial mobile plant site. The risk of noise from the mobile crushing and screening plant has been determined as ***low***.
		Contaminated stormwater	Ephemeral surface water systems	Stormwater run-off	Degradation of surface water quality leading to impacts to aquatic fauna	Yes	See detailed risk assessment in section 8.7.
Waste Water Treatment Plant expansion (including irrigation field expansion) Including Stage 2 WWTP	Treatment of sewage	Odour	No residences or other sensitive receptors in proximity	Air / wind dispersion	None	No	The closest residential receptor is more than 30 km from the premises. The Altura mine site is located approximately 5 km from the wastewater treatment plant. The risk is considered to be ***low***.
		Leaks/spills of pipelines and overtopping of tanks.	Soils and vegetation	Direct discharge	Degradation of the soil profile. Elevated contaminants within soils causing an impact to vegetation.	Yes	See detailed risk assessment in Section 8.13
	Irrigation of treated wastewater/ RO brine	Treated effluent to land	Soils and vegetation within the irrigation field. Soils and vegetation within the neighbouring tenement to the west. The downstream Northern Creek	Direct discharge Spray drift or run-off during a rainfall event.	Degradation of the soil profile. Elevated contaminants within soils causing an impact to vegetation. Impacts to the neighbouring tenement (E45/2287 held by Altura Lithium) Elevated contaminants in soils being washed off during a rainfall	Yes	See detailed risk assessment in section 8.8.
		Elevated levels of aluminium, arsenic, copper, chromium, zinc, boron, lithium and nitrate into the environment				Yes	See detailed risk assessment in section 8.8.

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
	Windblown treated effluent		Spray drift	event.	Yes	See detailed risk assessment in section 8.8.
(New) Landfill location in West Waste Dump Active trench/cell	Dust	No residences or other sensitive receptors in proximity	Air / wind dispersion	Amenity	No	No residences or sensitive land uses within 20 km of the Premises The Delegated Officer considers that the provisions of the *Environmental Protection (Noise) Regulations 1997* and section 49 of the EP Act are sufficient to regulate noise and dust emissions during operation of the Landfill.
	Noise				No	
	Odour	No residences or other sensitive receptors in proximity Fauna attractant		Amenity and fauna entrapment/ death	No	The landfill is fenced with a 1.8 m high ring lock fence with double lockable gates.
	Windblown waste	Terrestrial ecosystems	Discharges to land from waste disposal, air/wind dispersion	Ingestion by fauna Soil contamination	No	
	Leachate to groundwater	Groundwater dependent ecosystems, subterranean fauna	Direct discharge through the base of the landfill cell	Groundwater contamination	Yes	See detailed risk assessment in Section 8.12.

8.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 22 below.

Table 22: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 23 below.

Table 23: Risk criteria table

Likelihood		**Consequence**		
The following criteria has been used to determine the likelihood of the Risk Event occurring.		**The following criteria has been used to determine the consequences of a Risk Event occurring:**		
			Environment	**Public health* and amenity (such as air and water quality, noise, and odour)**
Almost Certain	The risk event is expected to occur in most circumstances	Severe	• **onsite impacts**: catastrophic • **offsite impacts local scale**: high level or above • **offsite impacts wider scale:** mid-level or above • Mid to long-term or permanent impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are significantly exceeded	• Loss of life • **Adverse health effects:** high level or ongoing medical treatment • Specific Consequence Criteria (for public health) are significantly exceeded • **Local scale impacts:** permanent loss of amenity
Likely	The risk event will probably occur in most circumstances	Major	• **onsite impacts**: high level • **offsite impacts local scale**: mid-level • **offsite impacts wider scale**: low level • Short-term impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are exceeded	• **Adverse health effects:** mid-level or frequent medical treatment • Specific Consequence Criteria (for public health) are exceeded • **Local scale impacts**: high level impact to amenity
Possible	The risk event could occur at some time	Moderate	• **onsite impacts**: mid-level • **offsite impacts local scale**: low level • **offsite impacts wider scale**: minimal • Specific Consequence Criteria (for environment) are at risk of not being met	• **Adverse health effects:** low level or occasional medical treatment • Specific Consequence Criteria (for public health) are at risk of not being met • **Local scale impacts:** mid-level impact to amenity
Unlikely	The risk event will probably not occur in most circumstances	Minor	• **onsite impacts**: low level • **offsite impacts local scale**: minimal • **offsite impacts wider scale**: not detectable • Specific Consequence Criteria (for environment) likely to be met	• Specific Consequence Criteria (for public health) are likely to be met • **Local scale impacts:** low level impact to amenity
Rare	The risk event may only occur in exceptional circumstances	Slight	• **onsite impact**: minimal • Specific Consequence Criteria (for environment) met	• **Local scale**: minimal to amenity • Specific Consequence Criteria (for public health) met

^ Determination of areas of high conservation value or special significance should be informed by the *Guidance Statement: Environmental Siting.*

* In applying public health criteria, DWER may have regard to the Department of Health's *Health Risk Assessment (Scoping) Guidelines.*

"onsite**"** means within the Prescribed Premises boundary.

8.3 Acceptability and treatment of risk event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 24 below:

Table 24: Risk treatment table

Rating of Risk Event	Acceptability	Treatment
Extreme	Unacceptable.	Risk Event will not be tolerated. DWER may refuse application.
High	May be acceptable. Subject to multiple regulatory controls.	Risk Event may be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk Event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk Event is acceptable and will generally not be subject to regulatory controls.

8.4 Risk Assessment - use of dewatering effluent and RO Brine for dust suppression (Construction and Operation)

8.4.1 General hazard characterisation and impact of emission

All dewatering discharge (raw water) will be transferred to a Raw Water Tank for use by the operation for dust suppression and mineral processing (GRM, 2017). Brine from the Camp RO system will also be used for dust suppression purposes. Brine from the Processing Plant RO system is all reused in the Processing Plant. The groundwater at the premises has elevated aluminum, arsenic, copper, chromium, zinc, boron, lithium and nitrate when compared to the ANZECC/ARMCANZ 95% protection guideline value for freshwater ecosystems for production bores (PWB001, PWB002) (PML, June 2017 and PML, 26 February 2018). The production bore that feeds the RO system for the processing plant is PWB005.

Three existing water supply bores (PWB001, PWB002 and PB5) will be utilised for the purposes of potable supply (via reverse osmosis), dust suppression and mineral processing (GRM, 2017 Groundwater Operation Procedure). It is understood PB5 was installed in 1996 as a water supply bore for the former Lynas Find Gold Mine, whilst PWB001 and 002 were installed in 2016 as part of the FS (GRM report J160002R04b). The three bores intercept groundwater bearing fractures adjacent to Pilgangoora Creek.

Section 7.5.1, Table 17 (Laboratory Analysis Data of Bores provided by the Works Approval Holder) identified that samples of groundwater abstracted for use on the Premises contain aluminium, arsenic, cadmium, copper, zinc, chromium, boron and nickel levels that exceeded ANZECC and ARMCANZ, 2000 recommended trigger values for freshwater quality. Lithium concentrations in groundwater at the Pilgangoora mine site are already elevated (up to 1.7 mg/L, Table 17). A monovalent cation, lithium is easily displaced by other cations in soil solution and is relatively mobile (ANZECC, 2000), meaning mobile in solution and thereby increasing its ability to be transferred to receiving environments more readily (ie: groundwater transfer and surface water runoff).

Where there is evaporation of the water used for dust suppression there is potential for build-up of metals and non-metals on roads and adjacent areas (stockpiles etc).

There are several ephemeral surface water systems located on the Premises. Adverse impact to the environment may be in the form of transport (via water), addition and build up of soluble elements (such a lithium) that may have a toxic effect on soils, and vegetation. Accumulation in water courses may also impact the surface, stream bed or hyporheic fauna, having a toxic effect.

Actual water quality results have been obtained for the Camp RO system brine. These are shown in Table 19, with a discussion also provided in Section 7.6.

8.4.2 Criteria for assessment

DWER's Contaminated Sites Regulation Branch has recommended that the short-term irrigation water guidelines (ANZECC/ARMCANZ, 2000) are the most relevant to use because the criterion is applicable for irrigation periods of up to 20 years, rather than the 100 year period allowed for the long-term irrigation water values. Monitoring results obtained meet these guidelines, aside from fluoride and Gross Alpha as discussed in Section 7.6.

DWER's Guidelines for Assessment and management of contaminated sites and ecological and human health assessment levels for soil are provided in the National Environmental Protection (Assessment of Site Contamination) Measure (ASC NEPM).

Vegetation health surrounding the areas where dust suppression is to be conducted on site is also considered an appropriate measure for the potential impact of concentrated metals and non-metals within the Premises.

8.4.3 Works Approval Holder controls

There are no specific controls are proposed by the Works Approval Holder for the treatment of raw water or RO Brine to be used for dust suppression, however, stormwater infrastructure (diversion bunds, culverts and sediment basins) have been incorporated into the site-wide design for the physical management of stormwater and sampling during creek-flow committed to, as shown in the following Table 25.

Table 25: Works Approval Holder's proposed controls for water runoff

Site infrastructure	Construction	Operation
Sedimentation ponds	Constructed at the processing plant area and mining contractors area only. Sized to store the initial flush of stormwater from significant rainfall events	Storm water from site will be directed to the infrastructure sedimentation ponds Minimum freeboard of 300mm will be maintained in the pond
Raw Water Tank	1.833 ML capacity (with 288 kL reserved for fire water capacity) HDPE lined steel impermeable tank Fully covered	Monitored after each runoff event to initiate pumping of the retained water into the process circuit or used for dust suppression
Process water pond	Capacity of Cell 1 is 9.2 ML and capacity of Cell 2 is 15 ML The process water pond will have a thicker liner to a	Minimum freeboard of 300mm will be maintained in the pond Water collected in the ponds will be reused in processing

Site infrastructure	Construction	Operation
	minimum of 1.8mm thickness Designed for 1:100 yr, 72 hr storm event Freeboard markers installed	
All	-	A Surface Water Management Plan will be employed on site. During periods of flow in the four creeks (Northern, Houston, Pilgangoora, Southern) at a minimum of once annually, surface water samples will be collected at one site upstream of the project and one site downstream of the Project with laboratory analyses for pH, TDS, TSS, electrical conductivity and the major cations and anions (including soluble lithium)

8.4.4 Key findings

The Delegated Officer has reviewed the information regarding the use of dewatering effluent for dust suppression during construction and operation and has found:

1. There is evidence that some of the raw water abstracted for use within the Premises has levels of Aluminium, Arsenic, Cadmium, Copper, Boron, Nickel, Zinc and Chromium displayed water quality values higher than ANZECC/ARMCANZ 95% (ANZECC 2000) protection guideline value for freshwater ecosystems.
2. The Works Approval Holder does not propose treatment of the raw water prior to discharge within the Premises for dust suppression purposes.
3. Elevations in fluoride and Gross Alpha are present above the ANZECC/ARMCANZ, 2000 guidelines, Short-term trigger values for irrigation. However, Contaminated Sites Branch has advised that there is unlikely to be significant impacts on vegetation and soil fauna from the use of water that contains about 2.9 mg/L of fluoride as this concentration is only marginally above the short-term irrigation value of 2 mg/L. As the Gross Beta criteria have been developed to protect against radiation-induced cancer, it is likely that they would be highly conservative when used to protect other environmental receptors. Therefore, it is considered unlikely that there would be any significant impacts on vegetation or soil fauna from the Gross Alpha levels that occur in the wastewater stream.

8.4.5 Consequence

If accumulation and localised contamination of soils and vegetation occurs and surface water is not contained on site, then this may result in low level onsite impacts, with minimal offsite impacts on a local scale. Therefore, the Delegated Officer considers the consequence of surface water to be **minor.**

8.4.6 Likelihood of Risk Event

Based on the water quality of the RO brine provided with elevations of fluoride and Gross Alpha,

the Delegated Officer has determined the likelihood to be **unlikely.**

8.4.7 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of environmental impact from the accumulation of metals and non-metals in the surface environment from application via dust suppression application during construction and operation is **low.**

8.5 Risk Assessment – seepage from TMF 1 (Operation)

8.5.1 Description of seepage from TMF1

Seepage of tailings water may occur from TMF1 to groundwater and potentially travel to Pilgangoora Creek.

8.5.2 Identification and general characterisation of emission

Tailings testing results provided in the application (Campbell and Associates, September 2016) indicated elevated levels of aluminium, arsenic, copper, zinc, lead and nickel when compared against the 95% (freshwater) protection levels in ANZECC/ARMCANZ, 2000.

USEPA LEAF1313 testing has shown that leachate from the tailings is unlikely to cause significant environmental impacts. Zinc concentrations were present at concentrations of up to 240 µg/L, higher than the ANZECC/ARMCANZ, 2000 criterion of 8 µg/L for the protection of freshwater ecosystems. Contaminates Sites Branch used the Domenico analytical solution to simulate the groundwater transport of leachate from mine wastes to the creeks and the assessment indicated that concentrations of zinc in groundwater would be much lower than the ANZECC/ARMCANZ, 2000 aquatic criterion on discharge to the hyporheic ecosystem, therefore, unlikely to cause significant environmental impacts.

The geochemical properties of the tailings components will be unchanged from those presented in Stage 1 of the Project. The accelerated mining and milling rate will not change the properties of the ore or waste (including tailings), as there is no change to the process design. The density of tailings discharged to the TMF will remain unaltered as discharge density is controlled via the tailings thickener.

8.5.3 Description of potential adverse impact from the emission

The Works Approval Holder has advised that the depth to groundwater is between 9 to 12 mbgl at TMF1. Seepage contains elevated levels of contaminants that may impact on the quality of groundwater and potentially access Pilgarangoora Creek affecting vegetation and fauna.

8.5.4 Criteria for assessment

ANZECC/ARMCANZ, 2000 provide recommended trigger values for freshwater quality, which is an appropriate comparison trigger value given that creeks located to the west of the deposit are likely to contain a sensitive macroinvertebrate fauna in saturated gravel below the creek beds (stygofauna) and this aquatic criteria would be required to protect this ecosystem.

The Livestock drinking water guidelines have been used also for comparison against the ambient groundwater quality.

DWER's Contaminated Sites Guidelines Assessment and management of contaminated sites provides ecological and human health assessment levels for soil and the ASC NEPM provides consistent guidance on site contamination assessments.

8.5.5 Works Approval Holder controls

The Application outlines the Works Approval Controls in place to reduce and manage seepage from TMF 1 as outlined in Table 26 below. These controls have been reviewed as part of this assessment.

Table 26: Works Approval Holder's proposed controls for seepage from TMF1

Site infrastructure	Construction	Operation
TMF	Not less than 0.3m clay material at the base of the impoundment area. Impoundment area proof compacted to between 1 x 10^{-6} m/s and 47 x 10^{-6} m/s hydraulic conductivity (permeability Facility will be unlined Cut off trenches under the embankment as per ATC Williams drawings 115275.04_007and 1157275.04_004 8 piezometers will be installed in the starter causeway embankments of the cells: 4 vibrating wire piezometers in the foundation starter embankment (TMF1 Stage 1A) and 4 standpipe piezometers installed in the TMF2 Stage 1B embankment. Six TMF (groundwater) monitoring bores installed at the following locations and sampled in accordance in accordance with Licence	TMF Operating Manual developed and implemented to provide direction on the appropriate operation of the TMF Operated to managed to design capacity of 3 Mtpa Decant water returned to the Process water dam for reuse during ore Processing. Operational pipeline pressure transmitters at both ends of the pipeline with alarms to indicate variation in flow pressure Flows will be monitored by flow meters positioned at the start and end of the tailings delivery line, with readouts displayed on the Control System In the event flow meter readings indicate pipeline failure, the affected pipeline will be shut down Twice daily inspections of TMF inflow and decant pipelines during operation A network of 10 monitoring bores installed at the Premises to provide background data, and, allow the assessment of groundwater during operations. Six groundwater TMF monitoring bores installed around the perimeter of the TMF

Site infrastructure	Construction	Operation
	conditions: TMFMB1 696492E 7671279N TMFMB2 697387E 7670649N TMFMB3 697575E 7669675N TMFMB4 696457E 7670088N TMFMB5 695880E 7670579N TMFMB6 696165E 7669570N	monitor water quality. If there is a rise in groundwater level in any monitoring bore to 5 mbgl, the Works Approval Holder commits to installing recovery bores (or trenches) to collect seepage and return the seepage water to the TMF decant pond.

8.5.6 Consequence

The USEPA LEAF 1313 testing has indicated that leachate from these materials is unlikely to cause significant environmental impacts. If seepage from TMF1 occurs, then the Delegated Officer has determined that the impact on the Pilgangoora Creek and the underlying groundwater may result in offsite impacts on a local scale. Therefore, the Delegated Officer considers the consequence of seepage to be **minor.**

8.5.7 Likelihood of Risk Event

Based on the modelling scenarios indicating that seepage would be more than 20 metres below the base of the creek bed, the Delegated Office has determined the likelihood to be unlikely.

8.5.8 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of seepage impacting the environment is **medium.**

8.6 Risk Assessment – reassessment of seepage from TMF 2 (Operation)

8.6.1 Description of seepage from TMF2

Seepage of tailings water may occur from TMF2 to groundwater and potentially travel to Pilgangoora Creek.

8.6.1 Identification and general characterisation of emission

Tailings testing results provided in the application (Campbell and Associates, September 2016) indicated elevated levels of aluminium, arsenic, copper, zinc, lead and nickel when compared against the 95% (freshwater) protection levels in ANZECC/ARMCANZ, 2000. Boron has been added to the monitoring suite as per Contaminated Sites Branch recommendations.

USEPA LEAF1313 testing has shown that leachate from the tailings is unlikely to cause significant environmental impacts. Zinc concentrations were present at concentrations of up to 240 µg/L, higher than the ANZECC/ARMCANZ, 2000 criterion of 8 µg/L for the protection of freshwater ecosystems. Contaminates Sites Branch used the Domenico analytical solution to simulate the groundwater transport of leachate from mine wastes to the creeks and the assessment indicated that concentrations of zinc in groundwater would be much lower than the ANZECC/ARMCANZ, 2000 aquatic criterion on discharge to the hyporheic ecosystem, therefore, unlikely to cause significant environmental impacts.

The geochemical properties of the tailings components will be unchanged from those presented

in Stage 1 of the Project. The accelerated mining and milling rate will not change the properties of the ore or waste (including tailings), as there is no change to the process design. The density of tailings discharged to the TMF will remain unaltered as discharge density is controlled via the tailings thickener.

8.6.2 Description of potential adverse impact from the emission

The Works Approval Holder has advised that the depth to groundwater is between 9 to 12 mbgl at TMF2. Seepage contains elevated levels of contaminants that may impact on the quality of groundwater and potentially access Pilgarangoora Creek affecting vegetation and fauna.

8.6.3 Criteria for assessment

Contaminated Sites Branch has advised that ANZECC/ARMCANZ, 2000 provide recommended trigger values for freshwater quality, which is an appropriate comparison trigger value given that creeks located to the west of the deposit are likely to contain a sensitive macroinvertebrate fauna in saturated gravel below the creek beds (stygofauna) and this aquatic criteria would be required to protect this ecosystem.

The Livestock drinking water guidelines have been used also for comparison against both the floatation tailings slurry and the ambient groundwater quality.

The Average Crustal Abundance concentrations from the Pilgangoora Lithium-Tantalum Project Mining Proposal can be used to assess flotation tailings solids concentrations against.

DWER's Contaminated Sites Guidelines Assessment and management of contaminated sites provides ecological and human health assessment levels for soil and the ASC NEPM provides consistent guidance on site contamination assessments.

8.6.4 Works Approval Holder controls

The Application outlines the Works Approval Controls in place to reduce and manage seepage from TMF 2 as outlined in Table 27 below. These controls have been reviewed as part of this assessment.

Table 27: Works Approval Holder's proposed controls for seepage from TMF2

Site infrastructure	Construction	Operation
TMF 2	Maximum hydraulic conductivity at the base of the TMF will be at or better than 1.45×10^{-6} Cut off trench will be constructed through the surficial deposits on the upstream side of the starter embankments and extended around the full TMF perimeter Constructed to manage a design capacity of 3 Mtpa Construction of central decant system comprising decant access causeway, decant comprising of 2.8m wide concrete base footing and 8 slot 1800 dia x 89 wall x 1220	TMF Operating Manual developed and implemented to provide direction on the appropriate operation of the TMF Operated to managed to design capacity of 3 Mtpa Decant water returned to the Process water dam for reuse during ore Processing. Operational pipeline pressure transmitters at both ends of the pipeline with alarms to indicate variation in flow pressure Flows will be monitored by flow meters positioned at the start and end of the tailings delivery line, with readouts displayed on the Control System In the event flow meter readings indicate pipeline failure, the affected pipeline will be shut down

Site infrastructure	Construction	Operation
	high rings 10 piezometers will be installed in the starter embankments of the cells: Four vibrating wire piezometers in TMF2 Stage 1A embankment and 6 Standpipe piezometers installed in TMF 2 Stage 1B embankment. The following monitoring bores will be used to monitor seepage: o *TMFMB01* o *PMB002* o *PMB001* o *TMFMB02* *(See Appendix 2 for further details on monitoring bores)*	Twice daily inspections of TMF inflow and decant pipelines during operation A network of 10 monitoring bores installed at the Premises to provide background data, and, allow the assessment of groundwater during operations. Six groundwater TMF monitoring bores installed around the perimeter of the TMF will monitor water quality. If there is a rise in groundwater level in any monitoring bore to 5 mbgl, the Works Approval Holder commits to installing recovery bores (or trenches) to collect seepage and return the seepage water to the TMF decant pond.

8.6.5 Key findings

The Delegated Officer has reviewed the information regarding the operation of TMF2 and has found:

1. **Structural integrity of TMF2 is regulated by DMIRS under the *Mining Act 1978.***
2. **Modelling has been provided, which indicates that seepage is unlikely to reach more than 20 metres below the creek bed. Contaminated Sites Branch has endorsed this modelling.**
3. **Groundwater monitoring has shown elevated levels of Gross Alpha in the vicinity of the TMF2, over ANZECC/ARMCANZ, 2000. This data has been referred to DMIRS for advice and guidance.**
4. **The design of TMF2 incorporates measures to reduce the volume of water retained to reduce seepage, however seepage and groundwater mounding beneath TMF2 is still anticipated.**
5. **Six monitoring bores are established to monitor groundwater adjacent to the TMF2 to enable detection of seepage and groundwater mounding.**
6. **The Works Approval Holder will install recovery bores/trenches to collect seepage and return it to the decant pond pending a rise in groundwater to 5mbgl in or around the TMF2.**

8.6.6 Consequence

The USEPA LEAF 1313 testing has indicated that leachate from these materials is unlikely to cause significant environmental impacts. If seepage from TMF2 occurs, then the Delegated Officer has determined that the impact on the Pilgangoora Creek and the underlying groundwater may result in offsite impacts on a local scale. Therefore, the Delegated Officer considers the consequence of seepage to be **minor.**

8.6.7 Likelihood of Risk Event

Based on the modelling scenarios indicating that seepage would be more than 20 metres below the base of the creek bed, the Delegated Office has determine the likelihood to be **unlikely.**

8.6.8 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of seepage impacting the environment is **medium.**

8.7 Risk Assessment – contaminated stormwater from the mobile crushing and screening plant (Operation)

8.7.1 General hazard characterisation and impact of emission

Stormwater containing processed fines could result in the emission of trace metals and metalloids to surface water systems. Stormwater run-off from the overflow area could result in crushed rock fines entering surface water systems where subsequent weathering could release contaminants.

Pegmatite host rocks contain negligible amounts of sulphide minerals. As a consequence, these materials would normally be considered to have a low potential for producing metalliferous drainage other than low concentrations that are produced by rainfall-induced weathering of minerals in crushed rock. However, pegmatite host rocks can contain substantial amounts of phosphate minerals (particularly lithiophilite and apatite), which make them vulnerable to bioweathering by symbiotic fungal communities (lichens and mycorrhizas) which often colonise rock surfaces (Gadd, 2007) and extract nutrients from minerals in the rocks. These communities can produce substantial amounts of organic acids (particularly citric and oxalic acids) which can both leach metals from minerals surfaces, and form complexes with metals and increase their mobility.

There are no watercourses within the vicinity of the initial mobile plant location (near the Monster Pit), however information on future locations has not been provided. There are several ephemeral surface water systems located on the Premises. Adverse impact to the environment may be in the form of transport, addition and build-up of soluble elements (such as lithium) that may have a toxic effect on soils, and vegetation. Accumulation in water courses may also impact the surface, stream bed or hyporheic fauna.

8.7.2 Criteria for assessment

ANZECC and ARMCANZ, 2000 provide recommended trigger values for freshwater quality and Assessment and management of contaminated sites and ASC NEPM provides ecological and human health assessment levels for soil.

8.7.3 Works Approval Holder controls

None proposed. No specific information on storm water management such as sediment basins or sumps has been provided for the mobile plant operation, however the Works Approval Holder has confirmed that they will adhere to the management measures as committed to in the (GRM, 2016) Surface Water Management Plan. These comprise but are not limited to (general, site-wide) surface grading, diversion drains, bunds, launders, sumps and pumps.

The Works Approval Holder has confirmed that they have constructed two sediment ponds within the Premises (Sediment Pond West) to capture runoff from the Processing Plant and Sediment Pond East within L45/147 tenure to capture runoff from the Power Station and Fuel Farm however, these are not located near the proposed initial mobile plant location.

8.7.4 Consequence

If contaminated stormwater runs-off to surface water systems, this could result in mid-level on-site impacts. Therefore, the consequence has been determined as **moderate**.

8.7.5 Likelihood of Risk Event

It is possible that the 95% protection levels in ANZECC/ARMCANZ 2000 could be exceeded in the receiving watercourses, therefore the Delegated Officer considers the likelihood to be **possible** due to lack of proposed controls.

8.7.6 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of stormwater contamination is **medium.**

8.8 Risk Assessment – irrigation of treated effluent and RO brine waste to land (Construction and Operation)

8.8.1 General hazard characterisation and impact of emission

As displayed in Table 17, samples of groundwater abstracted for use on the Premises contain aluminium, arsenic, cadmium, copper, zinc, chromium, boron and nickel levels that exceed ANZECC and ARMCANZ, 2000 recommended trigger values for freshwater quality.

The frequency and duration of this RO brine/treated effluent emissions is anticipated to be daily and sporadic, however quantities will vary daily during operations. This makes the quantification of the entire/ ongoing impact difficult, with this assessment based only on the current information at hand.

Whilst the deposition of the water for the WWTPs irrigation purposes is to be localised to the irrigation areas, there is the potential for runoff from this area contaminating off-site areas and contaminating terrestrial, surface water and groundwater ecosystems.

8.8.2 Criteria for assessment

The WWTPs treated effluent (stream) meets Low Exposure Risk Level in accordance with DoH, 2011. Relevant land and groundwater quality criteria include ANZECC and ARMCANZ, 2000 and the NEPM ASC.

Data presented in Section 7.5.1 suggests that samples of groundwater abstracted for use on the Premises contain aluminium, arsenic, cadmium, copper, zinc, chromium, boron and nickel levels that exceed ANZECC and ARMCANZ, 2000 recommended trigger values for freshwater quality.

Noting that there are two freshwater creeks within the Premises boundary (Houston and Pilgangoora Creeks) that flow during high rainfall events and there is a creek line identified 120m to the west of the irrigation area, the ANZECC/ARMCANZ 95% (ANZECC 2000) protection guideline value for freshwater ecosystems has been deemed the applicable criteria for assessment.

The nutrient loading rates meet WQPN 22.

8.8.3 Works Approval Holder controls

This assessment has reviewed the controls set out in Table 28 below.

Table 28: Works Approval Holder's proposed controls for irrigation of effluent and RO brine to land

Site infrastructure	Construction	Operation
Stage 1 Spray Field (3.03 ha + 4.72 ha irrigation area) Stage 2 Spray Field (2.63 ha irrigation area)	The land is not permanently or seasonally inundated or waterlogged, needs no artificial drainage or requires natural watercourses to be diverted There is no Sensitive Water Resource within 500m of the spray field, however a water course has been identified within 120m (west) of the irrigation field expansion area. The spray field is not within a Public Drinking Water Source Area, a wetland with defined conservation value, Environmental Protection Policy Lakes, Waterways Management Areas or other wetland Stock exclusion fence comprising star picket, 3 strand wire and corner strainer posts surrounding entire irrigation area Internal berm installed inside the fence line from excess soil Operational pipework constructed using HDPE with minimum pressure rating (PN) of 12.5 Stage 1 Spray Field: Total minimum spray area of 4.72 ha (expected nutrient loading of 290 kg/ha/yr of total nitrogen and 72.5 kg/ha/yr of total phosphorus. This is based on target discharge quality of ≤30 mg/L total nitrogen and ≤7.5 mg/L total phosphorus) Minimum of 48 irrigation sprinklers Stage 2 Spray Field: The treated effluent from the Stage 2 WWTP is to be mixed with the treated effluent from the Stage 1 WWTP and the total volume distributed across the 7.36 ha (Stage 1 4.72 ha + Stage 2 2.63 ha) Total minimum spray area of 7.36 ha (expected nutrient loading of 409 kg/ha/yr of total nitrogen and 102 kg/ha/yr of total phosphorus. This is based on target discharged quality of ≤30 mg/L total nitrogen and ≤7.5 mg/L total phosphorus) Minimum of 26 irrigation sprinklers	The spray fields containing natural vegetation will be managed to prevent waterlogging of the surface or ponding of water by alternating discharge between the three sets of sprinklers. Daily inspections of the spray fields will be undertaken to ensure there is no waterlogging of soil or ponding, and to identify maintenance requirements. Maintenance will be undertaken as required to ensure correct operation of the system. The spray field areas will be monitored for the presence of weeds on at least a quarterly basis, with herbicide treatment being carried out as required.

8.8.4 Key findings

The Delegated Officer has reviewed the information regarding the risk of RO brine/treated effluent irrigation and has found:

1. Treated effluent meets secondary treatment as per the National Water Quality Management Strategy, Australian guidelines for sewerage systems: Effluent Management, 1997.
2. Monitoring results indicate that fluoride and Gross Alpha levels exceed the short-term irrigation levels as listed in the ANZECC/ARMCANZ, 2000 water quality guidelines. Contaminated Sites Branch has advised that these elevations are

unlikely to result in significant environmental impacts.

3. The irrigation areas are suitably sized for the wastewater irrigation in accordance with soil nutrient loading WQPN 22.
4. There are no nearby significant receptors at the WWTP and a surface water drainage line has been identified within 120m of the irrigation area.

8.8.5 Consequence

Based on the information detailed above and distance to the nearest sensitive receptor (Creek line 120m away), the Delegated Officer has determined that the impact of this discharge could result in low level on-site impacts. Therefore, the Delegated Officer considers the consequence to be **minor**.

8.8.6 Likelihood of consequence

Based upon the Works Approval Holder controls within the spray irrigation areas, the Delegated Officer has determined that the likelihood of an environmental impact from the disposal of treated effluent to the spray fields and off site impacts from this disposal will not occur in most circumstances. However, ~~as~~ the groundwater around the WWTP and irrigation areas is relatively shallow, but Contaminated Sites Branch has advised discharges are unlikely to result in significant environmental impacts, and therefore the Delegated Officer considers the consequence to be **unlikely**.

8.8.7 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 22) and determined that the overall rating for the risk of discharges to land from the mixed (RO brine and effluent) irrigation water on sensitive receptors during operation is **low**.

8.9 Risk Assessment – Leaks, spills and stormwater runoff (Construction and Operation)

8.9.1 General hazard characterisation and impact

Stormwater at the Premises has the potential to become contaminated with sediments from processing, hydrocarbons, heavy metals, metalloids and hazardous chemicals and wastes during construction and operation, leading to contamination of land through direct contact or infiltration into soils. Similar impacts may be caused from spills or leaks of hydrocarbons, chemicals and wastes stored at the Premises.

Soil contamination may inhibit vegetation growth and cause health impacts to fauna. Contamination of groundwater is possible because depth to groundwater at the Premises is relatively shallow at approximately 9 to 12 mbgl and is fresh to brackish at 600 to 3,000mg/L TDS.

Stormwater runoff may also pick up sediment from cleared areas and result in smothering of nearby vegetation, impacting growth and survival. Rainfall events at the Premises are likely to be of short duration and high intensity, and large volume events can be experienced. Noting lithium is highly soluble, any spillage not cleaned up may end up in stormwater during rainfall events and be mobilised and transported within minor drainage systems on the Premises, potentially leading to localised or off-site impacts to sensitive ecosystems.

The processing plant is located west of Central open pit and northeast of the TMF with these two large structures protecting the plant from rainfall run-on. The only surface water that may impact the plant will be generated by the small catchment between Central pit, the TMF and the

processing plant area. The plant will be constructed on a raised pad and is on the side of a small hill, runoff will be diverted around the plant (structurally engineered).

Contaminated stormwater from the operation of the 1Mtpa throughput mobile crushing and screening plant has been assessed in Section 8.7.

8.9.2 Criteria for assessment

ANZECC AND ARMCANZ, 2000 provide recommended trigger values for freshwater quality and DER's Guideline Assessment and management of contaminated sites provides ecological and human health assessment levels for soil.

8.9.3 Works Approval Holder controls

The Application outlines the Works Approval Holder controls in place to reduce and manage stormwater and leaks and spills of hydrocarbons, chemicals and waster as outlined in Table 29 and Table 30, below. These controls have been reviewed as part of this assessment.

Table 29: Works Approval Holder's proposed controls for stormwater runoff

Site infrastructure	Construction	Operation
Earthworks/ site establishment	Constructed to separate clean and potentially contaminated water The processing plant will be placed on a concrete pad. The area will be bunded with a containment capacity equivalent to 110% of the capacity of all tanks Electric sump pumps will be installed in the concrete flooring at the Processing Plant to collect and pump any spilled material back into the process stream	Where stormwater is likely to be contaminated with hydrocarbons, water will be directed to an oil water separation system prior to discharge to the environment or re-use on-site
Sedimentation ponds	Constructed at the processing plant area and mining contractors area, both sized to store the initial flush of stormwater from significant rainfall events	Storm water from site will be directed to the infrastructure sedimentation ponds Minimum freeboard of 300mm will be maintained in the pond
Raw Water Tank	1.833 ML capacity (with 288 kL reserved for fire water capacity) HDPE lined steel impermeable tank Fully covered	Monitored after each runoff event to initiate pumping of the retained water into the process circuit or used for dust suppression
Process water pond	Capacity of Cell 1 is 9.2 ML and capacity of Cell 2 is 15 ML The process water pond will have a thicker liner to a minimum of 1.8mm thickness Designed for 1:100 yr, 72 hr storm event Freeboard markers installed	Minimum freeboard of 300mm will be maintained in the pond Water collected in the ponds will be reused in processing
TMF	500mm total freeboard	TMF Operating Manual developed and

Site infrastructure	Construction	Operation
	Freeboard indication markers will be installed on the water storage ponds and TMF Designed to contain rainfall associated with a 1 in 100 year, 72 hour average recurrence interval event Cut off trench will be constructed through the surficial deposits on the upstream side of the starter embankments and extended around the full TMF perimeter Constructed to manage a design capacity of 2 Mtpa The TMF 1 and TMF 2 Stage 1 cells will be constructed maximum height of 13.3m (RL 189.3m) each. Construction of central decant system comprising decant access causeway, decant comprising of 2.8m wide concrete base footing and 8 slot 1800 dia x 89 wall x 1220 high rings	implemented to provide direction on the appropriate operation of the TMF Operated to manage design capacity of 2 Mtpa from the Processing Plant Decant removed via submersible pumps within decant tower Minimisation of the surface area of the decant pond during operations Return of water to the plant will be maximised
All	-	A Surface Water Management Plan will be employed on site. During periods of flow in the four creeks (Northern, Houston, Pilgangoora, Southern) at a minimum of once annually, surface water samples will be collected at one site upstream of the project and one site downstream of the Project with laboratory analyses for pH, TDS, TSS, electrical conductivity and the major cations and anions (including soluble lithium)

Table 30: Works Approval Holder controls for hydrocarbons, chemicals and waste (including leaks and spills)

Site infrastructure	Construction	Operation
Hydrocarbons, chemicals and reagents storage areas	Constructed in accordance with Australian Standard 1940-2004 *The storage and handling of flammable and combustible liquids* Diesel pipelines will be fitted with pressure transmitters at both ends of pipelines with alarms to indicate variation in flow pressure	Stored and handled in accordance with the requirements of the: • *Dangerous Goods Safety Act 2004*; • *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007*; and • Australian Standard 1940-2004

Site infrastructure	Construction	Operation
All	Spill kits will be made available for use to contain hydrocarbon spills. In the event of a spill the contaminated soil will be collected and disposed of in accordance with the site procedures Construction of oily water separators for the treatment of hydrocarbon contaminated liquid Fuel and chemical handling will be in accordance with the current Australian Standards for the storage and handling of flammable and combustible liquids under the *Dangerous Goods Safety Act 2004* and associated Dangerous Goods Safety Regulations 2007 Storage and refuelling of vehicles will occur on concreted areas	All washdown water/spillages generated from within storage areas will be channelled to a triple oily-water interceptor that will treat the site hydrocarbon waste to a maximum TPH of <15mg/L. The sampling point will be the discharge outlet from the oily-water separator, located at the site wash down facility and monitored monthly. Spill kits will be available for use to contain hydrocarbon spills. In the event of a spill the contaminated soil will be collected and disposed of in accordance with the site procedures Power station self-contained day tank (20 kL) and waste oil tank and lubricants will be located in a concrete bund and comply with Australian Standard AS 1940 Waste oil will be stored in a bunded storage tank and disposed of by a licensed waste contractor. Used oil contaminated parts such as oil filters and oily rags will be stored in fully enclosed metal bins in existing bunded areas at the power station. These will be removed by a licensed recycling contractor Hydrocarbon and other chemical contaminated wastes will be stored in bins or drums and removed off-site by a licenced contractor for recycling or disposal. All chemical and reagents classed as dangerous goods will be stored in accordance with the requirements of the *Dangerous Goods Safety Act 2004* and the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 Fuel and chemical handling will be in accordance with the current Australian Standards for the storage and handling of flammable and combustible liquids under the *Dangerous Goods Safety Act 2004* and associated Dangerous Goods Safety Regulations 2007 Storage and refuelling of vehicles will occur on concreted areas.

8.9.4 Key findings

The Delegated Officer has reviewed the information regarding hydrocarbons, chemicals and waste (including leaks and spills) and has found:

1. The Surface Water Management Plan was provided with the Application
2. Infrastructure will be constructed to separate clean and contaminated stormwater
3. All potentially contaminated hydrocarbon/chemical water will be directed to an oily water separator for treatment prior to discharge or reuse
4. All water storage ponds will be lined and have freeboard markers installed
5. Hydrocarbon and chemical storage areas will comply with relevant Australian Standards

8.9.5 Consequence

The Delegated Officer has had regard to the nature and quantity of hazardous materials used on the Premises, the engineering / infrastructure controls in place and the distance to the nearest sensitive receptors (groundwater located approximately 9-11 mbgl) and has determined that the impact of stormwater runoff and leaks and spills of hydrocarbons, chemicals and waste will result in low level on-site impacts and minimal off-site impacts at a local scale. Therefore, the Delegated Officer considers the consequence to be **minor**.

8.9.6 Likelihood of consequence

Based upon the distance to nearest sensitive receptors and Works Approval Holder controls the Delegated Officer has determined that the likelihood of stormwater runoff and leaks and spills of hydrocarbons, chemicals and waste impacting on soil, groundwater and surface water will probably not occur in most circumstances. Therefore, the Delegated Officer considers the consequence to be **unlikely**.

8.9.7 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 22) and determined that the overall rating for the risk of stormwater runoff and leaks and spills of hydrocarbons, chemicals and waste on sensitive receptors during construction and operation is **medium**.

8.10 Risk Assessment – Overflows from the Raw Water Tank and Process Water Pond (Construction and Operation)

8.10.1 General hazard characterisation and impact

The Raw Water Tank will be located within the Premises over the life of the mine.

The process water pond is located adjacent to the processing plant and TMF (Figure 2).

Data provided by the Works Approval Holder has indicated that production bore water quality is slightly basic, with salinity ranging from 950-3,500 mg/L TDS. The Works Approval Holder has identified that the water quality to be abstracted is of good quality.

Raw water will be obtained from production bores and will pass through one of two package reverse osmosis/UV treatment facilities at the camp or processing plant prior to distribution around site. The brine/ reject water from the camp RO plant is sent to the irrigation tank at the WWTP for mixing with the treated effluent prior to distribution at the spray field. The brine/ reject water from the processing plant is returned to the Process Water Dam.

The process water pond will receive water from mine dewatering bores, production bores, decant water from the TMF and excess water from the tails thickener (during processing).

Water from this pond is recycled through the processing plant. With respect to tailings decant, over time, analytes within the tailings may concentrate through evaporation, process-cycling or if tailings leachate chemistry is affected by changes in redox chemistry. Anticipated composition and quality of the excess water from the processing plant tails thickener has not been provided by the Works Approval Holder to enable determination of impacts to the environment. However, this liquid will be mixed with the abovementioned water sources and reused within the processing plant and impacts from the multi-source water body have been jointly assessed as one. This assessment may need to be revisited when the composition and quality of the excess water from the processing plant tails thickener is available, and the requirement for further controls, assessed. Lithium is known to be highly soluble.

Potential emissions of raw water may occur from malfunctions of the Raw Water Tank or leaks/spills and may inundate vegetation. Contamination of groundwater is not anticipated by the raw water as it is has been identified as good quality.

Process pond water discharged to ground may inundate vegetation and contaminate terrestrial, surface water and groundwater ecosystems.

8.10.2 Criteria for assessment

ANZECC and ARMCANZ, 2000 provide recommended trigger values for freshwater quality and *Assessment and management of contaminated sites* and ASC NEPM provides ecological and human health assessment levels for soil.

Background water quality data provided by the Works Approval Holder has identified that the quality of the water being pumped to the Raw Water Tank will be of almost potable standard.

8.10.3 Works Approval Holder Controls

The Application outlines the Works Approval Holder controls for the raw and process water pond as set out in Table 31 below.

Table 31: Works Approval Holder's proposed controls for the Raw Water Tank and Process Water Pond

Site infrastructure	Construction	Operation
Raw Water Tank	1.833 ML capacity (with 288 kL reserved for fire water capacity) HDPE lined steel impermeable tank Fully covered	Monitored after each runoff event to initiate pumping of the retained water into the process circuit or used for dust suppression
Process water pond	Capacity of Cell 1 is 9.2 ML and capacity of Cell 2 is 15 ML Freeboard designed for 1:100 yr, 72 hr storm event Lined with a minimum 1.8 mm HDPE liner. Constructed to enable a minimum freeboard of 300mm to be maintained in the pond.	Minimum freeboard of 300mm will be maintained in the ponds. Monitored after each rainfall event to check for adequate freeboard being available and to initiate pumping of the retained water into the process circuit or used for dust suppression. The Works Approval Holder is

Site infrastructure	Construction	Operation
	Freeboard markers installed.	required verify the water quality to ensure that the ASC NEPM and ANZECC and ARMCANZ, 2000 water quality criteria are met

8.10.4 Key Findings

The Delegated Officer has reviewed the information regarding overflows from the Raw Water Tank and process water pond and has found:

1. Details on the composition and quality of the excess water from the processing plant tails thickener has not been provided by the Works Approval Holder
2. The Raw Water Tank and process water pond will be lined and have freeboard markers installed
3. Freeboard monitoring of each pond will occur after each rainfall event

8.10.5 Consequence

As the process water pond will receive water from mine dewatering bores, production bores, decant water from the TMF and excess water from the tails thickener and it is unknown if ASC NEPM and ANZECC and ARMCANZ, 2000 water quality criteria will be met if the water is discharged to the environment, The Delegated Officer therefore considers the consequence to be **Moderate**. This consequence may be revised once the Works Approval Holder provides sufficient supporting information that the source and concentration of analytes through the recycling of water through the process water pond will not have an impact on the environment.

8.10.6 Likelihood of consequence

Based upon the Works Approval Holder's proposed controls, the Delegated Officer has determined that the likelihood of overflows from the process water dam will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **Unlikely**.

8.10.7 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 22) and determined that the overall rating for the risk of overflows from the process water dam to be **Medium**.

8.11 Risk Assessment – TMF pipeline failure and overtopping (Construction and Operation)

8.11.1 Description of TMF1 pipeline failure and overtopping

Leaks/spills or overtopping of tailings may contaminate soils, smother vegetation and have toxic effects on terrestrial and freshwater ecosystems (Pilgangoora Creek). Infiltration of significant quantities of tailings decant may result in soluble contaminants leaching through the soil profile to affect local groundwater quality and may impact on the beneficial uses of groundwater.

8.11.2 Identification and general characterisation of emission

All tailings produced from processing are stored within the purpose built TMF1. The tailings solids are pumped to TMF1 as a slurry at 52% to 68% solids concentration (by weight) (i.e. 52 to 68% water by weight).

Tailings slurry and decant return water contains soluble metals and metalloids (and other chemicals). Tailings contaminants depend on the geochemical composition of the ore and the chemicals used in the process plant.

Over time it is recognized that some tailings analytes may become present at concentrations that indicate potential for concern if tailings decant is concentrated through evaporation or process cycling, or if tailings chemistry is affected by changes in redox chemistry within the tailings mass.The Application, Appendix 7: Geochemical Characterisation of Flotation-Tailings Samples, Implications for Tailings Management (September 2016) by Graeme Campbell and Associates Pty Ltd (Graeme Campbell and Associates, 2016) states that samples of tailings (Floatation Tailings [FT]) were tested using a programme of static-testing and kinetic-testing and indicates that:

- All tailings samples were classified as Non Acid Forming (NAF) due to negligible amounts of sulphide minerals;
- There were recorded enrichments in Lithium, Thallium, Bismuth and Tantalum, however, these are biogeochemically fixed (i.e. incorporated within the crystal-lattices of silicates, oxides, etc.);
- In terms of drinking water quality, the tailings-solids-leachates were essentially potable (based on NHMRC, 2015), with Arsenic slightly exceeding the 10 µg/L guideline;
- Tailings stream is inert with 'near zero' risk for water quality impacts where left in a free-draining state;
- Tailings have nothing to give geochemically during weathering;
- No stringent measures (e.g. HDPE lining) should be required in the design of TMF1; and
- Direct revegetation with endemic plant species is a sound option following TMF1 closure.

USEPA LEAF1313 testing has shown that leachate from the tailings is unlikely to cause significant environmental impacts. Zinc concentrations were present at concentrations of up to 240 µg/L, higher than the ANZECC/ARMCANZ, 2000 criterion of 8 µg/L for the protection of freshwater ecosystems. Contaminates Sites Branch used the Domenico analytical solution to simulate the groundwater transport of leachate from mine wastes to the creeks and the assessment indicated that concentrations of zinc in groundwater would be much lower than the ANZECC/ARMCANZ, 2000 aquatic criterion on discharge to the hyporheic ecosystem, therefore, unlikely to cause significant environmental impacts.

8.11.3 Description of potential adverse impact from the emission

Leaks/spills or overtopping of tailings may contaminate soils, smother vegetation and have toxic effects on terrestrial and freshwater ecosystems (Pilgangoora Creek). Infiltration of significant quantities of tailings decant may result in soluble contaminants leaching through the soil profile to affect local groundwater quality and may impact on the beneficial uses of groundwater.

8.11.4 Criteria for assessment

ANZECC/ARMCANZ, 2000 provide recommended trigger values for Livestock watering and freshwater quality, while DWER's Contaminated Sites Guidelines Assessment and management of contaminated sites provides ecological and human health assessment levels for soil and the ASC NEPM provides consistent guidance on site contamination assessments.

8.11.5 Works Approval Holder controls

The Application outlines the Works Approval Holder controls for the TMF pipelines as set out in Table 32 below.

Table 32: Works Approval Holder's proposed controls for the TMF pipelines

Site infrastructure	Construction	Operation
TMF Pipelines	Pipelines will be fitted with pressure transmitters at both ends of the pipeline with alarms to indicate variation in flow pressure Flow meters installed at the start and end of the tailings delivery line The tailings delivery line from the process plant to the TMF and the return water line will be situated above ground within bunds with spill catch pits Spill catch pits contain any spillage of materials resulting from leaks or lines that burst during operation for up to 12 hours of spillage Constructed of HDPE Spigots constructed using DN 100+2m pipe HDPE, PN6, DN100mm every 24 m around the perimeter of the TMF crest	TMF Operating Manual developed and implemented to provide direction on the appropriate operation of the TMF Operated to managed to design capacity of 2 Mtpa Operational pipeline pressure transmitters at both ends of the pipeline with alarms to indicate variation in flow pressure Flows will be monitored by flow meters positioned at the start and end of the tailings delivery line, with readouts displayed on the Control System In the event flow meter readings indicate pipeline failure, the affected pipeline will be shut down Twice daily inspections of TMF inflow and decant pipelines during operation

The Application outlines the Works Approval Holder controls for the overtopping of the TMF as set out in Table 33 below.

Table 33: Works Approval Holder's proposed controls for the TMF overtopping

Site infrastructure	Construction	Operation
TMF	Designed to contain rainfall associated with a 1 in 100 year, 72 hour average recurrence interval event Cut off trench will be constructed through the surficial deposits on the upstream side of the starter embankments and extended around the full TMF perimeter 500mm total freeboard Constructed to manage a design capacity of 2 Mtpa The Stage 1 (starter) embankment of Cell 2 will be constructed maximum height of 13.3m (RL 189.3m) Construction of central decant system comprising decant access causeway, decant comprising of 2.8m wide concrete base footing and 8 slot 1800 dia x 89 wall x 1220 high rings	TMF Operating Manual developed and implemented to provide direction on the appropriate operation of the TMF Operated to manage design capacity of 2 Mtpa Decant removed via submersible pumps within decant tower Minimisation of the surface area of the decant pond during operations Return of water to the plant will be maximised

Works Approval Holder controls for seepage management have been moved to Sections 8.5 and 8.6.

8.11.6 Key findings

The Delegated Officer has reviewed the information regarding the operation of the TMF and has found:

1. Structural integrity of the TMF is regulated by DMIRS under the *Mining Act 1978*
2. Consultant information provided to the Works Approval Holder advised that tailings are benign and decant water quality comparable to groundwater quality
3. The design of the TMF incorporates measures to reduce the volume of water retained within the cell
4. The TMF Operating Manual was not provided with the Application
5. A freeboard of 500mm will be maintained in the TMF
6. Six monitoring bores are established to monitor groundwater adjacent to the TMF
7. Pipelines will be fitted with pressure transmitters at both ends of the pipeline with alarms to indicate variation in flow pressure

8.11.7 Consequence

The Delegated Officer has had regard to the information detailed above for tailings composition, Works Approval Holder controls, water quality information provided by the Works Approval Holder and the distance to the nearest sensitive receptors (potable quality groundwater located approximately 9-11 mbgl) and has determined that the impact of overtopping events and pipeline joint failures could result in minimal off-site impacts. Therefore, the Delegated Officer considers the consequence to be **minor**.

8.11.8 Likelihood of consequence

Based upon the distance to nearest sensitive receptors and Works Approval Holder controls the Delegated Officer has determined that the likelihood of an environmental impact from TMF pipeline failures and overtopping will not occur in most circumstances. However, as the groundwater is relatively shallow, the Delegated Officer considers the consequence to be **possible**.

8.11.9 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 22) and determined that the overall rating for the risk of the TMF pipelines rupturing, and overtopping on sensitive receptors during operation is **medium**.

Despite the medium overall rating, over time (the life of mine is 35 years) it is recognized that some analytes may become present at concentrations that indicate potential for concern if tailings decant is concentrated through evaporation or process cycling, or if tailings chemistry is affected by changes in redox chemistry within the tailings mass. To monitor this, the following parameters in Table 34 will be included within the licence for the operation of this Premises:

Table 34: Parameters to be monitored

pH
Electrical Conductivity, EC1
Ammonia, NH_3
Nitrate, NO_3
Nitrite, NO_2
Bicarbonate Alkalinity as HCO_3
Calcium Carbonate $CaCO_3$
Carbonate Alkalinity as CO_3
Total Dissolved Solids, TDS
Calcium Carbonate $CaCO_3$
Nitrite, NO2 as NO_2
Nitrate, NO3 as NO_3
Total Alkalinity as $CaCO_3$
Total Dissolved Solids, TDS
Total Hardness by Calculation
Sulfate, SO4
Aluminium, Al
Antimony, Sb
Arsenic, As
Boron, B
Barium, Ba
Bismuth, Bi
Calcium, Ca
Cadmium, Cd
Chlorine, Cl
Cobalt, Co
Chromium, Cr
Copper, Cu
Fluoride, F
Hexavalent Chromium, Cr^{6+}
Iron, Fe
Potassium, K
Lead, Pb
Lithium, Li
Magnesium, Mg
Mercury, Hg
Molybdenum, Mo
Manganese, Mn
Nickel, Ni
Niobium, Nb
Phosphorus, P
Rubidium, Rb
Selenium, Se
Silicon, Si
Silver, Ag
Sodium, Na
Strontium, Sr
Tantalum, Ta

Thallium, Tl
Thorium, Th
Tin, Sn
Uranium, U
Vanadium, V
Zinc, Zn
Gross Alpha
Gross Beta
Radium-226
Radium-228

8.12 Risk Assessment – Landfill waste disposal and leachate (Operation)

8.12.1 General hazard characterisation and impact

All putrescible and inert waste type 1 will be disposed of into the landfill in accordance with the Landfill Waste Classification and Waste Definitions 1996.

The most significant impact of a landfill on the surrounding environment is from leachate as it can enter the environment through seepage and runoff of contaminated stormwater, resulting in groundwater contamination.

8.12.2 Criteria for assessment

Relevant land and groundwater quality criteria include the ANZECC and ARMCANZ, 2000 for freshwater and marine waters, the Landfill Waste Classification and Waste Definitions 1996 and ASC NEPM.

8.12.3 Works Approval Holder controls

The Works Approval Holder has the following controls in place to manage waste disposal and leachate at the landfill as set out in Table 35 below.

Table 35: Works Approval Holder's proposed controls for the landfill

Site infrastructure	Construction	Operation
Landfill within the Monster South WRL **and West Waste Dump**	Constructed to meet the requirements of the Environmental Protection (Rural Landfill) Regulations 2002 The location of the landfill has taken into consideration factors such as: • Located more than 5m from groundwater • Located more than 250m from any watercourse. Design capacity of 100 tonnes per year	Putrescible and inert waste will be disposed of in separate trenches Trenches will be covered a minimum of once per fortnight with soil material. Appropriate and adequate signage will be erected around the Pilgangoora landfill site. Place and compact waste to ensure that all faces are stable and capable of retaining restoration material. Restore cells (trenches) within 6 months after disposal in that cell (trench) has been completed.

Site infrastructure	Construction	Operation
	Trench will be excavated to a maximum depth of 4m.	Store sufficient, dense, inert and incombustible material that is readily available at all times to cover the landfill tipping area. The size of the tipping face is kept to a minimum, and not larger than 30 metres in length or more than 2 metres above ground level in height. Waste will be levelled and compacted (e.g. maximum 300 mm lifts, passed over at least 3 times by heavy earthmoving machinery) as soon as practicable after it has been placed within the cell (trench). Cover landfilled waste with sufficient clean fill (e.g. 100 mm) at least weekly, to ensure that the waste is completely covered and that no waste is exposed Windblown waste will be returned to the landfill site on a regular and recurring basis. The Works Approval Holder's Waste and Landfill Management Procedure requires that windblown waste around the landfill is undertaken regularly but at least on a monthly basis. Only putrescible waste, inert wastes and tyres will be disposed of at the landfill Unserviceable tyres shall be transported to a designated area within the approved waste rock dump disturbance footprint. They shall be stacked appropriately and periodically buried in accordance with Regulation 14(2) of the EP Regs No hydrocarbons and / or chemicals will be disposed of into the landfill facility The volume of waste disposed of into the landfill will be recorded based on an estimate of average weekly disposal. The waste is measured in bulk cubic metres (BCM).

8.12.4 Key findings

The Delegated Officer has reviewed the information regarding the landfill and has found:

1. Only putrescible and inert waste type 1 in accordance with the Landfill Waste Classification and Waste Definitions 1999 are to be accepted at the landfill for disposal. The acceptance of waste for disposal not meeting the types permitted

for disposal may result in a breach of section 53 of the EP Act

2. Detailed plans or specifications of the works relating to the landfill were not provided in the Application
3. No monitoring bores were proposed to determine any occurrence of seepage from the landfill
4. The landfill will be sited more than 5m from groundwater and more than 250m from any watercourse

8.12.5 Consequence

Based on the information detailed above, distance to the nearest sensitive receptors and the small scale of the landfill, the Delegated Officer has determined that the impact of waste disposal and leachate from the landfill will result in minimal off-site impacts on a local scale. Therefore, the Delegated Officer considers the consequence to be **slight**.

8.12.6 Likelihood of consequence

Based upon the distance to the nearest sensitive receptors and Works Approval Holder controls, the Delegated Officer has determined that the likelihood of an environmental impact from waste disposal and leachate associated with the landfill will not occur in most circumstances. However as the groundwater is relatively shallow, the Delegated Officer considers the consequence to be **possible**.

8.12.7 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 22) and determined that the overall rating for the risk of the landfill on sensitive receptors during operation is **low**.

8.13 Risk Assessment – WWTP failure of pipes and storage tank (Construction and Operation)

8.13.1 General hazard characterisation and impact

The release of wastewater to the environment due to failure of pipes and breakdown of pumps may cause contamination of the surrounding soils and groundwater. Treated and untreated wastewater may contain high levels of pathogens and nutrients which have been identified as key environmental hazards.

Assessment of irrigation of mixed effluent and RO Brine has been presented in Section 8.8, above.

8.13.2 Criteria for assessment

The WWTP treated effluent meets Low Exposure Risk Level in accordance with DoH, 2011. Relevant land and groundwater quality criteria include ANZECC and ARMCANZ, 2000 and the NEPM ASC.

8.13.3 Works Approval Holder controls

The Application outlines the Works Approval Holder controls for sewage discharge from the failure of pipes, tank failure and disposal to the spray field as outlined in Table 36 below.

Table 36: Works Approval Holder's proposed controls for sewage discharge from the failure of pipes and tank failure

Site infrastructure	Construction	Operation
WWTP	There is no Sensitive Water Resource within 500m of the WWTPs. The WWTPs are not within a Public Drinking Water Source Area, a wetland with defined conservation value, Environmental Protection Policy Lakes, Waterways Management Areas or other wetland MBBR WWTPs fully assembled and factory tested prior to site transfer Water treatment cultures will be generated off site and introduced into the plant Capacity to treat up to 125m^3/day (Stage 1) and 150m^3/day (Stage 2) of sewage The WWTPs are containerized with external pump skids and tanks The WWTPs are designed and constructed to meet the following emission standards: (a) Biochemical Oxygen Demand <20mg/L (b) Total Suspended Solids <30mg/L (c) Total Nitrogen <30mg/L (d) Total Phosphorus <7.5mg/L (e) Chlorine Residual >0.2-2mg/L (f) pH 6.5-8.5 (g) *E.coli* <1000cfu/100mL The WWTPs will have contingency storage capacity for up to two days of normal flow if discharge is suspended while any problems are fixed All tanks will be fitted with high level alarms (for overflow) Flow meter will be installed between the WWTPs outflow point and the spray field to record the spray field disposal rate Tie-in with Camp RO brine stream at the treated effluent irrigation tank (mixing tank).	The wastewater will be treated in MBBR WWTPs before being discharged to the spray fields The WWTPs will be operated to meet the following emission standards: (a) Biochemical Oxygen Demand <20mg/L (b) Total Suspended Solids <30mg/L (c) Total Nitrogen <30mg/L (d) Total Phosphorus <7.5mg/L (e) Chlorine Residual >0.2-2mg/L (f) pH 6.5-8.5 (g) *E.coli* <1000cfu/100mL The maximum TDS (mg/L) of the (final) effluent stream that is sent to the spray irrigation fields for disposal will be < 1000 mg/L. The WWTPs perimeter will be fenced Monthly Cumulative flow rate and volume (m^3) will be recorded Quarterly monitoring of the following will be conducted: Biochemical Oxygen Demand (BOD) mg/L, Total Suspended Solids (TSS) mg/L, Total Dissolved Solids (TDS) mg/L, pH, Total Nitrogen mg/L, Total Phosphorus mg/L, *E. coli* CFU/100mL A 300 kL mixing (irrigation) tank containing treated effluent (Stage 1) and 200 kL irrigation tank (Stage 2) will be operated with a tie-in with Camp RO brine stream prior to discharge to the spray field.

8.13.4 Key findings

The Delegated Officer has reviewed the information regarding the risk of sewage discharge from WWTP failure of pipes, storage tank failure and irrigation and has found:

1. **The WWTPs will have contingency storage capacity for up to 2 days of normal flow if discharge is suspended while any problems are fixed.**
2. **Treated effluent meets secondary treatment as per the National Water Quality Management Strategy, Australian guidelines for sewerage systems: Effluent Management, 1997.**
3. **Monitoring results indicate that fluoride and Gross Alpha levels exceed the short-term irrigation levels as listed in the ANZECC/ARMCANZ, 2000 water quality guidelines. Contaminated Sites Branch has advised that these elevations are unlikely to result in significant environmental impacts.**
4. **The irrigation areas are suitably sized for the wastewater irrigation in accordance with soil nutrient loading WQPN 22.**
5. **There are no nearby significant receptors at the WWTP**

8.13.5 Consequence

Based on the information detailed above and distance to the nearest sensitive receptors and that the wastewater will undergo treatment prior to discharge, the Delegated Officer has determined that the impact of WWTPs pipe failure and WWTPs tank failure will result in low level on-site impacts. Therefore, the Delegated Officer considers the consequence to be **minor**.

8.13.6 Likelihood of consequence

Based upon the treatment applied to the wastewater and Works Approval Holder controls both at the WWTP facilities and within the spray irrigation areas, the Delegated Officer has determined that the likelihood of an environmental impact from WWTPs pipe failures, tank failure and the disposal of treated effluent to the spray fields and off site impacts from this disposal will not occur in most circumstances. However, ~~as~~ the groundwater around the WWTPs and irrigation areas is relatively shallow, but Contaminated Sites Branch has advised discharges are unlikely to result in significant environmental impacts, and therefore the Delegated Officer considers the consequence to be **unlikely**.

8.13.7 Overall rating

The Delegated Officer has compared the consequence and likelihood ratings described above for the Risk Criteria (Table 22) and determined that the overall rating for the risk of discharges to land from the WWTPs and spray fields on sensitive receptors during operation is **low**.

8.14 Summary of acceptability and treatment of Risk Events

A summary of the risk assessment and the acceptability or unacceptability of the risk events set out above, with the appropriate treatment and control, are set out in Table 37 below. Controls are described further in Section 9.

Table 37: Risk assessment summary

	Description of Risk Event			Works Approval Holder controls	Risk Rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
1.	Leaks, spills and stormwater runoff	Ore processing and handling areas Breach of containment infrastructure and pipeline failures Washdown water Stormwater runoff Spillage of ore	Direct discharge to land and infiltration to soil	Infrastructure Design or Construction Requirements Management Plans Monitoring Requirement regarding Operation of Infrastructure	Minor consequence Unlikely **Medium risk**	Acceptable subject to regulatory controls Construction Requirements for the works approval Requirements regarding operation of infrastructure and monitoring requirements for the licence
2.	Overflows from the Raw Water Tank and process water pond	Raw water Process water pond (combined water from mine dewatering bores, production bores, decant water from the TMF and excess water from the tails thickener)	Direct discharge to land and infiltration to soil Potential contamination of soil due to presence of chemicals and heavy metals Temporary loss of habitat	1.833 ML capacity (with 288 kL reserved for fire water capacity) HDPE lined steel impermeable tank Fully covered Monitored after each runoff event to initiate pumping of the retained water into the process circuit or used for dust suppression	Moderate consequence Unlikely **Medium risk**	Acceptable subject to regulatory controls Construction Requirements for the works approval Requirements regarding operation of infrastructure and monitoring requirements for the licence
3.	TMF pipeline failure, overtopping	Failure of pipelines (tailings and return water) Overflow of TMF tailings	Direct discharge to land and infiltration to soil	Operating Manual Monitoring Infrastructure Design or Construction Requirements Requirement regarding Operation of Infrastructure Restriction on Input	Minor consequence Possible **Medium risk**	Acceptable subject to regulatory controls Construction Requirements for the works approval Requirements regarding operation of infrastructure and monitoring requirements for the licence
4.	Landfill waste disposal and	Leaching of material	Discharges	Siting of	Slight	Acceptable subject to

	Description of Risk Event			Works Approval Holder controls	Risk Rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
	leachate	below the facility Release of wind blown waste	to land	Infrastructure Infrastructure Design or Construction Requirements Requirements regarding Operation of Infrastructure Restriction on Input	consequence Possible **Low risk**	regulatory controls Construction Requirements for the works approval Requirements regarding operation of infrastructure and restriction of input for the licence
5.	WWTPs pipes and storage tank failure	Failure of pipes Overtopping of tanks due to failure of equipment Discharge of treated effluent land	Discharges to land	Siting of Infrastructure Infrastructure Design or Construction Requirements Requirements regarding Operation of Infrastructure Restriction on Input	Minor consequence Unlikely **Low risk**	Acceptable subject to regulatory controls Construction Requirements for the works approval Requirements regarding operation of infrastructure and restriction of input for the licence
6.	Use of dewatering effluent and RO Brine for dust suppression	Raw water RO Brine	Discharges to land and water	Surface Water Management Plan Siting of infrastructure and drainage control	Minor consequence Unlikely **Low risk**	Acceptable subject to regulatory controls Construction Requirements for the works approval Requirements regarding operation of infrastructure and monitoring requirements for the licence
7.	Seepage of tailings liquor/decant from the TMF	Seepage from TMF 1 and TMF 2	Discharges to land and water	Operating Manual Monitoring Infrastructure Design or Construction Requirements Requirement regarding Operation	Minor consequence Unlikely **Medium risk**	Acceptable subject to regulatory controls Construction, monitoring and reporting requirements for the works approval

	Description of Risk Event			Works Approval Holder controls	Risk Rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
				of Infrastructure Restriction on Input		Requirements regarding operation of infrastructure and monitoring requirements for the licence
8.	Contaminated stormwater from the mobile crushing and screening plant	Stormwater from the crushing and screening plant area	Discharges to land and water	Infrastructure Design or Construction Requirements Management Plans Monitoring Requirement regarding Operation of Infrastructure	Moderate consequence Possible **Medium risk**	Acceptable subject to regulatory controls Construction Requirements for the works approval Requirements regarding operation of infrastructure
9.	Irrigation of treated effluent and RO brine to land	RO brine / treated effluent from the WWTPs	Discharges to land and water	Surface Water Management Plan Siting of infrastructure and drainage control within the spray irrigation area	Minor consequence Unlikely **Low risk**	Acceptable subject to regulatory controls Construction and monitoring requirements for the works approval Requirements regarding operation of infrastructure and monitoring requirements for the licence

9. Works Approval controls

The Delegated Officer considers that the provision, operation and maintenance of the specified infrastructure and controls outlined in Section 9 are necessary to manage risks as assessed in Section 8.

In accordance with the Guidance Statement: Risk Assessments, DWER has had regard for the Works Approval Holder's proposed controls, and where they lower the assessed likelihood or consequence of a Risk Event, these controls will be conditioned in the instrument. These controls, which are based on the Works Approval Holder's commitments in the Application, will be included in the Issued Works Approval as specified infrastructure to be constructed.

9.1.1 Stormwater infrastructure and equipment

The following environmental controls, infrastructure and equipment (Table 38) should be constructed to prevent and manage leaks and spills and stormwater runoff at the Premises. The specified infrastructure requirements have been derived from obligations of the Application and are considered necessary to ensure regulatory oversight and outline what has been assessed under the Issued Works Approval.

Table 38: Infrastructure requirements for stormwater infrastructure

Infrastructure	Requirements (Design and Construction)
Diversion bunds and culverts	General collector drains to direct rainfall runoff to sedimentation pond (basin) across the Premises.
Sediment ponds (basins)	Sediment pond downstream (southwest) of the processing plant to capture storm water in the plant/workshop and power station area not contained by bunding. The ponds are sized to store the initial flush of stormwater from significant rainfall events. Sediment pond located northeast of the mining contractors area to capture run off from the contractors laydown area. Constructed within the Premises boundary to capture sediment – laden surface runoff prior to water exiting the Premises To be fitted with a control outlet to allow stored water to slowly continue downstream

9.1.2 Hydrocarbon and chemical storage areas infrastructure and equipment

The following infrastructure and equipment (Table 39) should be constructed to manage the risk of spills and leaks from the hydrocarbon and chemical storage areas:

Table 39: Infrastructure requirements for hydrocarbon and chemical storage

Infrastructure	Requirements (Design and Construction)
Hydrocarbon and chemical storage areas	Constructed in accordance with Australian Standard 1940-2004 The storage and handling of flammable and combustible liquids

9.1.3 Raw Water Tank and process water pond

The following infrastructure and equipment (Table 40) should be constructed to manage the Raw Water Tank and process water pond:

Table 40: Infrastructure requirements for Raw Water Tank and process water pond

Infrastructure	Requirements (Design and Construction)
Raw Water Tank	1.833 ML capacity (with 288 kL reserved for fire water capacity) HDPE lined steel impermeable tank Fully covered Monitored after each runoff event to initiate pumping of the retained water into the process circuit or used for dust suppression
Process water pond	Capacity of Cell 1 is 9.2 ML and capacity of Cell 2 is 15 ML Freeboard designed for 1:100 yr, 72 hr storm event

Infrastructure	Requirements (Design and Construction)
	Lined with a minimum 1.8 mm HDPE liner Constructed to enable a minimum freeboard of 300mm to be maintained in the pond Freeboard markers installed Water quality monitoring on operating Licence.

9.1.4 TMF infrastructure and equipment

The following environmental controls, infrastructure and equipment should be constructed to prevent pipeline failures, overtopping and seepage from the TMF. The specified infrastructure requirements have been derived from obligations of the Application and are considered necessary to ensure regulatory oversight and outline what has been assessed under the Issued Works Approval.

The following infrastructure and equipment (Table 41) should be constructed to manage the risk of spills and leaks from TMF pipelines:

Table 41: Infrastructure requirements for TMF pipelines

Infrastructure	Requirements (Design and Construction)
Pipelines	Constructed of HDPE Pipelines will be fitted with pressure transmitters at both ends of the pipeline with alarms to indicate variation in flow pressure Flow meters installed at the start and end of the tailings delivery line The tailings delivery line from the process plant to the TMF and the return water line will be situated above ground within bunds with spill catch pits Spill catch pits contain any spillage of materials resulting from leaks or lines that burst during operation for up to 12 hours of spillage
Spigot off takes	Connected into the main tailings distribution line with a HDPE offtake branch

The following infrastructure and equipment (Table 42) should be constructed to manage the risk of overtopping from the TMF:

Table 42: Infrastructure requirements for TMF overtopping

Infrastructure	Requirements (Design and Construction)
TMF (TMF 1 and TMF 2, Stage 1 only)	The Stage 1 embankment of TMF 1 and TMF 2 will be constructed maximum height of 13.3m (RL 189.3m) Cell 2 will be constructed to a maximum height of RL189.3 m and an impoundment area of 19.9 ha Designed to contain rainfall associated with a 1 in 100 year, 72 hour average recurrence interval event 500mm total freeboard Constructed to manage a design capacity of 2 Mtpa Construction of central decant system comprising decant access causeway, decant comprising of 2.8m wide concrete base footing and 8 slot 1800 dia x 89 wall x 1220 high rings

Infrastructure	Requirements (Design and Construction)
	Cut off trench constructed through the surficial deposits on the upstream side of the starter embankments and extended around the full TMF perimeter

The following infrastructure and equipment (Table 43) should be constructed to manage the risk of seepage from the TMF:

Table 43: Infrastructure requirements for management of TMF seepage

Infrastructure	Requirements (Design and Construction)
TMF	Constructed to manage a design capacity of 2 Mtpa Piezometers installed in the starter causeway embankments of the cells: (i) TMF 1 Stage 1A: Four Vibrating Wire Piezometers (VWP) will be installed in the embankment foundation (ii) TMF 1 Stage 1B: Four Standpipe Piezometers to be installed (iii) TMF 2 Stage 1A: Four VWP will be installed in the embankment foundation (iv) TMF 2 Stage 1B Six Standpipe Piezometers to be installed (TMF 1 Stage 1 Total of 8 Piezometers installed) (TMF 2 Stage 1 Total of 10 Piezometers installed) Groundwater monitoring bores will be installed at the following locations within a 20 m radius of the specified coordinates: (i) TMFMB3: 697575E 7669675N; (ii) TMFMB4: 696457E 7670088N; (iii) TMFMB5: 695880E 7670579N; (iv) TMFMB6: 696165E 7669570N; and (v) New shallow (50m) monitoring bore adjacent to PWB004: 696609E 7670135N. Groundwater monitoring bores will be monitored TMFMB01; TMFMB02; PMB005 PMB001; PMB002; and PWBMB004 Groundwater monitoring has been removed from the Works Approval as it is covered by the operating Licence L9056/2017/1.
TMF base	Hydraulic conductivity of the base of both TMF1 and TMF 2 cells to be compacted and material imported as required to ensure the TMF base(s) have lower hydraulic conductivity than as advised in consultant reports provided as part of the Application. Hydraulic conductivity is to be less than the following: TMF1: Impoundment area proof compacted to between 1 x 10-6 m/s and

Infrastructure	Requirements (Design and Construction)
	47 x 10-6 m/s TMF2: •Hydraulic conductivity of less than 1.0 x 10-7 m/s using compacted in situ material and imported clay as required Specific permeability testing is to be provided to DWER to confirm that the compaction of the base of each cell is compacted to reduce the potential for TMF seepage.
Underdrainage system	Cut off trench will be constructed through the surficial deposits on the upstream side of the starter embankments and extended around the full TMF perimeter to a nominal depth of 1.5 m or refusal on weathered rock
Decant pond area Decant tower	Designed to receive tailings decant (bleed water) and rainwater accumulation and gravity feed the liquid to a pump system installed in the decant tower Construction of central decant system comprising decant access causeway, decant comprising of 2.8m wide concrete base footing and 8 slot 1800 dia x 89 wall x 1220 high rings

9.1.5 Landfill infrastructure and equipment

The following environmental controls, infrastructure and equipment (Table 44) should be constructed to manage the landfill facility at the Premises.

Table 44: Infrastructure requirements for management of the landfill

Infrastructure	Requirements (Design and Construction)
Landfill	Constructed to meet the requirements of the *Environmental Protection (Rural Landfill) Regulations 2002* Located more than 8m from groundwater Located more than 250m from any watercourse Design capacity of 100 tonnes per year (note: value to be for the landfills within the entire Premises at any one time, should both be in operation) Trenches will be excavated to a maximum depth of 4m.

9.1.6 WWTP infrastructure and equipment

The following environmental controls, infrastructure and equipment (Table 45) should be constructed to prevent and manage pipeline failures, tank failure, irrigation at the WWTP spray irrigation area and annual loading of nutrients at the spray field.

Table 45: Infrastructure requirements for management of the WWTP infrastructure

Infrastructure	Requirements (Design and Construction)
Stage 1 WWTP	1 x Sequence Batch Reactor (SBR) -0100-C-X-X-X with less than 125 m3/day treatment capacity. 5 x Collection pump stations (PSPS-02-2-X-C-X-X) 1 x 200 kL Balance tank fitted with high level alarm wired to visual strobe light and sounder to alert of overflows 1 x 300 kL Treated effluent / Irrigation tank fitted with high level alarm

Infrastructure	Requirements (Design and Construction)
	1 x sludge thickening tank WWTP containerized with external tanks Flow meters to be installed at influent inlet point and effluent egress point The WWTP will be constructed to meet the following water quality emission standards: o Biochemical Oxygen Demand <20mg/L o Total Suspended Solids <30mg/L o Total Nitrogen <30mg/L o Total Phosphorus <7.5mg/L o Chlorine Residual >0.2-2mg/L o pH 6.5-8.5 o E.coli <1000cfu/100mL Stock exclusion fence surrounding entire WWTP facility Tie-in with Camp RO brine stream at the treated effluent irrigation tank Sampling points to be installed at the mixing tank outlet prior to release of effluent via pipeline to the spray irrigation area RO brine/WWTP effluent monitoring has been removed from the Works Approval as it is covered by the operating Licence L9056/2017/1.
Stage 1 Spray irrigation areas	Stock exclusion fence comprising star picket, 3 strand wire and corner strainer posts surrounding entire irrigation area Internal berm installed inside the fence line from excess soil to limit surface water runoff from the irrigation area Operational pipework constructed using HDPE with minimum pressure rating (PN) of 12.5 Total minimum spray area of 4.72 ha Minimum of 48 irrigation sprinklers Boundary coordinates RO brine/WWTP effluent monitoring has been removed from the Works Approval as it is covered by the operating Licence L9056/2017/1.
Stage 2 WWTP	1 x Sequence Batch Reactor (SBR) with less than 150 m3/day treatment capacity 1 x 200 kL Balance tank fitted with high level alarm wired to visual strobe light and sounder to alert of overflows 1 x 200 kL Treated effluent / Irrigation tank fitted with high level alarm 1 x 50kL sludge thickening tank WWTP containerized with external tanks Flow meters to be installed at influent inlet point and effluent egress point WWTP will be constructed to meet the following water quality emission standards: ➢ Biochemical Oxygen Demand <20mg/L ➢ Total Suspended Solids <30mg/L

Infrastructure	Requirements (Design and Construction)
	➢ Total Nitrogen <30mg/L ➢ Total Phosphorus <7.5mg/L ➢ Chlorine Residual >0.2-2mg/L ➢ pH 6.5-8.5 ➢ E.coli <1000cfu/100mL Stock exclusion fence surrounding entire WWTP facility Commissioning and Time Limited Operational conditions with monitoring applied to the Works Approval.
Stage 2 Spray irrigation area	Stock exclusion fence comprising star picket, 3 strand wire and corner strainer posts surrounding entire irrigation area Internal berm installed inside the fence line from excess soil to limit surface water runoff from the irrigation area Operational pipework constructed using HDPE with minimum pressure rating (PN) of 12.5 Total minimum spray area of 2.63 ha Minimum of 26 irrigation sprinklers Boundary coordinates Commissioning and Time Limited Operational conditions with monitoring applied to the Works Approval.

9.1.7 RO infrastructure

The following environmental controls, infrastructure and equipment (Table 46) should be constructed to monitor RO brine quality.

Table 46: Infrastructure requirements for RO Plant monitoring

Infrastructure	Requirements (Design and Construction)
Accommodation Camp RO Plant	Sampling points to be installed at the: • RO Brine outlet prior to the WWTP Mixing tank • RO brine/WWTP effluent monitoring has been removed from the Works Approval as it is covered by the operating Licence L9056/2017/1.
Processing plant RO Plant	• RO Brine outlet prior to the Process Water Dam • Monitoring of the Process Water Dam is conducted as per the operating Licence L9056/2017/1.

9.1.8 Monitoring requirements

Monitoring requirements for the TMF, groundwater (with triggers and limits), Process Water Pond, Camp RO Brine and WWTP (with comparisons to relevant guidelines) have been applied to the operating Licence L9056/2017/1 so have been removed from the Works Approval.

9.1.9 Environmental Commissioning and Time Limited Operations

Environmental Commissioning and Time Limited Operations conditions have been applied for

the Stage 2 Bulk Fuel Storage, Stage 2 Power Station generators Stage 2 Processing Plant, Stage 2 Temporary Construction WWTP and Stage 2 Temporary Construction WWTP Spray Irrigation Area.

9.2 Works Approval Reporting

The Works Approval Holder has stated that Project construction is anticipated to occur over a period of 35 weeks duration. The commissioning of all facilities is occurring under the Works Approval.

As the (Category 70) Crushing and Screening Facility will only be used for construction purposes, operational conditions for the Crushing and Screening Facility will be included under the Issued Works Approval.

Works will be completed progressively, with compliance reporting required for all premises. A suitably qualified person will be required to confirm each item of infrastructure specified in the works approval has been constructed to the specified requirements.

Commissioning of the processing plant, TMF (including tailings pipeline infrastructure), Crushing and Screening Facility, Power Station were authorised under the Issued Works Approval. No commissioning is required for the landfills; however a compliance report will be required following the initial establishment of the facility (Monster Waste Dump). A compliance report has been submitted for the West Waste Dump. The WWTP is now operated under the Licence L9056/2017/1.

During this amendment, irrelevant conditions were removed from the Works Approval, as the operating Licence L9056/2017/1 has been issued. Infrastructure that is relevant to the Works Approval is the Stage 1 Mobile Crushing and Screening Plant, Stage 1 Landfill (Monster Waste Dump), Stage 1 WWTP spray field expansion, Stage 2 Bulk Fuel Storage, Stage 2 Power Station generators, Stage 2 Processing Plant, Stage 2 Temporary Construction WWTP and Stage 2 Temporary Construction WWTP Spray Irrigation Area. Notification conditions have also been implemented for any non-compliances.

9.3 Licence controls

The following controls have been / will be imposed as conditions on the proposed Issued Licence to manage the risk of emissions during operation of the Premises. It should be noted that these controls are not final and will be subject to compliance with conditions of the Issued Works Approval and may change if additional information becomes available to further inform the risk assessment (as per Guidance Statement: Risk Assessments).

9.3.1 Operational requirements for stormwater and hydrocarbon management

Site Infrastructure	Management controls
Earthworks/ site establishment	Where stormwater is likely to be contaminated with hydrocarbons and other contaminants, water will be directed to an oil water separation system prior to discharge to the environment or re-use on-site (with TPH less than 15mg/L). Initial sampling for other contaminants will be required prior to discharge.
Sedimentation ponds	Storm water from the power station will be directed to the infrastructure sedimentation pond Minimum freeboard of 300mm will be maintained in the pond Inspected as required, and before known significant rainfall

	events to ensure they are capable of functioning to remove sediment during high-rainfall events Establishment of surface water monitoring sites, prior to the construction of the basin structures which will include sites upstream and downstream of the (entire) operation
Raw Water Tank	1.833 ML capacity (with 288 kL reserved for fire water capacity) HDPE lined steel impermeable tank Fully covered Monitored after each runoff event to initiate pumping of the retained water into the process circuit or used for dust suppression
Process water pond	Minimum freeboard of 300mm will be maintained in the pond Water collected in the ponds will be reused in processing Wastewater monitoring
TMF	TMF Operating Manual developed and implemented to provide direction on the appropriate operation of the TMF Operated to manage to design capacity of 5Mtpa Decant removed via submersible pumps within decant tower Minimisation of the surface area of the decant pond during operations Return of water to the plant will be maximised and an annual water balance, calculated
All	A Surface Water Management Plan will be employed on site During periods of flow in the four creeks (Northern, Houston, Pilgangoora, Southern) at a minimum of once annually, surface water samples will be collected at one site upstream of the project and one site downstream of the Project with laboratory analyses for pH, TDS, TSS, electrical conductivity, major cations and anions, and contaminants

9.3.2 Operational requirements for the Process Water Pond

Site Infrastructure	Management controls
Process water pond	Minimum freeboard of 300mm will be maintained in the ponds Liner to be maintained via regular inspections Monitored after each rainfall event to check for adequate freeboard being available and to initiate pumping of the retained water into the process circuit or used for dust suppression It was recommended that the Works Approval Holder verified the water quality prior to ensure that the ASC NEPM and ANZECC and ARMCANZ, 2000 water quality criteria are met, however, sampling hasn't been provided to DWER to date and thus DWER implemented monitoring conditions of wastewater quality onto the operating Licence.

9.3.3 Operational requirements for the TMF

Site Infrastructure	Management controls
Pipelines	TMF Operating Manual developed and implemented to provide direction on the appropriate operation of the TMF Operated to managed to design capacity of 5 Mtpa Operational pipeline pressure transmitters at both ends of the pipeline with alarms to indicate variation in flow pressure Flows will be monitored by flow meters positioned at the start and end of the tailings delivery line, with readouts displayed on the Control System In the event flow meter readings indicate pipeline failure, the affected pipeline will be shut down Twice daily inspections of TMF inflow and decant pipelines during operation
TMF	TMF Operating Manual developed and implemented to provide direction on the appropriate operation of the TMF Operated to managed to design capacity of 5 Mtpa Decant removed via submersible pumps within decant tower Minimisation of the surface area of the decant pond during operations Return of water to the plant will be maximised Groundwater monitoring is undertaken quarterly at the six monitoring bores adjacent to the TMF to enable detection of seepage and groundwater mounding/ quality Piezometers will be monitored for determining phreatic surface within the tailings If there is a rise in groundwater to 5mbgl then the Works Approval Holder will operate recovery bores/trenches to collect seepage and return it to the decant pond Minimisation of the surface area of the decant pond during operations

9.3.4 Operational requirements for the Landfills

Site Infrastructure	Management controls
Landfills	Putrescible and inert waste will be disposed of in separate trenches Trenches will be covered a minimum of once per fortnight with soil material. Appropriate and adequate signage will be erected around the Pilgangoora landfill site. Place and compact waste to ensure that all faces are stable and capable of retaining restoration material. Restore cells (trenches) within 6 months after disposal in that cell (trench) has been completed. Store sufficient, dense, inert and incombustible material that is readily available at all times to cover the landfill tipping area. The size of the tipping face is kept to a minimum, and not larger than 30 metres in length or more than 2 metres above ground level in height. Waste will be levelled and compacted (e.g. maximum 300 mm lifts, passed over at least 3 times by heavy earthmoving machinery) as soon as practicable after it has been placed within the cell (trench). Cover landfilled waste with sufficient clean fill (e.g. 100 mm) at least weekly, to ensure that the waste is completely covered and that no waste is exposed. Windblown waste will be returned to the landfill site on a regular and recurring basis. The Works Approval Holder's Waste and Landfill Management Procedure requires that windblown waste around the landfill is undertaken regularly but at least on a monthly basis. Only putrescible waste, inert wastes and tyres will be disposed of at the landfill. Unserviceable tyres shall be transported to a designated area within the approved waste rock dump disturbance footprint. They shall be stacked appropriately and periodically buried in accordance with Regulation 14(2) of the EP Regs. No hydrocarbons and / or chemicals will be disposed of into the landfill facility.

	The volume of waste disposed of into the landfill will be recorded. Waste acceptance specifications Limit of waste volume

9.3.5 Operational requirements for the WWTP

Site Infrastructure	Management controls
WWTPs (Discharge point from effluent and RO Brine mixing tank)	The WWTPs will be operated to meet the following emission standards: (h) Biochemical Oxygen Demand <20mg/L (i) Total Suspended Solids <30mg/L (j) Total Nitrogen <30mg/L (k) Total Phosphorus <7.5mg/L (l) Chlorine Residual >0.2-2mg/L (m) pH 6.5-8.5 (n) *E.coli* <1000cfu/100mL The WWTPs will be monitored quarterly for TDS, BOD, TSS, TN, TP, Residual chlorine, pH and *E.coli* Monthly Cumulative volume (m^3) will be recorded The maximum TDS (mg/L) of the (final) effluent stream that is sent to the spray irrigation field for disposal will be < 1000 mg/L.
Discharge point from the RO Brine tank and WWTP effluent	Monitoring conditions are on the operating Licence for RO brine mixed with WWTP effluent to the irrigation area.
Spray fields	The spray fields will be managed to prevent waterlogging of the surface or ponding of water by alternating discharge between the three sets of sprinklers. Daily inspections of the spray fields will be undertaken to ensure there is no waterlogging of soil or ponding, vegetation health is not declining and to identify maintenance requirements. Maintenance will be undertaken as required to ensure correct operation of the system. The spray field areas will be monitored for the presence of weeds on at least a quarterly basis, with herbicide treatment being carried out as required. Wastewater monitoring during commissioning and time limited operations.

9.3.6 Licence reporting

An Annual Environmental Report and Annual Audit Compliance Report will be required to be submitted as conditions of the proposed Issued Licence.

10. Works Approval Holder's comments

The Applicant (now Works Approval Holder) was provided with copies of the draft Works Approval document and draft Decision Report on the following dates. The dates are as follows:

- 25 September 2017 (original Works Approval) – comment provided.
- 13 October 2017 (DWER initiated amendment) – no comments provided.
- 15 June 2018 (Works Approval amendment) – comment provided.
- 26 September 2019 and 3 October 2019 (Works Approval amendment) – comments provided.

Where the Works Approval Holder has provided comment, these have been summarised, along with DWER's response, in Appendix 2.

11. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this Decision Report (summarised in Appendix 1).

Based on this assessment, it has been determined that the Issued Works Approval Amendment will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Manager, Resource Industries
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key Documents

This amendment

	Document details	In text ref	Availability
1.	Works Approval W6051/2017/1 – Pilgangoora Lithium-Tantalum Project	W6051/2017/1	Available at: www.der.wa.gov.au
2.	ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.	ANZECC 2000	Available at: www.environment.gov.au
3.	ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Livestock Guidelines, 2000 Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 3 Primary Industries — Rationale and Background Information *(Irrigation and general water uses, stock drinking water, aquaculture and human consumers of aquatic foods)* (Chapter 9), October 2000	ANZECC Livestock 2000	Available at: http://www.environment.gov.au/water/policy-programs/nwqms
4.	Australian Standard 1289.5.8.1 - 2007 Methods of Testing Soils for Engineering Purposes – Soil Compaction and Density Tests – Determination of Field Density and Field Moisture Content of a Soil Using a Nuclear Surface Moisture Density Gauge – Direct Transmission Mode	AS 1289.5.8.1 – 2007	Australian Standard 1289.5.8.1 - 2007
5.	Australian Standard 1289.5.7.1 – 2006 Methods of Testing Soils for Engineering Purposes – Soil Compaction and Density Tests – Compaction Control Test – Hilf Density Ratio and Hilf Moisture Variation (Rapid Method)	AS 1289.5.7.1 - 2006	Australian Standard 1289.5.7.1 - 20067
6.	Tailings Management Facility Feasibility Study Design prepared by	ATC Williams,	DWER records (A1567039 and A1363257)

	ATC Williams November 2016 (115275.01R02 Rev 0)	2016	
7.	Geotechnical investigation for TMF (Tailings Management Facility) prepared by ATC Williams April 2017 (115275.03R02)	ATC Williams, 2017a	DWER records (A1567037)
8.	Tailings Management Facility Technical Specification for Cell 1 Stage 1A Construction prepared by ATC Williams August 2017 (115275.04 SP01 Rev0)	ATC Williams, 2017b	DWER records (A1567040)
9.	ATC Williams Variation: Memo on construction of TMF 1 and TMF 2 and partial construction completion information on TMF1. 115275.04 M04 (DWER WORKS APPROVAL VARIATION) REV A.DOCX, dated 8/5/2018. 5 page memo. *Contained within email: RE: W6051/2017/1 - Notification of potential non-compliance dated 11 May 2018*	ATC Williams, 2018	DWER records (A1672487)
10.	Bradley, D.C., McCauley, A.D. and Stillings, L.M., 2010. Mineral-Deposit Model for Lithium-Cesium-Tantalum Pegmatites. US Geological Survey, Scientific investigations Report 2010-50700-O.	Bradley et. Al, 2010	Available at: https://pubs.er.usgs.gov/publication/sir20105070O.
11.	Broberg, K., Concha, G., Engström, K., Lindvall, M., Grandér, M. and Vahter, M., 2011. Lithium in drinking water and thyroid function. Environmental Health Perspectives, 119(6), 827-830.	Broberg, et al, 2011	Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3114818/pdf/ehp-119-827.pdf
12.	Graeme Campbell and Associated Pty Ltd Pilgangoora Lithium- Tantalum Project Geochemical Characterisation of Flotation-Tailings Samples, September 2016	Campbell and Associates Pty Ltd, September 2016	DWER records (A1363286)

13.	Stakeholder consultation response on proposed W6051/2017/1 and licence L9056/2017/1 from DBCA (Parks and Wildlife)	DBCA, 2017	DWER Records (A1469989)
14.	Stakeholder consultation response on proposed W6051/2017/1 and licence L9056/2017/1 from Land Use Planning/Approvals, (Water) DWER	DWER Water, 2017	DWER Records (A1471350)
15.	DMIRS comments on 2018 works approval amendment	DMIRS, 2018	DWER records (A1636358)
16.	Stakeholder consultation response on proposed W6051/2017/1 and licence L9056/2017/1 from DMIRS	DMIRS, 2017	DWER Records (A1471444)
17.	Code of Practice: Tailings storage facilities in Western Australia, Department of Mines and Petroleum, 2013	DMP, 2013	Available at: http://www.dmp.wa.gov.au
18.	DER, July 2015. Guidance Statement: Regulatory principles. Department of Environment Regulation, Perth.	DER 2015a	Available at: www.dwer.wa.gov.au
19.	DER, October 2015. Guidance Statement: Setting conditions. Department of Environment Regulation, Perth.	DER 2015b	
20.	DER, August 2016. Guidance Statement: Licence duration. Department of Environment Regulation, Perth.	DER 2016a	
21.	DER, February 2017. Guidance Statement: Risk Assessments. Department of Environment Regulation, Perth.	DER 2017a	
22.	DER, February 2017. Guidance Statement: Decision Making. Department of Environment Regulation, Perth.	DER 2017b	
23.	Gadd, G.D., 2007. Geomycology: biogeochemical transformations of	Gadd, 2007	Available at: https://faculty.unlv.edu/buckb/scan

	rock, minerals, metals and radionuclides by fungi, bioweathering and bioremediation. Mycological Research, 111, 3-49.		ned%20pfd/Gadd%202007_lichen%20chelation.pdf.
24.	Groundwater Resource Management Dewatering Assessment Pilgangoora Lithium Tantalum Project, August 2016	GRM, 2016	DWER records (A1608188)
25.	Geochemical Characterisation of Flotation-Tailings Sample Graeme Campbell and Associates Pty Ltd September 2016 (Job No. 1520/2)	Graeme Campbell and Associates, 2016	DWER Records (A1363257)
26.	Groundwater Resource Management Pilgangoora Lithium Tantalum Project – Site Water Balance Modelling. September 2016	GRM, September 2016	Available from the Works Approval Holder
27.	Groundwater Resource Management (Groundwater) Operating Strategy for Pilgangoora Project	GRM, 2017	Available from the Works Approval Holder
28.	IAEA Safety Standards Series, Application of the Concepts of Exclusion, Exemption and Clearance, Safety Guide No. RS-G-1.7, International Atomic Energy Agency, 2004	IAEA, RS-G-1.7	Available at: http://www-pub.iaea.org
29.	Maest, A.S., Kuipers, J.R., Travers, C.L. and Atkins, D.A., 2005. Predicting Water Quality at Hardrock Mines: Methods and Models, Uncertainties, and State-of-the-Art.	Maest, et al, 2005	Available at: http://pebblescience.org/Pebble-Mine/acid-drainage-pdfs/PredictionsReportFinal.pdf
30.	MMWC Environmental Pilgangoora Project Area Flora, Vegetation and Fauna Assessment V2 – July 2016	MMWC, July 2016	DWER records (A1363286)
31.	National Health and Medical Research Council (NHMRC), 2015, "Australian Drinking Water Guidelines 6, 2011", Version 3.1, Updated March 2015	NHMRC, 2015	Available at: https://www.nhmrc.gov.au/guidelines-publications/eh52
32.	Northcote,K.H. with Beckmann,G.G., Bettenay,E., Churchward,H.M., Van	Northcote, et	Available at: http://www.asris.csiro.au

	Dijk,D.C., Dimmock,G.M., Hubble,G.D., Isbell,R.F., McArthur,W.M., Murtha,G.G., Nicolls K.D., Paton,T.R., Thompson,C.H., Webb,A.A. and Wright,M.J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data (CSIRO Aust. and Melbourne University Press: Melbourne)	al,1960-68	
33.	National Water Quality Management Strategy, Australian guidelines for sewerage systems: Effluent Management, 1997	NWQMS, 1997	Available at: http://www.agriculture.gov.au/water/quality/nwqms/sewerage-systems-effluent-management
34.	Pilgangoora documentation received via email 21 June 2017.	PML, June 2017	DWER Records (A1459267)
35.	Works approval application form for TMF 1, TMF3 and relocation of putrescible landfill	PML, 15 November 2017	DWER records (A1567042)
36.	Revised works approval supporting documentation omitting TMF 3 and including mobile crushing and screening plant	PML, 18 December 2017	DWER records (A1583099)
37.	WORKS APPROVAL AND OPERATING LICENCE APPLICATION SUPPORTING DOCUMENT Pilgangoora Lithium-Tantalum Project. Report Version/Date: Version 1 18 January 2017 – *original application*	PML, 2017a	DWER Records (A1363257)
38.	RE: Pilgangoora documentation. Received 21 June 2017	-	DWER Records (A1459267)
39.	Additional information for inclusion in Pilbara Minerals Works Approval and Licence Application currently under assessment dated 19 July 2017	-	DWER Records (A1483348)
40.	Pilbara Minerals Limited – Pilgangoora project – Supporting documentation comprising: WWTP Process and Instrument diagram	-	DWER Records (A1363286)

	(PIL01-DRG-3300-PI-00, Rev 0)		
41.	Email RE: PILGANGOORA WORKS APPROVAL AND LICENCE APPLICATION received 5 May 2017	-	DWER Records (A1424492)
42.	Email WA_OL 2017-00317 Additional information received 8 August 17	-	DWER Records (A1500986)
43.	Email Fw: Figure clarification from PML received 20 September 2017	-	DWER Records (A1526154)
44.	Email Re: PML Pilgangoora - Fencing at Landfill site further clarification received 20 September 17		DWER Records (A1526166)
45.	Email Re: PML Pilgangoora - works approval assessment of fuel storage capacity confirmation received 18 September 17	-	DWER Records (A1525613)
46.	Email Re: Query regarding dewatering volumes for the PML Pilgangoora Project and request for figure received 18 September 17	-	DWER Records (A1525619)
47.	Email RE: Query regarding dewatering volumes for the PML Pilgangoora Project received 24 August 17	-	DWER Records (A1525622)
48.	Email RE: Works Approval for comment (PML response to draft for review) received 27 September 2017	-	DWER Records (A1529941)
49.	Email RE: W6051 - queries following draft review (PML response to draft review comments) received 27 September 2017	-	DWER Records (A1530475)
50.	Works approval amendment further information request to Pilbara Minerals	DWER, 1 February 2018	DWER records (A1603628)
51.	Pilbara Minerals response to further information request	PML, email - 5 February 2018	DWER records (A1607639)
52.	Works approval application form with supporting documentation for	PML, 5 February 2018	DWER records (A1607100)

	increased throughput for WWTP and irrigation field expansion		
53.	WWTP further information provided by Pilbara Minerals	PML, 26 February 2018	DWER records (A1624429)
54.	RO Plant throughput further information provided by Pilbara Minerals	PML, 5 June 2018	DWER records (A1686523)
55.	Soil Characterisation Study (Significant Environmental Services, 2016).	Significant Environmental Services, 2016	DWER records (A1624424)
56.	Australian Radiation Protection and Nuclear Safety Agency, Code of Practice & Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing – Radiation Protection Series Publication No. 9, August 2005	the Code	Available at: http://www.arpansa.gov.au
57.	Australian Radiation Protection and Nuclear Safety Agency, Code of Practice for Safe Transport of Radioactive Material – Radiation Protection Series, No. 2, 2008 Edition	Transport Code	Available at: http://www.arpansa.gov.au
58.	360 Environmental Pilgangoora Baseline Vertebrate Fauna Survey	360 Environmental, May 206	DWER records (A1363286)
59.	Department of Environment 2004 Water Quality Protection Note Irrigation with nutrient-rich wastewater (WQPN 22)	WQPN 22	Available at: https://www.water.wa.gov.au/__data/assets/pdf_file/0013/4045/82324.pdf
60.	Contaminated Sites Branch technical advice on Gross Alpha and Fluoride elevations in groundwater and wastewater	N/A	DWER records (A1769987)
61.	RE: Pilgangoora Lithium-Tantalum Project Meeting 8 February 2019 – outcomes summary (includes Conditions 1 and 2 Report	Conditions 1 and 2 Report and Radionuclides Characterisatio	DWER records (A1769120)

	and Radionuclides Characterisation)	n, February 2019	
62.	Contaminated Sites Branch technical advice on Conditions 1 and 2 Report and Radionuclides Characterisation Reports	N/A	DWER records (A1769988)
63.	Radiation Management Plan	Radiation Management Plan	DWER records (A1754360)
64.	DWER's Guideline: Industry Regulation Guide to Licensing June 2019	N/A	Available at: www.dwer.wa.gov.au
65.	Email titled" RE: L9056 Pilgangoora Queries" dated 26/08/2019 10:35am and authored by Pilbara Minerals Ltd	N/A	DWER records (A1817720)
66.	Email titled" FW: APPLICANT NOTIFICATION - W6051/2017/1 - NOTICE OF PROPOSED AMENDMENT TO WORKS APPROVAL" dated 26 September 2019 4:11pm and authored by Pilbara Minerals Ltd	N/A	DWER records (A1828798)
67.	Email titled"RE: APPLICANT NOTIFICATION - W6051/2017/1 - NOTICE OF PROPOSED AMENDMENT TO WORKS APPROVAL" dated 3/10/2019 11:49am and authored by Pilbara Minerals Ltd	N/A	DWER records (A1828797)

Appendix 2: Summary of Works Approval Holder's comments on risk assessment and draft conditions

Condition	Comments received	DWER response
26 September 2017		
-	• W6051/2017/1 Draft Works Approval (Instrument). The Applicant has stated that *"The draft conditions imposed within the draft Works Approval as presented, are acceptable to Pilbara Minerals."*	• PML's comment regarding the acceptability of the Works Approval Instrument and conditions is noted.
-	• W6051/2017/1 Draft Works Approval (Instrument) Decision Report – Applicants responses: o p13: addressing query regarding drain from concrete pad. "*Drains (from refuelling grates and self bunded tank sumps) feed to a local sump which is pumped to Power Station OWS (Diesel fuel farm). The oily water will be pumped to holding tank, collected by truck and unloaded into our vehicle wash water area / sump or dust suppression turkeys nest."* o p14: addressing query regarding where water from the power station oil-water treatment system travels to. "*Holding tank. We then collect the water in a truck and unload into our vehicle wash water area / sump or dust suppression turkeys nest.*" o p14: addressing query regarding sampling of sediment trap systems. "*yes pursuant to monitoring regimes*" o p14: addressing query regarding package WWTP commissioning including having the WWTP system cultures built-up ready off site. "*Cultures will be built up from an offsite source*" o p14: addressing query on throughput and outflow measurement. "*There is a flow meter directly upstream of the sprayfield to measure the output flow rate*". o p45: addressing query on where the brine waste from the package reverse osmosis/UV treatment facilities is deposited. "*For the Camp, the brine/reject water from the Reverse Osmosis plant is sent to the irrigation tank at the WWTP. For the Plant, the brine is*	• All comments and address of queries provided by PML were considered and used to update this report and the Works Approval instrument as appropriate.

Condition	Comments received	DWER response
	returned to the Process Water Storage Pond (Process Water Dam).” o p48: addressing query on varying ranges of tailings slurry concentration of solids. “*Nominally this should be between 52% w/w to 68% w/w to allow for transient conditions of the Plant*.” o p53: addressing query on how volume of waste disposed into the landfill will be recorded. “*Based on an estimate of average weekly disposal. The waste is measured in bulk cubic metres, (BCM).*” o p55: clarification on monthly cumulative volume and flow meters requested. “*There is a flow meter directly upstream of the sprayfield to measure the output flow rate.*” o p56: confirmation that “*The area where the sprayfield will be setup will contain natural vegetation.”* o p56: addressing query regarding water quality loading rates of TN and TP conforming to less than 480kg/ha/rear and 120 kg/ha/year respectively. Table provided demonstrating expected nutrient loading of 274 kg/ha/yr of total nitrogen and 68 kg/ha/yr of total phosphorus. This is based on target discharge quality of ≤30 mg/L total nitrogen and ≤7.5 mg/L total phosphorus.	
21 June 2018		
(General)	• Minor edits to Table nomenclature within the conditions text.	• All minor edits provided by the Works Approval Holder were considered and used to update this report and the Works Approval instrument as appropriate.
2	• Deletion of TMF1 Stage 1A within the condition for the provision of a construction report and risk assessment for seepage from the tailings management facilities. ‘*The Works Approval Holder must provide a report to the CEO prior to* the completion of the construction of ~~TMF1 Stage 1A and~~ TMF2 Stage 1A. The report is to contain a risk assessment on the potential impacts from seepage must include but is not limited to risk assessment on the	• The request for deletion of the requirement for a construction report for TMF1 Stage 1A has been considered. The condition as proposed in the draft is to remain with the only change being the timing of provision of the report.

Condition	Comments received	DWER response
	potential impacts from seepage from ~~TMF1 and~~ TMF2. The report must include but is not limited to: (a) An assessment of the leachate testing undertaken in accordance with Condition 1 of the Works Approval; (b) Information on the radial extent of the cone of depression around pit dewatering infrastructure to determine whether TMF~~1~~ 2 is within the dewatering capture zone. Information must include dewatering contours on a local scale to determine if the footprint of TMF ~~1~~ 2 is within the capture zone. Drawdown contours must be provided on a map at 50m, 10m, 5m and 1m intervals. The Works Approval Holder must provide the duration of dewatering activities. (c) Bore logs for any newly installed monitoring bores. (d) A seepage model for TMF ~~1~~ 2 for the life of mine which must: (i) estimate the total seepage magnitude; (ii) shows seepage flow direction from TMF ~~1~~ 2; and (iii) includes a site specific risk assessment for seepage from TMF ~~1~~ 2, identifying potential pathways and impacts on receptors including potential impacts to the hyporrheic zone of Pilgangoora Creek. (e) Any additional controls required to manage seepage in the event that testing undertaken in accordance with Condition 1 indicates that contaminants are at levels of environmental concern.	• The condition as originally drafted required a report on leachate testing, groundwater drawdown and seepage modelling prior to the construction of TMF1 however PML's current arrangements preclude deferring commissioning until after these reports can be completed. The condition has been amended so that the requirements still apply to both TMF1 and TMF2, but are not required to be submitted until TMF2 is nearing completion. • The consequence of this change in submission date is that a full risk assessment of the construction of TMF1 may determine that additional operational controls are required for the life of the TMF, or that a final design height should be reduced to limit the amount of tailings deposited. • In order to consistently implement this change, Condition 1 has also been amended to remove reference to leachate testing on representative tailings material prior to completion of TMF1 Stage 1A.
2 and 5	• Movement of text from Condition 5 to Condition 2: '*Inclusion of bore logs for newly constructed bores'*	• This inclusion has been considered and used to update this report and the Works Approval instrument as appropriate.

Condition	Comments received	DWER response
7	• Update to the wording of condition 7, to remove the requirement for establishment of surface water monitoring locations prior to commissioning of the mobile crushing and screening plant. • Removal of the word 'entire' with reference to not wanting to set up sites that will be monitored to obtain representative samples of the 'entire' operation. • The timeframe provided for completion of the monitoring site installation is proposed to be 31 December 2018.	• The timeframe prior to commissioning is proposed to be removed, and has been considered and adopted. Given the potential for rainfall and cyclonic activity that could occur in the area before 31 December, and the requirement to have sampling locations identified and procedures in place, DWER considers that the Works Approval Holder may not be able to accurately establish baseline freshwater quality and flow regimes if background monitoring is not undertaken prior to disturbance occurring. In this instance the Works Approval Holder, and later the Licence Holder, may be required to meet default water quality parameters based on either published guidance or similar environmental settings.
8	• Request to extend the commission period from original approved 2 months to 6 months for the '*Process Plant, Power Station, Landfill, Mobile Crushing and Screening Plants, Bulk Diesel Fuel Facility and TMF Cells'*	• This timing change and increase to include both TMF Cells 1 and 2 has been considered and updated in the Works Approval instrument as appropriate. Extended commissioning of ancillary infrastructure is required during commissioning of the process plant, which is complex.
9	• Request to extend the commissioning period from original approved 3 months to 12 months for the Camp WWTP. The Works Approval	• This timing change has been considered and updated in the

Condition	Comments received	DWER response
	Holder noted that the WWTP has been in commissioning since October 2017. *'The Works Approval Holder shall commission the Waste Water Treatment Plant for no more than 3 12 months to allow submission of the steady water quality data'*	Works Approval instrument as appropriate. • It is unclear at what throughput (rate) the WWTP has been commissioning at since October 2017.
11 (and new condition 12)	• Request to amend condition to remove the requirement for compaction/ hydraulic conductivity testing of TMF1 prior to the deposition of tailings into TMF 1 – in favour of management actions during deposition into this specific cell. *'Note DWER to insert new condition along lines of "management actions during deposition of tailings during commissioning designed to minimize seepage by accelerating decant recovery. Actions including but not limited to selective placement of spigots and active monitoring of decant pond size and return water pump operation'*	• As it is not practicable for PML to add compacted clay to the base of TMF1 to achieve a reduced permeability level, DWER consents to allowing PML to commence commissioning of TMF1 as is, with additional controls to promote recovery of decant water and prevent saturation of base and embankment sediments during early stage deposition. Ongoing monitoring to detect seepage will be required and management actions will also be required in the event of seepage impacts to nearby groundwater, soils, vegetation or watercourses. • Refer also to response to Condition 2. • The results of testing of TMF1 are still required to be submitted with all other 'as-built' information. The photos presented within compliance and construction information provided to date demonstrates that some areas in the base of TMF1 may not have received any

Condition	Comments received	DWER response
		compaction treatment by earthworks machinery, which was a commitment within the Application and a recommendation in the TSF design report (ATC Williams, 2017b). • It is considered that further work is required by the Works Approval Holder to demonstrate how the Works Approval Holder has obtained, as a minimum, the following information or constructed the following infrastructure: o Locations hydraulic conductivity testing was undertaken within the TMF base. o Information and results conducted during the embankment construction o Cut off trench location and installation details. Seepage during commissioning can be minimised by taking measures to actively recover as much water as possible in the early phases of deposition. Measures include selective deposition to achieve a long tailings beach running towards the decant pond and to direct fresh tailings away from perimeter embankments, as well as actively pumping decant water from the TMF and maintaining a water balance to account for as much

Condition	Comments received	DWER response
		water as possible. Condition 12 has been included to ensure that the initial deposition of tailings is conducted in such a way as to limit saturation of embankments and the TMF base until some tailings have been deposited and consolidated, as the consolidated tailings have lower hydraulic conductivity than the embankment and base materials.
14 and Row 14 of Schedule 3: Works, Table 7: Infrastructure and equipment requirements table	• Removal of 30 day timeframe (from within issue of the amended Instrument) for the installation monitoring bores. • Deletion of TMFMB01-06 monitoring bores that have already been assessed and approved under the original works approval. • Proposed new monitoring locations were provided (GPS locations added in Schedule 3 Table 7): o TMFMB01 o PMB002 o PMB001 o PWB004 o TMFMB02 • The timeframe for installation is proposed to be amended from *'within 30 days of the issue of this amendment'* to *'prior to commissioning of TMF2'.*	• The proposed timeframe limits and bore locations have been considered in relation to the urgency required for deposition into TMF1 for commissioning and the long-term capture of appropriate monitoring data of potential seepage and impacts to the environment. Proposed bore locations are not deemed acceptable to monitor for the detection of early depositional seepage. Four of the original authorised monitoring bores in addition to an extra monitoring bore to the west of the facility (near existing PWB004) will be required. As such, the original bore locations TMFMB 03 to 06 are to remain within the Works Approval and the condition for drilling and monitoring of these bores has been updated to

Condition	Comments received	DWER response
		be commensurate with the identified environmental risk and proposed deposition into the TMF (1 and TMF2) during commissioning. A new condition has been added to capture the requirement for the drilling of new monitoring bores • Note: the condition has now been numbered Condition 16, with the new condition being Condition 17.
15 and Table 5	• Monitoring frequency (in Table 5) for the: i) discharge point from the RO Brine tank, prior to receipt at the mixing tank: and ii) the discharge point from effluent and RO Brine mixing tank to be changed from fortnightly to monthly.	• The request for sampling frequency reduction has been reviewed. It is considered that the wording within the condition, being to *'undertake monitoring of RO Brine and mixed wastewater discharged to the irrigation field during commissioning until such time that the operational licence has been granted for this Premises'* remains appropriate given the facility is still in commissioning and the water quality of the RO brine remains unknown. • Note: the condition has now been numbered Condition 18.
16 and Table 6	• Groundwater monitoring 16 *The Works Approval Holder must undertake monitoring of ambient groundwater:* • *At the locations specified in Column 1;*	• The timeframe for background monitoring to occur prior to commissioning of TMF1 is proposed to be removed, and has been considered and adopted. Given the

Condition	Comments received	DWER response
	• *For the parameters specified in Column 2;* • *In the units specified in Column 3;* • *For the averaging periods specified in Column 4;* • *Twice prior to the commencement of any tailings deposition in ~~TMF1 and~~ TMF2, with the exception of total phosphorous and total nitrogen whereby one sample is required;* • *At least as frequent as the minimum frequencies specified in Column 5 following sampling as specified in Condition 15 (e); and* • *In accordance with the method specified in Column 6,* *in Table 6*	potential for seepage impacts to occur during early phase deposition, DWER considers that the Works Approval Holder may not be able to accurately establish baseline groundwater quality and level information if background monitoring is not undertaken prior to disturbance occurring. In this instance the Works Approval Holder, and later the Licence Holder, may be required to meet default water quality parameters based on either published guidance or similar environmental settings. • Note: the condition has now been numbered Condition 19 and Table 6 has been updated to include the provision for ongoing monitoring of new bores as listed in Condition 17.
Schedule 3: Works Infrastructure and equipment Infrastructure and equipment which are required to be built are listed in Table 7 3 as specified by Condition 3 1. Table 7: Infrastructure and	• Processing Plant: o reduction of Stage 2 cyclones from 4 to 1 in number o Cleaner scavenger spirals removed, deemed not required in the final design by the Works Approval Holder o Cleaner shaking table removed, deemed not required in the final design by the Works Approval Holder o Spray/ Sprinkler systems clarified to be located within the crushing circuit o Concrete pad containment capacity wording altered from '*110% of the capacity of all tanks'* to read..110% of the capacity of largest tank o Clarification that spray/sprinkler systems installed are on crusher conveyor transfer points.	The variations to the installed aspects of the Processing Plant have been considered and used to update this report and the Works Approval instrument as appropriate. • It is noted that the containment capacity of the concrete bunding around the Processing Plant has now been reduced to 110% of the largest tank. Whilst the likelihood of tank failure is low, it is recognised that the risk of this reduction in spill

Condition	Comments received	DWER response
equipment requirements table	• Power station: o Change of power standby MW from 2.2 to 2.9 MW • Diesel generators (for power station): o Changed from 16 x 1400 kVA diesel generators to 7 x 2500 kVA generators and addition of 2 x 1300 kVA generators and 1 x 3100 KvA (increase of 800kVA in generator capacity). • Landfill (Monster Waste Dump): o Amendment to require the landfill to be more than 250 m from any *named* watercourse. • Process plant sedimentation pond: o Deletion of '*sediment and surface water monitoring sites upstream and downstream of the sedimentation ponds'* • Tailings Management Facility (TMF) (Cell 2, Stage 1 only): o Deletion of '*10 standpipe piezometers installed in the starter causeway embankment'*. • Monitoring bores: o Discussed above in *'14 and Row 14 of Schedule 3: Works, Table 7: Infrastructure and equipment requirements table'* • Wastewater Treatment Plant (WWTP) o Edits to the minimum spray area, number of irrigation sprinklers, and amalgamation of boundary coordinates to depict the full (combined) boundary of the approved and expansion section of the irrigation area. o Insertion of text *'Constructed so that there is no spray drift or runoff crossing the Premises boundary during operation'* • TMF (Stage 1 only): o Deletion of text *'Hydraulic conductivity of less than 1.0 x 10^{-7} m/s using compacted in situ material and imported clay as required'* o Deletion of '*10 standpipe piezometers installed in the starter causeway embankment'*. • Landfill (West Waste Dump):	containment ability is at the risk of the Works Approval Holder. • Deletion of 'sediment and surface water monitoring sites upstream and downstream of the sedimentation ponds' has been considered and addressed in Condition 7 of the amendment. • Deletion of 10 piezometers has been noted and information updated as per Table 6 in this Decision Report. • The suggestion to amalgamate the WWTP irrigation area information has been considered. As the expansion is subject to this assessment, is has been deemed appropriate to keep the existing and expansion spray area information, separate. • TMF 1 Stage 1 amendments have been considered. TMF base compaction (hydraulic conductivity information) has been amended to reflect information provided on current TMF 1 Stage 1A construction state of the TMF base as at May 2018. • TMF 1 piezometer configuration has been updated to reflect information presented in Table 6 of this report. • The request for having both landfills to be more than 250m from any

Condition	Comments received	DWER response
	o Amendment to require the landfill to be more than 250 m from any *named* watercourse.	named watercourse has been considered. As it is the deposition of water within a landfill facility that has the potential to increase seepage through a landfill facility, it is considered that a drainage line (named or unnamed) has the potential to direct water into such a facility. As such, the wording requiring separation 250m from any watercourse is to be retained.
22 June 2018		
14	• Commitment to install an additional monitoring bore (50m depth) to the west of TMF1 and TMF 2 adjacent to PWB004.	• This commitment has been considered and used to update this report and the Works Approval instrument as appropriate.
26 September 2019		
Schedule 3, Table 7, Item 1 (Raw Water Tank) of the amended Works Approval	• Pilbara Minerals request removal of the requirement to monitor after each rainfall event as this tank is fully covered, not impacted by rainfall and also has continual level monitoring via the Citect system	• Updated as requested.
3 October 2019		
Expire date on Works Approval	• Requested 27 September 2022. Construction will not commence immediately and there is no detailed construction schedule yet in place. The delayed construction is a reflection of the softening global lithium market and current capital constraints. • Confirmed that Pilbara Minerals will not pursue authorisation of the discharge of excess pit dewater through this Works Approval.	• Updated as requested.

Attachment 1: Amended Works Approval W6051/2017/1