# Hydrogeologic Desk Top Study

# Golden Lode Project

# Minstrel Resources Pty Ltd

SHS060-DTS-Doc714RevA

22/8/2025

This report has been completed for

Minstrel Resources Pty Ltd

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# 1. Introduction

## 1.1. Background

Minstrel Resources Pty Ltd (Minstrel) propose to develop the Golden Lode Project (Project). It is proposed that a pit be mined for the purpose of extracting gold ore. Resource drilling campaigns are ongoing. Minstrel are progressing pit and site optimisation studies, geotechnical, geochemical and hydrogeologic studies. Mining will occur along the Golden Lode shear. The pit and site design are being optimised. Minstrel are compiling the relevant technical reports to support a mining licence. GDS have been requested to provide a hydrogeologic desk top study of the report to support future regulatory requirements.

## 1.2. Scope of Work

Compile a hydrogeologic desk top study to summarise information in support of mining approvals.

## 1.3. Location

The Golden Lode Project (Project) is located 700 km northeast of Perth, 120 km northwest of Kalgoorlie and 50 km southwest of Menzies. The project is in the Ularring Mining District of the North Coolgardie Goldfield. Access to the Project is via the Coolgardie to Menzies Road. The location is shown in Figure 1.

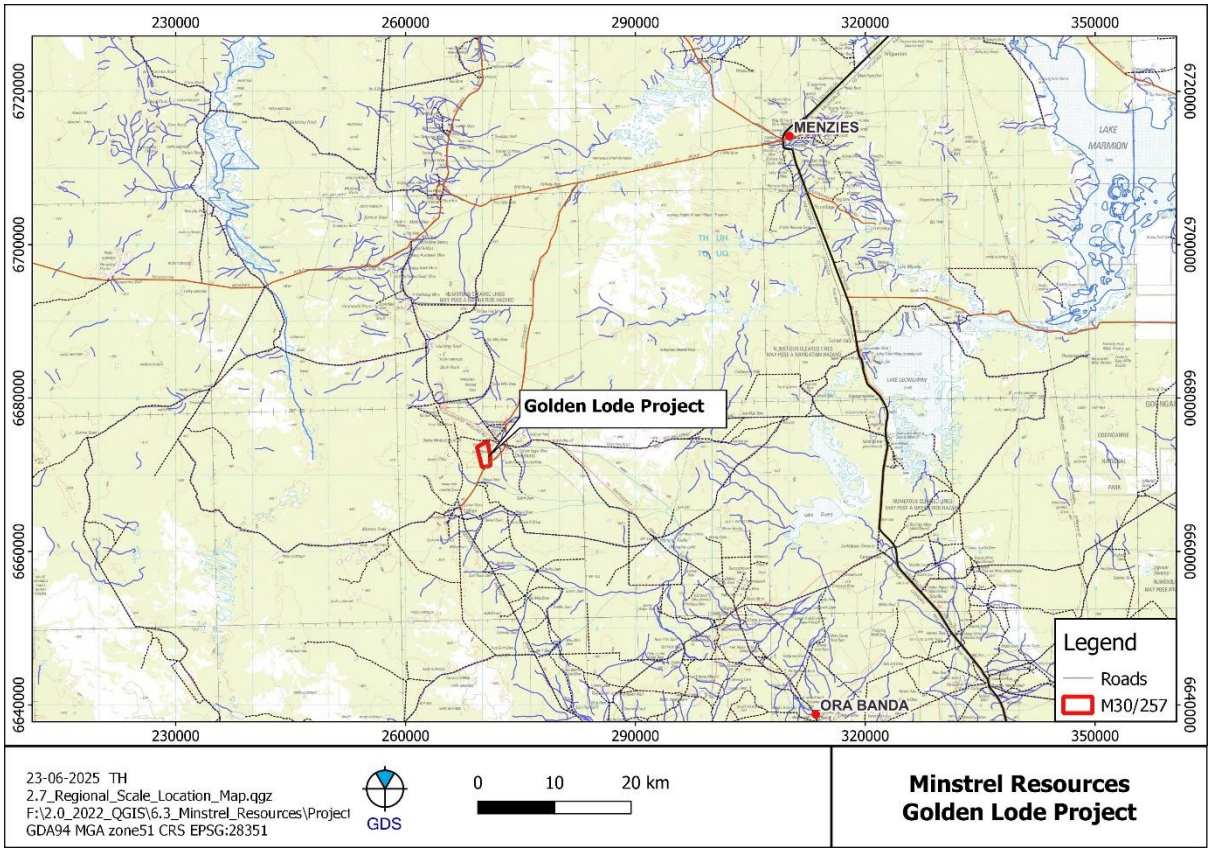



**Figure 1: Location Map**

### 1.4. Tenure

The Project currently comprises one mining tenement, M30/257, which is held by Minstrel Resources Pty Ltd. The location of the tenure is shown below in Figure 2.

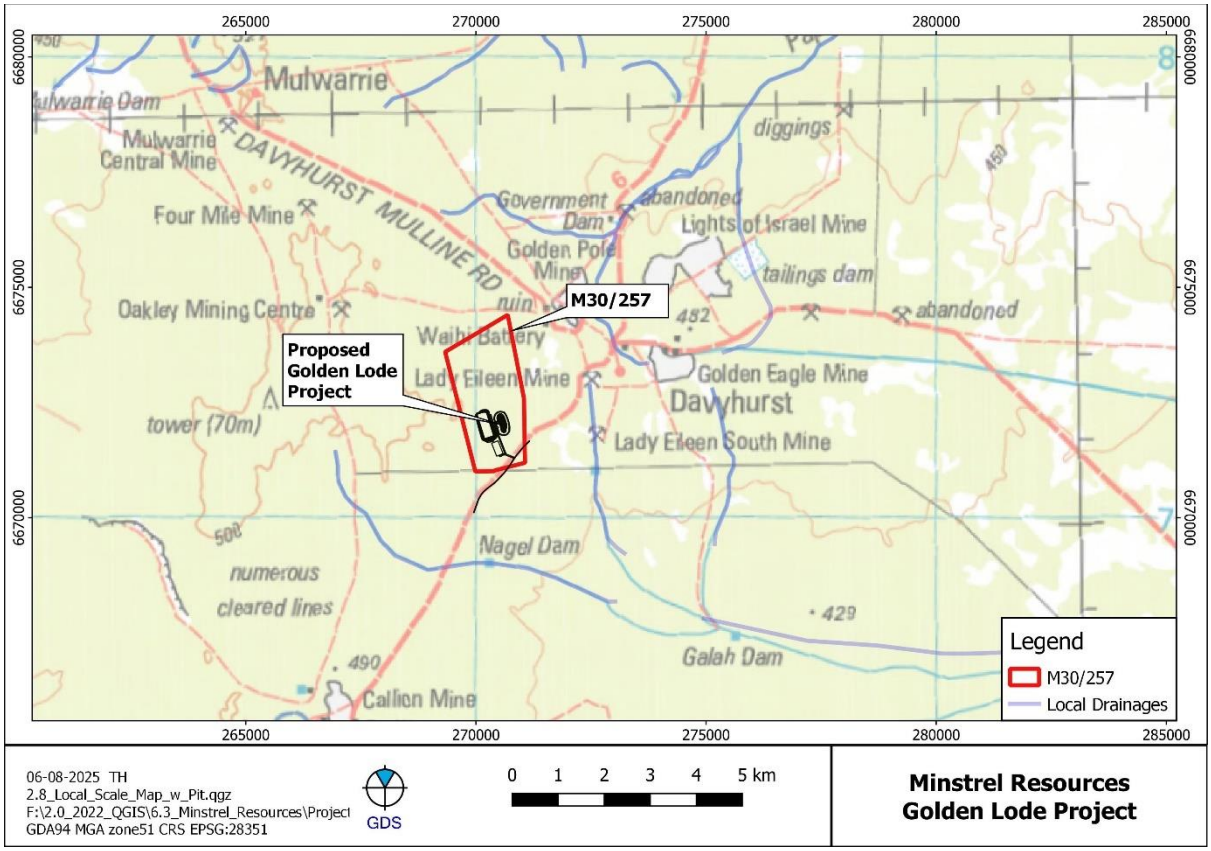



**Figure 2: Tenure**

### 1.5. Groundwater Areas and Sub Areas

The Project area lies within the Kalgoorlie (SH 51-9) 250,000 and the Davyhurst (3037) 100,000 geological map sheets. The Project is also located in the Kalgoorlie (51-9) 1:250,000 scale hydrogeologic map. The Project is in the Goldfields Groundwater Area and the Rebecca Groundwater Subarea as proclaimed in 1979 under the Rights in Water and Irrigation Act.

### 1.6. Current Licensing

There are currently no groundwater abstraction licences held by Minstrel Resources. The location and annual allocation of licensed groundwater users around the Project area are shown in Figure 3. The closest groundwater licence is GWL66199, which is owned by Carnegie Gold Pty Ltd. The draw points appear to be approximately 28 km to the South-East from the east boundary of M30/257.

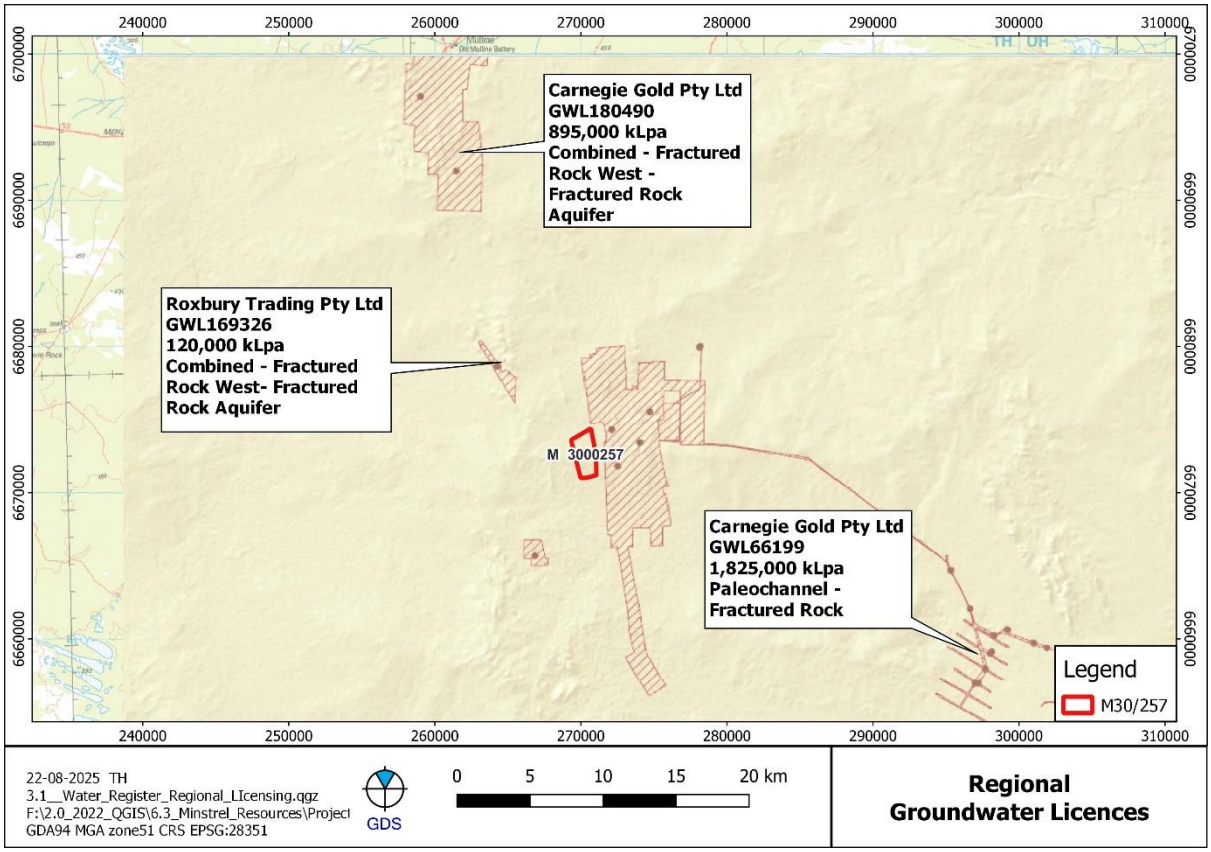



**Figure 3: Groundwater Licences**

## 1.7. Existing Bores

Figure 4 shows the location of regional bores within 10 km of the Golden Lode Project. Bores installed for the purpose of supporting mining operations are located to the north and south of the Project. Pastoral bores are located to the southwest. Mining bores located about 4 km to the north are generally shallow, low yielding and target fracture bedrock aquifers. Mining bores located 2 to 4 km to the south are shallow, low yielding and target paleochannel (calcrete) aquifers. Pastoral bores located about 7 km to the southwest are very shallow, very low yielding and are targeting alluvium and shallow fractured bedrock aquifers. There are no historic groundwater bores located on tenement M30/257.

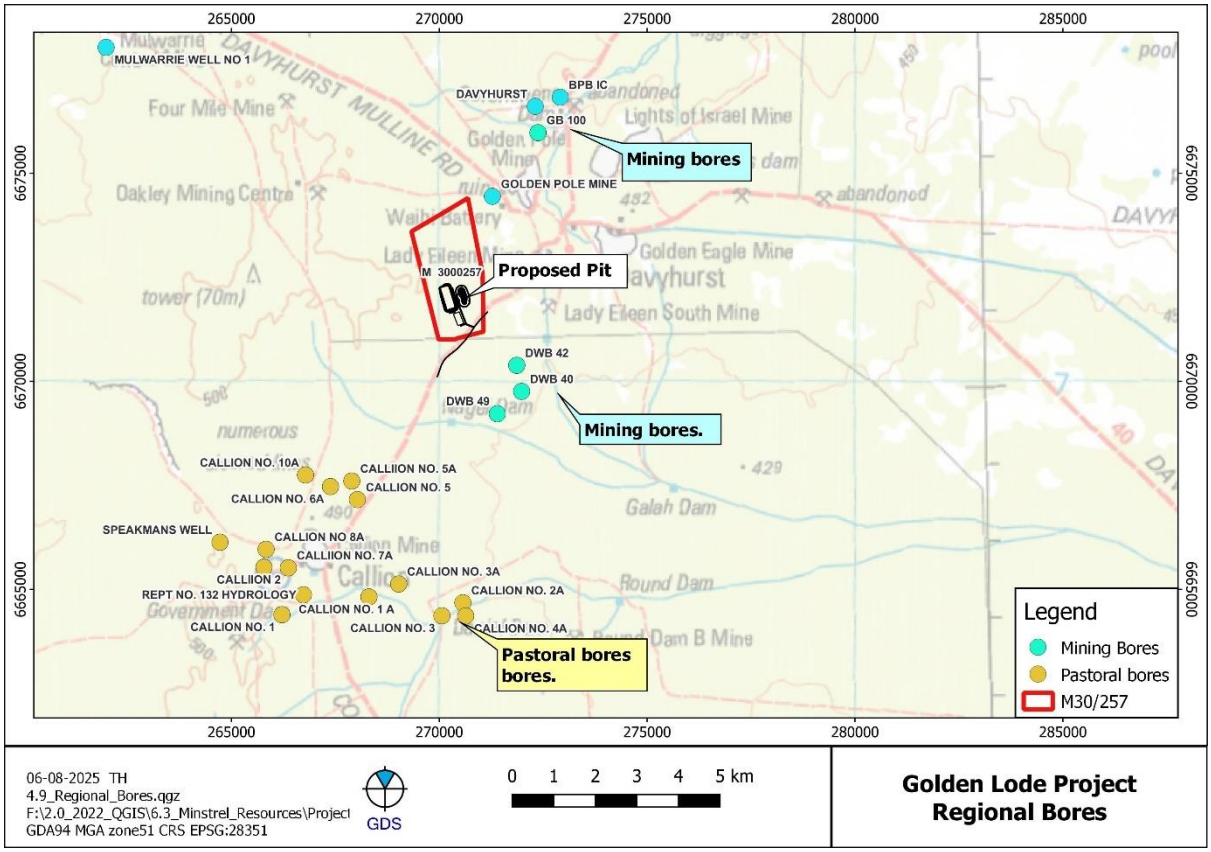



**Figure 4: Regional Bores**

## 1.8. Existing Groundwater Use

There are no known bores on site. Any water level information is anecdotal and based on observations made during resource drilling programs.

## 1.9. Proposed Groundwater Use

The primary use of water on site will be for the purpose of dust suppression. The potential for groundwater inflows into the pit are very low. Any inflows into the pit will be seepage. It is unlikely that dewatering bores will be required on site.

## 1.10. Location of Current and Proposed Activities

The site layout is shown below in Figure 5. The main activities on site will be the mining of the Golden Lode Pit and the establishment of a waste dump. Ore will be stockpiled on the Run of Mine (ROM). Each area will require a source of water for dust suppression.

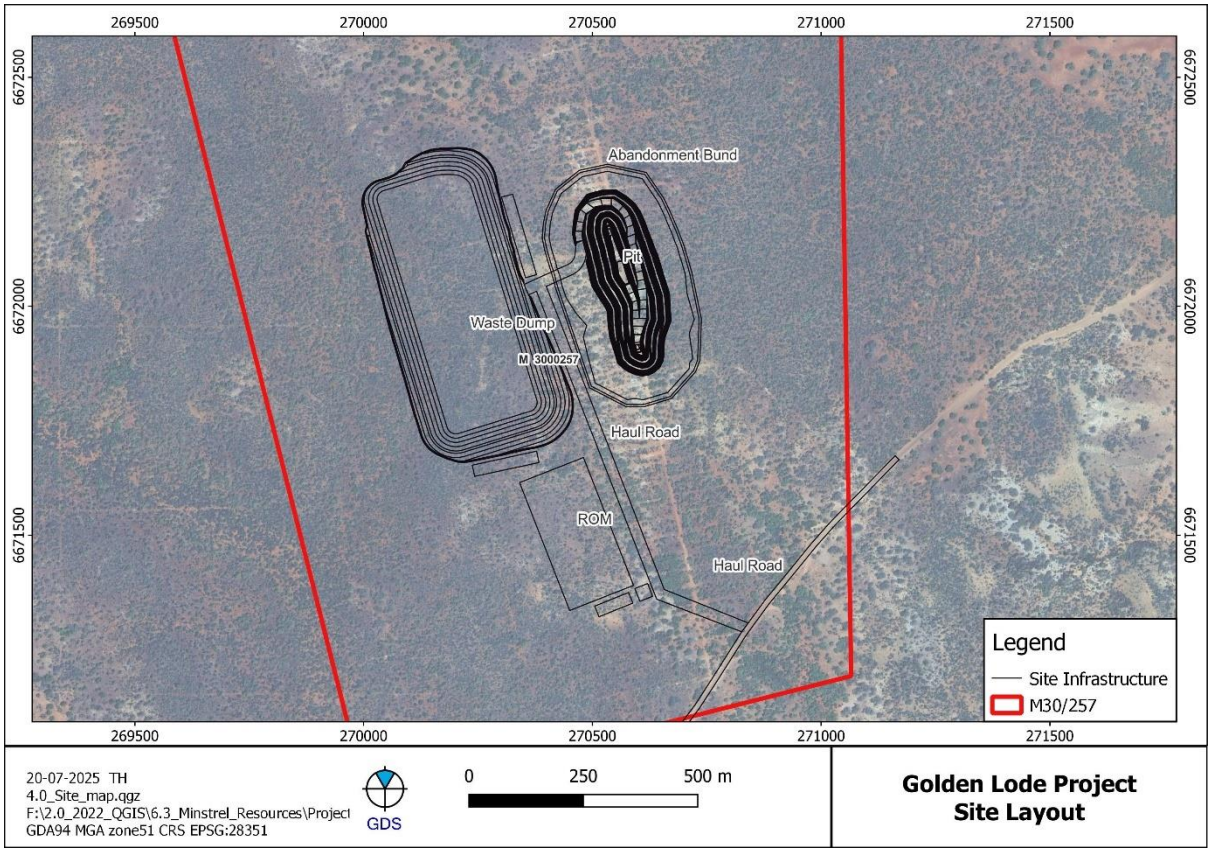



**Figure 5: Site Layout**

### 1.11. Historic Mining

The Golden Lode deposit is in the Davyhurst Gold District. Gold was first discovered in 1897. From the late 1800s to the early 1900s, the Golden Lode and Jack of Hearts mines were developed and produced low volume, very high-grade gold ore. Historic workings have been developed along the mineralised vein sets which resulted in the development of underground workings. It is estimated that approximately 108,000 ounces of gold were produced between 1897 and 1937. In recent years, the Golden Lode shear has had a few small underground mining campaigns. In the early 1990s, a shaft was sunk to 90 metres, and 12,000 tonnes of ore was mined (Dietman, 2024).

### 1.12. Historic Exploration

Modern mineral exploration commenced in the 1980s with several companies exploring around the historical underground workings. In 2002, a soil geochemistry survey was completed on previously untested areas surrounding the Golden Lode Mine. Exploration drilling campaigns were completed in the area at that time (Dietman, 2024).

The drilling targeted the continuation of the sediment/mafic contact that hosts the Golden Lode Mine. A second resource drilling program was completed in the area located north of the Golden Lode Project. The drilling tested the shallow (laterite) and bedrock anomalies identified in the previous exploration campaigns. The drilling tested the depth of mineralisation to a maximum of 285 metres below ground level (mbgl). The maximum depth of exploration holes was 315 mbgl (Dietman, 2024).

### 1.13. Recent Exploration

In 2022, exploration drilling was completed to further identify the controls of gold mineralisation at the Golden Lode Project. Significant mineralisation was intersected in several holes along the strike of the mineralising system. From the drilling results, a conceptual block model was produced to show the economic potential of the Prospect. The interpretation of the new model estimated 223 kilotonnes (kt) of ore with a grade of 4.5 g/t gold for a total of 32,000 ounces of gold (Dietman, 2024).

Over the past three years, Minstrel Resources has carried out approximately 13,000 metres of Reverse Circulation (RC) drilling. The deepest holes were 90 m in depth at a 60 degree angle (78 m vertical). No groundwater was encountered in any of these holes.

### 1.14. Recent Mining Studies

A review of the database and forward planning of the next RC drilling program was completed in Q1 of 2024. A Pit Optimisation Study was completed by Minecomp Pty Ltd in 2024. The pit, mine dump and site layout are being updated from more recent information as it becomes available. Drilling results have supported the creation of a more robust model of the Golden Lode Project. The model supports the ongoing optimisation of the pit shell and waste dump. Final optimisation and mine design are currently being conducted by Minecomp. Metallurgical and geochemical analysis of drilling samples are ongoing. Geotechnical and hydrogeological studies are currently underway. Resource and infill drilling are ongoing.

### 1.15. Proposed Mining

Minstrel Resources propose to develop the Golden Lode Project with open pit mining methods. It is estimated that approximately 74,322 tonnes of ore will be removed from the pit (Dietman, 2024). The maximum depth of the pit will be 66 mbgl. The proposed pit shell is shown below in Figure 6. A cross-section of the proposed design is shown below in Figure 7.

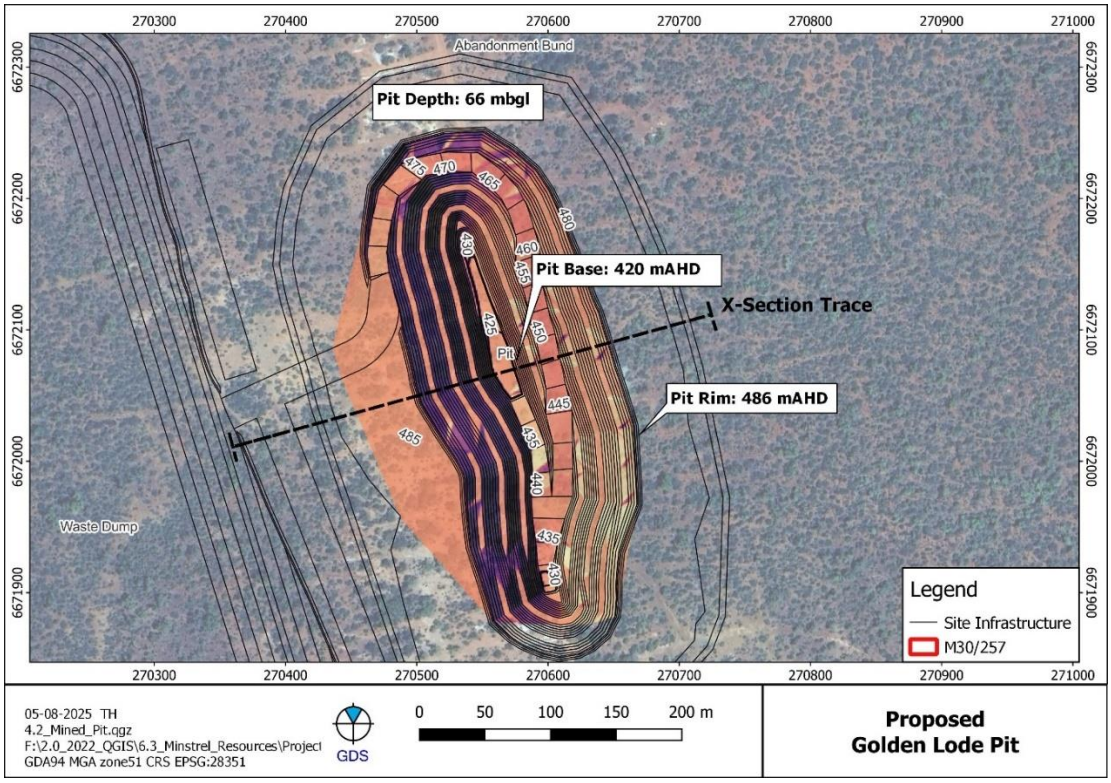



**Figure 6: Proposed Golden Lode Pit**

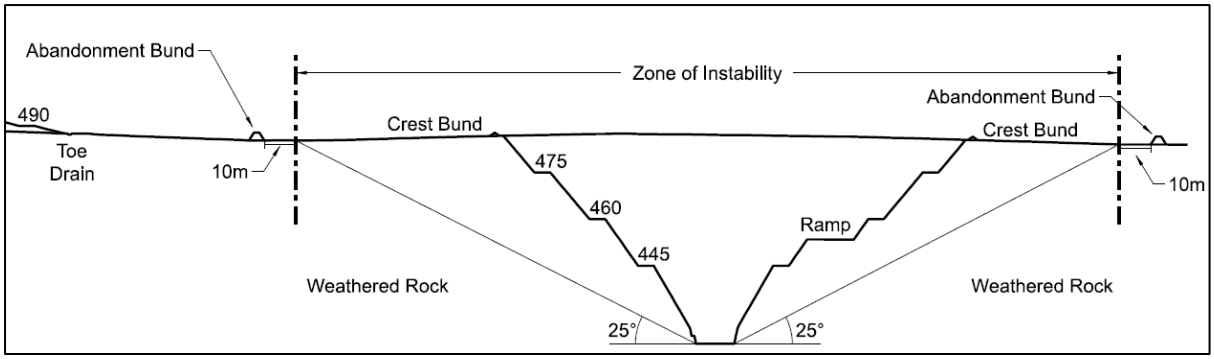



**Figure 7: Pit Cross-Section**

## 1.16. Climate

Climate information is taken from the Menzies (010252) BOM station. The climate in the project area is semi-arid. Temperature ranges are seasonal, with summer ranges 19.7 to 35.1° C, with maximum recorded temperatures of more than 40° C. In the winter, the temperatures range from 5.3 to 17.0° C. Mean rainfall is 249 mm. Higher rainfall events can occur in the summer months due to tropical cyclone activity in the northern part of the state. Evaporation rates are 2,700 mm per annum.

Table 1 represents the Menzies weather statistics for the period from 1893 to present (BOM, 2025a, 2025b).

**Table 1: Weather Statistics**

Site information

**Site name:** MENZIES
**Site number:** 012052
**Latitude:** 29.69 °S **Longitude:** 121.03 °E
**Elevation:** 426 m
**Commenced:** 1896 **Status:** Open
**Latest available data:** 17 Jan 2024

Additional information

Additional site information

Nearest alternative sites

1. 012046 LEONORA (93.7km)
2. 012241 LEONORA AERO (94.3km)
3. 012040 KANOWNA (114.1km)

View larger map

0 150 300 500 800m
Elevation - metres

View: Main statistics All available Period: Use all years of data Text size: Normal Large

| Statistics | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual | Years | | Plot | Map |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | | | | | | | | | | | | | | | | | |
| Mean maximum temperature (°C) | 35.1 | 33.9 | 31.1 | 26.2 | 21.3 | 17.7 | 17.0 | 19.0 | 23.1 | 26.8 | 30.7 | 34.0 | 26.3 | 93 | 1898 1996 | | |
| Mean minimum temperature (°C) | 19.7 | 19.4 | 17.2 | 13.4 | 9.3 | 6.7 | 5.3 | 6.1 | 8.6 | 11.7 | 15.5 | 18.2 | 12.6 | 94 | 1897 1996 | | |
| Rainfall | | | | | | | | | | | | | | | | | |
| Mean rainfall (mm) | 22.9 | 32.0 | 26.5 | 21.3 | 24.9 | 27.4 | 22.3 | 19.5 | 10.5 | 11.2 | 14.7 | 15.1 | 249.0 | 119 | 1896 2024 | | |
| Decile 5 (median) rainfall (mm) | 8.6 | 10.2 | 15.0 | 11.4 | 18.6 | 21.1 | 18.4 | 14.8 | 6.0 | 5.6 | 9.8 | 8.7 | | 122 | n/a n/a | | |
| Mean number of days of rain ≥ 1 mm | 2.1 | 2.4 | 2.8 | 2.5 | 3.2 | 3.9 | 3.9 | 3.4 | 2.0 | 1.8 | 2.2 | 2.1 | 32.3 | 110 | 1898 2024 | | |

## 1.17. Physiography

The area is gently undulating with elevations of about 490 metres Above Height Datum (mAHD) in the project area. The terrain dips gently from the west to the east. The hills located about 4 km west of the project are at elevations of 510 mAHD. The terrain drops gradually across the project area to an elevation of about 470 mAHD. Surface drainage is away from the project area in a generally east to south eastern direction.

### 1.18. Location of GDEs

There are no known Groundwater Dependent Ecosystems (GDEs) in the project area.

## 2. Geology

### 2.1. Regional Geology

The Golden Lode Project is located within the Kalgoorlie Terrane of the Norseman-Wiluna Greenstone Belt. It is located approximately 1.4 km west of the Mt Ida Lineament which separates the Kalgoorlie and Southern Cross Terranes. It also lies 10 – 20 km north of the confluence of major structures with the Mt Ida Fault. Regional metamorphic grade is upper greenschist (Dietman, 2024). The regional geology is shown below in Figure 8.

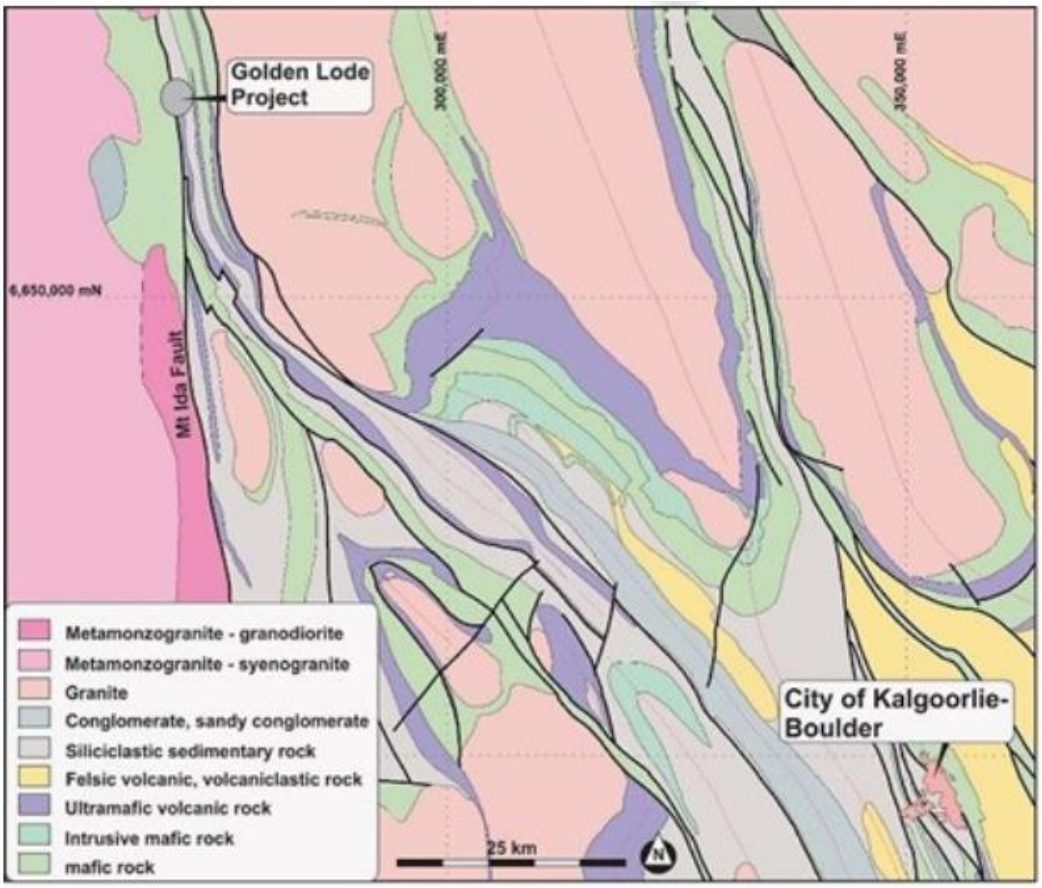



**Figure 8: Golden Lode Regional Geology (After Dietman, 2024)**

### 2.2. Local Geology

A well-defined vertical to steeply west dipping lithological contact extends north through the Golden Lode Project area. To the west is a sequence of metasediments; to the east mafic to ultramafic schists. The bedrock lithology is obscured beneath a thin but extensive cover of lateritic soil. The Golden Lode Project is located on a major shear, which is to the east of the geological contact. The western area's rocks are deemed lower gold prospectivity than the eastern shears and rocks, which hosts the main lodes in the region. The 'Golden Lode Fault' intersects the eastern rocks and has significant mineralisation. A second north east trending structure is speculated at the northern end of the tenements supported by geochemistry (Dietman, 2024).

## 3. Baseline Surface Water Information

While GDS is a groundwater specialist, the surface water assessment is best addressed by a suitably qualified surface water engineer. Baseline surface water information is presented as it has relevance to aquifer recharge. A broad scale assessment has been made of ecological values associated with surface water features.

The project lies within the Salt Lake Basin, and within the Raeside-Ponton Catchment. The catchment area is approximately 10,428 square kilometres. The project area and catchment are shown below in Figure 9.

There is a lack of drainages to the west of the project area. To the east, there are small, discontinuous drainages which are ephemeral. The project receives minimal rainfall recharge. The development of groundwater from any fractured rock aquifers will be challenging. Alternatively, the low prospective yields imply that mine dewatering will be minimal. Any pit inflows, should they occur, can be addressed with in-pit sumps. Any excess water can be used for dust suppression purposes. It is assumed that excess water will be minimal.

Surface water features will be dry during the summer months. Surface flows would occur only when rainfall is of sufficient duration and intensity to exceed soil moisture deficit. Groundwater connectivity between the proposed pit development and the regional surface water features is negligible.

As the surface water in this area is associated with saline lakes, it will be brackish to saline. Environmental values may be associated with vegetation which thrives in saline wetlands. Lake Ballard is located 60 km north of the project. Lake Goongarri is located 50 km east of the project. There are no beneficial uses associated with the surface water features, other than supporting flora or fauna which thrive in a saline environment. There are no threatened plant communities, RAMSAR Wetlands or mapped ecologically sensitive surface water features within 20 km of the project. The project area is located on a topographic rise and is not in an area prone to flooding. It is unlikely that the development of the pit will impact on surface water quality or drainage channels.

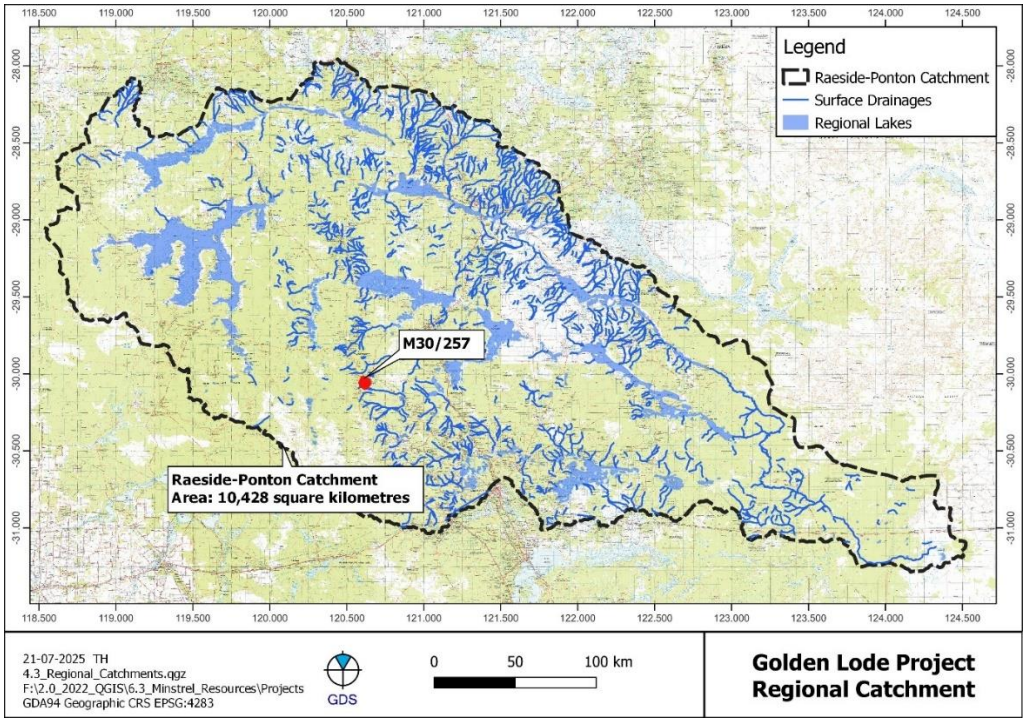



**Figure 9: Catchments**

# 4. Hydrogeology

## 4.1. Regional

The regional hydrogeology has been mapped at a scale of 1:250,000 (Kern, 1994). The project lies on a regional shear zone which may be a prospective aquifer in the immediate area. The shear is a north to south trending regional fault which has been identified to the west of the Project (Dietman, 2024). Figure 10 shows regional fault systems that were mapped at a broad scale in 1994.

If surface runoff was frequent in the area, a shear might be highly prospective. The drainage lines shown in Figure 10 indicate that the project area has minimal surface drainages. The shear in this location has low to moderate water prospectivity.

The area surrounding the shear zone(s) is predominantly bedrock which is a regional fractured bedrock aquifer. These aquifers are prone to dewatering. The success of drilling and intersecting a water bearing fracture is challenging. The area immediately around tenement M30/257 has very low recharge potential. Due to the low recharge across tenement M30/257, it is assumed that the potential of good groundwater flows in the fractured rock would be negligible to low.

Figure 10 shows a regionally mapped paleochannel aquifer. The headwaters of the paleochannel are about 4 km southeast of M30/257. Sourcing groundwater from the paleochannel would require the laying of 3 to 4 km of pipe. It would be necessary to apply for a Miscellaneous licence across the tenements of other tenement holders.

Paleochannel aquifers are known to have significant potential (e.g. >20 lps). This is commonly the case when the paleochannel has sufficient thickness (e.g. > 150 metres). Alternatively, the calcretes along the periphery of the paleochannels are often targeted for groundwater supply. The calcretes can be good producers, but due to the lack of thickness, they tend to dewater with time.

Bores constructed in the main portion of the paleochannel aquifer tend to be saline to hypersaline. This also applies to the calcrete aquifers. If there are surface drainage channels within the immediate area of the bore, there is the potential for the calcrete aquifer to freshen up on a seasonal basis. Water quality may range from brackish to saline.

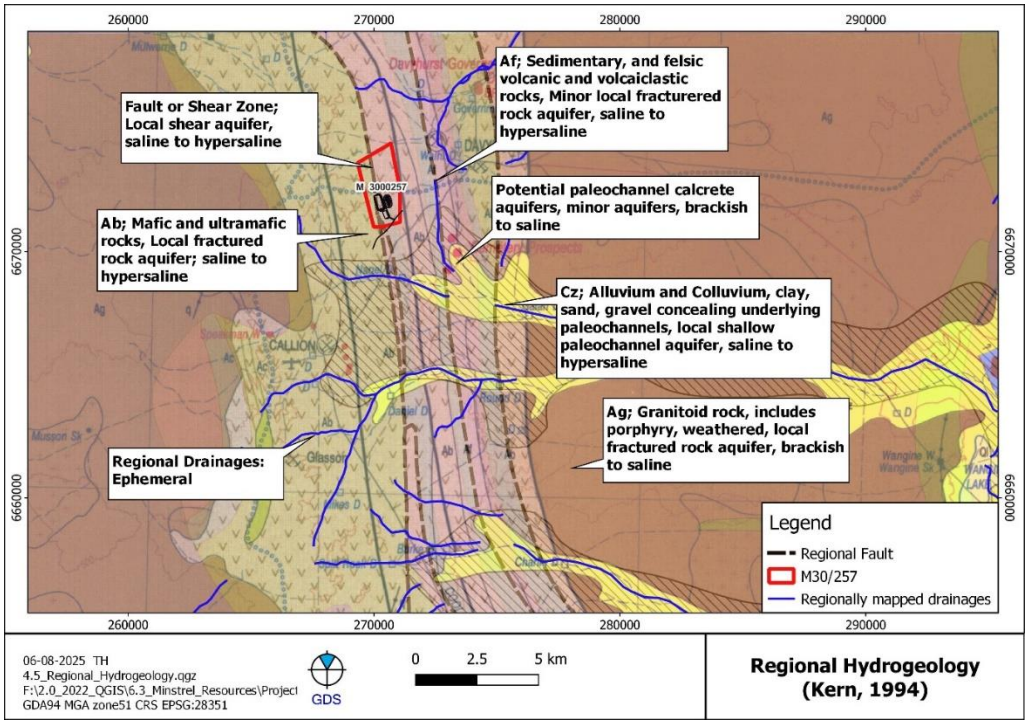



**Figure 10: Regional Hydrogeology**

### 4.2. Local Hydrogeology

In Figure 11, the regionally mapped shear is located along the western edge of the proposed waste dump. Running through the centre of the proposed Golden Lode Pit is a contact between mafic volcanics and metasedimentary rocks. The local hydrogeology of the pit is a fracture rock aquifer. The water prospectivity is expected to be very low due to the lack of local rainfall runoff and low aquifer recharge potential.

Establishing a groundwater supply within the boundary of M30/257 would be challenging. The most prospective area to drill would be on the north to south trending regional shear west of the proposed pit area.

The proposed pit will be mined to a maximum depth of 66 mbgl, but the occurrence of groundwater in resource holes has been reported to be at a vertical depth of 78 mbgl. It is assumed that groundwater flows into the pit will be negligible.

The paleochannel located 4 km to the south has groundwater prospectivity. The calcretes which may form along the edge of the paleochannel, combined with surface flow channels, may be the most prospective groundwater targets in the local area.

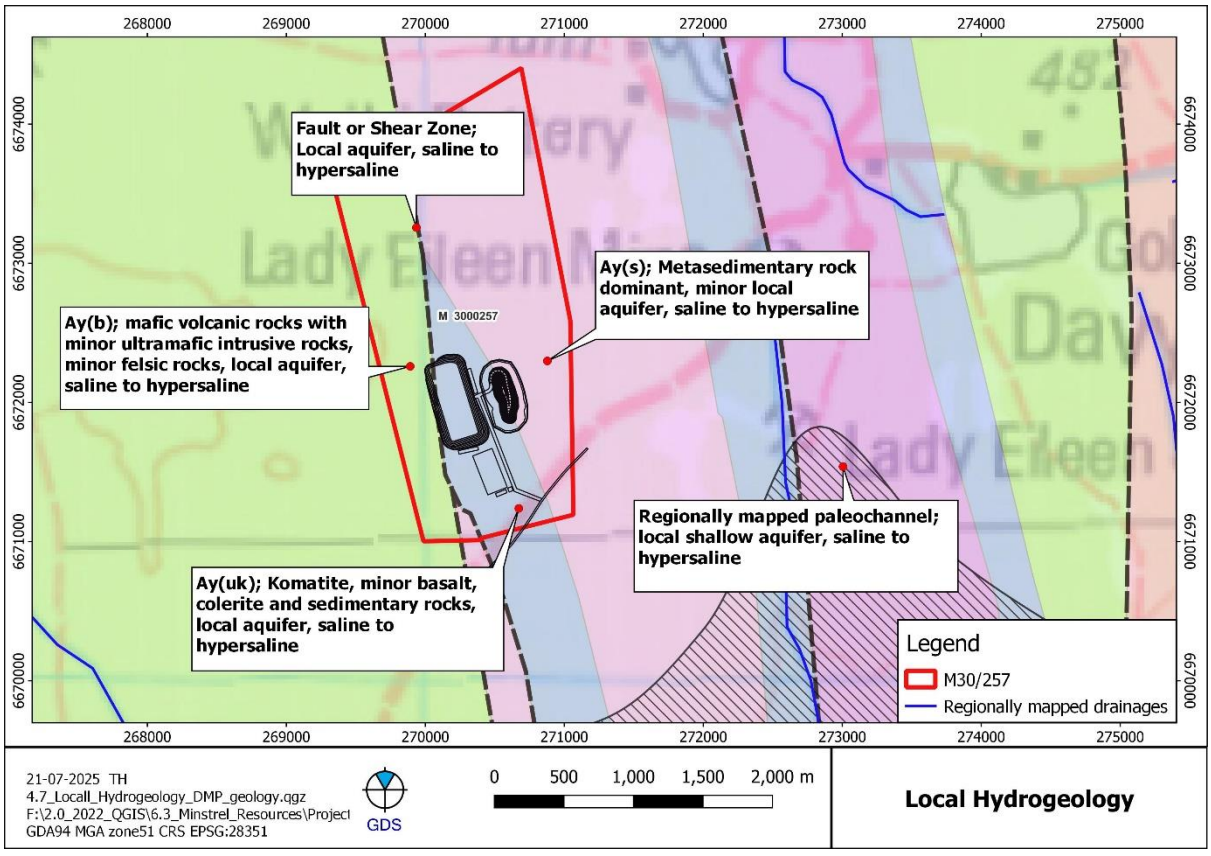



**Figure 11: Local Hydrogeology**

## 5. Aquifer Characteristics

### 5.1. Aquifer Types

Aquifers within the boundary of M30/257 are:

- Fractured rock aquifers
- Shear zones

Additional aquifers outside the boundary of the project are located 2 to 4 km to the south, which are:

- Calcrete aquifer
- Paleochannel aquifer

### 5.2. Aquifer Extents / Size

Fractured rock aquifers are ubiquitous across the area. Aquifer properties vary perpendicular to and along the strike of regional structures and contacts. It is assumed that groundwater flows would be higher along structures or strike of the formations. Groundwater flows would be reduced perpendicular to the strike of the regional structures and lithologic contacts.

### 5.3. Supply Prospectivity

Due to the lack of structure and recharge, it would be challenging to establish a viable supply with high groundwater flows.

### 5.4. Local Groundwater Levels

Resource drilling was completed by Minstrel Resources at an incline of 60 degrees. The calculated maximum depth of drilling was 78 mbgl. No groundwater was encountered in any of these holes. Minstrel Resources have dipped several of the historical, vertical diamond holes with no groundwater encountered to a depth of 75 mbgl. In the early 1990s, a shaft was sunk to a depth of 90 mbgl. A recent survey of the shaft by Minstrel Resources concluded that the shaft is dry. Local groundwater depth across the Golden Lode Project is assumed to be more than 78 mbgl. The maximum depth of pit development is 66 mbgl.

### 5.5. Regional Groundwater Levels

Historic bores located 4 km north of the Golden Lode project were drilled to maximum recorded depths of 92 mbgl. Recorded water levels are 29 mbgl. The bores targeted fractured rock aquifers and were drilled near a creek drainage.

Historic bores located 2 km south of the Golden Lode Project were drilled to maximum depths of 90 mbgl. Depths to water have been recorded to be 36 mbgl. The bores targeted calcrete aquifers and were drilled near a creek drainage.

There are no creek drainages on M30/257 as it is on a topographic high. Resource drilling has indicated that water levels in tenement M30/357 are at depths more than 78 metres.

### 5.6. Water Quality

Bores located 4 km northeast of the Golden Lode deposit have salinities that range from 20,000 to 42,000 mg/L. Bores located 2 km south of the Golden Lode Project have reported salinities that range from 38,000 to 45,000 mg/L. There are no historic bores reported on mining tenement M30/257. It is assumed that any bores which intersect water bearing fractures would have similar salinities to the regional bores.

### 5.7. Acid Forming Minerals

There is no information available about Potentially Acid Forming (PAF) minerals in the lithologies to be mined. Minstrel Resources are currently carrying out geotechnical and geochemical studies. If

PAF minerals are identified in the waste rock, then a post life of mine water quality plan will be required.

### 5.8. Flow Direction

Groundwater flows generally follow the topographic surface. The local direction of groundwater flow from the Golden Lode deposit is radially away from the area due to the topographic rise. Regionally, groundwater flows are generally to the east and south east.

### 5.9. Aquifer Parameters

There is no record of aquifer parameters for any of the regional bores. Given that the aquifer below M30/257 is a local fractured rock aquifer, it is assumed that the transmissivity and storage coefficients would be very low. This is consistent with other fractured rock aquifers in the Gold Fields. If bores intersect the regional north to south trending shear, it is assumed that transmissivity and storage coefficients will be higher.

### 5.10. Hydraulic Gradient

The local hydraulic gradient would generally follow the topographic surface. The regional topographic gradient is very shallow and drops to the east and south east. The topographic gradient is approximately 0.005.

### 5.11. Recharge Zones

Tenement M30/257 is on a topographic high and the direction of any surface runoff during rain events would be away from the deposit. There are no mapped stream drainages within the local area. All stream drainages outside of the area flow away from the deposit. It is assumed that recharge to the local fractured rock aquifers is extremely low. There are no active recharge zones associated with M30/257 other than what little surface runoff may seem downward during rain events.

### 5.12. Discharge Zones

Any groundwater present beneath tenement M30/257 would discharge away from the area. Locally, the direction of discharge would be radially away from the site. On a regional scale, discharge would be to the east into regional topographic lows, such as salt lakes.

### 5.13. Aquifer Interconnectivity

The local aquifer is fractured bedrock. There are three different bedrock lithologic units beneath M30/257 which strike north to south. The regional fault that runs through the tenement trends north to south. The hydraulic connectivity between different lithologies, from east to west, would be severely limited. Aquifer connectivity along strike or along the regional fault structure (north to south) would be much higher. Connectivity between the ore body and the local aquifer is restricted to minor fractures. The ore body is above the water table, so there is no hydraulic connectivity between them. There are no other aquifers above or below the fractured rock aquifer. The depth to the water table is about 78 mbgl and connectivity of the groundwater with any surface water in the area is negligible.

### 5.14. Water Supply Potential

Water supply potential on tenement M30/257 is limited. It would be very difficult to prove a sustainable water supply in the fractured rock aquifer which dominates the local area. Better prospectivity is assumed to be the north to south trending fault structure. Given the low recharge in the Project area, it is assumed that any groundwater supply would be prone to dewatering. Better groundwater potential exists in the paleochannel located about 2 to 4 km to the south.

### 5.15. Bore Yield Potential

Bores located 4 km to the northeast of the Golden Lode deposit have reported groundwater yields of 19 to 140 $m^3$/day (0.2 to 1.6 lps). These bores are drilled in fractured rock aquifers. Bores located 2 km to the south have reported groundwater yields of 85 to 289 $m^3$/day (1.0 to 3.3 lps). These bores have been drilled on the edge of the paleochannel. It is assumed that the drilling targeted calcrete aquifers.

It is assumed that any water exploration within tenement M30/257 would have limited success. Any yields encountered in the fractured rock aquifer would be very low and prone to dewatering. Any water bearing zone encountered in the north to south trending shear would have better yields (e.g. 2 to 3 lps) but would also be prone to dewatering.

### 5.16. Environmental Values

#### 5.16.1. Groundwater Dependent Ecosystems (GDEs)

There are no known GDEs in the local area within or around tenement M30/257. If a GDE did exist, the potential impacts would be negligible. The known depth of the local aquifer standing water level is about 78 mbgl. GDEs typically access groundwater to a maximum depth of about 20 mbgl.

#### 5.16.2. Stygofauna

Stygofauna may be present in water bearing fractures. The probability of intersecting a water bearing fracture in the fractured bedrock aquifer would be very low. There could be stygofauna in the regional shear, if saturated. The pit will be developed to a depth of 66 metres. The local water table is reported to be at least 78 mbgl. The proposed pit is above the water table. The presence of stygofauna being affected by development of the Golden Lode Project is unlikely.

### 5.17. Beneficial Uses

The local groundwater quality has been reported to be brackish to saline. The only beneficial use for groundwater encountered on tenement M30/257 would be for industrial and mining purposes only.

### 5.18. Water Management Areas

There are no water management areas near the project area. The nearest water management area is the Menzies Groundwater Protection Zone associated with the Menzies municipal borefield. The water management area is located 60 km from tenement M30/257. There will be no impact to any groundwater management areas.

## 6. Pit Dewatering requirements

The depth of the proposed pit is 66 mbgl. The depth to water in the local area is reported to be greater than 78 mbgl. The area is on a topographic rise and aquifer recharge is minimal. The aquifer type is

fractured rock aquifer. It is unlikely that dewatering of the pit will be required. If there is any seepage into the pit from the wall rock, the inflows can be controlled with in-pit sumps.

## 7. Disposal Requirements

An excess of water is not expected; there is no requirement to dispose of water.

## 8. Potential Impacts

### 8.1. Environment

The known water table depth is below the base of the proposed pit. Drawdown of the local aquifer during development of the pit is expected to be negligible.

### 8.2. GDEs

There are no known GDEs in the area. Impacts to GDEs will be negligible.

### 8.3. Stygofauna

The base of the pit is above the local water table. The presence of water bearing fractures is unlikely. Impacts to stygofauna will be negligible.

### 8.4. Other Users

The nearest other groundwater user is located more than 2 km to the east. There will be negligible drawdown to the local aquifer during pit development. Impacts to other users will be negligible.

### 8.5. Groundwater Management Areas Relative to the Operation

The nearest groundwater management area is in Menzies, 60 km from the project area. Impacts to groundwater management areas is negligible.

### 8.6. Aquifer

Dewatering bores will not be required during mining. It is expected that drawdown effects to the local aquifer will be negligible. Water quality in the local aquifer is brackish to saline. The impacts to the local aquifer are negligible.

### 8.7. Surface Flows

It is not expected that the development of the pit will impact on surface flows in the area. The project is on a topographic rise. Surface flows are away from the project area. The post mining pit void will be bunded. Potential impact to surface water is negligible.

### 8.8. Borefields

The nearest borefield is more than 2 km from the project. Impacts to nearby borefields are negligible.

### 8.9. Potential Chemical Contaminants

The deposit will be mined with standard open pit mining methods and the ore treated at a third-party mill. There is no plan to construct a processing plant (mill), nor is there a requirement to

construct a Tailings Storage Facility (TSF). Any potential contaminants are most likely associated with the storage of diesel, which will be managed using containment bunds. This type of potential impact would also come under the control of the environmental management plan. The potential impact from chemical contaminants is negligible.

## 9. Post Life of Mine Pit Lake Recovery

After completion of mining, groundwater inflows from the wall rock are expected to be negligible. Surface flows into the pit will be negligible due to the establishment of protective bunds. Average annual rainfall is about 249 mm. Average annual evaporation is about 2,700 mm. Any rainfall that collects in the base of the pit is minimised due to evaporation. If water in the base of the pit does collect, it is expected to be fresh to brackish. The local groundwater quality is brackish to saline. Any impacts to the aquifer due to the final state of (potential) pit lake development is expected to be negligible. There is no justification to conduct pit lake modelling for the proposed development.

## 10. Groundwater Licence: Approvals / Regulatory Pathway

### 10.1. 5C Licence to Abstract Groundwater / Surface Water

It is not expected that dewatering bores will be required. If a groundwater supply is developed to meet dust suppression requirements, it will be necessary to apply for a licence to abstract groundwater.

### 10.2. H1, H2 and H3 Level Hydrogeologic Reporting

Given the quality of groundwater and low volumes expected, it is assumed that the Department of Water and Environmental Regulation (DWER) will require only a desk top study in support of groundwater licensing. This level of reporting is referred to as an H1 report by the DWER. The decision-making table in the DWER reporting guidelines will indicate what level of hydrogeologic reporting may be required by the DWER (Department of Water, 2009).

### 10.3. Site Water Operating Procedure (SWOP)

Given the lack of dewatering requirements, quality of groundwater and low volumes expected to be required for dust suppression (e.g. 5 lps or 432 kL/day) it is unlikely that the DWER will require the authoring of an operating procedure. The DWER provide guidelines should an operating procedure be required in the future (Department of Water, 2011).

### 10.4. Annual Groundwater Monitoring Summary

If a groundwater licence is granted, the DWER will advise about the level of annual reporting. For very small volumes of abstraction (e.g. < 50,000 kL per year) the DWER often require only the reporting of monthly meter readings at the end of the water year. It seems unlikely that the DWER will require an annual monitoring summary.

### 10.5. Triennial Groundwater Monitoring Review

As per the above, annual or triennial monitoring reports may be unlikely, but the DWER will advise and list any reporting on the licence as a condition.

## 11. Mining Licence: Approvals / Regulatory Pathway

### 11.1. Prescribed Premises – Pit to Pit Water Storage

If excess dewatering volumes were expected, then one method of disposal is to store water in a nearby pit. The licensing of this type of disposal comes under the 'prescribed premises' guidelines of the Department of Mines, Industry Regulation and Safety (DMIRS). The requirement to store excess water into another pit is unlikely.

### 11.2. Prescribed Premises – Tailings Storage Facility (TSF) Construction and Operation

Minstrel Resources will be sending the ore to a third-party mill for treatment. There is no requirement to construct a TSF. The prescribed premises permit is not required.

### 11.3. Stygofauna Studies

It is unlikely that the regulators will request stygofauna studies due to the aquifer type, water quality and depth of the local standing water level. Also, the depth of the pit will be about 66 mbgl. The current estimate of the local standing water level is about 78 mbgl. The fractures in the rock wall material around the pit shell are most likely dry.

### 11.4. Mine Closure and Acid Mine Drainage

Minstrel Resources are conducting chemical analysis of the pit wall rock to determine if Potentially Acid Forming (PAF) minerals are present. If they are present, then the environmental consultant needs to prepare a post life of mine acid mine drainage plan. This is the extent to which the issue of mine closure and acid mine drainage is addressed in hydrogeologic reporting.

### 11.5. TSF Seepage Modelling Report

Seepage modelling is not required as a TSF is not proposed.

### 11.6. End of Life of Mine (LOM) Pit Lake Status

As stated above, the formation of a pit lake is unlikely. Should rainfall collect, the lake at the base of the pit may become brackish. The surrounding aquifer water quality is brackish to saline. Potential impacts from a post mining pit lake to the surrounding aquifer is unlikely.

## 12. Recommended monitoring

The proposed pit depth is 66 mbgl. The reported depth to groundwater, according to observations made during resource drilling, is 78 mbgl. The pit base is above the local water level.

Dewatering of the pit with ex-pit dewatering bores is not necessary. Any seepage which may flow in from the pit walls can be managed with in-pit sumps. Any seepage into the pit would be minimal.

It is unlikely that the DWER will require groundwater monitoring as part of the approval process. If they do require a monitoring program, then existing resource holes can be repurposed as monitoring bores. If the hole is angled, it is recommended that a length of 1 or 2-inch PVC tube be inserted in the resource hole. Otherwise, it will be difficult to run a dipper down a rough surface borehole incline. If a vertical resource hole is used, it may not be necessary to install PVC tube. Gravel pack is not required.

If a bore is drilled for the purpose of providing dust suppression water, it will need to be licensed. As a minimum, the DWER will require that monthly meter readings be recorded. The groundwater licence document will list monitoring requirements.

If the DMIRS requires water quality sampling from a resource hole, then the following parameters are considered standard for this purpose:

> *TDS, conductivity, pH, Aluminium, Arsenic, Cadmium, Chromium, Iron, Mercury, Potassium, Magnesium, Manganese, Sodium, Nickel, Lead, Selenium, Zinc, Chloride, Sulphate, Reactive Silica, Filterable Reactive Phosphorus, Ammonia-N, Nitrate-N, Ferrous Iron, Alkalinity, Bicarbonate Carbonate, Hardness.*

## 13. Conclusions

- Dewatering bores will not be necessary.
- Any pit wall inflows during mining can be controlled with in-pit sumps.
- The available information implies that the pit base may be above the local groundwater surface.
- Excess water for disposal is unlikely.
- If a pit lake forms post mining, it will not impact on the environment, the aquifer or other users.
- Drawdown of the local aquifer due to mining of the pit is unlikely.
- Drawdown impacts to the environment, the aquifer and other users is unlikely.
- Developing a small groundwater supply on M30/257 will be challenging. If a water supply is required for the purpose of dust suppression, the only viable option is the paleochannel calcretes located 2 to 4 km south of the project area.

## 14. Recommendations

- Consider establishment of a groundwater supply to meet dust suppression requirements.
- An application for 50,000 kL of groundwater (or less) will expedite licensing and reduce regulatory reporting.
- Repurpose existing resource holes as monitoring bores to gain a more accurate estimate of the depth to groundwater.

## 15. References

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