Decision Report

Application for Works Approval

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

Works Approval Number	W6518/2021/1
Applicant	Pilbara Iron Ore Company (Services) Pty Ltd
ACN	107 210 248
File Number	DER2018/001042-4~22
Premises	Yandicoogina Mine State Agreement Mineral Mining Lease ML274SA Shire of East Pilbara As defined by the Premises maps attached to the issued works approval
Date of Report	5 August 2021
Decision	Works approval granted

Alana Kidd

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ALANA KIDD
MANAGER, RESOURCE INDUSTRIES
an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

Table of Contents

1. Decision summary 1

2. Scope of assessment 1

2.1 Regulatory framework 1

2.2 Application summary and overview of Premises 1

2.2.1 Proposed activities – Waste fines cell (WFC) 3A Extension 1

2.3 Part IV of the EP Act 9

2.4 Department of Mines, Industry Regulation and Safety (DMIRS) 9

3. Risk assessment 11

3.1 Source-pathways and receptors 11

3.1.1 Emissions and controls 11

3.1.2 Receptors 13

3.2 Risk ratings 16

3.3 Detailed risk assessment for tailings deposition into WFC3A Extension 20

3.3.1 Seepage 20

4. Consultation 22

5. Conclusion 22

References 23

Appendix 1: Summary of applicant's comments on risk assessment and draft conditions 24

Appendix 2: Application validation summary 31

6. Appendix 4: Groundwater modelling Assessment tables (from National Water Commission, 2012) 34

1. Decision summary

This Decision Report documents the assessment of potential risks to the environment and public health from emissions and discharges during the construction and operation of the Premises. As a result of this assessment, Works Approval W6518/2021/1 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 26 October 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 works relating to extension of in-pit tailings storage facility 3A within Junction South East (JSE) Pit at the Premises. The Premises is approximately 90 km north-west of Newman.

The Premises relates to the category 5 and assessed design capacity under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in Works Approval W6581/2021/1. The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guidance Statement: Risk Assessments* (DER 2017) are outlined in Works Approval W6518/2021/1.

2.2.1 Proposed activities – Waste fines cell (WFC) 3A Extension

This proposal is to develop WFC 3A Extension to provide waste fines storage capacity at the Yandicoogina Mine. WFC3A Extension is located in the Junction South East (JSE) pit, north of the existing WFC3.

Deposition into WFC3A Extension is proposed to commence in 2021 and continue for 14 years. Modelling estimates approximately 46 million tonnes of waste fines will be produced by the Primary Crusher 3 (PC3) processing plant and deposited into the WFC3A Extension during this time.

Waste fine delivery will be via existing pipework from a single location point in the south-west corner of JSE pit at approximately RL 507 m. A contingency pipeline was installed in December 2020 within the existing pipeline corridor to the south-west ramp of the WFC3A to supplement and provide redundancy to the single deposition location.

There will be no additional clearing or disturbance outside the existing JSE Pit and pipeline routes. Waste fines slurry deposition will be done under both subaerial and subaqueous conditions. No decant water removal has been proposed.

Dewatering in the northern part of JSE pit will cease when this works approval is granted. Dewatering in the southern end of JSE pit, south of WFC3, will continue to support ongoing mining operations in the pit.

It was requested that Time Limited Operation be undertaken under the Works Approval, to allow for the assessment and determination of a Licence Amendment application.

The works approval application did not cover the long-term closure performance of WFC3A Extension, which has been considered in the context of the other closure landforms at the site as part of the site wide Yandicoogina Closure Plan.

The location of the proposed WFC3A is shown in Figure 1.

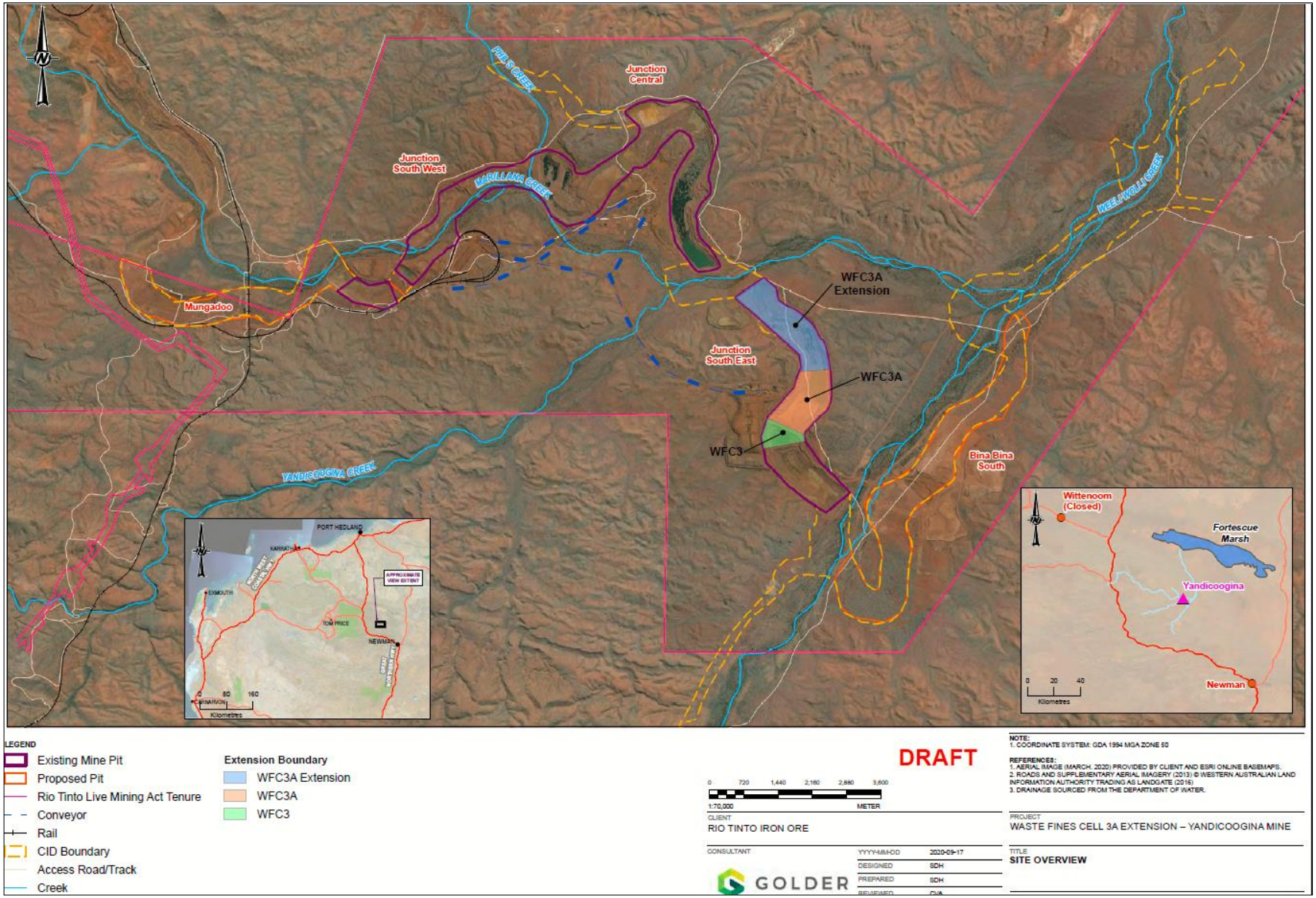

Figure 1: In-pit tailings storage facility location, WFC 3A Extension, at Yandicoogina mine.

Table 1 summarises the proposed infrastructure associated with WFC3A Extension and environmental commissioning requirements.

Table 1: WFC3A Extension proposed infrastructure and equipment.

Infrastructure and Equipment	Environmental Commissioning
WFC3A Extension - Total capacity for 46.3 Million dry tonnes of waste fines.	Not required
Waste fines pumping and pipelines - Use of WFC3A delivery pipeline and relocation of existing deposition pipelines. - Installation of a contingency pipeline within existing pipeline corridor.	Required
Stormwater infrastructure - Existing stormwater diversion drains will be used.	Not required

Site characteristics – JSE pit

The proposed WFC3A Extension is located within the Junction South East (JSE) deposit, which is part of the Marillana-Yandicoogina-Weeli Wolli Paleochannel system. The Marillana-Yandicoogina-Weeli Wolli Paleochannel system is a channel iron deposit (CID) made up of pisolite. The CID is approximately 300 to 500 m wide and bounded at depth (at a maximum depth of approximately 110 m) by the Weeli Wolli Formation. The hydraulic conductivity in the CID aquifer ranges between 0.003 and 2.9 cm/s. The estimated Weeli Wolli formation hydraulic conductivity is $1.15x10^{-6}$ cm/s.

The depth to groundwater at the Yandi Mine site varies from approximately 2 m bgl adjacent to Marillana Creek (e.g., at northern end of WFC3A Extension), to 20 or 30 m bgl in areas further away from Marillana Creek.

Marillana creek is located 250m from the northern edge of JSE pit. The Marillana Creek runs west-east through the Yandi Mine site, to the confluence with the Weeli Wolli Creek in the east of the Yandi Mine site. Surface flows in the Weeli Wolli and Marillana Creeks are typically ephemeral.

Limited groundwater quality information is available after deposition started into WFC3A pit in May 2016 as many monitoring bores located along JSE, pit were destroyed/decommissioned and not replaced. Available bores are shown in Figure 3.
Some of the site-specific guideline values (SSGVs) for Marillana Creek (MC) and Weeli Wolli Creek (WWC) were presented in the Golder (2020) report are shown in Table 2 below:

Table 2: SSGVs for for Marillana Creek and Weeli Wolli Creek

Parameter	Marillana Creek - SSGV	Weeli Wolli Creek - SSGV
Chloride	130 mg/L	85 mg/L
Nitrate (as N)	1.2 mg/L	0.2 mg/L
Electrical conductivity (EC)	1010 μS/cm	808 μS/cm

A summary of groundwater quality from the JSE pit groundwater bores (electrical conductivity, nitrate and chloride) before and after tailings deposition started in August 2014 are presented in Table 3 and Figure 2.

Table 3: Nitrate and chloride concentration in groundwater from monitoring bores around JSE pit.

	WB12YJSE001		WB12YJSE002		WB12YJSE003		WB10YRN001		WB10YRN002	
	Nitrate as N (mg/L)	**Chloride (mg/L)**	**Nitrate as N (mg/L)**	**Chloride (mg/L)**	**Nitrate as N (mg/L)**	**Chloride (mg/L)**	**Nitrate as N (mg/L)**	**Chloride (mg/L)**	**Nitrate as N (mg/L)**	**Chloride (mg/L)**
August 2012	-	-	-	-	-	-	0.9	110	1.24	100
August 2013	-	96	-	90	-	77	-	-	-	110
August 2014	1.5	99	8.1	89	3.8	100	1.1	110	1.4	110
September 2015	1.8	115	-	-	-	-	1.27	101	1.59	108
September 2016	-	-	12.3	132	22.2	123	1.52	114	1.61	130
September 2017	8.61	117	-	-	-	-	4.55	109	3.7	109
October 2018	-	-	-	-	-	-	4.1	120	3.64	116
September 2019	-	-	17.6	159	-	-	3.95	123	2.78	120

Note: red cells indicate values above ANZG (2018) freshwater 95% (Nitrate as N^- above 2.4 mg/L)

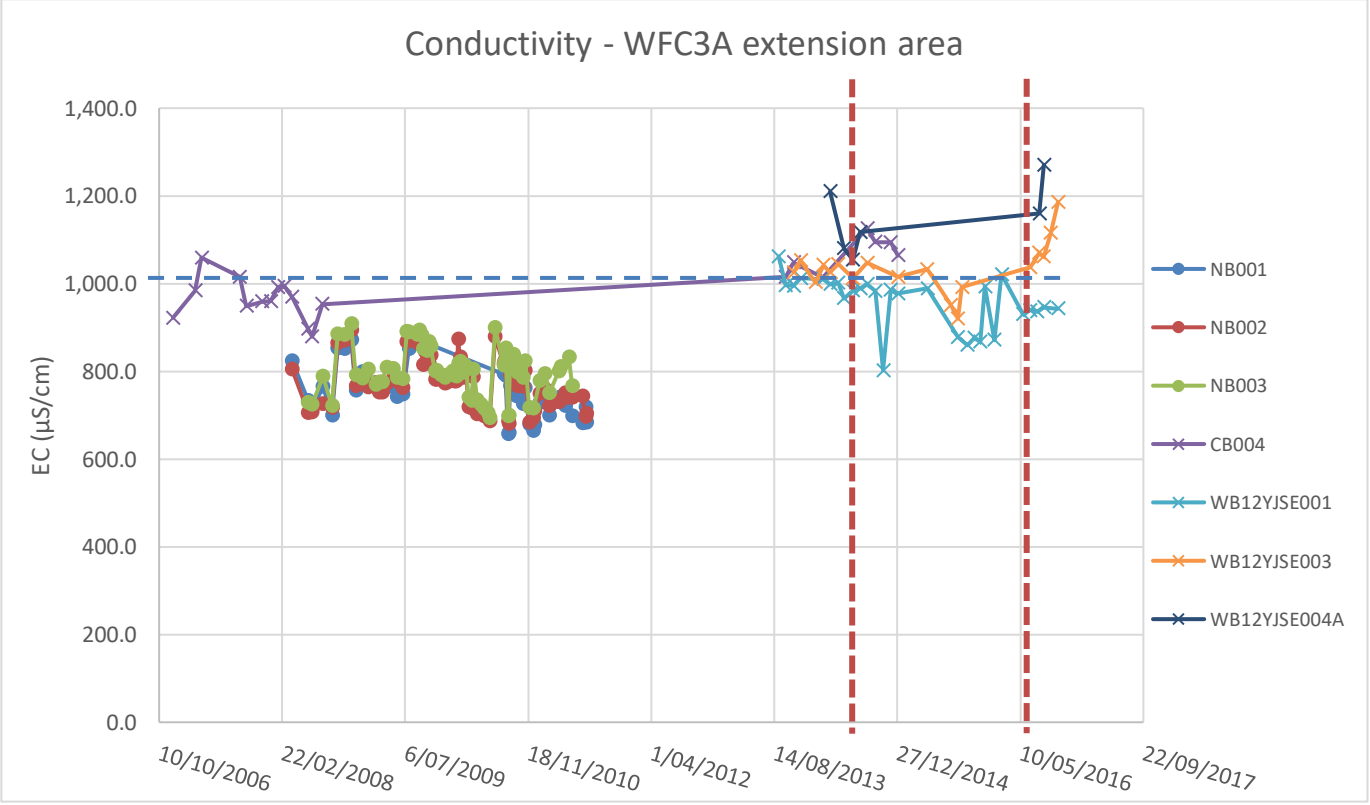

Figure 2: Electrical conductivity within the proposed WFC3A extension. Vertical dotted line indicates tailings deposition into WFC (08/2014) and WFC3A (12/2016). Horizontal blue dotted line indicates SSGV for Marillana Creek.

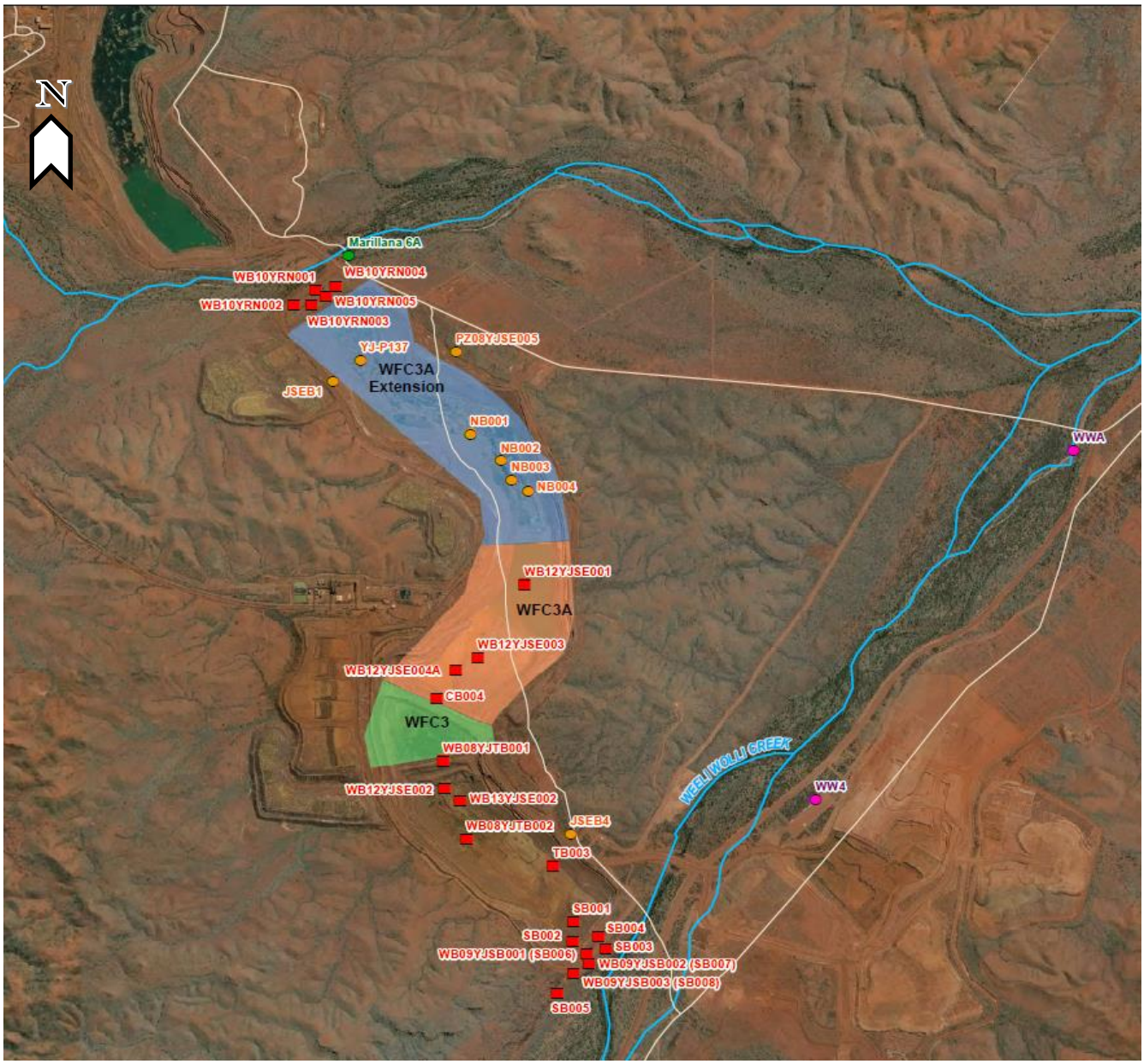

Figure 3: Monitoring bores location – JSE pit

Tailings characteristics

The waste fines comprise a mixture of water and solids derived from crushing and beneficiation of ore from local CID. Flocculant is added to the process to improve solid water separation from waste fines prior to deposition.

One waste fines sample plus two water samples (feed/process water) were collected in 2018, and four waste fines slurry samples plus water samples (feed, process water and decant) were collected in 2019. No current samples were analysed as part of this application.

Tailings, tailings pore water, feed water and decant compositions from 2019 samples are shown in Table 4. No samples from 2020 were tested and presented in the application document.

Tailings geotechnical characteristics

The waste fines parameters used in the design and deposition model were from samples collected in 2015.

Particle size distribution from samples collected between Q3 2018 and Q4 2019 show that the tailings are, approximately, 52% sand and 46% silt. The average soil particle density for the same period is 3.71 t/m^3.

Hydraulic conductivity of the tailings from JSE fine is 10^{-6} cm/s. Slurry solid concentration of 46.5% w/w.

WFC3A Extension Deposition Modelling

Waste fines are currently deposited from the southern end of WFC3A. Once WFC3A reaches its maximum operating level and until waste fines overtop WFC3A-FC embankment, supernatant water from the waste fines with seep through the WFC3A-FC embankment, contributing to the water level rebound in the northern portion of JSE pit.

Waste fines will then continue to accumulate below water in the extension until a beach forms above the pond level. Waste fines will continue to be deposited subaerially until the pond level reaches an elevation of 485 m RL. Once the pond reaches RL 485 m, RTIO plans to decant water for external use and to maintain a pond elevation at or below RL 485 m.

The deposition modelling indicates that a large portion of total consolidation occurs during the 14 years of operation of WFC3A Extension (between 35.5% and 68.7% of total settlement, depending on the feed type). Lower grade ore will take longer to settle than high grade ore. The waste fines to be deposited into WFCC3A Extension are likely to be a combination of these ore types tested.

The locations of WFC3, WFC3A and WFC3A Extension within JSE pit are shown in Figure 4.

Surface water management

The hydrological model study indicates that the existing diversion structures at JSE pit have sufficient capacity and freeboard to contain the critical 1:100 AEP events.

Existing flood levees and diversion drains are located along the JSE pit boundary to divert local runoff away from the mine area and waste fines facilities. The western diversion drain, which was designed to accommodate the 1:50 AEP event, conveys runoff south towards Weeli Wolli Creek, whilst the eastern drain and levee, designed to accommodate the 1:50 AEP with 0.5 m freeboard, conveys runoff north towards Marillana Creek. In addition, a flood levee was constructed along the eastern perimeter of the existing WFC3A to divert runoff around the facility. Intercepted runoff spills east towards a neighbouring watercourse where flows return to Weeli Wolli Creek.

However, the absence of flood diversion along the north-western boundary of WFC3A Extension, means runoff generated from external upslope catchments in this area will report directly to the facility.

Table 4: 2019 waste fines deionized water leach test results, tailings pore water and water quality at Yandicoogina site.

Analyte	Unit	Sample 1 Yandi 13/05/2019	Sample 2 Yandi 20/05/2019	Sample 3 Yandi 27/05/2019	Sample 4 Yandi 3/06/2019	Sample 1 Yandi 13/05/2019	Sample 2 Yandi 20/05/2019	Sample 3 Yandi 27/05/2019	Sample 4 Yandi 3/06/2019	Yandi raw water (process water)	Yandi decant
		DI water eluent - 1:2 (solid/liquid)				*Tailings pore water*					
pH	pH unit	7.72	7.89	7.85	7.89	8.14	8.20	8.18.	8.19	8.27	8.02
EC	µS/cm	203	188	159	192	864	857	860	861	814	1040
Al	mg/L	0.164	<0.005	0.166	0.089	0.006	<0.005	<0.005	<0.005	0.09	0.12
As	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.001
B	mg/L	0.084	0.077	0.059	0.072	0.17	0.155	0.160	0.15	0.23	0.26
Ba	mg/L	0.0048	0.006	0.004	0.0038	0.0182	0.0202	0.0188	0.0138	0.019	0.026
Ca	mg/L	12	13	10	10	50	50	49	47	47	56
Cd	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.0001	<0.0001
Cl^-	mg/L	13	11	9	12	105	104	105	106	99	146
Co	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.0005	0.0005	0.0004	0.0006	<0.001	<0.001
Cr	mg/L	0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	NA	NA
Cu	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.001
Fe	mg/L	0.423	0.01	0.348	0.21	<0.002	<0.002	<0.002	<0.002	NA	NA
Hg	mg/L	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.0001	<0.0001
K	mg/L	2	2	2	2	8	8	8	8	9	9
Li	mg/L	0.003	0.002	0.0033	0.0033	0.0061	0.0051	0.0061	0.0056	NA	NA
Mg	mg/L	10	9	8	9	41	39	41	41	39	46
Mn	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	0.0021	0.021	0.001
Mo	mg/L	0.0007	0.0008	0.0006	0.0003	0.0005	0.0008	0.0006	0.0004	<0.001	<0.001
Na	mg/L	14	12	10	11	64	64	64	62	61	87
Ni	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.001
Pb	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	**0.004**	<0.001
Sulphur as S	mg/L	4	4	3	4	20	21	21	21	NA	NA
SO_4^{-2}	mg/L	13	12	10	12	69	69	68	68	70	93

Works Approval: W6518/2021/1 (5/08/2021)

Analyte	Unit	Sample 1 Yandi 13/05/2019	Sample 2 Yandi 20/05/2019	Sample 3 Yandi 27/05/2019	Sample 4 Yandi 3/06/2019	Sample 1 Yandi 13/05/2019	Sample 2 Yandi 20/05/2019	Sample 3 Yandi 27/05/2019	Sample 4 Yandi 3/06/2019	Yandi raw water (process water)	Yandi decant
		DI water eluent - 1:2 (solid/liquid)				*Tailings pore water*					
Sb	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.001	<0.001
Se	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	0.0005	0.0005	0.0005	0.0004	<0.01	<0.01
Si	mg/L	11.5	9.81	10.1	10.2	13.8	13.6	14.7	12.8	10.8	18.9
Sn	mg/L	<0.0002	<0.0002	0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	NA	NA
Sr	mg/L	0.032	0.05	0.027	0.027	0.145	0.158	0.139	0.114	NA	NA
U	mg/L	<0.00005	0.00006	<0.00005	<0.00005	0.0005	0.00088	0.0006	0.00056	<0.001	<0.001
Zn	mg/L	<0.001	0.002	<0.005	<0.001	0.006	<0.001	0.002	<0.001	**0.27**	<0.005
NH_3 as N	mg/L	0.02	0.02	0.02	0.03	0.02	0.01	0.01	1.76	1.55	0.001
NO_2^- as N	mg/L	<0.01	<0.01	<0.01	0.77	<0.01	0.06	2.06	1.98	0.57	<0.01
NO_3^- as N	mg/L	**3.1**	**2.88**	**2.58**	**2.65**	**22.3**	**24.1**	**22**	**20.7**	**12.6**	**26.2**
Total N	mg/L	3.4	3.2	3	4	26.2	28.4	28.2	26.9	16.4	29.9

Note: blue numbers indicate total metals by ICP-MS

red numbers indicate value above ANZEG 2018 – 95% species protection for fresh water

The estimated water storage capacity atop waste fines at the end of facility life with an operating water of RL 485 m up to environment spillage elevation of RL 499 m is approximately 16.4 Mm^3 (or 16,400 ML). An inflow of 997 ML (corresponding to the worst-case 1:100 AEP 72-hour storm) would be expected to raise the water level in WFC3A Extension by less than 2 m.

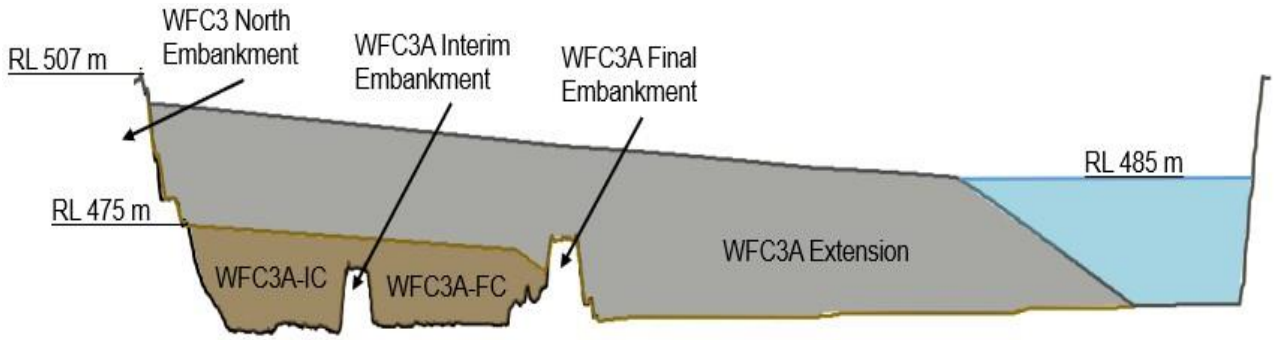

Figure 4: Sketch of the predicted final tailings deposition arrangement on WFC3A.

2.3 Part IV of the EP Act

The existing Yandicoogina iron ore project revised proposal was assessed by the Environmental Protection Authority (EPA), and approved under Ministerial Statement (MS) 1038 in October 2016.

MS 1038 states that the implementation of the proposal, including but not limited to land clearing, groundwater abstraction and surplus dewater discharge, must not:

- cause long term impacts to the environmental values of Weeli Wolli Creek;
- aboriginal heritage values linked to physical and/or biological surroundings of Weeli Wolli Creek; and
- cause long term impacts on the health or cover of riparian vegetation outside the Management Zone.

Requirements of MS 1038 are not re-assessed in this decision report and are not duplicated as conditions in the works approval.

2.4 Department of Mines, Industry Regulation and Safety (DMIRS)

Geotechnical Assessment

The geotechnically relevant aspects of the works approval in relation to the construction and operation of the WFC3A Extension presented in the report titled “Supporting Document for Works Approval Application, Waste Fines Cell 3A Extension – Yandicoogina Mine”, prepared by Golder Associates Pty Ltd, referenced 1783320-002-R-Rev4, dated October 2020 (Golder Report) were reviewed. The main findings and recommendations are listed below:

- According to the tailings storage facility (TSF) classification method used by DMIRS, WFC3A Extension is a Category 3 facility with a Low Hazard Rating.
- Since the extension is an in-pit storage facility, it has very low potential for overtopping or containment breach leading to inadvertent release of tailings. The Golder Report shows that the freeboard of the WFC3A Extension will be more than that required to prevent overtopping during a 1:100 AEP 72-hour storm event or even during a larger storm event. The freeboard will further reduce the potential for the release of tailings.
- The Golder Report presents the results of stability analyses of the waste fines containment pit walls of WFC3A Extension. The material properties used in the stability analyses are based on a geotechnical feasibility study conducted for another pit known as Bina Bina South pit. If

the material types in the Bina Bina South pit and WFC3A Extension are similar, this is acceptable.

- The stability analyses were for circular type failure modes only. Depending on the geological structural features in the pit walls, there may be other possible (non-circular) modes of failure as well. Nonetheless the results presented show that the factor of safety (FOS) against circular failure modes considered in the analyses are well above the minimum values recommended in the relevant guidelines.
- Three pit wall sections (Sections A, B and C) were selected for stability analyses (locations indicated in Figure 19 of the report). Section A represents the pit wall adjacent to the Marilana creek. Sections B and C represent the western and eastern walls, respectively, and appear to be located within the existing WFC3A.
- For pit wall Section A, three operational stages were modelled: pre-deposition, post-deposition and long term (closure stage). For Sections B and C only the post-deposition and long-term scenarios were analysed (see Table 21 of the report). This is acceptable because the pre-deposition stage of WFC3A (where Sections B and C are located) is no longer relevant.
- Regarding the wall Section A the report states (see s.6.4.3) "This section is considered critical due to the potential impact on Marillana Creek and the heritage site". DMIRS concurs with this statement.
- To ensure minimal impact on the Marilana creek, the stability analyses of Section A should consider three failure possibilities: overall slope (all batters from top of the wall to pit floor / tailings level), interim slope (several batters from the top), and a single batter at the top of the wall.
- The stability analyses for pit wall Sections B and C covered the three failure possibilities mentioned above: overall slope, interim slope, and a single batter at the top of the wall (Figures H4 to H7 in Appendix H of the Golder Report). This is endorsed.
- However, for wall Section A, only the stability of overall slope has been analysed (Figures H1 to H3 in Appendix H). From the information presented in the report, it is not clear why only the overall slope stability has been analysed for Section A, which "… is considered critical due to the potential impact on Marillana Creek and the heritage site". Besides that Figures H1 to H7 in Appendix H (if they are plotted at the same scale) indicate that Section A is the steepest of the three wall sections analysed.
- The overall pit wall stability analysis of Section A returned high FOS values well above the recommended minimum. However, that does not confirm the batter-scale stability at the top end of the wall. Stability of the uppermost batter will be critical to ensure that the Marilana creek will flow along its natural path during extreme wet conditions without breaking into WFC3A Extension. The batter-scale slope stability is also important to ensure the heritage site located at the northern end of the WFC3A Extension remains intact.
- Figures H2 and H3 in Appendix H show that the highest groundwater levels assumed for stability analysis of post-deposition and closure stages of Section A are at RL 485 m and RL 487 m, respectively. These levels could be realistic under extreme wet weather conditions. DIMIRS concurs with Golder Report regarding the assumed high groundwater and pit water levels.
- The high water level in the pit provides a buttressing effect to the pit wall during post-deposition stage. Moreover, during long term (closure stage), since the pit is assumed to have saturated waste fines, the buttressing effect will be much greater. Hence, the overall wall stability analysis for long term (Figure H3) becomes redundant, when the post-deposition analysis (Figure H2) has showed adequate FOS.
- If the post-deposition groundwater level and pit lake level have risen to the assumed levels (Figure H2) due to an extreme rain event, the wall materials above the groundwater level may

become fully saturated due to the same rain event. Simultaneously, the water level in Marilana creek may also rise due to the same event and the creek level could also contribute to the saturation of pit wall materials above the assumed groundwater level. This is a worst case scenario which may be possible during post deposition and long-term. This means, as a worst case scenario, the stability analyses should consider saturated conditions for the materials above the groundwater level. The results of the stability analyses do not indicate whether this possible worst case scenario has been considered.

- The construction work required for WFC3A Extension will be limited to reconfiguration and upgrading of the tailings delivery pipeline and relocation of the discharge point, if becomes necessary from time to time. These do not require major earthworks.

In summary, the proposed WFC3A Extension is a Category 3 facility with a Low Hazard Rating and very low potential for overtopping or containment breach leading to inadvertent release of tailings. The factor of safety against the circular failure modes considered in the WFC3A Extension pit wall stability analyses are well above the recommended minimum values. However, the report does not confirm the batter-scale stability at the top end of the pit wall adjacent to the Marilana creek. To ensure that the Marilana creek continues to flow along its natural path in the long term, the batter-scale failure and progressive multi-batter failure should be analysed taking into account the combined worst case effect of the assumed highest groundwater levels and the simultaneous high water level in the Marilana creek.

Until the additional batter-scale stability analysis has been completed, the WAA may be approved subject to a condition to the effect that:

The proponent should conduct further stability analysis of the pit wall adjacent to the Marilana creek and submit the details of the stability analysis within three months of the date of approval of the works approval. The analysis should consider possible worst case scenarios and focus on the:

(1) Stability of the uppermost batter.

(2) Potential for progressive multi-batter failure above the assumed maximum water level in the pit.

The stability analysis should take into account:

- The combined effect of the assumed highest groundwater and pit water levels, the effect of rainfall on the pit wall materials and the high water level in the Marilana creek during extreme wet weather conditions.
- All possible failure modes applicable to the material types and geological features in the pit wall.
- Engineering properties representative of the materials in the pit wall.

3. Risk assessment

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

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

3.1 Source-pathways and receptors

3.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises operation which have

been considered in this Decision Report are detailed in Table 5 below. Table 5 also details the proposed control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 5: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Operation			
Pipeline spillage	delivery of tailings to WFC3A Extension	groundwater	• use of the existing disturbed pipeline corridor between PC3 and WFC3A • engineering design of piping systems to use suitably sized pumps and pressure-rated pipelines and fittings • containment bunding around pipelines that protect pipelines from impacts with vehicles and direct spills away from environmental receptors • daily pipeline integrity inspections • pressure monitoring of pipelines
Seepage	Tailings.	Seepage to groundwater towards Marillana Creek	Impacts are mitigated by the operation of the supernatant pond below RL 485 m to create a groundwater sink during operations and the low-permeability waste fines which will reduce groundwater flow-through to the creeks. Additional controls and operational procedures will be integrated into operation of WFC3A Extension: • Groundwater quality and level will be monitored in bores located around the JSE pit • The water quality and level of the pond in WFC3A Extension will be monitored for comparison with nearby groundwater monitoring • The production bores located along the northern boundary between JSE pit and Marillana Creek will remain in place and can be used to draw down water levels along this boundary, if required to create a containment zone • The operating strategy for WFC3A Extension will be reviewed regularly during operations and can be amended as needed based on monitoring data.
Tailings overtopping	Tailings	Spill overland Marillana Creek Aboriginal site	The normal operating pond for WFC3A Extension will be maintained below RL 485 - approximately 14 m from top of the pit to pond level during operations.

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 6 and Figure 5 and Figure 6 below provide 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 6: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	**Distance from prescribed activity**
Newman Town	75 km south-east *Large distance to sensitive receptors. No further assessment.*
Phil's Creek Accommodation village	5.5 km south *Large distance to sensitive receptors. No further assessment*.
Recreational users of Marillana Creek pool	250m from the proposed activity
Environmental receptors	**Distance from prescribed activity**
Marillana Creek	250m north of WFC3A Extension
Weeli Wolli Creek	Approximately 2km south of WFC3A Extension
Groundwater	Approximately 2m below ground level at Marillana Creek
Aboriginal heritage site	45m north of WFC3A Extension
Priority flora	within 400 m north of WFC3A Extension
Groundwater dependent ecosystems – staygofauna	250m north of WFC3A Extension (Marillana creek) 2km south of WFC3A Extension (Weeli Wolli creek)

A conceptual site model for the site at the end of the deposition period is shown in Appendix 3.

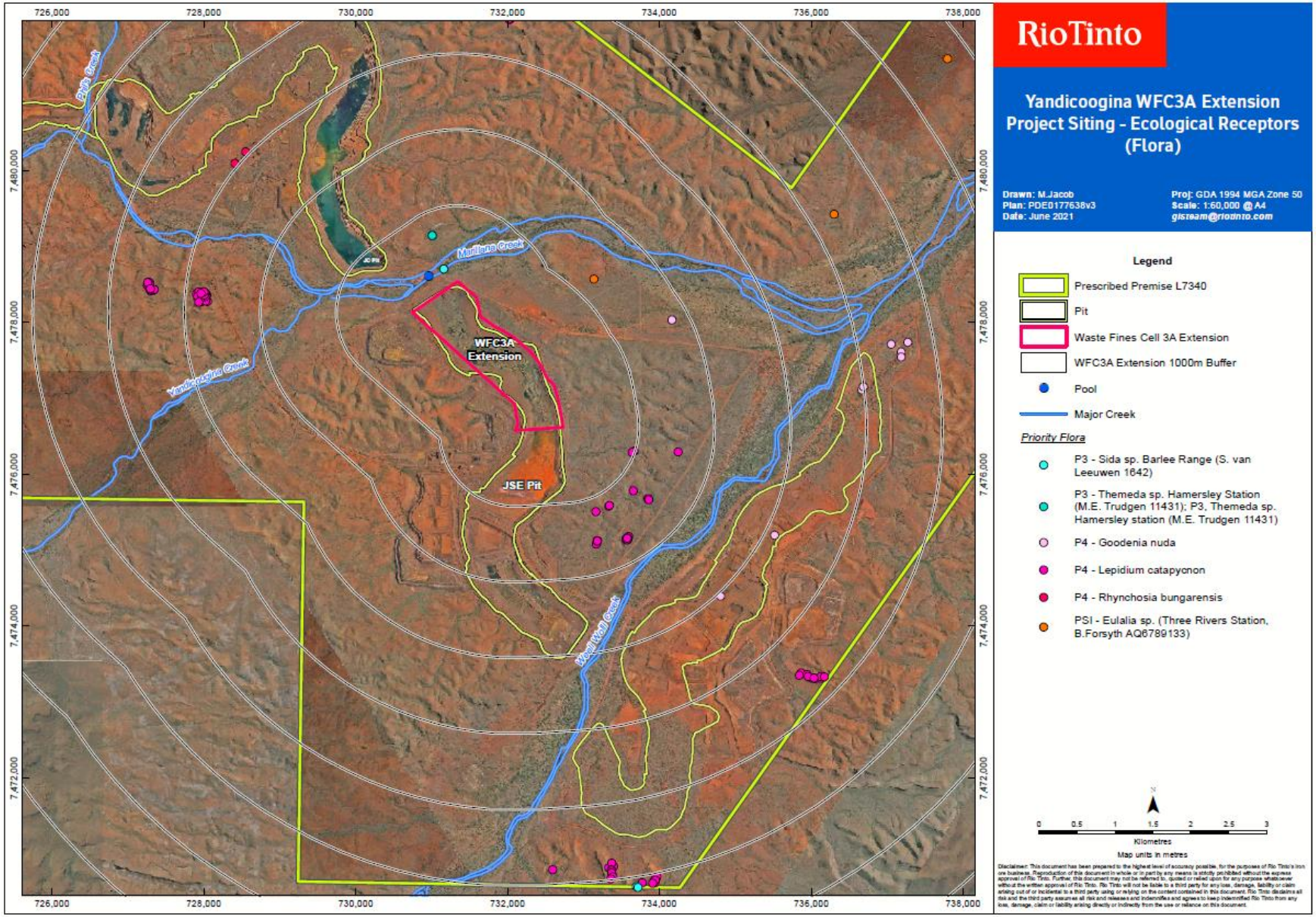

Figure 5: Distance to sensitive receptors – Flora

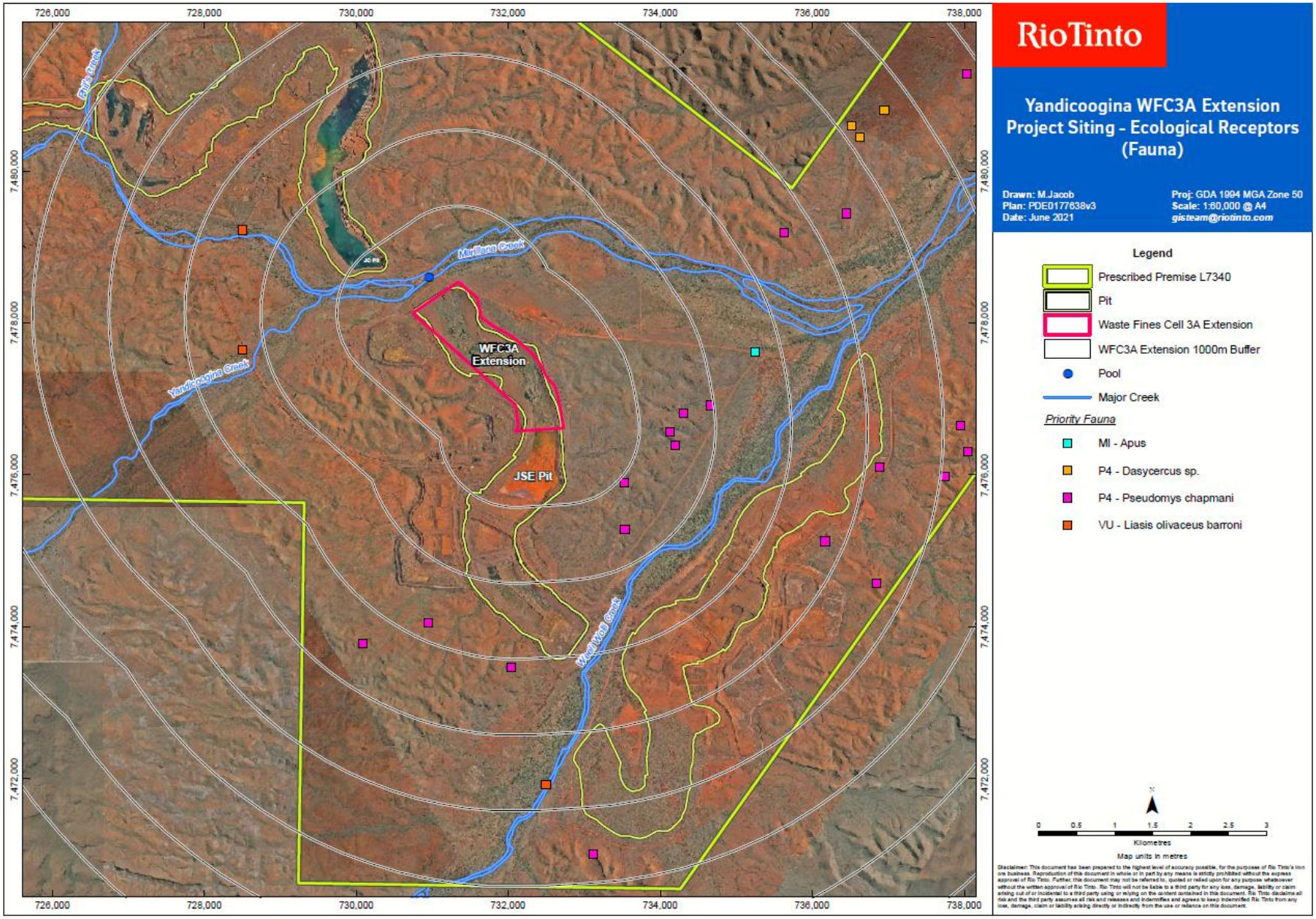

Figure 6: Distance to sensitive receptors – Fauna

Works Approval: W6518/2021/1 (5/08/2021)

3.2 Risk ratings

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

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

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 7.

Works Approval W6518/2021/1 that accompanies this Decision Report authorises construction and time-limited operations. The conditions in the issued Works Approval, as outlined in Table 7 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

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

Table 7: Risk assessment of potential emissions and discharges from the Premises during commissioning and operation

Risk Event					Risk rating[1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions[2] of works approval	Justification for additional regulatory controls
Source/Activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Time limited operation/operation								
Waste fines return pipeline	Tailings containing metals, metalloids and residual flocculant discharging to land	Direct discharge of tailings to land and seepage to groundwater causing contamination Direct contact from terrestrial fauna or birds	Groundwater	Refer to Section 3.1	C = Slight L = Unlikely **Low Risk**	Y	Condition 1, Table 1 included for the pipeline and services corridor in place, such as leak detection and secondary containment.	The WFC3A Extension facility will utilise the existing delivery pipelines and pipeline corridor.
Tailings discharge into WFC3A Extension Pipeline ruptures/ leaks Dust lift off	Tailings and flocculant solution seepage with elevated concentration Tailings spillage	Groundwater contamination Impacts to creek biodiversity, eutrophication etc. from elevated nitrates Groundwater mounding - Impacts to vegetation root zones impacting health and biodiversity Direct spillage to ground/ vegetation/ creek lines- increased sediments/ turbidity with rain	Marillana Creek and recreational pools Weeli Wolli Creek Vegetation/ creeks, environment	Refer to Section 3.1	C = Major L = Possible **High Risk – changes to groundwater already observed – Table 2.**	N	Condition 1, Table 1 included discharge point, exclusion bunding, survey prisms and piezometers. Condition 3, Table 2 included for the installation of ambient groundwater monitoring network. Two additional groundwater monitoring bores each side of WFC3A Extension, and two hyporheic zone bores in creek sediments at Marillana Creek and Weeli Wolli Creek.	Refer to detailed risk assessment As WFC3A Extension is not regulated under the Mining Act, an annual TSF audit report will be required once WFC3A Extension is incorporated into Licence L7340/1997/9.

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				
							Condition 4 to determine baseline ambient groundwater. Condition 10, Table 4 included for monitoring of tailings deposition during time limited operations. Condition 11, Table 5 included for ambient groundwater monitoring during time limited operations. Condition 13 included to verify tailings properties Condition 14 requires operating manual to be submitted to DWER Condition 16(d)(iv) requires water balance where the rate of evaporation is not assumed to the same as the pan evaporation rate. Condition 20 requires further stability analysis of the north pit wall	
	Overtopping	Discharge of waste fines outside of the containment	Localised soils and vegetation	Refer to Section 3.1	*C = Moderate* *L = Rare*	Y	Condition 10, Table 4 included for freeboard to be	The normal operating pond for WFC3A Extension will be maintained below RL 485 m. The pit

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**				
		infrastructure causing: - groundwater contamination - impacts to creek biodiversity, eutrophication etc. from elevated nitrates - increase turbidity in the creek	Aboriginal site Marillana Creek		***Medium Risk***		maintained during time limited operations.	crest for WFC3A Extension would overtop at RL 499 m, meaning that the facility will have a normal operating freeboard of approximately 14 m to pond level during operations. An inflow of 997 ML (corresponding to a 1:100 AEP 72-hour storm when all surface water diversion drains fail) would be expected to raise the water level in WFC3A Extension by less than 2 m

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.

3.3 Detailed risk assessment for tailings deposition into WFC3A Extension

3.3.1 Seepage

Water balance

Seepage from the waste fines or supernatant pond into the groundwater has potential to negatively impact downstream groundwater quality in CID and alluvial aquifers. The analytical water balance model prepared by the applicant indicates that during operation of WFC3A Extension the direction of groundwater flow is towards the pit. The risk of seepage migrating away from WFC3A Extension was considered low to negligible in the report.

DWER assessment identified that the water balance for the proposed waste-fines facility has accounted for all key water inputs and outputs from the system using a daily time-step. Most of the inputs and outputs from the model could be determined with a high level of certainty from site-specific measurements. However, this was not the case for evaporation, which was estimated to be 60% of the monthly pan evaporation rate (on a daily basis) at a weather station located some distance from the Yandicoogina mine site. Pan evaporation rates should be measured on-site as part of the weather data that is collected at the Yandicoogina mine site and not from a remote location. The actual rate of evaporation from a tailings storage facility (TSF) like WFC3A is likely to be overestimated, which can lead to large amounts of additional water in the TSF being available for seepage from the base of the facility.

Research by the Centre for Geomechanics at the University of WA (Newson and Fahey, 2003) suggests that the actual evaporation rate in a TSF that contains fresh pore-water in the tailings is about 60% of the pan evaporation rate, and can decline to about 20% of the pan evaporation rate as the salinity of pore-water in the facility increases.

The predicted water block model for WFC3A extension is shown in Figure 7.

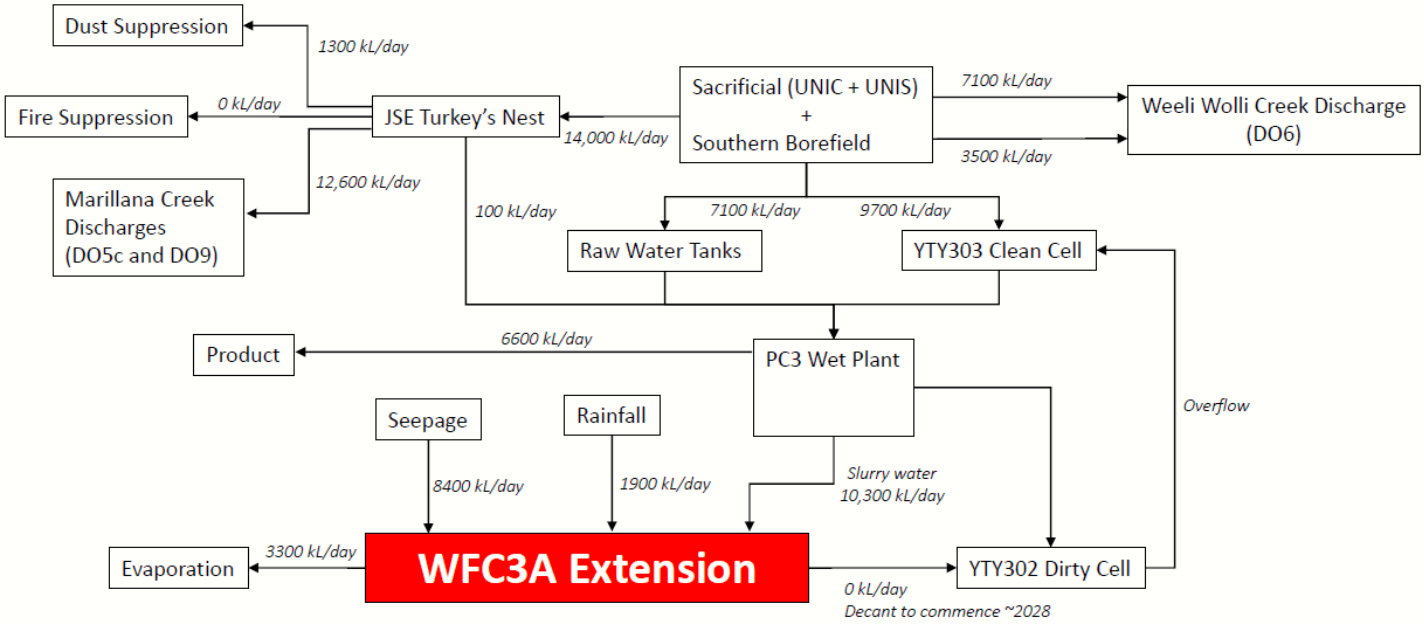

Figure 7: WFC3A Extension water block model.

Groundwater model

The groundwater modelling provided by the proponent was to assess the effects of water table rebound after mine closure on groundwater flow and water levels near the WFC3A waste fines disposal area, and associated pit lake at the Yandicoogina mine site.

The report did not present a new numerical model for this work but adapted an existing model that had been developed by RTIO. Consequently, a full description of how the model was developed was not provided in the report, only a brief summary of some key aspects of the model. The information provided in the summary was assessed against the requirements of the national groundwater modelling guidelines (National Water Commission, 2012) using the review table in the guideline document (Table 9.2). This Table, which shows whether the model complies with relevant sections of the national guideline document, is shown in Appendix 4.

Based the information provided, DWER concluded that the modelling has generally been carried out in an appropriate manner. However, limited information was provided in the report about how the RTIO model was calibrated, no information was provided about the time period used to calibrate the model using water level records from monitoring bores in the model domain, and no information was provided about the level of error (using root mean square error or other indicators) that may be associated with future predictions of water level changes or groundwater flow rates in the CID aquifer.

Groundwater flow models need to be calibrated using existing water level data from monitoring bores that are located within the area that is being modelled. The calibrated model is likely to give the most reliable predictions of how water levels and groundwater flow rates will respond to future stresses on an aquifer under the following conditions:

(i) The calibration has been undertaken using monitoring bores that are distributed throughout the model domain and which are constructed at various depths in one or more aquifers;

(ii) Simulated water level changes match observed changes in monitoring bores within a specified level of confidence; and

(iii) Modelling of future changes in aquifer conditions does not consider time intervals that are greater than five times the calibration period (refer to Chapter 6 in National Water Commission, 2012)

Contaminant plume

There has been a trend of increasing nitrate concentrations in some bores near the current tailings disposal area WFC3A. The timing of the recorded nitrate increases appears to coincide with the start of waste-fines disposal in the facility and there is a lack of recent data.

Electrical conductivity at JSE pit also show an increase above the SSGVs.

Concentrations of nitrate in some bores exceed the current ANZG trigger values for the protection of aquatic ecosystems, and would be of environmental concern if the contaminated groundwater were to discharge into the hyporheic zone of nearby creeks. Given the international significance of hyporheic fauna in the Pilbara region (Halse *et al*., 2014), it is important that pore-water quality in creek sediments is of suitable quality to protect these organisms.

Potentiometric head data provided indicates that elevated nitrate concentrations in groundwater near WFC3A would not discharge to Marillana Creek, as the direction of groundwater flow in the paleochannel is to the south. However, it is possible that nitrate and other chemical constituents in groundwater could discharge to the creek to the south of the WFC3A facility.

Hyporheic zone monitoring bore will be required as part of this assessment. Two bores must be constructed in creek sediments. One close to the north boundary of WFC3A extension and the other close to SB003. Information on constructing and sampling bores of this type can be found in UK Environment Agency (2009) and British Geological Survey (2010). It is recommended that this bore is constructed and sampled before the construction of the TSF to provide baseline

water quality data.

Additional monitoring bores along JSE pit and piezometers will be also required to verify changes in groundwater level and monitor the potential movement of contaminants.

4. 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 (10 March 2021)	None received	N/A
Shire of East Pilbara advised of proposal on 10 March 2021	No comments provided.	N/A
Department of Mines, Industry Regulation and Safety (DMIRS) advised of proposal on 12 March 2021 – request for geotechnical review	No comments provided	N/A
Gumala Corporation advised of proposal on 10 March	No comments provided.	N/A
Applicant was provided with draft V1 documents on 3 June 2021	29 June 2021	Refer to Appendix 1
Applicant was provided with draft V2 documents on 15 July 2021	22 July 2021	Refer to Appendix 1

5. Conclusion

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

References

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British Geological Survey, 2010. Technical Note: Hyporheic Zone Sampling Procedures. BGS Groundwater Science Program, Open File Report OR/10/048. http://nora.nerc.ac.uk/id/eprint/11707/1/OR10048.pdf.

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Rio Tinto 2020a. Application for a Works Approval under the Environmental Protection Act 1986 – Response Request for Information (1783320-036-M-Rev0), dated 15 December 2020.

Rio Tinto 2021. Application for a Works Approval under the Environmental Protection Act 1986 – Response Request for Information Nº2 (RTIO-HSE-0350099), dated 15 February.

UK Environment Agency, 2009. *The Hyporheic Handbook A handbook on the groundwater–surface water interface and hyporheic zone for environment managers*. UK Environment Agency Science report: SC050070. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291621/scho1009brdx-e-e.pdf.

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

<table>
<tr><th>Condition</th><th>Summary of applicant's comment</th><th>Department's response</th></tr>
<tr><td>Cover page</td><td>Duration of Works Approval: date of W6518/1/2021 be set for Q4 2027 to allow for the construction, commissioning and time limited operations (TLO) of decant infrastructure.</td><td>The extended works approval timeframe will not be granted. DWER recommend that the installation and operation of the decant infrastructure can be assessed under a Licence Amendment.
Decant infrastructure construction and commissioning was removed from decision report and works approval.</td></tr>
<tr><td>Condition 1</td><td>Request for the removal of 'on pit wall' to allow flexibility on where survey prisms are required to be located.</td><td>Amended</td></tr>
<tr><td>Condition 1</td><td>The infrastructure listed in line item 1 (In pit tailings storage facility WFC3A Extension) and line item 2 (Waste fines pumping and pipelines) is existing infrastructure supporting the existing WFC3A facility. The existing infrastructure was approved under W5630/2014/1 and then under a licence amendment made to L7340/1997/9 (submitted in February 2017 and approved via Licence Review for Yandicoogina Iron Ore mine site in September 2017).

As per section 4.2 Construction Phase of the RTIO Works Approval Supporting Document (RTIO-HSE-0347235), the existing delivery pipelines were reconfigured and upgraded (in line with the approved deposition locations) within the existing pipeline corridor in Q4 2020.

The existing infrastructure used to deliver waste fines to the existing WFC3A is proposed to continue to be used to deliver waste fines to the WFC3A Extension. No modifications to existing infrastructure are proposed, the asset reconfiguration and upgrade in 2020 negates the need for any further pipeline construction as part of the WFC3A Extension. As such, the timeframe for construction of pipelines is requested to be removed from Condition 1.</td><td>Supporting document (RTIO-HSE-0347235, October 2020) provided to the department as part of this works approval requested the relocation of existing deposition pipelines and installation of a contingency pipeline within existing pipeline corridor (Table 4-1).

Table 4-1 provides a summary of the proposed infrastructure associated with this works approval application and Figure 4-3 shows the proposed infrastructure on an aerial photo.

Table 4-1 Summary of Proposed Infrastructure and Equipment
<table><tr><th></th><th>Infrastructure and Equipment</th><th>Relevant Categories (if known)</th><th>Site Plan Reference</th><th>CCI Required</th><th>Enviro Commiss-ioning</th></tr><tr><td>1</td><td>WFC3A Extension
• Total capacity for 46.3 Million dry tonnes of waste fines.</td><td>5</td><td>Refer Figure 4-3</td><td>Y</td><td>N</td></tr><tr><td>2</td><td>Waste fines pumping and pipelines
• Use of WFC3A delivery pipeline and relocation of existing deposition pipelines.
• Installation of a contingency pipeline within existing pipeline corridor.</td><td></td><td></td><td>N</td><td>Y</td></tr><tr><td>3</td><td>Decant water pumping and pipeline
• A skid-mounted pump and decant return water pipeline between the pond and PC3 Turkeys nest in approximately 2028.</td><td></td><td></td><td>N</td><td>Y</td></tr><tr><td>4</td><td>Stormwater infrastructure
• Existing stormwater diversion drains will be used.</td><td></td><td></td><td>N</td><td>N</td></tr></table></td></tr>
</table>

Condition	Summary of applicant's comment	Department's response
		A review of previous W5630/2014/1 works approval amendment (RTIO-HSE-0289258, July 2016), compliance documentation (RTIO, 3 March 2017) and licence amendments related to WFC3A indicate that the approved pipeline location for WFC3A facility does not match the locations shown in W6518/ 2021/1 DRAFT Figure 1 and Figure 2. Retrospective approval cannot be granted; thus pipeline corridor construction and environmental commissioning were removed from the works approval.
Condition 1	The applicant requests that Condition 1 of the works approval emphasize that the decant pump pipeline specification provided is conceptual only. Due to the construction of decant infrastructure not being proposed for the next few years, the design is conceptual at this stage and subject to change as more detailed information becomes available.	Decant pump and associated pipeline were removed from this works approval (refer to first comment).
Condition 2	Compliance reporting timeframes: owing that the pipelines and other infrastructure listed in line item 1 and 2 of Table 2 have already been constructed (via previous approvals), the applicant requests the '60 day timeframe post construction' only be applied to infrastructure that has not yet been built (line item 3 - decant water pumping and pipeline). The Licensee recognises the requirement for DWER to have construction and commissioning information for infrastructure linked to emissions and proposes a separate condition for the provision of historic construction and commissioning information for existing items. The Licensee suggests the addition of Condition 3 and the following amendment (in Blue); Compliance reporting 2. The works approval holder must within 60 calendar days of an item of infrastructure or equipment required by condition 1 (line item 3) being constructed and/or installed: 3. An audit and Environmental Compliance Report for existing infrastructure (line item 1 and 2 of Table 1) must be submitted to the CEO prior to the commencement of TLO.	Amended to reflect that all infrastructure was already built.

Condition	Summary of applicant's comment	Department's response
Condition 3	Bore construction: As part of the Works Approval application, two new bores are proposed to be installed in the vicinity of the red crosses shown in Figure 5. Proposed Southern Bore The Licensee believes there are an adequate number of bores to the south of WFC3A Extension which provide sufficient coverage and target all aquifers. However, for DWERs information, the proposed monitoring bores to the south are primarily impacted by the nearby Weeli Wolli creek. This flows perennially due to discharge from Hope Downs 1 with a minor, but not insignificant contribution from Discharge Outlet 6. Flood events will occur irregularly and add to the water in the system. As a result, changes in the water chemistry will primarily be a downstream impact from Hope Downs 1. The Bore logs for listed bores are attached as Attachment 3. Proposed Northern Bore There are significant limitations to the installation of the bore required to the north with heritage and environmental constraints limiting access to the proposed location. Most notably, the assessment timeframe for relevant heritage and environmental approvals required to access the proposed locations in such close vicinity of Marillana Creek are expected to be years. As such, compliance with this particular location is not possible. The licensee proposes to redrill and replace Bore: Marillana 6A (731180E, 7478701N) as it would be using an existing track and minimise the ground disturbance. This is downstream of the initial proposed location and WFC3A Extension, so would theoretically be better at capturing any impact from the works.	The bore logs located south of WFC3A Extension were reviewed. The department concluded that most bores have very long screened intervals or they have a small screened interval at a large depth. None of the current bores will provide meaningful monitoring results for the gravel section. Given that environmental receptors (riparian vegetation and hyporheic fauna) are most likely to be affected by poor water quality in the shallow alluvial aquifer, the department requires bores with a short screened interval (less than 6 m long) constructed within this aquifer. Thus, the installation of a gravel bore at the south of WFC3A Extension remains. The department agrees to the reinstallation of Marillana 6A (731180E, 7478701N) as a gravel bore to the north of WFC3A Extension. However, this bore must have a short screened interval (less than 6 m long) constructed within the gravels.
Condition 3	Bore Construction – Timeframe: the applicant suggests the following amendment: Must be constructed, developed (purged), determined to be operational and sampled at least once prior to the deposition of waste fines into WFC3A Extension.	Amended
Condition 3	Baseline Sampling: The applicant requests that Table 2 (Infrastructure requirements – groundwater monitoring wells) be	No change to condition – refer to previous response.

Condition	Summary of applicant's comment	Department's response
	amended to remove the requirement for two groundwater monitoring bores in the Hyporheic zone creek sediments and replace with one groundwater monitoring bore in the Hyporheic zone creek sediments.	
Condition 6	Commissioning: The waste fines delivery pipeline infrastructure is already in operation for deposition of waste fines into WFC3A. The decant water pumping and associated pipelines are proposed to be constructed in 2026/2027. The applicant requests the removal of line item 1 (Waste Fines (Processing plant to WFC3A Extension)) from Table 3: Environmental commissioning requirements	Conditions related to commissioning were removed from works approval – conditions 6 and 7.
Condition 7	Instrumentation will be installed on decant infrastructure to provide feedback on any failures. As such, the applicant believes that twice daily inspections are excessive, daily inspections of pipelines are proposed. Daily inspections also align with the existing inspection schedule for WFC3A.	Conditions related to commissioning were removed from works approval - conditions 6 and 7.
Condition 12 Table 4	Line item 1 (Pipeline and services corridor (Processing Plant to WFC3A Extension) is existing infrastructure that is currently inspected daily under the existing WFC3A approval and current Operating Manual. Furthermore, telemetry, adequate bunding and ponds are in place for existing infrastructure. Twice daily inspections are excessive, daily inspections are proposed.	Amended to reflect daily.
Condition 12 Table 4	'Tailings containing ≥ 45% w/w solids and Beach angle of 0.7%' is too prescriptive. The discharge pipelines will not be constantly discharging at ≥ 45% as there will be times when the lines will be flushed at a low % solids. However, the long-term deposition average (back to Q1 2017) is approximately 47%. The applicant suggests replicating what will be contained in the OMS manual; Tailings containing long term average ≥35% w/w solids, ≤55% solids.	The risk assessment, tailings behaviour and seepage studies provided in the supporting documents used solid content between 45 and 50% w/w (SRK project memo, 13 July 2015; Swinburne laboratory report, July 2015; Golder, October 2020). To allow flexibility, the condition has been amended to tailings containing 45% w/w solids on average, Beach angle has been amended to provide a minimum of 25% tolerance.

Condition	Summary of applicant's comment	Department's response
	Beach angle of 0.7% is consistent with what the business is currently achieving, however the Licensee suggests that some margin is provided, i.e. 0.5 – 1.5%, to ensure compliance with this Condition is achievable.	
Condition 12 Table 4	The wording 'up to' and replaced with 'approximately'. 9.2 million tonnes per annum (wet) is the maximum predicted tailings discharge volume per annum.	Amended to discharge of 3.7 Mt (dry tailings) per year.
Condition 13 Table 5	Although there is the ability to install telemetry to measure Standing Water Level and Electrical Conductivity (EC), due to restricted access into the automated mining area the ability to physically sample these bores (for pH and DO) monthly may be limited. The applicant proposes that pH and DO be sampled quarterly rather than monthly.	Amended
Condition 13 Table 5	The list of bores is considered appropriate, but we would like to maintain flexibility to allow for bores that may be damaged or become inaccessible. If this occurs alternative bores and their coordinates will be provided. The Licensee requests the column be renamed 'Proposed Monitoring location'	No change. If a monitoring bore is going to be destroyed or removed, the works approval holder must notify the department and provide new location and timeframe for installation.
Condition 15 (a)	The conceptual model for the waste fines storage facilities operated by Rio Tinto in the Pilbara suggests they are typically saline and neutral pH. Recent testing at Hope Downs 4 support this model with results of the LEAF analyses suggesting that the pH of the waste fines material is consistently within a pH range of 6-8. Where Rio Tinto has intentionally increased the pH (by the addition of alkaline material) in the waste fines material, the waste fines naturally buffered back to a near neutral range. It has also been determined from the LEAF testing at Hope Downs 4 that at a near neutral pH range, the leachate produced is typically low in dissolved metal concentrations. It is noted that the Yandicoogina deposit is not expected to not encounter any material (such as potentially acid forming material in the way of black shale or lignite) that would result in moving the predicted pH range outside	No previous tailings sample analysis from Yandicoogina site were provided to date. Thus, condition 15 (a) was amended to reflect the pH fluctuation range for this site.

Condition	Summary of applicant's comment	Department's response
	of 6-8. Given the LEAF testing is typically utilised to assess the behaviour of a material at a range of pH values (2-13), the Licensee does not consider it applicable for the waste fine material produced at Yandicoogina operations, given this material is produced with an aqueous solution (water based) and has been demonstrated at comparative sites to be essentially pH neutral.	
Condition 16	Seven days is adequate time to update and review the Operating Manual once finalised conditions are provided. The applicant requests 7 days be replaced with 30 days	Amended
Condition 18 (iv)	Research carried out by CSIRO (McJannet et. al., 2019) suggests that the pan evaporation factor for similar in-pit ponds ranges from 0.8 to 1.2, while acknowledging the limitations of pan-evaporation approaches. Adopting a pan-evaporation factor of 1.0 (i.e. the same as the pan evaporation rate) is therefore in the expected range for facilities like WFC3A Extension. The DMIRS Guide to Preparation of a Design Report (2015) references ANCOLD Guidelines on Tailings Dams (2012) for the expected approach to tailings storage facility water balances in Western Australia. The ANCOLD guidelines state: "Losses from ponds can be evaluated from pan-evaporation data using appropriate adjustment factors or by calculations utilising wind speed, temperature, solar radiation, etc.". Rio Tinto applies the first approach recommended by ANCOLD to water balance for its waste fines cells at Yandi. While alternative calculation methods accounting for wind speed, temperature, solar radiation and thermal mass may provide improved estimates of evaporation, the results of such models will only be as accurate as their assumptions and inputs. Procurement of instrumentation to collect wind speed, air and water temperature data from the base of WFC3A Extension, collection of baseline data reflecting annual variation, and predictive modelling to support improved water balance calculations would be costly and take considerable time. This method is not considered feasible in the timeframe for time-limited operations. The applicant requests this condition be removed and that the water balance be developed using industry-standard approaches	Amended. The review of the TLO water balance and monitoring results will determine whether site specific pan evaporation will be a requirement in the licence.

Condition	Summary of applicant's comment	Department's response
	consistent with DMIRS requirements.	
Various	Administrative: incorrect references	Amended
Applicant response to second draft works approval		
Condition 8	The applicant notes that Environmental Commissioning (Condition 6 and 7 along with Table 3) have been removed from the licence, therefore condition 8 seems inconsistent with the intent of the removal of conditions 6 and 7 (Monitoring during environmental commissioning). However, the draft Decision Report states that infrastructure requiring commissioning includes WFC3A delivery pipelines, deposition pipelines and contingency pipelines, all of which have been commissioned over 60 days ago and are currently in use for deposition into WFC3A. The applicant suggested changes in wording: 'The works approval holder must submit to the CEO an Environmental Commissioning Report within 60 calendar days of the granting of this Works Approval for delivery pipelines and contingency pipelines'.	Decision report and works approval amended to reflect that the pipeline was already constructed and commissioned.
Condition 10	Condition 7 has been deleted. The applicant suggests deleting the wording 'under condition 7'	Amended
Condition 12	Table 4 - Line item 2 – 'Decant water pumping and pipeline' has been removed from the works approval. The applicant suggests the removal of Line Item 2 from Table 4.	Amended

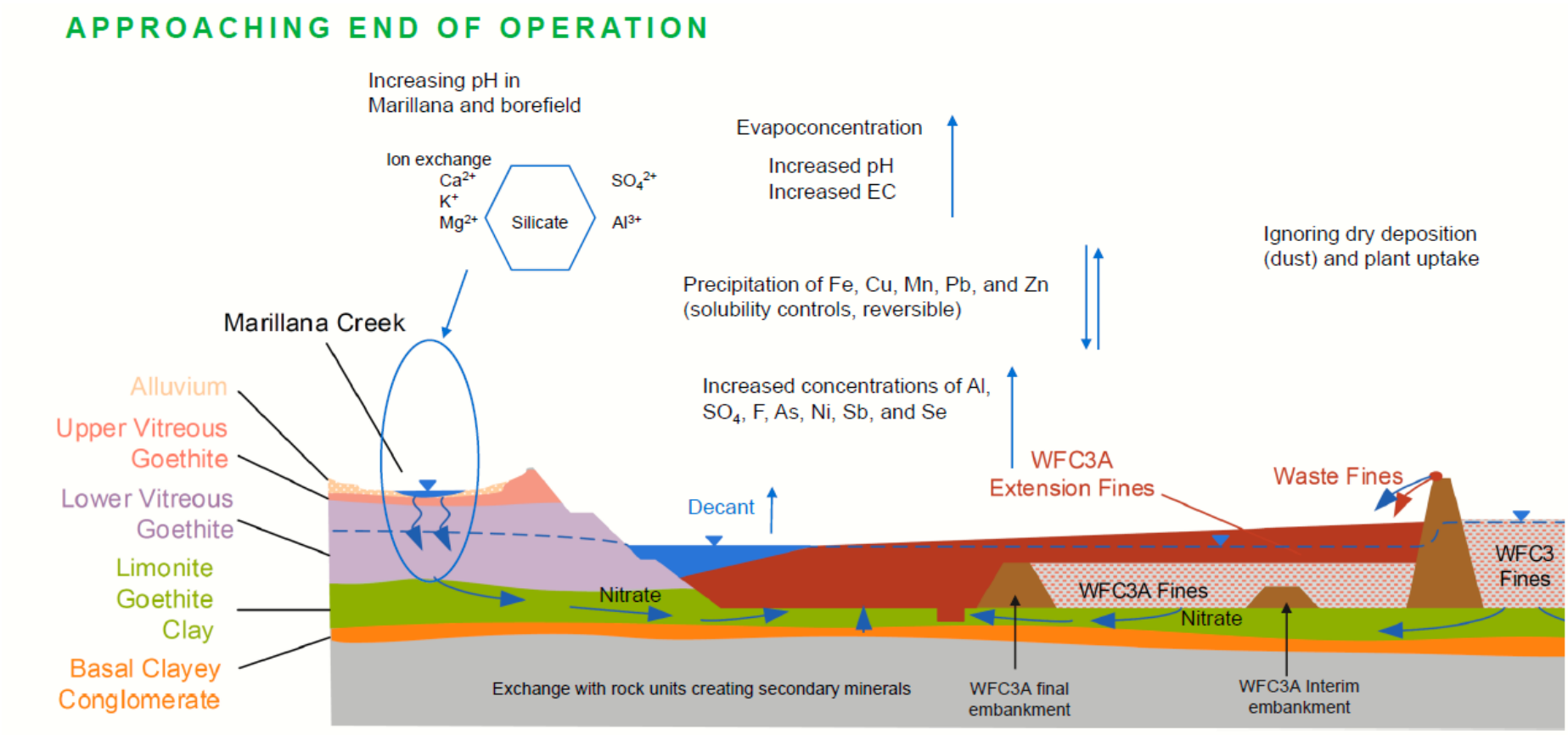
Appendix 2: Application validation summary

SECTION 1: APPLICATION SUMMARY (as updated from validation checklist)	
Application type	
Date application received	26/10/2020
Applicant and Premises details	
Applicant name/s (full legal name/s)	Pilbara Iron Company (Services) Pty Ltd (PICS)
Premises name	Yandicoogina Mine
Premises location	State Agreement Mineral Mining Lease ML274SA
Local Government Authority	Shire of East Pilbara
Application documents	
HPCM file reference number:	DER2020/000532
Key application documents (additional to application form):	Supporting Documents (DWERDT355801) - Works Approval supporting document - Waste Fines Cell 3A Extension – Yandicoogina Mine – Golder (October, 2020) - 1783320-002-R-Rev4 - Waste fines geochemistry - Groundwater quality in bores
Scope of application/assessment	
Summary of proposed activities or changes to existing operations.	• Extension of the operational WFC3A within Junction South East (JSE) Pit (WFC3A Extension) • deposition of waste fines into WFC3A Extension
Legislative context and other approvals	

Has the applicant referred, or do they intend to refer, their proposal to the EPA under Part IV of the EP Act as a significant proposal?	Yes ☐ No ☒	~~Referral decision No:~~ ~~Managed under Part V ☐~~ ~~Assessed under Part IV ☐~~
Does the applicant hold any existing Part IV Ministerial Statements relevant to the application?	Yes ☒ No ☐	Ministerial statement No: 1038 EPA Report No: 1573
Has the proposal been referred and/or assessed under the EPBC Act?	Yes ☐ No ☒	~~Reference No:~~
Has the applicant demonstrated occupancy (proof of occupier status)?	Yes ☒ No ☐	Certificate of title ☐ General lease ☐ Expiry: Mining lease / tenement ☐ Expiry: Other evidence ☒ Expiry: Sep 2039

Has the applicant obtained all relevant planning approvals?	Yes ☐ No ☐ N/A ☒	Approval: Expiry date: If N/A explain why?
Has the applicant applied for, or have an existing EP Act clearing permit in relation to this proposal?	Yes ☒ No ☐	CPS No: N/A Clearing covered under MS 1038.
Has the applicant applied for, or have an existing CAWS Act clearing licence in relation to this proposal?	Yes ☐ No ☒	Application reference No: N/A Licence/permit No: N/A
Has the applicant applied for, or have an existing RIWI Act licence or permit in relation to this proposal?	Yes ☐ No ☒	Application reference No: N/A Licence/permit No: N/A
Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the EP Act)?	Yes ☒ No ☐	Name: Pilbara Groundwater Area, 49 Pilbara Surface water Area, 54 Type: Proclaimed Groundwater Area and Surface Water Area Has Regulatory Services (Water) been consulted? Yes ☐ No ☒ N/A ☐ Regional office: North West
Is the Premises situated in a Public Drinking Water Source Area (PDWSA)?	Yes ☐ No ☒	Name: N/A Priority: N/A
Is the Premises subject to any other Acts or subsidiary regulations (e.g. *Dangerous Goods Safety Act 2004, Environmental Protection (Controlled Waste) Regulations 2004, State Agreement Act xxxx*)	Yes ☒ No ☐	Sate Agreement Iron Ore (Yandicoogina) Agreement Act 1996
Is the Premises within an Environmental Protection Policy (EPP) Area?	Yes ☐ No ☒	-
Is the Premises subject to any EPP requirements?	Yes ☐ No ☒	-
Is the Premises a known or suspected contaminated site under the *Contaminated Sites Act 2003*?	Yes ☐ No ☒	Classification: N/A

Appendix 3: Conceptual site model



6. Appendix 4: Groundwater modelling Assessment tables (from National Water Commission, 2012)

Review questions	*Yes/No*	*Comment*
1. Planning		
1.1 Are the project objectives stated?	Yes	
1.2 Are the model objectives stated?	Mostly	Interaction of CID aquifer with
1.3 Is it clear how the model will contribute to meeting the project objectives?	Yes	surrounding fms not clear
1.4 Is a groundwater model the best option to address the project and model objectives?	Yes	
1.5 Is the target model confidence-level classification stated and justified?	No	Calibration period not clear
1.6 Are the planned limitations and exclusions of the model stated?	No	
2. Conceptualisation		
2.1 Has a literature review been completed, including examination of prior investigations?	Yes	
2.2 Is the aquifer system adequately described?	Mostly	Interaction of CID aquifer with
2.2.1 hydrostratigraphy including aquifer type (porous, fractured rock ...)	Yes	surrounding fms not clear
2.2.2 lateral extent, boundaries and significant internal features such as faults and regional folds	Yes	
2.2.3 aquifer geometry including layer elevations and thicknesses	Yes	
2.2.4 confined or unconfined flow and the variation of these conditions in space and time?	No	In RTIO modelling report?
2.3 Have data on groundwater stresses been collected and analysed?	?	In RTIO modelling report?
2.3.1 recharge from rainfall, irrigation, floods, lakes	Yes	
2.3.2 river or lake stage heights	?	In RTIO modelling report?
2.3.3 groundwater usage (pumping, returns etc)	Yes	
2.3.4 evapotranspiration	Yes	
2.3.5 other?		
2.4 Have groundwater level observations been collected and analysed?	Yes	
2.4.1 selection of representative bore hydrographs	No	In RTIO modelling report?
2.4.2 comparison of hydrographs	No	
2.4.3 effect of stresses on hydrographs	No	
2.4.4 watertable maps/piezometric surfaces?	Yes	
2.4.5 If relevant, are density and barometric effects taken into account in the interpretation of groundwater head and flow data?		
2.5 Have flow observations been collected and analysed?	?	In RTIO modelling report?
2.5.1 baseflow in rivers	?	
2.5.2 discharge in springs	?	
2.5.3 location of diffuse discharge areas?	?	
2.6 Is the measurement error or data uncertainty reported?	No	
2.6.1 measurement error for directly measured quantities (e.g. piezometric level, concentration, flows)	No	
2.6.2 spatial variability/heterogeneity of parameters	No	
2.6.3 interpolation algorithm(s) and uncertainty of gridded data?	No	

Review questions	*Yes/No*	*Comment*
2.7 Have consistent data units and geometric datum been used?	Yes	
2.8 Is there a clear description of the conceptual model?	Mostly	Interaction of CID aquifer with surrounding fms not clear
2.8.1 Is there a graphical representation of the conceptual model?	Yes	
2.8.2 Is the conceptual model based on all available, relevant data?	?	In RTIO modelling report?
2.9 Is the conceptual model consistent with the model objectives and target model confidence level classification?	Yes	
2.9.1 Are the relevant processes identified?	Yes	
2.9.2 Is justification provided for omission or simplification of processes?	No	
2.10 Have alternative conceptual models been investigated?	No	
3. Design and construction		
3.1 Is the design consistent with the conceptual model?	Yes	
3.2 Is the choice of numerical method and software appropriate (Table 4-2)?	Yes	
3.2.1 Are the numerical and discretisation methods appropriate?	Yes	
3.2.2 Is the software reputable?	?	In RTIO modelling report?
3.2.3 Is the software included in the archive or are references to the software provided?	No	
3.3 Are the spatial domain and discretisation appropriate?	Yes	
3.3.1 1D/2D/3D	3D	
3.3.2 lateral extent	Yes	
3.3.3 layer geometry?	Yes	
3.3.4 Is the horizontal discretisation appropriate for the objectives, problem setting, conceptual model and target confidence level classification?	Yes	
3.3.5 Is the vertical discretisation appropriate? Are aquitards divided in multiple layers to model time lags of propagation of responses in the vertical direction?	Yes	
3.4 Are the temporal domain and discretisation appropriate?	?	In RTIO modelling report?
3.4.1 steady state or transient	Both	
3.4.2 stress periods	?	
3.4.3 time steps?	?	
3.5 Are the boundary conditions plausible and sufficiently unrestrictive?	Yes	
3.5.1 Is the implementation of boundary conditions consistent with the conceptual model?	Yes	
3.5.2 Are the boundary conditions chosen to have a minimal impact on key model outcomes? How is this ascertained?	Yes	
3.5.3 Is the calculation of diffuse recharge consistent with model objectives and confidence level?	No	Diffuse recharge ignored
3.5.4 Are lateral boundaries time-invariant?	Yes	
3.6 Are the initial conditions appropriate?	Yes	
3.6.1 Are the initial heads based on interpolation or on groundwater modelling?	?	
3.6.2 Is the effect of initial conditions on key model outcomes assessed?	?	In RTIO modelling report?

Review questions	*Yes/No*	*Comment*
3.6.3 How is the initial concentration of solutes obtained (when relevant)?	N/A	
3.7 Is the numerical solution of the model adequate?	?	In RTIO modelling report?
3.7.1 Solution method/solver	?	
3.7.2 Convergence criteria	?	
3.7.3 Numerical precision	?	
4. Calibration and sensitivity		
4.1 Are all available types of observations used for calibration?	?	
4.1.1 Groundwater head data	Yes	
4.1.2 Flux observations	No	Recharge set to zero in calibration
4.1.3 Other: environmental tracers, gradients, age, temperature, concentrations etc.	No	
4.2 Does the calibration methodology conform to best practice?	?	
4.2.1 Parameterisation	?	
4.2.2 Objective function	?	
4.2.3 Identifiability of parameters	?	
4.2.4 Which methodology is used for model calibration?		Potentiometric head matching
4.3 Is a sensitivity of key model outcomes assessed against?		
4.3.1 parameters	Yes	
4.3.2 boundary conditions	No	
4.3.3 initial conditions	Yes	
4.3.4 stresses	No	
4.4 Have the calibration results been adequately reported?	No	
4.4.1 Are there graphs showing modelled and observed hydrographs at an appropriate scale?	No	
4.4.2 Is it clear whether observed or assumed vertical head gradients have been replicated by the model?	No	
4.4.3 Are calibration statistics reported and illustrated in a reasonable manner?	No	
4.5 Are multiple methods of plotting calibration results used to highlight goodness of fit robustly? Is the model sufficiently calibrated?		
4.5.1 spatially	Yes ?	
4.5.2 temporally	?	
4.6 Are the calibrated parameters plausible?	Yes	
4.7 Are the water volumes and fluxes in the water balance realistic?	Yes	
4.8 has the model been verified?	?	
5. Prediction		
5.1 Are the model predictions designed in a manner that meets the model objectives?	Yes	
5.2 Is predictive uncertainty acknowledged and addressed?	No	
5.3 Are the assumed climatic stresses appropriate?	Yes	
5.4 Is a null scenario defined?	No	
5.5 Are the scenarios defined in accordance with the model objectives and confidence level classification?	No	

Review questions	*Yes/No*	*Comment*
5.5.1 Are the pumping stresses similar in magnitude to those of the calibrated model? If not, is there reference to the associated reduction in model confidence?	N/A	
5.5.2 Are well losses accounted for when estimating maximum pumping rates per well?	N/A	
5.5.3 Is the temporal scale of the predictions commensurate with the calibrated model? If not, is there reference to the associated reduction in model confidence?	?	Calibration period not known - in RTIO model report?
5.5.4 Are the assumed stresses and timescale appropriate for the stated objectives?	Yes	
5.6 Do the prediction results meet the stated objectives?	?	Calibration period not known
5.7 Are the components of the predicted mass balance realistic?	Yes	
5.7.1 Are the pumping rates assigned in the input files equal to the modelled pumping rates?	N/A	
5.7.2 Does predicted seepage to or from a river exceed measured or expected river flow?	?	
5.7.3 Are there any anomalous boundary fluxes due to superposition of head dependent sinks (e.g. evapotranspiration) on head-dependent boundary cells (Type 1 or 3 boundary conditions)?	?	
5.7.4 Is diffuse recharge from rainfall smaller than rainfall?	N/A	Diffuse recharge ignored in model
5.7.5 Are model storage changes dominated by anomalous head increases in isolated cells that receive recharge?	?	
5.8 Has particle tracking been considered as an alternative to solute transport modelling?	N/A	
6. Uncertainty		
6.1 Is some qualitative or quantitative measure of uncertainty associated with the prediction reported together with the prediction?	No	
6.2 Is the model with minimum prediction-error variance chosen for each prediction?	No	
6.3 Are the sources of uncertainty discussed?	No	
6.3.1 measurement of uncertainty of observations and parameters	No	
6.3.2 structural or model uncertainty	No	
6.4 Is the approach to estimation of uncertainty described and appropriate?	No	
6.5 Are there useful depictions of uncertainty?	No	
7. Solute transport		
7.1 Has all available data on the solute distributions, sources and transport processes been collected and analysed?	N/A	
7.2 Has the appropriate extent of the model domain been delineated and are the adopted solute concentration boundaries defensible?	N/A	
7.3 Is the choice of numerical method and software appropriate?	N/A	
7.4 Is the grid design and resolution adequate, and has the effect of the discretisation on the model outcomes been systematically evaluated?	N/A	
7.5 Is there sufficient basis for the description and parameterisation of the solute transport processes?	N/A	

Review questions	*Yes/No*	*Comment*
7.6 Are the solver and its parameters appropriate for the problem under consideration?	N/A	
7.7 Has the relative importance of advection, dispersion and diffusion been assessed?	N/A	
7.8 Has an assessment been made of the need to consider variable density conditions?	N/A	
7.9 Is the initial solute concentration distribution sufficiently well-known for transient problems and consistent with the initial conditions for head/pressure?	N/A	
7.10 Is the initial solute concentration distribution stable and in equilibrium with the solute boundary conditions and stresses?	N/A	
7.11 Is the calibration based on meaningful metrics?	N/A	
7.12 Has the effect of spatial and temporal discretisation and solution method taken into account in the sensitivity analysis?	N/A	
7.13 Has the effect of flow parameters on solute concentration predictions been evaluated, or have solute concentrations been used to constrain flow parameters?	N/A	
7.14 Does the uncertainty analysis consider the effect of solute transport parameter uncertainty, grid design and solver selection/settings?	N/A	
7.15 Does the report address the role of geologic heterogeneity on solute concentration distributions?	N/A	
8. Surface water–groundwater interaction		
8.1 Is the conceptualisation of surface water–groundwater interaction in accordance with the model objectives?	Yes	
8.2 Is the implementation of surface water–groundwater interaction appropriate?	Yes	River recharge treated as a line source
8.3 Is the groundwater model coupled with a surface water model?	Yes	OK for overall assessment of rebound
8.3.1 Is the adopted approach appropriate?		
8.3.2 Have appropriate time steps and stress periods been adopted?	?	
8.3.3 Are the interface fluxes consistent between the groundwater and surface water models?	N/A	