Application for Works Approval

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

Works Approval Number	W6403/2020/1
Applicant	Hamersley HMS Pty Ltd
ACN	008 694 246
Address	152-158 St Georges Terrace PERTH WA 6000
File Number	DER2020/000121
Premises	Hope Downs 4 Iron Ore Mine – Area 3 Mining Lease (ML) ML282SA and ML5SA NEWMAN WA 6753
Date of Report	23 October 2020
Decision	Works approval granted

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INDUSTRY REGULATION

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, commissioning and time limited operation of the Premises. As a result of this assessment, Works Approval W6403/2020/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this Decision Report, the department has considered and given due regard to its Regulatory Framework and relevant policy documents which are available at https://dwer.wa.gov.au/regulatory-documents.

2.2 Application summary and overview of Premises

On 9 March 2020, 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, commissioning and time limited operation relating to deposition of waste fines (Category 5) within three in-pit waste fines storage facilities (WFSF) at the existing Premises. The Premises, Hope Downs 4 is approximately 30 km north of Newman.

Waste fines material, generated from ore processing is currently being disposed to an existing above-ground WFSF, regulated under Part IV of the EP Act, and into an existing in-pit WFSF in the previously mined Desert Plains Satellite Pit (DSP), not assessed by Part IV but regulated under Part V. Both existing facilities have limited capacity remaining, therefore additional storage capacity is required for the remaining life of mine.

Waste fines are proposed to be deposited to three new in-pit WFSFs (Kalgan Pits; Kal 2, Kal 3 and Kal 4) within the Area 3 mining area (hereafter referred to as the Area 3 WFSF), in addition to the existing facilities. The deposition of waste fines into the Area 3 WFSF is planned to commence in 2020.

Owing that waste fines will be deposited in previously mined pits (once exhausted), and no external, confining embankments will be required (remnant pit walls will form the perimeter of the waste fines storage facility), construction work should be limited. Table 1 lists the documents submitted during the assessment process.

Table 1: Documents and information submitted during the assessment process

Document/information description	Date received
Works Approval Application	9/03/2020
Harmesley HMS response to request for further information - Part 1	30/04/2020
Harmesley HMS response to request for further information - Part 2	20/05/2020
Harmesley HMS response to request for further information - Part 3	04/06/2020
EPA advice on Ministerial Statement 854 – condition 7	16/06/2020
DMIRS advice on in-pit TSF construction design and management	18/06/2020
DWER Contaminated Sites branch advice on seepage modelling	25/06/2020

2.2.1 Timing for commissioning and operation

The Applicant seeks to undertake commissioning under the Works Approval. Commissioning is expected to commence following submission of compliance documentation and is expected to take 2 months. Given no embankments are to be constructed, a Critical Containment Infrastructure Report (CCIR) is not expected to be required prior to commissioning commencing.

Deposition of waste fines within the Kal 3 pit is proposed to commence in 2020 for 6 months until the Kal 2 pit becomes available, expected in March 2021.

2.3 Background

Table 2 lists the prescribed premises categories that have been applied for in this application.

Table 2: Prescribed Premises Categories in the Works Approval

Classification of Premises	**Description**	***Approved Premises throughput***
Category 5	Processing or beneficiation of metallic or non-metallic ore: premises on which — (a) metallic or non-metallic ore is crushed, ground, milled or otherwise processed; or (b) tailings from metallic or non-metallic ore are reprocessed; or (c) tailings or residue from metallic or non-metallic ore are discharged into a containment cell or dam.	2.088 million tonnes of tailings per annual period

2.4 Part IV of the EP Act

2.4.1 Background

The Hope Downs 4 Iron Ore (the Project) was referred to the Environmental Protection Authority (EPA) under Section 38 of the EP Act in January 2010 and was assessed at the level of Public Environmental Review (PER). The EPA released its Report and Recommendations (EPA Report 1374) in December 2010.

2.4.2 Ministerial Statement

Relevant to Part V of the EP Act, the proposed storage of waste fines within an above ground TSF was subject to assessment, The EPA's assessment (EPA Report 1374) determined that groundwater and surface water quality could potentially be impacted from contamination from the paddock tailings storage facility.

The EPA concluded that the Proposal could be managed to meet the EPA's environmental objectives for groundwater and surface water provided conditions are imposed requiring the Proponent to ensure that any discharge of water from tailings storage facilities is monitored and managed (if necessary) to ensure that surface and groundwater quality are maintained.

The Ministerial Statement includes conditions relevant to the management of the proposed facilities. Condition 7 of Ministerial Statement 854 (Water Quality) requires the Proponent to:

a) ensure that seepage from the tailings storage facility does not lead to the quality of surface water or groundwater within or adjacent to the Proposal area exceeding the trigger values for a slightly to moderately disturbed ecosystem provided in the Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000), *Australian Water Quality*

Guidelines for Fresh and Marine Waters and its updates, taking into consideration natural background water quality of the receiving environment.

b) monitor the quality of surface water and groundwater upstream and downstream of the tailings storage facility to ensure that the requirements of condition 7-1 are met.

Clearing, flora and vegetation impacts for the Project are regulated via MS 854.

On the 17 September 2020 Hamersley HMS applied for a Section 45C to change the Hope Downs 4 Iron Ore Mine Proposal approved under Ministerial Statement 854 (MS 854) to **include 3 in-pit tailings storage facilities**. The Area 3 WFSF is located approximately 5 kilometres from the existing above ground TSF and in closer proximity to Coondiner Creek. This change to MS 854 was granted on 2 October 2020. The changes to the proposal were assessed as insignificant with the regulation of the in-pit TSFs to be managed by Part V and the existing MS conditions remain applicable.

Attachment 4 (Section 45C) to MS 854 allows construction, commissioning, and operation of new in-pit TSFs in Area 3 (Figure 1) and additional abstraction of 3 gigalitres per annum to account for re-circulation of seepage from the TSFs. Once the pits are no longer in operation under Part V, they will continue to be regulated by Part IV of the EP Act.

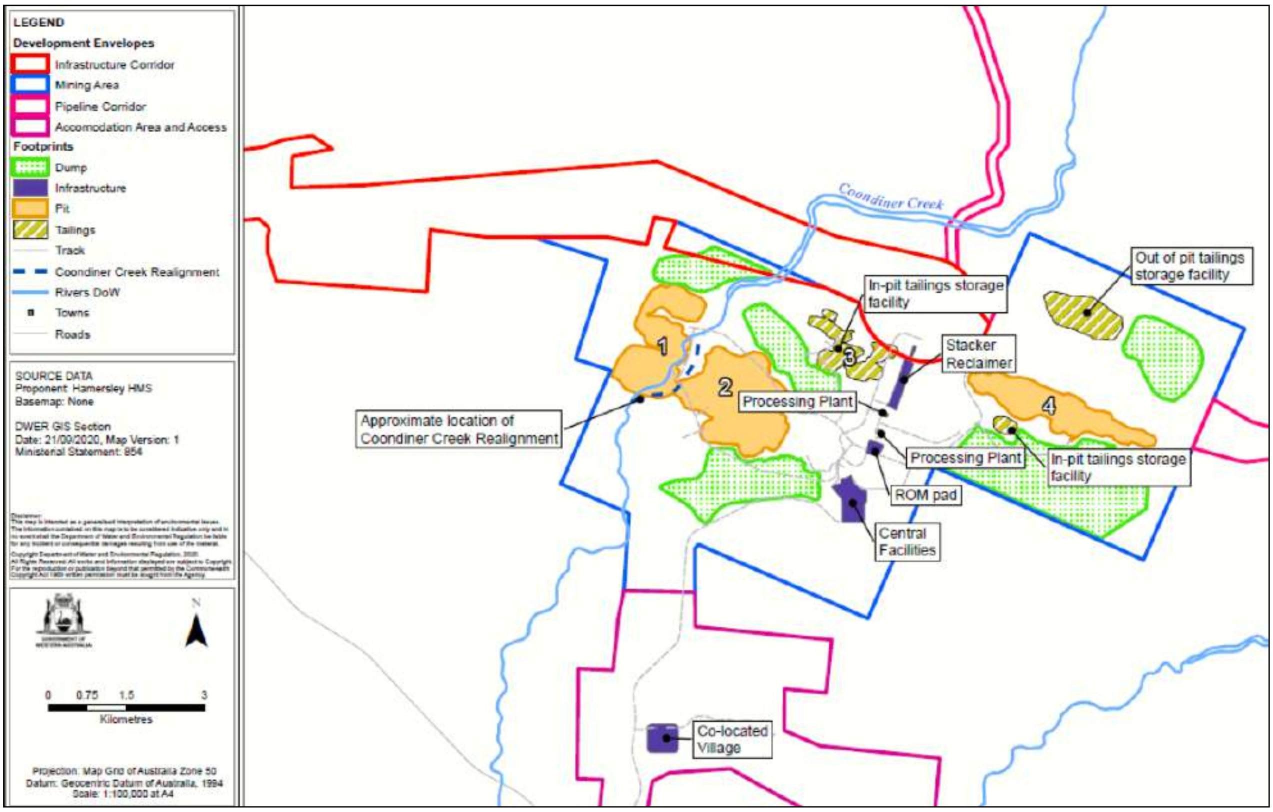

Figure 1: Conceptual Hope Downs 4 layout and associated infrastructure.

3. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guidance Statement: Risk Assessments* (DER 2017).

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

3.1 Source-pathways and receptors

3.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises construction, commissioning and time limited operation which have been considered in this Decision Report are detailed in Table 3 below. Table 3 also details the proposed control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 3: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Dust	Clearing, windblown from cleared areas, vehicle movements	Air/windborne	Clearing will be managed to ensure that areas are only cleared as required and rehabilitation of cleared areas is implemented as construction is completed. Dust suppression will be implemented (including the use of water trucks, control of vehicle movements / restricted speeds).
Hydrocarbon spills	Fuel storage facilities	Hydrocarbon spill causing soil contamination Seepage of hydrocarbon spill to groundwater causing contamination (include depth to groundwater in mbgl)	Hydrocarbons used during construction will be managed via relevant legislation (including Australian Standard AS 1940-2004: Storage and handling of flammable and combustible liquids), the existing requirements of Licence L8688/2012 and standard operating procedures, including: • Vehicle refueling will occur over concrete hardstand or compacted, lined earthen pad (with the exception of field based refueling where a drip tray will be used); • Fuel storage tanks will be designed and constructed to AS 1940-2004: The storage and handling of flammable and combustible liquids; • Fuel storage tanks will be above ground; • Fuel storage tanks will be self-bunded; • Concrete hardstand or compacted, lined earthen pad will be installed under hydrocarbon storage and refuelling facilities where there is potential for hydrocarbon spills; • Management structures (bunding / secondary containment) will be installed at all hydrocarbon storage facilities to ensure any spills are contained; • Regular inspection and preventative maintenance of hydrocarbon storage and refuelling facilities and management structures will be undertaken; and • Spill response will be provided.
Commissioning and time limited operation			
Dust	Windborne particulate (dust)	Air/windborne pathway	Dust emissions will be managed via the existing requirements of Part V Licence L8688/2012 and

Emission	Sources	Potential pathways	Proposed controls
	emissions generated during operation of processing facilities, transport of ore product, stockpiling of ore product		standard operating procedures, including: • Clearing will be managed to ensure that areas are only cleared as required; • Rehabilitation of cleared areas will be implemented as construction is completed; and • Dust suppression will be implemented (including use of water trucks, control of vehicle movements / restricted speeds) during operations. Standard management procedures are expected to effectively mitigate the risk of dust emissions during operations.
Seepage	Waste fines materials	Seepage to groundwater or surface water as a result of deposition of waste fines	Monitoring will be undertaken during and post-deposition to assess groundwater and pond water levels and quality, identify potential seepage, compare with baseline conditions, compare with model predictions and ensure that the proposed deposition of waste fines to the in-pit waste fines storage facility does not result in significant decline in groundwater quality. Groundwater from impacted abstraction bores is combined with (diluted by), groundwater from non-influenced abstraction bores across the site before being discharged to Kalgan Creek. The applicant may later install a decant removal system – details not provided or committed.
		Abstraction of groundwater from impacted abstraction bores discharged to Kalgan Creek	
	Seepage following closure of pits	Remnant seepage to groundwater as a result of seepage from waste fines migrating downgradient to Area 4 pit lake.	The applicant states that the remnant seepage will migrate towards the Area 4 pit lake as extraction bores are decommissioned and will be confined to the pit lake, which represents a groundwater sink. Backfilling of the pit void with tailings will reduce the evaporation rates. Applicant states water quality meets guidelines for livestock drinking water quality. Condition 7 of MS 854 require that groundwater quality should be maintained to ANZECC freshwater 95% protection.
Overtopping	Facility failure releasing waste fines or water from overtopping during operation	Waste fines or water released to natural surface water	The final waste fines surface will be below surrounding ground level such that any failure (with potential loss of waste fines containment) is not expected to release to the surrounding environment. Adequate capacity within facility to contain all storm events (including PMF) without risk of overtopping to the surrounding environment. Monitoring of waste fines volumes, water content in waste fines and rates of deposition will be undertaken.

Emission	Sources	Potential pathways	Proposed controls
Waste fines spill	Delivery pipeline failure releasing waste fines during operation	Waste fines released to natural surface water	The waste fines delivery pipeline will include flow meters / telemetry to detect any issues and will be contained within a bunded corridor reporting to containment ponds for the purposes of containing any spills or leaks caused by pipeline failure. Visual inspections of the integrity of the facility and discharge pipelines will be undertaken to detect any issues.

3.1.2 Receptors

In accordance with the *Guidance Statement: Risk Assessment* (DER 2017)*,* the Delegated Officer has excluded employees, visitors and contractors of the applicant's from its assessment. Protection of these parties often involves different exposure risks and prevention strategies and is provided for under other state legislation. Table 4 and Figure 2 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 *(Guidance Statement: Environmental Siting* (DER 2016)).

Table 4: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	Distance from prescribed activity
Closest residential premises: Township of Newman	Approximately 30 km to the south of the Prescribed Premises. **Screened out as receptor due to distance**.
Other residential premises (not considered sensitive receptors): Hope Downs 4 Village	Within the Premises but more than 7 km south of the proposed facility. **Not considered a receptor for this assessment.**
Marillana Pastoral Lease (P072910)	Approximately 12 km to the north east of the Prescribed Premises. **Screened out as a receptor due to distance.**
Environmental receptors	**Distance from prescribed activity**
Ramsar Sites in Western Australia	No RAMSAR wetlands are located within or near the Premises. The nearest wetlands are Eagle Rock Pool (site number 428), located approximately 4.8 km to the north east of the Premises.
Department of Biodiversity Conservation and Attractions (DBCA) - Conservation Reserves and Managed Areas	No Conservation Reserves or other Managed Areas are located within or near the Premises.
Public Drinking Water Source Area (PDWSA)	Beneficial use of groundwater at the Premises is limited. The nearest PDWSA; Newman PDSWA is located within the Premises but more than 9 km south east of the proposed facility. **Screened out as a receptor for this assessment.**

Threatened Ecological Communities and Priority Ecological Communities	There are no Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) located within or near the Premises.
Threatened/ Priority Flora	There are no Threatened Flora located within or near the Premises, however several Priority (P) Flora species have been recorded within the Premises including: • One P2 species: *Isotropis parviflora;* • Eight P3 species: *Acacia subtiliformis, Goodenia sp. East Pilbara* (A. A. Mitchell PRP 727)*, Rhagodia sp. Hamersley* (M. Trudgen 17794), *Gymnathera cunninghamii, Phyllanthus hebecarpus, Themada sp. Hamersley Station* (M.E. Trudgen 11431), *Goodenia purpurascens, Aristida jerichoensis var. subspinulifera;* and • Three P4 species: *Lepidium catapycnon, Eremophila magnifica subsp. Magnifica, Eremophila youngii subsp. Lepidota*.
Threatened/Priority Fauna	Five species of elevated conservation significance have been recorded or are considered likely to occur within the Premises: • Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (listed as 'Vulnerable' under the EPBC and BC Act), • Ghost Bat (*Macroderma gigas*) (listed as 'Vulnerable' under the EPBC and BC Act), • Grey Falcon (*Falco hypoleucos*) (listed as 'Vulnerable' under the BC Act), • Peregrine Falcon (*Falco peregrinus*) (listed as 'Other specially protected fauna' under the BC Act), and • Western Pebble-mound Mouse (*Pseudomys chapmani*) (Priority 4). The proposed facility will be located within pre-disturbed areas (in previously mined pits within the Area 3 mining area). None of the species of elevated conservation significance were recorded or are expected to occur within or near the proposed facility. As such, the proposed facility is not expected to have any impact on any population, alter the conservation status or threaten the continued existence of any conservation significant fauna species at a local or regional scale.
Riparian vegetation	Riparian communities of Kalgan Creek, which represent communities considered to be of elevated local conservation significance, have been recorded within the Premises. The nearest riparian communities to the proposed facility have been recorded more than 7.5 km to the east. The proposed facility will be located within pre-disturbed areas (in previously mined pits within the Area 3 mining area). None of the riparian communities or Priority flora species considered to be of elevated local conservation significance were recorded or are expected to occur within or near the proposed facility.
Surface water	The proposed in-pit TSFs are located approximately 700 m east of Coondiner Creek. Significant watercourses in the region include Coondiner Creek and Kalgan Creek. As for most parts of the Pilbara, creeks are ephemeral; surface water flow typically only occurs seasonally depending on the occurrence of significant rainfall events. The ephemeral, northeast flowing Coondiner Creek is the main surface drainage feature in the area. This creek transects the western portion of the Premises and follows a northeast trending fault structure until reaching the northern margin of the calcrete deposits where the creek turns sharply to the

	east. Coondiner Creek ultimately discharges via the Eagle Rock Pool and Eagle Rock Falls before draining to the northeast into the Fortescue Valley and the Fortescue Marsh. A local ephemeral tributary of Coondiner Creek originally flowed through Area 3 from south to north. However, the upstream catchments have been altered by mine activities.
Groundwater	The pre-mining groundwater level was measured at approximately 20 mbgl (635 mRL). Current readings from monitoring bores close to Kal 2 and Kal 3 show groundwater level has declined to 65 mbgl (590 mRL). Monitoring bores close to Coordiner Creek (MB05HD4008) declined from 20 mbgl to 26 mbgl (shallow bore) between December 2005 and June 2018, and from 20 mbgl to 32 mbgl (deep bore) between December 2005 and January 2020. The hydrogeological model indicates that the groundwater gradient is towards the east as a result of both drawdown from Area 4 dewatering and the high permeability geology connecting Area 3 and Area 4. Groundwater at Kal 2 prior to mining, was of good quality. Groundwater results are shown in Table 7.

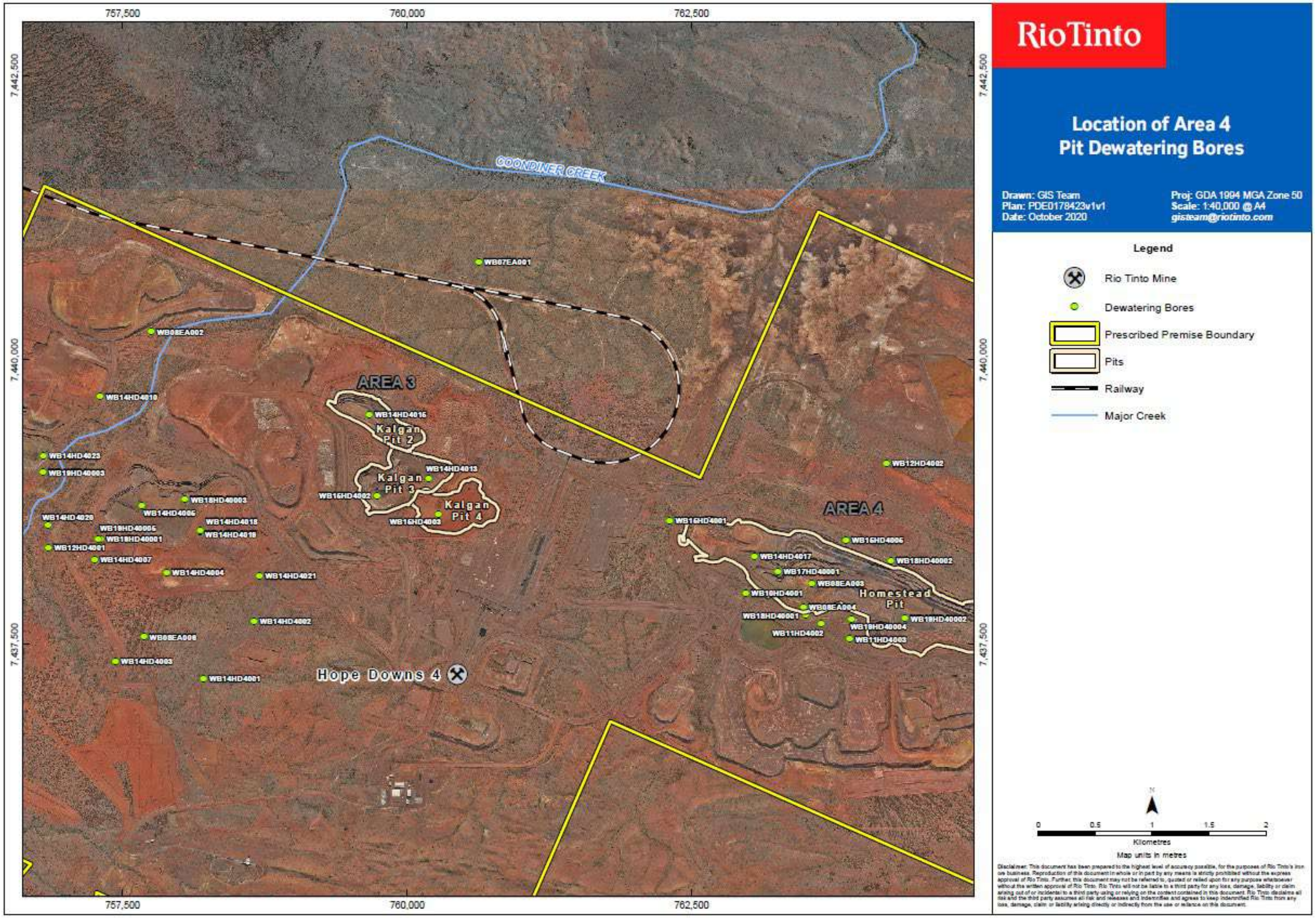

Figure 2: Indicative distance from Kal pits to Coondiner Creek.

4. Risk ratings

Risk ratings have been assessed in accordance with the *Guidance Statement: Risk Assessments* (DER 2017) for each identified emission source and takes into account potential source-pathway and receptor linkages as identified in Section 3.1. Where linkages are in-complete they have not been considered further in the risk assessment.

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

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 5.

Table 5: Risk assessment of potential emissions and discharges from the Premises during construction and operation

Risk Event					Risk rating[1]	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Source/Activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**	**C = consequence** **L = likelihood**			
Construction								
Construction of waste fines storage facility *Owing that waste fines will be deposited in previously mined pits, construction works will be limited.*	Dust	Air: windborne particulate (dust) emissions generated during construction activities including clearing and vehicle movements.	Terrestrial ecosystems: Vegetation, including vegetation communities of elevated conservation significance within and adjacent to the Premises.	*Refer to Section 3.1*	*C = Minor* *L = Unlikely* ***Low Risk***	*Y*	*No*	- Dust impacts on flora and vegetation were assessed by the EPA under Part IV of the EP Act.
	Hydrocarbons from fuel storage and refuelling used during construction	Hydrocarbon spill causing soil contamination Seepage of hydrocarbon spill to groundwater causing contamination Groundwater contamination with potential impacts to beneficial use of the groundwater (and declining health of any vegetation dependent on groundwater):	Land Groundwater of quality better than ANZECC freshwater 95% protection. Terrestrial ecosystems: Vegetation, including vegetation communities of elevated conservation significance located within and adjacent to the Premises	*Refer to Section 3.1*	*C = Minor* *L = Rare* ***Low Risk***	*Y*	No	Given the vertical distance to the groundwater, any hydrocarbon spills from storage and refueling during construction are not expected to seep to groundwater (or affect any associated terrestrial ecosystems).

Risk Event					Risk rating[1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Source/Activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Operation (including commissioning and time-limited-operations)								
Operation of waste fines storage facility - Deposition of slurry into pit voids	Dust windborne particulate (dust) emissions generated during operation of processing facilities, transport of ore product, stockpiling of ore product	Air: Declining health of vegetation including reduced ability for photosynthesis due to dust deposition / smothering: Sediment increases in stormwater	Terrestrial ecosystems: Vegetation, including vegetation communities of elevated conservation significance located within and adjacent to the Premises.	*Refer to Section 3.1*	*C = Minor* *L = Rare* ***Low Risk***	Y	*No*	Dust impacts on flora and vegetation were assessed by the EPA under Part IV of the EP Act.
	Seepage of waste fines from pit voids for 3 new in pit TSFs	Seepage entering groundwater and flowing down gradient to sensitive receptors may have the following impacts: • Water quality adversely affecting aquatic fauna in the Kalgan Creek discharge point. • Groundwater mounding; • Groundwater contamination.	Dewatering abstraction bores which are then discharged to the creek. Freshwater ecosystems. Groundwater dependent ecosystems.	Existing abstraction bores between Area 3 and Area 4 will be the first point of contact for changes in water quality. These are currently being blended with all site wide dewatering and discharge to Kalgan Creek. Decant removal not confirmed – details not provided.	*C = Moderate* *L = Rare* ***Medium Risk***	N	The works approval holder will be required to undertake long-term (over several months) saturated column tests. The works approval holder shall review the groundwater flow-model past 2037, addressing reduction in evaporation from Area 3 due to the backfilling of pits with waste fines. The works approval holder shall be required to provide a monthly water balance report during time limited operations. Decant has not been assessed or considered in the works approval.	Refer to Section 4.1.

Risk Event					Risk rating[1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Source/Activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
		Seepage from WFSF expressed as surface water. Water quality adversely affecting aquatic fauna in the Coondiner Creek (700m)	Local creek alignments. Freshwater ecosystems.	Area 3 Pit WFSF final surface remains below the surrounding ground level hence expression of seepage to surface is unlikely.	*C = Moderate* *L = Rare* ***Medium Risk***	N	The works approval holder will ensure that the WFSF operational and final surface remains below the surrounding ground level. The works approval holder is required to provide monthly groundwater level measurement from bores. MB05HD4004 MB05HD4008 (shallow and deep) MB11HD4010 MB11HD4011 MB14HD4026 MB14HD4027 MB14HD4028 MB15HD4002 MB15HD4004 MB15HD4025 MB15HD4026 MB17HD4005 MB17HD4007 MB17HD4012 MB18HD40008 Install a new monitoring bore (shallow and deep) between Kal2 and MB05HD4008. Reinstall MB14HD4028 Tailings analysis: geochemical and geotechnical during time limited operation.	Refer to Section 4.1.

Risk Event					Risk rating[1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Source/Activities	Potential emission	Potential pathways and impact	Receptors	Applicant controls				
							Installation of a decant return system would be conducted without seeking further approval from DWER. It will consist of a direct return line to the process water tank, similar to the existing above ground WFSF decant return.	
	Facility failure releasing waste fines or tailings contaminated water from overtopping.	Waste fines released into natural channels. Water quality adversely affecting aquatic fauna in the Coondiner Creek. Risk of structural failure leading to physical damage or smothering of vegetation by tailings or sedimentation of watercourses. Soil contamination with the possible addition of ions and metals.	Local creek alignments. Freshwater ecosystems.	Area 3 Pit WFSF final surface remains below the surrounding ground level hence pit wall failure cannot release to surrounding surface.	*C = Moderate* *L = Rare* ***Medium Risk***	N	The works approval holder will ensure that the WFSF operational and final surface remains below the surrounding ground level. The works approval holder will report on height of WFSF in compliance reporting documentation.	WFSF height relative to surrounding ground level is key factor in mitigating risk of emission via overtopping. Additional conditions are to ensure that the WFSF does not reach a height where the emission likelihood increases. Refer to Section 4.1.
	Pipeline failure releasing waste fines Possible decant spill (if and when installed)	Waste fines released into natural channels.	Local creek alignments. Freshwater ecosystems.	Waste fines pipeline contained within bunded corridor from tee off to pit void. Two containment ponds constructed at low points and flush valves with nominal 1,500m^3 capacity. End point of pipeline (near pit	*C = Moderate* *L = Possible* ***Medium Risk***	Y	The works approval holder will construct pipelines in accordance with proposed controls which will be conditioned in the works approval. Decant details not provided. Decant pipeline infrastructure has not been assessed or considered in this works approval.	N/A.

Risk Event					Risk rating[1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Source/Activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
				voids) includes flow meter and telemetry station to detect flow differences with flow meter at outlet of slurry pumps at the plant. Daily inspections of pipeline corridor				

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

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

4.1 Operation of waste fines storage facility - Deposition of slurry into pit voids

4.1.1 Description of Risk Event

Thickened waste fines material (35 – 40% w/w solids), generated from ore processing will be pumped to the Area 3 WFSF via a delivery pipeline, located within a bunded corridor, at a rate of approximately 1.5 – 2.1 mega tonnes per annum (Mtpa). Waste fines will be deposited in previously mined pits (Kalgan Pits; Kal 2, Kal 3 and Kal 4) within the Area 3 mining area (selected based on the forecast waste fines production relative to the available capacity).

Deposition will occur from two discharge points (spigots) located at the pit edge. The spigots will be slotted to allow discharge at different levels as the pipe is inundated. Typically a beach will form where the waste fines are deposited and a supernatant pond will form at the opposite end of the pit however, owing to the small pit area, limited beaching is expected to occur, the waste fines surface will be essentially flat with a progressively increasing inundation area / pond extent. Decant has not currently been proposed.

4.1.2 Identification and general characterisation of emission

The applicant conducted detailed geotechnical testing in 2015 and geochemical testing in 2019 (different orebody). The waste fines has previously been classified as non-acid forming (NAF) as part of the above ground WFSF design. An additional five operating tailings samples were tested over 2015 to 2017 and found to be circumneutral and also classed as NAF – Barren (Knight Piesold 2020a).

Four tailings samples collected in 2019 were analysed by the applicant for Acid neutralising capacity (ANC), total sulphur (%), chromium reducible sulphur (pyritic sulphur %), pH (1:2) and electrical conductivity (EC) 1:2, Net acid generation (NAG), and NAG pH (pHox). The pH results for all the samples are circum-neutral to mildly alkaline with values between pH 7.6 and pH 8. The EC is low for all samples showing between 105 and 126 µS/cm. Plotting total S against the Acid neutralising capacity (ANC) shows the Acid base accounting (ABA) for these samples. The red dashed line represents Net Acid Producing Potential (NAPP) NAPP=0 where the ANC=Maximum Potential Acidity (MPA). The MPA is conservatively calculated from the total sulphur and assumes that all the sulphur in the sample may be oxidised to produce acid. Samples that plot below this line have the potential to be potentially acid forming (PAF). Results are shown in Figure 3.

Analysis and comparison of the slurry supernatant water and decant return water to a monitoring bore close to the Desert Plains Waste Fines Storage Facility was conducted. The Results are shown in Table 6. Comparison of samples to ANZECC (2000) guidelines for slightly to moderately disturbed ecosystems indicates that slurry and tailings water samples exceed criteria significantly compared to groundwater samples.

Groundwater samples collected in bore near the DSP pit WFSF (not regulated under Part IV) (2.2 km east of Kal 4) show elevated nitrate (in 2014) and Zn above the guidelines. Slurry and decant waters have ammonium, oxides of nitrogen, total nitrogen and nitrates up to three orders of magnitude higher than the guidelines. These samples also have elevated concentrations of cadmium, chrome and zinc.

Table 6: Tailings quality analysis compared against ANZECC fresh water 95% protection.

		slurry HD3 2019				slurry HD4 2018	DSP 2019 water		original 2010 waste fines	Bores near DSP pit WFSF WB14HD40 11		
Parameter	**ANZECC (2000) – 95% Protection (mg/L)**	slurry HD4 Sample 1	slurry HD4 Sample 2	slurry HD4 Sample 3	slurry HD4 Sample 4	Tailing slurry fresh	EP1904720-1	EP1904720-2	Hope Downs 4 - Clnr + Rougher	Oct-14	Oct-14	Jun-15
Ca	no guideline	8	10	8	10	21	41	40	28.72	21	23	22
Mg	no guideline	5	6	5	6	14	28	27	13.43	20	21	22
Nitrate (NO_3)	0.7	4.38	7.97	10.2	8.55	8.5	47.7	48.2		3.5	3.9	0.24
Nitrite (NO_2)	no guideline	3.85	1.91	<0.01	5.17	0.05	4.37	4.34				<0.05
Ammonia	0.9	0.6	0.05	0.02	0.08	1.45				0.03	0.07	0.07
Sulphate	no guideline	7	7	11	6	43	43	43	8.8	14	15	10
TDS	no guideline	103.9	108.5	121.9	111.9	758.2	402.7	405.4	341.7			
Al (dissolved not total)	0.055	0.022	0.022	0.078	0.042	<0.005	0.01	0.017	<0.01	<0.005	<0.005	
Arsenic	0.024	0.0003	<0.0002	0.0004	0.0004	0.0013	0.0003	0.0004	0.6			<0.001
Beryllium	no guideline					<0.0001	<0.0001	<0.0001				
Boron	0.37	0.324	0.308	0.244	0.256	0.209	0.162	0.177		0.18	0.18	0.18
Cadmium	0.0002	0.00013	0.00025	0.00026	0.00028	0.00022	<0.00005	<0.00005	<0.00002	<0.0001	<0.0001	0.001

		slurry HD3 2019				**slurry HD4 2018**	**DSP 2019 water**		**original 2010 waste fines**	**Bores near DSP pit WFSF** WB14HD4011		
Parameter	**ANZECC (2000) – 95% Protection (mg/L)**	slurry HD4 Sample 1	slurry HD4 Sample 2	slurry HD4 Sample 3	slurry HD4 Sample 4	Tailing slurry fresh	EP1904720-1	EP1904720-2	Hope Downs 4 - Clnr + Rougher	Oct-14	Oct-14	Jun-15
Chromium	0.001	0.0007	0.0003	0.0025	0.0005	0.002	0.0005	0.0004	<0.01			
Cobalt	0.0014	<0.0001	<0.0001	0.0002	<0.0001	0.0003	<0.0001	<0.0001	0.0002	<0.001	<0.001	<0.001
Copper	0.0014	0.0007	0.0199	0.0007	0.001	<0.0005	<0.0005	<0.0005	<0.01	<0.001	<0.001	<0.001
Fluoride	no guideline								0.8	0.2	0.2	0.2
Lead	0.0034	0.0001	0.0003	0.0004	0.0001	<0.0001	<0.0001	<0.0001	0.0018	<0.001	<0.001	<0.001
Manganese	1.9					0.0231	<0.0005	<0.0005		0.25	0.068	0.47
Molybdenum	0.034	0.001	0.001	0.001	0.001	0.001	<0.0005	<0.0005	0.002	<0.001	<0.001	<0.001
Nickel	0.011	<0.0005	<0.0005	0.001	<0.0005	<0.0005	<0.0005	<0.0005	<0.01	0.001	<0.001	0.006
Selenium	0.011	<0.0002	<0.0002	<0.0002	<0.0002	0.001	0.0006	0.0005	0.001			<0.001
Uranium	0.055	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00094	0.00092	0.0	<0.001	<0.001	<0.001
Vanadium	no guideline					0.0003	<0.0002	<0.0002		<0.001	<0.001	
Zn	0.008	0.089	0.078	0.066	0.068	0.09	0.007	<0.001	<0.01	0.016	0.012	0.34

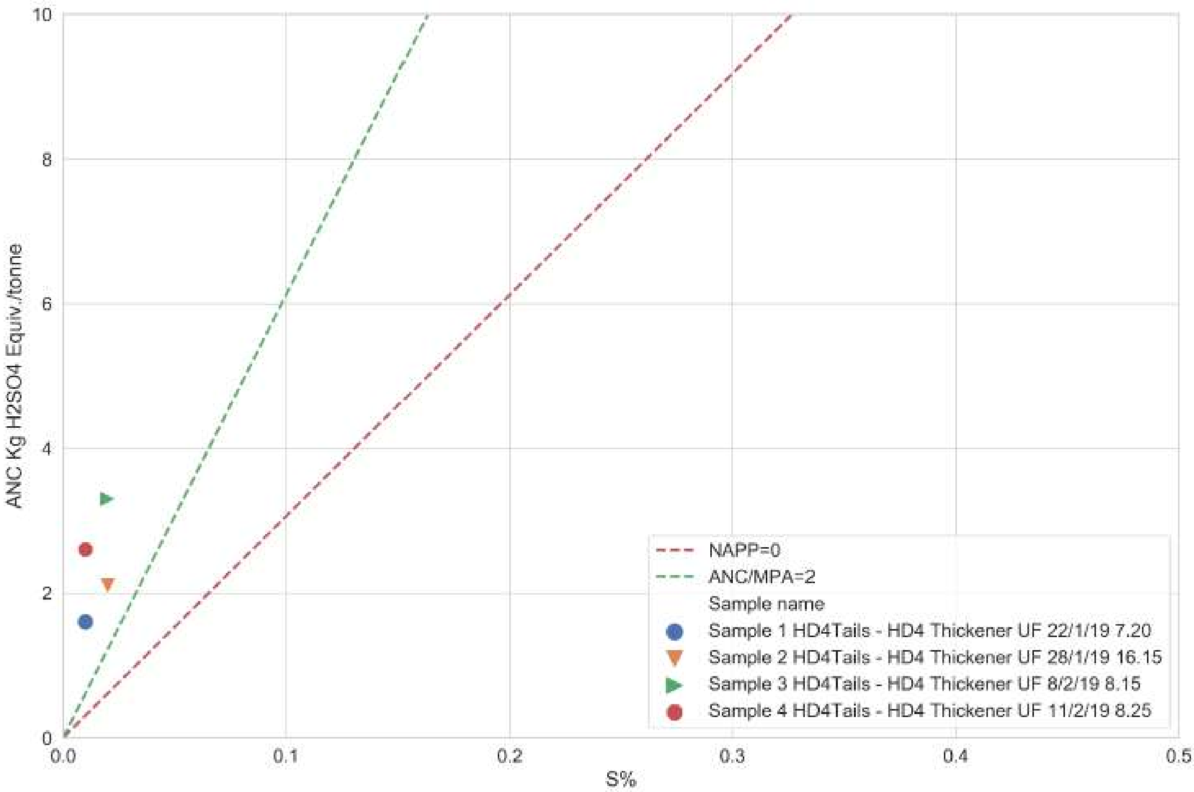

Figure 3: Acid-base accounting plot for tailings samples. ANC means acid neutralizing capacity.

Water quality records provided to DWER in June 2020 show samples taken at MB14HD4028, MB05HD4004, MB11HD4011, MB14HD4027, MB14HD4026, MB11HD4010, B05HD4008(DEEP), MB05HD4008(SHALLOW). These results show that Nitrate, Aluminium and Zinc tend to be above the ANZECC criteria, as well as Chromium at MB05HD4008.

The latest groundwater analysis for each bore are shown in Table 7. Bore locations can be found in Figure 8. Monitoring bore MB05HD4004 results can be used as groundwater quality reference. This monitoring bore was located at Kal pit 2.

Table 7: Quality data for monitoring bores located around the proposed new in-pit TSFs

Sample Point	MB05HD4004	MB05HD4008 (DEEP)	MB05HD4008 (SHALLOW)	MB11HD4010	MB11HD4011	MB14HD4026	MB14HD4027	MB14HD4028
Sample Date	**15/12/2014**	**24/06/2018**	**17/03/2011**	**3/10/2013**	**23/09/2014**	**4/07/2014**	**21/09/2014**	**24/06/2018**
Zn (mg/L)	0.01	0.06	0.14	0.04	0.01	0.05	0.05	0.01
pH	7.7	< 5		7.7		8.4	8.3	
TDS (mg/L)		< 0.001	< 0.02	300				221
Al (mg/L)	0.02	283	410	0.01	< 0.02	< 0.005	< 0.005	< 0.01
Ammonia (mg/L)	< 0.05		< 0.001	0.04	0.01	< 0.01	< 0.01	
Sb (mg/L)	< 0.001		1	< 0.001	< 0.001			< 0.001
As (mg/L)	< 0.001	62	110	< 0.001	< 0.001			< 0.001
Ba (mg/L)	0.05	< 1		0.04	0.05	0.02	0.02	
Be (mg/L)		58	390	< 0.001				< 0.001
Bi		< 0.001	< 0.005					
B (mg/L)	0.26	0.6	0.7	0.25	0.38	0.23	0.23	0.1
Br (mg/L)		< 0.05	0	0.27		3.1	0.24	
Cd (mg/L)	< 0.0001	< 0.001	< 0.005	< 0.0001	0.0	< 0.0001	< 0.0001	< 0.0001
Ca (mg/L)	65	47	140	35	76	47	46	6
Cl (mg/L)	66	< 0.001	< 0.01	47	240	53	41	104
Cr (mg/L)	< 0.001	0.02		< 0.001	0.0			< 0.001
Cr III (mg/L)						< 0.05	< 0.05	
Cr TOTAL (mg/L)		0.2				< 0.001	0.0	
Cr VI (mg/L)		< 0.01				< 0.004	< 0.004	
Co (mg/L)	< 0.001	0.2		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cu (mg/L)	0.0	< 0.1		0.01	0.02	< 0.001	< 0.001	< 0.001
F (mg/L)	0.4	0.2			0.3	0.4	0.4	0.3
Fe (mg/L)	0.13	82.9		0.02	< 0.02	< 0.02	< 0.02	51.9
Fe TOTAL (mg/L)	0.17							
Pb (mg/L)	< 0.001	< 0.01		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mg (mg/L)	49	12		29	77	37	34	1

Sample Point	MB05HD4004	MB05HD4008 (DEEP)	MB05HD4008 (SHALLOW)	MB11HD4010	MB11HD4011	MB14HD4026	MB14HD4027	MB14HD4028
Sample Date	**15/12/2014**	**24/06/2018**	**17/03/2011**	**3/10/2013**	**23/09/2014**	**4/07/2014**	**21/09/2014**	**24/06/2018**
Mn (mg/L)	0.02	< 0.01	< 0.02	< 0.001	0.01	0.01	0.01	2.01
Hg (mg/L)	< 0.00005		18	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00004
Mo (mg/L)	0.0	22		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Ni (mg/L)	0.01	< 0.001	< 0.005	0.01	0.01	< 0.001	< 0.001	< 0.001
Nitrate (mg/L)	5.1	33		2.6	3.3	2.2	3.2	0.04
Nitrite (mg/L)	< 0.2	46	200		< 0.05			
Nitrogen Inorganic (mg/L)					0.75	0.51	0.73	
P TOTAL (mg/L)	0.02	0.08	0.24	0.34	0.16	0.11	0.06	0.08
K (mg/L)	7.8			5.6	12	7.8	6.5	< 1
Se (mg/L)	< 0.002			< 0.002	< 0.002			< 0.01
Na	27			19	75	24	18	2
Sulphate (mg/L)	39			18	110	32	26	< 1
Sulphur (mg/L)						11	8.7	< 1
Zn (mg/L)	0.01			0.03	0.02	< 0.005	0.01	< 0.005

4.1.3 Seepage to groundwater

Seepage from the three in-pit facilities entering groundwater and flowing down gradient to sensitive receptors may have the following impacts:

- Water quality adversely affecting aquatic fauna in the Kalgan Creek discharge point.
- Groundwater mounding.
- Groundwater contamination.

Due to the substantial dewatering groundwater profile of Area 4, a seepage plume from Area 3 is currently directed east to this Area 4. The seepage plume currently appears to be confined to within the lease area and does not result in groundwater mounding as the area is being heavily dewatered.

Water balance modelling was completed to determine the residual volume of water expected as a result of the proposed deposition of waste fines. Sources and losses considered in the modelling included the rate of waste fines deposition, characteristics of the waste fines, consolidation, seepage losses and climatic factors such as rainfall and evaporation.

During deposition, a supernatant pond will form on the waste fines surface (Figure 4). The pond depth will progressively increase until a balance of water release from waste fines deposition and seepage / evaporation is achieved. Based on the modelling, it is expected that the supernatant pond in Kal 2 will stabilise at an average depth of around 0.5 m, the supernatant pond in Kal 3 will stabilise at an average depth of around 1.0 m, however, the supernatant pond in Kal 4 will stabilise at an average depth of around 2 – 4 m, attributed to the progressively lower permeability geology surrounding the pits from north to south through Area 3.

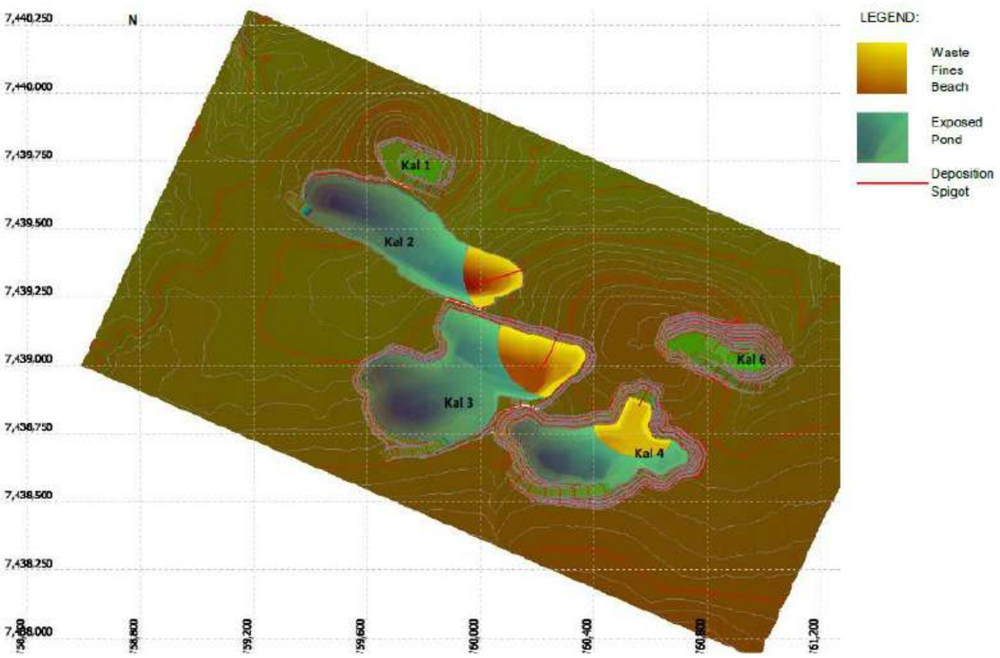

Figure 4: Deposition image showing pond and waste fines beach

Decant return

The applicant has included provision in the WFSF design to install a decant return pump at a later date following an observational approach. The following are noted for the decision:

- The initial rate of rise at the base of each of the pits is rapid and it is not practicable to safely manage water abstraction. The pond will also likely be too turbid to abstract sediment free water;

- The supernatant water quality beyond elevated nitrates is not significantly different to background water quality. The seepage is also confined to the site boundaries due to the dewatering gradient. The difference in modelled seepage extents with and without water recovery included is minimal as it is not possible to extract all decant water;
- Decant abstraction will not provide any increased dry density (desiccation) of the waste fines mass nor improve the freeboard or stability of the facility for the initial deposition;
- The site is in significant water excess, requiring discharge of abstraction water in Kalgan Creek all year. Return of additional decant water direct to the process plant will result in an increase in creek discharge as less abstraction water will be utilised as make up;
- The inclusion of pit infiltration reduces the groundwater drawdown impacts surrounding the Area 3 pits from site wide abstraction activities;
- Kal 2 is located in an identified high permeability east west strike zone, resulting in the low likelihood of a supernatant pond forming (seeping to the environment). If the ground is found to be of lower permeability, a deeper pond could form, triggering the preference to install a decant return system;
- The Kal 3 and Kal 4 pits are located in a lower permeability zone, hence are more likely to form a considerable pond depth to allow decanting to take place; and
- It is expected that a supernatant recovery system (trailer pump with floating intake) will be installed after several years of operation following observation of groundwater and pond development. At the latest, this would occur in 2024 when deposition in Kal 3 while mining in Kal 4 is occurring to manage the likelihood of a phreatic surface daylighting in the pit. At the earliest this would be expected around 2022 when the rate of rise in Kal 2 is lower than 20 m/year.

The applicant has stated that although whilst operating a decant return system for removal of supernatant water will lessen groundwater mounding, decant is not expected to reduce the impact of the seepage on groundwater elevation by any measurable amount.

The installation of a decant return system would be conducted without seeking further approval from DWER (notification would be given) to implement. It will consist of a direct return line to the process water tank similar to the existing Above Ground WFSF decant return. Noting the uncertainty of a decant system being installed and when, the assessment assumes this will not be installed. Decant from the Kal pits and associated infrastructure will require assessment.

Seepage modelling for three new in-pit TSFs

According to the applicant report, groundwater elevation has declined from pre-mining levels around 630 mRL to 560 mRL (modelled at the time deposition commences in 2020), below the base of the Area 3 pits (585 mRL) as a result of dewatering to facilitate below water table mining. Groundwater elevation is expected to remain below the base of the Area 3 pits for the duration of operation and closure, allowing water from the in-pit storage of waste fines to seep to groundwater beneath the pits. The seepage interacts with a larger groundwater regime influenced by dewatering of the mine area during operation and pit lakes at closure. Seepage modelling has been completed to understand the potential rate and extent of seepage emanating from the Area 3 WFSF.

Over the life of the facility, an average seepage rate of 1.8 GL/year is predicted (which equates to approximately 57% of the water in waste fines over the life of the facility). The results of seepage modelling show a distinct trend of higher seepage rates to the north (Kal 2 and Kal 3), reducing to reasonably low seepage rates to the south (Kal 4), attributed to the geology becoming progressively lower permeability from north to south through Area 3.

Seepage from the deposition of waste fines into the Area 3 pits will reduce the water level drawdown below the pits, forming a local groundwater mound perched above the groundwater.

Consistent with the distinct groundwater gradient towards the east (as a result of both drawdown from Area 4 dewatering and the high permeability geology connecting the two areas), seepage from the deposition of waste fines into the Area 3 pits is expected to flow to the east, towards Area 4 where the seepage will be captured within existing abstraction bores (expected to be detected within a period of 2 years from deposition). Seepage is not expected to migrate downgradient further east or further north (towards the calcrete).

Once deposition ceases, modelling indicates remnant seepage from Area 3 will migrate towards the Area 4 pit lake and will be confined to the Area 4 pit lake, which represents a groundwater sink (discussed further below).

Assessment of flow-model limitation

DWER assessment identified factors that could limit the ability of the applicant flow-model to predict the long-term direction of groundwater flow from the WFSFs, and of the receptors that could be affected by criteria-based contaminants of potential concern (CCOPCs) that are transported in groundwater from these facilities.

Solute Transport

According to the UK Environment Agency solute transport model guidance there are major limitations in the approach used to simulate the transport of CCOPCs in groundwater from the WFSFs. In particular, the modelling assumed that nitrate would be the only CCOPC in seepage from the WFSFs and that this chemical constituent would not react with minerals within the aquifer matrix.

This is unlikely to be the case because dissolved nitrate is a strong oxidising agent and will react with reducing agents in the aquifer. This is especially likely to be the case in aquifers that contain a large amount of iron oxyhydroxide minerals such as at the Hope Downs 4 mine site. This is due to chemical interactions between nitrate, ferrous ions and iron oxyhydroxide mineral surfaces. These reactions typically lead to the reduction and removal of nitrate from solution, but they also can change the mineralogy and chemical behaviour of mineral surfaces through the action of both iron oxidising and iron reducing bacteria under fluctuating redox conditions (Mejia et al., 2016).

These processes can also change the adsorption properties of mineral surfaces, potentially leading to the release of some metals and metalloids into solution, especially those that form stable oxyanions such as chromium, molybdenum, vanadium and selenium. The release of such oxyanions into solution is typically exacerbated by the presence of elevated concentrations of sulfate ions, which are likely to be present in leachate from the WFSFs. In situations where oxidising agents are fully utilised, chemically reducing conditions can lead to the partial reductive dissolution of iron oxyhydroxide mineral surfaces, leading to the release of iron and adsorbed manganese and arsenic into solution (Watson et al., 2016).

These factors indicate that the model provided lacks conceptual understanding of the likely chemical characteristics of seepage plumes from the WFSFs, and of the potential discharge of CCOPCs from groundwater to sensitive receptors. This means that the results of the solute transport modelling that have been provided are likely to be unreliable. The predicted concentrations of nitrate in seepage plumes from the WFSFs can be much lower than predicted by solute transport modelling, but concentrations of CCOPCs of greater environmental concern may be present at elevated concentrations in the plumes.

Long-term impact

The model has a relatively short calibration period, and the Australian Groundwater Modelling guidelines prescribe a limit to the period of time that can be simulated by flow-models based on the duration of the calibration period. Consequently, the modelling has only simulated groundwater flow from the WFSFs until 2037, during which period groundwater flow will be in an easterly direction towards an open mine void.

It is not certain whether this flow pattern would continue after 2037, depending on the extent to which the water table rebounds in the pit lake that will form in this mine void, or on whether the mine void is partially backfilled. Consequently, there is a risk that groundwater in the vicinity of the WFSFs would eventually resume the natural pre-mining flow direction of a northerly to north-westerly direction towards Coondiner Creek. If this were to occur, hyporheic fauna beneath sediments in Coondiner Creek and the adjacent riparian vegetation would be the receptors for CCOPCs from the WFSFs, rather than the pit lake to the east of these facilities. Receptors in Coondiner Creek would be much more sensitive to elevated concentrations of CCOPCs than fauna that might periodically utilise the pit lake.

A second possible limitation of the groundwater flow model is the assumption that the WFSFs will continue to act as terminal groundwater sinks after closure. This may not be the case because evaporation from these facilities will be greatly reduced when they have been backfilled with waste fines. This would reduce the extent to which the water table near the facilities would be drawn down by the effects of evaporative “pumping”.

Depending on the texture of the fill materials and the nature of the vegetation cover that is established on the closed WFSFs, evapotranspiration could be eliminated by as little as a 1 metre thick waste fines cover above the water table (Shah et al., 2007). This suggests that the assumption that these facilities will continue to behave as terminal groundwater sinks is likely to be invalid, and that CCOPCs will probably be transported in groundwater flow away from them after their closure.

4.1.4 Seepage expressed as surface water

Seepage from WFSF expressed as surface water may impact water quality at Coondiner Creek.

The applicant states that the Area 3 in-pit WFSF final surface will remain below the surrounding ground level hence expression of seepage to surface is unlikely. WFSF height relative to surrounding ground level is key factor in mitigating risk of emission.

The creek bed closest to the Kal 2 pit is slightly lower (creek bed 17 mbgl) than the highest deposition level (12 mbgl) in the pit separated by a ridge at approximately 7 mbgl. The water table ranges from 45 mbgl to 20 mbgl, and as little as 10 mbgl beneath Coondiner Creek. Localised connectivity between aquifers may occur where conduits for water flow are formed due to faulting and fracturing. Within Area 3 there is a distinct groundwater gradient towards the east as a result of both drawdown from Area 4 dewatering and the high permeability geology connecting the two areas.

Kal 2 is located in an identified high permeability east west strike zone. Figure 5 shows monitoring bore log located around Kal 2. The first 6 to 16 m layer is composed of permeable material, alluvium.

Figure 6 shows groundwater simulation once deposition starts. Groundwater levels around Kal 2 rise to pre mining levels.

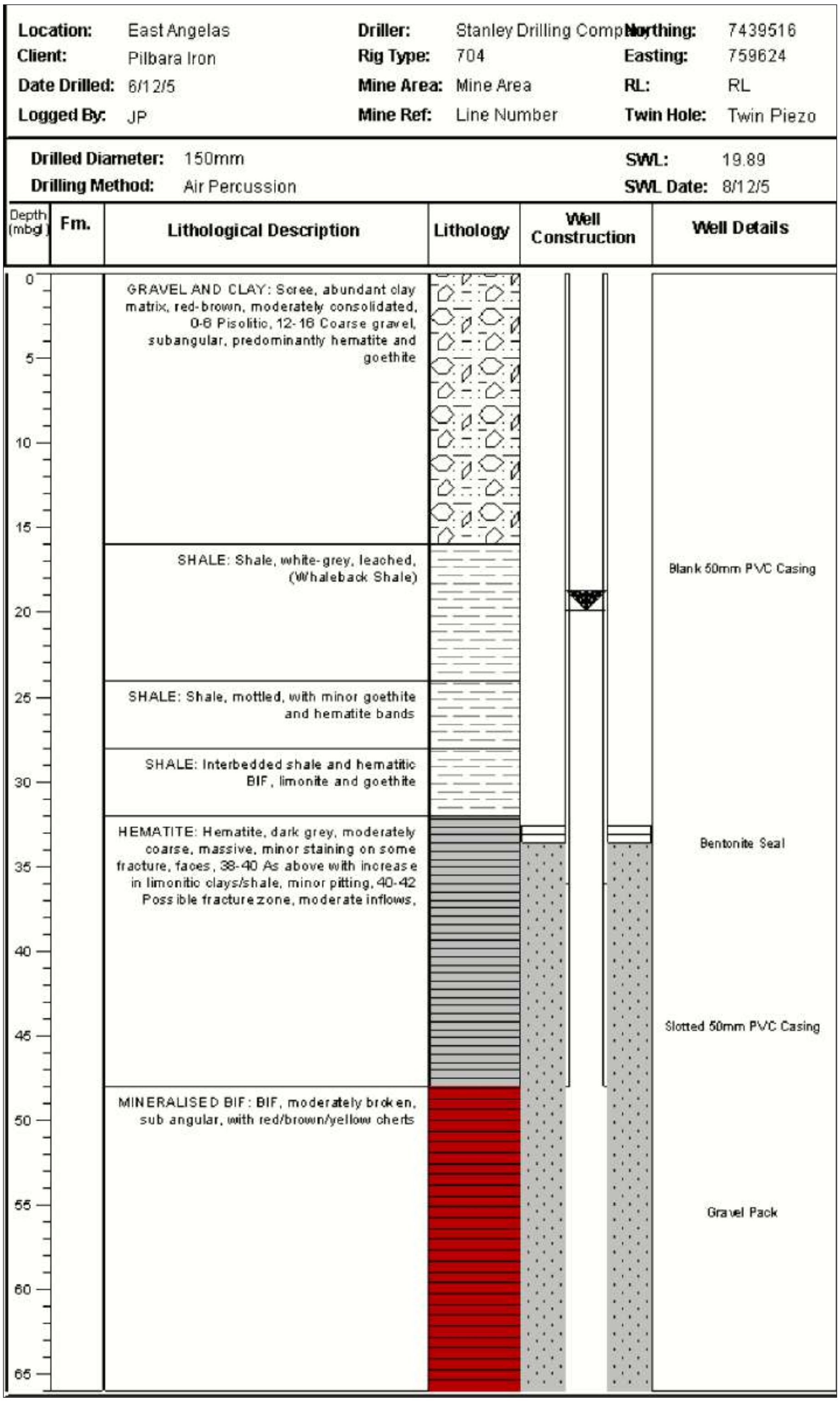

Figure 5: MB05HD4004 bore log.

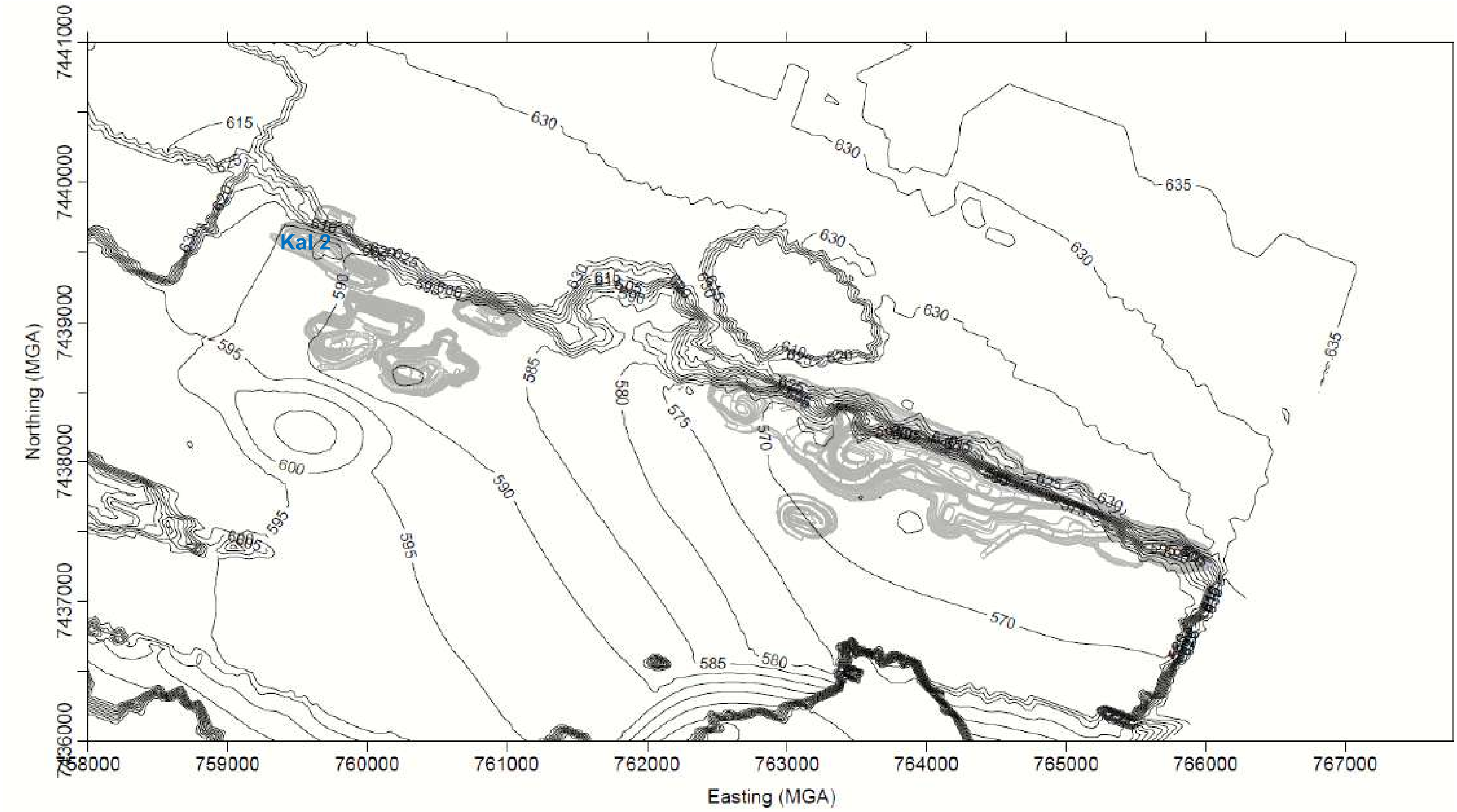

Figure6: Groundwater contours as of September 2019. RL 590m correlates to 65m below ground level.

4.1.5 Overtopping

The Area 3 Pit WFSF site is located within the original 100 year ARI flood extents determined prior to any development at the HD4 mine. A creek line originally flowed through Kal 2 and Kal 3 from south to north. The creek is a tributary to Coondiner Creek which reports to Eagle Rock Falls further north of the site.

Due to the site mining activities, the flood extents in the Area 3 Pit area are now considered redundant as the upstream catchments have been impacted by waste dumps and reduced by pit voids. The downstream creek has two culvert rail crossings before joining Coondiner Creek, hence back flooding is unlikely.

A runoff routing model was developed to size the spillway flow between each pit void and assess the freeboard to the pit edge. As the final waste fines surface in each pit is below the surrounding natural ground and controlled by the connecting pillar levels, all three pits are self-contained. At full capacity (assuming a flat surface), Kal 2 cascades into Kal 3 which subsequently cascades into Kal 4 which has adequate capacity to contain the design events, even at closure for PMF events, without risk of overtopping to the surrounding environment (Figure 7).

The same catchment areas, pit void stage storages and timing were used as the water balance modeling. The routing modelling indicated all storm events are contained within the pits by runoff storage being provided within Kal 4.

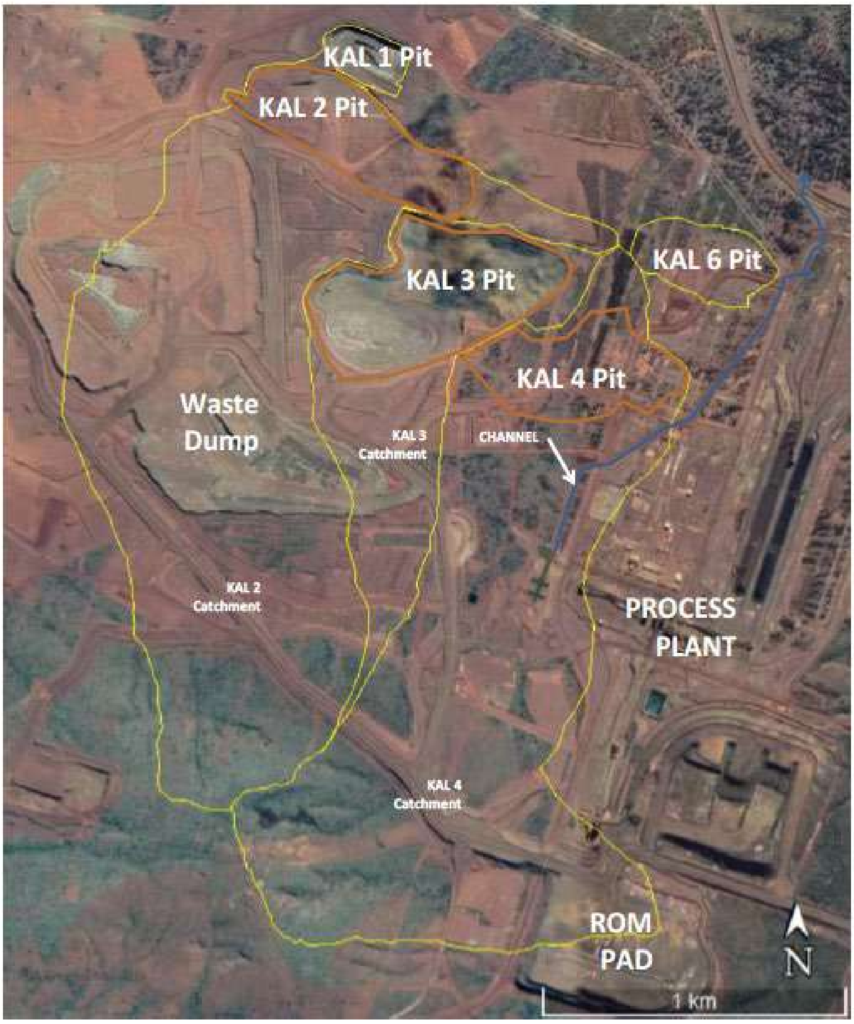

Figure 7: Catchments within Premises

4.1.6 Seepage post-closure

A water harvesting surface at closure is recommended with ephemeral pit lakes from rainfall runoff. This closure study will need to be based on monitoring data obtained during operation, trials as part of other in pit facilities, investigation of waste fines in situ strength/degree of consolidation and stability modelling to ensure factors of safety and procedures are acceptable prior to implementation as it is a variation to the standard closure guidelines.

At closure, remnant seepage from the waste fines will report to the Area 4 pit lake as all abstraction bores are decommissioned. Modelling indicates the Area 4 pit lake will act as a groundwater terminal sink for the Area 3 Pit WFSF hence seepage water will be confined to this area with no flow through.

The waste fines surface will be progressively allowed to settle and dry in Kal 2 and Kal 3. Intermittent topping up with waste fines is still possible while the plant is operational. Kal 4 will terminate at the end of operation and begin to consolidate. The final waste fines surface will remain below the surrounding ground as the connecting pillars between pits limits deposition elevation. Significant long term settlement is predicted under self-weight (high consolidation and low permeability) which will result in depressions in the centre of each pit. An assessment to cap/cover the facility after ceasing deposition (while direct haul mine waste may still be available) will be conducted in the future.

The closure plan has indicated that mine voids that are not backfilled will become pit lakes at the cessation of mining. The plan has also indicated that pit lakes within the Hope Downs 4 project area will become terminal groundwater sinks, where there will be a net flow of groundwater into these features with limited discharge of solutes.

Applicant states that after deposition, the supernatant pond will progressively evaporate such that no supernatant pond is expected to remain in the pits post closure. Applicant modelling suggests that ephemeral ponds may form following rainfall events however, evaporation exceeds rainfall and any ponds would be expected to dissipate.

The closure plan has not considered that pit lakes may develop simple ecosystems that have the potential to attract wildlife. This could result in some wildlife being exposed to harmful concentrations of chemical constituents. This is particularly the case for selenium, which has the potential to accumulate in these water bodies with increasing salinity under near-neutral pH conditions and can cause severe impacts on the populations of some animals (particularly bird species).

5. Consultation

Table 8 provides a summary of the consultation undertaken by the department.

Table 8: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website (20/08/2018)	None received.	N/A.
Local Government Authority advised of proposal (3 June 2020)	None received.	N/A.

Department of Mines, Industry Regulation and Safety (DMIRS) advised of proposal (9 June 2020 -A1901647)	DMIRS replied on 18 June 2020 with recommended conditions for inclusion within the instrument.	Conditions 393, 394, 396 included. Conditions 397 and 398 deferred to be included within Licence instrument.
Department of Water and Environment Regulation Contaminated Sites Branch Email (18 June 2020 - A1904610)	Memo response received 25 June 2020 (A1907167). Assessment of flow model and assumptions with recommendations.	Assessment included within decision report.
Referral to Department of Water and Environment Regulation EPA Services Unit (2 June 2020 - A1899385)	Response received on 16 June 2020. An application to amend a number of conditions of MS 854 was submitted in February 2017. Hamersley HMS Pty Limited are currently revising the application after being requested for further information. Currently the proposal description, approved key characteristics table and conditions of MS 854 do not preclude the discharge of tailings into an in-pit TSF at the Hope Downs 4 Iron Ore Mine.	N/A.
Applicant was provided with draft documents on (8 October 2020)	Applicant responded on 20 October 2020 providing comment and waivered the remaining comment period - Refer to Appendix 1.	Refer to Appendix 1.

6. 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.

Works Approval W6403/2020/1 that accompanies this Decision Report authorises construction and time-limited operations. The conditions in the issued Works Approval have been determined in accordance with the Department's *Guidance Statement: Setting Conditions*. A summary of the conditions to be applied to this works approval are described below.

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. deposition of waste fines into the WFSF. 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.

Monitoring

Existing abstraction bores between Area 3 and Area 4 will be the first point of contact for changes in water quality. The following monitoring requirements are to be installed/conducted under the Works Approval:

- MB05HD4008 (shallow and deep), MB11HD4011, MB14HD4027, MB14HD4028 (reinstalled), MB15HD4002, MB15HD4004, MB16HD4002, MB16HD4003, MB16HD4004, MB17HD40006, MB17HD40007, MB18HD40008, to measure level and water quality and abstraction bores WB15HD4003 (within Kal 4), WB15HD4001 and WB14HD4017 to measure water quality only.

- Monitoring of Vibrating Wire Piezometer (VWP) location HM18HD40002 (consisting of 3 nested VWPs), located between Kal 3 and Kal 4 and will be used for phreatic surface assessments.

An additional monitoring bore (shallow and deep) shall be installed between MB05HD4008 and MB18HD40008.

Monitoring locations are shown in Figure 8.

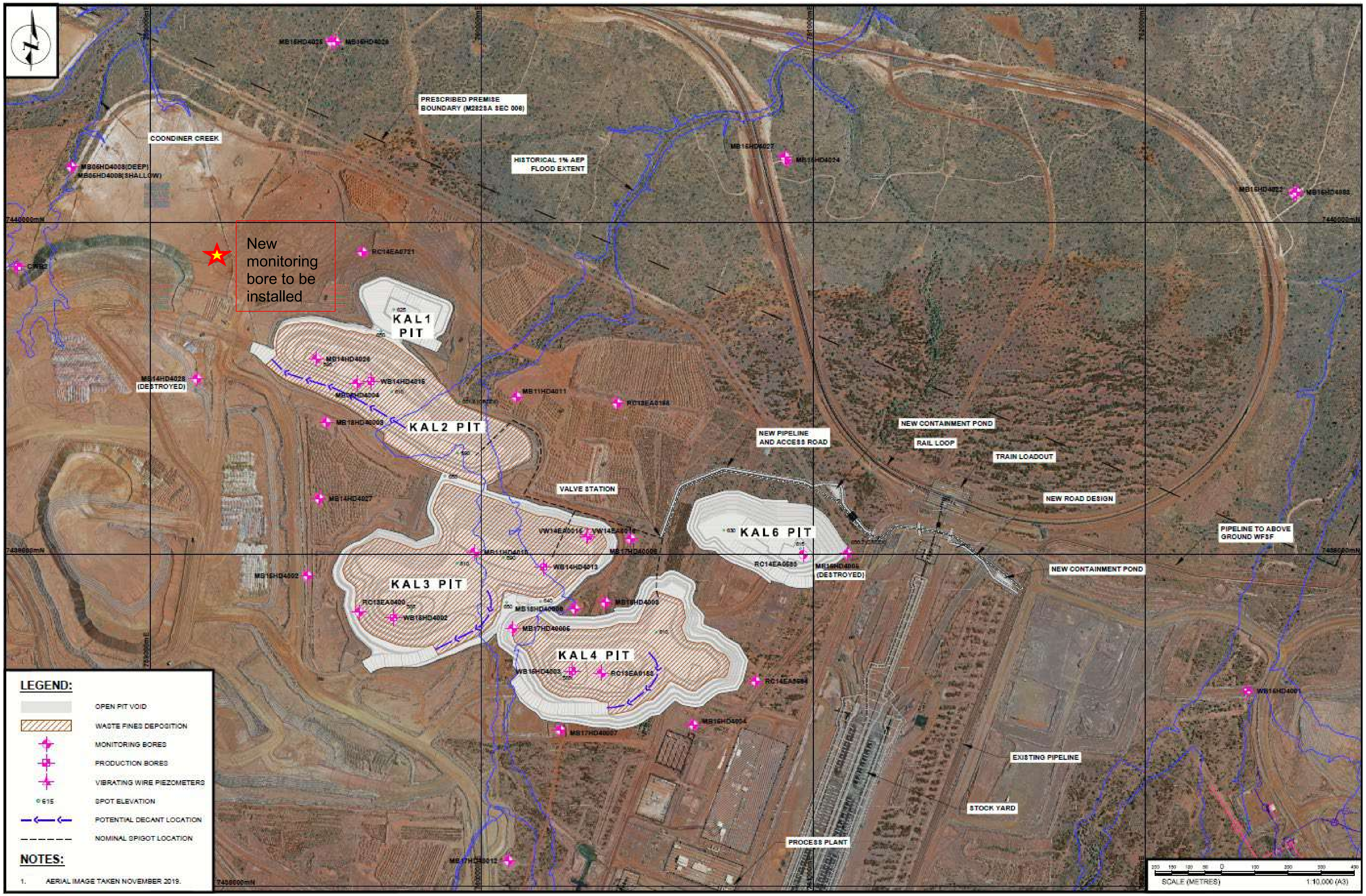

Figure 8: Area 3 Monitoring bores. The new monitoring bore is represented as a red star (★). MB14HD4028 to be reinstalled.

Contaminants in Tailings

Leaching Test

The works approval holder shall conduct leach testing of two saturated columns of representative waste fine/waste rock from the receiving Pit samples for a minimum period of 13 weeks. The leaching test methodology shall be representative of the anoxic conditions likely to be present at the WFSF and follow the protocol outlined in Watson et all 2016. The works approval holder shall analyse the concentrations of contaminants in the leachate and detail the methodology used, source of the samples and the results in a report.

Seepage and water balance

The works approval holder should consider reviewing the groundwater flow-model past 2037, addressing the reduction in evaporation from Area 3 due to the backfilling of pits with waste fines and subsequent reduction in pit lake surface area.

The works approval holder will be required to provide an annual water balance report and assessment to demonstrate the impact of seepage on groundwater elevation.

Infrastructure and overtopping

The works approval holder will ensure that the WFSF operational and final surface remains below the surrounding ground level. The works approval holder will report on height of WFSF in compliance reporting documentation.

The works approval / licence holder must ensure that all pipelines containing environmentally hazardous substances are provided with secondary containment adequate to contain any spill for a period equal to the time between routine inspections.

The works approval / licence holder must take all reasonable and practicable measures to prevent stormwater run-off becoming contaminated by the activities and operations undertaken at the premises.

7. References

1. Environmental Protection Authority (EPA) 2018, Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual, Environmental Protection Authority, Perth, WA.
2. Department of Environment Regulation (DER) 2016, *Guidance Statement: Environmental Siting*, Perth, Western Australia.
3. DER 2017, *Guidance Statement: Risk Assessments*, Perth, Western Australia.
4. DER 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
5. Knight Piesold Consulting, Area 3 Pit Waste Fines Storage Facility Design Report, prepared for Sustaining Capital Rio Tinto, February 2020
6. Mejia, J., Roden, E.E. and Ginder-Vogel, M., 2016. Influence of oxygen and nitrate on Fe (hydr)oxide mineral transformation and soil microbial communities during redox cycling. Environmental Science and Technology, 50(7), 3580-3588.
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Appendix 1: Summary of applicant's comments on risk assessment and draft conditions

Condition	Summary of applicant's comment	Department's response
Works Approval Table 2 – Infrastructure requirements - groundwater monitoring bores	The applicant proposes to construct, develop (purge), sample and have determined to be operational no later than 30 calendar days prior to the commencement of time limited operations. The applicant has a good understanding of the water quality in the local area due to the extensive existing bore network. It will be a significant time before the applicant would anticipate any influence from the deposition of waste fines on groundwater, therefore any sampling undertaken would still be considered to be baseline.	The department has changed the timeframe from 60 calendar days to 30 calendar days as requested.
Works Approval Table 3 – Environmental commissioning requirements	The applicant proposes to undertake construction, commissioning and time limited operations and associated reporting requirements of Kal 4 in pit waste fines storage facility under licence L8688. Deposition into Kal 4 pit is not proposed to occur until 2024 thus it will not be possible to undertake construction and commissioning within the timeframe specified within Condition 9, Table 3 W6403/2020/1.	The expiry date of the works approval is October 2025 to allow the applicant to undertake construction, commissioning and time limited operations under this works approval for Kal 4.
	'Ore' isn't run through pipelines and valves. Only water and slurry during environmental commissioning phase. Propose to remove the reference to 'ore'.	Reference to 'ore' has been removed.
Works approval Table 5 – Infrastructure and equipment during time limited operations	2.088 Mt(p)a is equal to 174kt per month over 12 months. This is the current plan and refers to dry tonnes, not wet. 2.088 Mtpa is also the highest production rate assumed in the Design Report Rev1 (Table 1.1 p.5).	Table updated to include the underline and remove the strikethrough as per below: • Can accept up to 2.088Mta (dry ~~wet~~) of tailings per year.
Works approval Table 6 – Authorised operation discharge points	The seepage doesn't discharge from the deposition points within Kal 2, Kal 3 and Kal 4 – the seepage discharges from the base of the WFSF. The Waste Fines are is discharged from the deposition points within Kal 2, Kal 3 and Kal 4.	Under Emissions in Table 6 the wording has been changed to include the underline and remove the strikethrough as per below: ~~Seepage from the placement of waste fines into pit voids~~ Waste Fines
Works approval Table 8 – Monitoring during time limited operations	Dissolved Oxygen is a parameter that must be analysed in the field due to short holding time, generally needing to be analyzed within 15 minutes. The applicant proposes to allow in field readings.	Table 8 has been updated to allow Dissolved Oxygen to be analysed in field.
	Please clarify if Note #: water quality only is referring to the field parameters only?	Note # updated to read: All parameters excluding surface water level
Decision Report Section 2.4.2	This is incorrect. Impacts to Coondiner Creek were considered in the s45C application. The applicant proposed the deletion of the text "*Impact to Coondiner Creek was not considered under the recent Section 45C.*"	DWER will regulate the TSF and emissions and the longer term impacts post operation will be managed by Part IV.