CORUNNA DOWNS PROJECT

Investigation of Relationships between Vegetation and Hydrology - “Soak” Area

ATLAS IRON LTD

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Corunna Downs Project – VT 8 Groundwater Investigation

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Cover Photograph: Vegetation in central part of soak showing dense *Schoenus falcatus* individuals

DOCUMENT REVISION AND STATUS

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1. Introduction

Atlas Iron Limited (Atlas) is the proponent of the Corunna Downs Project (the Project), located approximately 30 km south of Marble Bar. Atlas is proposing to abstract groundwater for construction, processing and dust suppression purposes from a series of bores at the Project. These bores are located in the vicinity of an area identified as a "soak", where groundwater is thought to discharge at the surface (Figure 1). As such, there is the risk of impacts to the hydrology of the soak, including associated terrestrial vegetation, as a result of groundwater abstraction. This report investigates the relationship between the hydrology of the soak and associated terrestrial vegetation, the likelihood of impacts to vegetation health as a result of the proposed groundwater abstraction, and the significance of such impacts.

778000 778500 779000

7634000 7633500 7633000 7632500

Legend

- Development Envelope
- Indicative Mine Disturbance Footprint
- Potential freshwater spring soak

Bore Location

- Abstraction
- Monitoring
- Depth to Groundwater

Life of Mine Drawdown

- 0.100000 - 0.500000
- 0.500001 - 1.500000
- 1.500001 - 2.500000
- 2.500001 - 3.500000
- 3.500001 - 4.500000
- 4.500001 - 5.250000
- 5.250001 - 6.500000

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This map should only be used in conjunction with WEC report Atlas17-54-01.

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Corunna Downs Project
Soak Location and Proposed Life of Mine Drawdown Contours

Revision: B - 26-03-2018 Scale: 1:5,000 (A3)

Author: David Coultas

WEC Ref: Atlas17-54-01

Filename: Atlas17-54-01-f01.mxd

Projection: GDA 1994 MGA Zone 50

Figure

1

2. Geomorphology, Hydrology and Soils of the Soak

Atlas recently commissioned Stantec (2018) to undertake an investigation into the geomorphology and hydrology of the soak and surrounds (see Plate 1). The soak is located on a gentle slope at the base of a relatively high linear range, and commences at the contact point between the Mount Roe Basalt Formation and Hardey Formation stratigraphic units, extending from the contact point into the lower elevations of the Hardey Formation. Data from bores established within both formations indicates that groundwater is approximately 3 m below the surface approximately 100 m upslope from the soak in the Mount Roe Basalt Formation, however is generally at approximately 10 m below the surface 150 m downslope of the soak in the Hardey Formation (seasonal fluctuations in groundwater of 2 m have been recorded). Figure 1 presents depth to water contours up to the 10 m depth contour. Previous studies in Western Australia have indicated that plant roots are unlikely to access moisture beyond a depth of 10 m, or the proportion of water requirements derived from groundwater beyond this depth is relatively low (Department of Water 2009); therefore, contours above 10 m are not considered relevant to this assessment.

Stantec hypothesise that the geological contact between the Mount Roe Basalt Formation and Hardey Formation may form a barrier to groundwater flow, potentially resulting in surface discharge of groundwater from the Mount Roe Basalt and the periodic saturation of sub-surface soils at the soak. Field observations have confirmed that there is no continuous surface water discharge, with no discharge observed to date. The soak drains into a minor creek, which ultimately flows into the Coongan River.

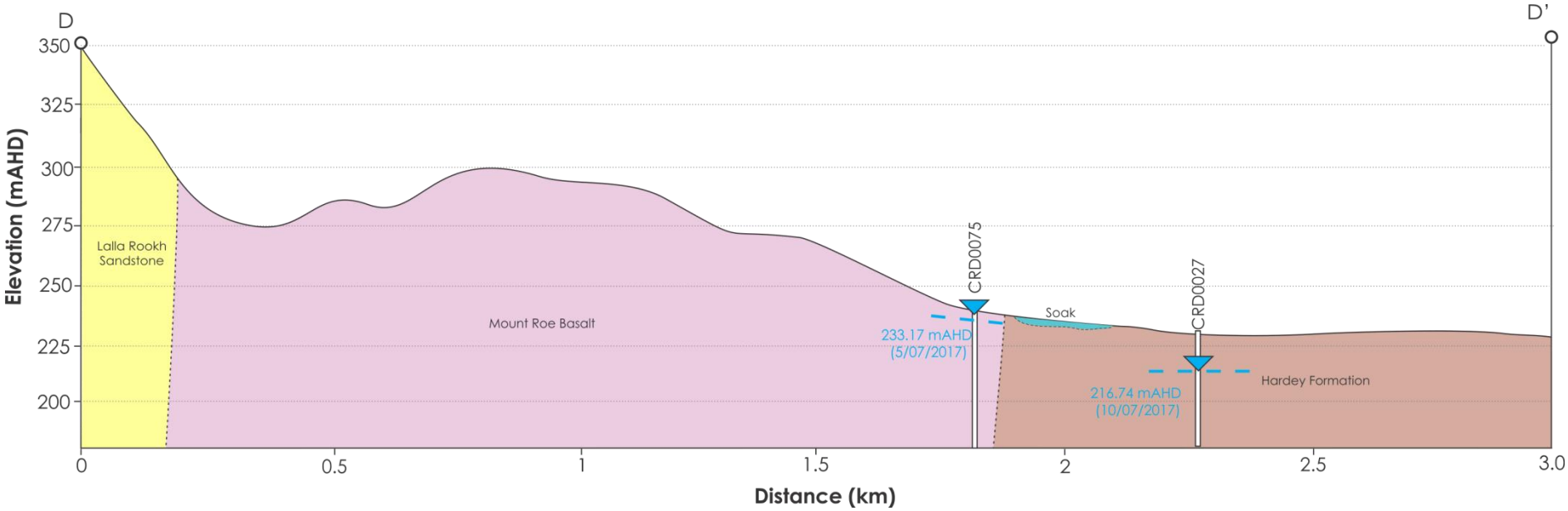

Plate 1: Cross section of Soak Area showing Stratigraphic Formations Bore Locations and Groundwater Levels

No detailed investigation of the soils of the soak has been undertaken to date, however field observations by Woodman Environmental Consulting Pty Ltd (Woodman Environmental) noted that the soils of the central part of the soak had a high clay content, and were an almost white colour; the clay content was considered to be greater than the red to red-brown clay loam soils of the surrounding plains and hills of the Mount Roe Basalt and Hardey Formations (Woodman Environmental 2016). The soils also contained a small amount of colluvial dolerite or basalt gravel (Plate 2). On the periphery, the soils are darker brown in colour, and contain a higher proportion of colluvial dolerite or basalt gravel, however have a similar clay content (Woodman Environmental field observations).

It is therefore considered likely that the soak consists of a clay soil layer overlaying rock that contains the aquifer intersected by Atlas' bores. There is likely to be some transmissivity between the clay layer and the underlying aquifer, which may periodically be saturated to the soil surface by groundwater, however transmissivity is expected to be low due to the high clay content of the soils. It is considered that the conditions at the soak are likely to be influenced to a greater extent by surface and sub-surface water flows saturating the clay layer, with water being retained in the clay layer for relatively long periods of time between significant rainfall events.

Plate 2: Image of Soils and Vegetation in the Central Part of the Soak

Plate 3: Image of Soils and Vegetation on the Periphery of the Soak

3. Vegetation of the Soak

3.1. Description of Vegetation

Woodman Environmental sampled the vegetation of the soak during a detailed flora and vegetation survey of the Project (Woodman Environmental 2016), with a sampling quadrat established within the vegetation. The vegetation in the central part of the soak is considered to be a sparse to open tall to mid shrubland dominated by *Acacia bivenosa* and *Melaleuca glomerata* with isolated emergent trees of *Eucalyptus victrix*, over a sparse shrubland dominated by *Stemodia grossa*, over a mid hummock grassland dominated by *Triodia longiceps*, over a low sedgeland dominated by *Schoenus falcatus* and *Cyperus vaginatus* (Plate 2). On the periphery, where the soak vegetation grades into vegetation of the surrounding plains and hills, *Acacia pyrifolia* var. *pyrifolia* dominates the tall to mid shrubland stratum, *Stemodia grossa* forms a low open shrubland, and *Triodia wiseana* replaces *Triodia longiceps* (Plate 3). A total of 11 taxa were recorded within the quadrat; no significant taxa (as per EPA 2016) were recorded.

Floristic analysis of data from quadrats established within the Project Study Area resulted in the quadrat established in the soak being assigned to vegetation type (VT) 8. A generalised vegetation description of this VT is presented in Woodman Environmental (2016). Only 2

other quadrats in the Study Area were assigned to VT 8; as it was of restricted occurrence in the Study Area, and all occurrences were small, it was therefore considered to be significant vegetation (as per EPA 2016) in a local context. The majority of dominant species in this VT are considered to be fairly typical for drainage lines (excluding major rivers) and floodplains in the Study Area; their presence on a lower slope such as that at the soak is therefore considered somewhat unusual. The presence of *Schoenus falcatus* as a dominant species is also unusual in the context of the Study Area; this species was only recorded at one other location, within a permanent or semi-permanent pool in a rocky gorge (Woodman Environmental 2016), which is considered to be more typical habitat for this species (Western Australian Herbarium 1998-).

In a regional context, the quadrats that comprise VT 8 are similar to several quadrats established by Woodman Environmental in the wider region as part of surveys for Atlas Iron's proposed infrastructure corridors (Woodman Environmental 2014a, b). In particular, one quadrat also occurs on a lower slope and flat base of a rocky hill, and contains all the dominant species found in VT 8 at the soak (including *Schoenus falcatus*), together with several other species that typically occur in drainage lines (e.g. *Acacia ampliceps*, *Melaleuca bracteata*) (Woodman Environmental 2014a). This provides a strong indication that VT 8 is represented regionally, although further floristic analysis would be required to confirm this with greater certainty. However, potential regional occurrences of this VT are few in number, scattered in distribution, and small in extent. Therefore, VT 8 is potentially of some regional significance due to its restricted area of occupancy.

3.2. Dependence of Vegetation on Groundwater

Woodman Environmental (2016) identified that VT 8, including the vegetation of the soak, is potentially dependent on groundwater. This was based on the presence of two species considered to be facultative phreatophytes capable of accessing groundwater, being *Eucalyptus victrix* and *Melaleuca glomerata*; no other species found at the soak are considered to be either obligate or facultative phreatophytes capable of accessing groundwater. Although limited information is available on the water requirements of either species, *Eucalyptus victrix* is considered to be a facultative phreatophyte; it is known to occur at Pilbara sites with shallow groundwater (Loomes 2010a), however is also known to occur at sites where the groundwater table is much deeper (Loomes 2010b). It is also tolerant of long periods of drought (Loomes and Braimbridge 2010). *Melaleuca glomerata* is also likely to be a facultative phreatophyte; it is also known to occur at Pilbara sites with shallow groundwater (Loomes 2010a); however, field observations by Woodman Environmental have recorded this species widely in minor drainage lines, including within rocky ranges, indicating that it can also tolerate long periods of drought.

Given that the groundwater table at the soak is generally likely to be between 3 – 10 m below the surface based on available bore data, it is possible that the vegetation may be partially dependent on groundwater. *Eucalyptus victrix* is considered likely to be able to

access groundwater at these depths based on general morphology of root systems of similar Eucalypt species; the root system morphology of *Melaleuca glomerata* is unknown, however it may be able to access groundwater at these depths. However, it is considered more likely that these species are present at the soak because of the soil type and periodic saturation of the soil from rainfall and surface flows off the adjacent range, rather than proximity to groundwater and associated periodic discharge or subsurface saturation. The high clay content of the soils of the soak likely means water is retained in the soil profile for a significant period of time, providing a relatively stable source of moisture for these species.

The presence of the sedge species *Schoenus falcatus* and *Cyperus vaginatus* at the soak also indicates the presence of a long-term soil-stored moisture source; neither are large enough to produce root systems capable of accessing groundwater, however both are usually found in major creeklines where pools form after major flow events, or in rocky gorges where surface flows generated from infiltration through rock layers are permanent to semi-permanent (Western Australian Herbarium 1998-; Loomes 2010a; Woodman Environmental 2016).

4. Proposed Groundwater Abstraction

Atlas are proposing to abstract groundwater from the aquifer underlying the soak area. Stantec (2018) have modelled worst-case scenario life of mine (2190 days) drawdown in the soak area; the life of mine drawdown contours are shown on Figure 1. The estimated life of mine drawdown for the soak is approximately 3.43 metres. Model parameters, including abstraction rates, are presented in Stantec (2018).

5. Assessment of Potential Impacts of Drawdown on Vegetation of the Soak

Based on the composition of the vegetation, and the geomorphology, hydrology and soils of the soak, it is considered unlikely that proposed worst-case scenario drawdown will result in impacts to the vegetation of the soak. Only two species found at the soak are considered to have the capability to access groundwater at the depths present in the soak area; however, the geomorphology and soils of the soak suggest that it is more likely that these species are exploiting surface water stored within a clay soil layer. The clay layer may be periodically saturated by groundwater, however it is considered more likely that surface water flows contribute the majority of the water.

Although considered unlikely, there is the possibility that *Eucalyptus victrix* and *Melaleuca glomerata* may be accessing groundwater in the soak. However, knowledge of the distribution and habitat preferences of these taxa indicates that they are capable of

tolerating long periods of drought. It is expected that both species would be capable of tolerating a drop in groundwater levels such as that estimated, with natural surface water recharge of the clay soil profile likely enabling these species to obtain their water requirements.

There is the possibility that groundwater may have a greater role in saturating the clay soil layer of the soak. with further investigation is required to confirm this. However, the lack of observed surface discharge to date (Stantec 2018) indicates that groundwater may infrequently saturate the clay soil profile. As outlined above, it is expected that both species could likely obtain their water requirements from surface water saturation of the clay soil profile.

Under a worst-case scenario where *Eucalyptus victrix* and *Melaleuca glomerata* are accessing groundwater, and groundwater is primarily responsible for saturation of the clay layer, the proposed drawdown may result in the decline in health of these species, and potential loss of individuals in the longer term if significant natural recharge does not occur. Decline in health and potential loss of individuals of *Schoenus falcatus* and *Cyperus vaginatus*, which are reliant on a relatively stable source of moisture such as that present in the clay layer of the soak, may also occur.

However, it is considered that any such impacts are not likely to be significant in a local or regional context. None of the individual species that may potentially be impacted are significant; all are known to occur widely in the Study Area except *Schoenus falcatus*, which is currently known from a single other location. All are also known to occur widely within the Pilbara region. There are several other occurrences of VT 8 within the Study Area that will not be impacted by the proposed drawdown, as well as several occurrences of vegetation considered likely to be VT 8 in the wider region, including one that is very similar to the soak occurrence (Woodman Environmental 2016). It is considered likely that further occurrences will also be present in the wider region, little of which has been surveyed to date.

Potential impacts to the vegetation are likely to be restricted to a small number of species within a relatively restricted area; therefore, it is considered likely that in the event of impact being recorded, the soak area could be effectively remediated via the re-establishment of these species following the cessation of water abstraction.

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