Government of Western Australia
Department of Water and Environmental Regulation

Amendment Report

Application for Licence Amendment

Division 3, Part V *Environmental Protection Act 1986*

Licence Number	L4504/1981/17
Licence Holder	South32 Worsley Alumina Pty Ltd
ACN	008 905 155
File Number	DER2017/001998
Premises	Worsley Alumina Refinery Gastaldo Road, ALLANSON WA 6225 Legal description - Lease No 3116/7574 being Wellington Locations 5314-5317 on Deposited Plan 220209
Date of Report	25 June 2020
Status of Report	Final

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1. Definitions and interpretation

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

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
AEP	Annual Exceedance Probability
AHD	Average Height Datum
Al_2O_3	means aluminium oxide
Amended Licence	the amended Licence issued under Part V, Division 3 of the EP Act following the finalisation of this assessment.
Amendment Report	refers to this document
ANCOLD	Australian National Committee on Large Dams
BRDA	Bauxite Residue Disposal Area
CAS	Collie Airshed Study
Category/ Categories/ Cat.	categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CEMS	means continuous emissions monitoring system
CEO	means Chief Executive Officer.
CO_3	means carbonate
Delegated Officer	an officer under section 20 of the EP Act
Department	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.
DMIRS	Department of Mines, industry Regulation and Safety
DWER	Department of Water and Environmental Regulation
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
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 Amendment
Licence Holder	South32 Worsley Alumina Pty Ltd
mbgl	Metres below ground level
mtpa	million tonnes per annum

NEPM	National Environmental Protection Measure
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
NO_2	means nitrogen dioxide
NPHD	Northern Pipehead Dam
Occupier	has the same meaning given to that term under the EP Act.
oxalate	means sodium oxalate cake, a mix of caustic liquor and sodium oxalate derived from the refinery process.
ppm	means parts per million
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Amendment Report applies, as specified at the front of this Amendment Report.
RCL	Refinery Catchment Lake
Risk Event	as described in *Guidance Statement: Risk Assessment*
RL	Reduced Level
RTO	Regenerative Thermal Oxidiser
SEP	Solar Evaporation Pond
SO_2	means sulfur dioxide
SO_4	means sulfate
VOC	means volatile organic compounds

2. Application details

This amendment is made pursuant to section 59 of the *Environmental Protection Act 1986* (EP Act) to amend licence L4504/1981/17 granted to South32 Worsley Alumina Pty Ltd (the Licence Holder) for its Alumina Refinery, located on Gastaldo Road, Allanson (the Premises). This amendment is given under *section 59B(9)* of the EP Act upon the initiative of an Officer Delegated under section 20 of the EP Act.

The guidance statements that have informed the assessment and decision of this application as outlined in this Amendment Report are listed in Appendix 1.

2.1 Purpose and scope of assessment

Two separate applications were received from the Licence Holder in relation to this amendment. The first was received on 3 October 2019 which sought the following five changes below:

1. inclusion of two existing gas fired Babcock and Wilcox Type D package boilers onto the licence as new point sources for the air emissions (new emission points A15 and A16);
2. alteration of the use of the Babcock and Wilcox Type D package boilers from back-up electrical power generation sources to prime energy generation units for refinery operations;
3. inclusion of the newly installed Continuous Emissions Monitoring Systems (CEMS) for boilers 1-3 onto the licence (emission points A1, A2 and A3) and removal of the requirement to undertake quarterly stack testing at these locations accordingly;
4. removal of the requirement to undertake quarterly stack testing for acetaldehyde, formaldehyde, benzene and mercury (where relevant) on emission points A4, A5, A6, A7, A8, A9, A10 and A11 (digestion RTO stack, calciner stacks 1-6 and the liquor burner stack); and
5. removal of the requirement to undertake ambient SO_2 monitoring from the licence and the deletion of the conditions and reference to monitoring station “J” from the licence.

In order to expedite the assessment, only changes 1 - 3 above were assessed, with 4 and 5 to be assessed separately under a subsequent application. As a result, an amended licence was granted on 9 March 2020 (see Appendix 2). Item 4 above was later withdrawn by the Licence Holder.

On 5 March 2020 a second application was received for item 5 above. In addition to item 5, the application sought approval to construct an oxalate storage facility at Solar Evaporation Pond (SEP) 4.

Summarily, this Amendment Report includes the combined assessment of the following proposed amendments, as requested by the Licence Holder:

1. works to construct an oxalate storage facility at SEP4, including:
   - the construction of an oxalate tipping area on the banks of SEP4;
   - the installation of an oxalate slurry hopper to receive the oxalate cake, sprinklers, an agitator, electrical infrastructure, pumps and a floating slurry release line into SEP4; and
   - the installation of a land based feed pump for recovery of water and a delivery line from SEP4 into the hopper (via the sprinkler system);
2. the operation of SEP4 as an oxalate storage facility; and
3. the removal of requirements relating to ambient SO_2 monitoring due to the completion of the Collie Airshed Study.

Table 2 lists the documents submitted during the assessment process.

Table 2: Documents and information submitted during the assessment process

Document/information description	Date received
Worsley Alumina Refinery licence amendment application form	3 October 2019 (DWER document reference DWERDT208328)
Worsley Alumina Refinery licence amendment application form and the following supporting information: • Hydrogeological risk assessment • New oxalate storage pond feasibility study basis of design	5 March 2020 (DWER document reference: A1873954)
Email correspondence from Worsley regarding Collie Airshed Study committee involvement and consultation	15 April 2020 (DWER document reference: EA172400)
Email correspondence from Worsley in response to draft amendment documents: • details of SEP4 design and installation of infrastructure provided	15 June 2020 (DWER document reference: A1902931)
Email correspondence from Worsley in response to draft amendment documents: • updated SEP4 design figure provided	22 June 2020 (DWER document reference: A1906110)

The requested construction and operation of an oxalate storage facility at SEP4 is considered by the Delegated Officer to present a potential change to the risk profile of the emissions and discharges from the Premises and, as such, has been considered in a risk assessment (Table 9 and Table 10) in accordance with the Department of Environmental Regulation's (DWER) published Regulatory Framework.

The Existing Licence includes conditions requiring the Licence Holder to monitor and report on ambient SO_2 concentrations to inform the Collie Airshed Study (CAS); an industry-funded study developed to establish a scientific foundation on which to base an airshed management strategy for the Collie area. The two year monitoring phase of the CAS concluded in November 2019, therefore ambient SO_2 monitoring is no longer required to inform the study. The request to remove the associated licence conditions does not alter the risk associated with emissions and discharges, as the conditions were included on the licence to support implementation of the CAS, therefore a risk assessment is not required. The Delegated Officer's grounds for this decision are discussed further in Section 8 of this report.

This Amendment Report only considers emissions and discharges associated with the proposed changes outlined above. Emissions and discharges associated with operation of the existing infrastructure have been previously subject to risk assessment and therefore, are not considered in this assessment.

2.2 CEO initiated amendment

As part of this licence amendment package, the CEO has initiated an amendment to the type and style of the licence. The obligations of the Licence Holder have not changed, and DWER has not undertaken any additional risk assessment related to the CEO initiated amendment.

In amending the licence, the CEO has:

- updated the format and appearance of the licence;

- revised licence condition's numbers, removed any redundant conditions and realigned condition numbers for numerical consistency;
- reformatted remaining conditions; and
- corrected clerical mistakes and unintentional errors.

3. Premises information

3.1 Premises background

The Licence Holder operates a bauxite refinery approximately 15 km northwest of Collie and 145 km south of Perth. The Worsley Alumina Refinery uses the Bayer alumina refining process where ore sourced from the nearby Boddington Bauxite Mine (operated under Licence L5960/1983/11) is transported 51 km via conveyor belt to the refinery. The first alumina was produced at the refinery in 1984.

Bauxite ore is broken down through mechanical grinding, heating and mixing with liquid sodium hydroxide to release alumina to solution. The alumina rich solution is subject to a precipitation process and alumina hydrate crystals are separated, washed and calcined at high temperatures to generate 99% pure alumina, which is then transported by rail to Bunbury Port for export around the world.

The legislative framework under which the refinery operates comprises the *Alumina Refinery (Worsley) Agreement Act 1973* (as amended) (the Agreement Act), Ministerial Statement 719 (as amended) issued under Part IV of the EP Act and Licence L4504/1981/17 issued under Part V of the EP Act.

3.2 Operations relevant to the amendment

3.2.1 Oxalate storage facility construction at SEP4

The Bayer alumina refining process generates sodium oxalate ("oxalate"), which forms when the hydroxide bonds with organic material contained within the ore. Oxalate is relatively insoluble and reduces the uptake of alumina into solution, therefore lowers the overall viability of the refining processes. Oxalate is periodically removed from the caustic liquor by binding it with gibbsite, washing the gibbsite, and crystallising the oxalate from solution to form an oxalate cake that can then be disposed of as a waste.

Sodium oxalate is toxic to humans and exposure through inhalation, digestion and ingestion can potentially cause acute health impacts (Sciencelab, 2013). It readily forms a white powder when exposed to wind and must therefore be stored within secured compounds or treated to render it innocuous. The Premises produces approximately 50,000 m^3 of oxalate each year. Oxalate cake has historically been buried in trench pits within consolidated, trafficable parts of the Bauxite Residue Disposal Areas (BRDA). The Licence Holder estimates that some 500,000 tonnes of oxalate has been disposed of this way over the operational life of the Premises.

In 2014, the areas suitable for oxalate disposal within the BRDA reached capacity. Subsequently, following an application initiated by the Licence Holder, the licence was amended to convert SEP3 into an oxalate storage facility. As SEP3 approached capacity, a further amendment was sought and granted in 2017 to convert SEP1 into oxalate storage. Prior to these amendments, the SEPs were used to store neutralised and un-neutralised spent acid waste. SEP2a continues to store un-neutralised acid wastes.

The Licence Holder estimates that the higher oxalate levels of the bauxite ore in FY20 and FY21 will increase the required storage volume from 50,000 m^3 to 75,000 m^3 per annum based on a liquor burner availability of 50 per cent. Consequently, by June 2022, the Licence Holder predicts that additional storage capacity will be required in the form of a HDPE lined oxalate

storage pond, and hence propose constructing one at the location of SEP4. Thus, an amendment to the Existing Licence has been sought and the associated environmental risks are assessed in this Amendment Report.

The SEPs were originally designed to act as a repository for the refinery's waste acid, which is generated from both cleaning and water treatment sources. SEP4 has not been used for this purpose, and currently contains water collected from rainfall. The aim of the SEP4 construction is to maximise the oxalate storage capacity of the existing SEP4 footprint; constrained by SEP2a to the north, SEP3 to the west, SEP1 to the south and the existing site access road to the east.

The depth of the SEP4 floor will be limited by the underlying groundwater levels and depth to bedrock (or large boulders which would require drill and blast to remove). The proposed floor of SEP4 is at 291.5 m RL, which is above the water table, thereby preventing direct contact with groundwater. It will be lined with 1.5 mm think HDPE liner to contain the oxalate, and a geosynthetic clay liner (GCL) to prevent downward migration of oxalate seepage through pinholes and other possible HDPE liner defects.

The hopper will be placed on a gravel bed underlain by 1.5 mm HDPE liner that extends from the bank, into the SEP. The raised oxalate hopper area will be constructed to allow the trucks delivering the oxalate from the processing plant to gravity feed the cake into the hopper.

Once the oxalate cake is tipped into the hopper, water will be drawn from the surface of the SEP via a land based pump and conveyed to the hopper via a sprinkler system. The cake will then be sluiced by an agitator to form a slurry which can then be pumped back out into the SEP. The oxalate will be submerged under water to manage dust and facilitate reformation upon its eventual recovery from the SEP in the longer term.

The storage of oxalate in the SEPs is considered as a short to medium term disposal option for the Licence Holder, while a more sustainable disposal option is developed. In 2000, the Premises trialed treating the oxalate through their liquor burner, and although it is still currently used, the rate of oxalate destruction is significantly less than the 80% destruction rate anticipated. The Licence Holder is currently looking at other methods for oxalate destruction, including the installation of a biological oxidation plant within the medium term (5-10 years).

The proposed oxalate storage facility infrastructure, as it relates to Category 46 activities, is detailed in Table 3 and with reference to the site plan in Figure 1 and SEP4 design in Figure 2 (and attached in the Amended Licence).

Table 3: Infrastructure changes under the amendment

	Infrastructure	**Site Plan Reference**
	Prescribed Activity Category 46: Bauxite refining	
Works to construct a lined oxalate storage facility at SEP4 to provide additional storage volume for the expected increase in oxalate production from 50,000 m^3 to 75,000 m^3 per annum in FY20 and FY21.		
1	Pond liner system: • 1.5 mm thick HDPE liner • Geosynthetic clay liner (GCL)	Within SEP4 (Figure 1 and 2)
2	Sprinklers, electrical infrastructure, pumps and a floating release line into SEP4	
3	Floating discharge line along the surface of SEP4 to discharge oxalate slurry from the hopper to the SEP4 void area	
3	Land based spray feed pump for recovery of water and a delivery line from SEP4 into the hopper (via the sprinkler system)	On the access ramp (Figure 2)

	Infrastructure	Site Plan Reference
4	Oxalate tipping area on the banks of SEP4	At the oxalate hopper platform (Figure 2)
5	Oxalate slurry hopper to receive the oxalate cake	Oxalate hopper (Figure 1 and 2)

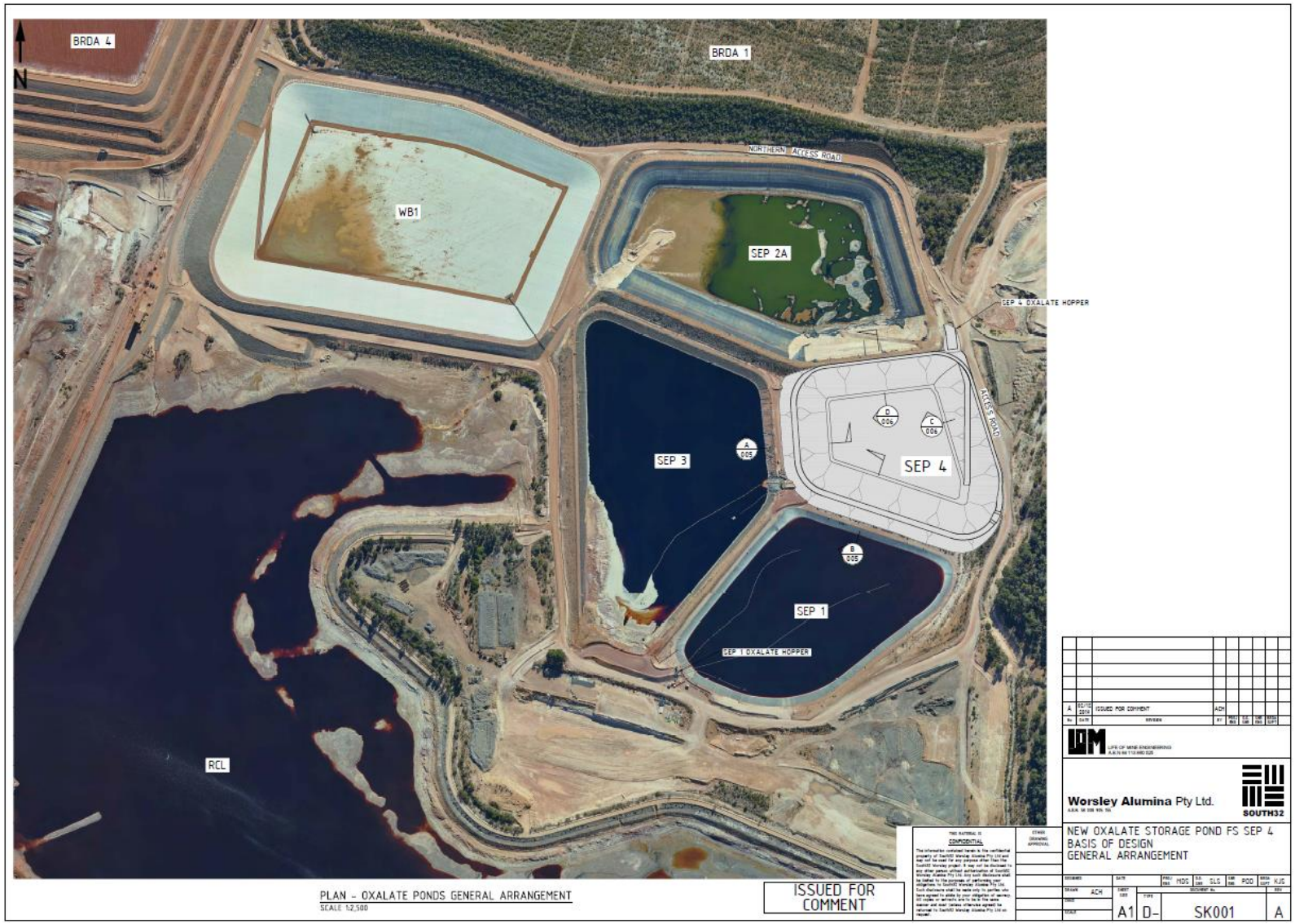

Figure 1: SEP4 site plan

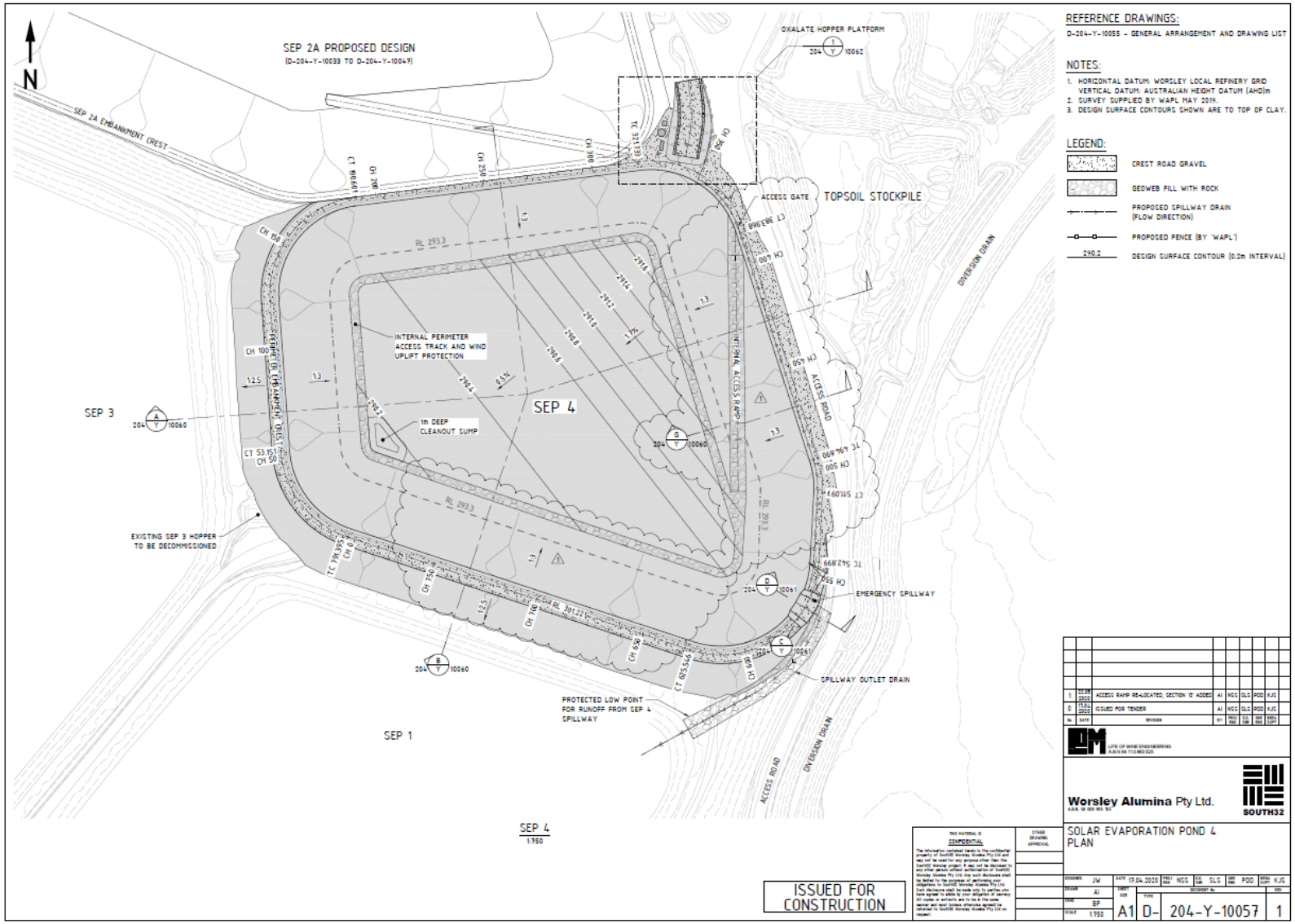

Figure 2: SEP4 design

3.2.1 Removal of ambient SO_2 monitoring conditions

In 2014, the major air emitters with the potential to impact Collie airshed quality (Worsley Alumina Refinery, Bluewaters power station, Muja power station and Collie A power station), collaboratively with the then Department of Environmental Conservation (DEC) established the industry-funded modelling and monitoring study, the Collie Airshed Study (CAS). The CAS was commissioned to establish a reliable, scientific foundation (comprehensive databases and a verified model/s) on which to base an airshed management strategy for the Collie area.

All of the CAS participants had conditions included on their respective licences requiring them to undertake ambient air monitoring. The monitoring/data gathering phase of the study commenced in November 2017 and concluded in November 2019, and involved strict meteorological and ambient emissions monitoring in order to reduce modelling uncertainties. The CAS participants (including the Licence Holder) no longer provide monitoring data to the study. The next phase of the study is focused on developing air emission modelling specifically for the Collie airshed, and this will be presented in December 2020.

In keeping with the study period, the Licence Holder negotiated with an adjacent private landowner to have an ambient monitoring station (Jones/ "J") on their property, approximate 8 km south-southeast of the Premises. The Licence Holder also entered into an agreement with a vendor to lease monitoring equipment for this period. These lease arrangements concluded in May 2020. The Licence Holder would like to now decommission the monitor and hand the site back to the landowner.

Therefore, the Licence Holder has requested the licence be amended to reflect the completion of the monitoring stage of the study by the deletion of the conditions and reference to ambient SO_2 monitoring and the "J" monitor.

4. Licensing history

Table 4 summarises the recent licence history for the Premises.

Table 4: Licence history

Instrument	Issued	Amendment
L4504/1981/17	24/09/2015	Licence reissue and amendment to change the occupier name to South32 Worsley Alumina Pty Ltd, extend reporting due date, add category 61 liquid waste facility and administrative changes.
L4504/1981/17	29/04/2016	DWER initiated amendment to extend the licence duration 30/09/2024 in accordance with *Guidance Statement on Licence Duration (November 2014)*.
L4504/1981/17	04/08/2016	Amendment Notice 1: Licence amended to include Minister's Appeal Determination (Appeal no: 80 of 2015) and extend the compliance date of Condition 4.1.1, table 4.1.1 (IR2) until the 30 November 2016.
L4504/1981/17	11/11/2016	Licence amended to include Boiler 5 and Boiler 6 and remove ambient SO_2 monitoring stations Willis and 303. This amendment was done within the licence no amendment notices issued.
L4504/1981/17	28/07/2017	Amendment Notice 2: approval to construct and operate an additional process water storage dam – water body 1. Conditions 1.2.8 to 1.2.13 added in the licence. IR conditions IR2 and IR3 were removed from the licence. Also some administrative corrections conducted.
L4504/1981/17	16/10/2017	Amendment Notice 3: • Construct of an oxalate tipping area (tip plate) on the banks of SEP1;

Instrument	Issued	Amendment
		• Installation of a oxalate slurry hopper to receive the oxalate cake, sprinklers, an agitator, electrical infrastructure, pumps and a floating slurry release line into SEP1; • A pontoon pump for recovery of water and a delivery line from SEP 1 into the hopper (via sprinkler system) Conditions 1.2.14 to 1.2.18 were added in the licence.
L4504/1981/17	10/03/2020	Amendment to include the two Babcock and Wilcox Type D package boilers as prime energy generation units, incorporate the newly installed CEMS monitoring for Boilers 1-3. Also includes a DWER initiated licence amendment to consolidate separately issued amendment notices in the licence (as detailed above in the instrument log).
L4504/1981/17	25/06/2020	Amendment to construct an oxalate storage facility at SEP4 in a similar way as approved for SEP1 via Amendment Notice 3. Amendment also includes the removal of SO_2 monitoring requirements and reference to ambient air monitor "J" from the licence following the conclusion of the monitoring phase of the Collie Airshed Study in 2019. A CEO initiated amendment to consolidated previous amendments with this one has been incorporated.

5. Other approvals

Other approvals relating to the Premises are outlined in Table 5.

Table 5: Other approvals

Legislation	Number	Approval	Delegated Officer considerations
EP Act – Part IV	Ministerial Statement No. 423 (MS423)	MS423 was granted on 2 July 1996 to increase production from 2.0 to 3.5 Mtpa.	The conditions and procedures of MS423 have been superseded by MS719 in accordance with section 45B of the EP Act. The Delegated Officer has therefore considered MS719, as opposed to MS423, in making a decision on the current amendment application.
	Ministerial Statement No. 719 (MS719)	MS719 was granted on 13 April 2006. In addition to making new commitments, MS719 replaces MS423 and its commitments relating to refinery water resources.	Condition 13-1 requires the development of a Water Resources Management Plan for the purpose of ensuring that the environmental values of surface and groundwater resources are maintained from adverse impacts of refinery operations. The Delegated Officer notes that the Plan includes various actions including the protection of water quality in the Augustus River, located downstream of the refinery; management and cleanup of spills and onsite contaminations; and surface and groundwater monitoring. The Delegated Officer has reviewed the refinery's Water Management Strategy, developed to address requirements of the Water Resources Management Plan, and notes that it is comprised of two catchments: • a clean water catchment in which non-contaminated surface water runoff is directed to the Freshwater Lake via a series of open diversion channels and dams, which in turn discharges to the Brunswick River system via

Legislation	Number	Approval	Delegated Officer considerations
			the Augustus River; and • a contained, closed system high-contamination risk catchment, which directs process liquors, water that comes into contact with process areas (including materials handling and refining areas, spill containment structures and residue areas) and recirculated process waters into the Refinery Catchment Lake (RCL).
			Condition 14-1 requires the development of an Air Quality Management Plan for the purpose of ensuring that best available technologies are used to minimise and monitor air emissions from the refinery and BRDAs. The Delegated Officer notes that the Plan includes an air emissions monitoring program, and actions to control fugitive dust emissions and point source particulate emissions. The Delegated Officer reviewed EPA Bulletin 1209 (published November 2005) which notes that a health risk assessment concluded with confidence that emissions from the refinery are very unlikely to cause direct health effects on the surrounding population and that the Air Quality Management Plan has been implemented to reduce fugitive emissions from BRDAs.
	Ministerial Statement No. 751 (MS751)	MS751 was granted on 24 September 2007 to authorise a production increase to 4.4 Mtpa of alumina.	The Delegated Officer notes MS751, however, its direct relevance does not extend to this amendment, and therefore has not been considered in its assessment.

Key Findings:

The Delegated Officer notes that there is potential for regulatory duplication between Part IV and Part V of the EP Act. In setting regulatory controls, the Delegated Officer will consider the requirements of MS719 conditions, and commitments made in the programs and management plans required by MS719, and will avoid duplication in licence conditions.

Where emissions and discharges have been assessed in this Amendment Report, the scope of the programs and management plans required by MS719 has been reviewed in order to avoid duplication and inconsistency in the conditions of the licence. Where the Delegated Officer has identified that environmental risk is not adequately regulated through other approvals, it may be regulated under Part V of the EP Act.

In consideration of the requirements of the Part IV approval relating to the Premises, the Delegated Officer has determined that the following environmental aspects are managed through MS719, under Part IV of the EP Act:

1) Regular groundwater monitoring to detect contamination, seepage and changes in water quality at the Premises is adequately addressed in accordance with the Water Resources Management Plan required by MS719.
2) The Licence Holder operates two high-volume dust samplers near the Premises boundary to monitor fugitive dust emissions in accordance with requirements of

MS719.

6. Location and receptors

6.1 Siting context

The Premises is located approximately 15 km northwest of Collie on the Darling Plateau, 145 km south of Perth. The Premises is nearly entirely situated within the upper reaches of the Augustus River catchment, which is a tributary of the Brunswick River. Water from the Brunswick River is used for agricultural and other purposes.

The location of SEP4 within the Premises boundary is shown in Figure 3.

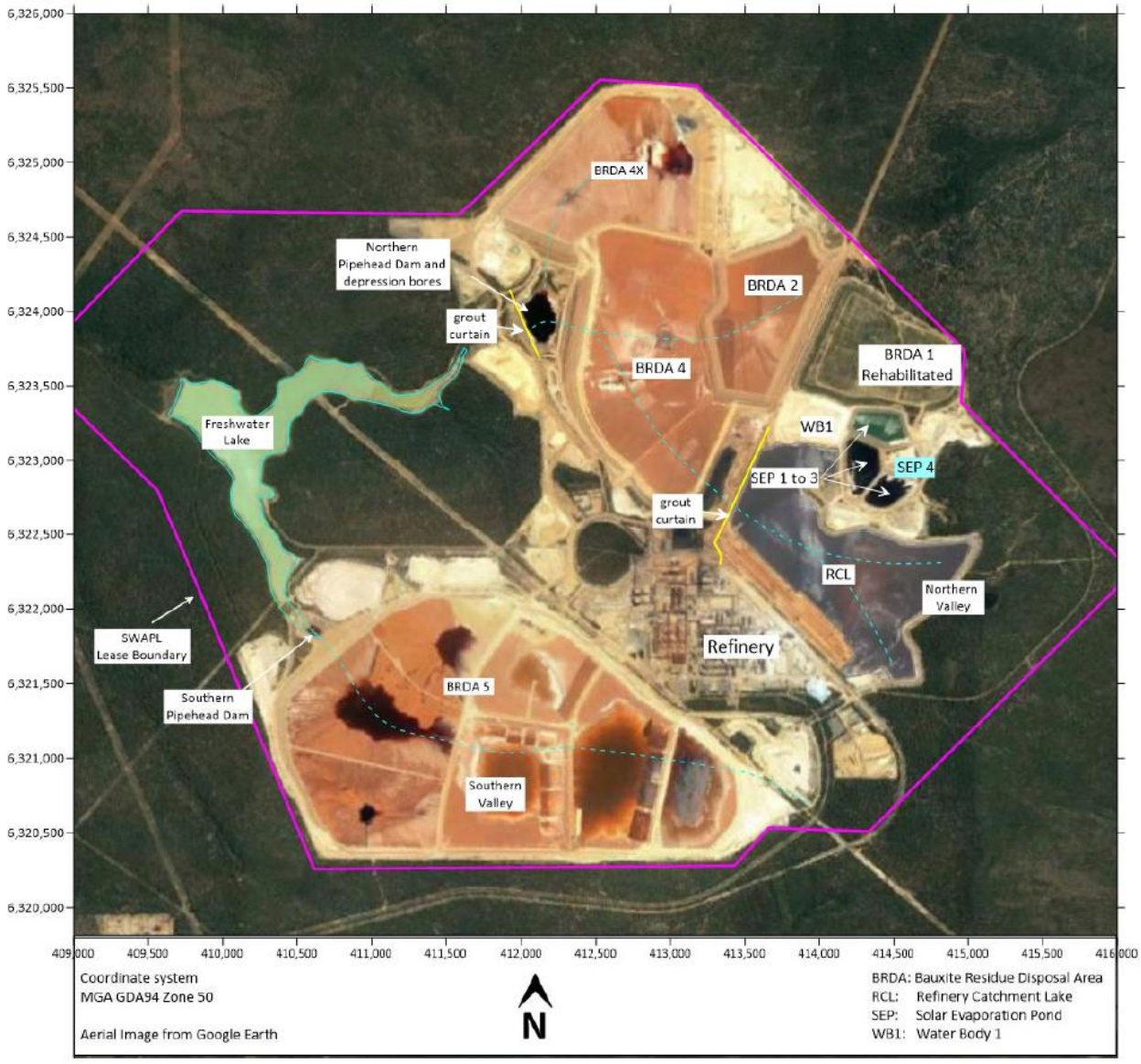

Figure 3: Location of Solar Evaporation Pond (SEP) 4 in relation to the Premises boundary.

6.2 Residential and sensitive receptors

The distances to residential and sensitive receptors are detailed in Table 6.

Table 6: Receptors and distance from proposed works

Residential and sensitive premises	Distance from the proposed works
Single Rural Dwellings:	Single residential dwelling approximately 8 km northeast of the proposed works.
Township of Allanson	Allanson is approximately 11 km south of the proposed works.

6.3 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 7. Table 7 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 7: Environmental values

Specified ecosystems	Distance from the proposed works
Waterways Conservation Areas	Leschenault Inlet Management Area approximately 4.5 km west
Biological component	**Distance from the proposed works**
Threatened/Priority Flora	Priority 4 species approximately 3.8 km northeast and 4 km southwest
Threatened/Priority Fauna	Priority 4 species approximately 810 m west Vulnerable species approximately 1.2 km south Endangered species approximately 3.1 km west

6.4 Groundwater and water sources

A description of ground and surface water resources is provided in Table 8.

Table 8: Groundwater and water sources

Groundwater and water sources	Distance from the proposed works	Environmental value
Public drinking water source areas (PDWSA)	SEP4 is approximately 580 m west from the Harris River Dam Catchment Area (HRDCA). Ground and surface water flows from the proposed development area towards the west of the Premises, away from this receptor.	The HRDCA is a Priority 1 PDWSA, meaning that it is managed to ensure there is no degradation of the quality of the drinking water source with the objective of *risk avoidance*.
Major watercourses/waterbodies	The Premises is within the upper reaches of the Augustus River Catchment. The Freshwater Lake is approximately 4 km west of the proposed works and discharges directly into the Augustus River within the Premises boundary. The Augustus River flows into the Brunswick River approximately 2.5 km north of the Premises boundary (5 km north of the	The Augustus River is a freshwater system with a slightly acidic pH. The upper reaches of the Brunswick River are dominated by the refinery and State Forest. Downstream uses include horticulture, stock watering, recreational and domestic purposes.

Groundwater and water sources	Distance from the proposed works	Environmental value
	proposed works). The upper reaches of the Hamilton River run approximately 2.8 km south of the proposed works (500 m south of the Premises boundary). Ground and surface water flows from the proposed development area towards the west of the Premises, away from this receptor.	The Hamilton River flows south into the Wellington Dam and the Collie River.
Groundwater	Within the vicinity of SEP4 the groundwater levels range between RL 290 m along the eastern catchment divide to RL 230 m downstream to the Freshwater Lake. The predevelopment baseline depth to groundwater is approximately 15 mbgl (between 270 and 275 mAHD).	The shallow aquifer originally fed into the upper reaches of the Augustus River. Shallow groundwater within proximity of SEP's feeds directly into the RCL which is used for site operations. In the vicinity of the SEP's, water from the fractured rock and saprolite aquifers feed into the RCL and at times of high water level in the RCL is at risk of feeding into the Freshwater Lake. The Freshwater Lake is a source for the Augustus River.
Rights in Water and Irrigation Act 1914 (RiWI Act)	The refinery operational area, including the location of SEP4, is within two surface water catchments and the irrigation districts associated with these catchments. These areas are proclaimed under the RiWI Act as: • the Brunswick River and Tributaries • Collie River Irrigation District	The water within the Premises boundary has no environmental value for irrigation purposes. However, water from within the Premises boundary has the potential to reach the Augustus River, which has beneficial uses associate of surface water within the irrigation districts for horticulture, stock watering, recreational and domestic purposes.

7. Risk assessment

Table 9 and Table 10 below describe the Risk Events associated with the amendment to covert SEP4 into an oxalate storage facility consistent with the *Guidance Statement: Risk Assessments*. Both tables identify whether the emissions present a material risk to public health or the environment, requiring regulatory controls.

Table 9. Risk assessment for proposed amendments during construction of SEP4

Risk Event						Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning
Source/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts				
Cat 46 *Bauxite refining*	Minor civil and construction works including construction of oxalate hopper area, installation of hopper, pumps, sprinklers, electrical equipment, land-based feed pump and floating slurry delivery line	Dust: from civil and construction activities	Single rural dwelling approximately 8 km northwest of the construction site	Air and wind dispersion	Health and amenity impacts	Slight	Rare	Low	Due to the separation distance between the source and the receptor, the Delegated Officer determines that there will be minimal to no health or amenity impacts as a result of dust from civil and construction activities at SEP4.
			Native vegetation approximately 50 m east of the construction site		Deposition on vegetation which may harm plants	Slight	Rare	Low	The construction works are considered to be minor, generating minimal dust, therefore the Delegated Officer determines there will be minimal impacts to native vegetation.
		Noise: from civil and construction activities	Single rural dwelling approximately 8 km northwest of the construction site	Air and wind dispersion	Loss of amenity	Slight	Rare	Low	Due to the separation distance between the source and the receptor, the Delegated Officer determines that there will be minimal to no amenity impacts as a result of noise from civil and construction activities. The *Environmental Protection (Noise) Regulations 1997* apply.
		Sediments: mobilised by stormwater	Augustus River approximately 5 km north of the construction site	No pathway: Stormwater runoff surrounding the SEP4 development area reports to the RCL					No pathway.

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the Department's Guidance Statement: Risk Assessments (February 2017)

Table 10: Risk assessment for proposed amendments during operation of SEP4

Risk Event					Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities		Potential emissions	Potential receptors, pathway and impact	Licence Holder controls					
Cat 46 *Bauxite refining*	Seepage from SEP4	Slurry water: containing Al_2O_3, Na_2, CO_3, and SO_4	Seepage of slurry water through the floor of SEP4 into the soil profile may cause increased pH, metals and other contaminants in underlying groundwater: Groundwater level ranges from 290 m RL to 230 m RL (minimum of 1.5 m separation from SEP4 floor level).	SEP4 engineering controls: • Floor level at 291.5 m RL • 1.5 mm thick HDPE liner • Geosynthetic Clay Liner	Moderate	Rare	Medium	Under normal operating conditions, the liner system will prevent seepage of dissolved oxalate into the groundwater. However, oxalate is slightly soluble in water (e.g. rainwater), and oxalate in solution could potentially move through defects in the liner system. The potential for seepage from the facility cannot be excluded, but even if some seepage occurred through small-scale defects, oxalate concentrations in the local groundwater is expected to be small. Furthermore, the risk of seepage of slurry water is expected to reduce overtime as the oxalate solids become consolidated within the SEP. Regular groundwater monitoring is undertaken across the Premises to detect contamination, seepage and changes in water quality in accordance with a Water Resources Management Plan required by MS719. The Delegated Officer considers these controls appropriate, and has included conditions in the Amended Licence for the purpose of further minimising the risk of contaminated water from SEP4 seeping into groundwater.	Condition 1.2.14 has been included to specify the construction and installation requirements for the SEP4 liner system to ensure risk of seepage is minimised. Condition 1.2.16 has been included to ensure the construction and installation of the SEP4 liner system, meets the design specifications for permeability prior to operation, in order to minimise risk of seepage.
			Seepage of slurry water through the floor of the SEP		Moderate	Rare	Medium	If oxalate in solution seeps through defects in the liner system it has the potential to contaminate groundwater as discussed	

Risk Event					Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities		Potential emissions	Potential receptors, pathway and impact	Licence Holder controls					
			may cause groundwater level to rise, subsequently causing harm to native vegetation 50 m east of SEP4, as the root zone is inundated.					above. Oxalate is alkaline and can be potentially caustic, and so has the potential to cause harm to native vegetation if it reaches the root zone via groundwater contamination. The risk of contaminated groundwater moving off-site is managed via the Water Management Strategy (within the Water Resources Management Plan, required by MS719), through operating a closed water circuit with all contaminated water directed via a network of underflow collection pipes to a central storage area (RCL) which is located west of SEP4. Therefore, it is unlikely that contaminated groundwater would reach native vegetation east of SEP4. Hence, the Delegated Officer considers the controls sufficient in minimising the risk of groundwater mounding and the adverse effects to the root zone of native vegetation.	
			Seepage of slurry water through the floor of SEP4, subsequently impacting groundwater discharging to surface water may cause a reduction in surface water quality: • Freshwater Lake: 4 km west • Augustus River: 5 km north		Slight	Rare	Low	The Water Management Strategy (within the Water Resources Management Plan, required by MS719) has several engineering controls at each of the containment structures with the aim of containing contaminated water on-site and to prevent contaminated water from moving off-site (see Fig 4). These controls include: • RCL grout curtain to prevent the down gradient movement of contaminated water; • Northern Pipehead Dam (NPHD) abstraction bores to maintain a groundwater depression in the area; and • NPHD grout curtain to protect outflow to groundwater. Oxalate in solution could potentially move through defects in the liner system, and ultimately a portion that is not absorbed within the vadose zone could enter groundwater. A further portion could subsequently be intercepted by the RCL or Water Body 1, situated downgradient of SEP4. However, oxalate that may have migrated into the fractured bedrock could potentially bypass the RCL and NPHD grout curtains and the depression bores and subsequently be discharged to the Freshwater Lake (see Fig 4). Due to the distance from SEP4, and the implementation of the Water Management Strategy, the Delegated Officer determines that the concentration of oxalate that could potentially reach the Freshwater Lake and Augustus River will be very low to undetectable in the event seepage through the SEP liner occurs. Therefore, risk to both the surface water and downstream groundwater users is considered low.	
			Seepage of slurry water through the floor of SEP4, subsequently impacting surface water quality may lead to exposure of wildlife, particularly water birds, to accumulation of oxalate.		Slight	Rare	Low		
	Overtopping of SEP4		Overtopping of oxalate from SEP4, leading to surface runoff may cause localised contamination of soil and groundwater with increased pH, metals and other contaminants.	The minimum operational freeboard will be 300 mm (contingency freeboard of 500 mm) and will also allow for a 1:100 AEP, 72 hour flood. The design of SEP4 incorporates a spillway within the adjacent topography which reports to the adjacent SEP1 oxalate storage pond. SEP1's operational	Moderate	Possible	Medium	In accordance with DMIRS/DMP Code of Practice (DMP, 2013), SEP4 attracts a 'Low' hazard rating based on an operational scenario where it is completely full of oxalate slurry (maximum depth of approximately 11.5 m). The Delegated Officer notes that a structural failure of the SEP4 embankment would lead to a release of the oxalate slurry into adjacent oxalate storage ponds SEP1 and/or SEP3, with the worst case scenario being that the oxalate slurry reaches the RCL. Based on the pathway and receptors, SEP4 is considered to have a 'Very Low' Dam Failure and Dam Spill Consequence Category rating, according to ANCOLD standards (ANCOLD, 2019).	The requirement to submit an Environmental Compliance Report (ECR) prior to operation of SEP4 (condition 1.2.16) has been included to ensure the construction of SEP4 meets the design specifications for stability prior to operation, in order to minimise risk of embankment wall failure leading to uncontrolled

Risk Event					Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities		Potential emissions	Potential receptors, pathway and impact	Licence Holder controls					
				freeboard is monitored weekly and water transfer between the SEP1, Water Body 1 and the RCL will occur should water level approach the minimum freeboard of 300 mm. Catastrophic failure or controlled release of stored oxalate slurry from SEP4 will report directly to the RCL.				The Licence Holder has adopted the ANCOLD recommended design criteria for a 'Low' consequence category facility. The Licence Holder will also adopt the minimum freeboard as required by DMIRS. The Delegated Officer determines that the controls implemented by the Licence Holder are appropriate and has included them as regulatory controls within the Amended Licence.	release of oxalate slurry. Condition 1.2.19 has been included to specify that the SEPs shall be managed to ensure a minimum embankment freeboard be maintained in order to minimise risk of overtopping.
	Pipeline failures associated with SEP4		No pathway - The oxalate hopper area will be located on HDPE liner with a gentle incline that will drain any discharge or spill back in to SEP4 and therefore will not impact surrounding soil or groundwater.					No pathway.	SEP construction and installation specifications are managed via existing condition 1.2.14 of the licence.
	Spills from oxalate hopper area								
	Dust lift off from hopper area and surface of SEP4	Dust: fine particulates containing oxalate	Air and wind dispersion could cause health and amenity impacts to closest human receptors: • Rural dwelling approximately 8 km northwest of SEP4	-	Slight	Rare	Low	Due to the separation distance between the source and the receptor, the Delegated Officer determines that there will be minimal to no health or amenity impacts as a result of dust from SEP4. Also, the Delegated Officer considers the existing regulatory controls requiring oxalate to be stored moist or submerged in water are sufficient to minimise risk associated with dust from SEP4.	Managed via the existing condition 1.2.6 of the licence.
			Air and wind dispersion could cause oxalate dust to deposit on nearby native vegetation (50 m east of SEP4), potentially causing harm to plants.	-	Minor	Rare	Low	Oxalate readily forms a white powder when dried, and can therefore be transported by air and wind to nearby vegetation. Being caustic, the oxalate has the potential to smother and burn plants within close proximity to the SEP. Oxalate within the Premises is to be stored moist or submerged in water in order to minimise dust emissions, as already regulated in the Existing Licence. The Delegated Officer considers this sufficient to minimise risk to nearby native vegetation from dust associated with SEP4.	Managed via the existing condition 1.2.6 of the licence.
	Storage of oxalate	Odour	Air and wind dispersion could cause impacts to amenity of closest human receptors: • Rural dwelling approximately 8 km northwest of SEP4	None proposed	Slight	Rare	Low	Due to the separation distance between the source and the receptor, the Delegated Officer determines that there will be minimal to no amenity impacts as a result of odour from oxalate storage.	-
		Slurry water: containing Al_2O_3, Na_2, CO_3, and SO_4	Normal operation of SEP4 could present risk to stock and wildlife, potentially causing them harm from direct contact with the slurry water.	Site has an existing security fence	Slight	Rare	Low	The security fence will keep out stock and large wildlife like kangaroos. The water proposed to be contained within SEP4 has the potential to be caustic and may cause soft tissue damage to birdlife that use the pond. However, the Delegated Officer determines that birds are likely to have a preference for the nearby Freshwater Lake, Augustus and Brunswick Rivers which have other characteristics appealing to birdlife such as insects and fringing vegetation. There have been no reports of wildlife contact issues with the current operations and so the Delegated Officer considers the Licence Holder's controls are adequate in minimising the risk to wildlife.	-

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the Department's Guidance Statement: Risk Assessments (February 2017)

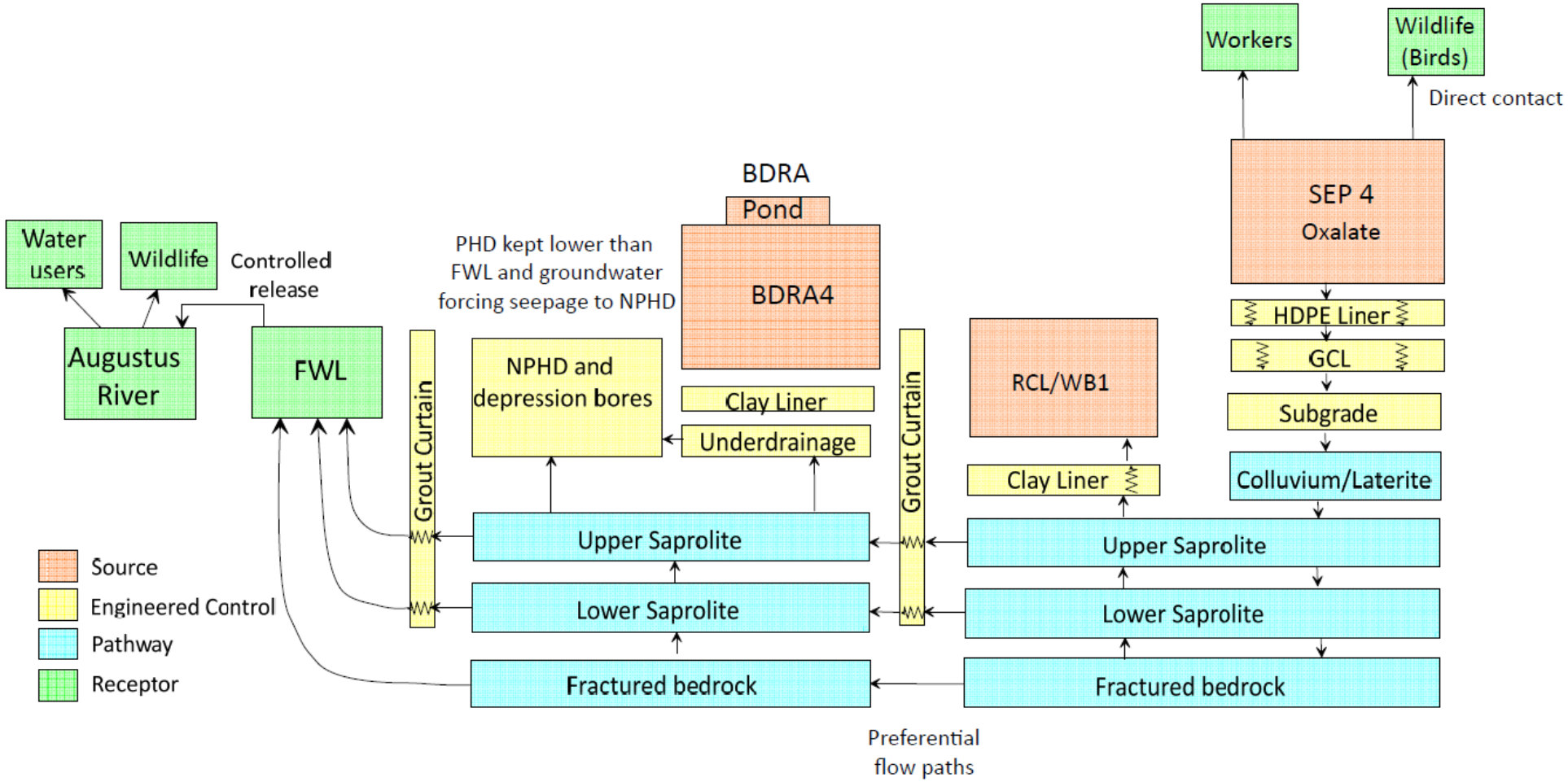

Figure 4: Conceptual site model describing the possible pathways by which exposure to oxalate stored within SEP4 may occur at a receptor.

8. Decision

The Delegated Officer has reviewed the risk associated with the proposed amendments, and has determined to amend licence L4504/1981/17 by inserting additional conditions associated with the construction of an oxalate storage facility at SEP4, and the deletion of conditions associated with the conclusion of the ambient SO_2 monitoring phase of the CAS.

8.1.1 Oxalate storage facility construction at SEP4

The Licence Holder proposes to construct an oxalate storage facility at SEP4 due to existing storage facilities SEP1 and SEP3 approaching capacity, and estimates that the higher oxalate levels of the bauxite ore in FY20 and FY21 will increase the required storage volume from 50,000 m^3 to 75,000 m^3 per annum.

The key emissions associated with the construction of an oxalate storage facility at SEP4 are noise and dust emissions during construction of the oxalate hopper area, installation of the oxalate hopper and associated pumping infrastructure. The Delegated Officer determined that a Works Approval is not required due to the minor nature of these works and the consideration that the potential risks associated are consistent with those from operational activities. Furthermore, the Delegated Officer has had regard to the location of the works within the context of the whole Premises activities, and the distance to sensitive receptors, in the decision not to apply regulatory controls to dust or noise emissions during the construction phase to the Amended Licence.

The key emission associated with the operation of SEP4 as an oxalate storage facility is oxalate slurry water containing Al_2O_3, Na_2, CO_3 and SO_4 that has the potential to seep through imperfections in the pond liner system, through the soil profile and then subsequently into groundwater. This then has the potential to have secondary impacts on surface water quality at nearby waterbodies and the root zone of nearby native vegetation. The installation of a HDPE liner and GCL liner to SEP4, in combination with the continued implementation of the Water Management Strategy, provides several engineering controls to prevent oxalate slurry water seepage and contaminated groundwater moving off-site, respectively. On this basis, the Delegated Officer considers the risk to off-site surface water and downstream water users **low** but suitable for regulation in order to ensure construction and installation specifications are enforced to further mitigate risk.

Oxalate is toxic and readily forms a white powder when dried that could be dispersed via wind, and so oxalate dust is a risk associated with the operation of SEP4 as an oxalate storage facility. The oxalate dust is potentially caustic and may deposit on nearby native vegetation causing tissue damage and burning of plants. The Delegated Officer has carried over existing conditions to the Amended Licence requiring oxalate to be stored moist or submerged in water in order to eliminate the pathway to sensitive receptors. In this context, the Delegated Officer also considers the risk to human health **low** due to the separation distance as well as these regulatory controls.

With regard to the proposed Licence Holder controls, the Delegated Officer has determined to grant the amendment subject to regulatory conditions as outlined in Section 8.2.

8.1.2 Removal of ambient SO_2 monitoring conditions

The Licence Holder proposes to remove conditions and reference to ambient SO_2 monitoring and the “J” monitor from the licence to reflect the completion of the monitoring phase of the CAS.

The Delegated Officer has determined that the removal of ambient SO_2 monitoring requirements associated with the decommissioning of the “J” monitor does not alter the risk profile of the Premises and therefore has granted the amendment, noting the following:

- the CAS monitoring period was conducted over two years, from 2017 to 2019. The SO_2 data from the "J" monitor has shown to be at a very low concentration over this period, ranging most days from 0 – 0.002 ppm;
- the maximum recorded SO_2 reading from the "J" monitor between 1 March 2019 and 31 March 2020 is 0.013 ppm which is just 60% of the maximum daily National Environmental Protection Measure (NEPM) (Ambient Air Quality) standard for SO_2 (0.08 ppm); and
- the CAS Scientific Director has acknowledged the conclusion of the monitoring phase of the study and the consistently low levels recorded, and is therefore supportive of the cessation of SO_2 monitoring currently required by the Licence Holder.

In making the decision to remove conditions and reference to ambient SO_2 monitoring from the licence, the Delegated Officer sought expert advice from the Air Quality Services (AQS) branch of DWER. Key considerations from AQS were:

- the "J" monitor was operated for the purposes of the CAS. The study's monitoring phase is now compete; and
- following a review of the monitoring data provided by the Licence Holder, it appears that the maximum one hour concentration of 114 micrograms per cubic metre is well below the applicable one hour criterion of 524 micrograms per cubic metre. Consequently, the likely risk of SO_2 to the ambient air environment is very low.

On this basis, the Delegated Officer determines that the "J" monitor may be decommissioned by the Licence Holder without altering the risk profile of the Premises. Accordingly, conditions referring to the "J" monitor and associated ambient SO_2 monitoring as required previously for the CAS will be removed from the licence.

The Delegated Officer has proposed changes to the licence in the above context and these are detailed in Table 11.

Other changes to the licence are a result of consolidation of prior amendments and correction of typographical errors and are considered administrative changes, and are therefore excluded from Table 11 of this report. The prior Amendment Report is attached to this Amendment Report (Appendix 2).

8.2 Summary of amendments

Table 11 provides a summary of the proposed amendments and will act as a record of implemented changes. All proposed changes have been incorporated into the Amended Licence as part of the amendment process.

Table 11: Licence amendments

Condition Reference	Proposed amendments
Introduction	Premises description and licence summary amended to include the use of SEPs as temporary oxalate storage facilities.
1.1 Interpretation	'Annual Audit Compliance Report' definition removed and replaced with updated 'AACR' definition. 'AS 3580.1.1' definition removed. 'AS 3580.4.1' definition removed. 'Civil Engineer' definition added. 'Collie airshed power generators' definition removed. 'Environmental Compliance Report' definition added. 'Licensee' definition amended.

	'SEP4' definition added.
Condition 1.2.3	Oxalate waste processing added to Table 1.2.2.
Condition 1.2.4	Rows in Table 1.2.3 amended to specify requirements of SEP construction and/or commissioning.
Condition 1.2.14 and Condition 1.2.15	Condition 1.2.14 and 1.2.15 amended and amalgamated into one condition to incorporate SEP1 and SEP4 construction and installation requirements. Renumbering of subsequent conditions accordingly.
Condition 1.2.15	Table 1.3.5 amended to incorporate SEP1 and SEP4 construction and installation requirements.
Condition 1.2.16	Condition updated as previous condition wording regarding certification of approved works has been superseded.
Condition 1.2.17	Condition added to specify requirements of the Environmental Compliance Report.
Condition 1.2.19	Condition added to specify the requirement of a freeboard at SEP1, SEP3 and SEP4.
Condition 3.4.1 – 3.4.6	Conditions referencing ambient SO_2 monitoring and the "J" monitor removed.
Condition 4.3.1	Reference to conditions 1.2.11 and 1.2.12 removed from Table 4.3.1 to avoid duplication of conditions 1.2.12, 1.2.15 and 1.2.16.
Schedule 1: Maps	Premises map amended to include SEP4 label. Reference to Table 3.4.1 removed from map of 'ambient air emission monitoring sites' to coincide with amendment to remove conditions relating to ambient SO_2 monitoring. Map of 'ambient air emission monitoring sites operated and maintained by Collie airshed power generators' removed to coincide with amendment to remove conditions relating to ambient SO_2 monitoring. Map of the 'location of SEP4 and associated equipment and infrastructure' added (Figure 2).

9. Licence Holder's comments

The Licence Holder was provided with the draft Amendment Report and draft issued Licence on 3 June 2020. The Licence Holder first responded on 15 June 2020 providing clarification on the design of SEP4 and installation of infrastructure. The Licence Holder provided an updated SEP4 design figure on 22 June 2020 as requested by DWER. The provided information has been included in this Amendment Report and issued Licence.

10. 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 Amendment Report (summarised in Appendix 1).

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

Caron Goodbourn
Manager, Process Industries
Delegated Officer under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key documents

	Document title	In text ref	Availability
1	Licence L4504/1981/17	L4504/1981/17	accessed at www.dwer.wa.gov.au
2	Licence Amendment application and supporting documentation	the Application	DWER records (A1873954 and DWERDT208328)
3	Material Safety and Data Sheet – Sodium Oxalte MSDS, Sciencelab.com	Sciencelab, 2013	accessed at: http://www.sciencelab.com
4	Ministerial Statement 423	MS423	accessed at www.epa.wa.gov.au
5	Ministerial Statement 719	MS719	
6	Ministerial Statement 751	MS751	
7	EPA Bulletin 1209, November 2005. *Report and recommendations of the Environmental Protection Authority.* Worsley Alumina - Efficiency and Growth Increase of Existing Operations to 4.4Mtpa Alumina Production, Environmental Protection Authority, Perth.	EPA Bulletin 1209	
8	DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	-	accessed at www.dwer.wa.gov.au
9	DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.		
10	DER, November 2016. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.		
11	DER, November 2016. *Guidance Statement: Decision Making*. Department of Environment Regulation, Perth.		
12	DWER, June 2019. *Industry Regulation Guide to Licensing,* Department of Water and Environmental Regulation, Perth.		
13	DMP, 2013. *Department of Mines and Petroleum (DMP) Code of Practice (CoP): Tailings Storage Facilities in Western Australia*. Government of Western Australia.	DMP, 2003	accessed at www.dmp.wa.gov.au
14	ANCOLD, 2019. Australian National Committee on Large Dams (ANCOLD): Guidelines on Tailings Dams Planning, Design, Construction, Operation and Closure.	ANCOLD, 2019	available for purchase at www.ancold.org.au

Appendix 2: Licence Amendment (9 March 2020)

Attachment 1: Amended Licence L4504/1981/17