Decision Report

Application for Works Approval

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

Works Approval Number	W6407/2020/1
Applicant	Silver Lake (Deflector) Pty Ltd
ACN	101 224 999
File Number	DER2020/000240
Premises	Gullewa Gold-Copper Operations M59/49, L59/49, L59/64, M59/68, M59/132, M59/294, M59/356, M59/391, M59/392, M59/335, M59/442 L59/35, M59/507, M59/336, M59/522, L59/71, L59/158, L59/159 and L59/160 Morawa - Yalgoo Road YALGOO WA 6635
Date of Report	25 November 2020
Decision	Works approval granted

Rebecca Kelly
A/Senior Manager, Resource Industries

an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

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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 and operation of the Premises. As a result of this assessment, Works Approval W6407/2020/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this Decision Report, the department 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 9 June 2020, the applicant applied for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act). The application is to:

- construct a new two-cell paddock-style above-ground Tailings Storage Facility;
- add a Carbon in Pulp Leach Upgrade circuit (CIP circuit) to the processing plant; and
- install a new 60 m^3/day Wastewater Treatment Plant (WWTP) to replace the current WWTP at the Premises.

The location of infrastructure is shown in Figure 1.

The Premises relates to Category 5 and Category 85 and assessed production capacities under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in Works Approval W6407/2020/1. The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guidance Statement: Risk Assessments* (DER 2017) are outlined in Works Approval W6407/2020/1.

The department notes that the current power station onsite will remain below the threshold for Category 52, notwithstanding implementation of this application.

2.3 Other relevant approvals

DWER sought comments from the Department of Mines, Industry Regulation and Safety (DMIRS) regarding the structural integrity and the materials to be used for construction of the embankments on 22 July 2020. DMIRS reviewed the Mining Proposal and design report during the assessment. On 12 November 2020, DMIRS advised that the responses from the further requests for information from the proponent were acceptable and DMIRS approved the Mining Proposal (Reg ID 88751) for the construction of the TSF on 6 November 2020.

DMIRS have applied several non-standard tenement conditions on M59/442 relating to the construction and operation of TSF2. The non-standard tenement conditions (and the condition number) relevant to the DWER approval are:

33. The construction of any tailings impoundment embankment shall be supervised by an engineering or geotechnical specialist.

34. The construction details of any tailings storage embankment shall be documented by an engineering or geotechnical specialist and confirm that the construction satisfies the design intent. The construction document shall include the records of all construction quality control testing, the basis of any method specification adopted, and any significant modifications to the original design together with the reasons why the modifications were necessary. The construction document shall also present as-built drawings for the embankment earthworks and pipework. A copy of the construction document shall be submitted to DMIRS for its records.

35. The tailings storage facility shall be checked on a routine daily basis by site personnel during periods of deposition to ensure that the facility is functioning as per the design intent.

36. An engineering or geotechnical specialist shall audit and review the active tailings storage facility on a biennial basis. The specialist shall review past performance, validate the design, examine tailings management, and review the results of monitoring. Any deficiencies noted in the audit and review report shall be suitably addressed and improved. The audit and review report shall be submitted to DMIRS and should be accompanied by a recent survey pick-up of the facility and an updated tailings storage data sheet.

38. Where tailings material from TSF2 is utilised in the construction or foundation of stage 2 and 3 embankment lifts, submit a report to DMIRS that demonstrates tailings material behaviour complies with design assumptions. A copy of the construction document shall be submitted to DMIRS for its records.

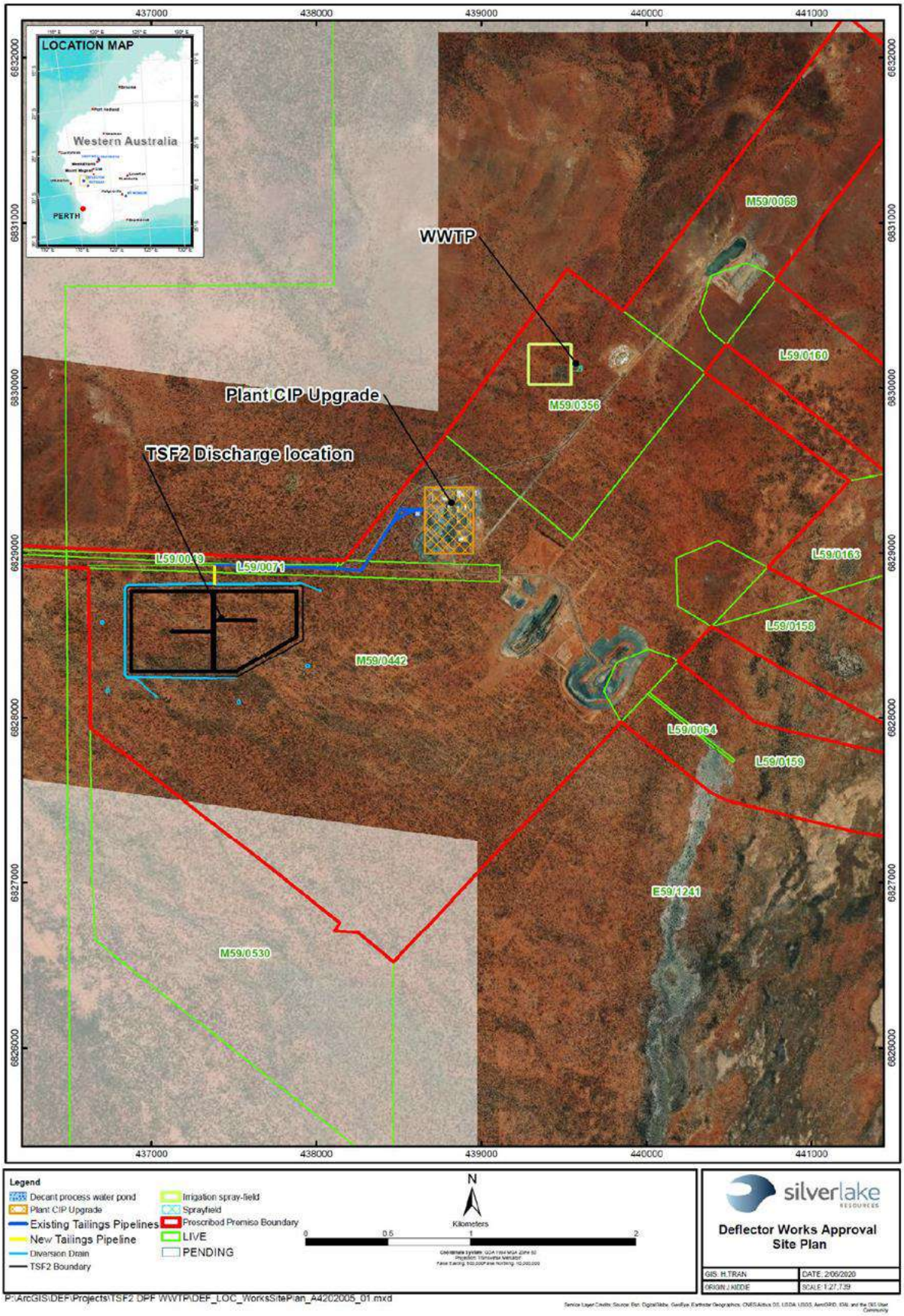

Figure 1: Location of infrastructure

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 *Guidance Statement: Risk Assessments* (DER 2017).

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 operation which have been considered in this Decision Report are detailed in Table 1. Table 1 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

3.1.2 Receptors

In accordance with the *Guidance Statement: Risk Assessment* (DER 2017), the Delegated Officer has excluded employees, visitors and contractors of the applicant from its assessment. Protection of these parties often involves different exposure risks and prevention strategies, and is provided for under other state legislation.

Table 2 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 *(Guidance Statement: Environmental Siting* (DER 2016)). Figure 2 shows the distance to the sensitive receptors.

3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guidance Statement: Risk Assessments* (DER 2017) 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 3.

Works Approval W6407/2020/1 that accompanies this Decision Report authorises construction and time-limited operations. The conditions in the issued Works Approval, as outlined in Table 3 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

A licence is required following the time-limited operational phase authorised under the works approval to authorise emissions associated with the ongoing operation of the Premises. A risk assessment for the operational phase has been included in this Decision Report, however, licence conditions will not be finalised until the department assesses the licence application.

Table 1: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Industrial waste	Construction	Contamination to soil and water.	Any non-hazardous, Inert type I and II waste generated by the project construction will be buried in the existing licensed landfill located in the existing Deflector Waste Rock Dump.
Operation			
Seepage/ Leachate	TSF: Storage of tailings (including cyanide)	Seepage of tailings through base of TSF	Full details are provided in Section 3.3, summary of controls are: • TSF will be a two-cell, paddock-style facility, designed to store approximately 5 Mt of tailings (approximately a 7-year lifespan). • Tailings solids of 40 per cent, tailings water content of 60 per cent. • Tailings slurry discharged sub-aerially and cyclically in thin >300 mm layers with each layer subject to a drying cycle. • Starter embankment of TSF2 will be 4.5 m with two embankment raises 3.0 m and 3.5 m, respectively. Starter embankment to be constructed from November 2020, Raise 1 completed by June 2023 and Raise 2 by December 2025. • Perimeter cut-off trench, up to 1.2 mbgl to refusal on the competent Ferricrete layer. • Decant water removed by a decant structure within each cell, with the pond maintained away from the perimeter of the embankments. • A 150 m diameter HDPE liner with a permeability of 1 x 10^{-8} m/s or less constructed around each decant structure within in each cell. • Re-use of decant water in the Deflector Processing Facility. • Seepage recovery system at south west corner of the TSF2 site. • Stormwater diversion bund to the north and west of the TSF. • Dust suppression during construction and as required during commissioning and operation.

Emission	Sources	Potential pathways	Proposed controls
	TSF/ CIP circuit: Process water pond	Seepage of process water through process ponds Direct contact with fauna	Return water will be pumped to a new 4,000 m^3 HDPE-lined pond with a permeability of 1 x 10^{-8} m/s or less for reuse in the processing plant. Any stormwater that falls on the TSF will be used within the processing plant. Freeboard of 500 mm. The pond will be fenced and animal egress matting or similar will be installed.
Tailings/ decant water	TSF: Storage of tailings/ decant water	Direct contact with fauna Tailings pipeline rupture	For fauna, the following will be implemented: • observations will be made once per shift to identify and record any fauna interactions and deaths • fauna mortalities will be investigated to identify trends/contributing factors • if cause is due to cyanide ingestion, investigate mitigation strategies • consult with DWER before implementing any strategies. Groundwater is hypersaline (TDS ~40,000 mg/L). CIP circuit process adds cyanide (approximately 395 ppm). The high salinity acts as a fauna deterrent (Adams et al 2008). Tailings delivery and decant return water pipelines will be located within bunds, and secondary alarms and/or and telemetry installed. Sumps will be installed at low points within the pipe route for spill management and/or maintenance.
		Overtopping during extreme weather events	Provision of a minimum of 500 mm total freeboard comprising minimum operational freeboard (vertical height between the tailings beach and embankment crest) of 300 mm and a minimum beach freeboard of 200 mm plus and allowance for the 1:100 yr. AEP 72 hour event of 159 mm. Any stormwater will be captured and utilised at the plant.
Reagent/ chemical spills	CIP circuit	Storage failure at the CIP circuit	All reagents, storage tanks, mixing tanks, pumps and pipes are located within concrete bunds designed and constructed in accordance with AS 1940:2017. Potentially contaminated stormwater is directed to an existing event pond (volume of 1,320 m^3). This event pond at present services the proposed CIP circuit; however, the area containing the proposed CIP circuit and new reagents area will be concrete bunded and separated from the catchment reporting to the existing event pond, reducing the overall catchment reporting to the event pond.

<table>
<tr><th>Emission</th><th>Sources</th><th>Potential pathways</th><th>Proposed controls</th></tr>
<tr><td rowspan="2">Sewage</td><td rowspan="2">WWTP</td><td>Storage failure at the WWTP</td><td>WWTP housed in a containerised plant room, fully insulated and airconditioned in a fenced compound.

Bunded containerised store for reagents.</td></tr>
<tr><td>Direct discharge to land</td><td>Existing 4 ha irrigation sprayfield on site and no increase in area is required for the upgraded WWTP.

The WWTP is located approximately 150 m away from the nearest accommodation room (an increase in distance from the current treatment facility) and the sprayfield is located to the west, away from the accommodation camp.

Monitoring of effluent quality will be undertaken at the WWTP, as follows:
<table>
<tr><th>Parameter</th><th>Limit</th><th>Units</th><th>Frequency</th></tr>
<tr><td>pH</td><td>6.5 to 8.5</td><td>-</td><td rowspan="8">Quarterly</td></tr>
<tr><td>E. coli</td><td>1000</td><td>cfu/100mL</td></tr>
<tr><td>Biochemical Oxygen Demand</td><td>20</td><td rowspan="6">mg/L</td></tr>
<tr><td>Residual chlorine</td><td>0.2 to 2</td></tr>
<tr><td>Total Phosphorus</td><td>12</td></tr>
<tr><td>Total Nitrogen</td><td>30</td></tr>
<tr><td>Total Suspended Solids</td><td>30</td></tr>
<tr><td>Volumes of wastewater discharged to the environment</td><td>-</td><td>m^3</td><td>Continuous</td></tr>
</table></td></tr>
</table>

Table 2: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	**Distance from prescribed activity**
Barnong Station Homestead	Located 10 km away. The homestead is located within the former Barnong Pastoral Lease. This pastoral lease is managed by the Department of Biodiversity, Conservation and Attractions (DBCA). The homestead is unoccupied and is in a state of disrepair. DBCA has advised DWER there are no plans to repair the homestead for the purpose of occupation.
Environmental receptors	**Distance from prescribed activity**
Surface water	The Salt River is located approximately 3 km away in an east to south easterly direction from the Premises. Sheet flow from the surrounding catchment contributes to the Salt River during periods of heavy rainfall and it is the main drainage channel for the catchment. Water quality is highly saline (20,000 - 23,000 mg/L TDS) and alkaline (pH 8.3 - 8.4), with elevated concentrations of total nitrogen and some metals. The Salt River supports permanent pools of saline water in topographic lows. In the vicinity of the mine, the river flows in a southerly direction for approximately 15 km, before intercepting a chain of salt lakes including Burra Lake which is the local terminus. Burra Lake is a large shallow evaporative basin that experiences high evaporation rates and shallow water depths. During flooding events, the lake is highly productive, with primary producers comprising benthic algal mats and macrophytes providing a food source for a range of aquatic invertebrates and waterbirds. The riparian zone is dominated by samphire (*Tecticornia*) and several chenopod species. Burra Lake has also been affected by secondary salinisation, with the addition of salts from the river and the surrounding catchment via runoff. Burra Lake is located on a working pastoral station which is currently stocked with cattle. From Amendment Notice 4 for the related mine Licence (L7798/1993/6), a baseline ecological assessment of Salt River was undertaken to review the relocation of a mine dewatering discharge outlet (disposing average 40,000 mg/L TDS). Downstream of the discharge location (SR08 in Licence L7798/1993/6) or the lower reaches of Salt River, the ecological value was described as low to moderate in contrast to the high value of the upstream aquatic environment. The assessment by Stantec Australia Pty Ltd (Stantec 2019) showed that the aquatic ecology of Salt River (algae, macrophytes, aquatic invertebrates, fish and amphibians, waterbirds and riparian vegetation) studied in both minor and major flood events in 2018, that there were no aquatic species of conservation significance identified and most taxa had been previously recorded from the Yalgoo bioregion or inland WA. Three new species of ostracod and gastropod were identified and were abundant and widespread from the study findings. Groundwater flow (to the south east) from the proposed TSF2 would be in the direction of the lower-value aquatic environment of the Salt River, downstream of the discharge location (SR08 in Licence L7798/1993/6).

Environmental receptors	Distance from prescribed activity
Groundwater	The geology of the TSF2 area is expected to consist of 2 m of cover/soil over a ferruginous hard cap of around 3 to 10 m. Below this, an upper saprolite area to around 25 to 30 m and a lower saprolite layer to 30 to 50 m. Saprock and fresh bedrock are located below these. Groundwater is likely to be located within the upper and lower saprolite area. The upper saprolite refers to the zone immediately beneath the ferruginous hard cap where the rock has undergone complete chemical decomposition into heavy textured clay minerals, which may display remnant rock textures. The upper saprolite is mostly unsaturated but can form a slow seepage zone where water is present. Being mostly massive heavy textured clays, the upper saprolite is expected to have very low vertical and horizontal permeability (in the order of 0.001 m/day) and a specific yield of less than 0.1% (Pennington Scott 2020). The transition into lower saprolite (the zone of joint oxidation) is characterised by a change from heavy textured clay to soft, decomposed, friable rock 5 to 10 m thick. The lower saprolite zone is typically the most reliable water target in a fractured rock environment; permeabilities in the Yilgarn Craton tend to vary between 0.2 and 10 m/day, with 1 m/day being a generally accepted average. Specific yield is difficult to determine accurately, but between 0.5% and 1% is conservative (Pennington Scott 2020). The presence of dykes, faults or other structural features in the vicinity of the Premises is likely to compartmentalise groundwater in bedrock into a number of distinct flow-systems that will only have a limited degree of hydraulic interconnection. This is supported by the large variation in groundwater salinity that is observed near the Premises. Groundwater at the TSF2 area is hypersaline, with TDS levels of between 35,000 to 44,000 mg/L. The high salinity is likely associated with the saline groundwater aquifer underlying the Salt River. The groundwater is not suitable for human, livestock or horticultural purposes due to the high salinity levels. Groundwater levels are approximately 20 m below ground level (mbgl) predominantly within the lower saprolite layer, flowing in a south easterly direction toward Salt River, with a velocity of approximately 1 m/day (GRM 2018), equivalent to $1.15x10^{-5}$ m/s. No groundwater-dependent ecosystems have been identified during environmental assessments (Botanica 2019).
Fauna	From CPS 5128, the vegetation associations, landforms, and fauna habitat types occurring within the amended permit area are similar to those occurring within previously approved permit area and are well represented in the region. Additional clearing is unlikely to have a significant impact on fauna habitat availability at a local or regional scale. Clearing of fauna habitat has been assessed and permitted under CPS 5128. Fauna may use the TSF and the process water pond as a source of water.

Environmental receptors	Distance from prescribed activity
Flora/vegetation	From CPS 5128, the broad vegetation units at the TSF2/processing plant/WWTP locations consist of Acacia shrubland. East of the mine, the vegetation changes to a low floodplain consisting of Chenopods. Plant communities are well represented in surrounding areas. No threatened or priority-listed flora of conservation significance have been found, nor any threatened or priority ecological communities. No groundwater- or surface water-dependent ecosystems have been identified during environmental assessments (Botanica 2019). Clearing of flora/vegetation has been assessed and permitted under CPS 5128. Flora and vegetation will remain surrounding the proposed infrastructure.

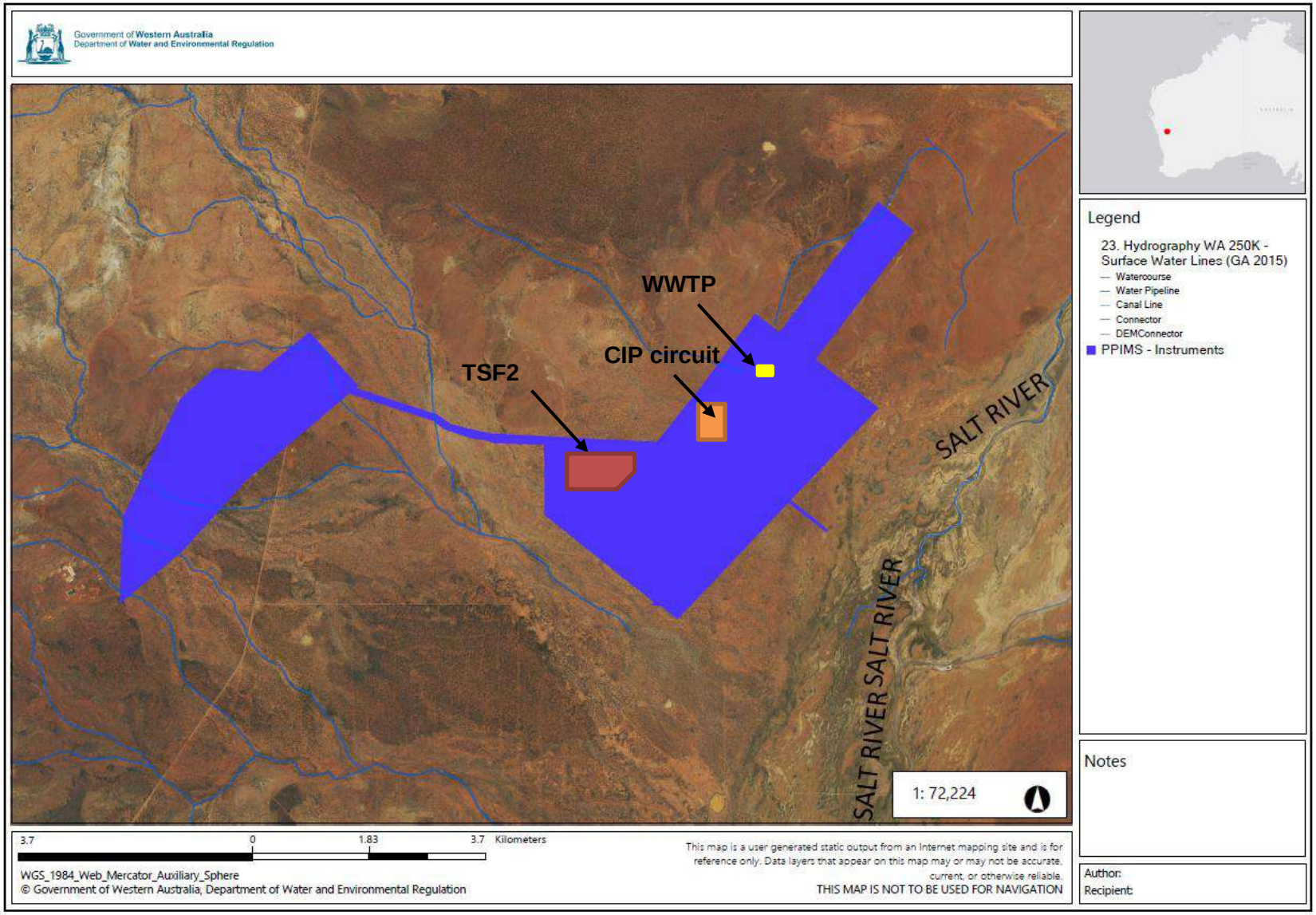

Figure 2: Distance to sensitive receptors (approximate)

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Table 3: Risk assessment of potential emissions and discharges from the Premises during commissioning and operation

Risk Event					Risk rating[1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for controls
Source/Activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Commissioning and operation (including time-limited-operations)								
Category 5 – TSF Deposition into TSF	Seepage/ Leachate (to groundwater) potentially containing elevated TDS, metals, metalloids and weak acid dissociable (WAD) [>50 mg/L] cyanide	Receptors: Groundwater, migration to surface water Path: Seepage of tailings through base of TSF Impact: Groundwater mounding potentially affecting surrounding vegetation, groundwater contamination	Flora/ vegetation Groundwater, surface water (Salt River)	Refer to Section 3.1.1 and Section 3.3	C = Moderate L = Possible **Medium Risk**	N	Conditions **2,** 3, **4 to 9, 12, 13, 17, 18, 20, 21,** 22, 23**, 24, 25, 26, 27,** 28, 29, **30, 31, 32, 35 to 40**	Refer to Section 3.3
Category 5 – TSF Overtopping of TSF	Tailings/ decant water	Receptors: groundwater, surface water, soils/vegetation Path: overtopping during extreme weather events Impact: Contamination of surrounding environment, infiltration to groundwater	Groundwater, surface water (Salt River)	Refer to Section 3.1.1	C = Moderate L = Rare **Medium Risk**	Y	Condition 22 Condition 28	Freeboard of 500 mm with capacity for a 1:100, 72 hour storm event.
Category 5 – TSF Tailings surface/ process water pond	Decant/ tailings water potentially containing elevated TDS, metals, metalloids and WAD [>50 mg/L] cyanide	Receptors: Fauna (birds/bats) using the TSF/ process water pond Path: Direct contact Impact: fauna health	Fauna	Refer to Section 3.1.1	C = Minor L = Unlikely **Medium Risk**	Y	Condition 26 Condition 28	Tailings will be hypersaline, with TDS ~40,000 mg/L. CIP circuit process adds cyanide; expected concentration approximately 395 ppm WAD. Likely that the high salinity would act as a fauna deterrent (Adams et al 2008). Regular inspections to be undertaken to check for fauna usage.
Category 5 – TSF Tailings surface	Dust lift of from dried tailings	Receptors: surrounding vegetation Path: dust lift off from the TSF Impact: smothering of vegetation	Vegetation surrounding TSF	Refer to Section 3.1.1	C = Slight L = Unlikely **Low Risk**	Y	Condition 28	Tailings are wet and are not expected to create dust during operations. The TSF will be capped at closure.
Category 5 – TSF Process water pond	Seepage/ Leachate (to groundwater) potentially containing elevated TDS, metals, metalloids and weak acid dissociable (WAD) [>50 mg/L] cyanide	Receptors: groundwater Path: seepage to underlying groundwater Impact: Groundwater mounding and contamination	Groundwater, surface water (Salt River)	Refer to Section 3.1.1	C = Moderate L = Rare **Medium Risk**	Y	Condition 2 Condition 12 Condition 28	HDPE lined pond with a permeability of 1 x 10^{-8} m/s or less. 500 mm freeboard maintained. Level sensors installed to indicate high level. Emergency overflow channel to the present tailings scour pit to the west of the processing plant.
		Receptors: groundwater, surface water, soils/vegetation Path: Process water overtopping pond Impact: Contamination of surrounding environment, infiltration to groundwater	Groundwater, surface water (Salt River)	Refer to Section 3.1.1	C = Moderate L = Rare **Medium Risk**	Y	Condition 20 Condition 28	Regular inspections to be undertaken. Spills to be cleaned up immediately.
Category 5 – CIP Circuit Ore processing/pipelines	Ore/tailings slurry potentially containing elevated TDS, metals, metalloids and weak acid dissociable (WAD) [>50 mg/L] cyanide	Receptors: groundwater, surface water, soils/vegetation Path: spills, pipeline failure Impact: Contamination of surrounding environment, infiltration to groundwater	Groundwater, surface water (Salt River)	Refer to Section 3.1.1	C = Slight L = Unlikely **Low Risk**	Y	Condition 1 Condition 28	All pipes will be bunded and telemetry installed. Regular inspections to be undertaken. Spills cleaned up immediately RO reject water to be reused in the process plant
Category 5 – CIP Circuit (processing of ore) Reagents/chemical storage	Reagent/ chemical spills							Located within concrete bunds designed and constructed in accordance with the current version of AS 1940.
Category 85 – WWTP Rupture/ failure of new pipelines, overtopping of new tanks, Chlorine Dosing System	Discharge of sewage/ chlorine to land	Receptors: Soil, vegetation and groundwater, surface water Path: Direct discharge to land Impact: Contamination of surrounding environment, infiltration to groundwater	Groundwater, surface water (Salt River)	Refer to Section 3.1.1	C = Slight L = Unlikely **Low Risk**	Y	Condition 1, 15, 16, 22, 23, 28, 33, 34	Regular inspections to be undertaken. Spills to be cleaned up immediately.

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guidance Statement: Risk Assessments* (DER 2017).

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

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3.3 Detailed risk assessment for seepage of tailings

3.3.1 Seepage emissions

TSF design

The TSF2 will be a 54 ha standalone facility that will comprise two cells designed to store approximately 5 Mt of tailings. TSF2 will have a maximum embankment height of 10.25 m. The starter embankment will be approximately 4.0 m and will be raised in two stages (1 x 3.0 m and 1 x 3.25 m raises) using upstream construction techniques.

The starter embankment will comprise an upstream zone and a downstream zone. The upstream zone will consist of low permeability roller compacted select borrow material and a HDPE liner with a permeability of 1 x 10^{-8} m/s or less, and the downstream zone will consist of traffic compacted mine waste material. The two embankment raises will be constructed using compacted clayey borrow material or compacted dried tailings and will not include a liner. A perimeter cut-off trench will be constructed up to 1.2 mbgl or to refusal on the competent Ferricrete layer.

At least five pairs of vibrating wire piezometers (VWPs) will be installed in the starter embankment to monitor the phreatic surface within the embankment.

The Deflector mine will process blended Deflector and Rosthay ore (hauled from the Rothsay mine 70 km south of the Deflector mine) and the resultant tailings will be deposited into TSF2. The ratio of blended Deflector ore to Rothsay ore will be 60:40.

A CIP circuit will be installed to the ore processing plant to process the blended ore, which is expected to result in tailings solids of 40 per cent, tailings water content of 60 per cent. The total water discharged to the TSF is expected to be 1.14 GL/year. The Applicant expects tailings moisture retention to be up to 0.3 GL/year.

The CIP circuit requires the addition of cyanide, with expected concentrations in the tailings of approximately 395 ppm WAD cyanide; a cyanide destruction plant has not been proposed as the tailings are hypersaline (approximately 40,000 ppm).

Tailings slurry will be discharged sub-aerially and cyclically into the facility in approximately 300 mm layers, subjecting each layer to a drying cycle. Deposition will take place via at least 130 spigots located on the upstream perimeter embankment crest.

Decant water will be removed using a decant pump deployed within a central decant structure within each cell. A 150 m diameter HDPE liner with a permeability of 1 x 10^{-8} m/s or less will be installed around each decant structure to reduce seepage.

Seepage

The Works Approval Holder has provided information on the permeability of the TSF embankments. Permeability through the embankment and the 150 m HDPE liner around the decant structure is expected to be 1 x 10^{-8} m/s. The permeability in the foundation of the TSF is expected to be 1 x 10^{-7} m/s. Seepage through the embankment is estimated by the Applicant to be approximately 1 m^3/day. There is some remaining uncertainty regarding the seepage rate through the base. The works approval requires monitoring of groundwater down gradient of the TSF prior to commissioning and during time limited operations.

Tailings properties

Geochemical and geotechnical testing of the tailings has not been undertaken as the combined ores are not yet being processed together. The Applicant has estimated tailings properties using separate ore properties and the tailings at the existing TSF1 at the Deflector mine. The Applicant expects the properties of the tailings being deposited into TSF2 will be similar to TSF1.

The Applicant has advised that investigations of Deflector ore properties from 2017 reflect the current properties of the ore as the mine mineralogy has not changed since 2017. Investigations into Rothsay ore properties from 2016 are also current as it has not been mined since 2016. The ore mineralogical properties compared to the GAI index are shown in Appendix 3.

Expected tailings properties as shown in Table 4.

Table 4: Tailings properties

Parameter	Value	Description
Slurry Density (Solids by weight)	40%	
Final Tailings Density	1.45 t/m^3	From Laboratory Test Work
Percentage fines	53%	From Laboratory Test Work
Unified Soil Classification	ML	From Laboratory Test Work
Drained Friction Angle	30°	From CPT Testing
Undrained Shear Strength	30 kPa	From CPT Testing
Hydraulic Conductivity – Compacted Tailings	1.0 x 10^{-8} m/s	Based on CPT Dissipation Tests
Tailings Beach Slope	1%	From Survey Pickup at Gullewa TSF
Plasticity Index	Non-Plastic	From Laboratory Test work
pH	10	-
TDS	38,000-45,000 ppm	Hypersaline, similar to tailings in TSF1 and with the groundwater in the area
AMD Risk	PAF	Deflector ore fraction (60 per cent) Potentially Acid Forming (PAF) due to high sulfur content
Free cyanide	450 ppm	Currently <50 ppm and concentration will increase to 450 ppm with addition of a CIP Upgrade.
WAD cyanide	371-441 (average 395 ppm)	Currently <50 ppm and concentration will increase to average 379 ppm with addition of a CIP Upgrade

3.3.2 Pathway and receptors

Seepage could result in groundwater mounding which could impact surrounding vegetation. Seepage could also contaminate groundwater that moves towards the Salt River, approximately 3 km south east of the TSF.

3.3.3 Applicant controls

The decant pond will be managed to be within the 150 m diameter HDPE liner around the cell (managed to approximately 50 m diameter with management outlined in the operations manual). The Applicant has provided an excerpt of their TSF operational manual which considers management actions for situations where the decant pond diameter exceeds 50 m.

In case seepage occurs, the Applicant has proposed a seepage recovery system at south west corner of the TSF, comprising a shallow trench backfilled with clean competent waste grading to a sump with water recovered pumped back into TSF2. The seepage recovery system can be broadened to include other areas around the TSF, as required.

The Applicant proposes a network of six monitoring bores (increased from four) installed around TSF2 into the lower saprolite layer (to a depth of at least 30 m).

3.3.4 Risk rating

The main uncertainties are the volume of seepage expected through the foundation of the TSF and what contaminants (properties) are likely to be within the seepage.

The impact to vegetation surrounding the TSF is not certain. The potential for mounding increasing the water levels from approximately 20 mbgl to within 4 mbgl could occur at some time, especially during early tailings deposition. The vegetation in the area is not groundwater dependant or conservation significant, and it is well-represented in the area. Therefore, onsite and offsite local impact to vegetation surrounding the TSF is likely to be low.

The impact to the Salt River is based on whether contaminants are likely to report to the groundwater under the TSF and then be transported towards the Salt River. The movement of water though the ferruginous hard cap and the upper saprolite area is likely to be restricted. This means that some seepage may reach the water table and move through the groundwater system toward the Salt River. The Salt River is hypersaline (approximately 20,000 mg/L TDS) and is used by the applicant to dispose of hypersaline mine dewater discharge (average 40,000 mg/L TDS). The Salt River also has elevated concentrations of total nitrogen and some metals, and is of lower ecological value downstream of the mine dewater discharge location (as described in Licence L7798/1993/6). Therefore, offsite impacts on a local scale are of a low level considering the reduced ecological value of the Salt River.

There is unlikely to be a direct link from the TSF to the salt lakes approximately 15 km downstream of the Salt River, given the direction of groundwater flow. There may be impacts from the groundwater reaching the Salt River and being transported downriver. Therefore, the offsite impacts on a wider scale would be minimal.

Overall, the likelihood that seepage will have an impact on receptors at some time is **Possible**, as there is uncertainty regarding the amount and properties of the seepage. The consequence would be **Moderate**, in that if an impact occurred, this could result in mid-level onsite impacts from localised groundwater mounding, low-level localised offsite impacts to the Salt River and minimal impacts to the wider area. Therefore, the Delegated Officer considers that the risk to receptors is a **Medium** risk. Based on this rating, the risk event is subjected to regulatory controls.

3.3.5 Regulatory controls

The Delegated Officer notes the groundwater in the area is hypersaline and not suitable for human, livestock or horticultural purposes due to the high salinity levels.

The Delegated Officer notes that groundwater mounding from seepage could impact vegetation around TSF2. The Applicant has stated that seepage from the TSF will be low; however, as the geotechnical behaviour of the combined tailings is not known, this cannot be confirmed based on the likely seepage from the base of the TSF. Groundwater modelling has not been undertaken to support seepage assessment. The Water Balance submitted by the applicant is in Appendix 3.

The south west area of TSF2 is the closest to an existing drainage line and seepage may be more likely in this area of the TSF. The Applicant has proposed a seepage recovery system in this area to capture any seepage; however, as TSF2 is located within an area which is flat, lateral seepage could be experienced anywhere around the TSF. The Applicant has increased the number of bores from four to six to better monitor the potential groundwater quality and quantity around the TSF. The Delegated Officer considers that the two additional bores are sufficient to monitor changes in groundwater quality and quantity around the TSF, considering the main sensitive receptor is the vegetation surrounding the TSF. The Applicant has stated that the seepage recovery system can also be expanded, as required.

The Delegated Officer notes that seepage collected from the seepage recovery system is to be pumped back into the TSF. The Delegated Officer notes that this is consistent with the management of the existing TSF1 at the mine. Considering the amount of seepage from the base of the TSF has not been quantified, the preference would be for any collected seepage to be pumped to the process water pond to limit the amount of water in the TSF which could seep to the environment. At this stage, pumping seepage collected in the seepage recovery system to the process water pond is not required but will be considered during amendment to licence L7798/1993/6 to include the operation of the TSF2 and during subsequent Annual Environmental Reporting, pending the seepage recovery volumes collected and the management of the decant pond.

The Delegated Officer notes that the existing TSF1 at the mine has seepage issues and in licence L7798/1993/6, a standing water level limit in the groundwater bores of 4 mbgl has been applied for the predominantly mulga vegetation in the area. This limit has also been applied to TSF2 as the vegetation around TSF2 is mulga vegetation. Further monitoring requirements have been conditioned in the works approval if the limit is breached.

A bore upstream of the groundwater flow direction (north west of the TSF) has not been proposed to provide background groundwater quality or quantity. An upstream bore is not considered necessary at this stage as, with the addition of two additional bores (totalling six) around the TSF, these will give an understanding of the quality and quantity of groundwater. The bores will be required to be operational and sampled prior to discharge of tailings into the TSF to provide baseline data.

A critical containment infrastructure report (CCIR) is required prior to commissioning which must provide certification that TSF2 and the process water pond have been built to specifications, including as-constructed permeability of the embankment, foundation, liner around each decant structure and the process water pond.

A TSF water balance is to be regularly updated and reported through time limited operations to support the tailings and seepage assumptions in the risk assessment.

Tailings are expected to consolidate over time and seepage is likely to reduce; however, until the tailings geotechnical properties are known, this timeframe cannot be established.

Geotechnical characterisation of tailings is required during time limited operations to determine the behaviour of the tails. This includes determining the particle size distribution, volume of solids, settling test (drained and undrained), air drying test and hydraulic conductivity of the tails.

As the tailings and decant water quality of the combined Deflector and Rothsay ores are not known, further testing is required during time-limited operations to confirm the geochemical parameters of the tailings, to support the assumptions in the risk assessment. The Delegated Officer considers that, as part of the time-limited-operations, testing under steady state conditions should be undertaken, taking into account the likely pH and the high salinity of the tailings. Based on the crustal abundance comparison provided by the applicant on the separate Deflector and Rothsay ores, the tailings could leach silver, arsenic, bismuth, chromium, cobalt, copper, molybdenum and selenium; these parameters have been included in the testing. From the most recent Annual Environmental Report for the mine, exceedances of aluminium, cadmium, lead, mercury, nickel and zinc were reported in groundwater around TSF1. These parameters have also been added to the testing.

In addition, for decant water, analysis is required of electrical conductivity, total cyanide, weak acid dissociable cyanide and Total Dissolved Solids.

4. Consultation

Table 5 provides a summary of the consultation undertaken by the department.

Table 5: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website (20/07/2020)	None received	N/A
Local Government Authority advised of proposal (20/07/2020)	None received.	N/A
DMIRS advised of proposal (20/07/2020)	DMIRS has advised that the assessment of the associated Mining Proposal has not yet been finalised.	N/A
DBCA advised of proposal (20/07/2020)	DBCA replied on 28/07/2020 advising that the nearby Barnong Station Homestead is unoccupied and that DBCA has no current plans to repair the homestead for the purpose of future occupation.	N/A
Applicant was provided with draft documents on 22/10/2020 and 23/11/2020	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. Adams, M.D., Donato, D.B., Schulz, R.S. and Smith, G.B., 2008, *Influences of Hypersaline Tailings on Wildlife Cyanide Toxicosis*; MERIWA Project M398 (II) 'Cyanide Ecotoxicity at Hypersaline Gold Operations' Final Report Volume 2 – Definitive Investigation.
2. Botanica Consulting 2019, *Desktop Flora/ Vegetation and Fauna Assessment: Deflector Gold Project (M59/442)*, unpublished report for Silver Lake Resources, Boulder, Western Australia.
3. Department of Environment Regulation (DER) 2016, *Guidance Statement: Environmental Siting*, Perth, Western Australia.
4. Department of Environment Regulation (DER) 2017, *Guidance Statement: Risk Assessments*, Perth, Western Australia.
5. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
6. Department of Water and Environmental Regulation (DWER) 2018, *Industry Regulation fact sheet: Industry Regulation fees*, Joondalup, Western Australia.
7. Department of Water and Environmental Regulation (DWER) 2019, *Guideline: Industry Regulation Guide to Licensing*, Joondalup, Western Australia.
8. Groundwater Resource Management (GRM) 2018, *Deflector Gold Project: Gullewa Groundwater Study*, West Perth, Western Australia.
9. Pennington Scott Pty Ltd (Pennington Scott) 2020, *Deflector TSF2 Design Study – Hydrogeology and Hydrology Rev 4*, Technical Memorandum.
10. Stantec Australia Pty Ltd (Stantec) 2019, *Deflector Gold and Copper Mine: Baseline Aquatic Ecology and Discharge Impact Assessment of Salt River and Burra Lake*, DWER ref: DWERDT179042

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

Condition	Summary of applicant's comment	Department's response
Cover Page, Prescribed premise category description	Silver Lakes Resources (SLR) question why *Category 7: Vat or in situ leaching of metal*. has been applied. No vat or In-situ leaching is proposed. The CIP process is a standard part of processing and beneficiation of metallic or non metallic ore. This CIP process is conducted at other SLR processing facilities (Salt Creek and prior, Lakewood, Tuckabianna and Andy Well) without the addition of this category. SLR are concerned there will be double up in accounting for both Category 5 and 7 including tonnes per annum, tailings waste and fee accounting as the proposed CIP and existing Flotation circuits are not mutually exclusive.	The process is captured under Category 5. Category 7 has been removed from the works approval.
Table 1, Item 4: Irrigation field	SLR request 16 is a minimum to ensure ponding does not occur.	The requirement has been modified to 'at least 16 sprinklers' to ensure flexibility of discharge to avoid ponding.
Table 2	Please clarify 'at least 1.0 mbgl or to refusal' as it is not clear, the trench may be shallower than 1 m if refusal to ferricrete occurs.	The text has been modified to read "A perimeter cut-off trench 1.2 mbgl *or* to refusal on the competent Ferricrete layer."
Table 3: Cell B, Raise 1 Crest Height (mRL)	The figure should read 292.0 as per the drawings.	Noted and updated to 292.00.
Table 4	The Design, construction, and installation requirements for well construction appear quite onerous and prescriptive in the absence of sensitive receivers (saline groundwater/no conservation significant flora/fauna or other groundwater users). This is particularly questionable in comparison to W6195 where there are more sensitive receivers and no construction/development requirements other than coordinates. SLR is concerned there are additional cost and time burdens potentially incurred, non-commensurate to comply with ASTM D5092/D5092M-16 in a low sensitivity environment.	This condition standardises monitoring bore construction around TSFs. Considering the uncertainty regarding the seepage rates from the TSF, this condition identifies the departments minimum requirements for installation of bores to ensure they can adequately monitor groundwater levels while the TSF is operational.
	Please clarify the timeframe for constructing and developing the bores as 'no later than' is confusing. As discussed, please word 'prior to 30 days before commissioning.'	Wording changed to… '*at least* 30 days prior to the commencement of environmental commissioning…'

Condition	Summary of applicant's comment	Department's response
Condition 12	This is a concerning requirement for SLR as SLR will require commissioning to commence as soon as the CIP plant is constructed whilst technical specialists are mobilised to site. Construction of the CIP and TSF will be completed in parallel and are scheduled for completion as follows: • TSF2: End of April • CIP plant: Early to mid-May SLR considers a delay of potentially 45 business days or 9 weeks will cause significant costs and time delays in commissioning the plant. SLR considers if the Critical Containment Infrastructure Report is signed as compliant with the requirements of Table 2, commissioning can commence once the report is submitted (as has been applied to previous Works Approvals). SLR considers this should also apply if 'any departures from the requirements specified in Table 2 that do not require relocation or rectification and do not constitute a material defect' occurs and has been signed off by the Design Consultant's qualified engineer. If notification from the CEO must be required to commence commissioning in this alternate situation, SLR requests the timeframe be reduced to 10 business days (2 weeks).	As per the Industry Guide to Licencing (DWER 2019), the Department considers it appropriate, on the basis of risk, to ensure that critical containment infrastructure meets its requirements prior to environmental commissioning, or any form of operation commencing. With this type of infrastructure, the Department recognises both the potential environmental impact and the practical inability to easily rectify issues once the containment infrastructure is in use. The TSF is considered a **Medium** risk, so the Department will still require some time to review that the construction has been undertaken as described (or if any departures have occurred whether the risk to receptors is affected). Considering the above, the timeframe can be reduced to 10 business days to allow for internal reviews of the report.
Table 9, Item 2: WWTP	Please can the final bullet point be removed or revised. SLR wish to retain the existing decommissioned WWTP on site as a backup in case of failure of the new system	Noted and has been revised to "Existing WWTP to be decommissioned and kept onsite as backup in case of failure of the new WWTP"
Table 11	Please confirm if total or dissolved metal analysis is required	Dissolved metal analysis is required.
Condition 39	SLR requests in lieu of 'stopping' deposition of tailings, tailings deposition be 'modified' or 'other mitigation strategies be implemented' to allow groundwater levels to reduce. There is no conservation significant flora or vegetation within the vicinity of the TSF and stopping tailings deposition will cause the entire Deflector Operations to cease. SLR will provide DWER a report of the action taken in this situation.	Modification (such as slowing) or other mitigation strategies are acceptable to allow groundwater levels to reduce.

Appendix 2: Application validation summary

SECTION 1: APPLICATION SUMMARY (as updated from validation checklist)					
Application type					
Works approval	☒	*Related to L7798/1993/6*			
Licence	☐	Relevant works approval number:		None	☐
		Has the works approval been complied with?		Yes ☐ No ☐	
		Has time limited operations under the works approval demonstrated acceptable operations?		Yes ☐ No ☐ N/A ☐	
		Environmental Compliance Report / Critical Containment Infrastructure Report submitted?		Yes ☐ No ☐	
		Date Report received:			
Renewal	☐	Current licence number:			
Amendment to works approval	☐	Current works approval number:			
Amendment to licence	☐	Current licence number:			
		Relevant works approval number:		N/A	☐
Registration	☐	Current works approval number:		None	☐
Date application received		9 June 2020			
Applicant and Premises details					
Applicant name/s (full legal name/s)		Silver Lake (Deflector) Pty Ltd			
Premises name		Gullewa Gold-Copper Operations			
Premises location		M59/49, L59/49, L59/64, M59/68, M59/132, M59/294, M59/356, M59/391, M59/392, M59/335, M59/442, L59/35, M59/507, M59/336, M59/522, L59/71, L59/158, L59/159 and L59/160 Morawa - Yalgoo Road YALGOO WA 6635			
Local Government Authority		Shire of Yalgoo			

Application documents	
HPCM file reference number:	DER2020/000240
Key application documents (additional to application form):	Supporting document, including: • APPENDIX B TSF2 Design Report • APPENDIX C Tailing Geochemical Reports • APPENDIX D CIP Upgrade Design Report (including water balance) • APPENDIX E WWTP Design Report • APPENDIX F Commissioning Plans CIP Upgrade and WWTP • APPENDIX G Stakeholder Consultation • APPENDIX H Flora and Fauna Reports • APPENDIX I Hydrogeological/Hydrological Reports
Scope of application/assessment	
Summary of proposed activities or changes to existing operations.	Construction of a new TSF and WWTP at an existing mine. TSF (Category 5): • On 18/06, applicant advised that TSF starter embankment likely to go ahead in two stages rather than as one stage as reported in the documentation • a new TSF (TSF2) located approximately 500m south west of Deflector Processing Facility (DPF) • TSF2 will be an above ground paddock style facility with the following dimensions: Footprint: 54 ha; Max height (magl): 10.25 m, Max height RL: 296.75 m; Design: 2 Cell stand-alone facility with a central decant in each cell. Capacity: 3.66 Mm^3/ 5.31 Mt. DMIRS Medium Risk Facility • Tailings are currently deposited into the Gullewa TSF *(TSF1)* which will become decommissioned once TSF2 is operational. • TSF2 area is currently undisturbed (however, have clearing permit) • PAF materials likely to be present Plant upgrade (Category 5): • upgrades to the plant to include a Carbon in Pulp (CIP) Leach Upgrade to treat ore received from Rothsay Mine and improve recoveries from the Deflector ore • new RO plant and process water dam/pond (HDPE lined) • no change to the throughput amount WWTP (Category 85): • an upgrade and increase in throughput from 50 to of 60m^3/day to the accommodation WWTP (for 220 person day camp) • irrigation area not changing (200m x 200m (4ha) area) Need commissioning for CIL and WWTP (15 July 2021) Need TLO for all three to allow for an amendment to L7798 (31 August 2021)

Category number/s (activities that cause the premises to become prescribed premises)

Table 1: Prescribed premises categories

Prescribed premises category and description	Proposed production or design capacity
Category 5	760,000 tonnes per annual period (**no change** from that in L7798/1993/6)
Category 85	Increase at existing WWTP 60 cubic meters a day (future amendment to L7798/1993/6 required)

Legislative context and other approvals

Has the applicant referred, or do they intend to refer, their proposal to the EPA under Part IV of the EP Act as a significant proposal?	Yes ☐ No ☒	Referral decision No: Managed under Part V ☐ Assessed under Part IV ☐
Does the applicant hold any existing Part IV Ministerial Statements relevant to the application?	Yes ☐ No ☒	Ministerial statement No: EPA Report No:
Has the proposal been referred and/or assessed under the EPBC Act?	Yes ☐ No ☒	Reference No:
Has the applicant demonstrated occupancy (proof of occupier status)?	Yes ☒ No ☐	Certificate of title ☐ General lease ☐ Expiry: Mining lease / tenement ☐ Expiry: Other evidence ☐ Expiry:
Has the applicant obtained all relevant planning approvals?	Yes ☐ No ☒ N/A ☐	Approval: **WWTP approval** Expiry date: **Approval for the WWTP will be applied for through the Shire of Yalgoo/Department of Health**
Has the applicant applied for, or have an existing EP Act clearing permit in relation to this proposal?	Yes ☒ No ☐	CPS No: **CPS 5128/4** **Clearing of approximately 70 ha of native vegetation will be conducted under approved CPS 5128/4.**
Has the applicant applied for, or have an existing CAWS Act clearing licence in relation to this proposal?	Yes ☐ No ☒	Application reference No: N/A Licence/permit No: N/A

Has the applicant applied for, or have an existing RIWI Act licence or permit in relation to this proposal?	Yes ☒ No ☐	Application reference No: N/A Licence/permit No: **GWL18757(6)**
Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the EP Act)?	Yes ☒ No ☐	Name: Gascoyne GA, Type: Proclaimed Groundwater Area Has Regulatory Services (Water) been consulted? Yes ☐ No ☒ N/A ☐ **Regional office: Mid-West Gascoyne**
Is the Premises situated in a Public Drinking Water Source Area (PDWSA)?	Yes ☐ No ☒	Name: N/A Priority: P1 / P2 / P3 / N/A Are the proposed activities/ landuse compatible with the PDWSA (refer to WQPN 25)? Yes ☐ No ☐ N/A ☐
Is the Premises subject to any other Acts or subsidiary regulations (e.g. *Dangerous Goods Safety Act 2004, Environmental Protection (Controlled Waste) Regulations 2004, State Agreement Act xxxx*)	Yes ☒ No ☐	A Mining Proposal submitted to DMIRS to account for disturbance and approval under the Mining Act 1978.
Is the Premises within an Environmental Protection Policy (EPP) Area?	Yes ☐ No ☒	
Is the Premises subject to any EPP requirements?	Yes ☐ No ☒	
Is the Premises a known or suspected contaminated site under the *Contaminated Sites Act 2003*?	Yes ☒ No ☐	Classification: possibly contaminated – investigation required (PC–IR) Date of classification: Sep 25, 2018 CSS_SITE_ID: 11089 DESCRIPTION: Deflector Gold Copper Mine, Mining Tenement E59/1241, Shire of Yalgoo.

Appendix 3: GAI table and Water Balance

Rothsay tailings

Table 2: Multi-Element-Analysis Results for Tailings Samples

		Si	Al	Fe	Na	K	Mg	Ca	As	Sb	Se	Mo	B	F	Cu	Zn	Cd	Pb	Ag	Ba	Bi	Co	Cr	Hg	Mn	Ni	P	Sn	Sr	Th	Tl	U	V
		%							mg/kg						mg/kg				mg/kg															
AUA03001	Fine-Tailings	22.1	1.35	4.66	3.71	0.13	8.91	3.3	71.2	1.10	2.16	1.9	<50	103	1,258	85	0.67	8.6	2.69	17.6	16.09	44.7	1,699	0.08	793	218	66	0.4	58.49	0.54	0.10	0.21	82
AUA03003	Fine-Tailings	23.3	1.42	4.85	3.83	0.16	9.18	3.3	66.1	1.12	2.07	1.7	<50	124	1,264	84	0.68	9.2	2.60	16.3	15.61	42.6	1,812	0.03	799	218	59	0.2	51.52	0.46	0.12	0.22	79
AUA03002	Coarse-Tailings	26.5	1.73	5.41	1.42	0.19	10.66	3.6	137.7	1.84	1.90	1.0	<50	169	1,803	114	0.87	39.4	0.38	11.9	23.74	63.8	1,834	0.03	986	371	72	0.5	15.38	0.29	0.29	0.18	87
AUA03004	Coarse-Tailings	23.2	1.78	4.96	2.80	0.23	10.99	3.3	114.5	1.73	2.42	0.9	<50	146	2,285	108	1.13	20.5	0.76	10.5	25.24	65.1	1,757	0.03	872	363	68	0.3	14.71	0.29	0.17	0.19	77
	Average-Crustal Abundance (Bowen 1979)								1.5	0.2	0.05	1.5	10	950	50	75	0.11	14	0.07	500	0.048	20	100	0.05	950	80	1,000	2.2	370	12	0.60	2.4	160

signifies element content 10-100 times average-crustal abundance

signifies element content 100+ times average-crustal abundance

Reference: Bowen HJM, 1979, "Environmental Chemistry of the Elements", Academic Press, New York

Parameter	GAI – fine tailings (test AUA03001)	GAI – coarse tailings (test AUA03004)
Arsenic	5	6
selenium	5	6
Copper	5	5
Cadmium	N/A	3
Silver	5	3
Bismuth	8	9
Chromium	4	4

Deflector tailings

Table 2: Multi-Element-Analysis Results for Tailings-Solids Sample

GCA-SAMPLE NO.	S	Ca	Mg	Na	K	Al	Fe	Si	As	Sb	Se	Mo	B	F	Ni	Cr	Co	Cu	Zn	Cd	Pb	Hg	Ag	Tl	Ba	Sr	Bi	P	Mn	Sn	V	Th	U
	%								mg/kg						mg/kg			mg/kg					mg/kg											
GCA11818	2.79	4.8	5.26	1.60	1.24	5.17	8.93	25.1	15.3	0.87	1.88	4.8	<50	529	298	996	382	959	85	0.26	6.3	<0.01	1.52	0.58	343	141	3.61	448	961	1.6	162	3.65	1.34
Average-Crustal Abundance (Bowen 1979)									1.5	0.2	0.05	1.5	10	950	80	100	20	50	75	0.11	14	0.05	0.07	0.6	500	370	0.05	1,000	950	2.2	160	12	2.4

Highlighted Assays:

signifies element content 10-100 times average-crustal abundance

signifies element content 100+ times average-crustal abundance

Reference: Bowen HJM, 1979, "Environmental Chemistry of the Elements", Academic Press, New York

Parameter	GAI
Arsenic	3
selenium	5
Cobalt	4
Copper	4
Mercury	4
Bismuth	6

PROJECT	**TAILINGS STORAGE FACILITY 2**
CLIENT	**DEFLECTOR MINING LIMITED**
LOCATION	**DEFLECTOR GOLD PROJECT**
SUBJECT	**: WATER BALANCE TOTAL TAILINGS STREAM CALENDAR YEAR**

Date	8-Jan-20
Job No	PER2019-0243
File	0
Subject	Water Balance
Revision	0

		Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
INFLOWS		Days per month	31	28.25	31	30	31	30	31	31	30	31	30	31	
RAINFALL															
Rainfall (mm)			15.80	25.00	25.00	20.70	31.60	41.30	34.50	25.50	11.70	8.10	8.00	11.80	259
Average Daily Rainfall (mm)			0.51	0.88	0.81	0.69	1.02	1.38	1.11	0.82	0.39	0.26	0.27	0.38	
Tailings Dam Storage Area (m2)			250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	
Runoff Coefficient Tailings			0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	
Catchment Area above Storage (m2)			0	0	0	0	0	0	0	0	0	0	0	0	
Runoff Coefficient Catchment			0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	
Pool Area (m2)	<150m radius		55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	55,000	
Running Beaches (m2)	150m x200m		30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	
Rainfall Inflow Total Volume (m3/day)			81.2	140.9	128.4	109.9	162.3	219.2	177.2	131.0	62.1	41.6	42.5	60.6	
SLURRY WATER															
Tonnes per year	760,000														
Total tonnes per month			63,333	63,333	63,333	63,333	63,333	63,333	63,333	63,333	63,333	63,333	63,333	63,333	760,000
% Solids =	40		40	40	40	40	40	40	40	40	40	40	40	40	
Tailings Output Solids (tpd)			2,043.0	2,241.9	2,043.0	2,111.1	2,043.0	2,111.1	2,043.0	2,043.0	2,111.1	2,043.0	2,111.1	2,043.0	
Volume of Water (m3/day)			3,064.5	3,362.8	3,064.5	3,166.7	3,064.5	3,166.7	3,064.5	3,064.5	3,166.7	3,064.5	3,166.7	3,064.5	1,140,000.0
OTHER WATER INFLOWS															
Pit Dewatering (m3/day)			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Other Water Inflow Total (m3/day)			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TOTAL INFLOW (m3/day)			**3,146**	**3,504**	**3,193**	**3,277**	**3,227**	**3,386**	**3,242**	**3,196**	**3,229**	**3,106**	**3,209**	**3,125**	

OUTFLOW-LOSSES FROM TAILINGS DAM			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
EVAPORATION (from pond and beaches)															
Evaporation Rate (mm)	Technical Report 65		450	390	330	230	155	90	90	125	155	260	315	400	**2,990**
Pan Factor			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Monthly Dam Evaporation Rate (mm)			337.5	292.5	247.5	172.5	116.3	67.5	67.5	93.8	116.3	195.0	236.3	300.0	
Average Daily Evaporation Rate (mm)			10.89	10.35	7.98	5.75	3.75	2.25	2.18	3.02	3.88	6.29	7.88	9.68	
Pool Area & Running Beaches (m2)			85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	85,000	
Daily Evaporation Loss/Outflow (m3/day)			925.4	880.1	678.6	488.8	318.8	191.3	185.1	257.1	329.4	534.7	669.4	822.6	
EVAPO-TRANSPIRATION (from drying tailings)															
Evaporation Rate (mm)			450	390	330	230	155	90	90	125	155	260	315	400	
Evapo-transpiration Rate (Pan/3)			150.0	130.0	110.0	76.7	51.7	30.0	30.0	41.7	51.7	86.7	105.0	133.3	
Average Daily Evapo-transpiration Rate (mm)			4.84	4.60	3.55	2.56	1.67	1.00	0.97	1.34	1.72	2.80	3.50	4.30	
Area Transpiring (m2)			8,250.0	8,250.0	8,250.0	8,250.0	8,250.0	8,250.0	8,250.0	8,250.0	8,250.0	8,250.0	8,250.0	8,250.0	
Daily transpiration Loss (m3/day)			39.9	36.0	29.3	21.1	13.8	8.3	8.0	11.1	14.2	23.1	28.9	35.5	
SEEPAGE															
Downstream Embankment (m3/day)			30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	
Upstream Embankment (m3/day)			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Seepage Rate m/sec	1.00E-07	Lower K than TSF1 site													
Dam Floor (m3/day).			475.2	475.2	475.2	475.2	475.2	475.2	475.2	475.2	475.2	475.2	475.2	475.2	
Total Seepage Outflow (m3/day)			506.0	506.0	506.0	506.0	506.0	506.0	506.0	506.0	506.0	506.0	506.0	506.0	
RETENTION															
Tailings Output (tpd)			2,043.0	2,241.9	2,043.0	2,111.1	2,043.0	2,111.1	2,043.0	2,043.0	2,111.1	2,043.0	2,111.1	2,043.0	
Assumed Moisture Content of Tailings (average)		40.0%													
Volume Retained in Tailings (m3/day)			817.2	896.8	817.2	844.4	817.2	844.4	817.2	817.2	844.4	817.2	844.4	817.2	
TOTAL OUTFLOW-LOSSES FROM TAILINGS DAM			**2,288.5**	**2,320.8**	**2,031.1**	**1,860.3**	**1,655.7**	**1,549.9**	**1,516.3**	**1,591.3**	**1,694.0**	**1,880.9**	**2,048.7**	**2,181.3**	
BALANCE INFLOW-OUTFLOW/LOSSES (m3/day)			857.2	1,183.0	1,161.8	1,416.3	1,571.1	1,836.0	1,725.5	1,604.2	1,534.7	1,225.2	1,160.4	943.9	
BALANCE INFLOW-OUTFLOW/LOSSES (m3/month)			26,571.8	33,418.4	36,016.9	42,488.1	48,705.5	55,078.7	53,489.8	49,729.0	46,042.4	37,980.6	34,813.2	29,259.8	
RETURN WATER TO THE PLANT (if available)															
Total Water Return per month (balance of inflow -outflow for planning)			26,571.8	33,418.4	36,016.9	42,488.1	48,705.5	55,078.7	53,489.8	49,729.0	46,042.4	37,980.6	34,813.2	29,259.8	
Volume of Water (m3/day),estimated at			857.2	1,183.0	1,161.8	1,416.3	1,571.1	1,836.0	1,725.5	1,604.2	1,534.7	1,225.2	1,160.4	943.9	
Average water return			28%	35%	38%	45%	51%	58%	56%	52%	48%	40%	37%	31%	**43%**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Summary of Water Balance													
Water shortfall (make up water) or excess of requirements (m3/day)	**-2,207**	**-2,180**	**-1,903**	**-1,750**	**-1,493**	**-1,331**	**-1,339**	**-1,460**	**-1,632**	**-1,839**	**-2,006**	**-2,121**	
Total water in excess of requirements (m3/month)	**-68,428**	**-61,582**	**-58,983**	**-52,512**	**-46,295**	**-39,921**	**-41,510**	**-45,271**	**-48,958**	**-57,019**	**-60,187**	**-65,740**	**-646,406**
Total water in excess of requirements (m3/year) =	**-646,406**												