Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Works Approval

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

Works Approval Number	W6927/2024/1
Applicant	Silver Lake (Integra) Pty Limited
ACN	093 278 436
File number	DER2024/000132
Premises	Randalls Gold Processing Facility EMU FLAT WA 6431 Legal description – Mining tenements M25/71, M25/125, M25/133, M25/307, M25/347; General purpose lease L25/27, L25/29, L25/31, L25/33, L25/41; and Miscellaneous licence G25/02, As defined by the premises maps attached to the issued works approval
Date of report	06 August 2024
Decision	Works approval granted

Christine Pustkuchen
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MANAGER, RESOURCE INDUSTRIES

INDUSTRY REGULATION (STATEWIDE DELIVERY)

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 Randalls Gold Processing Facility (the premises). As a result of this assessment, works approval W6927/2024/1 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

On 22 March 2024, the Silver Lake (Integra) Pty Limited (the applicant) submitted an application for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act).

The application is to undertake construction works relating to expansion of existing tailings storage facilities (TSF) at the premises, including:

1. Construction of three embankment raises at tailings storage facility (TSF) 2, to a maximum embankment height of RL 330.5 m;
2. Construction of three embankment raises at TSF1, to a maximum embankment height of RL 330.5 m;
3. Time limited operation of the corresponding embankment raises for up to 180 calendar days;
4. Construction of two return water ponds to store bore water, return water, recovered groundwater, and process water;
5. Modification works to the West Groundwater Recovery Drain (GRD) at TSF2; and
6. Installation of additional groundwater monitoring bores at six locations.

The proposed activities are detailed further in Section 2.4.

The premises comprises of mining tenements M25/125, M25/133, M25/307, M25/347, general purpose leases L25/27, L25/29, L25/31, L25/33, L25/41, and miscellaneous licence G25/02, and is approximately 60 km south-east of Kalgoorlie-Boulder. The proposed activities will primarily be undertaken within mining tenement M25/347.

The premises relates to the category and assessed production / design capacity under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in works approval W6927/2024/1. 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 2020b) are outlined in works approval W6927/2024/1.

2.3 Overview of premises

Emissions and discharges associated with Category 5 (i.e., processing or beneficiation of metallic or non-metallic ore), Category 6 (i.e., mine dewatering) and Category 64 (i.e., Class II or III putrescible landfill site) activities and is regulated under existing licence L8457/2010/2. The premises contains two existing TSFs.

The TSF1, also known as IWLTSF, is a currently inactive integrated waste landform tailings storage facility. The facility's southern embankment is integrated with a waste rock dump. The TSF1 was constructed in 2010 and designed to a maximum embankment height of RL 323.0 m. It is understood that TSF1 reached maximum tailings storage capacity in December 2014. Since then, the facility has not received tailings, with existing tailings being left to dry.

A diversion channel is located along the TSF1 northern embankment to divert upstream surface water runoff. The channel slopes from east to west over 1,700 m. The department understands that there is limited seepage management infrastructure installed at TSF1, as seepage modelling undertaken at the time of its assessment indicated that tailings seepage would migrate predominantly south, towards the waste rock dump and the Salt Creek open pit. As such, a downstream external toe drain was not considered necessary at the time.

It is understood that the surface tailings have drained and consolidated such that construction vehicles can mobilise on parts of the tailings beach in order to harvest dried tailings. The tailings were used for the construction at the neighbouring TSF2. The borrow zones extend up to 3.0 m deep and 1.5 m deep along the southern and eastern extent of TSF1, respectively.

Following the completion of TSF1, the applicant commissioned the Salt Creek in-pit TSF in 2015. The Salt Creek Pit was initially an open cut pit that was later sterilised and used for tailings deposition. The in-pit TSF received tailings slurry from 2015 to 2021. While the in-pit TSF was designed to provide approximately eight years of tailings storage capacity (at a deposition rate of 1,200,000 tonnes per annum and average *in situ* dry density of 1.5 tonnes/m^3), subsequent surveys found the remaining storage life to be shorter than expected, due to an increase in tailings deposition rate and lower dry densities observed.

In 2021, the department granted works approval W6316/2019/2 to authorise the construction of TSF2 to provide additional tailings storage capacity for three years. The TSF2 was designed as an aboveground 'side-hill' facility, surrounding the Salt Creek in-pit TSF (with tailings overtopping into TSF2 upon reaching capacity at the in-pit TSF), with a maximum embankment height of RL 310.0 m (Stage 3). The northeastern embankment was integrated with the existing waste rock dump, while the south-eastern embankment abuts an existing hillslope.

Embankment raises were constructed using downstream construction method, utilising compacted tailings (i.e., some from TSF1) and suitable mine waste. A seepage cut-off trench was installed under the upstream starter embankment, and a downstream external toe drain was constructed at the starter embankment and during each embankment raise. The Stage 2 toe drain was connected to the Stage 3 toe drain prior to the construction of the Stage 3 embankment raise to retain its functionality and enable continued capture of groundwater.

At the time of the assessment, it is understood that applicant has completed construction of the Stage 3 embankment raise and is undertaking tailings deposition at that embankment.

2.3.1 Groundwater mounding issues

It is expected that tailings deposition into the TSFs at the premises would cause tailings seepage to infiltrate and migrate into the surrounding surface environment. Furthermore, pre-mining groundwater monitoring showed that local groundwater at the premises is naturally shallow. Therefore, appropriate management of groundwater is an ongoing consideration during the operational life of the TSFs at the premises.

Based on groundwater monitoring to date (undertaken in accordance with existing licence L8457/2010/2), it is understood that groundwater mounding at the TSF areas has been a continuous issue at the premises. Groundwater mounding appeared to be caused by tailings deposition. In the early 2010s, groundwater bores near TSF1 (e.g., MB002, BH02, IGRH044, IGRH045) exhibited a shallowing trend, as tailings deposition was occurring at TSF1. Rockwater (2024) noted that standing water levels (SWL) had peaked around 2014 and have been declining since, coinciding with cessation of tailings deposition at TSF1.

During the operation of the Salt Creek in-pit TSF, groundwater mounding was evident at the now-decommissioned monitoring bores SC01, SC02 and SC03 installed around the in-pit TSF (Coffey 2021). Despite the rising water table, groundwater elevation remained relatively low, likely due to the belowground nature of tailings deposition during this period of operations. Nevertheless, the SWL measurements at these monitoring bores continued to rise until their final reading and decommissioning.

Shortly after the commencement of tailings deposition into TSF2 in 2021, the SWL at several nearby monitoring bores continue to show a rising trend. At some monitoring bores, a significant increase in groundwater elevation was observed to coincide with the commencement of tilaings deposition into TSF2 (e.g., MB001, MB002). The NMB series bores (e.g., NMB01, NMB02, NMB03) installed to monitor groundwater impacts from TSF2 immediately exhibited shallow groundwater levels (i.e., <10 meters below ground level (mbgl)) that continued rising over time. Existing licence L8457/2010/2 specifies a limit for SWL for monitoring bores surrounding TSF2, which has been exceeded at one or more bores during every quarterly groundwater monitoring event since March 2021 (Table 1). Controlling groundwater levels has been an ongoing challenge and concern throughout the operation of TSF2.

Table 1: Recent standing water level limit exceedances

Date	MB001[1]	MB002	BH02	NMB01	NMB02[2]	NMB03[3]	NMB04	NMB05	NMB06
Limit	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**N/A**	**N/A**	**4.0**
2020 – Q1	7.03	6.12	6.07	-	-	-	-	-	-
2020 – Q2	6.07	6.24	5.97	-	-	-	-	-	-
2020 – Q3	5.5	6.43	6.00	-	-	-	-	-	-
2020 – Q4	4.68	6.19	5.95	-	-	-	-	-	-
2021 – Q1	3.78[4]	3.8	5.45	6.43	3.88	6.87	-	-	-
2021 – Q2	2.92	3.41	5.27	5.97	3.33	6.50	-	-	-
2021 – Q3	2.41	3.04	5.15	5.12	2.70	6.10	3.55	-	-
2021 – Q4	2.08	2.8	5.10	2.11	2.4	5.66	5.66	-	-
2022 – Q1	1.83	2.27	5.03	4.4	1.91	5.17	2.54	-	-
2022 – Q2	1.91	2.44	4.73	4.71	1.90	4.80	2.32	-	-
2022 – Q3	-	1.98	5.50	4.22	1.84	4.39	1.80	-	1.34
2022 – Q4	-	1.79	4.72	3.92	1.02	3.79	1.64	2.26	0.57
2023 – Q1	-	1.73	4.93	3.63	1.10	3.79	1.69	2.03	0.54
2023 – Q2	-	1.53	4.63	3.36	0.86	3.35	1.29	1.72	0.47
2023 – Q3	-	1.55	4.25	3.21	0.86	3.16	1.16	1.98	0.47
2023 – Q4	-	2.93	4.50	3.37	1.03	2.95	1.23	1.93	2.87

Note 1: Monitoring bore MB001 was decommissioned during quarter 3 of 2022 for the construction of the North Groundwater Recovery Drain.

Note 2: The limit for standing water level at monitoring bore NMB02 was amended from 4.0 mbgl to 0.9 mbgl on 1 July 2022.

Note 3: The limit for standing water level at monitoring bore NMB03 was amended from 4.0 mbgl to 1.5 mbgl on 1 July 2022.

Note 4: Red cells indicate an exceedance of standing water level limit.

2.3.2 Environmental incident at TSF2

On 8 May 2023, the applicant encountered evidence of groundwater expression along the western embankment toe of TSF2 (Figure 1), likely as a result of both the growing mound and also recent heavy rainfall. The incident resulted in varying degrees of environmental impacts to nearby receptors, including vegetation stress and death, salt crusting, and soil and sediment salinisation, which may migrate downstream through the ephemeral Salt Creek. Another similar surface expression event was reported in the same area on 15 August 2023, following another series of rainfall events. These incidents were reported to the department and was further detailed in the Amendment Report for authorising the Stage 2 embankment raise (DWER 2023).

2.3.3 Environmental incident at TSF1

Separate from TSF2, surface expression of groundwater was found occurring at the base of the TSF1 embankment toe on 16 March 2023 (Figure 2a) and reported to the department on 18 March 2024, likely from an un-grouted historical exploration borehole. The bore had likely become artesian and began expressing groundwater as a result of heavy rainfall during the preceding fortnight, resulting in saturated subsurface conditions (Coffey 2024b).

Since the incident, Coffey (2024b) have reviewed the TSF1 embankment and found no changes in the geotechnical stability of the embankment. Furthermore, there were no signs of sand or silt along the discharge flow path that may be indicative of ‘internal erosion’. The incident will be included as part of the applicant’s annual TSF geotechnical audit. Coffey (2024b) concluded that the controlled discharge from the former exploration borehole may have beneficial impacts in reducing subsurface groundwater pressure, such that the bore is acting as an additional groundwater recovery bore.

Aerial drone imagery indicated that the discharged water had entered the premises stormwater drainage network and flowed into Salt Creek, upstream of the previous incident in 2023 (Figure 2c). The release of hypersaline groundwater was limited to this upstream area and the downstream areas that were already impacted in 2023.

Nevertheless, there was evidence of salt crusting and deterioration of vegetation condition in the flow path to Salt Creek. Salt scarring of Salt Creek is also evident in the aerial drone imagery (Figure 2d). The discharge was promptly diverted to an existing turkeys nest, located north of TSF2 (Figure 2b). The rate of water flow entering the turkeys nest was estimated to be up to 7 L/s, though it has since been reduced to approximately 1 L/s. The turkeys nest is equipped with a pump to return the diverted water to the TSF2 supernatant pond. The applicant has also expanded their vegetation monitoring program to include this area, with a snapshot of vegetation condition shown in Figure 3.

Water quality monitoring undertaken on 22 March 2024 at the turkeys nest have found comparable concentrations of pH, total dissolved solids (TDS), and weak acid dissociable (WAD) cyanide (CN) with the supernatant pond and groundwater recovery drains (GRD) at TSF2 (Table 2). This suggests some level of influence from tailings seepage[1].

[1] Source of tailings seepage is likely to be TSF2, as TSF1 has not been receiving tailings slurry since 2014 and any residual WAD CN would likely have degraded. This is plausible as monitoring bore BH02, which is further north of TSF2 (compared to TSF1) has exhibited signs of groundwater mounding, indicating that the widespread extent of tailings seepage from TSF2.

Table 2: Water quality at groundwater recovery and storage locations

Parameter	Unit	Turkeys nest	TSF2 supernatant pond	East Groundwater Recovery Drain	West Groundwater Recovery Drain	Groundwater recovery bore PB1
pH	pH unit	180,000	180,000	190,000	160,000	120,000
Total dissolved solids	mg/L	7.3	7.6	7.1	7.5	4.7
WAD CN	mg/L	3.0	6.1	19.0	0.5	0.008

Nevertheless, surface water within Salt Creek does not appear to be impacted, with water quality remaining brackish and slightly alkaline (Table 3). Notably, the TDS concentrations during this monitoring event appearing to be lower than those measured by Stantec (2023) following the May 2023 incident[2]. No WAD CN was detected above the limit of reporting during both monitoring events.

Table 3: Surface water quality along Salt Creek

Parameter	Unit	Upstream	Central	Downstream
pH	pH unit	3,500	8.3	<0.004
Total dissolved solids	mg/L	3,600	8.4	<0.004
WAD CN	mg/L	3,600	8.4	<0.004

In response to persisting groundwater mound and groundwater expression incidents, the applicant has designed Groundwater Management Plans (GMP) (Coffey 2021, 2023a, 2024), undertaken investigations (Stantec 2023), groundwater (Rockwater 2024) and vegetation monitoring (SLR 2022b, 2023b, 2023c, 2024b), as well as implemented groundwater recovery measures, in order to manage the extent of groundwater mounding.

[2] That being said, it is not certain where the upstream, central, and downstream monitoring locations were in the 22 March 2024 monitoring event and how accurately they corresponded to the monitoring locations specified in Stantec (2023). The findings of the Stantec (2023) assessment are detailed in DWER (2023).

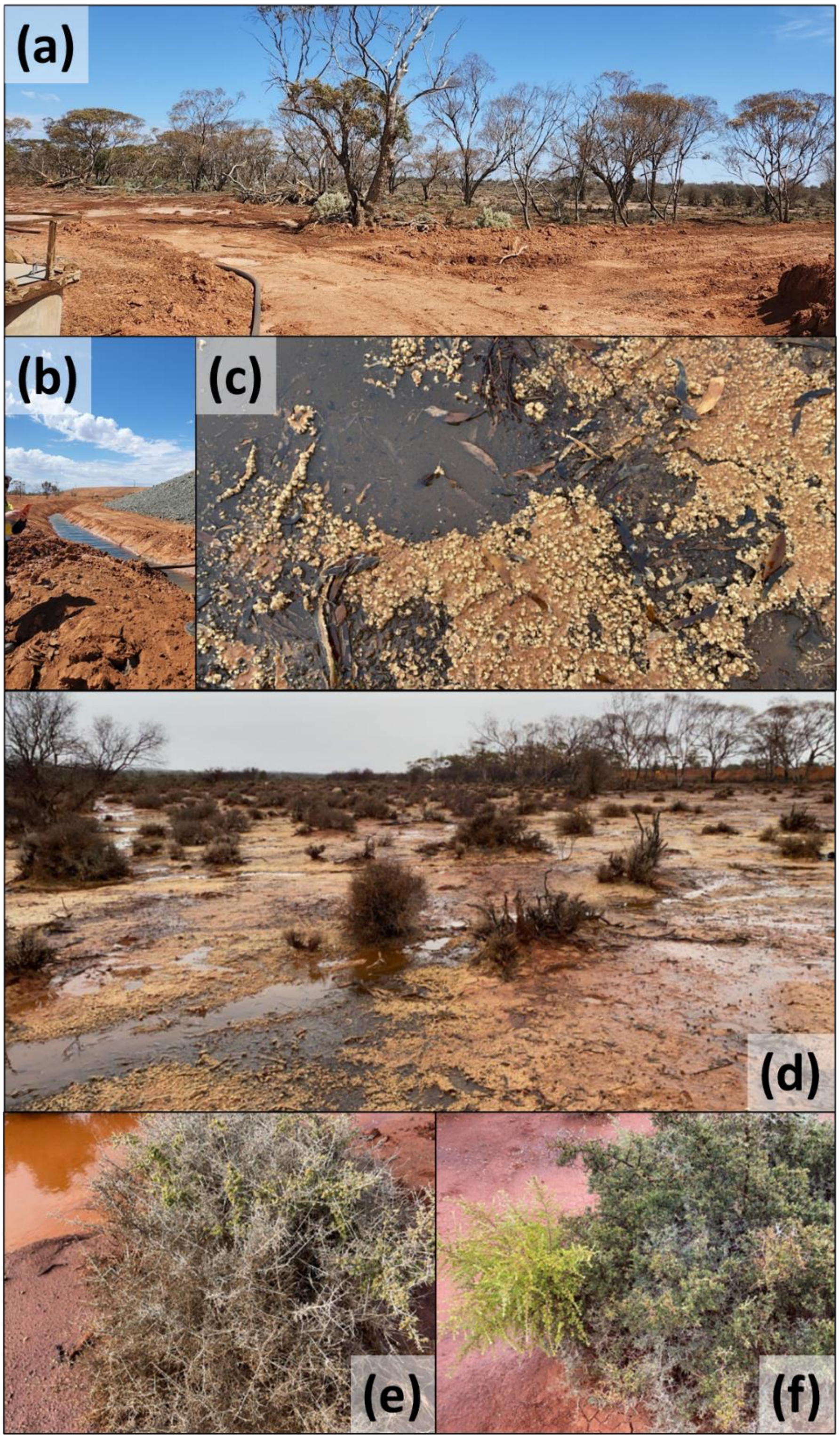

Figure 1: Photographic documentation of environmental impacts from surface expression at TSF2[3]

[3] (a) Vegetation stress and potentially vegetation death on the northern boundary of TSF2, observed at an inspection by Department of Energy, Mines, Industry Regulation and Safety in March 2023. (b) TSF2 toe drain filled with intercepted groundwater, (c) Salt crusting and (d) Vegetation degradation due to surface expression of groundwater, (e) Stressed vegetation condition in the impacted area, compared to (f) vegetation outside the impacted area.

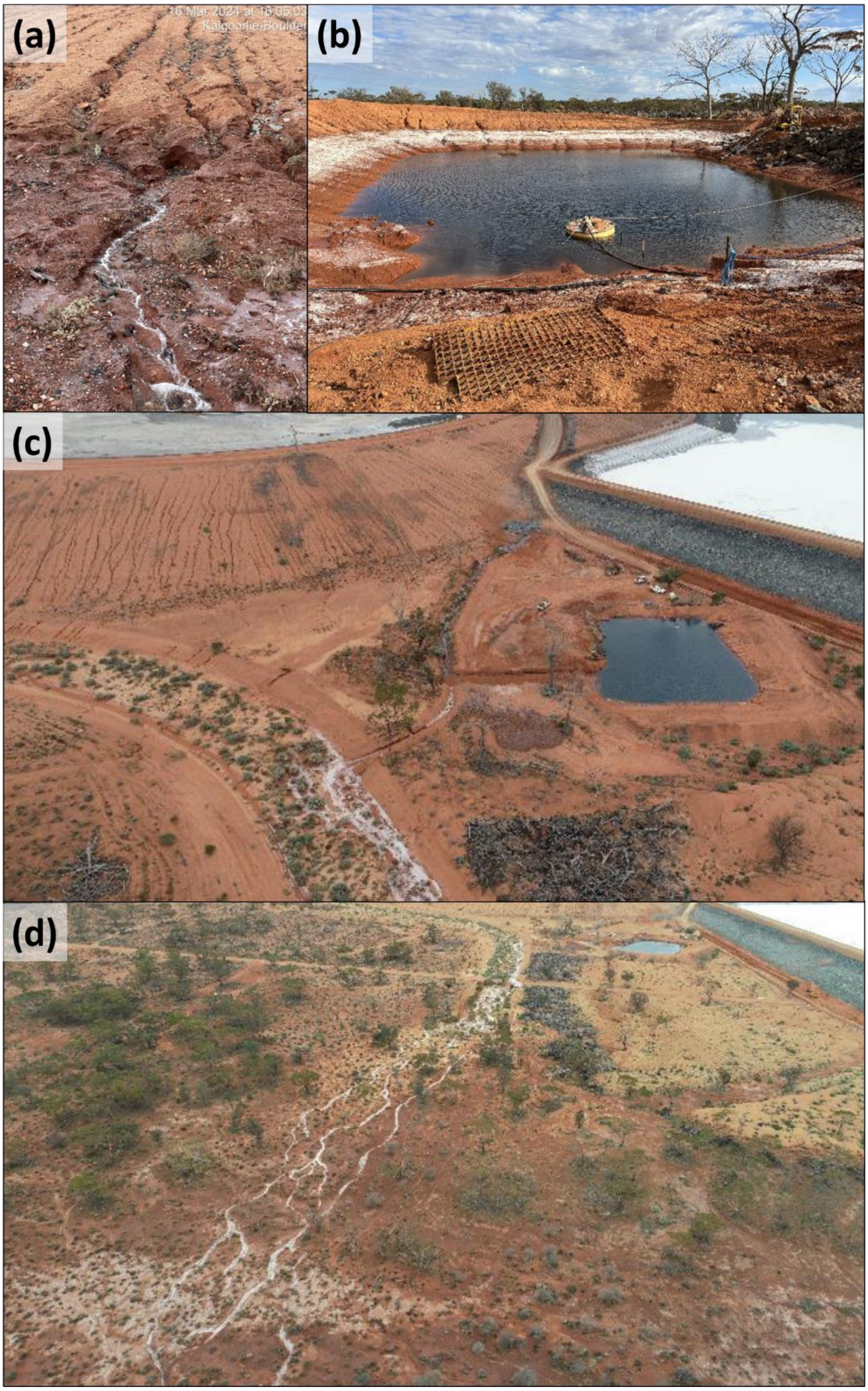

Figure 2: Photographic documentation of environmental impacts from surface expression at TSF1[4]

[4] (a) Surface expression of groundwater from the toe of TSF1 western embankment, (b) Surface expression directed to the TSF turkeys nest for storage, (c) Aerial view of trench diverting surface expression to TSF turkeys nest, where it had previously flowed into and along Salt Creek, (d) Salt crusting along Salt Creek showing the extent of the discharge.

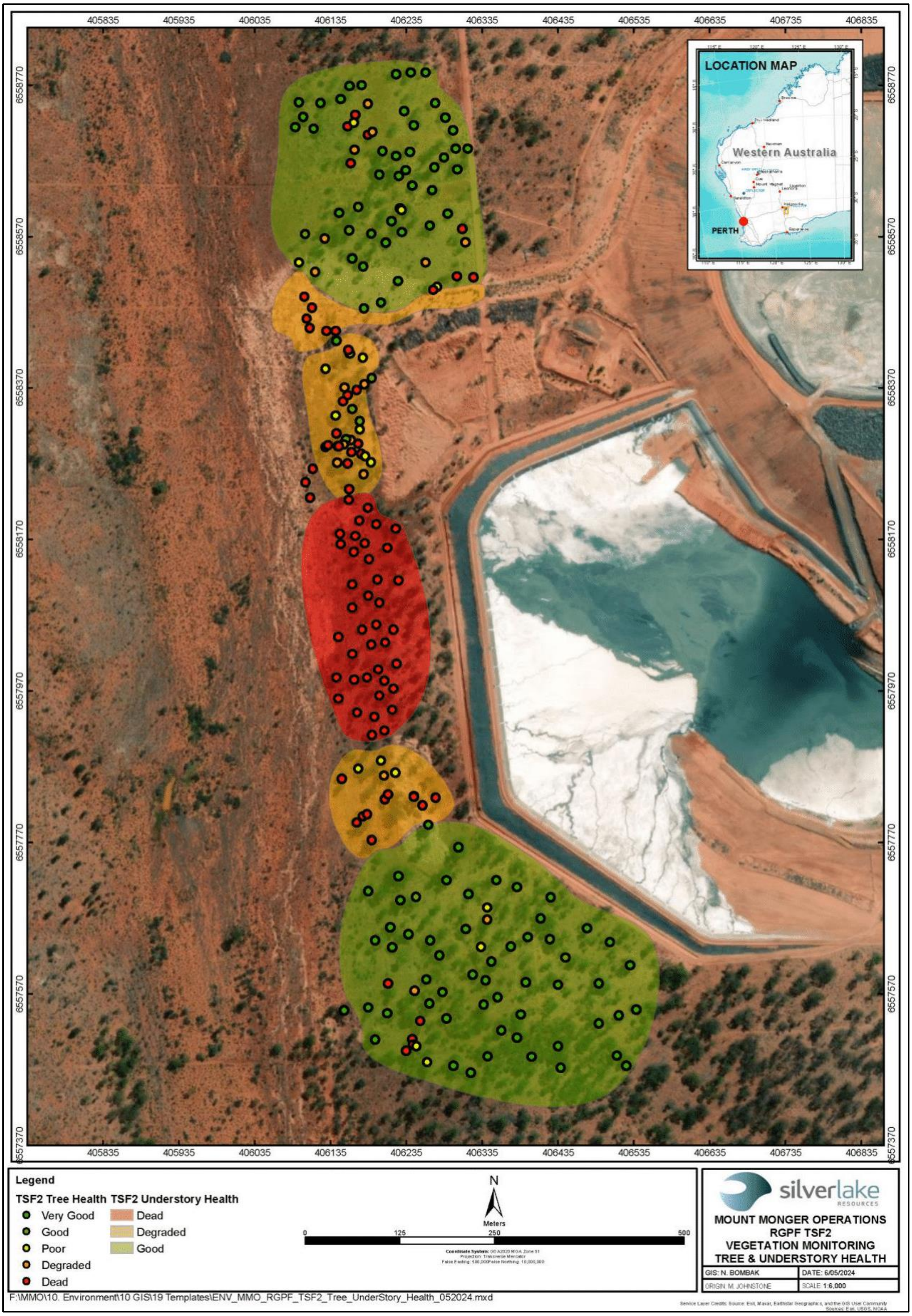

Figure 3: Heat map of tree and understorey vegetation condition

2.3.4 Specified actions

In a previous amendment to existing licence L8457/2010/2 (DWER 2023), the department had conditioned a number of specified action requirements to address ongoing groundwater management issues at TSF2. The applicant has since met the specified action requirements, which is summarised in Table 4 and will be considered in this assessment, in relation to the proposed activities. While the specified action requirements were conditioned with the intention to manage long-term tailings deposition at TSF2 (i.e., beyond Stage 3), the applicant intends to implement the actions to TSF1 as well.

Table 4: Licence L8457/2010/2 specified action requirements and actions taken

Item	Specified action requirements	Aim	Actions taken
1	Preparation of a Water Reduction Action Plan (WRAP).	To reduce water input into TSF2, reducing the potential amount of tailings seepage generated. This specified action targeted the minimisation of the emission source.	The applicant submitted a WRAP on 22 March 2024 (SLR 2024a), with the following actions: 1. Maintain supernatant pond at TSF2 and TSF1 as small as practicable; 2. Design lined return water ponds at the processing facility to store bore water, instead of discharging directly into TSF2; and 3. Discharge recovered groundwater into lined return water ponds for reuse in the processing circuit, instead of discharging directly into TSF2.
2	Investigation of the extent of groundwater mounding and review of existing groundwater monitoring bore network.	To better characterise the existing groundwater mounding at TSF2 and to ensure that the premises' groundwater monitoring bore network had adequate coverage to continue delineating the groundwater mound.	The applicant submitted a review on 22 March 2024 (Rockwater 2024), with the following findings: 1. Premises hydrogeology comprised shallow aeolian sands, followed by clayey and silty materials of alluvial and colluvial origin, then clayey material interspersed with paleodrainage sands overlaying a mafic bedrock; 2. Aquifer permeability based on falling head test, showing low permeability at bores west of TSF2; 3. Analysis of groundwater levels and quality data suggesting that seepage is flower from west to south-east of TSF2, with the groundwater mound is likely contained locally to the east of TSF2, near bore IGRSM006 with limited migration. Recommendations included: 1. Installation of shallow and deep monitoring bores at six additional locations to better delineate extent of groundwater mound; 2. Monitoring of existing bore IGRSM007; 3. Identification of WAD CN source at IGRH044; 4. Monitoring and comparison of water quality between groundwater recovery drains and TSF2 tailings supernatant.
3	Investigation of feasibility to convert historical production bores into groundwater recovery bores.	To determine additional groundwater recovery capabilities at the premises, including the use of active abstraction to complement existing passive recovery methods (e.g., drains	The applicant submitted a report on 21 December 2023 (SLR 2023a) summarising the bores that were investigated. The report is continuously updated based on new bores investigated. As of 22 May 2024, the findings included: 1. Up to nine historical bores investigated; 2. Three bores were successfully converted (e.g., PB1, RB1, RB3), with four bores awaiting pump installation or requiring further investigation (e.g., RB2, RB4, RB5,

Item	Specified action requirements	Aim	Actions taken
		and sumps).	PB5); 3. Two bores were determined to be unfeasible for conversion due to low yield.
4	Preparation of a groundwater management plan / strategy.	To review and propose controls for managing groundwater mounding, such that standing water level limits can be complied with, for the remaining operational life of TSF2. This specified action addressed the pathway linking the emission source and sensitive receptors.	The applicant submitted an addendum (Coffey 2024b) to the existing Groundwater Management Plan (Coffey 2021) on 22 March 2024, with the following actions: 1. Develop additional groundwater recovery bores north of TSF2, including one potentially near monitoring bore NMB01 (subject to further hydrogeological investigation); 2. Monitor the efficiency of the East Groundwater Recovery Drain; 3. Monitor and manage historical exploration boreholes that become artesian; 4. Install additional groundwater monitoring bores to better understand local hydrogeology (refer to Specified Action Item 3); 5. Improve seepage collection practices and potentially installing additional recovery drainage and/or recovery bores; and 6. Implement the WRAP.

2.4 Proposed activities

2.4.1 TSF1 and TSF2 embankment raises

Perimeter embankments

As part of the proposed activities, TSF1 and TSF2 will be raised to a maximum embankment height of RL 330.5 m and RL 319.0 m, respectively. The embankment raises at each TSF will be constructed over three stages, beginning with TSF1 Stage 1 embankment (Table 5). The proposed series of embankment raises is expected to provide up to 7,810,000 tonnes of additional tailings storage capacity, which is sufficient for meeting tailings storage requirements for the next 6.01 years (assuming average tailings deposition rate of 1,300,000 tonnes per annum at dry density of 1.4 t/m^3 and an average tailings beach slope of 1%).

Table 5: Proposed TSF embankment raise and storage characteristics

TSF	Stage	Embankment height (mRL)	Embankment raise increase	Construction sequence	Storage capacity (tonnes)	Storage life (years)
TSF1	1	325.5	2.5 m per embankment raise	1	830,000	0.64
	2	328.0		3	720,000	0.56
	3	330.5		5	690,000	0.53
TSF2	4	313.0	3.0 m per embankment raise	2	1,750,000	1.35
	5	316.0		4	1,900,000	1.46
	6	319.0		6	1,920,000	1.47

The TSF1 and TSF2 embankment raises will be constructed using compacted dried tailings material sourced from their respective tailings beaches. Dried tailings material will be placed and compacted in uniform horizontal layers no thicker than 300 mm to achieve a density ratio greater than 95% of the maximum dry density (SMDD) within the range of ±2% of the optimal moisture content, in accordance with *Australian Standard 1289.5.1.1*.

The downstream embankments will be capped with 500 mm of traffic-compacted mine waste rock for erosion protection. The embankment crests will have a 2% crossfall towards the upstream embankment with intermittent gaps to allow for surface drainage and spigotting requirements. Tailings delivery pipelines and spigots will need to be reinstated at TSF1.

As TSF2 is constructed abutting an existing hill slope to the south-east, additional starter embankment will be constructed as the facility is raised. Consistent with the design of the existing embankments, a seepage cut-off trench will be constructed under the upstream starter embankment, as well as an external toe drain next to the downstream embankment. Captured groundwater will drain towards a sump.

The embankment raises for TSF1 and TSF2 will be constructed using upstream construction method. Hence, the consolidation and strength of the deposited tailings, as well as the rate-of-rise at these facilities are an important consideration in the design and operation of these embankment raises. This differed from existing embankment raises at both TSFs, which had been constructed using downstream construction method up to this stage, which were not as reliant on the consolidation and strength of deposited tailings.

Decant system

A decant tower will be re-constructed and raised using slotted pre-cast concrete pipes stacked vertically and surrounded by a rock ring at TSF1, while the existing decant tower at TSF2 will continue to be raised using the same material. The location of the TSF1 decant tower will be changed from the previous location (i.e., near the southwest embankment) to a centre of the facility, which will be connected to the southern embankment via an accessway. The decant accessways will be constructed using selected clean rock fill.

Each decant tower will be equipped with a dedicated pumping system to recover tailings supernatant and pump it to the processing plant via return water pipelines. The decant water will be stored in return water ponds and be reused in the ore processing circuit.

Operational activities

The applicant has requested time limited operation for each embankment raise for up to 180 calendar days while existing licence L8457/2010/2 is amended to authorise their ongoing operation.

During operation of the TSF1 and TSF2 embankments raises, tailings slurry will be discharged sub-aerially and cyclically via multiple spigots in thin discrete layers of nominal 300 mm thickness. This allows deposited tailings to dry and consolidate, which improves the density and strength of the material. Depositional cycles will enable a tailings beach to form a 'depressed cone', which channels water away from the perimeter embankments to the decant tower, while maintaining freeboard requirements (i.e., sufficient to contain a storm event of 1:100-year Annual Exceedance Probability [AEP] for 72 hours, in addition to 500 mm of total freeboard). Tailings deposition will also rotate between TSF1 and TSF2 to support this and embankment construction activities.

Current water management practices at the premises involve discharging bore water from the Luck Bay borefield into the TSF2 supernatant pond to ensure sufficient water levels at the supernatant pond before decant water is returned to the processing facility. Doing so also allows minerals in the water to precipitate and settle, which minimises the occurrence of scaling damage within the processing circuit. It is likely that the addition of bore water would also be required for decant recovery at TSF1. Furthermore, recent groundwater recovery activities at TSF1 and TSF2 have also resulted in recovered groundwater being discharged into the TSF2 supernatant pond as well.

As part of the proposed embankment raises, the applicant will implement a Water reduction Action Plan (WRAP) (SLR 2024a), which includes the construction of additional return water ponds at the processing facility to store bore water and recovered groundwater. Hence, water addition from external sources (e.g., Lucky Bay borefield, groundwater recovery) is not proposed to continue beyond operation of the TSF2 Stage 3 embankment. A smaller supernatant pond is expected to produce decant water that is more turbid or 'dirtier'. The applicant will manage the supernatant pond such that decant recovery can be maximised without compromising embankment stability or exacerbating seepage losses from the facilities.

In order to minimise tailings seepage generated from the facilities, the supernatant pond will be maintained at a size as small as practicable at all times, in accordance with the WRAP. To minimise potential seepage through the embankment, a separation distance will also be maintained between the perimeter embankments and the supernatant pond boundary.

There will be no changes to the geotechnical or geochemical properties of the tailings slurry that is proposed to be deposited into the raised embankments. The tailings slurry will be sent from the adjacent processing facility, which utilises conventional carbon-in-pulp process to recover gold. The processing facility will accept various ore types, comprising oxide transition and fresh ore, as well as blends of the two, from the Daisy Milano, Mount Belches underground and open pit mines and the Aliss open cut pits.

2.4.2 Return water ponds

As part of the applicant's WRAP, two additional return water ponds will be constructed at the processing facility, located east of TSF1 and TSF2. The applicants to reduce water discharged into and contained within TSF2 by ceasing input of bore water and recovered groundwater into the facility. Instead, bore water and recovered groundwater will be pumped to and stored at the return water ponds. The return water ponds will also be used to store return water from TSF1 and TSF2, as well as process water from the processing plant.

The return water ponds will be constructed using compacted suitable cut material from the basin area or borrow material from elsewhere in the premises. The embankment, walls and base of the ponds will be lined with 2.0 mm of high-density polyethylene (HDPE) over a geosynthetic clay liner (GCL) subgrade. The GCL will be smooth and free of projections.

The northern and southern ponds will have a storage capacity of approximately 4,982 m^3 and 5,043 m^3, respectively. The combined storage capacity of 10,025 m^3 is expected to store up to 2.8 days of water, at an estimated rate of 3,560 m^3/day.

The return water ponds will be equipped with emergency spillways to prevent overtopping. An internal spillway will also be installed between the two ponds. Spillways will be 20 m wide and 0.5 m deep, with at least 300 mm thick rip-rap rock layer placed below the external spillway for erosion protection. Diversion channels will also be constructed to divert spillway flow away from access roads and downstream embankments. The design of the return water pons is based on meeting operational freeboard requirements of 300 mm below the spillway elevation. The flow capacity of the spillway provides sufficient capacity to contain a 1-in-100 year 72-hour storm event.

2.4.3 Modifications to West Groundwater Recovery Drain

The open West GRD was constructed by the applicant in July 2023, as a control to managing the groundwater expression incident at TSF2 in May 2023. At the time, the department decided that the construction of the drain did not require approval under Part V Division 3 of the EP Act as it was time-critical and necessary for mitigating further environmental harm.

Since then, the applicant has constructed the East GRD (authorised under existing licence L8457/2010/2), which is parallel to the West GRD, closer to TSF2. While the efficacy of the East GRD is still being monitored, it appears to be effective in capturing groundwater, as the West GRD have been mostly dry, except to the north. Furthermore, monitoring bore NMB02, which was adjacent and hydraulically downgradient of the West GRD, have experienced declining SWL since April 2024.

For operational purposes, the applicant has proposed to retain the West GRD, with the following modifications made to it:

1. Installation of a concrete-lined sump, equipped with pumping capabilities, at the northern and southern ends of the drain;
2. Re-level of the drain base to ensure adequate grading for flow to reach sump well;
3. Backfilling of the drain with coarse broken rock material to 0.5 mbgl, and clay subsoil material to natural ground level, to improve operational safety and minimise input from rainfall and surface runoff.

No time limited operation is authorised under this works approval for the West GRD, as its operation is also authorised and required under existing licence L8457/2010/2.

2.4.4 Additional groundwater monitoring bore installation

Recommendations from a groundwater mounding characterisation and monitoring bore review (Rockwater 2024) included the installation of additional groundwater monitoring bores around TSF1 and TSF2. The rationale for the additional bores was to better characterise the groundwater mounding at TSF2 (and potentially at TSF1 once tailings deposition recommences). Additional information obtained from the bore drilling and groundwater monitoring program will further refine the conceptual hydrogeological model and inform siting of future seepage management infrastructure (e.g., recovery bores).

The proposed locations of these monitoring bores were based on better groundwater mounding delineation to the west and south-east of TSF2, where groundwater levels are shallow and rapidly rising, respectively. Monitoring bore NMB12 was proposed to identify the source of WAD CN detected in existing monitoring bore IGRH044.

It is proposed that a shallow and deep monitoring bore be installed at each monitoring location. The shallow monitoring bores will be slotted in the shallow sediments (i.e., approximately six metres below the intercepted water table, or up to 15 mbgl), while the deep monitoring bores will be slotted in the deeper saprolitic clays (i.e., approximately 36 mbgl). The monitoring bores will be constructed with 50 mm uPVC casing.

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 2020b).

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

3.1 Source-pathways and receptors

3.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises construction and operation, which have been considered in this decision report are detailed in Table 6 below. Table 6 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 6: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Dust	Construction of the TSF1 (Stage 1 to 3) and TSF2 (Stage 4 to 6) embankment raises; Construction of two return water ponds; Modifications to West Groundwater Recovery Drain.	Air / windborne pathway	• Water carts will be utilised for dust suppression during construction activities, with dribble bars used to avoid over-spraying. • Embankment construction material will be moisture conditioned at borrow locations and/or at the TSF embankment areas to minimise dust lift-off.
Sediment laden stormwater		Overland runoff during rainfall event	None.
Hydrocarbon and other chemical reagent		Loss of containment, resulting in spills and leaks	• Storage of hydrocarbons will be managed and inspected during construction activities.
Operation (including time limited operation)			
Dust (dried tailings)	Tailings deposition into TSF1 (Stage 1 to 3) and TSF2 (Stage 4 to 6) embankment raises.	Air / windborne pathway	• Tailings delivery spigot points will be rotated around the TSF perimeter embankment to maintain damp tailings beach conditions. Spigot rotation may be adjusted to have shorter drying cycles in order to maintain damp beach conditions and minimise dust liftoff, though care will be given to maintain the intent of the deposition plan.
Sediment laden stormwater		Overland runoff during rainfall event	• Downstream embankments will be capped with at least 500 mm of compacted mine waste. • Embankment crest will be constructed to have 2% crossfall towards the upstream side of the TSF, with intermittent gaps to allow surface drainage into the tailings beach.
Tailings supernatant		Vertical infiltration and lateral migration through base and embankment wall	• Tailings deposition strategy will involve discharging tailings slurry subaerially and spirally around the full perimeter of the TSF embankments to form and maintain desire tailings beach and supernatant pond. • Tailings deposition will rotate between TSF1 and TSF2 to allow tailings in inactive TSF to dry and embankment raise to be constructed. • Supernatant pond will be maintained as small as practicable, around the decant tower. • New decant tower will be constructed to be at the centre of the TSF1. • Separation distance between supernatant pond boundary and respective perimeter embankments will be maintained (i.e., at least 120 m at TSF1 and at least 200 m at TSF2). • Decant tower pumping will be maintained to maximise decant water recovery from the

Emission	Sources	Potential pathways	Proposed controls
			supernatant pond. • Floating pontoon mounted pump will be kept on standby in case decant tower is rendered inoperable (e.g., blockage, maintenance, etc.). • Supernatant pond and TSF embankments will be inspected at least daily for evidence of seepage, as well as embankment cracking or erosion. • Seepage cut-off trench will be constructed underneath starter embankments (applicable to south-eastern portion of TSF2. • The West Groundwater Recovery Drain will be retained and backfilled to be a closed system, such that rainfall and runoff input is minimised. • Groundwater management infrastructure (e.g., downstream toe drain, groundwater recovery drain, groundwater recovery bores, etc.) will be maintained to maximise groundwater capture and recovery. Where possible, these infrastructure will be operated continuously, as needed (other than during maintenance activities). • Exploration bores that become artesian and are discharging groundwater will be inspected and managed, such that the discharge does not impact on sensitive receptors. • Two additional return water ponds will be constructed next to existing process water ponds to store bore water from the Lucky Bay borefield, recovered groundwater and process water; • With the commissioning of the return water ponds, discharge of bore water directly into TSF2 will cease; • Routine groundwater monitoring will continue to be undertaken around TSF2 (including existing monitoring bore IGRSM007), in accordance with condition 15 of existing licence L8457/2010/2. • A deep and shallow groundwater monitoring bore will be installed at six additional locations around the TSF area to further characterise groundwater mounding and assess potential impact to sensitive receptors. • Where available, captured groundwater from groundwater recovery drains will be sampled periodically for comparison against ambient groundwater and tailings decant water quality. • Additional groundwater recovery drains and/or recovery bores will be designed based on further hydrogeological information obtained from additional bore installation and monitoring. • Updated hydrogeological assessment and recovery bore design to be undertaken within nine months of granting works approval

Emission	Sources	Potential pathways	Proposed controls
			W6927/2024/1. • Monthly water balance monitoring will continue to be undertaken to estimate and assess seepage trends over time, in accordance with condition 16 of existing licence L8457/2010/2. • Routine vegetation condition monitoring will continue to be undertaken around TSF2 (including where groundwater monitoring bores are located), in accordance with condition 17 of existing licence L8457/2010/2. • Phreatic surface of embankments will be monitored using vibrating wire piezometers (VWP), with new VWPs to be installed at TSF1 (where there is none currently) and malfunctioned VWPs to be replaced at TSF2.
Tailings slurry		Overtopping of TSF1 and/or TSF2	• TSF1 and TSF2 have been designed to temporarily store rainfall from a 1:100-year annual exceedance probability (AEP) 72-hour storm event, in addition to maintaining a minimum operational freeboard of 300 mm and beach freeboard of 200 mm. • TSF1 and TSF2 have also been designed to temporarily store rainfall from a 4-hour probable maximum precipitation event of 610 mm at full storage capacity (i.e., immediately prior to an embankment raise). • During operation, a total freeboard of 500 mm will be maintained, in addition to sufficient capacity to contain a 1:100-year AEP storm event for at least 72 hours. • Supernatant pond will be inspected at least daily to ensure required freeboard is available.
Decant / return water	Operation of return water ponds	Pipeline rupture or failure, resulting in leaks and spills	• All tailings delivery and decant/return water pipelines will be bunded and equipped with pressure sensors/telemetry or cut-off valves. • Pipelines installed will be designed to consider high ambient temperature and loss in pipe strength. • Tailings delivery pipeline will be located within bunded corridor with associated scour sump at sag points along the corridor. • Pipelines will use automated leak detection system, where flow rates and pressure losses can be monitored from a control room. • All tailings delivery and decant/return water pipelines will be inspected at least every 12 hours (i.e., once per shift). • Pipelines will be replaced periodically as part of preventative maintenance.
		Overtopping of return water ponds	• An emergency spillway, lined with rip-rap rock layer, will be constructed at each return water pond to prevent overtopping. Both return water ponds will also be connected via an internal

Emission	Sources	Potential pathways	Proposed controls
			spillway. • Diversion channels will be constructed to the south and west of the return water ponds, along access roads, to divert water from spillways away from downstream pond embankments. • Return water ponds will be equipped with high water level alarms. • Return water ponds will be inspected regularly to ensure pond water levels are below the design water level.
		Vertical infiltration and lateral migration through base and pond wall	• Return water ponds will be lined with 2.0 mm of HDPE over a geosynthetic clay liner (GCL) subgrade. The GCL will be smooth and be free of projections that could damage the liner.

3.1.2 Receptors

In accordance with the *Guideline: Risk Assessment* (DWER 2020b), 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 7 below provides a summary of potential human and environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises *(Guideline: Environmental Siting* (DWER 2020a)).

Table 7: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	Distance from prescribed activity
None	N/A
Environmental receptors	**Distance from prescribed activity**
Native vegetation	A vegetation survey of the premises identified *Maireana, Eremophila, Eucalyptus, Acacia* and *Atriplex* as the dominant genera (**Outback Ecology 2009b**). Vegetation communities at the premises were considered typical of the Goldfields region and was well represented outside the premises. Recent vegetation quadrat monitoring in 2024 showed that floristic species richness around TSF area ranged between three to up to 16 species within a 100 m^2 area. Vegetation conditions around TSF2 was shown to range between 'Degraded' to 'Excellent', with majority of quadrats rated as 'Degraded' or 'Poor'. Based on the location of degraded quadrats, the primary cause of deterioration of vegetation health was due to recent events involving surface expression of hypersaline groundwater, which had also formed a salt crust in these areas. There was also evidence of cattle grazing in the area, which were likely the cause of vegetation degradation in areas outside of the salt crust. Riparian vegetation, including *Cratystylis subspinescens, Maireana pyramidata* and *Tecticornia* species were sighted along Salt Creek (Outback Ecology 2009a), which are common species on saline clay pans (Western Australian Herbarium 2023).
Conservation significant	There is one sighing of *Eucalyptus websteriana* subsp. *norsemanica* (Priority 1)

flora	located near the premises boundary, approximately one kilometre south-east of TSF2.
Surface water body	Salt Creek, a tributary of Lake Randall, is located approximately 200 m west of the TSF2 western embankment. The creek is ephemeral, flowing from the north to the south periodically for short periods following extreme rainfall events. The morphology of Salt Creek is characterised by braided channelling. Previous studies have found diatom species from sediments at Salt Creek, with *Navicula symmetrica* and *Nitzschia palea* being the most dominant species (Outback Ecology 2009a), which are generally associated with low salinity lakes and creeks (John 1998; Taukulis & John 2009). Only one algal specimen was observed in a non-flowing pool during a recent site visit (Stantec 2023). To date, no biologically significant elements have been identified at the Salt Creek. Algal, invertebrate, vegetation and fauna associated with salt creek were not considered to be unique and were typical of inlands lakes throughout the semi-arid region of Western Australia (Outback Ecology 2009a). Salt Creek flows into Lake Randall, a major ephemeral playa within the Lefroy paleodrainage located approximately 4.5 km south of TSF2.
Groundwater aquifer	The regional water table occurs at a depth ranging from less than one metre below ground level (mbgl) around the low-lying Lake Randall to over 50 mbgl in elevated areas. Regional groundwater flows towards Lake Randall, where the water table is closest to the surface. During the December 2023 groundwater monitoring event, groundwater depths at the premises ranged from 1.03 mbgl to 24.94 mbgl, with shallowest groundwater present west of TSF2 gradually deepening to the east. Groundwater at the premises has been influenced by seepage and groundwater mounding, especially at bores near TSF2. Field groundwater pH ranged from 3.71 pH unit to 7.53 pH unit, indicating acidic conditions. Field total dissolved solid (TDS) concentrations ranged from 34,190 mg/L to 110,695 mg/L (dominated by sodium chloride), which is considered saline to hypersaline and characteristic of the regional groundwater quality. There are no third-party groundwater users within 20 km of the TSF area, except for other mining operations. While there are no groundwater dependent ecosystems within the premises, national assessment from the GDE Atlas predicted that native vegetation at the Lake Randall playa may be groundwater dependent.

3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020b) 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 8.

Works approval W6927/2024/1 that accompanies this decision report authorises construction and time-limited operations. The conditions in the issued works approval, as outlined in Table 8 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 i.e. tailings deposition at TSF1 and TSF2. 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 8: Risk assessment of potential emissions and discharges from the premises during construction and time limited 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 of three embankment raises at TSF1 (Stage 1 to 3) and TSF2 (Stage 4 to 6) to RL 330.5 m and RL 319.0 m, respectively; Construction of two return water ponds; Modifications to West Groundwater Recovery Drain	Dust	***Pathway:*** Air / windborne pathway ***Impact:*** Impact to ecological health and amenity	Native vegetation; Surface water bodies.	Refer to Section 3.1	C = Slight L = Unlikely **Low risk**	Y	Condition 1 – Infrastructure construction requirements	The Delegated Officer has determined that the proposed controls for managing dust, sediment laden stormwater, as well as hydrocarbon and other chemical reagent emissions from the construction of the proposed infrastructure to be adequate. No additional regulatory controls are required.
	Sediment laden stormwater	***Pathway:*** Overland runoff during rainfall events ***Impact:*** Impact to ecological health		None	C = Slight L = Unlikely **Low risk**	Y	None	
	Hydrocarbon and other chemical reagent	***Pathway:*** Loss of containment, resulting in leaks and spills ***Impact:*** Direct discharge to land, resulting in impact to ecological health		Refer to Section 3.1	C = Slight L = Unlikely **Low risk**	Y	None	
Operation (including time-limited-operations operations)								
Tailings deposition into TSF1 and TSF2 up to maximum embankment operating height of RL 330.5 m and RL 319.0, respectively.	Dust (dried tailings)	***Pathway:*** Air / windborne pathway ***Impact:*** Impact to ecological health and amenity	Native vegetation; Surface water bodies.	Refer to Section 3.1	C = Minor L = Unlikely **Medium risk**	Y	Condition 9 – Time limited operation requirements	The Delegated Officer has determined that the proposed controls for managing dust and sediment laden stormwater emissions from the operation of the proposed
	Sediment laden stormwater	***Pathway:*** Overland runoff during rainfall events	Native vegetation; Surface	Refer to Section 3.1	C = Slight L = Rare	Y	Condition 1 – Infrastructure construction	

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				
		Impact: Impact to ecological health	water bodies.		**Low risk**		requirements	infrastructure to be adequate. No additional regulatory controls are required.
	Tailings supernatant	***Pathway:*** Vertical infiltration and lateral migration through base and embankment wall ***Impact:*** Groundwater mounding and deterioration of groundwater quality, potentially resulting in impact to ecological health	Native vegetation; Surface water bodies; Groundwater aquifer.	Refer to Section 3.1	C = Moderate L = Possible **Medium risk** Refer to Section 3.3	N	Condition 1 – Infrastructure construction requirements **Condition 2 – Additional monitoring bore installation requirements** **Condition 6 – Specified action requirements** Condition 9 – Time limited operation requirements Condition 10 – Authorised discharge points Condition 11 – Inspection requirements Condition 15 – Discharge monitoring requirements **Condition 16 – Ambient groundwater monitoring**	Refer to Section 3.3.

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**				
							requirements	
	Tailings slurry	***Pathway:*** Overtopping of TSF1 and/or TSF2 ***Impact:*** Discharge to land, resulting in impact to ecological health	Native vegetation; Surface water bodies.	Refer to Section 3.1	C = Moderate L = Unlikely **Medium risk**	Y	Condition 1 – Infrastructure construction requirements Condition 9 – Time limited operation requirements Condition 11 – Inspection requirements	The Delegated Officer has determined that the proposed controls for managing overtopping and pipeline leakage of tailings slurry emissions from the operation of the proposed infrastructure to be adequate. No additional regulatory controls are required.
		Pathway: Pipeline failure, resulting in spills or leaks ***Impact:*** Discharge to land, resulting in impact to ecological health	Native vegetation; Surface water bodies.	Refer to Section 3.1	C = Moderate L = Unlikely **Medium risk**	Y	Condition 1 – Infrastructure construction requirements Condition 10 – Inspection requirements	
Decant water recovery at TSF1 and TSF2; Transfer of return water to return water ponds.	Decant / return water		Native vegetation	Refer to Section 3.1	C = Moderate L = Unlikely **Medium risk**	Y	Condition 1 – Infrastructure construction requirements Condition 11 – Inspection requirements	The Delegated Officer has determined that the proposed controls for managing infiltration, overtopping, and pipeline leakage of decant / return water from the operation of the proposed infrastructure to be adequate. No additional regulatory controls
Storage of decant / return / process water at return water ponds		***Pathway:*** Overtopping of return water ponds ***Impact:*** Discharge to land, resulting in impact to ecological health	Native vegetation	Refer to Section 3.1	C = Moderate L = Unlikely **Medium risk**	Y	Condition 1 – Infrastructure construction requirements Condition 11 – Inspection	

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				
							requirements	are required.
		Pathway: Vertical infiltration and lateral migration through base and embankment wall ***Impact:*** Groundwater mounding and deterioration of groundwater quality, potentially resulting in impact to ecological health	Native vegetation; Groundwater aquifer	Refer to Section 3.1	C = Minor L = Unlikely **Medium risk**	Y	Condition 1 – Infrastructure construction requirements Condition 11 – Inspection requirements	

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

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

3.3 Detailed risk assessment for tailings seepage from TSF1 and TSF2

3.3.1 Overview of risk events

Through the expansion and continued operation of TSF2 and the recommencement of operation at TSF1, it is anticipated that tailings seepage will continue to be released into the environment through infiltration of the base and embankment walls of the TSFs. Tailings seepage, characterised by the source tailings slurry that is deposited into the TSFs, has the potential to impact surrounding environmental receptors, including nearby native vegetation, surface water body (i.e., the neighbouring Salt Creek), and the local groundwater aquifer.

As detailed in Section 2.3, it is understood that tailings seepage has already been released to the environment during the operation of TSF2, which has resulted in groundwater mounding of the local water table, as well as other associated issues. In considering the proposed activities, a detailed risk assessment is required to assess the risk events associated with the expansion of TSF1 and TSF2. Based on previous assessments (DWER 2023), the risk events of greatest concern involve tailings seepage from TSF2 (and TSF1) infiltrating into the subsurface environment, resulting in the following impacts:

1. Localised mounding of the water table, resulting in potential inundation of the root zone of surround native vegetation; and
2. Subsurface and potentially surface lateral migration of seepage contaminants, resulting in contamination of the unconfined aquifer and potentially migrating to the nearby ephemeral Salt Creek.

3.3.2 Source characterisation: Tailings seepage

Tailings seepage is largely characterised by the properties of the source tailings slurry, which depends on the ore type, as well as chemical reagents added during the mining and beneficiation process.

Tailings slurry that are proposed to be deposited into TSF1 and TSF2 will be produced at the Randalls Gold Processing Facility, located within the premises. The processing facility utilises conventional carbon-in-pulp processes to recover gold from varying grade ore sourced from the Daisy Milano, the Mount Belches underground and open pit mines, and the Aldiss open cut pits (Coffey 2024a).

Tailings seepage quality

The tailings slurry produced were characterised in 2009 to support their deposition into TSF1 and subsequently, the Salt Creek In-Pit TSF (Golder 2009). The applicant has not undertaken further geochemical characterisation works since then as the ore type and processing method has not been modified (Coffey 2024). TSF1 and TSF2 will receive the same type of tailings slurry.

Based on the existing tailings characterisation report (Golder 2009), the tailings slurry is expected to have the following properties:

- Tailings slurry density was between 45% to 50% solids. Recent water balance monitoring between January 2021 and March 2024 indicated that tailings slurry has remained within or above this range, with densities ranging between 47% and 54%. Tailings slurry densities have remained above 50% solids since April 2022 (with one exception).
- Particle size distribution indicated the tailings was slightly coarser than typical gold tailings in the region, suggesting the material may have somewhat higher permeability and favourable consolidation properties. A steeper tailings beach slope may be formed

due to larger particles settling closer to the discharge spigots, hence the proposed 1% slope in the design of TSF1 and TSF2 design. Permeability was expected to decrease logarithmically with increasing tailings height, predicted in the order of 1×10^{-8} m/s at a tailings height of 20 m.

- Settled tailings density ranged between 1.24 t/m^3 and 1.35 t/m^3 (averaging at 1.3 t/m^3), depending on the drainage features, with greater densities achieved when bottom drainage is present (e.g., where seepage can infiltrate through a permeable foundation), though it did take longer. The settled density was revised to 1.4 t/m^3 following an operational review (Golder 2014).
- Air drying test indicated the peak dry density achieved was 1.93 t/m^3, requiring four and 11 days during summer and winter periods, respectively.
- Based on the geotechnical characterisation, cycling tailings discharge between depositional areas every four to five days would allow sufficient drying and consolidation of tailings.
- Tailings slurry was classified as non-acid forming (NAF), with the overall risk of leaching considered to be low due to high acid neutralising capacity buffering against potential acid mine drainage.
- Total elemental analysis indicated that tailings were relatively enriched with arsenic and sulfur.
- Peroxide oxidation leaching tests suggested potential leaching of chloride, fluoride, magnesium, potassium, sodium, manganese, iron, molybdenum, vanadium, and arsenic under acidic conditions after sulfide weathering. Leachate concentrations of other elements generally correlated with respective total concentrations.
- The pH of the tailings slurry post-oxidation was alkaline, after oxidation. However, the pH of tailings leachate (using distilled water) was slightly acidic (>6 pH unit).
- Based on the tailings storage data sheet, tailings supernatant is expected to be saline to hypersaline, as the ore is processed using local groundwater, which is known to be hypersaline. Recent supernatant monitoring at TSF2 recorded TDS at 180,00 mg/L and WAD CN concentration at 6.1 mg/L (Table 2).

Tailings seepage volume

Seepage volume is an important consideration in assessing the potential impacts of tailings seepage on the environment. The volume of seepage has implications for contaminant loading as well as alteration of local hydrogeological flow regime.

While Coffey (2024a) has undertaken seepage analysis and water balance modelling for the TSF1 and TSF2 up to their respective maximum embankment heights, these predictions (as well as those provided previously) have relied on model assumptions and have not been verified using empirical operational data collected during the operation of the TSF.

Existing licence L8457/2010/2 requires monthly seepage[5] to be calculated as the residual of empirical input and output data, such as rainfall, evaporation, water added as tailings slurry, bore water additions, return water, water retained in the tailings, etc. In comparing this data against the seepage estimated from the most recent water balance model[6] (Coffey 2023b), it was found that empirical seepage remained below the modelled seepage rate during the review period (July 2022 to June 2023) (Figure 4). However, the empirical seepage rate exceeded the modelled rate in May and June 2023, which was likely due to increased water input (e.g., rainfall

[5] For the sake of clarity, this will be referred to as ‘empirical seepage’.

[6] For the sake of clarity, this will be referred to as ‘modelled seepage’.

in winter months, bore water addition) and reduced evaporation rates.

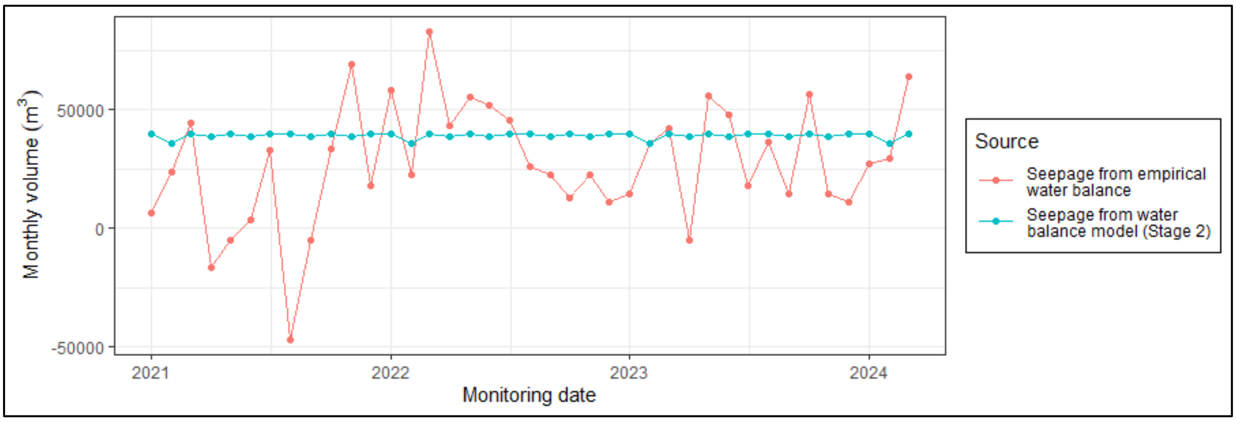

Figure 4: Comparison of historical seepage trends

Overall, empirical seepage data collected to date has shown a high degree of variability, without exhibiting strong seasonal trends. Nevertheless, linear regression analysis has indicated that the strongest predictors of seepage volume was the volume of bore water added (R^2 = 0.27) and volume of return water recovered (R^2 = 0.65) (Figure 5), more so than environmental factors such as rainfall and evaporation. This highlights the importance of minimising additional water inputs into the TSF and maximising water recovery, respectively.

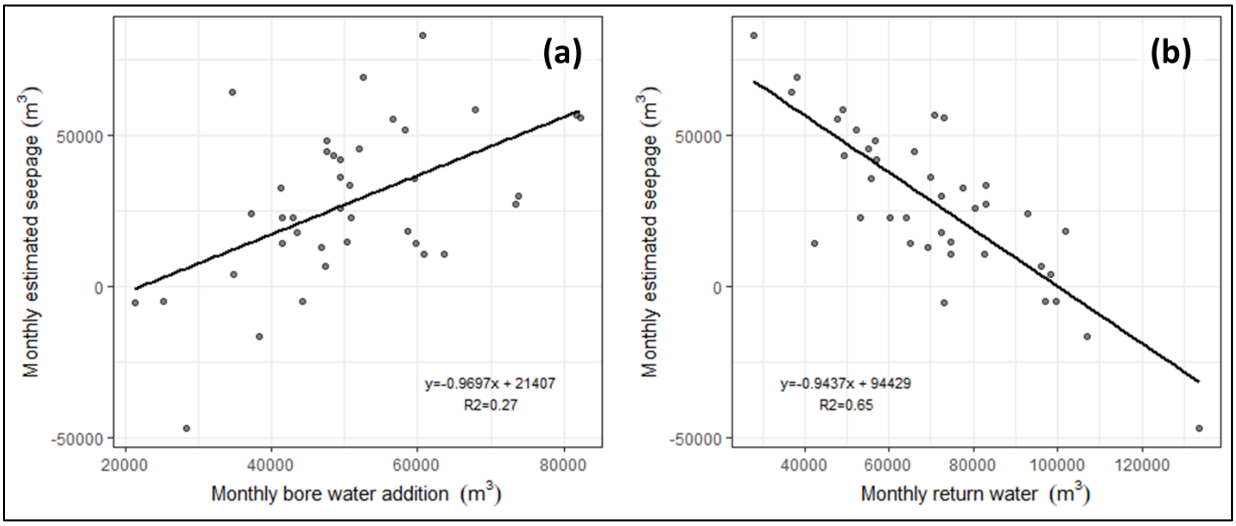

Figure 5: Linear regression analysis between estimated seepage and (a) monthly bore water addition and (b) return water

In considering the above, the water balance model for Stage 6 embankment may provide a useful indication of expected water movements but should be verified using empirical operational data. The following aspects of the water balance were noted[7]:

- Relatively similar volumes of water inputted to both facilities, with total annual input expected to be 2,836,264 m^3. Annual water input to TSF2 has decreased by at least 34%, due to cessation of bore water addition, with potential for slightly more reduction when recovered groundwater also ceases being discharged into TSF2.
- Cumulative annual seepage loss of 655,354 m^3 is expected, primarily from TSF2.

[7] While separate water balances were prepared for TSF1 and TSF2 due to differences in tailings storage areas, discharge lengths, supernatant pond sizes and relative decant locations between the two facilities, water balance parameters will be discussed cumulatively.

Generally, the volume of seepage lost through the base of the TSF is higher than seepage lost through the perimeter embankment (Table 9). While TSF1 is expected to have higher seepage lost through the perimeter embankment, TSF2 will have nearly three times the volume of seepage lost through the base compared to TSF1.

- While the volume of modelled seepage at the expanded TSF2 is comparable with current modelled seepage, the predicted cumulative seepage losses are likely to be higher than previously observed, due to the operation of both TSF1 and TSF2 concurrently. Historically, tailings deposition had only occurred at one facility at a time. Furthermore, the pan evaporation factor applied to both facilities was likely higher, which would lead to an overestimation of evaporative losses[8]. Therefore, the expected increased volume of seepage over a larger footprint will likely require additional and proactive seepage management.
- The expected annual average decant water recovery rate for TSF1 and TSF2 is expected to be 53.5% and 27.3%, respectively. The expected recovery rate at TSF2 is significantly lower than TSF1. Furthermore, it is also lower than the current observed recovery rate of 66.1% during the 2022/2023 period (Coffey 2023b). The low recovery rate is due to the model methodology and constant seepage rate. Where possible, a greater recovery rate is likely to be achievable, which would reduce the amount of seepage lost to the environment.

The water balance indicated that seepage from the TSF area will be higher than previously experienced at the premises. While seepage reduction and management actions have been proposed for the TSF1 and TSF2 expansion, the water balance model provided for the expanded TSF as well as empirical water balance highlights the importance of managing water inputs into the TSFs and maximising water removal from the TSFs.

Table 9: Key parameters from seepage analysis and water balance analysis at TSF1 and TSF2

Parameter	TSF1	TSF2	Cumulative	Comments
Seepage rate through perimeter embankment	77.4 m^3/day	46.3 m^3/day	123.7 m^3/day	Based on minimum separation distance between perimeter embankment and supernatant pond.
Seepage through TSF base	399.2 m^3/day	1,272.7 m^3/day	1,671.9 m^3/day	Based on average hydraulic conductivity of foundation material of 3×10^{-7} m/s.
Total seepage	476.6 m^3/day	1,319 m^3/day	1,795.6 m^3/day	----
Excess water available for recovery	1,903 m^3/day	972.0 m^3/day	2,875 m^3/day	Excess water rate derived residual between water output and input. Water balance indicated that 100% of excess water can be recovered.

[8] Pan evaporation factor of 0.65 was applied to both TSF1 and TSF2. This was slightly reduced from the 0.7 applied to the water balance model TSF2 Stage 1 to Stage 3 embankments. However, evaporation rates from hypersaline water bodies are typically lower than those for similar freshwater bodies, with measurements taken from TSFs with hypersaline water in the Goldfields region having a pan evaporation factor of about 0.4 and 0.2 for the supernatant pond and tailings beach, respectively (Newson and Fahey 2003). These pan factors were applied to amended licence L8457/2010/2 in 2023 (DWER 2023).

Parameter	TSF1	TSF2	Cumulative	Comments
Decant recovery rate	53.5%	27.3%	N/A	Excess water available for recovery relative to the total volume of water discharge to TSF as part of tailings slurry. Excludes rainfall and other water inputs.

3.3.3 Pathway characterisation: Hydrogeology

The regional hydrogeology is characterised by weathered and fractured Archean and Proterozoic bedrock of the Yilgarn-Goldfields fractured groundwater province, overlain by widespread Tertiary sedimentary rocks in paleochannels and Cainozoic alluvium and lake deposits (GRM 2014). Bedrock typically outcrops in the south-east of the TSF area, with the overlaying sediment unit thickening towards towards the west beneath Salt Creek. The sediment unit consists mainly of low permeability clay with minor sands and gravels. Rockwater (2024) provided a conceptual hydrogeological model at the premises, which is shown in Table 10 (in order of increasing depth).

Table 10: Conceptual hydrogeological model

Unit	Geology	Depth (m)	Thickness (m)	Description
1	Aeolian sand	0 to 2	< 2	---
2	Alluvial/colluvial	2 to 42	30 to 40	Consisting mottled clay with minor sand and silt with interspersed ferricrete.
3	Clays/silts – carbonaceous	30 to 82	30 to 40	---
4	Sandy with silt and clay	60 to 100	< 20	Often with basal layer gravel/pebbles; typically referred to as the 'lower paleochannel'.
5	Bedrock	>80 to 100	---	Weathered to fresh mafic bedrock (basal or dolerite).

Groundwater is present in shallow deposits of alluvium and colluvium, which have low permeability due to their clayey and silty characteristics. This unconfined aquifer is the aquifer of primary concern, as it is the closest to the surface, and thus, most likely to be impacted by tailings seepage from TSF1 and TSF2. The local water table around the TSF area is considered relatively shallow, which represents a challenging environment for groundwater management.

Prior to commencement of mining, groundwater levels were thought to be irregular and did not represent a consistent spatial distribution, caused by either geological heterogeneity or disturbance from drilling activities. However, groundwater elevation and flow direction were thought to generally mirror regional topography, which was to the south and south-west (Rockwater 2024).

Falling head tests undertaken recently showed that groundwater monitoring bores around the TSF area were primarily screened against Units 2 and 3, as the derived hydraulic conductivities were characteristic of a clayey aquifer unit (Table 11). Of note, hydraulic conductivity of monitoring bores west of the TSF area were relatively low, at less than 0.01 m/day, except at NMB04 and NMB06. On the other hand, monitoring bores to the east of the TSF area had higher and more variable hydraulic conductivity, with the highest conductivity recorded at monitoring bore IGRSM006 in the south-east.

Understandably, monitoring bore NMB04 was required by the department to be screened in the shallow gravel unit, which is likely to be more permeable. On the other hand, monitoring bore NMB06 indicated the bore was screened in the clay unit (SLR 2022a) but has hydraulic conductivity more similar to the eastern monitoring bores. This is consistent with the most severe groundwater mounding observed at monitoring bore NMB06 and the decommissioned MB001.

Table 11: Falling head test parameters

Monitoring bore ID	Saturated aquifer thickness, b (m)	Initial displacement, m (m)	Transmissivity, T (m^2/day)	Hydraulic conductivity, K (m/day)
BH02	26	3.94	0.25	0.010
IGHR044	11	1.63	0.30	0.028
IGHR045	15	2.77	0.23	0.015
IGRSM006	26.5	0.42	1.59	0.060
MB002	56.5	0.45	0.18	0.003
NMB01	31	3.08	0.27	0.009
NMB02	23	1.68	0.18	0.008
NMB03	25	3.34	0.15	0.006
NMB04	16	1.70	0.30	0.019
NMB06	18	1.33	0.65	0.036

3.3.4 Pathway characterisation: Groundwater assessment

The risk events considered in this detailed risk assessment depends on whether (and if so, the extent of) the local aquifer has been or may be impacted by tailings seepage, which may result in either groundwater mounding and/or contamination of the groundwater quality. Routine groundwater monitoring is a useful tool for assessing and detecting changes in groundwater properties.

Groundwater levels

Groundwater monitoring has been undertaken at the TSF area since commencement of mining operations, initially for TSF1 and then subsequently for TSF2. Based on recent groundwater monitoring, SWL has been increasing as a result of groundwater mounding. The SWL limit specified in existing licence L8457/2008/2 (i.e., 4 mbgl) was exceeded at several groundwater monitoring bores throughout the 2022 and 2023 annual periods (e.g., BH02, NM01, NMB02, NMB05, NMB06)(Table 1). The timing of the SWL exceedances broadly coincided with the transition from the in-pit TSF to the aboveground TSF2. Further details on SWL trends during this period were provided in a previous Amendment Report (DWER 2023).

Recent SWL measurements taken at higher frequencies showed that the SWL at these groundwater monitoring bores had been declining and are now able to comply with their corresponding SWL limits, except for MB002, which remained non-compliant at 3.53 mbgl by the end of May 2024. While still non-compliant with the licensed limit, monitoring bore MB002 has exhibited a similar decline in SWL since December 2023. The Licence Holder attributed the recent decline in SWL to improvements in groundwater management infrastructure and operations implemented for TSF2 since October 2023.

The most significant groundwater mounding, and consequently the shallowest groundwater, have been primarily observed in monitoring bores located west of the TSF area, along the Salt

Creek. While this trend is consistent with the regional hydrogeology pre-mining, groundwater levels are significantly shallower to the west (Rockwater 2024).

On the other hand, groundwater monitoring bores located to the east have remained relatively deep and compliant with their corresponding SWL limit (i.e., 6 mbgl) throughout their monitoring lifetime. It is worth noting that, while compliant with its SWL limit, monitoring bore IGRSM006 located south-east of TSF2 has experienced a significant increase in SWL (i.e., approximately 24 m) since 2017, which could potentially be caused by tailings deposition at the Salt Creek In-Pit TSF and TSF2. Rockwater (2024) postulated that IGRSM006 may represent the south-east extent of the groundwater mound.

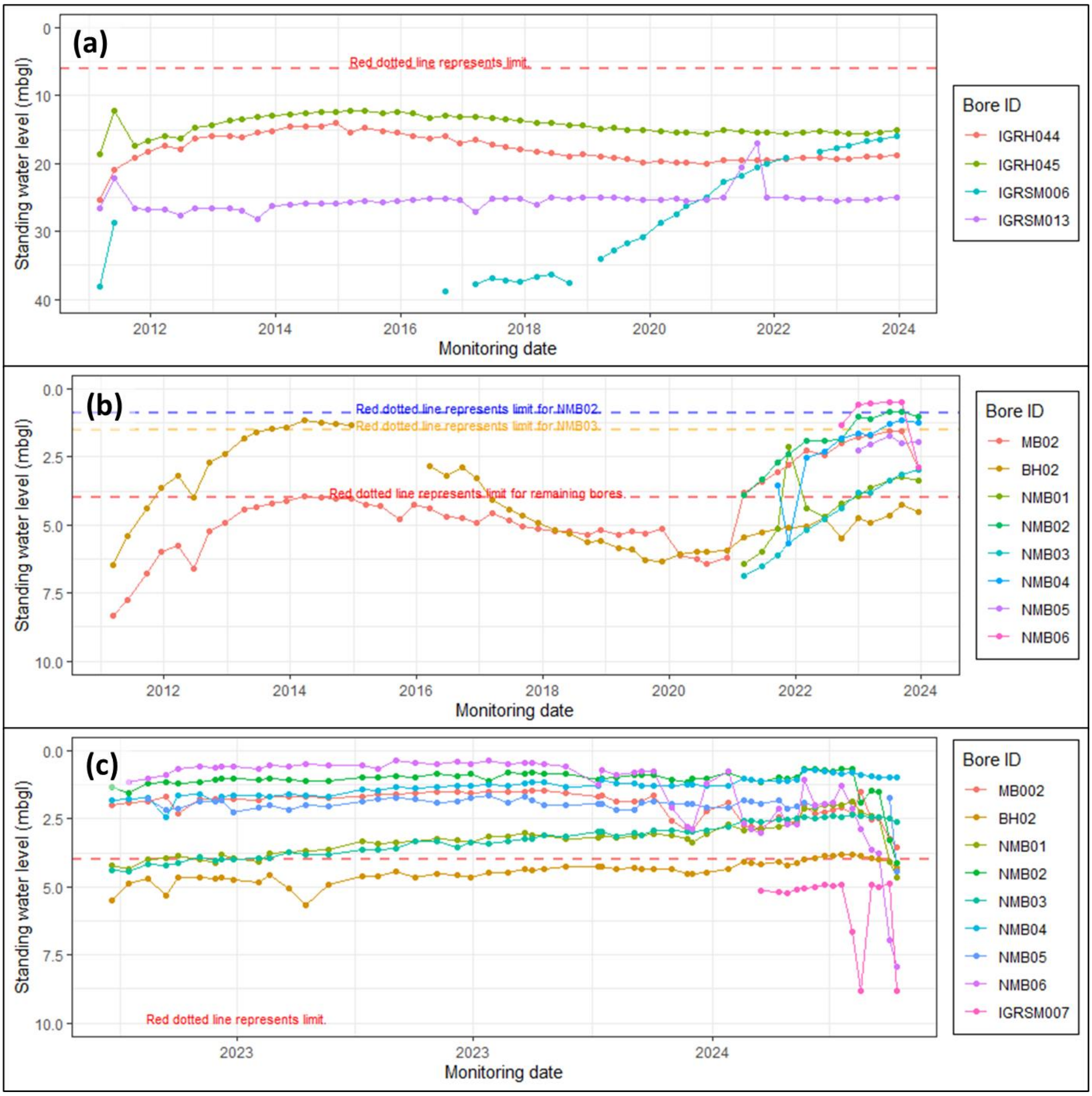

Figure 6: Standing water level trends at groundwater monitoring bores (a) east of TSF area, (b) west of TSF area, and (c) west of TSF area (high frequency)[9]

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[9] High frequency monitoring of standing water level was recently undertaken as a response to groundwater mounding in the western groundwater monitoring bores.

Currently, only monitoring bores BH02, IGRH044, IGRH045, IGRSM006, IGRSM013, and MB002 have been continuously monitored since 2011. Other historical monitoring bores have either been destroyed or decommissioned over the years. Nevertheless, historical monitoring data may be relevant for understanding influences from tailings seepage at TSF1 when it was operational. Monitoring bores MB002, BH02, IGRH044, and IGRH045 showed rising SWL during tailings deposition into TSF1, but have declined since 2014, when tailings deposition at TSF1 ceased.

Unlike monitoring bores IGRH044 and IGRH045, which did not exhibit signs of groundwater mounding from the operation of TSF2 (and the underlying Salt Creek In-Pit TSF), monitoring bores BH02 and MB02 did exhibit signs of mounding. Once again, this indicates that monitoring bores to the west of the TSF area are more prone to groundwater mounding, likely due to their closer proximity to the TSFs and the naturally shallower water table near Salt Creek. Only monitoring bore IGRSM013, located further south-east of the TSF area, has not been impacted by groundwater mounding, SWL measurements at this location has remained stable throughout the operational life of TSF1 and TSF2.

Groundwater quality

Based on groundwater chemistry monitoring data from 2015 to 2023, the following observations were made:

- No clear temporal trends in groundwater chemistry were evident in monitoring bores where groundwater mounding was observed through an increase in SWL.
- Dissolved metals and metalloids (e.g., arsenic, cadmium, chromium, copper, lead, molybdenum, mercury, selenium, zinc) have historically been measured below their corresponding limits of reporting.
- However, these metal and metalloids have been detected periodically at some monitoring bores around TSF2 during 2022 and/or 2023 annual period. There is still insufficient monitoring data to identify any long-term trends.
- Previously, the department observed high concentrations of metals (e.g., copper, nickel, manganese, and cadmium) and WAD CN at decommissioned monitoring bore MB001, north-west of TSF2 (DWER 2023). However, replacement monitoring bore NMB06 has not exhibited similar levels of impact, based on monitoring undertaken to date. Similarly elevated concentrations of cobalt have been observed in the nearby North Groundwater Recovery Drain, but not for other potential contaminants.
- WAD CN has historically been measured below its limit of reporting. However, WAD CN was detected at most groundwater monitoring bores around the TSF area during the 2023 annual period, including BH02, MB002, NMB01, NMB02, and NMB06 (Figure 7). So far, WAD CN has not been detected above its limit of reporting at monitoring bores NMB03 and NMB04, located south-west of TSF2. That being said, the specified limit for WAD CN (i.e., 0.5 mbgl) has not been breached during the operation of TSF2.
- While the impacts of groundwater mounding have not been clearly evident in SWL monitoring data, WAD CN has been detected above its limit of reporting at the eastern and south-eastern monitoring bores (e.g., IGRSM006, IGRSM013, IGRH044, and IGRH045) during the 2023 annual period. WAD CN was also detected at these monitoring bores during the previous operation of TSF1 (Figure 7).
- Rockwater (2024) stated that monitoring bore IGRSM013 was a regional bore, unlikely to be impacted by tailings seepage. However, WAD CN was subsequently detected at 0.004 mg/L during the December 2023 monitoring event (Figure 7), suggesting some levels of impact. The source of the WAD CN is currently not known. Similarly, it is unclear whether WAD CN was detected at monitoring bore IGRH044 as a result of tailings seepage from the TSF area or the gold processing facility.

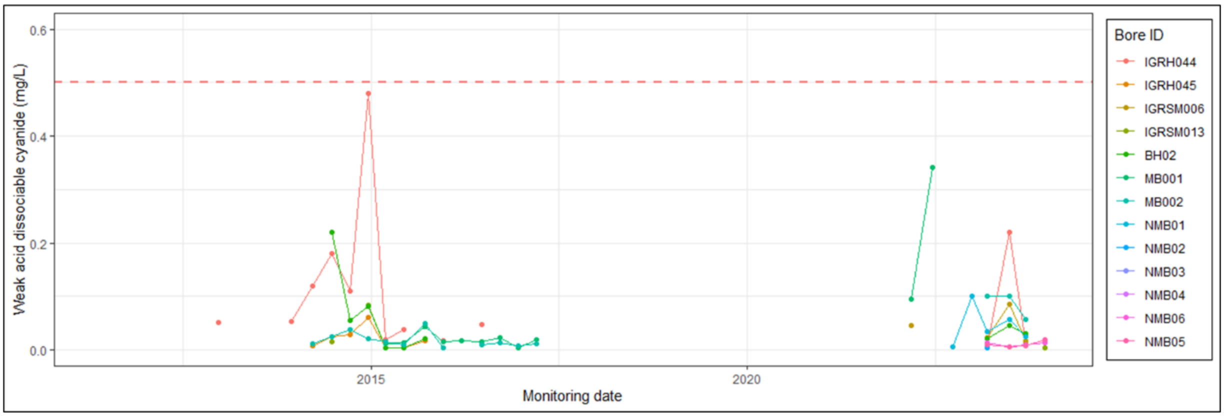

Figure 7: WAD CN concentrations in ambient groundwater[10]

Ambient groundwater monitoring was supplemented with monitoring of decant water and recovered groundwater (Table 2). The concentration of WAD CN of groundwater intercepted by the East Groundwater Recovery Drain was 19 mg/L, though it had reduced to 0.5 mg/L at the hydraulically downgradient parallel Western Groundwater Recovery Drain. North of TSF2, groundwater expression in the turkey's nest contained WAD CN at 3 mg/L. These concentrations are relatively similar to WAD CN detected at the supernatant pond.

While it is challenging to clearly identify potential impacts from tailings seepage on the ambient groundwater quality, the detection of WAD CN in the groundwater environment is likely a strong indication of tailings seepage, as it is not naturally present in high concentrations in the region and is a key reagent in gold processing. Furthermore, tailings seepage has occurred long before WAD CN is detected in groundwater, as cyanide may undergo rapid biodegradation in some aquifer environments or become bound up in metal-complexes that are not detectable by analytical procedures. The monitoring results to date show some level of impact in the surrounding ambient groundwater, with greater impacts shown around and west of the TSF area.

[10] Figure only shows weak acid dissociable cyanide concentrations detected above laboratory limit of reporting.

3.3.5 Water management at TSF1 and TSF2

Water management is a key consideration in managing tailings seepage emissions from operating TSFs. The applicant has proposed several water management strategies, which have been detailed throughout Section 2.3.4, 2.4, and 3.1.1. These are summarised in Table 12 and grouped into reducing seepage generation (e.g., reducing water inputs, maximising decant water recovery) and increasing seepage capture (e.g., increasing groundwater recovery), as well as further investigations to better understand the local hydrogeological regime and potential impacts. Specifically, these strategies not only aim to recover seepage losses, but also target the primary drivers of seepage generation (i.e., bore water addition, decant water recovery; refer to Section 3.3.2).

Table 12: Water management at TSF1 and TSF2

Water management objectives	Description	Decision
Reducing water input into TSF	• Bore water will no longer be discharged into TSF supernatant pond. • Groundwater recovered from groundwater recovery drains and bores will no longer be discharged into TSF supernatant pond. • Return water ponds will be constructed near Randalls Gold Processing Facility to store bore water and recovered groundwater.	These have been conditioned under **condition 10**, where TSF1 and TSF2 are only authorised to receive tailings slurry during time limited operation. Once the Return Water Ponds have been constructed, existing licence L8457/2010/2 will also be amended shortly to include operation of the Return Water Ponds and remove authorisation for discharge of bore water into TSF2.
Improving decant water recovery and reducing seepage generation	• Permanent decant tower has been constructed at TSF2 and will be constructed at a new location at TSF1, with floating pontoon mounted pump maintained for emergency use, if required.	These have been included as construction requirements for TSF1 under **condition 1**. The TSF2 decant tower has been constructed and will be raised accordingly.
Improving seepage and groundwater recovery	• Continuous pumping at the North, East, and West Groundwater Recovery Drains, with the West Groundwater Recovery Drain to be backfilled and upgraded for improved seepage collection. • Installation of seepage cut-off trench at sections of the TSF2 side-hill beneath where starter embankments will be constructed.	Continuous operation of the North, East, and West Groundwater Recovery Drains are authorised and required under existing licence L8457/2010/2. As such, no authorisation for time limited operation is required to operate the upgraded West Groundwater Recovery Bore. Construction requirements for the West Groundwater Recovery Bore modifications and seepage cut-off trench has been conditioned under **condition 1**.
	• Expansion of groundwater recovery bore network, with up to seven locations west of the TSF area. • Additional groundwater recovery bores may be installed, including one potentially near monitoring bore NMB01, once further hydrogeological investigations have been completed to identify optimal locations. Additional groundwater recovery drains and/or extension to existing drains may also be constructed, pending further	Operation of existing feasible groundwater recovery bores will be required and regulated under licence L8457/2010/2. Going forward, it is intended that additional groundwater recovery bores be included in licence L8457/2010/2, either when historical production bores are found to be feasible for groundwater recovery or further hydrogeological investigations lead to the design of new

Water management objectives	Description	Decision
	hydrogeological investigations.	dedicated recovery bores.
Further investigations	• Hydrogeological assessment undertaken by Rockwater (2024), including falling head test to determine hydraulic conductivity of aquifer. • Updated hydrogeological assessment to be undertaken within nine months of works approval W6927/2024/1 being granted, considering additional information from installation of additional groundwater monitoring bores. • Based on the updated hydrogeological assessment, siting and design for additional recovery bores will also be proposed.	The department has considered the findings from the hydrogeological assessment in the detailed risk assessment (refer to Section 3.3). The requirement to provide an updated hydrogeological assessment, as well as propose additional groundwater monitoring and recovery bores, has been conditioned as a specified action under **condition 6**.
	• Existing monitoring bore IGRSM007 will be included in the routine groundwater monitoring program.	Monitoring of existing monitoring bore IGRSM007 is required under existing licence L8457/2010/2. The monitoring bore is also required to be monitored during time limited operation of the TSF1 and TSF2 embankment raises, as specified under **condition 16**.
	• Six additional locations are proposed for the installation and monitoring of shallow and deep groundwater monitoring bores to better characterise groundwater mounding and inform locations for additional groundwater recovery bore installations.	The department considers the proposed locations and design of additional groundwater monitoring bores to be appropriate for the characterisation of the full lateral and vertical extent of the groundwater mound. The construction of the monitoring bores has been required under **condition 2**. However, further monitoring locations are also required and have been included as additional regulatory requirements (refer to Section 3.3.7). Monitoring of these additional groundwater monitoring bores during time limited operation has been specified under **condition 16**. Going forward, these monitoring bores will be required under licence L8457/2010/2 under a future amendment.
	• Periodic monitoring of recovered groundwater and decant water will be undertaken to supplement ambient groundwater monitoring program.	The department has specified requirements for periodic discharge monitoring under **condition 15**. Going forward, it is intended that the discharge monitoring program will be require under licence L8457/2010/2 under a future amendment.

3.3.6 Potential adverse impacts of tailings seepage

Seepage that occurs as a result of tailings deposition into TSF1 and TSF2 could adversely impact sensitive receptors through several mechanisms and pathways (i.e., risk events).

Primarily, tailings seepage influences the characteristics of the unconfined aquifer underlying the TSF footprint, by altering its physical (i.e., groundwater mounding) and chemical (i.e., contamination of metal, metalloids, and/or cyanide) properties.

Groundwater monitoring data discussed in Section 3.3.4 have shown indications of these impacts. In this respect, the unconfined aquifer is considered both a receptor that could be impacted, as well as a pathway mechanism for impacting other environmental receptors (i.e., native vegetation, surface water bodies, etc.).

(1) Groundwater mounding impacting native vegetation

Groundwater mounding around TSF1 and TSF2 may impact surrounding native vegetation if the local water table reaches a level where the root zone becomes inundated. Waterlogged soils become deficient in oxygen, disrupting root respiration and normal cellular processes, causing plant stress and potentially death (Pan *et al.* 2021). Furthermore, hypersaline conditions may exacerbate plant stress (Craig *et al.* 1990; Barrett-Lennard 2003).

While the TSF area has been mostly cleared for operational purposes, native vegetation is still present at the boundary of and around the TSF area. This risk event has occurred previously (refer to Section 2.3.1, 2.3.2, and 2.3.3) and has resulted in vegetation stress and death west of TSF2. Recent monitoring undertaken in this area indicated the vegetation health of this area remains as 'Degraded' or 'Poor' (SLR 2024b). Consistent with past observations, the vegetated areas west of the TSFs are most likely to be impacted, due to the shallower groundwater present near the Salt Creek.

Due to the higher tailings seepage volume expected from the TSF expansions, impacts may also occur at other locations around the TSFs. For example, SWL at monitoring bore IGRSM006 south-east of TSF2 has been steadily rising since 2017. While the SWL at that location is currently compliant with its specified limit, further tailings deposition may result in sustained mounding and potentially inundation of the root zone and/or surface expression of groundwater.

Furthermore, the proposed expansions will also involve the recommencement of tailings deposition at TSF1. Based on historical groundwater monitoring data, there is potential a groundwater mound to form beneath TSF1 and potentially impact vegetation to the north and east of the TSF area.

(2) Contaminated groundwater impacting unconfined aquifer and ephemeral Salt Creek

The release of tailings seepage from the TSF area may impact the chemical characteristics and quality of the superficial aquifer. Based on existing monitoring data, ambient groundwater in the clay unit has shown signs of impact, primarily through the detection of WAD CN. Potential impacts to deeper aquifers have not been characterised recently. The extent of this deterioration in groundwater quality may extend further away from the TSF area, depending on the emission rate of tailings seepage and the rate in which contaminants attenuate/biodegrade. That being said, groundwater in the region has limited beneficial use as it is hypersaline, unpalatable for livestock, and is not currently being abstracted for use by third parties for non-mining purposes.

The ephemeral Salt Creek is located approximately 200 m west of the TSF2 western embankment. Due to the regional groundwater flow direction and groundwater mounding from the TSFs, it is possible for groundwater to express more readily at the Salt Creek bed, which has a lower elevation than its surroundings. Alternatively, groundwater expression at the TSF area may also enter Salt Creek as overland runoff. The expressed groundwater may introduce high salt loading, as well as contaminants associated with tailings seepage.

This risk event has occurred previously (refer to Section 2.3.1, 2.3.2, and 2.3.3) and has resulted in varying levels of impacts to the creek bed as its surrounding riparian vegetation. Previous monitoring in 2023 showed that sediments and surface water was highly saline cross- and downstream of the areas where surface expression had occurred and flowed into the Salt Creek (Stantec 2023). A more recent incident that resulted in surface expression to flow into Salt Creek did not result in an increase to the salinity of surface water flow (Table 3).

While the aquatic ecology of the Salt Creek is not well understood, sediment and surface water monitoring to date has suggested limited impacts downstream. That being said, the contaminant loading entering Salt Creek may increase due to the potentially higher tailings seepage volume that is expected to be released as a result of the TSF expansion.

3.3.7 Risk assessment and additional regulatory controls

In considering the source characteristics, pathway mechanism, sensitivity of the receptors, as well as existing monitoring information and the applicant's proposed controls, a risk rating has been assigned to each risk event for the proposed TSF expansion, as detailed in Table 13.

Table 13: Risk rating for tailings seepage from expansion of TSF1 and TSF2

	Risk event	Consequence	Likelihood	Risk rating
1	Tailings seepage from expanded TSF1 and TSF2 infiltrating into the subsurface environment, causing localised mounding of the water table. Resulting in potential inundation of the root zone of surrounding native vegetation.	**Moderate** Vegetation stress and/or death	**Possible** Groundwater around the TSF area is naturally shallow and hypersaline, making it more susceptible to groundwater mounding and potentially surface expression. Expected increase in volume of tailings seepage form the TSF2 expansion, as well as from recommencement of operations at TSF1. Previous incidents involving surface expression of hypersaline groundwater and vegetation death at TSF2 and TSF1 reported in 2023 and 2024, respectively. Return water ponds will be constructed to store bore water and recovered groundwater. No discharges will occur at TSF1 and TSF2, except for tailings slurry. Standing water levels have decreased as a result of additional groundwater recovery, with most monitoring bores compliant with their corresponding limits, though some continue to exceed the limit. Further hydrogeological investigations and groundwater management actions have been proposed.	**Medium risk** Additional regulatory controls required. The risk rating will be reassessed when the application to authorise operation of the expanded TSFs under licence L8457/2010/2 is submitted.
2	Tailings seepage from expanded TSF1 and TSF2 infiltrating into the subsurface environment, causing subsurface and potentially surface lateral migration of tailings seepage contaminants.	**Moderate** Degradation of groundwater quality. Groundwater has limited beneficial use and values. Degradation of Salt Creek water quality and potential	**Possible** Same as above. Impacts have been observed (i.e., WAD CN) in ambient groundwater immediately surrounding TSF2. Previous incidents involving surface expression of hypersaline groundwater from TSF2 and TSF1 have resulted in overland	**Medium risk** No additional regulatory controls required. The risk rating will be reassessed when the application to authorise operation of the expanded TSFs under licence

	Risk event	Consequence	Likelihood	Risk rating
	Resulting in contamination of unconfined aquifer and potentially migrating to the nearby Salt Creek.	impacts to creek biota. Salt Creek unlikely to contain conservation significant ecology, but this is not well understood.	discharge into Salt Creek, respectively. Previous sediment and surface water monitoring has shown varied results, in regard to salt enrichment. However, no WAD CN has been detected so far.	L8457/2010/2 is submitted.

Where relevant for managing the risk of potential impacts from tailing seepage, licence holder proposed controls and actions have been conditioned in the works approval (Table 12). Additionally, the department has imposed the following additional regulatory requirements as conditions in works approval W6927/2024/1:

1. **Condition 2** – Installation of groundwater monitoring bores at two additional locations, on top of the six proposed.
2. **Condition 6** – Specified actions to prepare and submit an audit of the recommendations made under the most recent Groundwater Management Plan (Coffey 2024b).
3. **Condition 15** – Monitoring of groundwater monitoring bores at the four additional locations specified in condition 2 during time limited.

Table 14: Additional groundwater monitoring bore locations

Monitoring bore ID and location	Monitoring bore design	Rationale
NMB13 – North-east of TSF1, between existing monitoring bores BH02 and IGRH045.	Shallow and deep monitoring bore with the design proposed by Rockwater (2024)[1].	There is currently no existing or proposed groundwater monitoring bore in this area. While groundwater elevation in this area is likely deeper than the groundwater elevation west of the TSF area (i.e., near Salt Creek), the recommencement of tailings deposition at TSF1 may result in groundwater mounding north of the TSF area. Furthermore, it is understood that TSF1 was not equipped with seepage management infrastructure during its initial construction, which may result in a greater proportion of tailings seepage being released into the environment. Historical groundwater monitoring undertaken during the initial operation of TSF1 resulted in groundwater mounding around the facility, which was not limited to the shallower western side. As such, similar groundwater mounding may be observed with the proposed activities.
NMB14 – West of existing monitoring bore NMB04, close to Salt Creek	One shallow monitoring bore with the design proposed by Rockwater (2024)[1].	Existing monitoring bore NMB04 was installed as a shallow bore, screened in the permeable gravel unit. At the time, the department required the installation of this monitoring bore to detect any potential preferential flow in the more permeable unit. An additional shallow monitoring bore should be installed west of monitoring bore NMB04, close to Salt Creek, to monitor potential interaction between the potentially impacted water table and Salt Creek.

Note 1: Refer to Section 2.4.4 for summary of proposed bore design.

The department had also required the installation of groundwater monitoring bores located (1) between monitoring bore NMB02 and NMB04, close to Salt Creek, and (2) south of existing monitoring bore IGRSM006, between proposed monitoring bores NMB09 and NMB10. However, the applicant suggested that these two monitoring locations were not required due to lack of impact observed to date and may benefit from being installed in the future, once further hydrogeological information is obtained from the installation and monitoring of the proposed monitoring bores, to refine their design and location.

The department agreed with the rationale provided by the applicant and has removed these bores from the works approval (refer to Appendix 1 for further information). Installation of these monitoring bores may be required in the future, depending on trends observed from existing monitoring bores. Accordingly, the applicant should determine and propose any additional groundwater monitoring bores in the hydrogeological review, which is required as a specified action under condition 6.

4. Consultation

Table 15 provides a summary of the consultation undertaken by the department.

Table 15: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website from 16 May 2024 to 6 June 2024. Application advertised in The West Australian on 20 May 2024.	None received.	N/A
City of Kalgoorlie-Boulder (CKB) advised of proposal on 17 May 2024.	CKB responded on 30 May 2024 with no objection or significant comment.	N/A
Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) advised of proposal on 17 May 2024.	DEMIRS responded on 1 July 2024, advising on the following: • The scope of the works approval broadly aligns with Mining Proposal Reg ID 123855, which was under assessment at the time of the advice; • Comments were provided relating to previous environmental incidents and proposed controls to manage further tailings seepage and groundwater mounding.	The department has considered the comments provided in the detailed risk assessment for tailings seepage (refer to Section 3.3).
Applicant was provided with draft documents on 19 July 2024.	Comments on draft documents, regarding additional regulatory requirements for additional monitoring bore installation, received on 26 July 2024. 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 (W6927/2024/1) will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

References

1. Barrett-Lennard EG 2003, *The interaction between waterlogging and salinity in higher plants: causes, consequences and implications*, Plant and Soil, 253, pp. 35-54.
2. Craig GF, Bell DT & Atkins CA 1990, *Response to salt and waterlogging stress of ten taxa of Acacia selected from naturally saline areas of Western Australia,* Australian Journal of Botany, 38(6), pp. 619-630.
3. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
4. Department of Water and Environmental Regulation (DWER) 2020a, *Guideline: Environmental Siting*, Perth, Western Australia.
5. DWER 2020b, *Guideline: Risk Assessments*, Perth, Western Australia.
6. DWER 2023, *Licence L8457/2010/2 Amendment Report*, granted 7 November 2023, Perth, Western Australia.
7. Golder Associates (Golder) 2009, *Randalls Gold Project Feasibility Study – Integrated Waste Landform Design*, ref: 097641008010 R Rev 1, Perth, Western Australia.
8. Golder 2014, *Silver Lake Resources, Randalls Gold Processing Facility 2013 Operational Review of Tailings Storage Facility*, ref: 137645057-001-R-Rev0-2013, Perth, Western Australia.
9. Groundwater Resource Management Pty Ltd (GRM) 2014, *Salt Creek Tailings Storage Options Hydrogeological Assessment – Randall's Gold Project,* ref: J130022R02, Wembley, Western Australia.
10. John J 1998, *Diatoms: Tools for bioassessment of river health, a model for south-western Australia* (Project UCW 3).
11. Newson TA & Fahey M 2003, *Measurement of evaporation from saline tailings*, Engineering Geology, 70, pp. 217-233.
12. Outback Ecology 2009a, *Biological Baseline Survey of Salt Creek and Lake Randall – Randalls Gold Project*, Jolimont, Western Australia.
13. Outback Ecology 2009b, *Salt Creek Level 2 and Maxwells/Cock-Eyed Bob Level 1 Vegetation and Flora Surveys – Randalls Gold Project*, Jolimont, Western Australia.
14. Pan J, Shariff R, Xu X & Chen X 2021, *Mechanisms of Waterlogging Tolerance in Plants: Research Progress and Prospects*, Front. Plant Sci. 11:627331.
15. Rockwater Pty Ltd (Rockwater) 2024, *Mount Monger Operations Randalls Gold Processing Facility Groundwater Mounding Characterisation and Monitoring Bore Review*, ref: 588-0/Report/24-01, Jolimont, Western Australia.
16. Silver Lake Resources Limited (SLR) 2022a, *L8457/2010/2 Well Construction Report NMB06*, South Perth, Western Australia.
17. SLR 2022b, *Salt Creek TSF2 Vegetation Monitoring Report for Prescribed Premises Licence L8457/2010/2*, South Perth, Western Australia.
18. SLR 2023a, *RGPF Prescribed Premise Licence L8457/2010/2 Groundwater Recovery Bore Investigation*, South Perth, Western Australia.
19. SLR 2023b, *Salt Creek TSF2 Quarterly Vegetation Photographical Monitoring*, South Perth, Western Australia.
20. SLR 2023c, *Salt Creek TSF2 Vegetation Monitoring 2023*, South Perth, Western Austraila.

21. SLR 2024a, *RGPF Prescribed Premise Licence L8457/2010/2 TSF2 Water Reduction Action Plan*, South Perth, Western Australia.
22. SLR 2024b, *Salt Creek TSF2 Vegetation Monitoring (L8457/2010/2) Q1 2024 interim report*, South Perth, Western Australia.
23. Stantec 2023, *Ecological Impact Assessment of Groundwater Mounding and Surface Expression Adjacent to Randall Gold Processing Facility TSF2, 2023*, ref: 304501080, Perth, Western Australia.
24. Taukulis FE & John J 2009, *Development of a diatom-based transfer function for lakes and streams severely impacted by secondary salinity in the south-west region of Western Australia*, Hydrobiologia, 626, pp. 129-143.
25. Tetra Tech Coffey Pty Ltd (Coffey) 2021, *Mount Monger Operations Tailings Storage Facility 2 – Groundwater Management Plan*, ref: 754-PERGE293686, Perth, Western Australia.
26. Tetra Tech Coffey Pty Ltd (Coffey) 2023a, *Mount Monger Operation TSF2: DWER Licence Exceedance 2023*, ref: 754-PERGE327132_Mount Monger TSF2 GWMP 2023 Memo Rev1, Perth, Western Australia.
27. Tetra Tech Coffey Pty Ltd (Coffey) 2023b, *Randalls Gold Project Tailings Storage Facility Audit and Management Review 2023*, ref: 754-PERGE32758, Perth, Western Australia.
28. Tetra Tech Coffey Pty Ltd (Coffey) 2023a, *Mount Monger Operations – Randalls Gold Processing Facility TSF1 & TSF2 Raise Design Report*, ref: 754-PERGE340046_R01, Perth Western Australia.
29. Tetra Tech Coffey Pty Ltd (Coffey) 2024b, *Mount Monger TSF2: Water Management March 2024*, ref: 754-PERGE340046_Mount Monger TSF1 & 2 Design GMP 2024 Rev 2, Perth, Western Australia.
30. Western Australian Herbarium 2023, FloraBase – the Western Australia Flora, Department of Biodiversity Conservation and Attractions.

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

Condition	Summary of applicant's comment	Department's response
Condition 2	The applicant provided comments on the additional groundwater monitoring bores required as additional regulatory requirements (Table 14), where up to four additional groundwater monitoring locations (NMB13 to NMB16) were required by the department (in addition to the six proposed by the applicant). Specifically, the applicant noted the following: 1. Monitoring bore NMB13 would be beneficial and will be installed as required. 2. Monitoring bore NMB14 (located between existing monitoring bores NMB02 and NMB04, close to Salt Creek) would not be required as the proposed alternative location for monitoring bore NMB16 will be nearby. Furthermore, there has been minimal impacts observed near monitoring bores NMB02 and NMB04, though there is a lack of baseline monitoring data near Salt Creek. The applicant considered monitoring bore NMB07 to be located in a more critical location, due to previous impacts identified at existing monitoring bores nearby. The applicant proposed not to install this monitoring bore. 3. Monitoring bore NMB15 (located south of existing monitoring bore IGRSM006, between proposed monitoring bores NMB09 and NMB10) would be beneficial, acting as an additional regional bore. However, the applicant indicated that the installation of monitoring bores NMB09 and NMB10 would assist in identifying whether there is potential preferential flow towards this area and suggested waiting until the installation and monitoring of NMB09 and NMB10 prior to deciding on a suitable location for NMB15. The applicant holder requested an additional six months for the installation of monitoring bore NMB15 to allow for sufficient monitoring and assessment (i.e., one year after the granting of works approval W6927/2024/1). 4. Monitoring bore NMB16 was proposed to be a shallow bore only (instead of a deep bore) and be located slightly west of the existing NMB04, closer to the Salt Creek. The shallow bore will be screened to the water table, shallower than the existing NMB04 screened between 12 mbgl and 18 mbgl. This alternative design is beneficial as it would allow for the	The department has considered the comments provided by the applicant and determined the following: 1. No changes made to monitoring bore NMB13. 2. Monitoring bore NMB14 has been removed from condition 2. The monitoring bore is not considered to be required at this stage. However, the department may require a monitoring bore to be installed and monitored in the future, depending on ongoing groundwater monitoring trends observed during the proposed activities. Consequently, monitoring bore ID, condition 16, and Figure 3 have been updated to account for the removal of monitoring bore NMB13. Section 3.3.7 of the Decision Report has also been updated. 3. Monitoring bore NMB15 has been removed from condition 2. The department agrees that the installation of monitoring bores NMB09 and NMB10 may provide information required to better target the location of the proposed monitoring bore NMB15. Consequently, monitoring bore ID, condition 16, and Figure 3 have been updated to account for the removal of monitoring bore NMB15, while condition 6 has been updated to require the proposal of additional groundwater monitoring bores (if required) as part of the hydrogeological review specified action. Section 3.3.7 of the Decision Report has also been updated. 4. The department has no issue with the proposed alternative design and location of monitoring bore NMB16. Consequently, condition 2 and Figure 3 have been updated. The bore ID at this monitoring location has been renamed to NMB14 due to the removal of the two monitoring bores (see above).

Condition	Summary of applicant's comment	Department's response
	interaction between the water table and Salt Creek to be monitored. Furthermore, the need for monitoring bore NMB14 will be removed.	
Condition 6	In response to the department requiring an assessment (and if required, proposal) of additional groundwater monitoring bores as part of the hydrogeological review, the applicant requested the timeframe for the submission of the hydrogeological review to the CEO be extended from six months after the date of granting works approval W6927/2024/ to nine months. This is to ensure adequate data collection to inform the hydrogeological review, with consideration given to additional groundwater monitoring bores that will be installed and monitored in accordance with conditions 2 and 16, respectively.	The department considers the proposed timeframe to be acceptable and has amended the condition accordingly. Consequently, the department has also aligned the reporting condition.