

Technical Memorandum

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Project No.: J1843

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MEDCALF VANADIUM PROJECT – HAUL ROAD WATER SUPPLY

Introduction

Audalia Resources Limited (Audalia) is proposing to develop their Medcalf Vanadium Project, located approximately 100 km west of Norseman. The project will comprise a series of open pits, a processing plant, tailings storage facility, evaporation ponds, workshops and an accommodation village. The pits will be developed to a maximum depth of around 50 m below surface and should not require mine dewatering.

The ore production rate is likely to be in the order of 1.5 million tonnes per annum (Mtpa), over a 13 year life of mine (LoM). Beneficiation will be undertaken on site, with the concentrate transported via haul trucks along an 80 km haul road east of the project (Figure 1), to a transfer depot adjacent to the Esperance Highway. The concentrate will then be transferred to smaller road trains and transported to the Esperance port for export.

The project has a projected water demand of approximately 1.2 GL per annum, comprising:

- 0.8 GL per annum (25 L/s) of groundwater for the purposes of beneficiation, dust suppression within the mining area and camp supplies (which will need to be treated via reverse osmosis).
- 0.4 GL per annum (12.7 L/s) of groundwater for dust suppression purposes along the 80 km haul road and transfer depot.

Groundwater Resource Management (GRM) has undertaken several hydrogeological studies for the project, including a pre-feasibility level desktop study (GRM, 2015¹) and more recently a hydrogeological assessment, including field investigations, for the 0.8 GL per annum supply for the mining area (GRM, 2020²).

Audalia has subsequently engaged GRM to provide a brief technical memo, based on information from the studies completed to date, to identify potential water supply sources for the 0.4 GL per annum (12.7 L/s) haul road demand and provide an indication of likely drawdown impacts to the surrounding groundwater environment.

Proposed Haul Road Borefield

Audalia has indicated that a groundwater supply of 0.4 GL per annum (12.7 L/s) will be required, from a series of between three to five bores, roughly equidistant along the 80 km haul road. Individual bores will

¹ Groundwater Resource Management "Medcalf Project Water Supply Desk Study" internal report J150007R01 prepared for Audalia Resources Limited, dated September 2015

² Groundwater Resource Management "Groundwater Supply Investigation Audalia Resources Limited Medcalf Vanadium Project" internal report J1843R03 prepared for Audalia Resources Limited, dated March 2020

need to be capable of producing between 2.5 L/s and 4.2 L/s and be located within the existing corridor (Figure 1). Audalia has indicated a preference for low salinity groundwater (less than 10,000 mg/L total dissolved solids (TDS)), to minimise detrimental impact to equipment and vehicles.

Water Supply Options

Previous studies undertaken by GRM (2015) identified three potential aquifers along the proposed haul road corridor, as shown in Figure 1. A discussion of the potential water supply options are provided below:

- i. Palaeo-tributary aquifer within the Cowan Palaeodrainage. Recent field investigations (GRM, 2020) within the Lefroy palaeo-tributary adjacent to the mining area indicate a 10 m thick medium grained sand aquifer, overlain by a 16 m thick clay aquitard. Field investigations indicate individual bore yields in this aquifer of potentially around 4 to 5 L/s of hypersaline (76,000 mg/L TDS), although acidic (3.4 pH) groundwater. Given the regional similarities between the Lefroy and Cowan palaeodrainage systems, it is possible that similar yields and groundwater quality could be expected from the Cowan palaeo-tributary, although lower salinity is also possible based on other palaeo-tributaries in the region. Whilst the investigations conducted to date indicate this aquifer would be a suitable water supply source in terms of likely bore yields, the groundwater quality (salinity and pH) may limit their use, although further investigations would be necessary to confirm this.
- ii. Fractured bedrock aquifers within the palaeo-tributary interfluves (defined as un-dissected uplands between adjacent palaeo-tributaries). Regional information (GRM, 2015) indicates modest yielding low salinity aquifers can be found in palaeo-drainage interfluves. Recent investigations within the mining area (GRM, 2020) indicated yields of up to 14 L/s in fractured bedrock bores, which is well above the required yield for the haul road water supply. However the salinity in the mining area was highly variable, ranging from 54,000 to 170,000 mg/L TDS, which is likely attributed to the close proximity to the Lefroy palaeo-tributary. Lower salinity groundwater supplies are possible along the haul road corridor, particularly away from the palaeo-tributaries (i.e. closer to the catchment divides), although field investigations would be required to confirm this.
- iii. Surficial aquifers. Regionally, small quantities of low salinity groundwater are known to occur in alluvial sequences, particularly along small drainage lines where the alluvium is sufficiently thick to extend below the water table. Surficial aquifers are readily recharged by rainfall, although supplies can diminish during prolonged dry periods. This aquifer type may provide a suitable shallow water source for the haul road, although field investigations would be required to confirm this.

In order to achieve three to five equidistant water supply bores along the haul road corridor the bores will likely comprise a combination of aquifer sources (as shown in Figure 1). It would be recommended that a geophysical survey is initiated along the corridor to further delineate the targets. Alternatively, Audalia may prefer to undertake a preliminary exploration drilling programme at the potential surficial aquifer targets shown on Figure 1, extending the drill holes into the underlying bedrock or palaeo-tributary sediments to assess two potential aquifer types per drill-hole. It should be noted that this approach may be unsuccessful and may require further assessment (geophysical surveying) to better define the targets.

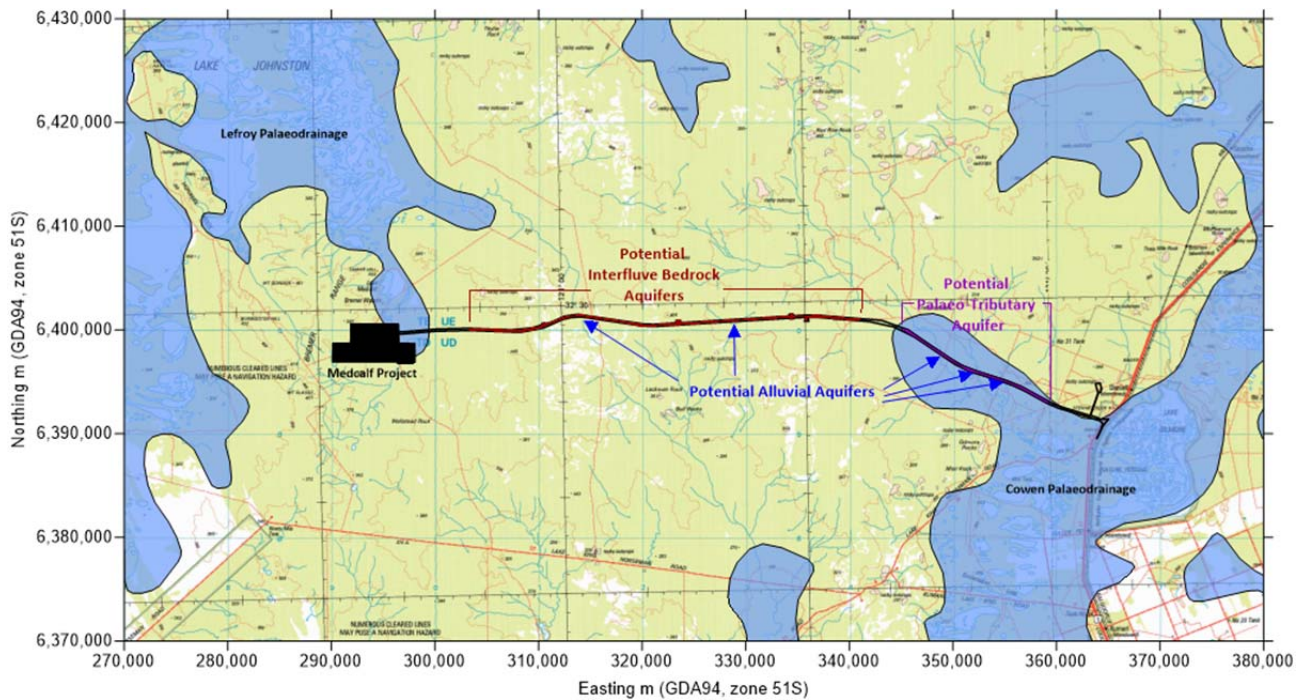


Figure 1: Water Supply Options

Discussion of Potential Impacts

Drawdown impacts associated with water supply bores installed along the haul road corridor are likely to be limited, due to the low yield requirement per bore and the large distance between bores. However, it is important to note that drawdown impacts will likely differ depending on the aquifer type, for example:

- Groundwater abstraction from palaeo-tributary aquifers typically result in drawdown extending laterally along the palaeo-tributary, with very limited leakage from the overlying clay aquitard. This typically results in minimal drawdown response in the shallow groundwater environment. Assuming similar permeability conditions to the Lefroy palaeo-tributary (GRM, 2020), drawdown in the Cowan palaeo-tributary associated with a bore yield of 4 L/s over the 13 year LoM could potentially result in a drawdown of less than 1 m in the shallow groundwater environment.
- Groundwater abstraction from fractured rock aquifers typically extend laterally along the fracture orientation, with limited drawdown into the surrounding intact rock. Assuming similar hydraulic conditions to the fractured bedrock aquifers tested during the recent field investigations within the mining area (GRM, 2020) drawdown associated with a bore yield of 4 L/s over the 13 year LoM could potentially result in a 1 m drawdown contour extending up to 1 km along strike from each fractured rock bore.
- Groundwater abstraction from alluvial aquifers typically results in drawdown extending uniformly in all directions, which is usually recharged following rainfall events. This aquifer type was not assessed during recent field investigations. However previous experience suggests that the 1 m drawdown contour would likely extend 1 to 2 km from the bore depending on the aquifer thickness and pumping rate. Alluvial bores would likely provide lower salinity groundwater than the other two aquifer types. However the bore yields may diminish after prolonged periods of dry conditions if the aquifer storage is limited, although the yields would likely increase again following rainfall recharge. It is understood that there have been no groundwater dependant ecosystems identified along the haul road corridor which could be impacted by drawdown in the alluvial aquifer.

Summary

The proposed Medcalf Vanadium Project will require a groundwater supply of 0.4 GL per annum (12.7 L/s) for dust suppression purposes along their proposed 80 km haul road which extends from the project to the Esperance Highway.

Audalia require a series of between three to five bores, preferably equidistant along the haul road. Individual bores will need to be capable of producing between 2.5 L/s and 4.2 L/s. Audalia has indicated a preference for low salinity groundwater (less than 10,000 mg/L TDS), to minimise detrimental impact to equipment and vehicles.

Previous studies undertaken by GRM indicate three potential aquifers along the proposed haul road corridor, comprising the Cowan palaeo-tributary aquifer, fractured bedrock aquifers within the palaeo-tributary interfluves, and shallow surficial aquifers within small drainage lines. The palaeo-tributary aquifer may not be suitable due to the potential for high salinity and low pH groundwater. However further field investigations would be necessary to confirm this. The alluvial aquifer would likely have the lowest salinity but the supply may diminish with time during prolonged dry periods. To achieve three to five reliable, equidistant water supply bores along the haul road corridor the bores will likely comprise a combination of two or three of the aquifer types.

Drawdown impacts associated with water supply bores installed along the haul road corridor are likely to be limited, due to the low yield requirement per bore and the large distance between bores. Drawdown impacts to the shallow groundwater environment would likely be lower in the palaeo-tributary, due the overlying clay aquitard. Alternatively, drawdown impacts may be higher in the alluvial aquifer due to the likely limited thickness of the aquifer.



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