



## Application for Works Approval

### Part V Division 3 of the *Environmental Protection Act 1986*

---

**Works Approval Number** W6694/2022/1

**Applicant** South32 Worsley Alumina Pty Ltd

**ACN** 008 905 155

**File number** DER2022/000252

**Premises** Worsley Alumina Refinery

Gastaldo Road,  
ALLANSON WA 6225

Legal description -

Lease No 3116/7574 being Wellington Locations 5314-5317 on  
Deposited Plan 220209

As defined by the premises maps attached to the issued works  
approval

**Date of report** 12 October 2022

**Proposed Decision** Intent to grant works approval

# Table of Contents

<b>1. Decision summary .....</b>	<b>1</b>
<b>2. Scope of assessment .....</b>	<b>1</b>
2.1 Regulatory framework .....	1
2.2 Application summary and overview of premises .....	1
2.3 Proposed works .....	3
2.4 Part IV of the EP Act .....	1
<b>3. Risk assessment .....</b>	<b>1</b>
3.1 Source-pathways and receptors .....	1
3.1.1 Emissions and controls .....	1
3.1.2 Receptors .....	7
3.2 Risk ratings .....	8
3.3 Embankment failure .....	13
3.3.1 Embankment Failure .....	13
3.4 Decision .....	13
<b>4. Consultation .....</b>	<b>14</b>
<b>5. Conclusion.....</b>	<b>14</b>
<b>References .....</b>	<b>14</b>
<b>Appendix 1 .....</b>	<b>15</b>
<b>Summary of applicant’s comments on risk assessment and draft conditions ....</b>	<b>15</b>

Table 1: Summary of Works to be undertaken to embankments during Stage 1 and Stage 2 of development.....	3
Table 2: Summary of Bauxite Residue Disposal Area 5 storage characteristics .....	1
Table 3: Proposed applicant controls .....	2
Table 4: Sensitive human and environmental receptors and distance from prescribed activity.	7
Table 5: Risk assessment of potential emissions and discharges from the premises during construction, and operation .....	9
Table 6: Consultation.....	14
Figure 1: Bauxite Disposal Area layout at the premises .....	2
Figure 2: Financial Year 2023 works .....	4
Figure 3: Financial Year 2024 works .....	5

## 1. Decision summary

This Decision Report documents the assessment of potential risks to the environment and public health from emissions and discharges during the construction of embankment raise Stage 6B of Bauxite Residue Disposal Area (BRDA) 5 at the premises. Under this Works Approval a 5m raise is planned for BRDA 5 cells 1, 4, 2, 3 and 5. As a result of this assessment, Works Approval W6694/2022/1 has been granted.

## 2. Scope of assessment

### 2.1 Regulatory framework

In completing the assessment documented in this decision report, the Department of Water and Environmental Regulation (the department; DWER) has considered and given due regard to its regulatory framework and relevant policy documents which are available at <https://dwer.wa.gov.au/regulatory-documents>.

### 2.2 Application summary and overview of premises

On 8 June 2022, the applicant submitted an application for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act).

The application is to undertake construction works to raise the embankments of BRDA 5 from 285.5 m by 5m to a final height of RL 290.5 m AHD as part of Stage 6B of development for Cells 1-5. This report assesses the emissions and discharges associated with the construction of the Stage 6B embankment raise only. Deposition of bauxite tailings into these areas does not form part of the current application and is not assessed within this decision report. A separate application will be submitted following completion of geotechnical studies to inform the stability and thereby suitability of the embankments for the long term storage of bauxite residue of the long term under a range of operating conditions.

The premises relates to the Category 46: bauxite refining and assessed production capacity of 4.7 million tonnes per annum under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in Works Approval W4432/2008/1) (Licence Amendment date 24 August 2012) and EPA Ministerial Statement 719 (MS 719 amendment 30 Nov 2016). The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guideline: Risk Assessments* (DWER 2020) are outlined in Licence L4504/1981/17.

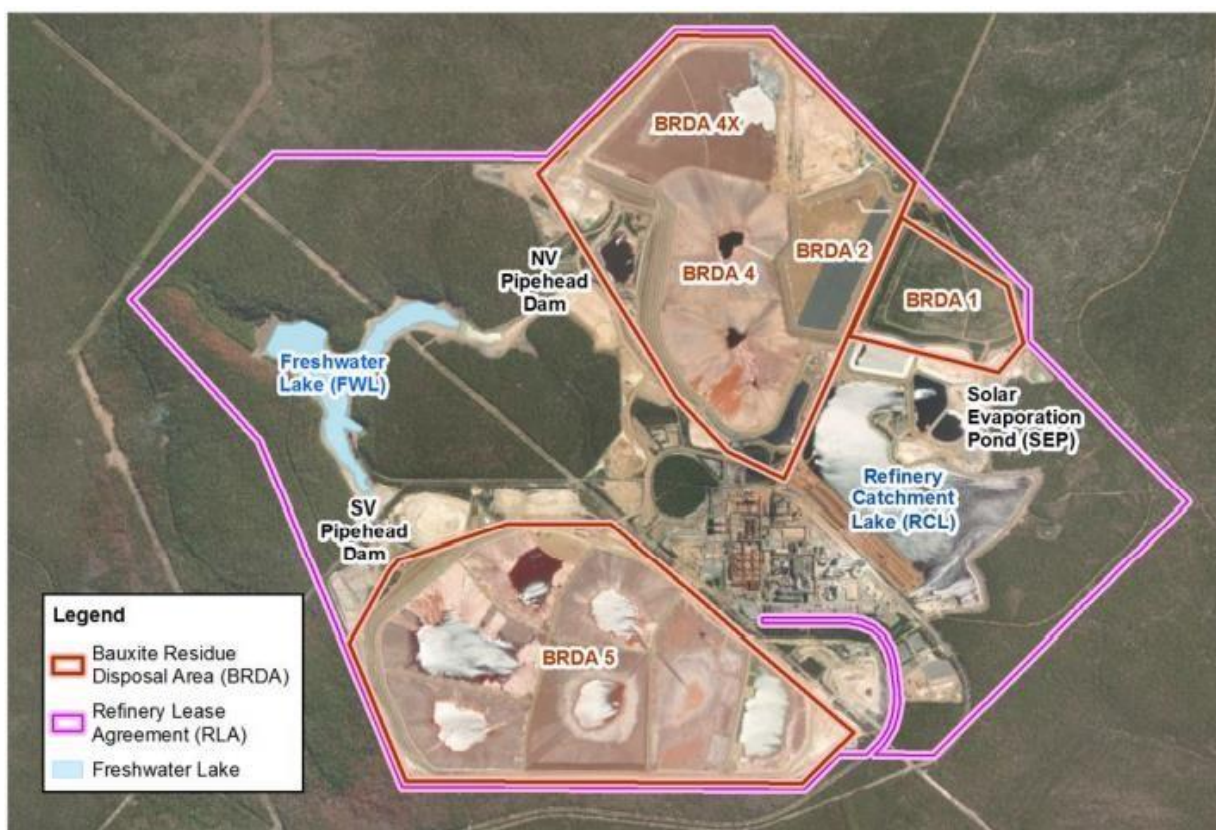
#### Background

The Worsley Alumina Refinery is located approximately 15km north-west of the town of Collie and primary function is to process bauxite mined from the nearby Boddington Bauxite Mine into calcined alumina via the Bayer process. The process generates approximately 2.44 tonnes of bauxite residue per tonne of alumina produced, and this is disposed into the onsite BRDA's each year. The residue is pumped to the BRDA's at an average 55% (by weight) solids at a rate of approximately 1,244 tonnes per hour (and with an average 1.5 tonnes/m<sup>3</sup> settled dry density) The authorised maximum throughput of the premises is 4.7 million tonnes of bauxite per annum resulting in approximately 10.1 million tonnes of residue each year. In addition, approximately 105,000 tonnes of fly ash from coal combustion is also disposed of into the BRDA's each year. At this rate of production, the expected life of the refinery is 2078, when the refinery is likely to reach its capacity within the current footprint.

The premises was granted initial approval under The Alumina Refinery (Worsley) Agreement Act 1973. As part of this agreement Act, it is required to maintain compliance with zero discharges to nearby sensitive water resources as the premises is located within the upper catchment of Augustus River and directly adjacent to a Public Drinking Water Source Protection

Area (as detailed in Table 4 of this report) during all stages of construction, operation and closure of the facility. The zero discharges provisions within the approval requires high level of management and planning surrounding the BRDA's as the restriction applies to worse case storm events, dam break, spillway, seepage or overflow scenarios. The management and monitoring of ground and surface water is regulated under Ministerial Statement 719.

The premises has two main BRDA's at the premises. To the north of the refinery, within the Northern Valley BRDA's, lies: BRDA 1; BRDA 2, BRDA 4 (cells 1 & 2) and BRDA 4X (cells 1 & 2 have been merged) and to the south of the refinery lies the Southern Valley BRDA which consists of BRDA 5 (Cells 1 – 7) as shown in Figure 1 below. BRDA 5 commenced construction in 1994 and was approved for construction on 12 March 1997 (Works Approval 01882) and has been subject to 5 stages of embankments raises and expansion works. The height of the BDRA is currently approximately 52m (RL 285.5 mAHD) above ground level, and the embankment height proposed by this application for Stage 6B, will bring the height to RL 290.5 m AHD.



**Figure 1: Bauxite Residue Disposal Area layout at the premises**

Source Figure 3-2 of Worsley Alumina BRDA Embankment Raises FY23-24 Works Approval Supporting Document(South32, 2022).

BRDA 5 is contained within a Valley and the valley slopes from east to west. The original embankment was 30m high and constructed in 1994 and construction methods have been downstream to the east at 5m increments that expand the footprint with each raise. Subsequent embankment raises occurred in 2001, 2005, 2009 and 2014. Following completion of stage 6 works (current stage) it is anticipated that all subsequent embankment raises will be upstream. The final height of the BDRA 5 is anticipated to be 315.5m AHD over 10 stages (stages 7 – 10 will be subject to future applications). Noting, Worsley Alumina is seeking a 29 m height increase, from RL 316 m AHD to RL 345 m AHD, as part of the current environmental review assessment EPA#2216. Future works approvals may be submitted in accordance with this height if approved.

Since it was first constructed, the footprint of BRDA 5 has changed significantly as the paddock style compound expanded to complete the design footprint area within the southern valley. As the height of the perimeter embankments exceeded the localised topography, the construction

method of the perimeter embankments has altered from downstream and centreline methods of construction to the upstream method of construction. The current embankment raise will be the last to utilise downstream and centreline construction methods along the external perimeter embankment, and future stages 7 to 10 will utilise the upstream method of construction only, with future embankment walls and future deposition mass being laid on top of the existing footprint area. The works will be undertaken over two years, to optimise construction works during drier months of the years, and these are detailed below:

The fly ash and bauxite are conveyed to the BRDA's as a slurry and the removal of slurry water (liquor) through decant and drainage infrastructure and accelerated evaporation are critical to the operation of the premises. The drained liquor is recovered and pumped to one of two the Pipe Head Dams (Northern and Southern Valley) which is then returned to the Refinery Catchment Lake (RCL) which is recycled into use for processing.

BRDA 5 is constructed of a low permeability clay liner with two underdrainage systems, one beneath the compound to capture and divert rising groundwater away from the base of the BRDA; the second underdrainage system lies above the floor of the BRDA liner and collects contaminated seepage. Both underdrainage systems convey residue and groundwater to the Southern Pipehead Dams, where the liquor is then returned to the RCL for processing. The two under drainage layers are separated by a clay drainage blanket, and the upstream toe drainage is connected to the leachate collection underdrainage system, and this is referred to as a Closed Liquor System.

This application is for Stage 6B and will cover the construction required for the 2023-2024 financial years for Cells 1-5. Development stage 6A is for cells 6-7 and is not part of this application.

## 2.3 Proposed works

The construction works proposed to be undertaken as part of this works approval are listed below in Table 1 and illustrated in Figures 2 and 3 for ease of reference.

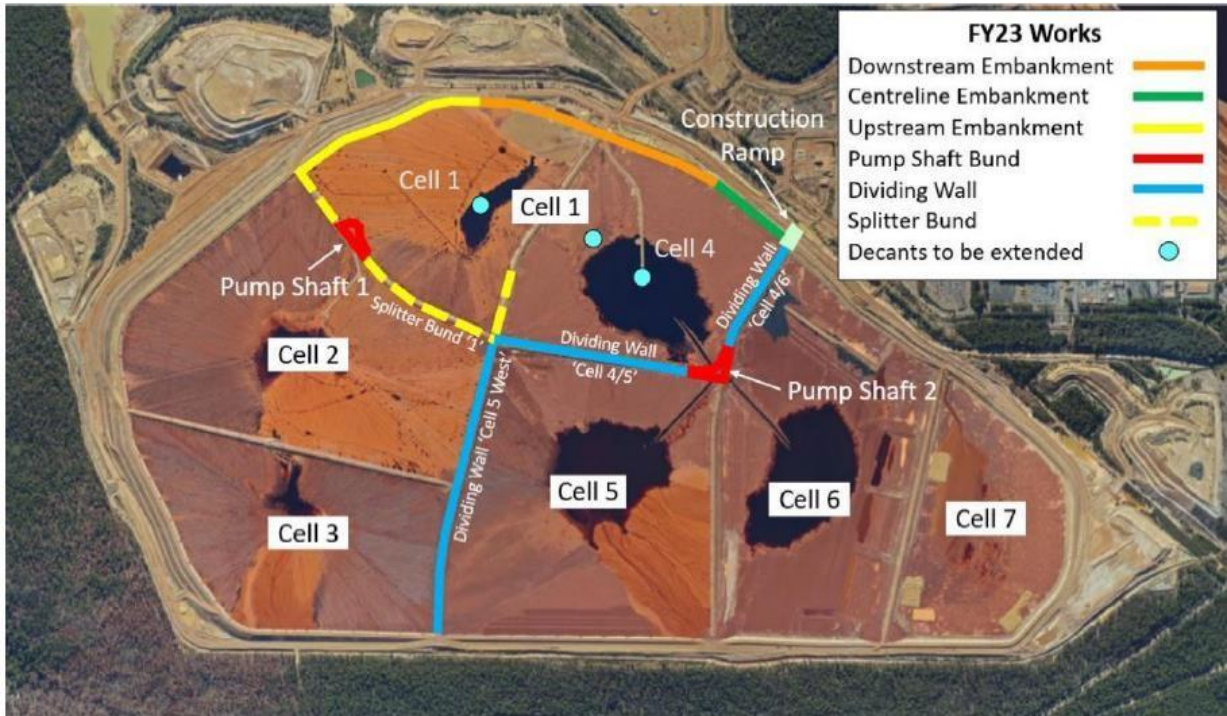
**Table 1: Summary of Works to be undertaken to embankments during Year 1 and Year 2 of development**

Financial Year 2023	Financial Year 2024
<ul style="list-style-type: none"> <li>• Subgrade and residue surface preparations as detailed in in 070 - Earthworks Specifications FY 2020-2022 and 2023-2024 (received at part of the current Application, Worsley, undated).</li> <li>• Construction of the construction ramp where the Cell 4/6 dividing bund meets the northern perimeter embankment;</li> <li>• Raising BRDA 5 Cells 1 and 4 outer embankments by means of centreline, downstream and upstream raise</li> <li>• Construction of "Splitter bund 1" separating Cell 1 and 2;</li> <li>• Construction of a limited causeway between Cells 1 and 4 to allow for access to new decant;</li> <li>• Construction of dividing walls in the locations marked Dividing Wall Cell 5 West, Cell4/5 and Cell 4/6;</li> </ul>	<ul style="list-style-type: none"> <li>• Raising BRDA 5 Cells 2, 3 and 5 perimeter embankments comprising of an upstream embankment raise.</li> <li>• Construction of Splitter Bund 2 between Cells 2 and 3, and</li> <li>• Construction of a Splitter Bund between Cells 5 and 6.</li> <li>• Proposed northwest haul ramp and amphirol ramp into cell 2</li> <li>• Proposed West haul ramp construction and include amphirol ramps into Cells 2 and 3</li> <li>• Cell 3/5 Haul ramp and amphirol ramps into cells 3 and 5</li> <li>• Decant causeway into cells 3 and 5</li> <li>• Existing decant tower extended; tower 3 and 4 7 (Cells 3 &amp; 5) and decant 1 &amp; 2 (Cell 2)</li> </ul>



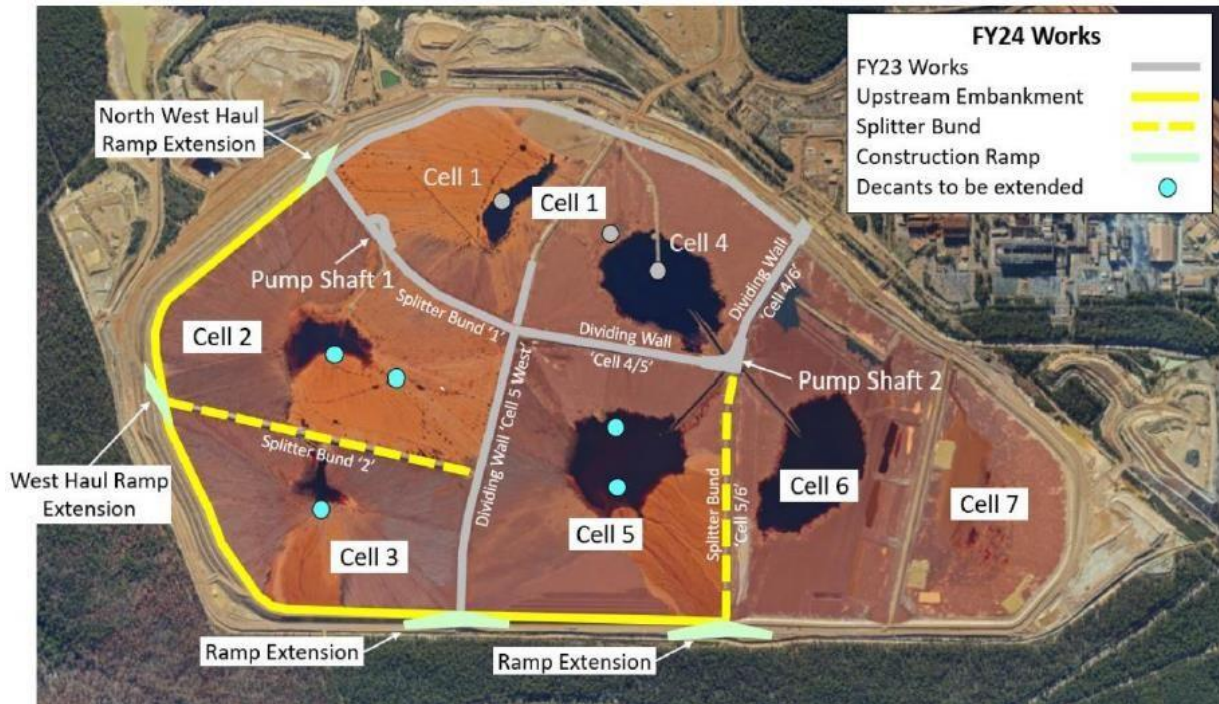
- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Construction of pump shaft bunds in the locations marked Pump Shaft 1 and Pump Shaft 2; and</li> <li>• Installation of internal drainage at all upstream raise lifts (FY23 and FY24) of Cells 2,3 and 5 and the western section of Cell 1 (as indicated in Figure 4-6)</li> <li>• Pumps shaft No. 2 with multiple access ramps including amphirool ramps</li> <li>• Existing decant towers No. 6, 8 and 12 to be extended</li> <li>• Decant causeways raised Cells1 &amp; 4, Cell 6 and Cell 2</li> <li>• Installation of upstream toe drain system along perimeter embankments comprised of slotted polyvinyl chloride (PVC) drain. (Cell 1, 4)</li> <li>• The drains extend 50 m from the embankment upstream toes approximately three per 100 m of embankment.</li> </ul> | <ul style="list-style-type: none"> <li>• Installation of upstream toe drain system along perimeter embankments comprised of slotted polyvinyl chloride (PVC) drain. (Cell 2, 3, 5)</li> <li>• The drains extend 50 m from the embankment upstream toes approximately three per 100 m of embankment.</li> </ul> |
|---|--|

Source: *Adapted from Worsley Alumina Refinery (June 2022) Worsley Alumina BRDA Embankment Raises FY23-24 Works Approval – Supporting document*



**Figure 2: Financial Year 2023 works**

Source: *Adapted from Figure 4-4, Worsley Alumina Refinery (June 2022) Worsley Alumina BRDA Embankment Raises FY23-24 Works Approval – Supporting document*



**Figure 3: Financial Year 2024 works**

Source: Adapted from Figure 4-5, Worsley Alumina Refinery (June 2022) Worsley Alumina BRDA Embankment Raises FY23-24 Works Approval – Supporting document

Detailed construction design diagrams of Works to be undertaken in the 2023 and 2024 Financial years are provided in Schedule 1 of the Works Approval.

These works include underdrainage system drainage pipes for the embankment raise (PVC slotted pipes, decant recovery and stormwater diversion infrastructure that forms part of the closed liquor management system); stormwater and erosion management features such as geotextile fabric, riser pipes and sand fingers installed along the external perimeter embankments which vary according to the upstream, downstream or centerline embankment raise construction method.

Batter slope inclination, crest fall and coverage of trafficable areas as well as construction of toes drains on downstream side of embankments are provided.

**Table 2: Summary of Bauxite Residue Disposal Area 5 storage characteristics**

Stages proposed in Works approval application	BRDA cell	Current embankment crest height RL (m AHD)	Height of rise (m)	New Embankment crest height RL (m)	Embankment raise configuration	Current Cell footprint area (ha)	New Cell footprint area (ha)	Additional Storage volume (Mm <sup>3</sup> )	Cumulative Storage Volume
Stage 6B <sup>1</sup>	Cell 1	290.5	5	295.5	Northern wall downstream and upstream	41	Cells 1 & 4 to be combined (80)	BRDA5 Stage 6B Available volume 17.3Mm <sup>3</sup>	BRDA 5 Stage 6B plus existing volume (60.9Mm <sup>3</sup> )  78.2Mm <sup>3</sup>
	Cell 2	290.5	5	295.5	Centreline around internal splinter bunds	68	67		
	Cell 3	290.5	5	295.5	Centreline around internal splinter bunds	48	45		
	Cell 4	290.5	5	295.5	Northern wall downstream and centreline	45	Cells 1 & 4 to be combined (80)		
	Cell 5	290.5	5	250.5	Centreline	70	65		

1. Additional BRDA raises to be subject to further works approvals applications



## 2.4 Part IV of the EP Act

Ministerial Statement (MS) 719 applies to the Worsley Alumina Refinery and the associated Boddington Bauxite Mine. In relation to the current application, Worsley Alumina is required to implement the Water Resource Management Plan for the protection and management of nearby proclaimed water resources and to give effect to a zero discharge to these natural resources, and thereby not diminish their environmental value or use. The site undertakes a monthly water balance assessment which includes measurement of daily rainfall, pan evaporation and predictive rainfall events such that stormwater capture. BRDA 5 decant systems will be designed to accommodate the requirement to maintain a normal operating pond at approximately 10% of the cell area and provide pumping capacity to remove the ANCOLD design storm within 30 days. This capture and diversion allows for zero discharge following the incidence of a 1:1000 year annual exceedance rainfall event. In emergency situations the site undertakes water transfer between all onsite containment systems (as required).

All surface and groundwater monitoring is undertaken under the MS with the purpose of noting changing rainfall patterns, and to address strategic water source planning and to protection of water quality in the Augustus River, which is located downstream of the refinery. It provides for the maintenance of environmental water use, surface and groundwater quality monitoring and management and clean-up of spills, as well as on site contamination.

In relation to fugitive dust emissions from the BDRA's, MS 719 also applies to the management of fugitive dust emissions, incidents and complaints management as well as annual reporting on ambient particulate air quality. The main source of dust at the refinery is from the BRDA's and this is influenced by the moisture of the dry BRDA's, trafficable area dust lift off, construction activities, prevailing weather and wind conditions and ongoing dust mitigation and management measures.

## 3. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk Assessments* (DWER 2020).

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.

### 3.1 Source-pathways and receptors

#### 3.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises construction and operation which have been considered in this decision report are detailed in Table 3 below. Table 3 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

**Table 3: Proposed applicant controls**

Emission	Sources	Potential pathways	Proposed controls
<b>Construction</b>			
Dust	Transport, mixing, compaction of materials for the construction of embankments, internal causeways, splinter bunds, construction ramps, vehicle movements, lift-off from stockpiles and/or stored product, earthworks etc.	Air / windborne pathway	<p>Water carts</p> <p>Surface binding agents</p> <p>Adherence to construction material moisture requirements</p> <p>Cessation of a particular operation or an amendment to operational procedure when dust cannot be controlled</p> <p>Air Quality Management Plan</p>
Noise	Mobilised by stormwater run off	Air / windborne pathway	<p>All onsite machinery compliant with vehicle noise emission requirements.</p> <p>Site will conduct works in accordance with Section 4 of AS 2436-2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites (standards Australia 2010)</p> <p>Separation distances are such that any noise and vibration from construction works is sufficient that will not occur.</p>
Sediments	Mobilised by stormwater run off	Overland flow	<p>Outside batters of BRDA 5 is captured by toe drains, diversion culverts to the Freshwater Lake via silt traps.</p> <p>Construction of a bund on the downstream side of the construction areas so that loose materials subject to mobilization to stormwater runoff will be undertaken such that the drainage of rainfall falls to the upstream side of embankments where possible</p> <p>Water quality monitored within the Freshwater Lake include parameters for turbidity. If exceedance of a trigger level is exceeded, as defined in the sites Trigger Action Response Plan an investigation into the source of the exceedances and well as implementation of corrective action will occur to address the cause of the incident.</p>
<b>Operation</b>			

<p>Bauxite residue</p> <p>Slurry water: containing Al<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>, CO<sub>3</sub>, and SO<sub>4</sub></p>	<p>Embankment failure (Dam Break)</p>	<p>Direct discharge and overland flow to nearby land and water</p>	<p><u>Construction</u></p> <p>The construction methods determine the capacity of the embankments to remain stable under a range of conditions during operations. Construction will occur in accordance with the Life of Mine Design Report BRDA 5 – Stage 6B Raise (2022); 070 -Earthworks specifications FY2023-2024 and the premises Construction Quality Assurance Plan.</p> <p>The Works Approval Holder provides that these report demonstrates the embankment raise is compliant with the</p> <ul style="list-style-type: none"> <li>• Code of Practice for Tailings Storage Facilities (DMIRS)</li> <li>• Australian National Committee on Large Dams (ANCOLD)</li> <li>• Guidelines on Tailings Dam Planning Design, Australian National Committee on Large Dams (ANCOLD)</li> <li>• Guidelines on Dam Safety Management (ANCOLD, 2003); and</li> </ul> <p>The Design Report BRDA 5 – Stage 6B Raise (2022) contains an assessment of the Stability of the dam under seismic loading, drained and undrained conditions. The report claims the BRDA 5 when constructed to the above specifications, will meet the minimum factors of safety. These claims are yet to be independently assessed, and deposition will not be authorized under this Works Approval until DWER has obtained third party independent geotechnical assessment of the Design Report and until any critical issues identified through the third party review, are satisfactorily addressed.</p> <p><u>Operation</u></p> <p>Management of water within the raise prior to deposition mass being consolidated is through careful management of tailings deposition and supernatant in accordance with the <i>BRDA Operating Maintenance and Surveillance Manual</i>,</p> <ul style="list-style-type: none"> <li>• Daily inspections of BRDA's</li> <li>• Delivery mudline fitted with dropper pipe spigots that minimize velocity of deposition</li> <li>• Spigots paced an average of 72m apart and managed 4 -hourly short pours around perimeter embankments to maintain pond around the decant tower;</li> <li>• Beach length of approximately 500m with tailings deposition of 55% solids and a 0.6% degree beach slope;</li> <li>• Wet pours of a maximum of 1.1m at a time;</li> <li>• Use of amphirollers on wet pours within 72hours of pour until an undrained shear strength of 28kPa is achieved for each layer</li> </ul>
--	---------------------------------------	--	---

Emission	Sources	Potential pathways	Proposed controls
			<p>to achieve 72% final solids content;</p> <ul style="list-style-type: none"> <li>• Shear strength of each rise to be a minimum of 100kPa to a depth of 1m prior to further embankment raises</li> <li>• Insitu vane shear strength testing is undertaken to verify assumptions prior to embankments;</li> <li>• Use of vibrating wire piezometers in embankment walls at various depths (see page 70 design report) at three location to monitor</li> <li>• Management of centralized decant pond within each cell to an approximate maximum 10% of overall surface area</li> <li>• To maintain ~10% decant pond area, excess water is stored in water management ponds on site (Southern Valley Pipe Head Dam, Water Body 1, SEP1, 3, 2A, 4; Refinery catchment Lake, Freshwater Lake)</li> <li>• Maintenance of operational freeboard;</li> <li>• Daily recording of rainfall and evaporation, monthly reconciliation of water balance</li> <li>• Upstream toe drains and sand fingers installed on upstream face of embankment</li> <li>• Trigger Response Action Plan to identify and respond to issues as they arise</li> </ul>
<p>Bauxite residue, and decant water</p> <p>Slurry water: containing Al<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>, CO<sub>3</sub>, and SO<sub>4</sub></p>	<p>Leaks and spills from pipelines, mudlines, pumps and associated infrastructure</p>	<p>Direct discharge and overland flow to nearby land and water</p>	<ul style="list-style-type: none"> <li>• Comprehensive and daily monitoring of BRDA's including mudlines delivering bauxite to the BRDA's, decant recovery pipelines and valves,</li> <li>• scheduled maintenance,</li> <li>• incident recording and reporting.</li> <li>•</li> <li>• Trigger Response Action Plan to identify and respond to issues as they arise</li> <li>• The site is operated as a closed system, contaminated water and leachate from spills is contained within the premises.</li> <li>• Extensive groundwater and surface monitoring is undertaken to validate effectiveness of controls (under Ministerial Statement 719)</li> </ul>



Emission	Sources	Potential pathways	Proposed controls
<p>Bauxite residue, and decant water</p> <p>Slurry water: containing Al<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>, CO<sub>3</sub>, and SO<sub>4</sub></p>	<p>Overtopping of BRDA due to excess loading or heavy rainfall events or both.</p>	<p>Overland flow, direct discharge to soil, infiltration to groundwater</p>	<ul style="list-style-type: none"> <li>• Maintenance of operational freeboard of 0.5 between the tailings at the top of the beach and the embankment crest (inclusive of wave action)</li> <li>• The beach angle over 100m of beach is 0.6m</li> <li>• Only 2 or 3 cells are actively used at any one time, may be used in the event of an extreme storm event to temporarily store storm water</li> <li>• Maximum operating levels are calculated to only be exceeded in a 1:1,000 year annual recurrence interval storm event ;</li> <li>• Ability to move contaminated storm water following high rainfall events to other containment infrastructure on site such that a water from an extreme 1: 1000- year annual rainfall incidence 72 hour duration event is completely contained within the premises infrastructure, enabling compliance with the sites "zero discharge" requirements under the Worsley State Agreement Act 1973. This includes Cell 7 of BRDA, Southern Valley Pipe Head Dam, Water Body 1, SEP1, SEP2, SEP3 and SEP4, Refinery catchment Lake and Freshwater lake as a last resort.</li> <li>• Trigger Response Action Plan to identify and respond to issues as they arise</li> </ul>
<p>Leachate</p> <p>Slurry water: containing Al<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>, CO<sub>3</sub>, and SO<sub>4</sub></p>	<p>Seepage of contaminants through the base of the BRDA liner causing groundwater contamination and mounding</p>	<p>Direct discharge to soil, infiltration to groundwater</p>	<ul style="list-style-type: none"> <li>• Inspection of underdrain at Southern pipe head dam inflow</li> <li>• Report any changes</li> <li>• Vacuum pumping to unblock pipes if required</li> <li>• Trigger Response Action Plan to identify and respond to issues as they arise</li> <li>• The site is operated as a closed system, contaminated water and leachate is contained within the premises.</li> <li>• Extensive groundwater and surface monitoring is undertaken to validate effectiveness of controls (under Ministerial Statement 719)</li> </ul>

Emission	Sources	Potential pathways	Proposed controls
Contaminated stormwater run off		Overland flow, direct discharge to soil, infiltration to groundwater	<ul style="list-style-type: none"> <li>• Design such that stormwater that falls on the downstream side of perimeter embankments is diverted to of Gravel lined spoon drains at the toe of embankment leading to rock drops</li> <li>• The rock drops report to southern diversion dam through southern valley silt trap to the southern arm of the freshwater lake</li> <li>• Periodic testing of Freshwater Lake is undertaken.in accordance with Ministerial Statement 719</li> </ul>
Dust lift off	Dry deposition surface	Air / windborne pathway	<ul style="list-style-type: none"> <li>• Dust from the the BRDA's is managed in accordance with the sites <i>Air Quality and Dust Management Plan – RLA Business Blueprint</i> and includes:</li> <li>• Daily visual monitoring of BRDA surface</li> <li>• Dust monitoring stations upstream and downstream to monitor dust lift off</li> <li>• Addition of dust suppression and surface binding agents hydro mulch and Gluon500 to control dust over residue deposition areas</li> <li>• Use of water carts and sweeping in dry weather</li> <li>• Mechanical ploughing and ripping of BRDA surfaces</li> <li>• Trigger levels and corrective action response and reporting.</li> </ul>

### 3.1.2 Receptors

In accordance with the *Guideline: Risk Assessment* (DWER 2020), the Delegated Officer has excluded the applicant's employees, visitors, and contractors from its assessment. Protection of these parties often involves different exposure risks and prevention strategies and is provided for under other state legislation.

Table 4 below provides a summary of potential human and environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises (*Guideline: Environmental Siting* (DWER 2020)).

**Table 4: Sensitive human and environmental receptors and distance from prescribed activity**

Human receptors	Distance from prescribed activity
Single Rural dwellings	No rural dwellings within 5km of the premises. Single residential dwelling approximately 6 km due south and north of the proposed works
Town of Allanson	Approximately 11km south of the premises boundary
Environmental receptors	Distance from prescribed activity
Priority 1 Public Drinking Water Source Area (PDWSA)	The Priority 1 Harris River Catchment Dam Area
Major watercourses/waterbodies	The refinery Freshwater Lake feeds into the Augustus River
Groundwater	Groundwater beneath BRDA is collected via a specifically designed groundwater underdrainage system that reports to the freshwater lake
Rights in Water and Irrigation Act 1914 (RiWI Act)	Premises lie across the boundary of the following surface water areas: Collie River Irrigation District Brunswick River and tributaries
Waterways Conservation Areas	Leschenault Inlet Management Area adjoins western point of the premises boundary
Threatened/Priority Flora	A number of priority flora species within proximity of the premises boundary, the closest to the being 580m, 660m south and 1.5 and 1.7km Southwest respectively of the BRDA 5.

## 3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for each identified emission source and takes into account potential source-pathway and receptor linkages as identified in Section 3.1. Where linkages are in-complete they have not been considered further in the risk assessment.

Where the applicant has proposed mitigation measures/controls (as detailed in Section 3.1), these have been considered when determining the final risk rating. Where the delegated officer considers the applicant's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the works approval as regulatory controls.

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 5.

Works approval W6694/2022/1 that accompanies this decision report authorises construction only. The conditions in the issued works approval, as outlined in Table 5 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).



**Table 5: Risk assessment of potential emissions and discharges from the premises during construction, and operation**

Risk events					Risk rating <sup>1</sup> C = consequence L = likelihood	Applicant controls sufficient?	Conditions <sup>2</sup> of works approval	Justification for additional regulatory controls
Sources / activities	Potential emission	Potential pathways and impact	Receptors	Applicant controls				
<b>Construction</b>								
Civil construction works from BRDA 5 embankment raise Stage 6B	Dust from civil and construction activities	Air and wind	Single rural dwelling approximately 6km due south and north of premises	Refer to Section 3.1	C = Slight L = Rare <b>Low Risk</b>	Y	Conditions 1, 2, 10 and 11	Standard works approval construction, compliance and reporting conditions will apply  Condition 10 and 11 require the Works Approval Holder to record and report any complaints or incidents
	Noise from civil and construction activities	No Pathway			C = Slight L = Rare <b>Low Risk</b>	Y	Conditions 1, 2, 10 and 11	Standard works approval construction, compliance and reporting conditions will apply  Condition 10 and 11 require the Works Approval Holder to record and report any complaints or incidents

Risk events					Risk rating <sup>1</sup> C = consequence L = likelihood	Applicant controls sufficient?	Conditions <sup>2</sup> of works approval	Justification for additional regulatory controls
Sources / activities	Potential emission	Potential pathways and impact	Receptors	Applicant controls				
	Sediments mobilized by stormwater	Overland flow  No pathway as stormwater surrounding the BRDA reports to the Freshwater Lake	Augustus River approximately 2km north west of the BRDA		C = Slight L = Rare <b>Low Risk</b>	Y	Conditions 1, 2 , 10 and 11	Standard works approval construction, compliance and reporting conditions will apply  Condition 10 and 11 require the Works Approval Holder to record and report any complaints or incidents
<b>Operation</b>								
Embankment Failure	Bauxite residue and slurry water containing Al <sub>2</sub> O <sub>3</sub> , Na <sub>2</sub> , CO <sub>3</sub> , and SO <sub>4</sub>	<i>Overland flow</i> causing inundation of adjacent ecosystems, the freshwater Lake leading to the Augustus River	Nearby vegetation in state forest,  Augustus River and catchment area, approximately 2km north west of the BRDA	Refer to Section 3.1	Unable to determine at the present time	To be determined	Conditions 2, 5, 6 ,7, 8 and 9	See detailed risk assessment below
Leaks and spills from pipelines, mudlines, pumps and associated infrastructure	Bauxite residue, and decant water  Slurry water: containing Al <sub>2</sub> O <sub>3</sub> , Na <sub>2</sub> , CO <sub>3</sub> , and SO <sub>4</sub>	Surface runoff directed towards the Freshwater Lake, where water is diluted and diverted to the refinery for operational use, or where it may be	Augustus River approximately 2km north west of the BRDA	Refer to Section 3.1	C = Slight L = Rare <b>Low Risk</b>	Y	Condition 1, 3 and 4	Standard works approval construction, compliance and reporting conditions will apply  Water Balance is managed under

Risk events					Risk rating <sup>1</sup> C = consequence L = likelihood	Applicant controls sufficient?	Conditions <sup>2</sup> of works approval	Justification for additional regulatory controls
Sources / activities	Potential emission	Potential pathways and impact	Receptors	Applicant controls				
Overtopping of BRDA	Slurry water: containing Al <sub>2</sub> O <sub>3</sub> , Na <sub>2</sub> , CO <sub>3</sub> , and SO <sub>4</sub>	discharged to the Augustus River potentially causing ecosystem disturbance or impacting surface water quality		Refer to Section 3.1	C = Slight L = Rare <b>Low Risk</b>	Y	Condition 1, 3 and 4	the Part IV Ministerial Statement 719
Contaminated stormwater run off	Stormwater contaminated with dilute Al <sub>2</sub> O <sub>3</sub> , Na <sub>2</sub> , CO <sub>3</sub> , and SO <sub>4</sub>			Refer to Section 3.1	C = Slight L = Rare <b>Low Risk</b>	Y	Condition 1, 3 and 4	
Contamination of groundwater via leachate/seepage	Slurry water: containing Al <sub>2</sub> O <sub>3</sub> , Na <sub>2</sub> , CO <sub>3</sub> , and SO <sub>4</sub>	Infiltration through clay liner to soil and groundwater  No pathway as BRDA has an underdrainage system above the clay liner for collection and diversion of contaminated seepage towards the Refinery Catchment Lake and another underdrainage system below the clay liner to divert groundwater away from BRDAs towards the Freshwater Lake	Shallow aquifer discharging to Freshwater Lake and Augustus River	Refer to Section 3.1	C = Slight L = Rare <b>Low Risk</b>	Y	NA	This is managed under the Part IV Ministerial Statement 719

Risk events					Risk rating <sup>1</sup> C = consequence L = likelihood	Applicant controls sufficient?	Conditions <sup>2</sup> of works approval	Justification for additional regulatory controls
Sources / activities	Potential emission	Potential pathways and impact	Receptors	Applicant controls				
Dust lift off		<i>Overland flow</i> causing inundation of adjacent ecosystems, including forests, the freshwater Lake leading to the Augustus River	Nearby vegetation, nearby Augustus River approximately 2km northwest of the BRDA	Refer to Section 3.1	C = Slight L = Possible <b>Medium Risk</b>	Y	NA	This is managed under the Part IV Ministerial Statement 719

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk Assessments* (DWER 2020).

Note 2: Proposed applicant controls are depicted by standard text. **Bold and underline text** depicts additional regulatory controls imposed by department.



## 3.3 Embankment failure

### 3.3.1 Embankment Failure

The primary control mechanism to prevent, control and mitigate impacts to the environment from embankment raises is the structural integrity of the residue and the BRDA. The design and construction characteristics of the embankment raises will determine if the BRDA has the ability to contain bauxite residue under variable conditions. This will be validated by a third party.

At the request of the Works Approval applicant, this application does not support the deposition of bauxite residue into the BRDA. This is to enable the applicant sufficient time for the applicant to submit information relating to the audit of the BRDA, and to allow DWER to review the assessment of geotechnical stability information submitted of the current BRDA 5 embankment raise, and the whole compound without affecting the ability to process bauxite, through the delay of these time critical construction activities. On this basis an assessment of embankment stability and the whole compound will be undertaken post construction. Reporting may be undertaken in a staged approach as construction is completed, which will support a staged commencement of deposition within the cells included in this works approval application (noting deposition will require an amendment to this Works Approval prior to commencing).

#### Embankment Construction Material

The Works Approval Holder has advised the use of variable construction materials for the proposed embankment materials. This includes on site borrow materials as well as stockpiled materials that meet the material specifications and construction quality assurance practices and auditing requirements as detailed in 070 -Earthworks Specifications FY 2020-2024 (received at part of the current Application, Worsley, undated).

The materials used are required to meet predetermined design criteria and will be blended and tested during construction to ensure they possess suitable engineering properties for use in embankments.

The accepted industry design criteria to be used in this instance is derived from the ANCOLD Guidelines and the Code of Practice for Tailings Storage Facilities in Western Australia (DMP, 2013). Considerations include compaction density, particle size, shear strength, Atterberg limits, consolidation, erosion resistance, dispersion characteristics, elasticity (shrinkage), slake durability, hydraulic conductivity and resistance to liquefactions (DMP 2013).

#### Construction Quality Control

The Works Approval Holder has a Construction Quality Assurance Plan to oversee the construction works and ensure that site preparation, embankment construction meets the designs specifications contained within the Works Approval Application.

This includes overview of the design and aims to incorporate any items excluded from the prescribed quality assurance works and construction activities (methods and Materials) such as modifications to proposed construction, compliance testing, health safety and environment. It is an independent certification and reporting of the construction process.

The accepted industry design criteria to be used in this instance are derived from ANCOLD Guidelines and the Code of Practice for Tailings Storage Facilities in Western Australia (DMP, 2013).

Following completion of works the Works Approval Holder is required to submit a construction compliance report as well as an audit report on the BRDA, to confirm that the construction materials and methods have been undertaken in accordance with the design report as part of this application, and that the foundations of the BRDA are suitable to support the current raise.

## 3.4 Decision

The Delegated Officer has concluded that the proposed embankment raise is capable of being constructed to the required standards with relevant controls to mitigate the environmental risk.

However, in construction and operation there is the potential for a number of characteristics to vary from the design specifications; therefore, the overall performance could vary depending on the scale and nature of the variations, and these may be impacted by variable foundation materials and construction methods. Consequently, requirements have been added to the Works Approval for the audit of the BRDA to ensure that the controls remain adequate.

As such, in accordance with Works Approval conditions 7, 8 and 9, the Works Approval Holder is required to audit the works in accordance with the accepted industry standards for Tailings storage Facility, and to demonstrate that BRDA 5 is capable of remaining stable over the range of operating scenarios, over the long term.

## 4. Consultation

Table 6 provides a summary of the consultation undertaken by the department.

**Table 6: Consultation**

Consultation method	Comments received	Department response
Application advertised on the department's website on 4 July 2022	None received	N/A
Department of Mines, Industry Regulation and Safety (DMIRS) advised of proposal 25 August 2022	DMIRS replied on 14 September 2022 advising that the information contained within the application was not sufficiently detailed to enable an assessment of the stability of the BRDA lift.	DWER is currently seeking assessment on further geotechnical and design information submitted by the Works Approval Holder to address the information deficiencies identified by DMIRS.
Applicant was provided with draft documents on 3 October 2022	Refer to Appendix 1	Refer to Appendix 1

## 5. Conclusion

Based on the assessment in this decision report, the delegated officer has determined that a works approval will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

## References

1. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
2. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
3. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.

## Appendix 1: Summary of applicant's comments on risk assessment and draft conditions

Conditions	Summary of applicant's comment	Department's response
1 & 2	Various administrative and editorial comments were recommended in relation to the infrastructure listed in Table 1 and Table 2. This included corrections to errors and clarifying detail.	All changes have been made as recommended by the Works Approval Holder
3, 4 , 5 and 6 general	The Works Approval Holder suggested removing or combining the requirement to submit an environmental compliance report (conditions 3 and 4) and a critical containment infrastructure compliance report (Condition 5 and 6).	<p>The changes proposed to the management of critical and non-critical containment infrastructure by the Works Approval Holder have not been made and the conditions have been largely retained in their original form. The critical and non-critical infrastructure are managed differently by the CEO as when the infrastructure transitions to operational phase, the failure of critical infrastructure to meet specifications can fatally compromise the ability of the premises to meet the environmental operating standards should such infrastructure be operated, and therefore third-party independent verification is required to validate the construction works. Verification of critical containment infrastructure often involves third party certification by parties who are highly technically trained and where works may be subject to rigorous quality assurance standards.</p> <p>Deviations reported through "as constructed compliance audits" are required for all infrastructure (critical and non-critical infrastructure) as deviations may affect the functioning of the infrastructure and require further risk assessment as environmental impacts may result of non-conforming infrastructure.</p> <p>For the purpose of meeting reporting requirements, compliance reports for critical and non-critical infrastructure can be combined into one document.</p> <p>If construction is completed in stages. A report for each stage can be submitted separately (noting that amendment to the works approval is required prior to commencing operations)</p>

3	<p>Specific recommended changes to condition 3 include:</p> <p>3(a) replacing word audit with review</p> <p>3(b) including the provisions of condition 4 within condition 3 (b)</p> <p>3(c) deleted reference to Design Report BRDA 5 – Stage 6B Raise (LOM Engineering, 16/08/2022).</p> <p>3(d) altered the reference to preparation of an environmental compliance report to a construction completion report</p>	<p>3(a) the word ‘audit’ is retained as per the standard wording of the condition as a specific comparative examination of differences between proposed infrastructure and constructed infrastructure is required, opposed to a general evaluation (review).</p> <p>3(b) the condition is retained in its original form to keep the intent of the condition clear, simplistic and enforceable.</p> <p>3(c) reference to Design Report BRDA 5 – Stage 6B Raise (LOM Engineering, 16/08/2022) has been retained as it contains detail on critical infrastructure which has yet to be subject to geotechnical review.</p> <p>3(d) The original wording is retained as compliance against specific infrastructure is required so that an environmental assessment of impacts can be understood, (in case of deviations to methods, or infrastructure) and this enables changes to an assessment of probable environmental impacts from any such changes.</p>
4	Deleted and inserted into condition 3	This is a standard format condition and has been retained as such. This condition specifies the reporting requirements the compliance report is required to meet to demonstrate compliance to the level deemed acceptable by the CEO.
5	<p>5(c) deleted refence to Design Reporty BRDA 5 – Stage 6B Raise (LOM Engineering, 16/08/2022)</p> <p>5(d) altered the reference to preparation of an environmental compliance report to a construction completion report. This subcondition includes a comment about staged completion.</p>	<p>5(c) reference to Design Report BRDA 5 – Stage 6B Raise (LOM Engineering, 16/08/2022) has been retained as it contains detail on critical infrastructure which has yet to be subject to geotechnical review.</p> <p>5(d) The original wording is retained as compliance against specific infrastructure is required so that an environmental assessment of impacts can be understood (in case of deviations to methods, or infrastructure) and this enables changes to an assessment of probable environmental impacts from any such changes.</p> <p>The text about staged reporting doesn’t need to be included. It is stated within the decision report and can be stated within the compliance report .</p>
6	6(e) The Works Approval Holder included detail stating the third party who undertake signs off on the quality control/ quality assurance certificate for critical containment	This detail has been removed, and the standard wording applied., As the certificate forms part of the report required to be submitted by the Works Approval Holder, it is therefore considered implied.



	infrastructure “is sourced by the proponent and the certificate forms part of the Construction Completion Report”.	
--	--	--