Decision Report

Application for Works Approval

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

Works Approval Number	W6675/2022/1
Applicant	Northern Star (HBJ) Pty Ltd
ACN	127026519
File number	DER2022/000088
Premises	Lot 15 on Plan 58833, Lot 50 on Plan 226299 and Lot 51 on Plan 226303, Lot 103 on Plan 40395 Lot 105 on Plan 40396, and mining tenements M26/118, M26/143, M26/204 and M15/456 Kalgoorlie WA 6430 As defined by the premises map attached to the issued works approval
Date of report	10 May 2023
Decision	Works approval granted

Alana Kidd

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ALANA KIDD
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 W6675/2022/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

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

2.2 Application summary and overview of premises

The South Kalgoorlie Operations (SKO) – Jubilee Gold Mine (Premises) is located approximately 18 km north-west of the town of Kambalda.

SKO comprises a large amalgamation of over 40 decommissioned gold mines with a total land area of approximately 1,149 km^2. Ore is processed from SKO's HBJ underground mine, and adjacent mines owned and operated by Northern Star Resources Ltd, at the Jubilee Processing Plant. The SKO tailings storage facilities (TSFs) include the above-ground Jubilee TSF3A and TSF3B, and 'in-pit' TSFs Bellevue, Golden Hope, Mt Goddard and Samphire. Samphire in-pit TSF is located approximately 8 km east south-east of the Jubilee Processing Plant.

SKO's future tailings management strategy, based on a 10-year Life of Mine (LoM) with a deposition rate of 1.2 Mtpa, includes developing the existing Samphire in-pit TSF into an above ground 'paddock style' facility providing an additional 8.3 years of storage space. The existing Samphire in-pit TSF operates under L5107/1988/13.

The proposed paddock style embankment design consists of 3 stages (Starter embankment, Stage 1 and Stage 2) and will abut two existing waste dumps. The design will involve both downstream and upstream construction techniques and at the final design crest level, the maximum height of the facility will be approximately 15.5 m. This will provide an additional 7,410,000 m^3 of storage volume or about 10Mt capacity, corresponding to approximately 8 years of production based on a tailings production rate of 1.2 Mtpa and an adopted tailings dry density of 1.35 t/m^3.

On 22 February 2022, Northern Star Resources Ltd (the Applicant) submitted an application for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act) for the construction and time limited operations of Samphire paddock style TSF (STSF) at the Premises as shown in Figure 1.

The application relates to category 5 activities under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) and the assessed capacity of 1.65 million tonnes per annum (Mtpa).

The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guideline: Risk Assessments* (DWER 2020) are outlined in works approval W6675/2022/1.

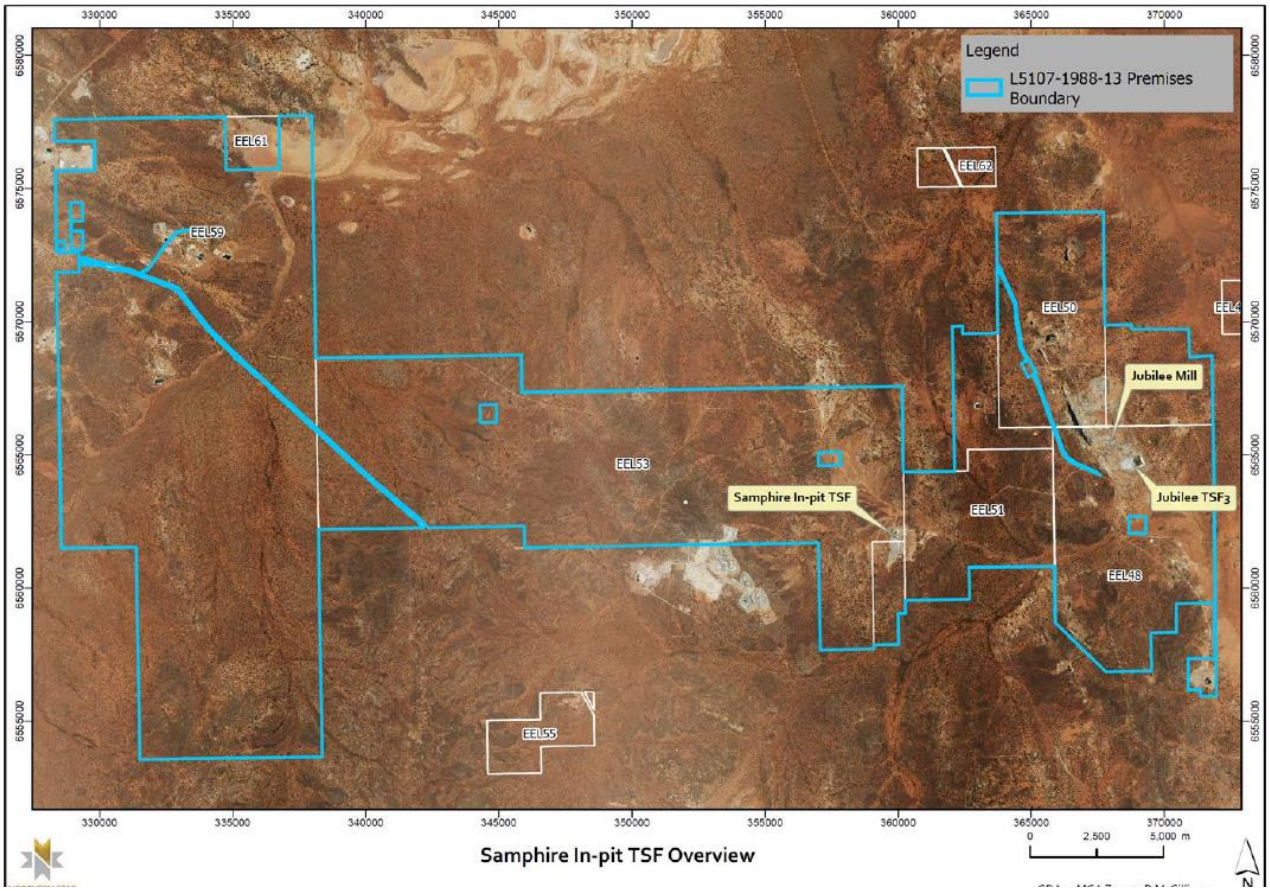

Figure 1: Location of Samphire in-pit TSF at the Premises (as shown by blue area)

Samphire Paddock Style TSF (STSF)

The STSF will be a paddock-type facility comprising an embankment constructed around the existing Samphire In-Pit TSF (Coffey, 2021a). Tailings in the form of slurry will be discharged in discreet layers (<300 mm thick) primarily from the southern embankment via multiple spigots located on the upstream crest of the perimeter embankment (Figure 2).

Spigotting/tailings deposition will be carried out such that a tailings beach will form, and the supernatant water pond (from both rainfall events and tailings deposition) will be maintained around the decant structure located at the north-eastern corner end of the STSF. Limiting the size of the supernatant water pond will reduce seepage and evaporation from the facility and hence assist in optimising water recovery and tailings density.

Water (comprising supernatant and surface stormwater) from the STSF will be removed via a decant pump in a decant tower located at the north-eastern end of the STSF and will be pumped back to the process plant.

The tailings storage area will assume the form of a sloped tailings beach profile from the southern side down to the northern end of the STSF. The facility will have sufficient capacity to store a considerable volume of water during a storm event of 1:100-year AEP, 72-hour duration whilst maintaining the required minimum total freeboard of 1.65 m.

Upon decommissioning, the TSF will remain a permanent feature of the landscape and the tailings will consolidate to an increasingly stable mass. The top surface and batters will be stabilised and rehabilitated.

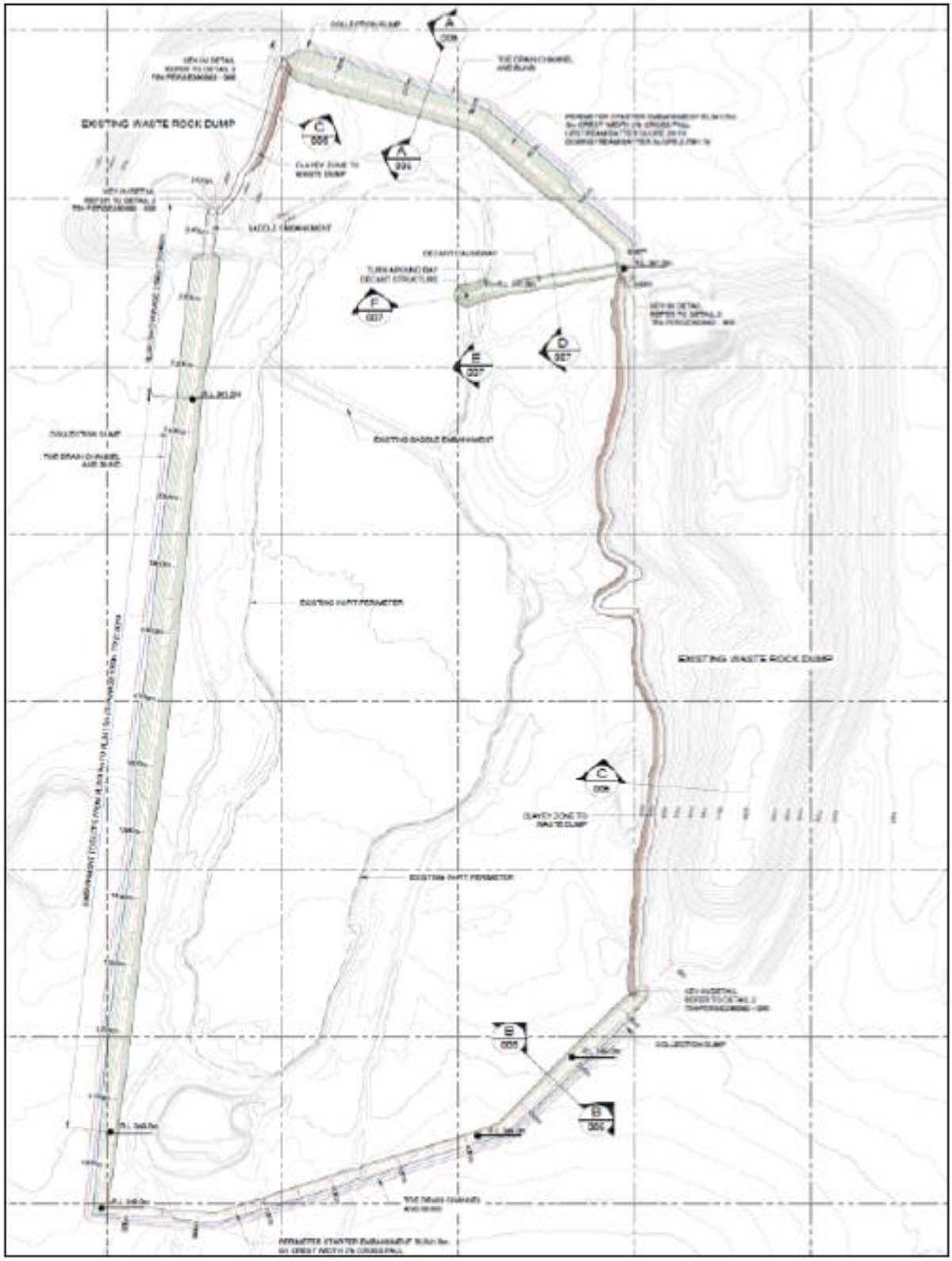

Figure 2: Samphire paddock style TSF – General arrangement

The STSF design is based on a single-cell arrangement. The perimeter embankment will convert the existing in-pit storage to a paddock-type facility with a planned final footprint area of approximately 103.2 ha. The starter embankment crest level at RL 349.0 m (southern end) and RL 341.5 m (northern end) with two additional embankment raises of 2 m height each (final Stage 2 crest level of RL 353.0 m (southern end) and RL 345.5 m (northern end)), provides a

total storage capacity of 7.41 Mm^3 (Figure 3).

The decant accessway will be constructed and raised in stages by the centreline construction technique using traffic compacted mine waste. The decant accessway has design slopes of 1:1.5 (V: H) on both sides and a minimum crest width of 8 m. The decant accessway crest will have 0.5 m high (min.) windrows on both sides. The decant accessway for the starter embankment will be constructed in a single stage using mine waste rock. For the rest of the upstream raising stages, the decant accessway will be raised concurrently with the embankment raise for each stage.

Tailings deposition will be completed in a manner that enables a free supernatant water pond to pool near the northern end of the facility. The decant water recovery system will comprise a submersible pump within pre-cast, slotted concrete rings, surrounded by rockfill of nominal 10 m radius. Access to the pump will be via a decant accessway, with return water pumped back to a process water pond nearer to the plant for reuse.

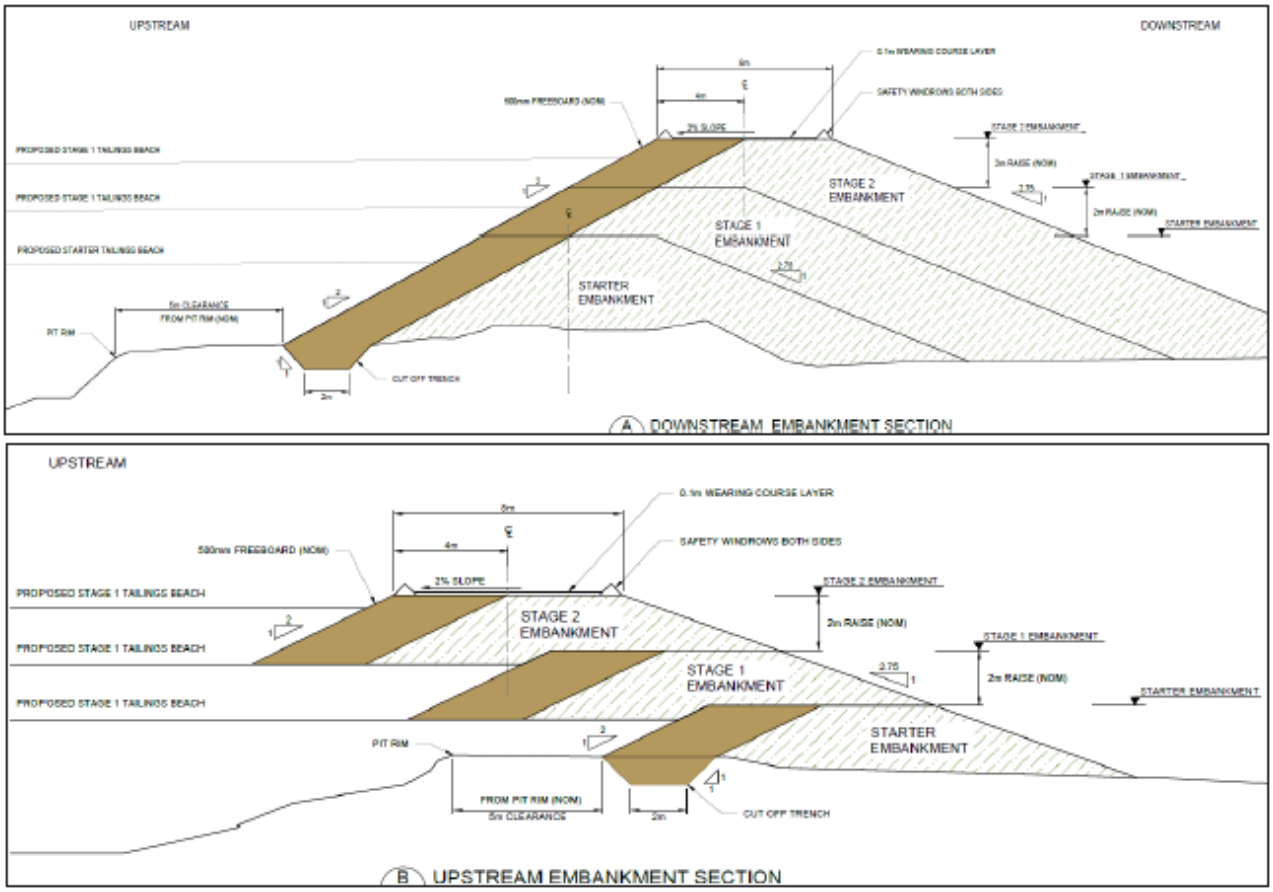

Figure 3: Samphire paddock style TSF – Embankment raise

Table 1: STSF construction and rate of rise

Stage	Embankment Crest RL (m)	Storage Vol. (Mm^3)	Cumulative Storage Vol. (Mm^3)	Cumulative Storage Cap. (Mt)	Cumulative Storage Life (Years)	Rate of Rise (m/year)
Samphire in-pit	-	0.73	0.73	0.99	0.82	-
Starter Stage	349 – 341.5	3.35	4.08	5.51	4.59	1.59
Stage 1	351 – 343.5	1.99	6.08	8.21	6.84	0.89
Stage 2	353 – 345.5	2.06	8.14	10.99	9.16	0.86

Works approval W6675/2022/1 will authorise the starter stage construction and deposition to crest level at RL 349.0 m (southern end) and RL 341.5 m (northern end) only, which is expected to accommodate the first 4.5 years of tailings production/deposition.

The subsequent raises to the Samphire paddock style TSF - Stage 1 and 2 and associated deposition are to be included as a subsequent amendment to the existing licence L5107/1988/13 for the Premises, with compliance documentation provided following completion of each raise.

Other infrastructure

Tailings delivery and return water pipelines

Tailings will continue to be delivered from existing tailings delivery pipeline routes (Figure 4 and 5). The newly designed STSF will continue using the existing decant water return system.

The slurry distribution pipework will be assembled on the embankment crest and extend around the cell's perimeter following each raised construction.

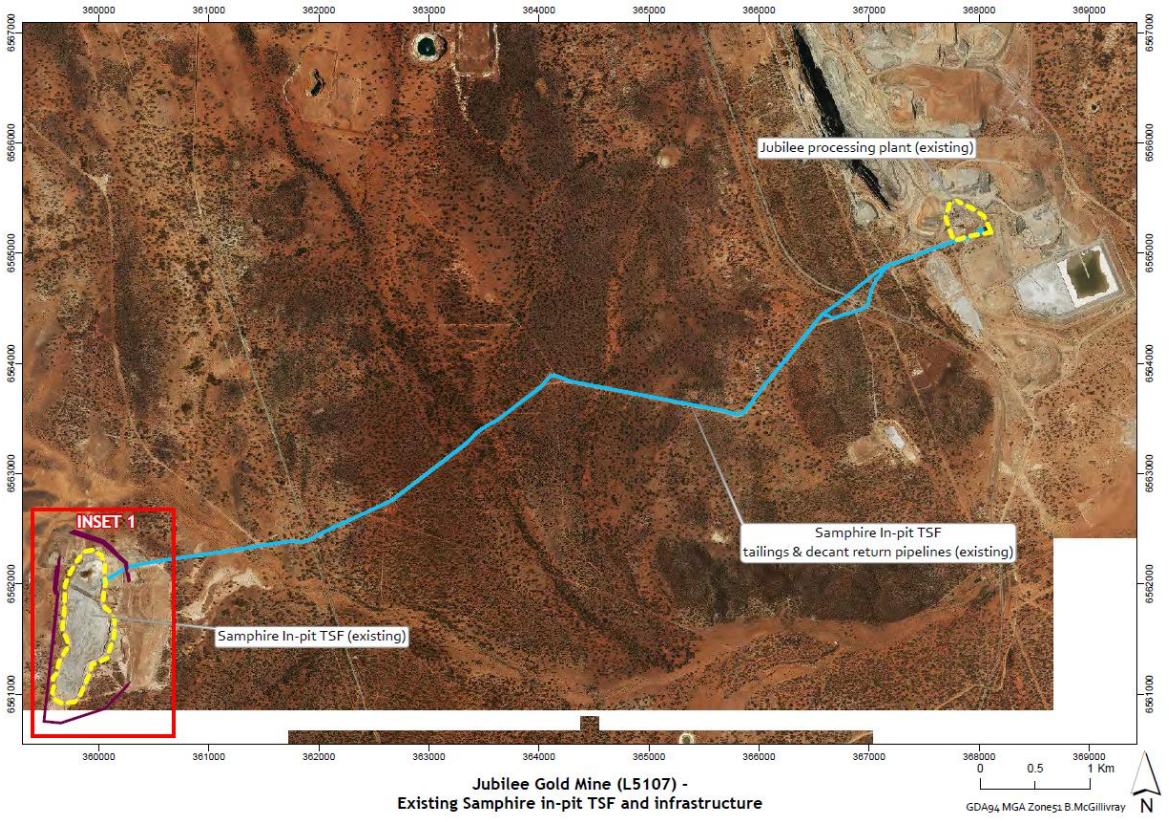

Figure 4: Samphire paddock style TSF – Existing tailings delivery pipeline route.

Figure 5: Samphire paddock style TSF – Inset 1 showing relevant infrastructure.

Seepage interception system

The seepage interception system is proposed to be installed as part of the initial construction works and will operate for the life of the facility. A cut-off trench with a 4 m wide base is proposed to be excavated beneath the perimeter embankment, backfilled with compacted clayey mine waste to limit horizontal seepage losses. The trench will be excavated to a nominal depth of 2 m (below ground surface) with cut side batters of 1:1 (V:H).

A toe drain is proposed to be installed at the foot of the embankment, the toe drain being 1 m deep with a collector drain and groundwater levels maintained at the elevation of the drain via pumping from sumps.

Seepage bores and/or additional trenching are proposed to be installed as a contingency strategy.

Existing Monitoring bores and proposed monitoring network

Vibrating wire piezometers (VWPs) will be installed around the perimeter of the facility to provide ongoing monitoring of the phreatic surface within the embankment. The VWPs will be located at the base of the embankment.

The monitoring system will be further enhanced by constructing additional monitoring bores located around STSF to allow measurement of groundwater levels and water quality sampling. It is noted that some monitoring bores will need to be decommissioned during the construction of STSF, but the remaining bores will continue to be monitored where possible during the construction and operational stage of STSF.

Figure 6: Samphire paddock style TSF – Monitoring network showing existing and proposed bores, including bores proposed to be decommissioned.

The Applicant has committed to developing a detailed seepage recovery and groundwater monitoring plan prior to continued deposition into the STSF.

2.3 Premises Hydrogeology

The Applicant engaged Tetra Tech Coffey (Coffey) to design the proposed paddock style Samphire TSF (SFSF) (Coffey, 2021a); review the hydrogeological conditions and undertake a groundwater impact assessment of the proposed STSF (Coffey, 2022).

Seepage analyses were carried out using the Rocscience Inc. computer software package 'Slide'. This module enables 2D finite element seepage analysis for saturated/unsaturated, steady-state flow conditions. The objectives of the analyses were to:

- Estimate outgoing seepage from the STSF via the immediate foundation and embankment.
- Predict the phreatic surface for stability modelling of the STSF perimeter embankment.

The results of the seepage analyses indicated the total seepage from the STSF will range between approximately 19.43 and 23.70 m^3/day under normal operating conditions.

It is noted from the analyses that the pond size has a great influence on the seepage outflows from the facility and also the position of the phreatic surface. The supernatant pond size, when present, should be minimised as far as possible during operation, which will reduce the risk of the phreatic surface daylighting at the downstream embankment face and minimise outgoing seepage through the STSF base and embankments.

An assessment of the predicted groundwater response to the proposed STSF was carried out using the proprietary finite element software GeoStudio Seep/W Version 8.16.1. Seep/W is capable of modelling of two dimensional groundwater flow in saturated and unsaturated conditions and supports a wide range of boundary conditions (Coffey, 2022).

The predicted groundwater response around the proposed STSF is characterised into two assessment zones for the purposes of modelling:

- Section 1: Modelling the groundwater level response adjacent to STSF embankments (downstream and/or upstream embankments) away from the waste rock dump to the east of the proposed STSF.
- Section 2: Modelling the groundwater level response around the waste rock dump to the east of the proposed STSF.

Based on the results of the Groundwater Study, Tetra Tech Coffey (Coffey, 2022) makes the following conclusions:

- Groundwater flow is predominantly to the south to southeast but may be locally affected by geological structures in certain areas, which enhance permeability;
- Groundwater is hypersaline in nature, limiting its use to industrial use;
- There are no registered bores within a 5km radius of the site;
- Modelling of seepage and groundwater levels across two representative sections of the site has revealed that mitigation measures are likely to be required to lower groundwater levels on the downgradient side of the TSF embankment. Whilst mitigation measures may not be necessary downgradient of the existing eastern waste rock dump, it is recommended that these are considered to ensure adherence to licence conditions by keeping groundwater levels at 4 mbgl or more; and
- Modelling of cyanide migration has revealed that the TSF facility does not appear to pose an unacceptable risk to identified receptors and impacts to groundwater quality are likely to be limited to a very localised area, maintaining the beneficial uses of groundwater throughout the surrounding area.

2.4 Premises Hydrology

Hydrology of the proposed Samhpire paddock style TSF area was assessed by Tetra Tech Coffey (Coffey, 2021b) and used to support the STSF design.

The proposed STSF embankment is located outside the 1% AEP floodplain extents for the 68-km^2 catchment area draining through the main channel north of the project site. The proposed embankment intercepts several small catchment areas that will require excavation and / or bund construction to avoid water ponding.

A perimeter bund and drain system is recommended by Tetra Tech Coffey (Coffey, 2021b) to prevent erosion and ponding from external runoff. Surface water runoff from contributing external catchment areas can generally be diverted around the perimeter with maximum excavation depths of approximately 1 m. The bund and drain concept assumes that a toe drain would be constructed around the perimeter to intercept runoff from direct rainfall on the STSF landforms with sediment removal and treatment as needed.

Flow toward the embankment perimeter under existing conditions generally occurs as mild-gradient, shallow, low-velocity flow without concentrated flow channels. As the external flows approach the northwest corner of the existing WRD, some potentially erosive velocities are indicated.

Based on an assessment of the shear stresses and velocities associated with flood flows, the rock facing on the embankment slope may sufficiently resist erosion of the toe up; however, periodic monitoring and maintenance are recommended to identify and mitigate areas where erosion may reach the toe of the STSF embankment batter over time.

The proposed perimeter toe drain has a base width of 5 m with a nominal depth of approximately 1 m. The recommended drain size is sufficient to provide 500 mm of freeboard in the 10% AEP event and to prevent the need for riprap lining in events up to the 1% AEP event.

Ongoing, periodic monitoring and maintenance activities are recommended across the site to identify and mitigate for any potential localised erosion. Because the flow path around the perimeter may be increased relative to existing conditions, there is a potential for sedimentation that may need to be periodically removed, particularly prior to the establishment of vegetation and initial armouring of the surface layer.

2.5 Tailings chemical and physical properties

The chemical and physical properties of the SKO tailings based on field and laboratory testing provided by Tetra Tech Coffey design report (Coffey, 2021a) are summarized in Table 2 and 3 below.

Table 2: SKO tailings chemical properties

Parameter	Average Value or Range	Source
Total Dissolved Solids (Return Water)	62,000 to130,000 mg/L	2020 TSF audit datasheet
Total Cyanide (Tailings Slurry)	15 to 119 mg/L	2020 TSF audit datasheet
WAD Cyanide (Tailings Slurry)	0 to 100 mg/L	2020 TSF audit datasheet
Total Cyanide (Return Water)	0 to 76 mg/L	2020 TSF audit datasheet
WAD Cyanide (Return Water)	0 to 21 mg/L	2020 TSF audit datasheet
pH (Tailings Slurry)	8.3 to 9.7	Jubilee TSF3 Tailings Slurry pH data

Table 3: SKO tailings physical properties

Parameter	Average Value or Range	Comments
Percent solids of discharge	40%	Nominal average value
Tailings particle density	2.7 t/m^3	Nominal average value
Tailings settled dry density	1.8 t/m^3	Inferred from 2020 CPTu data
Percent fines (<75 µm)	34 to 75%	Measured from 2020 GI
Beach slope (V:H)	1:200	Measured average 2018 survey
Friction angle (sand-like tailings)	32 to 35°	Inferred from 2020 CPTu data
Undrained shear strength (clay-like tailings)	>30 kPa	Inferred from 2020 CPTu data

Geochemical assessment of tailings characteristics were undertaken in 1996, 2005 and 2008. The latest report (GCA, 2008) indicated that the process tailings stream to be discharged to the Samphire Pit should pose no geochemical concerns during both the active-lifetime of the TSF, and post-closure. Applicant has confirmed there will be no change to ore body being mined from the HBJ Underground Mine. The chemicals used in the Jubilee Processing Plant have also not changed nor are they expected to change for the current life-of-mine.

2.6 Groundwater levels and quality – review summary

Tailings deposition into the current Samphire in-pit TSF is regulated under the licence L5108/1988/13. The current licence sets out quarterly groundwater quality monitoring (for pH, Total Dissolved Solids, Weak Acid Dissociable Cyanide and Conductivity) and monthly monitoring of the standing water level in Samphire in-pit TSF proximity (Figure 5). The limit as per the licence for the standing water level in all groundwater bores is 4 meters below ground level (mbgl).

Groundwater levels for the Samphire Pit TSF area have been reviewed by Tetra Tech Coffey (Coffey, 2022). The monitoring data indicates the current depth to groundwater around Samphire TSF ranges between 4 m and 17 m. Groundwater levels appear to have risen significantly since the start of monitoring however, all levels appear to have remained below the licence limit of 4 mbgl. Groundwater levels also appear to be stabilising over recent years with some areas even showing a decline in groundwater levels over the last couple of years. The gradual rise in groundwater levels is expected to have been caused by both the recovery of groundwater levels post mining operations following cessation of dewatering and conversion of the Samphire Pit into a TSF, together with recharge from the rising phreatic surface within the tailings beach and from the rising decant pond. The stabilising of water levels and decline in some places is likely to be representative of groundwater levels re-equilibrating to pre-mining water levels.

The salinity of groundwater has been noted to have remained relatively unchanged, within the pre-tailings deposition range of 50,000 to 100,000 mg/L. Total cyanide has historically been reported in bores SMB2, SMB6, SMB7 and SMB11 (Figure 6), reflecting seepage from the pit, (Coffey, 2022) and also within SMB10, reflecting seepage from the decant pond. WAD Cyanide has only been detected on one occasion at SMB08 in October 2019 at a concentration of 0.07 mg/L.

Conductivity values across the monitoring bores around Samphire Pit TSF ranged between 60,000 and 169,000 µS/cm from 2016 to 2021, which is consistent with the observed TDS readings. In general, concentrations appear to be lowering, which may be a result of dilution from recovery of groundwater and mixing with generally less saline water from the discharge to the TSF.

The majority of wells show pH in the range of around 5 - 7.5, which is indicative of acidic to neutral conditions and these values are relatively consistent throughout time. pH in SMB03

appeared to decline with time and then rise from 2020 whereas pH values in SMB05 and SMB08 appear to have become gradually less acidic with time. This may be reflective of initially acidic conditions gradually becoming more alkaline with dilution from recovery of pit water levels.

The Applicant believes the local acidity is most likely associated with historic mining and not tailings input or seepage. In response to the draft Works Approval and Decision Report the Applicant provided a water analysis report from October 2022 which show only SMB-05 and SMB-08 (see Figure 6) have a low pH and the remaining monitoring bores are closer to neutral than acidic. Additionally, there has been no acidity observed at any of the other three in-pit TSFs (which are near full capacity) or the Jubilee TSF3A/B above ground facility.

2.7 Department of Water and Environmental Regulation – Hydrogeological advice – review summary

The application was referred to DWER'S Hydrogeological team for technical advice on suitability of seepage analysis and controls, cyanide migration modelling, tailings characterisation, water balance and proposed monitoring network. In summary, the following advice was received:

- The modelling of seepage from the TSF using SEEP/W is considered to be suitable and is considered to produce seepage rates that are consistent with estimates obtained using a simple analytical solution.
- Calculations of the transport and fate of cyanide in seepage from the TSF that were undertaken by Tetra Tech Coffey (Coffey, 2022) are considered to be overly simplistic, and do not consider the complex geochemical behaviour of cyanide compounds in the presence of dissolved metals in hypersaline water. However, the overall environmental risks posed by cyanide in seepage from the TSF are considered to be low.
- It is important that the proposed seepage recovery bores are located on basement rock fracture zones that are likely to be major conduits for groundwater flow near the TSF. Significant fracture zones can often be identified from information that has been obtained from historical geological and geophysical investigations in an area, and from undertaking additional ground-based geophysical investigations.
- The proposed distribution of monitoring bores around the TSF looks to be suitable as it would enable radial flow of groundwater from the facility to be monitored. it is recommended that monitoring bores in fractured rock environments are sited on structural features that are likely to be significant conduits for groundwater flow.
- It is recommended that ongoing water balance assessments for the new TSF are undertaken using evaporation measurements that are obtained from a meteorological station that is established at the site.

Details on how the technical advice above was considered in risk assessment and addressed as part of the works approval are detailed in section 3 below.

2.8 Department of Mines, Industry Regulation and Safety (DMIRS) – review summary

The application was referred to DMIRS to advise on environmental risks being regulated under the *Mining Act 1978* and to advise on geotechnical aspects of the facility. DMIRS Mines Safety Directorate (MSD) performed a geotechnical review of Samphire Paddock Style TSF as part of the submitted Mining Proposal (REG ID 110383) and concluded on 26 May 2022 that "*The proponent has now demonstrated reasonable geotechnical considerations were given to this project and, from a geotechnical perspective, the project may be accepted*." MSD has proposed a number of tenement conditions that will be placed on the Samphire TSF *Mining Act 1978* Tenure upon approval of the Mining Proposal.

DMIRS has also advised that the portion of the Samphire paddock style TSF located on freehold lots is not subject to the *Mining Act 1978* and as such DMIRS would not regulate stability, rehabilitation and closure aspects of this portion. DMIRS recommended that the following conditions are imposed as part of the W6675/2022/1 and subsequent licence amendment:

- The construction of any tailings storage embankment shall be supervised by an engineering or geotechnical specialist.
- 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.
- 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.
- Edge of the water pond to be at least 150 m away from the embankment under normal operating conditions.
- The TSF will be closed and rehabilitated in accordance with the recommendations set out in Section 17 of the South Kalgoorlie Operations, SKO Samphire Tailings Storage Facility Design Report – Tetra Tech Coffey Ref: 754-PERGE290892, Dated 22 December 2021.

Details on how the technical advice above was considered in risk assessment and addressed as part of the works approval are detailed in section 3 below.

3. Risk assessment

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

To establish a risk event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

3.1 Source-pathways and receptors

Emissions and controls

The key emissions and associated actual or likely pathway during premises construction and time-limited operation which have been considered in this decision report are detailed in Table 4 below. Table 4 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 4: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Dust	Construction activities associated	Air / windborne	• A water truck(s) will be allocated permanently to the earthworks and be

Emission	Sources	Potential pathways	Proposed controls
	with Samphire paddock style TSF including raise and vehicle movement	pathway	on site during the duration of construction for moisture conditioning and dust suppression purposes. • The use of saline water for dust suppression will be controlled to avoid overspray which may affect surrounding vegetation.
Noise	Construction activities associated with Samphire paddock style TSF including raise and vehicle movement	Air / windborne pathway	• Adherence to the *Environmental Protection (Noise) Regulations 1997.*
Sediment laden stormwater	Flooding and runoff from TSF construction area	Overland flow	• Topsoil will be stockpiled around the perimeter of the facility to form a bund, to stop any sediment laden runoff from entering the environment. • Any flooding and runoff from the TSF in the construction area will be captured in toe drains and seepages ponds. Once captured, pumps will be used to pump the excess water captured into the decant dam where it gets recycled. • Toe drains and ponds clogged with sediment will be dug out and disposed of appropriately.
Time limited operations			
Dust	Dry tailings (particulates) on exposed beaches potentially containing concentrations of elements with environmental significance	Air / windborne pathway	• Tailings to remain damp and a crust of salt will develop on the surface as the tailings dry between deposition cycles. There will also be minimal vehicle movement around the TSF, except during monitoring and maintenance. • Investigation of any further required options for dust suppression during fallow periods will occur. This may involve application of chemical dust suppressants/ agents.
Spillage of tailings and decant return water	Pipeline ruptures	Direct discharges to land and infiltration to soil	No changes to existing delivery and return pipeline infrastructure and management is proposed. As per SKO Samphire Tailings Storage Facility Operation Manual, the following controls are in place: • The delivery and return lines are bunded.

Emission	Sources	Potential pathways	Proposed controls

			• All pipelines checked for during routine shift inspections:
			  ○ External damage;
			  ○ Potential fractures;
			  ○ Stress due to temperature extremes;
			  ○ Welds;
			  ○ Flange gasket leaks;
			  ○ Joint leaks; and
			  ○ Valve failures.
			• In the event of a tailings pump breakdown or pipe leakage/rupture, the standby pump to be activated, and all spilt tailings to be contained to minimise environmental impact then cleaned up as soon as is practical.
			• The pipeline telemetry will detect any leaks or ruptures between the tails pump and the discharge point, registering an alarm at the control room in the mill. An investigation of the alarm will be conducted immediately, and appropriate rectification procedures employed.

Tailings seepage	Increased deposition of tailings into Samphire paddock Style TSF	Seepage to soil/ground adjacent to Samphire paddock style TSF and infiltration to groundwater	• Tailings discharge or spigotting carried out such that the supernatant water pond is maintained around the decant structure. The supernatant pond is to be maintained as small as practical and is to be kept away from the perimeter containment embankments at all times. By maintaining control of the water balance, that is, by keeping the supernatant pond around the decant structure as small as practical and removing excess water from the STSF, the volume of seepage which could potentially occur through the floor of the STSF can be minimised. • Surface soil within the STSF embankment footprint area compacted to target a minimum permeability requirement of 1 x 10^{-7} m/s as part of the embankment construction, to limit seepage through the foundation. • Cut-off trench excavated into the foundation soils and backfilled with low permeability fill, which reduces seepage losses through the

Emission	Sources	Potential pathways	Proposed controls
			embankment foundation. The cut-off trench to be located beneath the central core of the starter embankment and was cut to a nominal depth of 2 m. It is continuous along the upstream toe of embankment. • Perimeter bund and drain system placed around the perimeter of the Samphire paddock style TSF to contain seepage. • Toe drains and ponds clogged with sediment will be dug out and disposed of appropriately. • Decant return to the plant to be maximized. This will keep the supernatant pond away from the perimeter embankment and reduce seepage. • Seepage recovery bores or additional trench are proposed as a contingency to ensure standing water levels do not exceed 4 mbgl. • The existing monitoring system will be further enhanced by constructing additional monitoring bores located around STSF to allow measurement of groundwater levels and water quality sampling.
Discharge of tailings material	Overtopping	Direct discharges to land and infiltration to soil	• Tailings will be deposited in discrete layers from numerous spigot point discharges (i.e. multipoint spigotting). The discharge points will be regularly moved to ensure the even development of sloped tailings beaches. The length of time between successive depositions (i.e. drying time) on any one area is to be maximised. The deposition regime is aimed at maintaining the water pond adjacent to and around the decant structure. • The edge of decant water pond shall be kept at least 150 m away from the embankment under normal operating conditions. • The minimum operational freeboard, as detailed in the DMIRS guidelines, to be maintained at 300 mm, and the minimum total freeboard at 700 mm.

Emission	Sources	Potential pathways	Proposed controls
Discharge of tailings material	Erosion or rupture/ failure of Samphire paddock style TSF embankment	Direct discharges to land and infiltration to soil	• Embankment has been designed with an adequate factor of safety (FoS) against failure under normal operating conditions and under seismic loading appropriate to the storage location. • The embankments to be inspected once per shift (12-hourly). Berms (benches) and batter slopes to be inspected for cracking, seepage, scouring (caused by tailings deposition or rainfall runoff) and general erosion and weathering. • No water to be allowed to pool and rest against perimeter embankments. • A perimeter bund and drain system will be placed around the perimeter of the Samphire paddock style TSF to prevent erosion and ponding from external runoff. The proposed perimeter toe drain has a base width of 5 m with a nominal depth of approximately 1 m. The drain size is sufficient to provide 500 mm of freeboard in the 10% AEP event and to prevent the need for riprap lining in events up to the 1% AEP event. • Toe drains and ponds clogged with sediment will be dug out and disposed of appropriately. • The minimum operational freeboard, as detailed in the DMIRS guidelines, to be maintained. • The edge of decant water pond shall be kept at least 150 m away from the embankment under normal operating conditions. • Periodic checking of embankment piezometers to be conducted, in conjunction with quarterly bore monitoring, to ascertain changes in phreatic surface level within the embankment.
Tailings Water	Ingestion of supernatant from TSF by wildlife	Ingestion by wildlife	WAD Cyanide (in Return Water/decant water) is up to 21 mg/L and decant water hypersaline, which might be considered unsuitable as a source of drinking water for wildlife.
Tailings Material and Water;	Unstable, unsafe and contaminating landform due to unsuccessful	Direct discharges to land, infiltration to	The TSF will be decommissioned and rehabilitated to remain a safe, stable, erosion resistant and non-polluting landform in accordance with requirements of the DMIRS. A

Emission	Sources	Potential pathways	Proposed controls
Sediment laden stormwater	decommissioning, rehabilitation and closure of the tailings storage facility	soil and seepage	TSF closure plan detailing the post-closure landform design will be developed for DWER/DMIRS approval. The following rehabilitation criteria are adopted: • Once tailings deposition is complete and the top surface has been allowed to dry, settle and consolidate, and as pore water drains from the tailings mass, the top surface of the storage can be rehabilitated. Due to segregation of the tailings, consolidation settlement of the tailings around the embankment (structural zone) is expected to be considerably faster, with consolidation time increasing with distance away from the structural zone toward the decant pond. • A geotechnical investigation including CPTu probing on the tailings beach shall be conducted to investigate the consolidation and strength parameters of the tailings. • Based on available tailings properties, at this stage, a concaved (store and release cover) profile is favoured, combined with a store-and-release type cover system. The choice of the final profile will largely be determined by the tailings geochemistry and will be subject to a further study as part of detailed rehabilitation planning. • A safe construction methodology for the cover layer can be developed, especially for soft, fine failings near the decant area. Consolidation and corresponding gain in shear strength around this zone will occur at a very slow rate, which may necessitate commencement of cover layer placement prior to the completion of consolidation. • The top surface may be segmented into sub-catchments to limit runoff potential to the centre of the facility after closure. The design event for any hydrological assessment will be the 100-year rainfall. The requirement for a spillway at closure will be subject to further studies as part of detailed rehabilitation planning.

Emission	Sources	Potential pathways	Proposed controls
			• The top surface will be revegetated by applying a cover system and topsoil. • Batter slopes will be rock armoured.

Receptors

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

Table 5 provides a summary of potential environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises *(Guideline: Environmental Siting* (DWER 2020)).

Table 5: Environmental receptors and distance from prescribed activity

Environmental receptors	Distance from prescribed activity
Residential premises	No residential premises or homesteads near prescribed premises. Woolibar Pastoral Station Homestead is located approximately 13km south-east from the project area. The nearest town of Kambalda is approximately 18 km south-east of the proposed TSF. City of Kalgoorlie-Boulder is 21km north-west and Coolgardie 37kms north-west of the proposed TSF. **Screened out receptors due to distance from prescribed activity.**
Ephemeral unnamed surface water drainage	Bed of ephemeral drainage within 160 m from proposed TSF, within prescribed premises It flows into a salt pan approximately 12 km southeast
Surrounding Native Vegetation	Within Premises boundaries. Sparse to relatively dense eucalypt woodlands with understoreys of saltbush and bluebush, mulga shrublands (acacia, casuarina and melaleuca), minor stands of spinifex grasslands and bare salt lake surfaces. No conservation significant species identified within proximity to proposed TSF.
Conservation significant fauna	Threatened Fauna are located within the Premises but not at the proposed Samphire paddock style TSF. One historic mound of the threatened fauna species *Leipoa ocellata* (Malleefowl) was recorded within the survey area. This inactive mound was identified approximately 2.7 km south of the proposed Samphire paddock style TSF.
Groundwater	Underlying and surrounding TSF Underlying aquifers (hypersaline.- 50,000 to 1000,000 mg/L) – Two main aquifers: Paleochannel aquifer and Basement Rock aquifer – latest associated with regional and local shear zones. Groundwater around Samphire TSF ranges between 4 m and 17 m bgl. Flow is predominantly to the south to southeast but may be locally affected by geological structures in certain areas, which enhance permeability.
Heritage site ID 18371 (lodged – artefacts/scatter)	Lodged site within 500 m of Samphire TSF

3.2 Risk ratings

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

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

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 6.

Works approval W6675/2022/1 that accompanies this decision report authorises construction, commissioning and time-limited operations. The conditions in the issued works approval, as outlined in Table 6 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

An amendment to existing licence L5107/1988/13 is required following the time-limited operational phase authorised under the works approval to authorise emissions associated with the operation of Samphire paddock style TSF at the premises.

Table 6: Risk assessment of potential emissions and discharges from the premises during construction and operation

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Construction								
Construction activities associated with Samphire In-pit TSF and vehicle movement	Dust	Air / windborne pathway causing impacts to vegetation health due to dust deposition leading to reduced ability for photosynthesis and smothering	Surrounding Vegetation	Refer to Section 3.1	C = Slight L = Possible **Low Risk**	Y	N/A	The Delegated Officer considers that construction works are temporary and that the provisions of the *Environmental Protection (Noise) Regulations 1997* and section 49 of the EP Act are sufficient to regulate noise and dust emissions during construction of the TSF embankments.
	Noise	Windborne noise which may disrupt nocturnal foraging behaviour	Fauna (including *Leipoa ocellata* - Malleefowl)	Refer to Section 3.1	C = Slight L = Unlikely **Low Risk**	Y	N/A	
	Sediment laden stormwater	Flooding and runoff from TSF construction area impacting surrounding vegetation and resulting in sedimentation of surface water drainage	Surrounding Vegetation Surface water (160m north to north-east of TSF northern embankment)	Refer to Section 3.1	C = Slight L = Unlikely **Low Risk**	Y	N.A	N.A
Time-limited operations of Samphire paddock style TSF								
Deposition of tailings into Samphire paddock style TSF and ongoing management of the facility	TSF supernatant containing concentrations of elements with environmental significance (hypersaline, acidic, with cyanide and potentially containing	Increase in Seepage / Infiltration of supernatant water through basin and embankments resulting in reduced groundwater quality.	Groundwater (>4 m bgl with south, southeast directional flow).	Refer to Section 3.1	C = Moderate L = Possible **Medium Risk**	N	**Condition 1, 2, 3, 4, 5, 10, 11, 12, 13.** **Monitoring conditions: 14, 15, 16, 17** **Reporting conditions 6, 7, 8, 9, 18 and 19** **Notification and records conditions: 20, 21, 22, 23**	As per internal DWER advice received (refer to section 2.7 and 3.3) seepage controls need to be supported by geological and geophysical investigations in an area. These need to be undertaken as part of the works approval to confirm seepage controls design and location prior to continued deposition of tailings into the facility. Proposed monitoring network also needs review based on results from geological and geophysical

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
	metals and metalloids)							investigations in an area. For further details refer to section 3.3
		Groundwater mounding resulting in seepage expression on surface, impacting vegetation and reducing surface water quality.	Land/soils Surface water (160 m north to north-east of TSF northern embankment)	Refer to Section 3.1	C = Moderate L = Possible **Medium Risk**	N	**Condition 1, 2, 3, 4, 5, 10, 11, 12, 13.** **Monitoring conditions: 14, 15, 16, 17** **Reporting conditions 6, 7, 8, 9, 18 and 19** **Notification and records conditions: 20, 21, 22, 23**	Applicant must ensure seepage expression on surface does not occur and standing water level is maintained below 4 m bgl. Monitoring of standing water level is required. This is consistent with current licence requirements.
		Ingestion of supernatant from TSF by wildlife leading to reduced fauna health or deaths.	Fauna (including *Leipoa ocellata* - Malleefowl	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	Y	N.A	WAD cyanide concentration in decant water is below 21 mg/L, no additional controls are deemed required. Delegated Officer also notes that decant water is hypersaline and unlikely to be suitable as a source of drinking water for wildlife.
		Overtopping of tailings resulting in direct discharges to land and infiltration to soil resulting in in reduced soil and surface water quality and impacting health of surrounding vegetation	Surrounding Vegetation Land/soils Surface water (160 m north to north-east of TSF northern embankment)	Refer to Section 3.1	C = Moderate L = Possible **Medium Risk**	Y	Condition 1 and 12. Monitoring condition: 17 **Reporting conditions 6, 7, 8, 9, 18 and 19** **Notification and records conditions: 20, 21, 22, 23**	The Delegated Officer notes that an incident of overtopping occurred in May 2022. The incident is currently under investigation by DWER compliance team. Conditions relating to freeboard and decant pond maintenance and routine inspections are added – condition 1 and 12.
	Sediment laden stormwater	Erosion of embankments due to rainfall and surface water interaction resulting in sedimentation downstream and potentially compromising stability of	Surrounding Vegetation Land/soils Surface water (160 m north to north-east of TSF northern	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	N	**Condition 1 and 12** **Reporting conditions 6, 7, 8, 9, 18 and 19** **Notification and records conditions: 20, 21, 22, 23**	DMIRS will not regulate environmental risks (including during rehabilitation and closure) related to stability of the facility for sections of proposed TSF located outside *Mining Act 1978* tenure, thus additional regulatory controls from DWER are required.

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
		the facility in the long term.	embankment)					Erosion of embankments is unlikely to occur during time limited operations (due to its short timeframe), however the existing waste rock landform which forms part of the facility is noted to be actively eroding (sediment plumes downstream are noted from aerial imagery). As part of this works approval, the Applicant is expected to undertake an assessment of the outer slopes of surrounding WRDs and appropriately manage active gullies to ensure sedimentation downstream does not continue and stability of the facility is not compromised in the long term. For further details refer to section 3.3
	TSF material containing concentrations of elements with environmental significance (Talings mud and water - hypersaline, acidic, with cyanide and potentially containing metals and metalloids)	Rupture or failure of embankments resulting direct discharge to land, vegetation loss, contamination of surface water and soils.	Surrounding Vegetation Land/soils Surface water (160 m north to north-east of TSF northern embankment)	Refer to Section 3.1	C = Major L = Rare **Medium Risk**	N	**<u>Condition 1 and 12</u>** **<u>Reporting conditions 6, 7, 8, 9, 18 and 19</u>** **<u>Notification and records conditions: 20, 21, 22, 23</u>**	DMIRS will not regulate environmental risks (including during rehabilitation and closure) related to stability of the facility for sections of proposed TSF located outside *Mining Act 1978* tenure, thus regulatory controls from DWER are required. For further details refer to section 3.3
	Dust	Air / windborne pathway causing impacts to vegetation health due to dust deposition leading to reduced ability for photosynthesis and smothering	Surrounding Vegetation	Refer to Section 3.1	C = Slight L = Possible **Low Risk**	Y	N.A	N.A

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Tailings delivery and return water pipelines	Spillage of tailings and decant return water through leaks, pipeline ruptures or failure	Direct discharges to land and infiltration to soil resulting in in reduced soil and surface water quality and impacting health of surrounding vegetation	Land/soils Surrounding Vegetation Surface water (it crosses the pipeline route)	Refer to Section 3.1	C = Moderate L = Possible **Medium Risk**	Y	N.A	Additional regulatory controls not necessary as there is no proposed change to current tailings delivery and return water infrastructure and management. Conditions related to delivery pipelines are in place under current licence L5107/1988/13.
Rehabilitation and closure of Samphire Paddock style TSF								
Rehabilitation and Closure of Samphire Paddock Style TSF	TSF material containing concentrations of elements with environmental significance Sediment laden stormwater	Unsuccessful decommissioning, rehabilitation and closure of the tailings storage facility result in an unstable, unsafe, or contaminating landform which is not capable of supporting the surrounding ecosystem or post-mining land use	Surrounding Vegetation Land/soils Surface water (160 m north to north-east of TSF northern embankment) Groundwater	Refer to Section 3.1	C = Major L = Unlikely **Medium Risk**	Y	**Condition 24**	DMIRS will not regulate environmental risks (including during rehabilitation and closure) related to stability of the facility for sections of proposed TSF located outside *Mining Act 1978* tenure, thus regulatory controls from DWER are required. Commitments made in Section 17 of Design report (Coffey, 2022a) are considered sufficient at this stage of the TSF life and are imposed as a condition of the works approval, which will be later transferred into the licence. For further details refer to section 3.3

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

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

3.3 Additional regulatory controls

Condition 1 and 4 – Seepage Recovery Infrastructure

Internal DWER advice was sought regarding suitability of seepage and cyanide migration modeling and proposed controls.

The modelling of seepage from the TSF using SEEP/W is considered to be suitable, and is considered to produce seepage rates that are consistent with estimates obtained using a simple analytical solution.

Calculations of the transport and fate of cyanide in seepage from the TSF that were undertaken by Tetra Tech Coffey are considered to be overly simplistic, and do not consider the complex geochemical behaviour of cyanide compounds in the presence of dissolved metals in hypersaline water. However, the overall environmental risks posed by cyanide in seepage from the TSF are considered to be low.

It is important to note that the predicted rate of seepage is highly sensitive to small changes in potentiometric heads, and in the hydraulic properties of materials used to construct the TSF embankment. In particular, given the current uncertainties about the hydraulic properties of the embankment wall for the constructed TSF, the rate of seepage from the facility could easily be one or more orders of magnitude higher than the current estimates. It is therefore important that any seepage recovery infrastructure is designed to cope with this level of uncertainty in seepage rates.

The design report indicates that a toe-drain will be constructed for the facility that will be about 5 m wide and will be sunk to a depth of 1 m. Although this is a common design for toe-drains for TSFs in the region, the effectiveness of such a feature for capturing seepage would depend on the properties of the regolith that underlie the footprint of the proposed facility. In situations where the ratio of the horizontal hydraulic conductivity of the regolith to its vertical hydraulic conductivity is very high (i.e., the material has highly anisotropic hydraulic properties), there would be a significant risk that some seepage could bypass the drain.

Modelling that was undertaken by Tetra Tech Coffey (Coffey, 2022) indicated that seepage from the TSF could be captured using recovery bores sunk at 100-250 m intervals parallel to the embankment faces of the facility.

However, in practice, such a network of recovery bores would have a limited effectiveness unless bores were correctly sited on fracture zones or joint planes that are likely to be the dominant conduits for groundwater flow in bedrock in the area. It would therefore be important that the Applicant identifies suitable locations for installing such bores as soon as possible to ensure that they could be rapidly commissioned if needed.

Fracture zones that are likely conduits for groundwater flow in bedrock could be identified from information gathered in historical geological and geophysical investigations at the site, and by undertaking additional ground-based investigations in the area.

The proposed 6-metre-deep interception trench could be subject to the same problems that were previously discussed for the toe drains. Additional groundwater flow modelling under a range of hydraulic conditions may be required to optimise the design of this structure to ensure that it would be effective in capturing contaminated groundwater.

In response to the draft Works Approval and Decision Report the Applicant clarified that a qualified hydrogeologist would be employed to design and supervise the installation of seepage recovery bores to ensure they are located appropriately and perform optimally.

Regulatory Controls: Proposed seepage infrastructure as designed by Tetra Tech Coffey are added to condition 1. Further investigation and design requirements for the construction and installation of the proposed additional seepage recovery infrastructure have been imposed to ensure these are installed correctly and able to collect seepage.

Conditions 2 and 3 – Monitoring Bores location

The Applicant has committed to review and install additional monitoring bores during construction of the Samphire paddock style embankments and prior to continued deposition. It is also noted that some monitoring bores will need to be decommissioned during the construction of the facility, but the remaining bores will continue to be monitored (see Figure 6).

The proposed distribution of monitoring bores around the proposed Samphire paddock TSF are likely to be suitable as it would enable radial flow of groundwater from the facility to be monitored. However, it is not clear from the information provided whether these bore locations have been selected based on the presence of structural features around the facility, or whether they have just been sited to give a uniform distribution of bores around the facility. It is expected that monitoring bores in fractured rock environments are sited on structural features that are likely to be significant conduits for groundwater flow. Such structural features can often be identified from a review of information gathered from historical geological and on-ground geophysical investigations in an area, or from an assessment of lineaments that are identified in remote sensing imagery.

Regulatory Controls: Further investigation and design requirements for the construction and installation of the proposed monitoring bores have been imposed to ensure bores are installed correctly and able to detect contamination.

It is also requested that the Applicant uses the information provided in the national guideline document "*Minimum Construction Requirements for Water Bores in Australia*" for guidance on decommissioning abandoned monitoring bores. The current version of this guideline document (2020) can be downloaded from the following web site: https://adia.com.au/waterwell/water-bore-construction/.

Condition 14 – Monitoring parameters and Frequency

Monitoring parameters and frequency to continue quarterly, consistent with current licence (L5107/1988/13).

Applicant must ensure seepage expression on surface does not occur and standing water level is maintained below 4 m bgl. Monthly monitoring of standing water level required, consistent with current licence (L5107/1988/13).

Condition 5 and 17 – Water Balance

Information was provided about the likely water balance for the proposed TSF in the supporting documents. It is important that a water balance is undertaken on an ongoing basis during the operational life of a TSF to ensure excessive seepage is not taking place from the facility.

In such a water balance, the main inputs to the new paddock style TSF would be:

- Water in the tailings slurry;
- Seepage water from trenches or bores;
- Make-up water to maintain the appropriate tailings density; and
- Rainfall

The outputs from the TSF would be:

- Runoff from the facility during rainfall events;
- Decant water stored and recovered for use in processing;
- Evaporation from the surface of the facility; and
- Seepage from the facility.

Generally, it is assumed that all components of the water balance other than seepage are known for a TSF with a high level of certainty. The seepage rate is then estimated to be the difference of the sums of the inputs to, and the sums of the outputs from the facility. For most TSFs, this assumption is generally correct with the exception of evaporation.

This is because proponents usually assume that evaporation data from the nearest BoM weather station are also applicable at a mine site. However, research by CSIRO (McJannet *et al*., 2017) has shown that this is not the case, and that evaporation data measured on a mine site may correlate poorly with data from the nearest BoM weather station.

It is therefore requested that a meteorological station with evaporation pan unit is established as close as possible to the Samphire paddock style TSF to collect meteorological data during its operation. Such a monitoring station would enable rainfall and evaporation rates near the facility to be determined on a daily to weekly basis. The preferred method of doing this is using the approaches outlined in McJannet *et al*. (2017).

Regulatory Controls: Maintenance of a water balance and on-site meteorological station requirements have been included in the works approval.

Condition 1, 12, and 24 – TSF Design, Embankment stability, rehabilitation and closure of the facility

As stated in section 2.8, DMIRS has advised that the portion of the Samphire paddock style TSF located on freehold lots is not subject to the *Mining Act 1978* and as such DMIRS would not regulate environmental risks related to stability, rehabilitation and closure of this portion.

Regulatory Controls: To address DMIRS' comments (refer to section 2.8) and ensure environmental risks related to stability of the facility are minimised, Conditions 1, Table 1 and Condition 12, Table 4 are added into the works approval. Erosion of embankments are unlikely to occur during time limited operations (due to its short timeframe), however the existing waste rock landform which form part of the facility are noted to be actively eroding (sediment plumes downstream are noted from aerial imagery). As part of this works approval, the Applicant is expected to undertake an assessment of the outer slopes of surrounding waste rock dump and appropriately manage active gullies to ensure sedimentation downstream does not continue and stability of the facility is not compromised in the long term (Condition 1, Table 1, last row and condition 12, Table 4, last dot point).

In regard to rehabilitation and closure of the facility, the Delegated Officer notes that a preliminary closure and rehabilitation concept has been provided in section 17 of proposed Samphire Paddock style TSF (Coffey, 2022), with a commitment to decommission and rehabilitate the TSF to remain a safe, stable, erosion resistant and non-polluting landform in accordance with DMIRS requirements. The Applicant also commits to further develop a post-closure landform design for DWER and DMIRS approval. Considering the above, condition 24 is imposed as part of the works approval and will be later transferred into the licence. A review of rehabilitation and closure requirements for the Jubilee Mine site as part of any future licence amendment will be undertaken with further advice from DMIRS being sought.

Conditions 6, 7, 8, 9, 18 and 19 – Reporting

The works approval requires the following reports to be submitted:

- Critical Containment Infrastructure Report
- Environmental compliance Report
- Time Limited Operations Report

Grounds

Reporting requirements are necessary for the administration of the works approval, validating ongoing acceptability of the operations and for validation against design criteria prior to operation.

4. Consultation

Table 7 provides a summary of the consultation undertaken by the department.

Table 7: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website on 16/05/2022	No comments received	N/A
Local Government Authority (Shire of Kalgoorlie Boulder and) advised of proposal on 23/05/2022	No comments received	N/A
DMIRS advised of proposal on 23/05/2022	DMIRS responded on 23/06/2022 Refer to section 2.8	Refer to Section 3.3
Applicant was provided with draft documents on 6/09/2022	The applicant provided comment on 27/04/2023 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. ANZG 2018. Australian and New Zealand Governments and Australian state and territory governments. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Canberra. http://waterquality.gov.au/anz-guidelines.
2. Coffey 2021a. Tetra Tech Coffey December 2021, South Kalgoorlie Operations, SKO Samphire Tailings Storage Facility Design Report. Reference: 754-PERGE290892
3. Coffey 2021b. Tetra Tech Coffey December 2021, Samphire TSF Embankment Design, Hydrological Assessment. Reference: 754-PERGE290892
4. Coffey 2022. Tetra Tech Coffey February 2022, South Kalgoorlie Operations Samphire Pit TSF Groundwater Study Reference: 754-PEREN291496_R01
5. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
6. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
7. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
8. Graeme Campbell and Associates Pty Ltd (GCA), January 2008. HBJ Minerals Pty Ltd Dioro-South Kal Operations, Jubilee Gold Mine, Geochemical Characterisation Of Process-Tailings-Slurry Sample
9. McJannet, D., Hawdon, A., van Niel, T., Boadle, D., Baker, B., Trefry, M. and Rea, I., 2017. Measuring evaporation from a mine void lake and testing of modelling approaches. *Journal of Hydrology*, **555**, 631-647.

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

Condition	Summary of applicant's comment	Department's response
2.4 Premises Hydrology (Page 12) Applicant to clarify whether this drain to prevent erosion of embankment due to ponding and external runoff is the same toe drain proposed to capture seepage as shown in Coffey's supporting documents and TSF drawings?	The Applicant confirms that the 'toe drain' and the 'run-off drain are the same thing. Refer to '754-PERGE290892_STSF Embankment cross section' attachment for the only drain that will be constructed around the perimeter of the embankment.	Delegated Officer notes this clarification.
2.6 Groundwater levels and quality – review summary (Page 14) • Applicant to confirm pH of tailings slurry provided as part of design report and groundwater study undertaken by Coffey. • The pH of tailings slurry is indicated as alkaline, please confirm. • Please provide actual characteristics of tailings currently being deposited into the Samphire in-pit (Jubilee TSF3 data for pH has been provided instead in table 2). • Also, is there a bore further downstream of SMB03, SMB05 and SMB08 showing that seepage/acidity is localised only?	The local acidity is most likely associated with historic mining and not tailings input/ seepage as only SMB-05 and SMB-08 have a low pH and the remaining monitoring bores are closer to neutral than acidic (see results from Oct 2022 sampling 'EP2214606_0_COA Oct22'). Additionally, there has been no acidity observed at any of the other three in-pit TSFs (which are near full capacity) or the Jubilee TSF3A/B above ground facility. Bores are planned to be installed downstream to the east to monitor seepage in that direction as per the 'DWER RFI STSF groundwater monitoring network map'. A qualified hydrogeologist will design and supervise the installation of all groundwater monitoring and seepage recovery bores to ensure they are located appropriately. The seepage and groundwater management plan will reflect this.	Section 2.6 Groundwater quality has been updated with additional information supplied by the Applicant.

Condition	Summary of applicant's comment	Department's response
3.1 Source pathways and receptors (Page 16) **Emissions and controls** **Table 4: Proposed applicant controls** **Construction** Sediment laden stormwater – Flooding and runoff from TSF construction area. **3.2 Risk ratings (Page 23)** **Table 6: Risk assessment of potential emissions and discharges from the premises during construction and operation.** Flooding and runoff from TSF construction area impacting surrounding vegetation and resulting in sedimentation of surface water drainage. Proposed controls: Applicant to provide details of controls in place. • Are these toe drains and seepage ponds, existing infrastructure related to the existing in-pit TSF (are they placed at suitable locations to capture run-off of proposed construction works)? Or is the applicant referring to the proposed infrastructure? • If proposed, are they proposed to be installed and operational prior to construction of embankments commencing?	The reference is to proposed infrastructure which will be constructed at the same time as the embankment. Construction is anticipated to take 6-months. The likely sequence is as follow: 1. Clearing and stockpiling (or redeployment) of vegetation and topsoil from the footprint area of the STSF plus 10 m outside the embankment toe. Vegetation and topsoil shall be stockpiled separately. 2. Excavation of the perimeter embankment seepage cut-off trench. 3. Formation of the perimeter embankments to the nominated RL using approved construction materials, including the rock toe, downstream capping zone, etc. 4. Formation of the decant accessway and decent structure using competent mine waste materials. 5. Excavation of an external downstream toe drain. Topsoil is to be stockpiled around the perimeter of the facility. It will form a bund and will stop any sediment laden runoff, following a storm event, from entering the environment.	Proposed infrastructure related to stormwater management and perimeter bund has been added to the works approval (Condition 1 and 12) with relevant reporting, notification and record keeping conditions included.
3.1 Source pathways and receptors (Page 16) **Emissions and controls** **Table 4: Proposed applicant controls** Time limited operations Proposed controls: Contingencies / strategies to be provided, including management of dust during fallow periods. **3.2 Risk ratings (Page 25)**	The Applicant stated that there has been no observable dust leaving the facility to date. The Applicant notes that at other Northern Star Resources (NSR) sites in the region that the high salt content in the tailings binds it and forms a crust on the surface as it dries which helps to mitigate dusting. However, in the event that dust becomes an issue NSR will investigate chemical dust suppressants/ agents. A source of water will be maintained at the facility for use for construction purposes. A 'water truck' will be used for dust suppression during construction activities as dust is both an	The Applicant has proposed standard dust management measures, such as the use of a water truck and saline water spray. Based on evidence from other Northern Star Resources sites the Applicant is confident this will control dust emissions. The Delegated Officer considers dust to be generated mainly during construction of the embankments, which will be temporary and not an

Condition	Summary of applicant's comment	Department's response
Table 6: Risk assessment of potential emissions and discharges from the premises during construction and operation. Air / windborne pathway may cause impacts to vegetation health due to dust deposition leading to reduced ability for photosynthesis and smothering. Please be specific regarding current and ongoing management of dust for the facility.	environmental and safety hazard.	ongoing source of dust emissions. No additional regulatory dust management controls have been added by DWER.
3.1 Source pathways and receptors (Page 18 and 19) **Emissions and controls** **Table 4: Proposed applicant controls** Time limited operations Applicant to provide additional control in the event the toe drain is no longer effective – e.g. due to sedimentation; becoming clogged by ferruginous precipitates	The Applicant confirms that drains will be cleaned of sediment to ensure they remain unclogged. NSR plans to install seepage recovery bores around the perimeter of the facility as per the 'DWER RFI STSF groundwater monitoring network map'. A qualified hydrogeologist will design and supervise the installation of the seepage recovery bores to ensure they are located appropriately and perform optimally. The seepage and groundwater management plan will reflect this. It is expected that the network of seepage recovery bores will be sufficient to manage seepage in the unlikely event that the proposed drains do not perform as predicted.	Conditions related to construction of the bore network are included in the works approval. The Delegated Officer added a regulatory condition to ensure the drain system is maintained in a good working order.
3.3 Additional regulatory controls (Page 27) **Condition 1 and 4 – Seepage Recovery Infrastructure** It is requested that the applicant provides more information about the properties of the regolith, and of the modelling that was undertaken to indicate how the drain would capture seepage. This information would be needed to justify why the proposed drain dimensions would be adequate to capture seepage from the TSF. Additionally, there is a risk that the efficiency of the proposed toe-drain would decline over time due to it progressively becoming clogged by ferruginous precipitates derived from high iron concentrations in tailings pore-water (strategies to address this are required to be provided, as above). It is also	The Applicant clarified that the seepage drain is referred to as an alternative to seepage recovery bores as a suggested method of intercepting and managing seepage. It has not been designed or engineered yet and therefore is not planned to be constructed during the initial construction phase. Section 6.5 on page 36 of 754-PEREN291496_R01 states: *'Similar results to extraction bores may be achieved by the use of an open trench or subsurface drain 6.0 m deep with water levels in the trench/drain maintained at the base of the trench/drain. This would require detailed design and a groundwater monitoring plan which are beyond the scope of this report'.* NSR plans to install seepage recovery bores around the perimeter of the facility as per the 'DWER RFI STSF groundwater monitoring	The Delegated Officer notes that seepage controls need to be supported by geological and geophysical investigations in an area. These investigations need to be undertaken by the Applicant as part of the works approval to confirm seepage controls design and location prior to continued deposition of tailings into the facility. Applicant must ensure seepage expression on surface does not occur and standing water level is maintained

Condition	Summary of applicant's comment	Department's response
understood that this drain will receive and manage surface runoff and embankment erosion. **Construction phase (Page 3 & 4)** **Table 1: Critical containment infrastructure and equipment** Applicant to demonstrate suitability of drain dimensions/ location. See decision report page 27.	network map'. A qualified hydrogeologist will design and supervise the installation of the seepage recovery bores to ensure they are located appropriately and perform optimally. The seepage and groundwater management plan will reflect this. It is expected that the network of seepage recovery bores will be sufficient to manage seepage in the event that the proposed drains do not perform as predicted.	below 4 mbgl. The Delegated Officer believes that the monitoring of standing water level is required and has included conditions in the works approval. These conditions are consistent with current licence requirements.

Appendix 2: Application validation summary

SECTION 1: APPLICATION SUMMARY		
Application type		
Works approval	☒	W6675/2022/1
Date application received	23/02/2022	
Applicant and Premises details		
Applicant name/s (full legal name/s)	Northern Star (HBJ) Limited – ACN 79009473054. The South Kalgoorlie Operations (SKO) are owned and operated by Northern Star Resources Ltd.	
Premises name	South Kalgoorlie Operations - Jubilee Gold Mine	
Premises location	Notes: affected land :Lot 105 on Plan 40396; Lot 51 on 226303 and Mining tenement M15/456. Prescribed premises covers: Lot 15 on Plan 58833, Lot 50 on Plan 226299 and Lot 51 on Plan 226303, Feysville, Lot 103 on Plan 40395 Lot 105 on Plan 40396, Karamindie, and mining tenements M26/118, M26/143, M26/204 and M15/456	
Local Government Authority	City of Kalgoorlie-Boulder and Coolgardie Shire	
Application documents		
HPCM file reference number:	DER2022/000088	
Key application documents (additional to application form):	• Works approval supporting document – Samphire Tailings Storage Facility • South Kalgoorlie Operations SKO Samphire Tailings Storage Facility Design. • South Kalgoorlie Operations Samphire Pit TSF – Groundwater Study • Samphire TSF embankment Design – Hydrological Study. The following were provided following RFI: Tailings characterization reports; Certificate of Titles, ASIC extracts, Hydrogeological reports, additional maps, LoM schedule for TSF, Letter of Authority.	
Scope of application/assessment		

Summary of proposed activities or changes to existing operations.	The South Kalgoorlie Operations (SKO) proposes to further develop the existing Samphire in-pit TSF into a paddock style facility providing additional 8.3 years of storage space (the current in-pit TSF has 5 months capacity only). This will be undertaken by constructing an embankment around the existing in-pit TSF. The proposed paddock style embankment design consists of 3 stages (Starter Embankment, Stage 1 and Stage 2) and will abut two existing waste dumps. The maximum height of the facility will be approximately 15.5m above ground level. The existing in-pit TSF and proposed integrated landform are located within M15/456 and freehold lots EEL 53 and EEL51. It is understood that provisions of the *Mining Act 1978* and associated regulations do not apply to the portion of the proposed integrated landform located on freehold lots EEL 53 and EEL51 issued pre-1899. SKO currently operates under L5107/1988/13.

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

Table 1: Prescribed premises categories

Prescribed premises category and description	**[Proposed] [Assessed] production or design capacity**	**Proposed changes to the production or design capacity (amendments only)**
Category *5*: Processing or beneficiation of metallic or non-metallic ore	Maximum production: 1,650,000 tonnes per year Actual throughput 1,200,000 tonnes per year.	N.A

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 ☒	
Does the applicant hold any existing Part IV Ministerial Statements relevant to the application?	Yes ☐ No ☒	
Has the proposal been referred and/or assessed under the EPBC Act?	Yes ☐ No ☒	
Has the applicant demonstrated occupancy (proof of occupier status)?	Yes ☒ No ☐	Certificate of title ☒ Mining lease / tenement ☒ Expiry: 2nd August 2022 Other evidence ASIC extracts
Has the applicant obtained all relevant planning approvals?	Yes ☐ No ☐ N/A ☒	

Has the applicant applied for, or have an existing EP Act clearing permit in relation to this proposal?	Yes ☒ No ☐	CPS No: CPS 9551/1 and CPS9575/1 (both applied for)
Has the applicant applied for, or have an existing CAWS Act clearing licence in relation to this proposal?	Yes ☐ No ☒	
Has the applicant applied for, or have an existing RIWI Act licence or permit in relation to this proposal?	Yes ☒ No ☐	Application reference No: GWL106836
Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the EP Act)?	Yes ☐ No ☐	Name: Goldfields Type: Proclaimed Groundwater Regional office: Goldfields
Is the Premises situated in a Public Drinking Water Source Area (PDWSA)?	Yes ☐ No ☒	
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 ☐	• *The Mining Act 1978* • *EP Act 1986* • *Environmental Protection (Controlled Waste) Regulations 2004* • *The Aboriginal Heritage Act 1972* The provisions of the *Mining Act* do not apply to the portion of the TSF located on freehold title lands (EEL 53 and EEL 51).
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 ☐	Yes Classification: possibly contaminated – investigation required (PC–IR) Date of classification: April 2009