Application for works approval

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

Works approval number	W6342/2020/1
Applicant	Mt Magnet Gold Pty Ltd
ACN	008 669 556
DWER file number	DER2019/000590
Premises	Mt Magnet Gold Mining tenements M58/121, M58/193 and M58/205 MOUNT MAGNET WA 6638
Date of report	17 July 2020
Decision	Works approval granted

1. Definitions

Key terms relevant to this decision report and their associated definitions are listed in Table 1.

Table 1 Definitions

Term	Definition
Applicant	Mt Magnet Gold Pty Ltd
Category / categories	Categories of prescribed premises as set out in Schedule 1 of the EP Regulations.
Decision Report	refers to this document.
Delegated Officer	An officer delegated under section 20 of the EP Act.
Department	The department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental Protection Act 1986* along with other legislation.
Emission	has the same meaning given to that term under the EP Act.
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
Existing Licence	The Licence issued under Part V, Division 3 of the EP Act and in force prior to the commencement of, and during this Review
mbRP	Meters below reference point
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
Prescribed premises	This has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Risk Event	As described in *Guidance Statement: Risk Assessment*

Term	Definition
Works Approval Holder	Mt Magnet Gold Pty Ltd

2. Overview of premises

Mt Magnet Gold Pty Ltd (applicant) operates the Mt Magnet Gold Mine (premises) under *Environmental Protection Act 1986* (EP Act) Part V licence L5529/1988/12 for prescribed premises category 5, 6 and 64. The premises is located in the Shire of Mount Magnet, and located approximately 2.4km from the town of Mount Magnet.

The premises has a long history of gold mining, with operations dating back to 1891. Current operations include open pit and underground mining, with the mined ore processed onsite for gold production. The most recent amendments to the licence reflected an increase of landfill throughput and changes to mine dewatering activities on site.

The premises currently operates the Checkers processing plant (Checker Mill) which is approved for a capacity of 2.4 million tonnes per annum (Mtpa), and only Checkers Tailings Storage Facility 3 (CTSF3) of the three existing Tailings Storage Facilities (TSF).

Table 2 Prescribed premises categories in the existing licence

Category	Description	Assessed production or design capacity or throughput
6	Mine dewatering	1 500 000 tpa
5	Processing or beneficiation of metallic or non-metallic ore	2 400 000 tpa
64	Class II putrescible landfill site	10 000 tpa

2.1 Description of proposed activity

A works approval application (application) was submitted by the applicant to the Department of Water and Environmental Regulation (department) on 29 October 2019 for embankment raises of CTSF1, CTSF2 and CTS3 to achieve an additional 15.3 Mt of tailings storage capacity. Embankment raising will be from RL 483m to 488m (CTSF1), RL 476m to 488m (CTSF2) and RL 485m to 490m (CTSF3). The reinstatement of CTSF1 and CTSF2 to receive tailings is also proposed. CTSF1 and CTSF2 have not been in use since 2000 and 2001, respectively.

Proposed works are within mining tenements M58/121, M58/193 and M58/205 (Figure 1) and are in relation to category 5 activities.

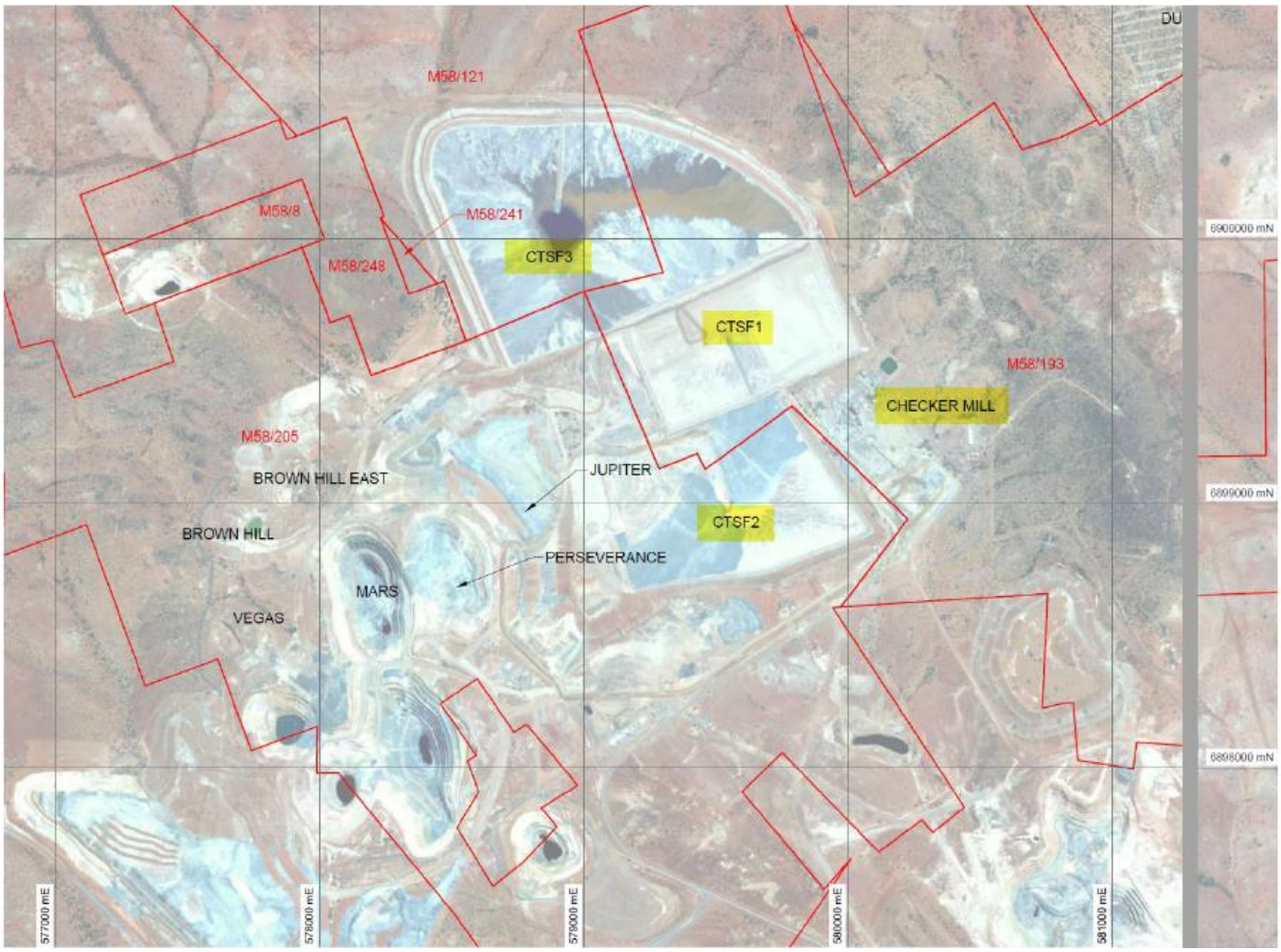

Figure 1 Premises map

2.2 Operational aspects

The CTSF1, CTSF2 and CTSF3 are above ground and paddock style tailing storage facilities.

Embankment raising will use dried tailings and mine waste (for downstream capping) sourced from the Galaxy mining area (Figure 4). Dried tailings are borrowed from within each CTSFs and are free of organic matter and other deleterious material, non-dispersive, with a fines content (passing 0.075 mm sieve) in excess of 33%. Waste rock used for embankment raises is geochemical and physical benign with no acid drainage or heavy metal contamination potential (MP83570, 2019).

The tailings deposition strategy involves the depositing to one CTSF while another CTSF embankment is raised. The deposition pipeline is removed from the recently deposited CTSF to start once embankment is complete.

Tailings (slurry) are discharged sub-aerially and cyclically into the CTSF in layers not exceeding 300 mm thickness to ensure optimum density and strength. Multiple spigots located on the upstream side of the CTSF crest will deposit tailings. The supernatant pond is maintained around the central decant structure of the CTSFs, and regulating its size will assist to optimise water recovery and tailings density. Water is pumped to the process plant for re-use.

2.3 Decision

During the assessment of the application, uncertainties about seepage management of CTSF1 and CTSF2, both proposed to be reinstated, were identified. Concerns in regards to potential adverse impacts on the Public Drinking Water Source Areas (PDWSAs) remain, and require additional investigation and assessment to confirm that there are geological and/or hydrogeological barriers which prevent seepage from reaching the PDWSAs.

This works approval permits the construction of the proposed embankment raises only and does not approve tailings deposition into CTSF1 and CTSF2. Tailings deposition into CTSF3 is currently authorised under licence L5529/1988/12.

For the reinstatement of CTSF1 and CTSF2, additional seepage management infrastructure is required to be constructed, and further information to confirm that seepage is contained permanently by the Galaxy pits needs to be submitted to the department. The approval of the embankment raises with this works approval is no assurance that future approval will be granted for deposition of tailings into CTSF1 and CTSF2. Approval to undertake this activity will be subject to a new risk assessment which will consider the information complied through seepage investigations and associated hydrogeological investigations required under the conditions of this works approval. Refer to section 5.1 for the detailed risk assessment.

The embankment raise and deposition of additional tailings into the currently operational CTSF3 has been approved, but improved seepage management measures are necessary to be considered an acceptable risk. Refer to section 5.2 for the detailed risk assessment.

3. Legislative context and other approvals

The legislative framework for this assessment is the Environmental Protection Act 1986 (EP Act) and Environmental Protection Regulations 1987 (EP Regulations).

Relevant guidance documents are outlined in Appendix 1: Key documents.

Approvals relevant to the premises are outlined in the table below.

Legislation	Number	Approval
Mining Act 1978	Code 83570 J00159	Embankment raise of CTSF1, CTSF2, CTSF3 Approved 16 December 2019
Rights in Water and Irrigation Act 1914	GWL151513(8)	3 700 000 kL/year for purpose of: Cooling water, mine dewatering, dust suppression, mineral ore processing, mining, mining camp Valid to 27 September 2026

4. Emission sources, pathways, receptors and controls

4.1 Emissions

The potential for emissions to impact on sensitive receptors has been assessed in accordance with the Department's Risk Framework. The key emissions during premises construction which have been considered in this report are dust and noise from construction activities including equipment placement and use and vehicle movements.

The applicant has proposed measures to assist in controlling these emissions, where

necessary. The control measures proposed by the applicant have been considered when undertaking the risk assessment detailed in section 5.

Following completion and compliance with this works approval, a prescribed premises category 5 licence under Part V of the EP Act will be required to authorise emissions associated with the operation of the premises. A risk assessment for the operational phase has been included in this decision report, however licence conditions will not be finalised until DWER assesses the licence application. The key emissions considered in during premises operation are seepages from CTSF1, 2 and 3.

4.2 Pathways

4.2.1 Pathway by seepage

Seepage from CTSF1, 2 and 3 has the potential to infiltrate through the base of the TSF and reach the groundwater. The premises is located within the East Murchison Groundwater Area and is located adjacent to the east of Priority 1 and 2 PDWSAs (Figure 3).

Application documents describe a variation of permeability on structures which partly reflects basement lithology, and enhanced permeability in banded iron formations and areas of gold mineralisation.

Application documentation refers to spatial permeability variations reflecting underlying saturated bedrock after regolith materials become saturated. A clayey horizon (mid-regolith) forms a semi-confining layer.

It further mentions high rates of vertical seepage after commencing tailings deposition into CTSF1 and CTSF2 in the past, resulting in the water level below the CTSFs to raise to the natural surface within 12 months. It also suggests seepage to occur after reinstatement, once old tailings have been re-saturated.

Potential seepage pathways were identified in application documentation to be the following:

1. shallow seepage discharge to the surface near the dam toe and remobilisation as stormwater runoff; or
2. transport through bedrock fractures; Supporting documentation provided by the applicant states within the upper Genga catchment, the broader flow paths are to the southwest.

It is also noted in application documents that flow paths are contained by the Galaxy complex pits (Figure 4). A review of the application documentation by the department's Principal Hydrogeologist suggested not all seepage may be captured by pits, and that there is potential for dense, saline groundwater staying near the base of the regolith, flowing along an inclined bedrock surface by gravity.

Advice from DWER's regional hydrogeologists suggest a low risk of seepage reaching the Mount Magnet Water Reserve, due to mine voids being present west and south of CTSF1 and CTSF2 acting as sinks. However, further investigations of the premises and seepage management measures are required to confirm that no pathway for seepage to the PDWSAs exists.

The application documents suggest that existing management systems will identify requirements to control shallow seepage, while transport through bedrock fractures was not specifically addressed. No data to support the claims of seepage containment by the Galaxy complex pits have been received by the department.

These pathways have been considered in the risk assessment table in section 5.

4.2.2 Pathway by air/wind dispersion

Prevailing winds in relation to sensitive receptors can affect potentially adverse dust and noise impacts. Dust and noise emissions can occur during construction works and vehicle movements. The closest human receptor is 2.4 km south east of the premises boundary. The closest identified weather station is located approximately 8 km south of the premises (BOM station 007600).

The annual average wind speed and direction shows predominant winds from east and north east (BOM, accessed June 2020) (Figure 2). It should be noted that depending on topography and other factors, predominant winds may differ at the actual premises location.

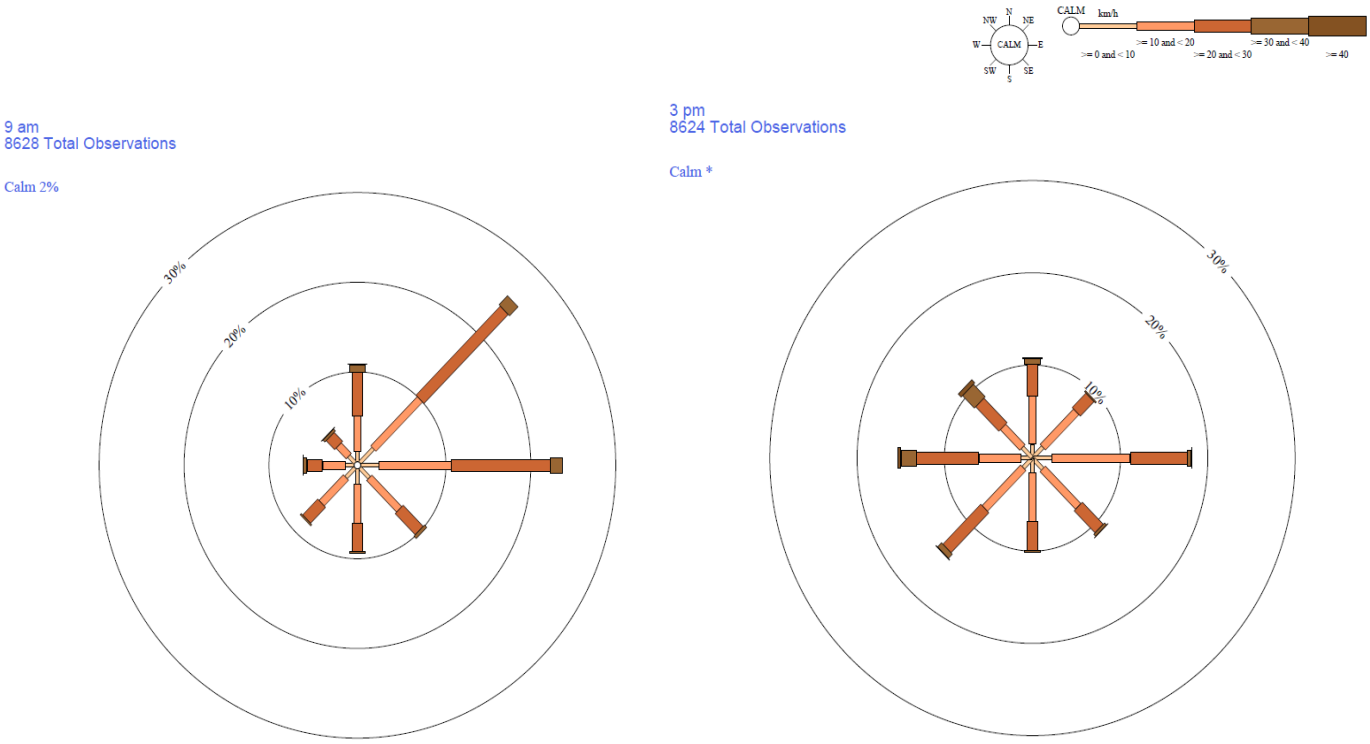

Figure 2 Annual windroses from BOM station 007600

4.3 Receptors

Risk is assessed as a combination of emission sources, the proximity and sensitivity of receptors to those emission sources and any pathways that can allow the emission to reach and potentially harm the receptor. Figure 3 and the table below provides a summary of human and environmental receptors in proximity to the premises which have a potential to be impacted from site activities, and the risk assessment in section 5 considers these receptors in the context of emissions and potential pathways.

4.3.1 Public drinking water source areas

The Mount Magnet Water Reserve is a PDWSA, proclaimed under the *Country Areas Water Supply Act 1947* (CAWS Act) and consists of the Genga and Lennonville water reserves. Parts of the premises lies within the Genga water reserve to the west, and borders on the Lennonville water reserve on the northern boundary (Figure 3). According to the department's *Guidance Statement: Environmental Siting* (DER, 2016), PDWSAs are considered Specified Ecosystems

with high conservational value and special significance.

The southern part of Genga, and the Lennonville water reserve are classified as priority 1 areas (P1) by the department. As set out in the department's Water Quality Protection Note No. 25, *Land use compatibility tables for public drinking water source areas* (DOW, 2016), P1 areas are defined and managed to ensure there is no degradation of the drinking water quality source, with the objective of risk avoidance, consistent with the preventative risk-based framework of Western Australian Government.

The northern part of Genga water reserve is classified as a priority 2 area (P2), which is defined and managed to maintain or improve the quality of the drinking water source with the objective of risk minimisation.

The Drinking Water Source Protection Plan (DWSPP) for the Mount Magnet water reserve (DOE, 2005) underwent a review (DWER, 2019) which includes additional recommendations in regards to the boundary amendments of the PDWSAs. The DWSPP reports on activities and risks to water quality within the Mount Magnet water reserve, and discusses management strategies to minimise identified risks. The DWSPP does not specifically refer to groundwater impacts through seepages from mining activities.

The DWSPP states mine pits themselves do recharge groundwater but are believed to be far enough removed with sufficient subsurface barriers and infiltration is believed to be limited and presenting a low risk to Genga water reserve. No specific references to the Lennonville water reserve were included. However, while the application documentation refers to seepage being 'permanently contained by the Galaxy complex pits', no confirmation or assessments to investigate these assumptions have been provided.

Human receptors	**Distance from activity or prescribed premises**
Town of Mount Magnet	Approximately 2.4 km south east of premises boundary. Prevailing winds are from east and north-east
Environmental receptors	**Distance from activity / prescribed premises**
Public Drinking Water Source Areas (PDWSA) P1 and P2 The Mount Magnet Water Reserve consisting of Genga and Lennonville Water Reserve (Figure 3)	The Lennonville Water Reserve (P1) borders on the northern side of the premises boundary. The northern part of the Genga Water Reserve (P2) lies within the premises boundary, while the P1 area of this reserve lies approximately 5 km south of the premises boundary.
Groundwater East Murchison Groundwater area (RIWI Act 1914)	Groundwater flow in the borefield area is generally southward (DER, 2005). Groundwater levels are typically 5 - 15 mbgl, but can be substantially deeper in areas affected by pumping (DER, 2005). CTSF1 & CTSF2 depth to original Groundwater estimated to be 30 mbgl. Depth to groundwater at Ruby Queen Pit estimated to be 30 mbgl.
Surrounding vegetation	Surrounding vegetation of CTSF3 may be impacted by seepage and raising groundwater levels.

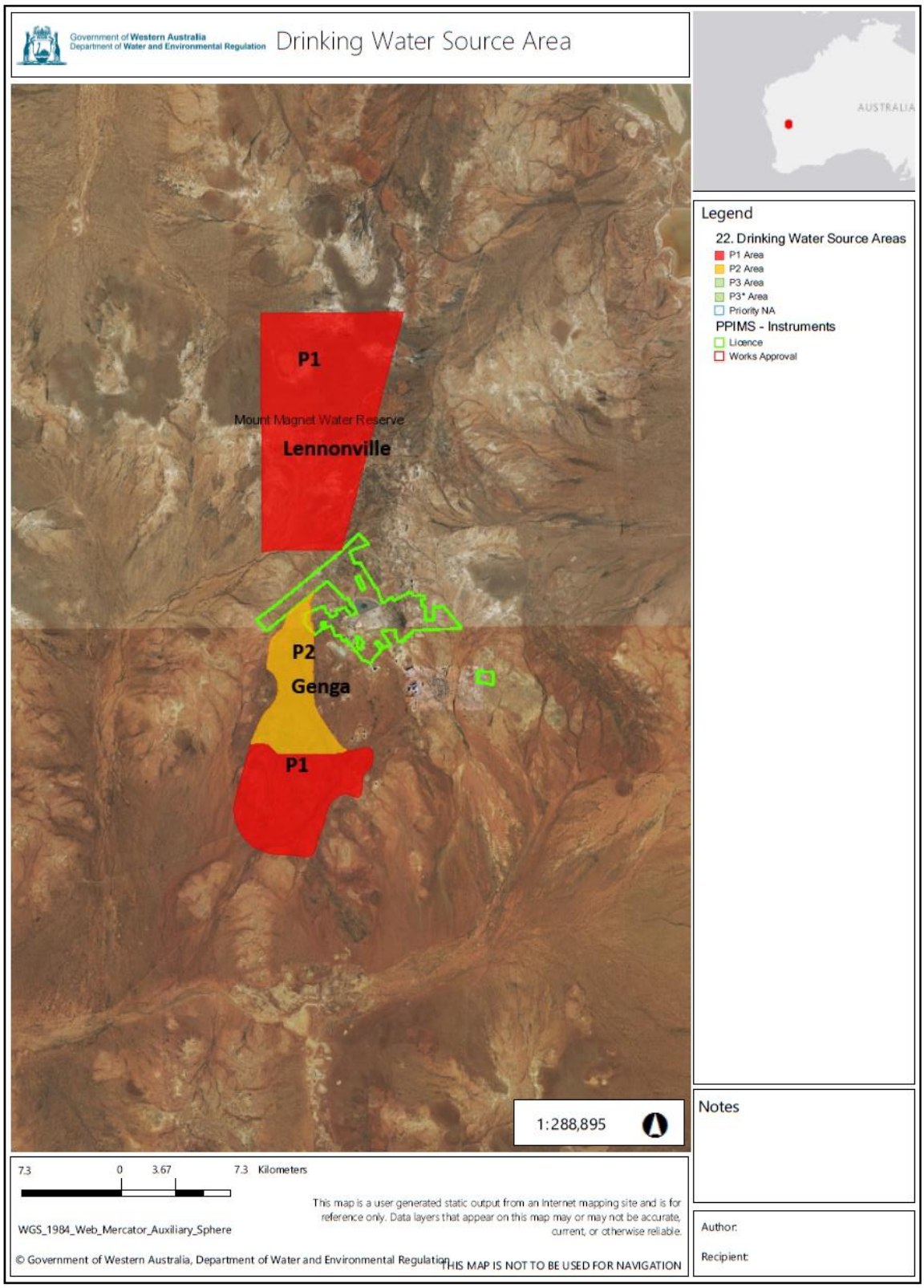

Figure 3 Drinking Water Source Area

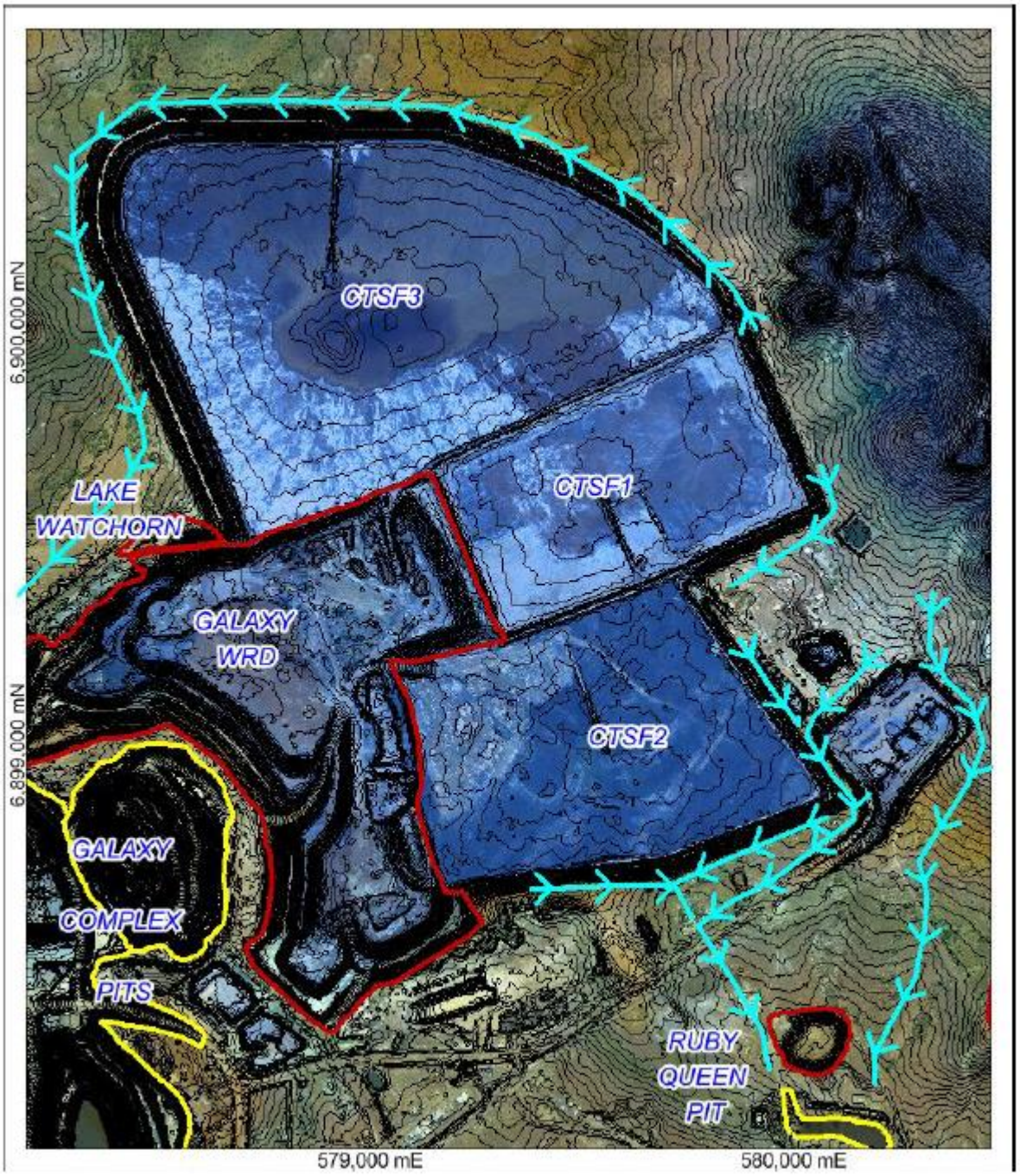

Figure 4 Stormwater drainage and topography

5. Risk assessment

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 3 and Table 4 below, consistent with the Guidance Statement: Risk Assessments. Risk ratings have been assessed for each key emission source and take into account potential source-pathway-receptor linkages.

The mitigation measures / controls proposed by the applicant have been considered in determining the risk rating. Emissions during construction and operation have been assessed separately to allow clear delineation of activity phases.

The works approval that accompanies this report authorises construction only. A licence is required to operate the premises.

The conditions in the issued works approval, as outlined in Table 3 and Table 4, have been determined in accordance with the Guidance Statement: Setting Conditions.

Table 3 Risk assessment for proposed amendments during construction

Risk Event				Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
Category 5 Construction – excavation, earth moving activities, vehicle movement	Dust	Town of Mount Magnet located approx. 2.4 km south east of premises boundary and surrounding flora. Air dispersion Adverse impacts on surrounding flora and amenity or adverse health impacts on sensitive human receptors.	Water carts used as dust suppression when required	Slight	Possible	Low	Applicant controls considered sufficient.	N/A
	Noise	Town of Mount Magnet located approx. 2.4 km south east of premises boundary Air dispersion Amenity impacts on sensitive receptors.	None specified	Slight	Possible	Low	The Delegated Officer considers it unlikely a risk event for noise emissions to occur, as such, the Delegated Officer does not consider the risk to be significant enough to warrant further assessment	N/A

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

Table 4 Risk assessment for proposed amendments during operation

Risk Event				Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (refer to conditions of the granted instrument)
Source/Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
Category 5 CTSF1, 2, 3	Dust	Town of Mount Magnet located approx. 2.4 km south east of premises boundary and surrounding vegetation Air dispersion Adverse impacts on surrounding flora and amenity or adverse health impacts on sensitive human receptors.	Watercart usage as required	Slight	Unlikely	Low	Applicant controls considered sufficient.	N/A
Category 5 Deposition into CTSF1 and CTSF2 after embankment raises	Seepage	Shallow seepage discharge to the surface near toe dam, stormwater runoff; Groundwater solute transport through bedrock fractures Groundwater mounding	Existing monitoring bores When noting visible seepage, construction of trench(es) and/or recovery bores are proposed	Moderate	Almost certain	High	See section 5.1	See section 5.1
		Potential migration of seepage through groundwater causing contamination to PDWSAs		Severe	Possible	Extreme		
Category 5 Additional tailings received by CTSF3 after embankment raise		Shallow seepage discharge to the surface near toe dam, stormwater runoff; Groundwater solute transport through bedrock fractures Groundwater mounding	Existing monitoring bores	Moderate	Almost certain	High	See section 5.2	See section 5.2
		Potential migration of seepage through groundwater causing contamination to PDWSAs		Severe	Unlikely	High		

**The works approval that accompanies this Report authorises construction only. A licence is required for operations.*

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

5.1 Risk event - Seepage from CTSF1 and CTSF2

Deposition of tailings into CTSF1 and CTSF2 can result in increased seepages impacting the groundwater and Mount Magnet water reserve water quality. The premises is adjacent to the Lennonville water reserve (P1), lies within parts of, and borders on the Genga water reserve (P2) to the west. The P1 area of the Genga water reserve is located directly south of its P2 area (Figure 3).

Additionally, recommencing the deposition of tailings into CTSF1 and CTS2 can result in mounding outside of the containment structure footprint. Previous operations of CTSF1 and CTSF2 have resulted in high rates of vertical seepage. The water level below CTSF1 and CTSF2 rose to the natural surface within 12 months of commencing operations (MWES Consulting, 2019). No additional seepage controls are proposed by the applicant.

No tailings have been deposited into CTSF1 and CTSF2 since 2000 and 2001, respectively. There have been no integrity tests to confirm the structure or suitability of these TSFs for re-use.

Current groundwater monitoring is focused on capturing impacts of operational CTSF3, and is less comprehensive for seepage impacts from historical use of CTSF1 and CTSF2. The applicant provided a map showing groundwater bores with relevant historic monitoring data available (Figure 5). Further correspondence (Correspondence 22 April 2020) confirmed the majority of these bores have been destroyed or are not operational anymore (Table 5), limiting the extent of the existing borefield for all CTSF's onsite.

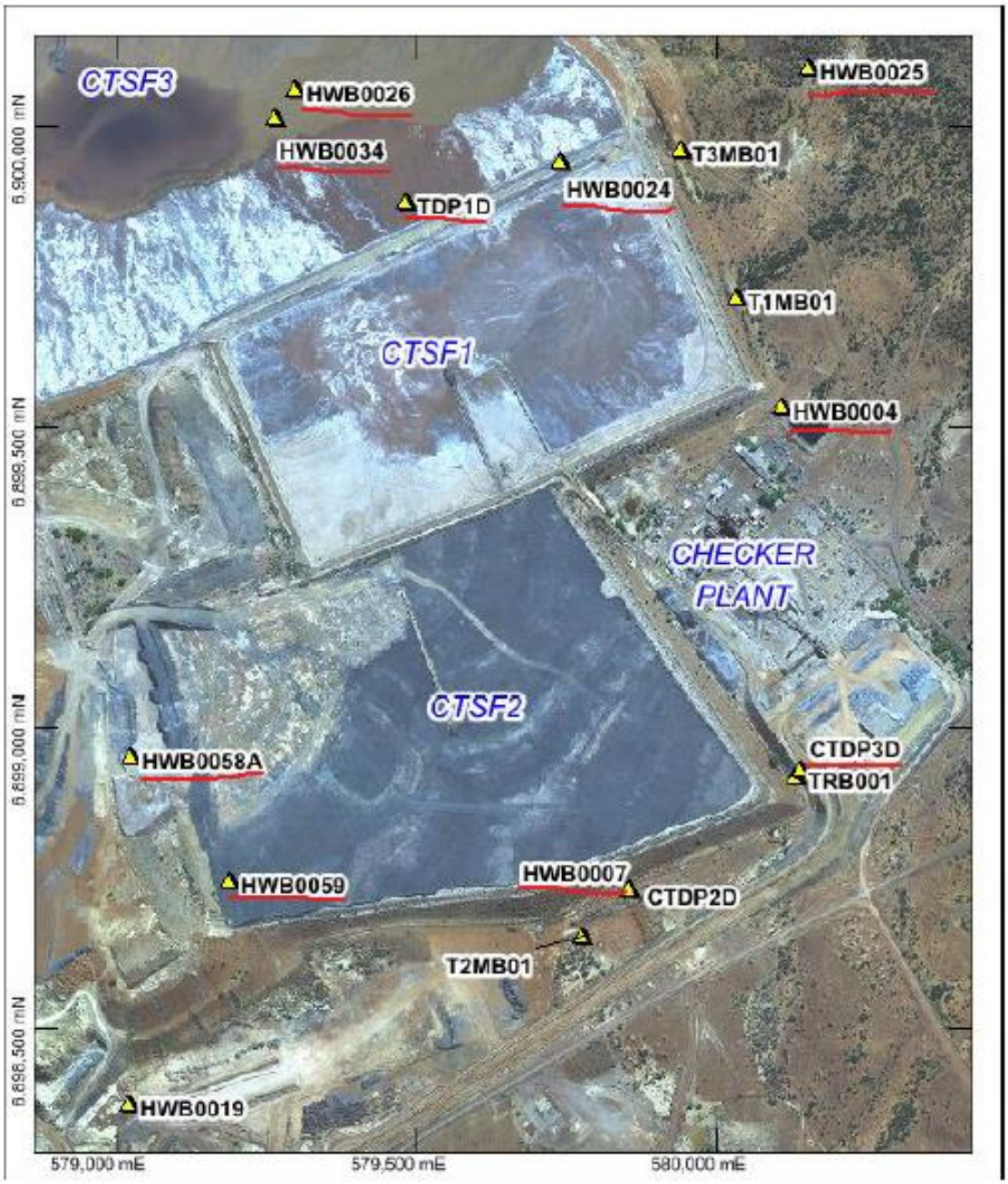

Figure 5 Groundwater bores with relevant historical data available. Red underlined monitoring bores have been destroyed or are not operational anymore.

Table 5 Status of monitoring bores

Bore ID	Status
CTDP1D (TPD1D)	Destroyed under tailings
CTDP2D	Active
CTDP3D	Destroyed & replaced by TRB001
HWB0004	Abandoned & not cased
HWB0007	Abandoned & not cased
HWB0019	Active
HWB0024	Abandoned & not cased
HWB0025	Decommissioned
HWB0026	Destroyed under tailings
HWB0034	Destroyed under tailings
HWB0058A	Destroyed under waste rock dump
HWB0059	Destroyed under tailings
T1MB01	Active
T2MB01	Active
T3MB01	Active
TRB001	Active

Historical data indicated multiple bores were detecting seepage from CTSF1 and CTSF2 during operations. CTDP1D, CTDP2D and HCB058 showed increased salinity and detectable cyanide, directly linked to tailings seepage impacts. Bores CTDP3D/TRB001 had an increase in salinity but not cyanide, and impacts are possible but not confirmed (MWES Consulting, 2019).

Salinity levels of selected monitoring bores recorded are shown in Figure 6. The local baseline groundwater salinity is approximately 4000 mg/L TSD. A summary of 421 water samples from CTSF1 and CTSF2 monitoring bores (1990-2019), identified WAD cyanide detected in 61% of the samples, with an average of 0.05 mg/L. The defined seepage impact criteria for WAD cyanide is 0.01 mg/L as set out in Table 6 (MWES Consulting, 2019).

Concentrations in monitoring bores relevant to CTSF3 are set out in section 5.2.

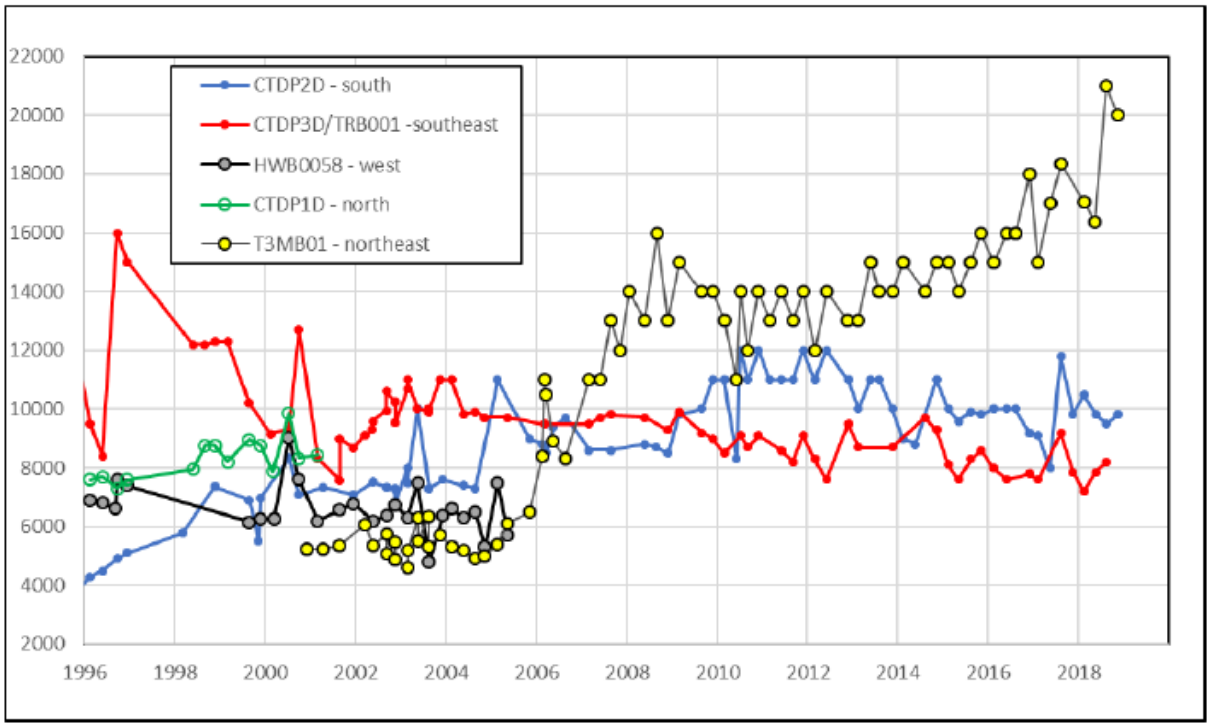

Figure 6 Salinity (mg/L) recorded as TDS in selected monitoring bores

5.1.1 Identification and general characterisation of emission

Seepages can occur during operations when CTSF1 and CTSF2 have been reinstated and start receiving tailings. Tailings characteristics to be deposited into CTSF1 and CTSF2 are expected to resemble tailings currently deposited in CTSF3. Previous analysis of tailings water from CTSF3 (2001-2016) from the decant underdrain and toe trenches have identified the seepage chemistry as set out in Table 6.

Two-dimensional seepage analyses were undertaken to examine flows under the perimeter embankments (Coffey, 2019a). The report states that seepage analysis was only undertaken for CTSF2, due to similar results expected for CTSF1. For CTSF3, 2 main sections (western and north eastern perimeter embankment) were included in the modelling. No modelling for seepage from the CTSFs base is available. The report does refer to the ~20 m old tailings in the currently non-operational CTSF1 and CTSF2, and predicts seepage may develop on the eastern end of CTSF2 south wall after about 5 years (Coffey, 2019a). Seepage can also result in salt build up which needs to be managed (MWES, 2019). No further details were provided.

Cone penetration tests (CPT) were undertaken at 15 sites, only along the embankments of CTSF1, 2 and 3 (Coffey, 2019c) but not the base. Two dissipation tests (CTSF3- CPTu01, CPTu05) were analysed, which indicated a horizontal permeability of $7.1E^{-08}$ and $8.1E^{-09}$, respectively. Permeability tests of the old tailings currently present in CTS1 and CTSF2 are not available. In the report a permeability for upper and lower tailings in CTSF1 and CTSF2 was therefore based on estimation ($5x10^{-8}$ to $5x10^{-7}$) (Coffey, 2019a).

An audit and management review of the CTSFs was undertaken in 2019 (Coffey, 2019b), which provided properties of tailings (Table 6). The audit identified cyanide concentrations (WAD and total) in CTSF1 and CTSF2 to be substantially higher than in the currently operating CTSF3.

Table 6 Seepage source chemistry, impact criteria and tailings characteristics

	TDS [g/L]	SO_4/TDS	WAD cyanide [mg/L]	Total cyanide [mg/L]	pH	Iron [mg/L]
Seepage	14-23	0.16	0.01-6.4		7.9	2.8
Impact criteria	>10	>0.14	>0.01		-	-
Property of tailings						
CTSF1	20		72	100	9	-
CTSF2	20		72	100	9	-
CTSF3	15		2.3	20	7.8	-

5.1.2 Pathway and receptor

Seepages can infiltrate and contaminate the groundwater and the Mount Magnet Water Reserve. In the CTSF1 and CTSF2 area, low bedrock permeability in the unmineralised mafic rock type is present.

Data from previous deposition into CTSF1 and CTSF2 and predictions for the recommencement of the containment structures have identified the following (MWES Consulting, 2019):

- Initial seepage to the water table will be low until old tailings have re-saturated;
- Seepage rates are predicted to be lower than previously observed due to ~20 m dry tailings pile;
- Seepage is controlled by operations including deposition cycle and rate of rise.

The applicant states that no seepage is expected to impact the Mount Magnet Water Reserve (Genga) due to discharge being captured and retained by the Morning Star and Galaxy pits. A previous study found that only minor and localised impacts on the groundwater environment from groundwater pit outflows would occur, and the Genga Water Reserve is unlikely to be impacted (MWES, 2017).

Advice from the department's regional Hydrogeologists has indicated that it is thought to be a low risk of seepage impacting the P1 and P2 PDWSA. However, these claims need to be confirmed by further assessments and require additional seepage management measures to ensure no contaminants are reaching the PDWSAs.

5.1.3 Applicant controls

Monitoring bores

The applicant proposes to use 3 existing monitoring bores (HWB0019, T1MB01, T2MB01), which are not listed on the current licence (L5529/1998/12), to monitor for characteristics of tailings that may occur in seepage of TSF's. These monitoring bores were reinstated in October 2019 (Figure 5). Monitoring bore HWB007 was suggested by the applicant to have been reinstated (RFI 9 April 2020), however it appears this bore has been replaced with monitoring bore CTDP2D which is listed on the existing licence. Details about the monitoring bores which are not yet licensed under L5529/1998/12 are shown in Table 7.

The department is currently assessing a separate licence amendment application to L5529/1998/12 which proposes these monitoring bores to be added to the licence.

Table 7 Proposed monitoring bores for CTSF1 and CTSF2

Bore ID	Easting	Northing	Grid	Total casing depth [mbRP)	Notes
HWB0019	579033	6898371	MGA-Zone 50	120	Re-set up as MB in Sept 2019 with 120m 50mm PN12 uPVC. Original outer steel casing was 180m deep.
T1MB01	580033	6899716	MGA-Zone 50	7	Dry to 7m depth in Sept 2019.
T2MB01	579778	6898652	MGA-Zone 50	48	Re-set up as 48m deep 100mm PVC cased MB in Sept 2019

Internal technical advice identified that proposed monitoring bores are targeting different depths which results in inconsistent monitoring results. T1MB01 in particular appears to be too shallow and is dry most of the time. These proposed monitoring bores are not adequate to monitor seepage impacts. After review of the provided data, the department's Principal Hydrogeologist suggested the contaminant is moving at the base of the regolith, along the surface of fresh bedrock. Therefore this would be a more appropriate depth interval to monitor. It is recommended that the applicant consider this in further detail before the installation of any additional monitoring bores so that any new bores are appropriately placed and installed.

Seepage infrastructure

The application stated that previously installed trench and sumps will be reinstated for CTSF1 and CTSF2, however after further correspondence this was found to be an error as this infrastructure does not exist and is not proposed to be initially constructed (Correspondence 30 April 2020).

In further correspondence, the applicant proposes quarterly inspections of the embankments and surrounds to visually identify any seepage. If any seepage appears to be occurring, a seepage trench may be considered which will report to a lined seepage recovery pond. Captured water is then pumped to Checker Saltwater Dam and back into Checker Mill (Correspondence 30 April 2020). No further details are available.

No records of design including underdrainage or other existing seepage infrastructure of CTSF1 and CTSF2 are available.

5.1.4 Rating of this risk event

Seepage has been identified when CTSF1 and CTSF2 were operational and is already occurring from CTSF3 (section 5.2). The applicant proposes no additional preventative infrastructure to capture seepage and significant uncertainties about seepage impacts remain.

Seepage resulting in groundwater impacts

The Delegated Officer considers the consequence of seepage resulting in groundwater mounding, shallow seepage, stormwater runoff to be **Moderate.**

Seepage has occurred previously and is expected to occur in most circumstances when reinstating CTSF1 and CTSF2. The Delegated Officer has considered the likelihood as **Almost Certain.**

The Delegated Officer has compared the consequence and likelihood of this risk event and determined the overall rating is **High.** Based on this rating, the risk event is subject to multiple regulatory controls.

Seepage resulting in PDWSA impacts

The Delegated Officer considers the consequence of seepage resulting impacts to PDWSAs to be **Severe.**

Seepage has occurred previously and containment of seepage by mine pits needs further confirmation however advice from regional Hydrogeologists supports that the pits to the south and south-west of the TSF's will contain seepage. Based on this, the Delegated Officer has considered the likelihood as **Unlikely** although there is still uncertainties around this which need to be investigated further**.**

The Delegated Officer has compared the consequence and likelihood of this risk event and determined the overall rating is **High**. Based on this rating, the increase in seepage that will result from the deposition of tailings into CTSF1 and 2, and the uncertainties surrounding the lack of pathway for seepage to reach the PDWSA's, the Delegated Officer has taken a conservative approach and considers that this risk event is unacceptable. This is consistent with the department's objectives of risk avoidance for P1 and risk minimisation for P2 PDWSAs.

The acceptance of tailings into CTSF1 and CTSF2 will be subject to a separate risk assessment which will incorporate the results of the additional investigations and monitoring required under this works approval.

5.1.5 Regulatory controls

For the embankment raises and reinstatement of CTSF1 and CTSF2, an appropriate groundwater monitoring network is required to be established. The proposed bores (section 5.1.3) have been found to be unsuitable for this purpose. An adequate amount of monitoring bores with representative depth and location are necessary to identify potential seepage impacts. Monitoring bores are required to be placed in near proximity of CTSF1 and CTSF2, as well as to the west side of the Galaxy pits to detect any potential seepage not captured by the presumed geological barrier to the PDWSAs.

As this is a matter of urgency, the groundwater monitoring bores are required to be completed within 1 month of issuing this works approval. In addition, the premises requires adequate seepage management measures. Seepage infrastructure is required to be completed within 6 months of issuing this works approval.

The risk rating indicates unacceptable outcomes, and uncertainties of seepage impacts on the PDWSAs remain. Based on the detailed assessment above, only the embankment raises are permitted, and tailings cannot be deposited into CTSF1 and CTSF2. Further assessments and confirmation of appropriate seepage containment is required before tailings can be deposited into CTSF1 and CTSF2.

5.1.6 Conclusion

The risk event of seepage from CTSF1 and CTSF2 when reinstated and embankments raised is considered to be unacceptable. Proposed controls by the applicant are not sufficient, and seepages are expected to occur in most circumstances. Further investigations are needed to assess impacts of the additional seepage from CTSF1 and CTSF2 to the current CTSF3 seepage and to confirm that there are no pathways to the PDWSA's. Regulatory controls will require appropriate seepage management measures to reduce adverse impacts, and confirmation of the permanent containment by the Galaxy pits. The embankment raises can

be constructed, but further infrastructure and assessments are essential for the department to be confident seepage impacts are mitigated.

5.2 Risk event – Seepage from CTSF3

CTSF3 was recommissioned in 2012, after the premises had been in care and maintenance for an extended period of time. Seepage from CTSF3 was first noted in 2004, which prompted the installation of a shallow cut-off trench backfilled with coarse rock fill and geotextile at the top interface. The trench drains to two recovery sumps where water and seepage is collected and pumped back to the process plant.

Other seepage management infrastructure consists of recovery bores, which are located on the western and northern side of CTSF3 (Figure 7). It should be noted that no record of recovery bore labelled on Figure 7 as T3RB5 is available and appears to not exist.

The average seepage recovery for CTSF3 was reported to be 29.9 % (292 726 m^3). However, it was not clear what the total seepage volume is and how the remaining seepage is addressed (Coffey, 2019b). A further information request from the department referring to the seepage recovery rate states that seepage not captured by CTSF3 decant or recovery bores is not considered to cause any environmental harm by the applicant (RFI 9 April 2020). However, no further information to confirm this has been provided.

No surface seepage was identified along the northern wall during the audit (Coffey, 2019b). Further information provided to the department during the assessment has provided results of an Electromagnetic Survey undertaken in 2019, which suggests seepage from CTSF3 occurring at the southern side of CTSF2. These results are further discussed below.

5.2.1 Identification and general characterisation of emission

The Annual Environmental Report (AER, 2019) covering operations from 2018 - 2019 submitted to the department as required by the current licence L5529/1988/12, showed cyanide present in most CTSF3 monitoring bores (Figure 7). Any detectable cyanide, and TDS concentrations >10 000 mg/L in the groundwater is considered by the applicant to be from seepage, as set out in Table 6.

Concentration ranges of WAD, total cyanide and TDS measured in samples quarterly (August, November 2018; February, May 2019) are listed in Table 8. Monitoring bores suggesting seepage in accordance to criteria listed in Table 6 are highlighted in grey.

Relevant water quality guidelines describe criteria of 0.007 mg/L in freshwater and 0.004 mg/L in marine waters for free cyanide (ANZECC & ARMCANZ 2000). While total and WAD cyanide analysis includes the free cyanide in its measurements, other forms of cyanide are also measured. A direct comparison of the total and WAD cyanide to free cyanide is therefore not appropriate. Non-detection of total and WAD cyanide in the groundwater does also not necessarily exclude the possibility of cyanide contamination being present, as these measurements fail to detect many forms of cyanide which may be present at a mine site.

Table 8 Cyanide concentrations in CTSF3 monitoring bores

Bore ID	WAD Cyanide [mg/L]	Total Cyanide [mg/L]	TDS [mg/L]
T3MB01	<0.004 - 0.01	0.33 – 0.4	20 000 – 21 000
T3MB02	<0.004	<0.004	2900 – 3400
T3MB04	<0.004	0.070 – 0.11	9400 – 20 000
T3MB05	<0.004 – 0.006	0.078 - 0.12	15 000 – 20 000
T3MB06	<0.004 – 0.004	0.10 – 0.16	14 000 – 15 000
T3MB08	<0.004	<0.004	3100 - 3400
T3MB09	<0.004	0.077 - 0.098	11 000
T3MB10	<0.004	0.045 – 0.055	15 000 – 17 000
CTDP2D	<0.004 – 0.004	0.081 – 0.11	9500 – 11000
TRB001	<0.004	0.099 – 0.15	7900 – 17 000

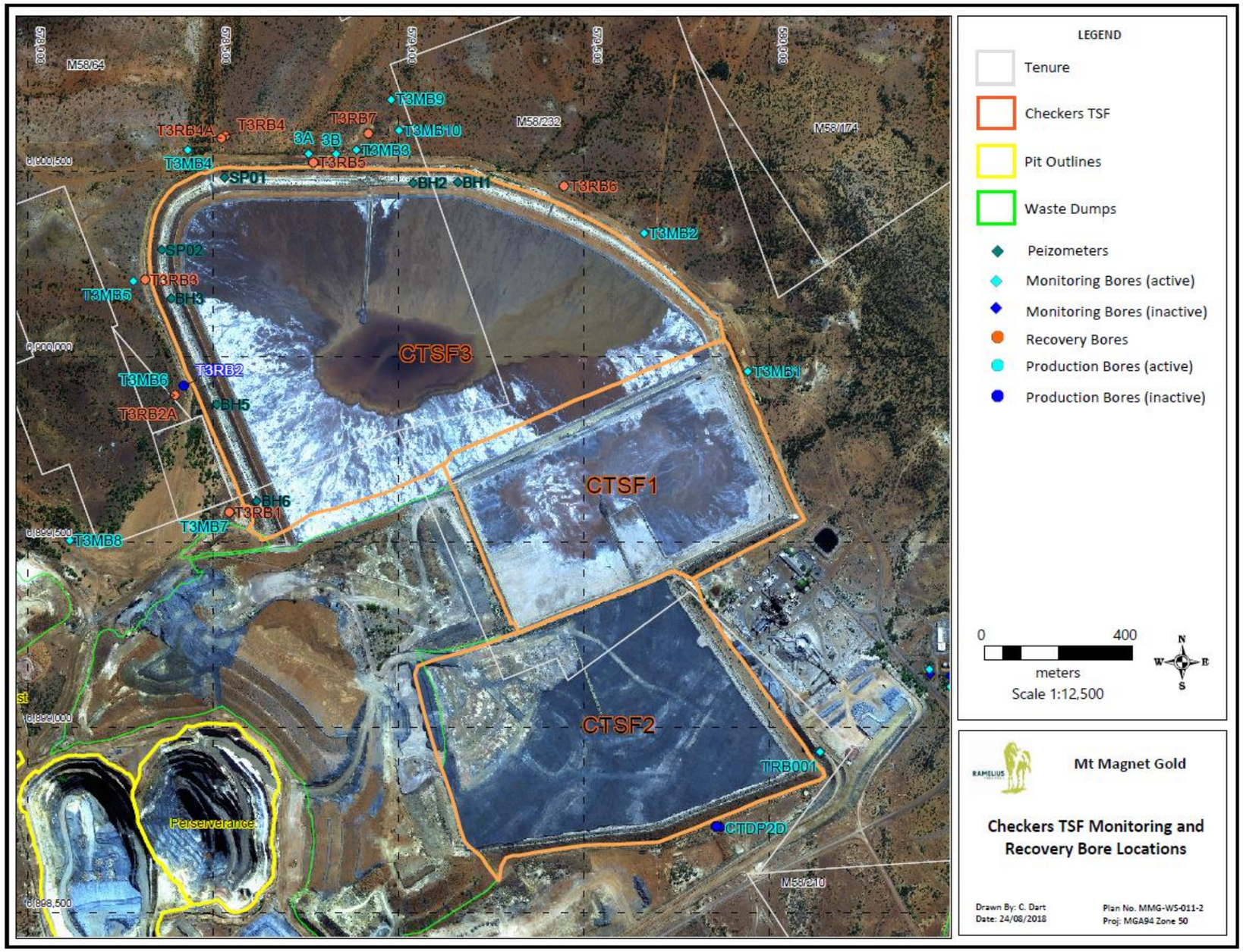

Figure 7 Monitoring and recovery bores at the premises

It should be noted that only two of the CTSF3 monitoring bores are located at the southern side, below the adjacent to CTSF3 located CTSF2. Therefore limited groundwater quality concentrations are available. The groundwater monitoring bores CTP2D and TRB001 south of CTSF2 both indicate impacts of seepage (Table 8), agreeing with findings in the Electromagnetic Survey discussed below. Findings from the Electromagnetic Survey were made available to the department during the assessment, which indicates extensive seepage at the southern side as described below.

As part of further information requested by the department from the applicant, findings from an Electromagnetic Survey which was carried out 2019, were provided (NEWEXCO 2019). The study identified anomalies at the southern side of CTSF2 associated with increased salinity which appears to be sourced from tailings seepage as suggested in the report (Figure 8). The report compared findings to a survey undertaken in 2012 and concluded that the anomalies have formed in the past 7 years. The installation of recovery bores in those locations of suspected seepage were recommended by NEWEXCO. It should be noted that the applicant does not accept the interpretations and recommendations in the report as stated in further correspondence with the department (RFI 9 April 2020). However no evidence has been provided to the department to suggest otherwise and therefore the Delegated Officer considers the findings of the NEWEXCO report to be valid.

Data from the few groundwater monitoring bores (T3MB1, CTP2D and TRB001) located within the area identified in the NEWEXCO report (Figure 8), agree with suggestions of seepage occurring. A review of the provided data by the department's Principal Hydrogeologist confirmed the necessity of seepage recovery and further investigation of the saline groundwater plumes discharging from the southern wall of CTSF2.

The actual extent of seepage remains unknown and should be considered and investigated further due to the location and proximity to the PDWSAs (Figure 3). It was further advised due to pH and high salinity, to analyse oxyanion-forming metals (chromium, molybdenum, vanadium), arsenic and antimony. Additional technical advice provided by the department's Principal Hydrogeologist raised concerns about the suitability and efficiency of recovery bores, due to low hydraulic conductivity of fractured bedrock and the overlying regolith in the affected area. The applicant should note this and consider the best options for seepage recovery going forward.

Pathways and receptors are identical to CTSF1 and CTSF2 and are discussed in sections 5.1.1 and 5.1.2.

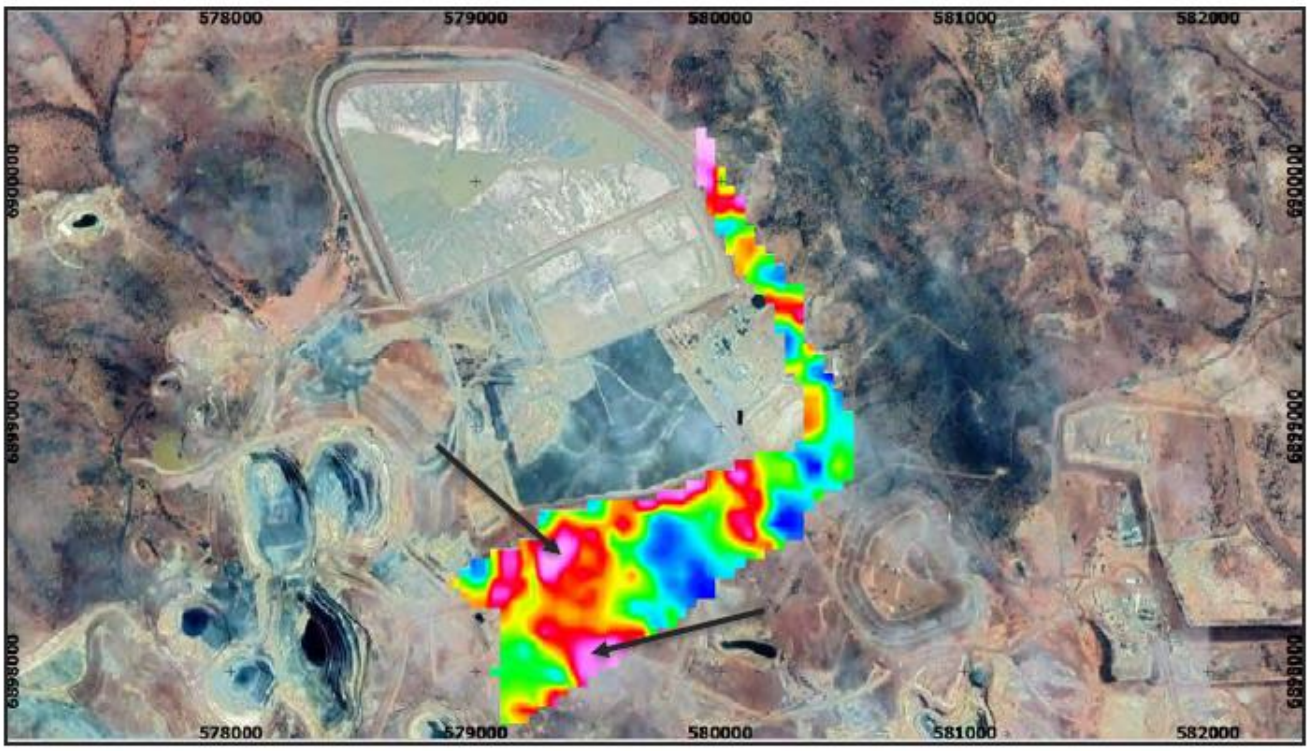

Figure 8 Anomalous zones indicating seepage (NEWEXCO 2019)

5.2.2 Applicant controls

No additional controls for seepage management are proposed by the applicant.

5.2.3 Rating of this risk event

Seepage resulting in groundwater impacts

Taking into consideration that seepage is currently occurring and not adequately managed, with no additional preventative infrastructure proposed to capture seepage, the Delegated Officer has considered the consequence to be **Moderate**.

Seepage is occurring and will continue to occur, especially with the continued deposition of tailings into CTSF3 associated with the embankment rise. The Delegated Officer has considered the likelihood as **Almost Certain.**

The Delegated Officer has compared the consequence and likelihood of this risk event and determined the overall rating is **High.** Based on this rating, the risk event is subject to multiple regulatory controls.

Seepage resulting in PDWSA impacts

Seepage is currently occurring, and the actual extent required further investigation. No further controls have been proposed by the applicant. The Delegated Officer has considered the consequence to be **Severe**.

The proposed embankment raise is not thought to significantly add to the already occurring seepage and the risk of seepage reaching the PDWSA. Advice from regional Hydrogeologists supports that the pits to the south and south-west of the TSF's will contain seepage. Based on this, the Delegated Officer has considered the likelihood as **Unlikely** although there is still

uncertainties around this which need to be investigated further.

The Delegated Officer has compared the consequence and likelihood of this risk event and determined the overall rating is **High.** Based on this rating, the risk event is subject to multiple regulatory controls.

5.2.4 Regulatory controls

In order to permit an embankment raise of CTSF3, the current occurring seepage is required to be investigated, addressed and managed. While the applicant is cautious about the interpretation of the Electromagnetic Survey (NEWEXCO, 2019) suggesting seepage, monitoring bores have indicated seepage in the past. This requires further investigation into the extent of seepage.

Additional seepage recovery infrastructure needs to be installed, and efficiency of seepage recovery demonstrated. As significant seepage is already occurring, the installation of seepage infrastructure is of high urgency and is to be completed within 6 months of the issuing date of this works approval.

Additionally, monitoring bores at the southern side are required to be installed to get a clear understanding of seepage impacts. Construction and operation of additional monitoring bores are required to be completed within 1 month of issuing this works approval. Based on the Electromagnetic Survey (NEWEXCO 2019) and geophysical data, the contamination is likely moving at the base of the regolith along the surface of fresh bedrock. Therefore this appears to be the most appropriate depth interval to monitor.

The TSF seepage management plan (MMG, 2013) also needs to be updated to reflect new findings, proposed operations and appropriate seepage management.

5.2.5 Conclusion

Seepage from CTSF3 is currently occurring and additional tailings deposited after embankment raise around likely to result in the generation of any significant additional seepage or impacts. While the embankment raise and deposition of tailings into CTSF3 have been approved, additional infrastructure for seepage management and mitigation, including further assessment is required.

6. Regulatory controls

6.1 Works approval

Rationale and summary of conditions set out in W6342/2020/1 are listed in Table 9.

Table 9 Summary of conditions to be applied

Condition Ref	Reasoning
Infrastructure 1 - 3	The conditions are valid, risk-based and contain appropriate controls on infrastructure requirements. Proposed infrastructure is constructed in accordance with application documents and based on further investigation.
Compliance reporting 4 - 7	These conditions are valid and are necessary administration and reporting requirements to ensure compliance. Correct installment and construction of infrastructure is certified and reported to the department within 30 days after completion. Seepage recovery is reported to the department to show adequate efficiency.

	Groundwater monitoring data is reported to the department.
Monitoring 8 - 9	Groundwater monitoring is required to be undertaken prior, during and after construction of infrastructure and during time limited operations.
Records and reporting (general) 10 - 12	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.

6.2 Proposed licence controls (by amendment to existing licence L5529/1988/12 following completion and compliance with this works approval)

Condition Ref	Reasoning
Infrastructure Infrastructure is required to be located at the agreed location and is maintained/operated in accordance with corresponding requirements. Constructed infrastructure is included in the licence with location. Additional seepage recovery infrastructure may be required including further assessments.	The conditions are valid, risk-based and contain appropriate controls on infrastructure requirements.
Compliance reporting	Annual Environmental Report with monitoring data. Annual Audit Compliance Report to set out any non-compliance.
Monitoring	Groundwater quality monitoring is undertaken at new constructed bores in accordance to existing licence conditions. Seepage recovery and efficiency is monitored.
Records and reporting	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.

7. Consultation

Method	Comments received	DWER response
Application advertised on DWER website (05 Mach 2020))	None received	N/A
Shire of Mt Magnet advised of proposal (17 March 2020)	None received	N/A

DMIRS advised of proposal (17 March 2020)	None received	N/A
Applicant referred draft documents (2 July 2020)	Applicant requested the timeframe for the installation of seepage management measures to be extended from 3 to 6 months after the issue of this works approval (condition 1, table 1). This is due to committed workflows, planned plant shutdown, resource and mobile plant availability. The applicant requested the remaining comment period to be waived following this change.	Accepted, the timeframe was adjusted in the issued works approval. Infrastructure for seepage management is required to be installed within 6 months of instrument issue.

8. Conclusion

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

Construction of embankment raises for CTSF1 and CTSF2 have been granted however the risk posed by deposition of tailings into these TSF's is considered to be unacceptable and has not been approved at this time.

The raised embankment of CTSF3 has been granted.

Lauren Fox

Digitally signed by Lauren Fox
Date: 2020.07.17 13:43:26 +08'00'

Lauren Fox

A/MANAGER – RESOURCE INDUSTRIES

INDUSTRY REGULATION

An officer delegated by the CEO under section 20 of the EP Act

Appendix 1: Key documents

Document title	Availability
Licence (W6342/2020/1) application form and supporting documentation (October, 2019)	DWER records (A1836315, A183616)
BOM, Bureau of Meteorology	accessed at http://www.bom.gov.au/
MWES, 2019 MWES Consulting, Mt Magnet Gold Project Checker TSF1 and 2 Reinstatement Groundwater Impacts Assessment	DWER records (A1836309)
MWES, 2017 Mt Magnet Gold Multi Pit Mining Project Hydrology & Hydrogeology Assessment	DWER records (A1508316)
Coffey, 2019a Mt Magnet Gold Mine CTYSF1, 2 and 3 Embankment Raise Design Report (October 2019)	DWER records (A1836308)
Coffey, 2019b Tailings Storage Audit and Management Review Tailings Storage Facility 1 to 3 and Yuletide Pit (August 2019)	DWER records (DWERDT192789)
Coffey, 2019c Mt Magnet Gold Mine Mt Magnet TSF Geotechnical Investigation (July 2019)	DWER records (A1836308)
DOW, 2016 Water quality protection note no.25 Land use compatibility tables for public drinking water source areas	accessed at www.dwer.wa.gov.au
DOE, 2005 Department of Environment Mount Magnet Water Reserve Drinking Water Source Protection Plan	accessed at www.dwer.wa.gov.au
DWER, 2019 Department of Water and Environmental Regulation Mount Magnet Water Reserve drinking water source protection review	accessed at www.dwer.wa.gov.au
RFI 9 April 2020 Response to Request for further information	DWER records (DWERDT272023)
Correspondence 30 April 2020	DWER records (A1889414)
Correspondence 22 April 2020	DWER records (DWERDT27500)
DER, 2005 Department of Environment Mount Magnet Water Reserve Drinking Water Source Protection Plan	accessed at www.dwer.wa.gov.au
MP83570, 2019 Checker Tailings Storge Facility CTSF1,2 & 3 Embankment Raise Mining Proposal	accessed at https://www.dmirs.wa.gov.au/
NEWEXCO 2019 Mount Magnet Project An interpretation of the Moving Loop Electromagnetic Survey using the Loupe	DWER records (DWERDT274626)

Document title	Availability
System	
AER, 2019 Mt Magnet Gold Pty Ltd Annual Environmental Report 2019-2020, Ramelius	DWER records (A1826792)
MMG 2020 Mt Magnet Gold Pty Ltd Response to draft instrument and decision report	DWER records (DWERDT308970)
ANZECC & ARMCANZ 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality	
DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	accessed at www.dwer.wa.gov.au
DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.	
DER, August 2016. *Guidance Statement: Licence duration.* Department of Environment Regulation, Perth.	
DER, February 2017 *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	
DWER, June 2019 *Guideline: Decision Making* Department of Water and Environmental Regulation	