ADDENDUM

PEER REVIEW: WEST ANGELAS C&D: HYDROGEOLOGICAL ASSESSMENT

INTRODUCTION

A review report on Pre-Feasibility (PFS) studies was completed in November 2017. This report summarises and provides comment on subsequent Feasibility-level studies (FS) in and around the sites of the West Angelas C2 and D Deposits and is presented as an Addendum to the previous report.

The FS review has involved discussions with technical personnel and review of the primary report - West Angelas - Deposits C, D and G: H3 Hydrogeological Assessment, v1.3 July 2018 (RTIO-PDE-0155692). Supporting technical documentation reviewed included:

- West Angelas Deposit C & D Feasibility Study Groundwater Modelling Dewatering Prediction, January 2018 (internal memo).
- West Angelas Deposits C & D Feasibility Study Groundwater Impact Assessment, February 2018 (internal memo).
- West Angelas Deposits C and D hydrogeological conceptualization review, February 2016 (internal memo).
- Summary tables relating to the drilling and testing completed within the 2017 FS field programme.

Primary attention has been given to reported changes to the hydrogeological conceptualization and consequent modifications to the associated groundwater model and predictions arising therefrom.

An overview of the content of the three (3) primary references is provided hereunder followed by a summary of the key findings as recorded. This is followed by Review Comments.

West Angelas - Deposits C, D and G: H3 Hydrogeological Assessment, v1.3 July 2018 (RTIO-PDE-0155692).

This report is largely an extension of an earlier report describing the hydrogeological conceptual model (RTIO-PDE-0152088, June 2017) review comments for which have been previously provided.

The report provides a listing of all relevant studies and summary data relating to the 2017 drilling and testing programme that included four additional test bores. Information is provided on a revised conceptualisation relating to the extent of the regional aquifer system and consequent upgrade of the existing model (elaborated on below). Specifically, the barrier boundary previously assumed to exist to the north-west of the defined groundwater flow system has been removed given that no evidence for such a boundary could be established on a re-assessment of available geological and geophysical data. Figures showing the revised model domain, aquifer base/area and estimates of mean annual recharge and groundwater discharge are provided.

Calibration of the model in steady-state is described and observed versus computed groundwater levels presented with RMS error of 1.06m reported. Key findings relating to dewatering predictions and impact assessments are reported as follows:

- The total dewatering rate predicted for Pit D1 is 10.4ML/d with cumulative volume 26GL (over period 8 years 2021-2028).
- Drawdown was predicted to occur across the potential GDE between 2023 and 2039, with the maximum rates of drawdown at the potential GDE expected to vary between 0.32 and 0.80m/year, as per the sensitivity analysis which considered a range of 1 to 10 %.
- With no groundwater level recovery mitigation post-dewatering, groundwater levels would continue to decline within KNP as groundwater levels recovered post mining. The absolute change in groundwater levels varied between 1 and 6 m over a 100-year post-mining time frame which is comparable to previous predictions.

West Angelas Deposit C & D Feasibility Study Groundwater Modelling Dewatering Prediction, January 2018 (internal memo).

This document describes the update of the numerical model in relation to aquifer depth and extent and provides dewatering predictions based on the current mine schedule. The model update results primarily from additional resource drilling. With use of Leapfrog, revised cross sections were developed which indicated that the C2 pit would be openly connected to the Wittenoom Fm aquifer (which was not represented in the earlier model). As a consequence the base and areal extent of the aquifer section was revised. The Leapfrog geological model for the minesite areas was translated into a groundwater model using its hydrogeology module and the model domain extended to match the existing regional model boundaries. Formation parameter values adopted were consistent with the earlier model. Predictive scenarios were run to establish FS dewatering requirements. For Pit C2, the uncertainties in the extent of the aquifer to the north of the deposit led to consideration of three (3) concepts. Dewatering predictions for all 3 concepts showed a significant increase in dewatering rates (range 10-20 ML/d) than had previously been established. The revised dewatering programme includes only operations at Pit D1 which has the deepest benches. Under the current conceptualisation, Pits D2 and D3 are within the area of drawdown resulting from dewatering at Pit D1 and it is not envisaged that any additional dewatering will be required.

West Angelas Deposits C & D Feasibility Study Groundwater Impact Assessment, February 2018 (internal memo).

This document describes the northward extension of the model domain and presents new predictions of regional drawdown impacts under varying recharge conditions and post-mining water level recovery. Predictions were run with the revised mine schedule (dewatering of Pit D1 only). Predictions indicate drawdown and recovery patterns at WANG-14 similar to that shown in previous results. Water level recovery at Pit D1 is shown graphically with 100m rise within the first 10 years and recovery to within 5m of pre-mining levels after 50 years. The sensitivity of water level drawdown and recovery to cyclone (high recharge) events is assessed with consideration of 2* recharge value and 5* recharge value on 5-year cycles. When compared to an even annual recharge, little impact results on the drawdown but recovery rates are enhanced.

REVIEW COMMENTS

Planned works relating to additional drilling and testing, re-assessment of the occurrence of the barrier to the NW of Deposit C, review of stratigraphy and basement geology and upgrade of the existing regional groundwater model have been completed during the FS study and provided advances in definition of local and regional hydrogeology.

The additional drilling and testing that has been completed during the 2017 FS programme largely confirm aquifer characterization and parameters around the Deposits but have identified the potential for greater inter-connectivity between the deposits and the regional aquifer. The deepening of the aquifer north of the C2 deposit in the model is considered appropriate.

Similarly, in the absence of evidence to support a barrier boundary that would constrain groundwater flow in the northwest, the expansion of the model domain to the north is also considered appropriate.

Revised dewatering predictions are considered reasonable given the controls provided by geological drilling and aquifer testing in the relevant Deposit areas.

Such controls do not exist, however, for the broader model domain given that no data exists for the northern catchment newly added to the domain.

Reasonable model calibration is reported with a degree of “control” provided by balance of various recharge and groundwater discharge estimates. Whilst all such estimates have wide error potential, the consistency of values <1GL/yr testifies to the low-flow environment and offers some confidence in model predictions of water level drawdown impacts.

As previously recorded however, these predictions of drawdown in the KNP are useful in indicating potential impacts but the magnitude and timing can only be considered indicative given the simplified modelling approach adopted and the omission of potential key processes and features (eg indirect recharge from streamflow and the role of the downstream calcrete deposit).

Overall, the view that the approach adopted is conservative with consequent likely over-prediction of drawdown impacts within the KNP is retained and previously documented recommendations remain valid.