

Memo

Technical Response to Groundwater Related Items Raised in “Draft ERD - Amendments Required - APP-0012119”

OUR REF	NS-16018-RP-WM-0005	DATE	9-Sep-24
TO	Vladimir Rios-vera	CC	Guy Stock
FROM	Michael Carroll		

This memorandum has been developed to respond to specific feedback from EPA Services on the North Star Extension draft ERD (APP-0012119 – 23 August 2024). These items are listed below and addressed in turn within this document.

The intent is for this document to be used as either a source of information for responding to EPA Services or appended in its entirety to the Fortescue Iron Bridge response.

Table 1: EPA Services queries addressed in this memorandum

Section Reference	Comment	Action
1	Water reinjection is included as an option to manage groundwater levels (Appendix 36, Table 2 and Table 3).	<ul style="list-style-type: none"> a. Update the ERD to include an assessment of impacts to subterranean fauna as a result of groundwater reinjection. b. Provide maps of reinjection sites and modelled groundwater mounding in relation to restricted troglofauna species
3	The water balance in Table 5 (Section 2.1.10) currently accounts for 3.6 GL/a of TSF return water and 0.3 GL/a of dewatering and pit rainfall recovery. This is not aligned with the water sources in Section 2.1.9, which include 5 GL/a in-pit dewatering and 0.5 GL/a of TSF seepage recovery.	<ul style="list-style-type: none"> a. Update Table 5 to accurately represent water inflows and outflows.

1. WATER REINJECTION

a. MOUNDING

An important consideration in the implementation of injection to manage groundwater levels is that the practice is not managed as a volume target (i.e. inject “x” GL/a) but rather as a means of creating a hydraulic barrier between the source of water level drawdown and the receptor. As shown in Figure 1 below, the barrier (injected water) results in flow towards the receptor as well as the source. The hydrogeological assessment (IB-5700-RP-WM-0002) and associated Groundwater Operating Strategy



(661MI-0000-PL-HY-0001) have highlighted the need for adaptive management to deal with the uncertainty resulting from the complex, fractured rock nature of the Iron Bridge hydrogeology. A tier one response in groundwater levels, and a threshold response for vegetation is to “investigate causes and develop designs for further contingency actions”. The development of designs will include specific injection locations and the development of trigger levels for mounding, if warranted by the presence of nearby receptors sensitive to mounding.

A 2-D model has been developed to undertake a high-level assessment and support the suitability of injection as an adaptive management strategy as written in the Groundwater Operating Strategy. This model applies an arbitrary abstraction stress (to represent borefield or pit dewatering drawdown) which results in 3 m of drawdown at a hypothetical trigger bore. The 3 m drawdown can be considered representative of the magnitude of drawdown at stygofauna trigger bores which may prompt implementation of supplementation. Smaller values of drawdown would apply to pools; rendering the approach taken conservative. Ten (10) scenarios with injection at distances between 100 m and 1,000 m away from the trigger bore have been simulated. Figure 1 illustrates how the mounding remains largely localised to injection location, and that the magnitude of mounding increases as the distance from the trigger bore increases. The required injection volumes also increase with proximity to the source of drawdown. It is important to note that this outcome is specific to the applied hydraulic parameters; however the chosen parameters reflect a reasonable approximation of the weathered aquifer properties at Iron Bridge.

The outcome of this modelling assessment suggests that mounding is generally localised to the site of injection and can be managed if the objective is only to maintain water level at a receptor, rather than to discharge of excess volumes of water. A range of mounding radii of between 84 and 285 m is observed from the modelling outcome.

The EPA Services require an assessment of potential impacts to troglofaunal species from the proposed drawdown mitigation strategy of injection. An estimate of the volume of mounding has been extracted from the 2-D modelling assessment, and is presented in Figure 2. The outcomes are aligned with Figure 1, in that mounded volumes increase with the distance between the site of injection and the target receptor and range from 19,000 – 500,000 m³.

Figure 3 illustrates the spatial location of the sampled species relative to a 1,250 m buffer from trigger locations and managed receptors. This buffer distance has been chosen to reflect two concepts:

- i. Injection to supplement receptor locations is likely to be planned within 500 m of the receptor, but may be up to 1,000 m if access is constrained; and
- ii. A mounding radius of approximately 250 m is expected at an injection distance of 1,000 m

The map demonstrates that, if injection sites are not designed with consideration of troglofauna, then it is theoretically possible that the modelled mounding may intersect areas of known troglofaunal occurrence. There are however two practical considerations to this potential outcome:

- a. the underlying depth to groundwater data presented in the map contextualises this potential outcome against the depth to groundwater at these sites of more than 20 m. Mounding is therefore unlikely to completely impact available habitat in the area; and



- b. Importantly, many areas of this theoretically calculated mounding do not account for the presence of the pit footprints. Within these footprints, dewatering will prevent mounding and the low permeability geology surrounding the pits to the East and West will limit propagation of mounding. Limited range species are all located within pit footprints and are unlikely to be affected by mounding.

The outcomes of the model and spatial assessment are consistent with a low inherent risk to troglofauna species from groundwater injection to manage receptor water levels. As stated in the Groundwater Operating Strategy, any requirement to inject will require a detailed assessment, with management through the Groundwater Operating Strategy and also a relevant Part V Licence. This regulation will further mitigate potential risks of impact.

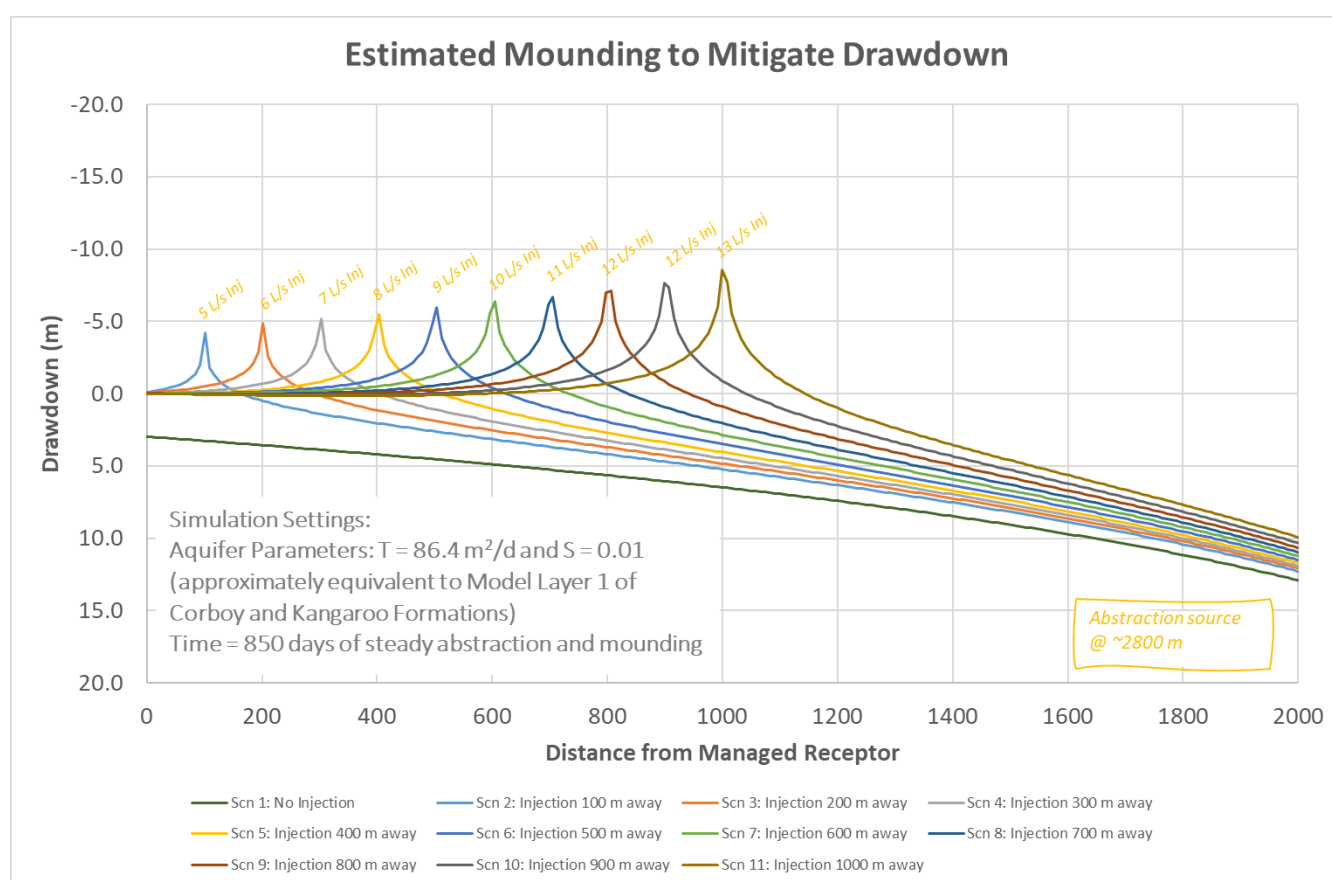


Figure 1: Predicted 2-D mounding associated with injection as a means of mitigating a source of drawdown

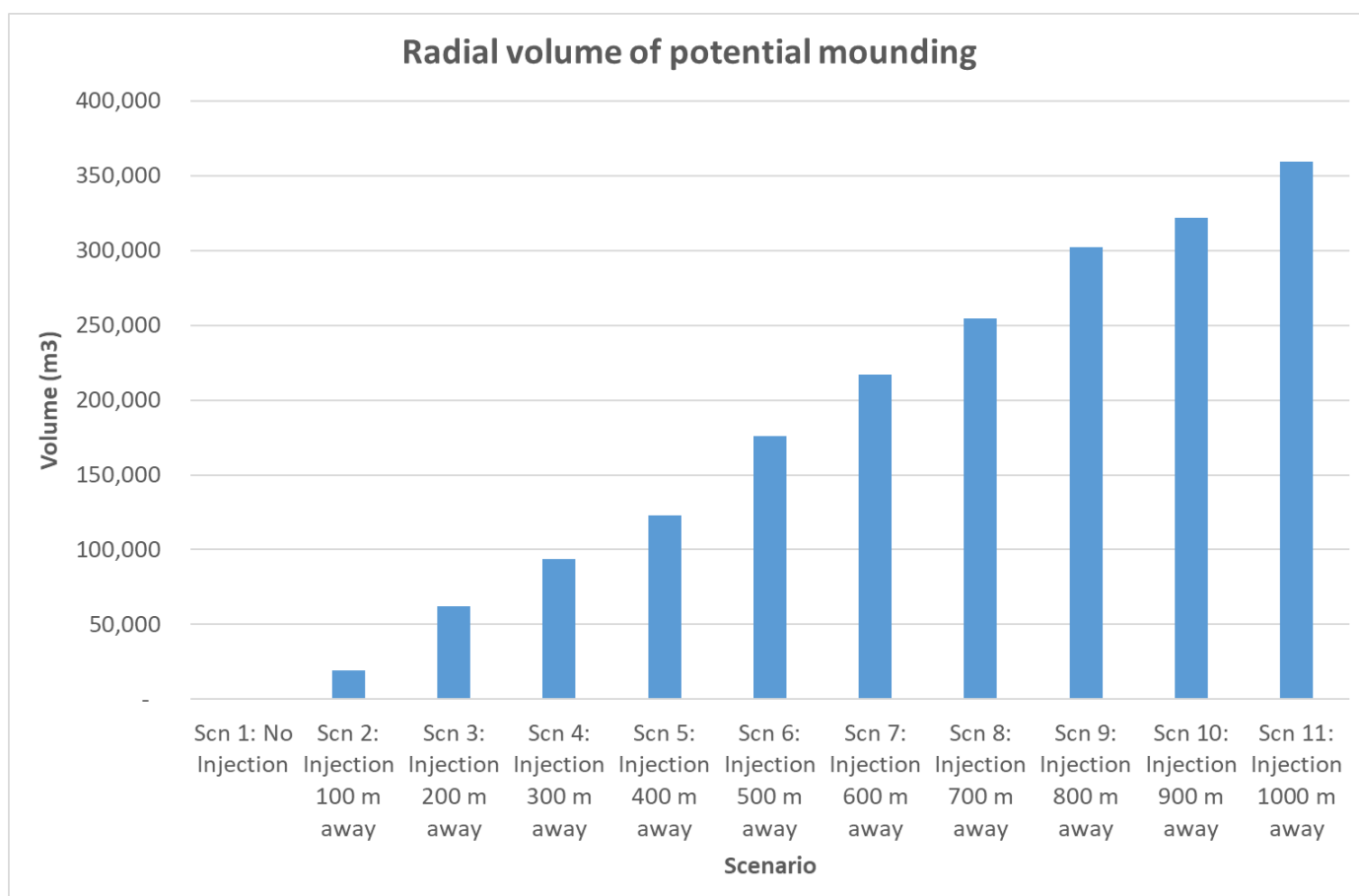


Figure 2: Calculated 3-D mounding volumes for each of the ten prediction scenarios

a. WATER QUALITY

To achieve the adaptive management approach for supplementation via injection, water from the raw water supply system will be piped to the required injection location(s). This raw water will represent a blend of supply from bores across the North Star Project area. The exact blend will depend on the available bores at the time of implementation, and the hydraulics of the supply system. A dedicated supply line from a discrete number of bores is also a possibility to manage the engineering and reliability of the supply.

The Iron Bridge Mine Area Hydrogeological Assessment (IB-5700-RP-WM-0002) identified that the majority of samples taken (370 samples from 92 bores) indicate a magnesium bicarbonate type. Furthermore, the salinity of water from equipped abstraction bores is within a small range of 500 – 1,600 mg/L TDS. This is indicative of a general suitability of groundwater from the Project area to be utilised for supplementation at any location within the Project area.



An overarching objective of groundwater management at North Star, written into the Groundwater Operating Strategy, is that “Groundwater quality [...] are in line with expectation; i.e. that unexpected aquifer trends are identified and investigated. Annual reporting under the RIWI Act will contain a review of borefield data and trends; this will help inform the ongoing suitability of certain bores or borefield areas for the purpose of environmental supplementation. Furthermore, any supplementation activity will have to take place with an appropriate licence under Part V of the EP Act. It is anticipated that this licence, or the Groundwater Operating Strategy, will contain water quality trigger levels and contingency actions to manage the low risk of water quality impact to the target receptor from injection activity.

2. WATER BALANCE

By way of clarification, Section 2.1.9 outlines the maximum annual abstraction rates permitted under current *Rights in Water and Irrigation Act* approvals for the groundwater sources at Iron Bridge. Table 5 of Section 2.1.10 on the other hand is listed as an “indicative” water balance, reflecting one potential outcome in how the Iron Bridge demands will be met by supply once in steady operation. This is reflected in the following text included above Table 5 in the ERD.

“...with material flows for ore processing provided as averaged, annualised rates. These values are indicative only as the water balance will vary owing to factors such as incident rainfall in the TSF, changes in dust suppression requirements and any alterations to processing that may occur over time. Raw water required for processing is primarily supplied from the Canning Basin, (20 GL/a) with an additional raw water sourced from near mine bores to provide water for camp facilities, supplementary raw water for the beneficiation of ore and for dust management in the mining areas. Some additional source capacity is indicated by the water balance; however not all sources may be available at the rates stated at all times.”

As stated above, the values will range year on year depending on factors influencing both water usage and water sourcing. If water usage varies (i.e. during ramp up or in a period of lower than expected recovery from the TSF Return Water), supply from other sources will adjust to suit, up to a limit of the permitted maximum values stated in Section 2.1.9. If water from pit dewatering is greater than 0.3 GL/a, then a reduced volume of water will be abstracted from either of the Canning Basin or Near Mine Borefield. For example, in the event that 5 GL/a of in-pit dewatering water is recovered in a given year, then Iron Bridge may elect to reduce abstraction from Canning Basin to 16 GL/a and the Near Mine Borefield to 2.8 GL/a.

Based on this explanation, Table 5 and the explanatory text is considered to appropriately represent an “indicative water balance”; however some adjustments have been made to the “Notes” column to better reflect the licence information in Section 2.1.9



Table 5: Indicative IBO Water Balance

Water Usage	Value	Units	Note
OPF Plant	0.8	GL/a	Ore Feed moisture losses through Air Classifiers
OPF Camp & Mine DS	1.5	GL/a	0.4 for Camp / 1.08 for Mine dust management
Dry Rejects	0.3	GL/a	Dry Reject Dust Suppression
To TSF	21.3	GL/a	Losses to TSF
Product Concentrate	2.2	GL/a	Losses to Concentrate Product
Port Losses	0.3	GL/a	Losses at Port due to evaporation
Total Water Usage	26.4	GL/a	-
Water Sources	Value	Units	Note
Near Mine - Bore Water Makeup	3.5	GL/a	3.5 GL/a maximum as per license from Near Mine bores (under assessment)
TSF Return Water	3.6	GL/a	Recovered water from TSF
Dewatering & Pit Rainfall	0.3	GL/a	Limit of 5 GL/a as per licence allowance
TSF and WRD Seepage Recovery	0	GL/a	Limit of 0.5 GL/a as per licence allowance
Raw Water - Canning Basin	20	GL/a	Limit of 20 GL/a as per licence allowance
Total Water Sources	27.4	GL/a	-

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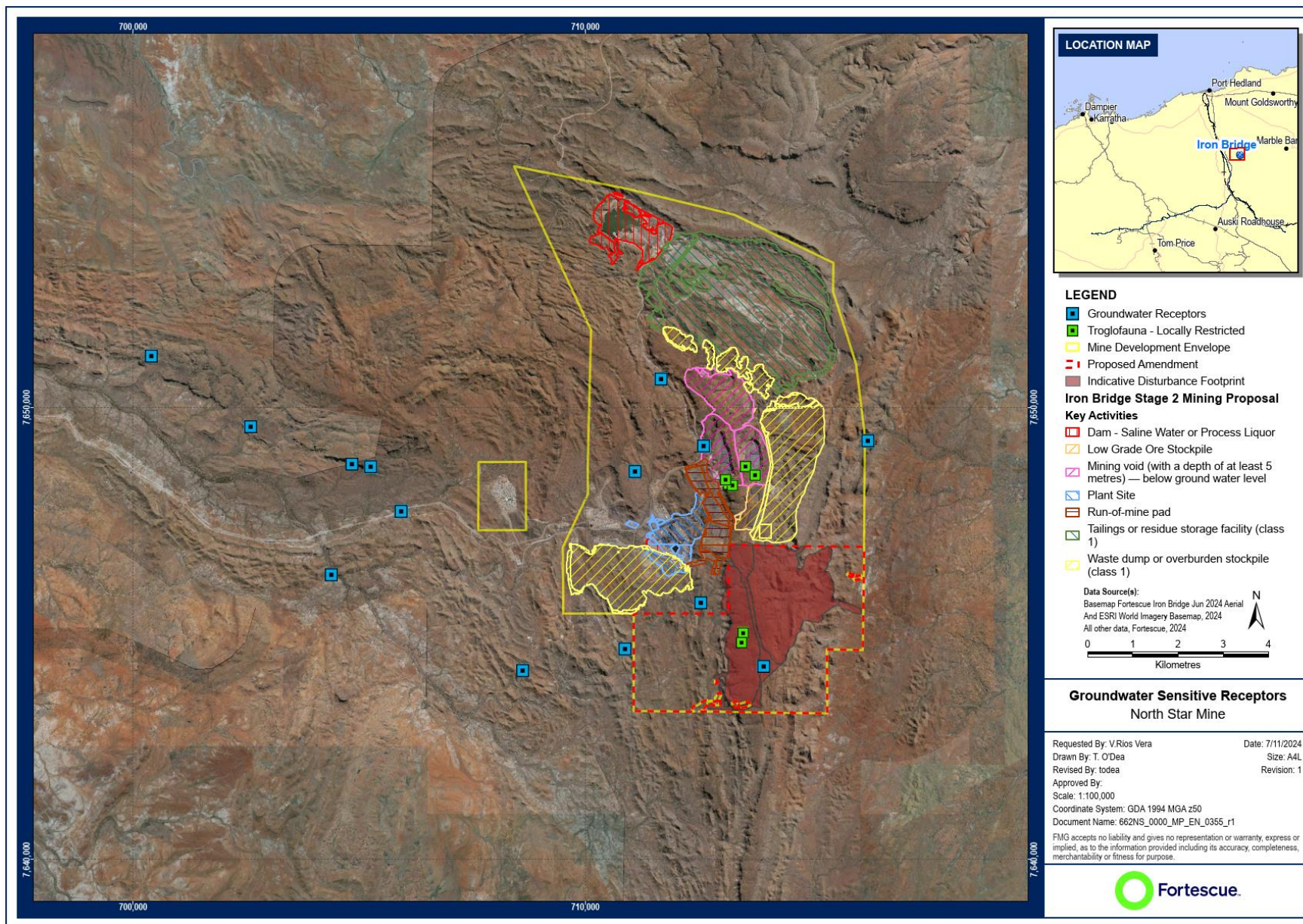


Figure 3: Maximum area of potential mounding based on existing GDE receptors that might require injection management