# Appendix 1
# GCE (Ground Control Engineering) (2015); *Hera Mine Northern Pod Subsidence Assessment*

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February 24th 2016

Attn: Dean Fredericksen
Aurelia Metals Ltd
PO Box 7058
Orange NSW 2800

Dear Dean Fredericksen,

**RE: HERA MINE NORTHERN POD SUBSIDENCE ASSESSMENT**

Please find attached the final report of GCE's geotechnical subsidence assessment for the Northern Pod mining area crown at Aurelia Metals Ltd's Hera Mine.

We trust that this report meets your requirements. Should you require further clarification, please do not hesitate to contact the undersigned.

Yours sincerely,

**GROUND CONTROL ENGINEERING PTY LTD**

**David Dickson**

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# HERA MINE

# NORTHERN POD SUBSIDENCE ASSESSMENT

FOR

# AURELIA METALS LTD

| Date | Version | Description | Prepared by: |
|---|---|---|---|
| February 2015 | V02 | G0099_AA_RE01_V02 | David Dickson |

**AURELIA METALS LTD. HERA MINE NORTHERN POD SUBSIDENCE REVIEW**

## EXECUTIVE SUMMARY

Ground Control Engineering Pty Ltd (GCE) has conducted a subsidence assessment of the proposed Northern Pod mining area at the Hera Mine.

This geotechnical assessment is based on core recovered from resource diamond drilling programmes intersecting the upper portion of the Northern Pod orebody and the lower crown area. Data logging has been undertaken by Aurelia Metals Ltd personnel.

The results of this assessment indicate the likelihood of surface subsidence associated with the proposed mining plan is very low. Should poorer conditions exist than those identified from drill hole data, there is a low likelihood of a minor expression of subsidence associated with the proposed blind uphole open stope scenario.

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# 1 INTRODUCTION

This report presents the results of a subsidence assessment for the Northern Pod mining area at the Hera Mine.

Ground Control Engineering Pty Ltd (GCE) has conducted this assessment at the request of Ms Jolene Moore, at Aurelia Metals Ltd's Hera Mine. The scope of work was formalised in accordance with GCE's proposal dated 13th October 2015[1].

## 1.1 Scope of work

The agreed scope of work included the following:

1. Assess the potential for surface subsidence
2. Assess the likely depth limits of the possible migration of open voids
3. Consider mining methodology and other relevant factors to minimise subsidence potential

# 2 PROPOSED NORTHERN POD MINING AREA

The Northern Pod is an extension of the current Hera underground mine comprising an upper and lower mining panel. Each panel comprises 5 levels of long-hole stopes separated by a sill pillar. It is understood that the mining sequence in each panel will comprise stoping retreating from north to south in a bottom up sequence utilising mullock fill.

The crown of the proposed upper panel comprises a stepped geometry with depth below the surface of between 273m and 318m. The surface above the crown is at RL10310m.

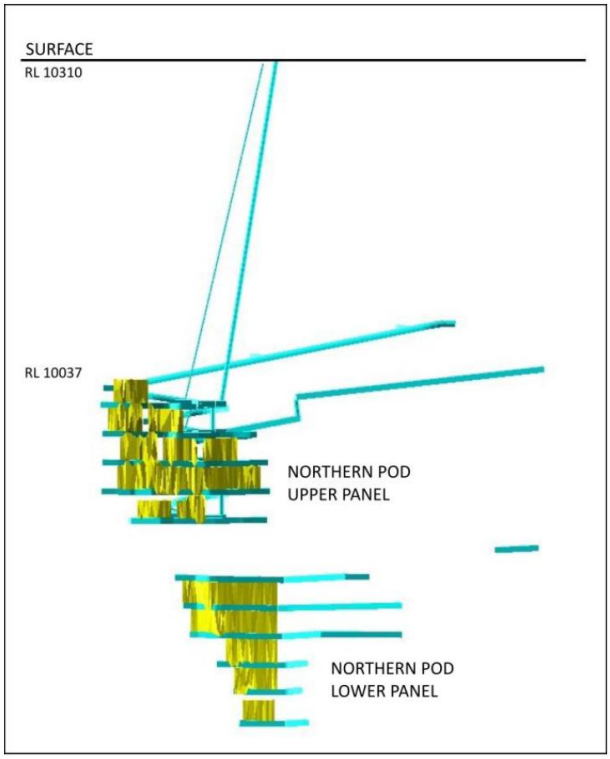


Figure 1. Longsection schematic showing Northern Pod extents

[1] GCE, Proposal G0099, 13th October 2015, Northern Pod Subsidence Review

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# 3 AVAILABLE DATA

## 3.1 Data Supplied to GCE

Data available to GCE for this assessment comprised:

- Digital models of planned development and stoping for the Northern Pod area
- Diamond drillhole logs from resource drilling in the vicinity of the proposed stoping area and crown pillar region.
- Core photographs of logged intervals.

## 3.2 Data Selection

GCE has reviewed the available geotechnical and mine design data. Rockmass fracture frequency data in the form of RQD (rock quality designation) and fracture count (fractures per metre) is available from logged diamond holes.

Four holes intersect the crown region above or at the planned limit of stoping and are the primary source of data for this assessment:

| | |
|---|---|
| CNYDD019: | Passes through the base of the central crown area |
| HRD048: | Intersects the Southern crown area above proposed stoping |
| HRD049: | Intersects the Northern crown area above proposed stoping |
| HRD042W1: | Intersects the planned upper stope |

Three holes intersect or pass close to the proposed Northern Pod stoping area upper panel and have been used comparatively to gain an appreciation of regional hangingwall and footwall conditions:

| | |
|---|---|
| HRD046: | Passes to the North of the upper stoping area |
| HRD056: | Passes through the South of the upper stoping area |
| HRD042W2: | Intersects the planned second level stoping |

The locations of these holes at their point of intersection with the crown or stoping area are shown in figure 2.

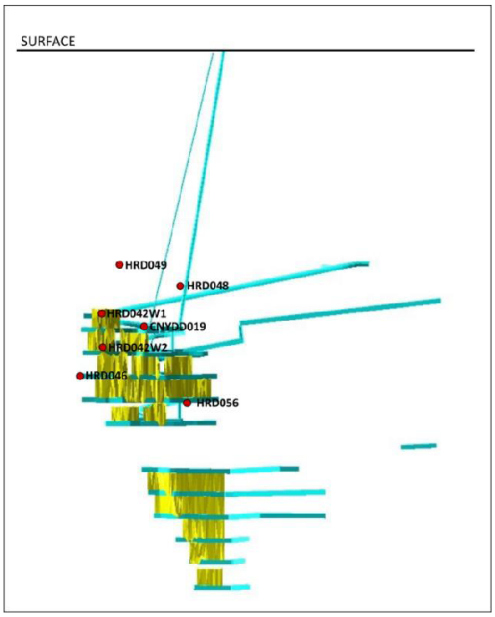


Figure 2. Section Schematic Showing Diamond Hole Locations

### 3.3 Data Review

RQD and FPM data has been logged for all holes. With the exception of CNYDD019 these parameters have been logged over downhole intervals of up to ten metres. Measurements of these parameters from core have subsequently been averaged over the logged intervals to provide a measurement of each parameter in units of one metre. A qualitative review of core photographs against logged values has been undertaken and confirms the logging method used for the HRD holes has resulted in 'smearing' of data to the extent that the resolution of logged data does not accurately reflect discrete areas of geotechnical significance. As a result, weighting of this data has been applied to avoid misrepresenting the variability of actual ground conditions.

Fracture frequency parameters logged from CNYDD019 are considered a reliable representation of the crown conditions. Observations of core fractures in holes HRD042W1, HRD048 and HRD049 in the crown area have been taken into consideration with regard to determining variability against data from hole CNYDD019.

Measurements of defect orientations have been undertaken over variable intervals of core. Data from holes HRD042W1, HRD048 and HRD049 has been used for this assessment to best represent rockmass joint sets in the crown area. No oriented structural measurements are available from hole CNYDD019.

## 4 GEOTECHNICAL CONDITIONS

### 4.1 Rockmass Discontinuities

Rockmass defect frequency data logged from diamond core has been plotted against downhole intervals in relation to the crown location to gain an appreciation of possible variability in crown conditions. The rockmass has been classified using the rock quality designation (RQD) descriptions as shown in table 1.

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| RQD Range | Description |
|---|---|
| 0-25 | Very Poor |
| 25-50 | Poor |
| 50-75 | Fair |
| 75-90 | Good |
| 90-100 | Excellent |

Table 1. Rock Quality Designation (RQD) Intervals

Core intervals used for this assessment comprise a lateral zone of 50m centred on the orebody. Downhole core lengths shown over this interval vary for each hole according to hole orientation.

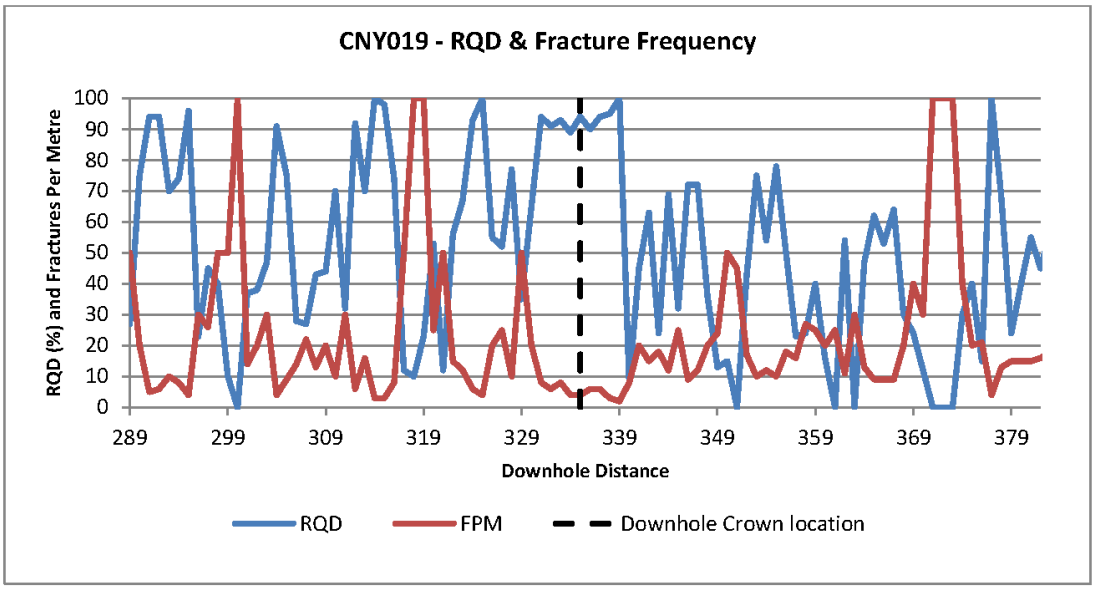


Figure 3. CNYDD019 Defect Frequency

Data plotted in Figure 3 presents a significant variability in rockmass quality across the crown area. Average conditions on the East side of the orebody (footwall) are poorer than those on the West. Conditions in the immediate vicinity of the crown are good to excellent, primarily due to silica flooding of the sediments in this region. Logged variability in hangingwall and footwall conditions is supported by core photograph records which highlight a significant variation in the local intensity of fracturing throughout the sediments. Core photographs for intervals plotted are presented in Appendix 1.

Rock quality designation classifications across the crown region presented in figure 4 for hole CNYDD019 indicate up to 50% of the core is rated poor to very-poor (RQD values <50%) and there is a relatively uniform distribution of quality classes.

Plotting classification against the hangingwall and footwall domains as shown in figure 5 indicates conditions in the hangingwall (West crown) are slightly better than in the footwall (East Crown).

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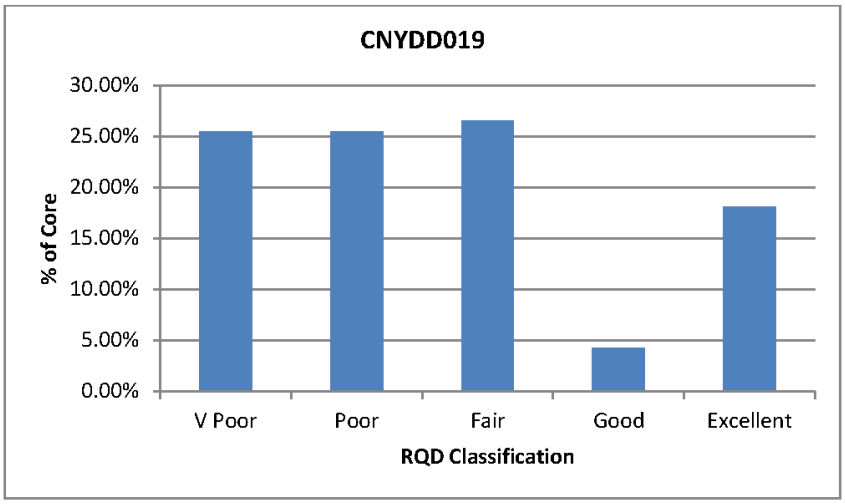


Figure 4. CNYDD019 Crown Interval RQD Classification

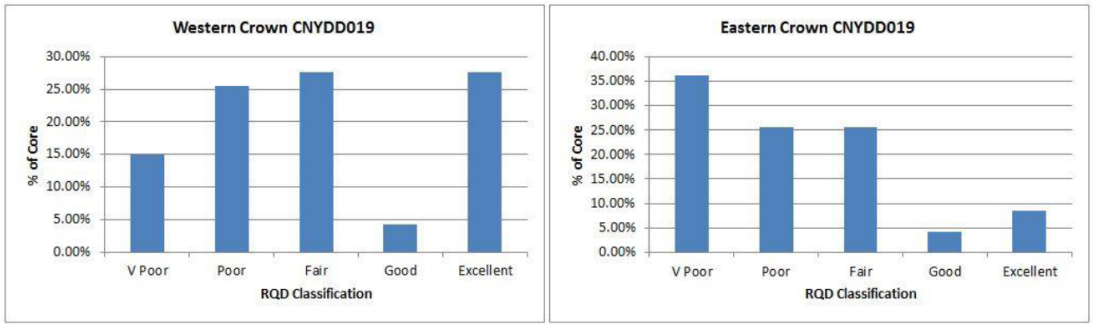


Figure 5. CNYDD019 Hangingwall and Footwall Intervals - RQD Classification

| RQD Range | Description | Hangingwall RQD | Footwall RQD |
|---|---|---|---|
| 0-25 | Very Poor | 15% | 36% |
| 25-50 | Poor | 26% | 26% |
| 50-75 | Fair | 28% | 26% |
| 75-90 | Good | 4% | 4% |
| 90-100 | Excellent | 28% | 9% |

Table 2. CNYDD019 RQD Classification of core by domain

Due to the low resolution of logged data for holes HRD042W1, HRD048 and HRD049 there is insufficient data to present a breakdown of classifications by domain for individual holes. The 'smearing' effect of logging over downhole intervals of up to 10m is illustrated in figures 6 to 8.

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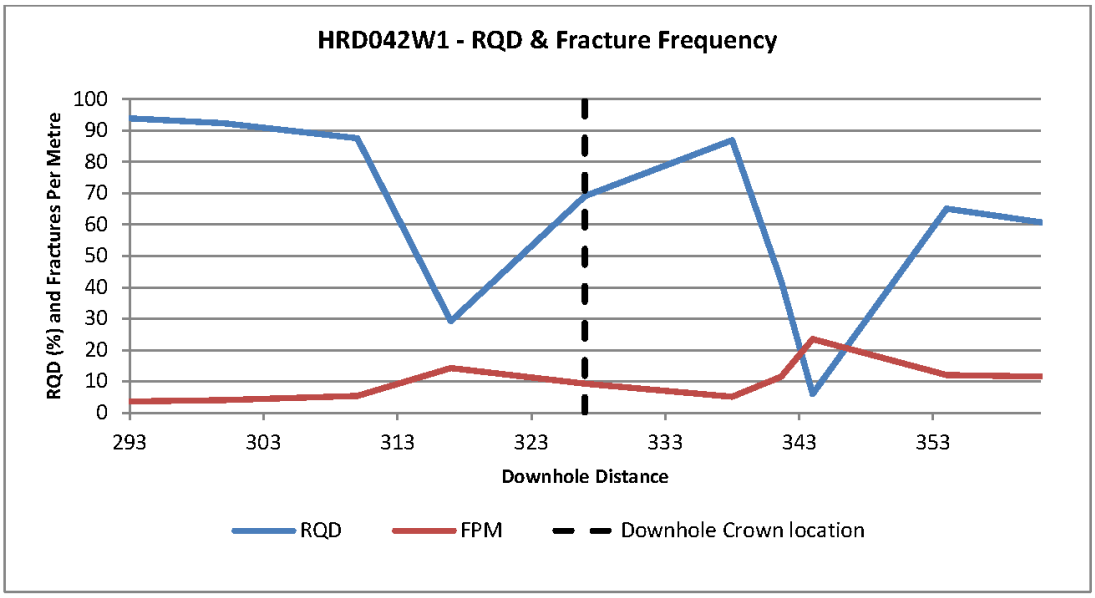


Figure 6. HRD042W1 Defect Frequency

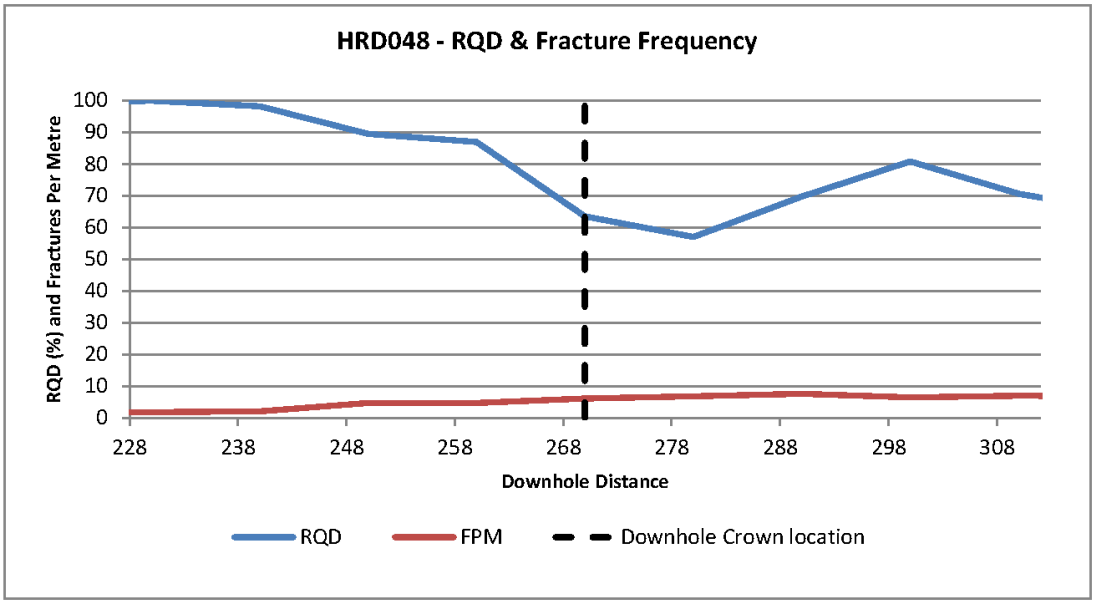


Figure 7. HRD048 Defect Frequency

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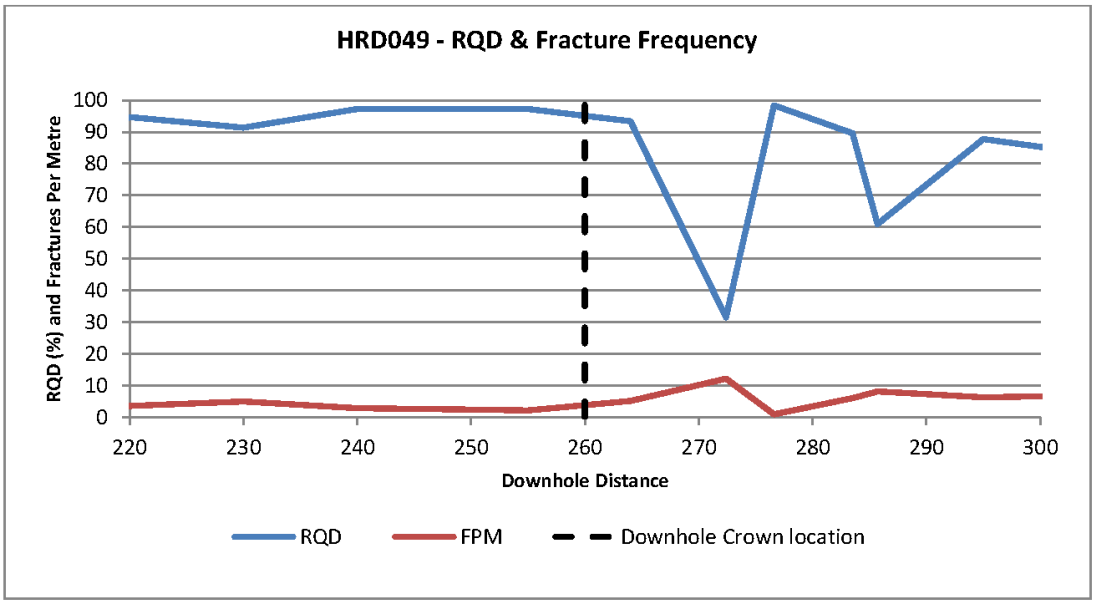


Figure 8. HRD049 Defect Frequency

Based on a review of core photographs, conditions intersected in hole CNYDD019 qualitatively appear poorer than those in holes HRD042W1, HRD048 and HRD049. Using the RQD data from all four holes, the combined and combined weighted mean and first quartile values have been determined for the hangingwall and footwall zones. These values are presented in table 3, with weighted values adopted as a fair representation of overall rockmass quality in the crown region.

| | Hangingwall/ore RQD | | Footwall RQD | |
|---|---|---|---|---|
| Hole | Mean | 25th Percentile | Mean | 25th Percentile |
| CNYDD019 | 59% | 36% | 42% | 20% |
| HRD042W1 | 76% | 86% | 50% | 42% |
| HRD048 | 95% | 89% | 70% | 63% |
| HRD049 | 96% | 93% | 74% | 61% |
| Combined | **81%** | **76%** | **59%** | **47%** |
| Weighted | **66%** | **49%** | **47%** | **29%** |

Table 3. Combined RQD by domain

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## 4.1 Rockmass Jointset Orientations

Rockmass joint set orientations have been determined from alpha and beta measurements of core from holes HRD042W1, HRD048 and HRD049. The joint orientations measured from these holes appear consistent with measurements compiled from other holes through the main orebody. The dominant joint sets are summarised in Table 4. Variability is illustrated in the stereonet for each joint set presented in figures 9 to 12.

| Description | Dip/Dip Direction |
|---|---|
| Bedding | 83/249 – 86/260 |
| Cleavage | 87/254 |
| Flat Joint Set | 08/270 |
| QTZ Veining | 88/253 – 82/077 |

Table 4. Hera Northern Pod Joint Sets

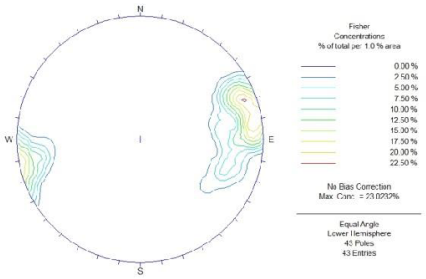


Figure 9. Bedding

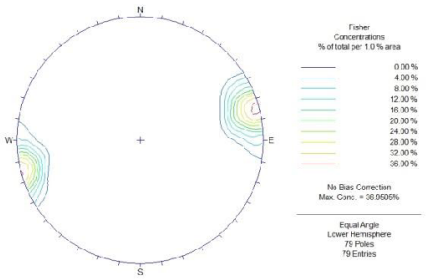


Figure 10. Cleavage

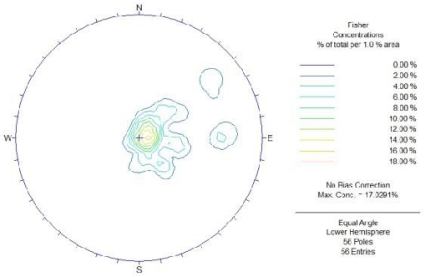


Figure 11. Joints

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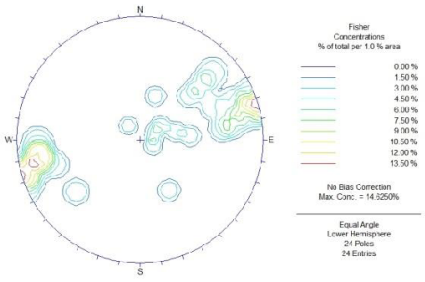


Figure 12. Veins

The dominant defect types in order of prevalence are cleavage, bedding and a flat variable joint set. The orientation of quartz veining is consistent with the other three sets, but less dominantly on the flat structures.

## 4.1 Rockmass Joint Set Characteristics

Joint surface parameters of roughness (Jr) and alteration (Ja) have been documented in the site ground control management plan. Dominant alteration types are silica, chlorite and sericite which occur variably across the stratigraphy as summarised in table 5.

| Alteration Type | Hangingwall | Orezone | Footwall |
|---|---|---|---|
| Silica | 42% | 78% | 30% |
| Chlorite | 30% | 4% | 26% |
| Sericite | 7% | 2% | 17% |

Table 5. Joint alteration types as a percentage of occurrence on logged structures

Joint surface geometry descriptions for the dominant defect types are shown in table 6 as interpreted over the relevant scale of the crown.

| Joint | Joint Surface Description |
|---|---|
| Bedding | Undulating & Smooth |
| Cleavage | Planar & Smooth |
| Flat Joint Set | Planar & Smooth |

Table 6. Joint surface geometry descriptions

## 4.2 Weathering Profile

The depth below surface (RL10310) to the top of fresh rock has been determined from logged data with depth logs matched to weathering intervals in the area of interest from four holes:

- HRD046 (Collared West of the crown)
- HRD048 (Collared West of the crown)
- HRD049 (Collared West of the crown)
- HRD056 (Collared East of the crown)

The downhole depths at which the top of fresh rock has been logged in these holes occurs at RL10196 ±9m (114mbs). From the same holes, the base of highly weathered rock occurs at RL10253 ±4m (57mbs). The weathering profile between these two horizons in the moderately weathered region is highly variable with the occurrence of some discrete highly weathered intervals between predominantly moderately weathered rock, and surface oxidation and staining of joints down to the top of fresh rock.

## 4.3 In situ Stress

No stress measurements have been undertaken specifically for the Hera Mine. High stress mining conditions are not expected in the Northern Pod crown pillar region.

## 4.4 Rock Mass Classification

The rock mass classification system used for this assessment is the Tunnelling Quality Index (Q)[2]. The numerical value of the index Q varies on a logarithmic scale from 0.001 to 1000 and is defined as:

$$Q = \frac{RQD}{Jn} * \frac{Jr}{Ja} * \frac{Jw}{SRF}$$

Where:

RQD: Rock Quality Designation index (defined by Deere et al, 1967). RQD is defined as the percentage of intact core pieces longer than 100 mm in the total length of core. RQD is a directionally dependent parameter and its value might change significantly depending on the borehole orientation.

Jn: Joint set number. This refers to the number of joint sets identified in the section of core logged. The RQD/Jn parameter is an approximate representation of the block or particle size in the rock mass.

Jr: Joint roughness number. This refers to the surface roughness of the joint. It is made up of two components, namely planarity of the surface and its roughness. The higher the Jr value, the higher the expected peak strength of the joint.

Ja: Joint alteration number. This refers to the type and thickness of infill in the joint which affects its frictional characteristics. A high value of Ja denotes lower frictional strength of the joint.

Jw: Joint water reduction. Jw is a measure of water pressure, which has an adverse effect on the shear strength of joints by reducing the normal effective stress. Water can also cause softening or wash clay infill from joints.

SRF: Stress Reduction Factor. SRF is a measure of three parameters; loosening load in an excavation through shear zones and clay bearing rock, rock stress in competent rock and squeezing loads in plastic incompetent rock. The Jw/SRF quotient indicates the conditions of active stress around an excavation.

| Q Range | Rockmass Description |
|---|---|
| 0.001-0.1 | Extremely Poor |
| 0.1-1 | Very Poor |
| 1-4 | Poor |
| 4-10 | Fair |
| 10-40 | Good |
| 40-100 | Very Good |
| 100-400 | Extremely Good |
| 400-1000 | Exceptionally Good |

Table 7. Range of Q intervals and description classifications

[2] Barton, N, Lien, R and Lunde, J, 1974 Analysis of rock mass quality and support practice in tunnelling and guide for estimation support requirements. NGI Internal Rept No 54206.

For this assessment, an upper and lower estimate of average anticipated conditions has been used to reflect the likely variability of conditions over the scale of the crown pillar.

Upper and lower Q input variables have been applied as follows:

RQD: 49% - 66% (weighted first quartile and mean of ore/hangingwall RQD values)
29% - 47% (weighted first quartile and mean of footwall RQD values)

Jn: 4 (2 Joint sets, bedding and cleavage parallel and the flat joint set)
9 (3 Joint sets, bedding + cleavage + flat set)

Jr: 1.0 (planar smooth joints)
1.5 (planar undulating joints)

Ja: 2 (Sparse mineral coating)
3 (Low friction infill veneer)

Jw: 1 (Dry conditions anticipated)

SRF: 1 (Negligible stress induced strain damage anticipated)

The combinations of these parameters selected as being representative of expected conditions results in a range of Q values as shown in table 8.

| | Hangingwall Domain | Footwall Domain |
|---|---|---|
| Weighted First Quartile Q | 1.8 | 1.06 |
| Weighted Mean Q | 12.38 | 8.6 |

Table 8. Crown rockmass Q classifications

## 5 CROWN PILLAR STABILITY ASSESSMENT

### 5.1 Scaled Crown Span ($C_s$) assessment

An empirical assessment of likely crown stability has been undertaken using the scaled crown span method developed and refined by Carter et al. The method comprises input values of rockmass quality (Q) and Scaled Crown Span. The scaled crown span is a function of the pillar geometry defined as follows:

$$C_s = S\left\{\frac{\gamma}{t(1+S_R)(1-0.4cos\theta)}\right\}^{0.5}$$

Where: S= crown pillar span cross section (m)

$\gamma$= unit weight of the rock mass (t/m$^3$)

$S_R$= span ratio = S/L (crown pillar span/crown pillar strike length)

$\theta$= dip of the orebody or foliation (degrees)

$t$ = Crown pillar thickness

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Values of Q vs $C_s$ are plotted and compared to a database of approximately 500 case histories of crown stability performance to predict likely stability.

For this assessment the following parameters have been used to determine $C_s$:

S: 6 - 10m (drive width - open stope span)

γ: 2.8 t/m$^3$

L: 130m

t: 160m

θ: 85°

Whilst the true crown thickness above the panned extent of stoping is 273m, the top of fresh rock (at RL10196) is 160m above the backs of the planned uphole stope (at RL10037). Above the top of fresh rock, rockmass conditions are expected to be poorer than those logged in fresh rock and likely highly variable with decreasing depth to the base of highly weathered material.

The Scaled crown span chart representing the range of Q values described in the previous section is shown in figure 13. Plotted against probability of failure regression contours from case history data, the probability of failure of the crown ranges from <10% to <0.5%.

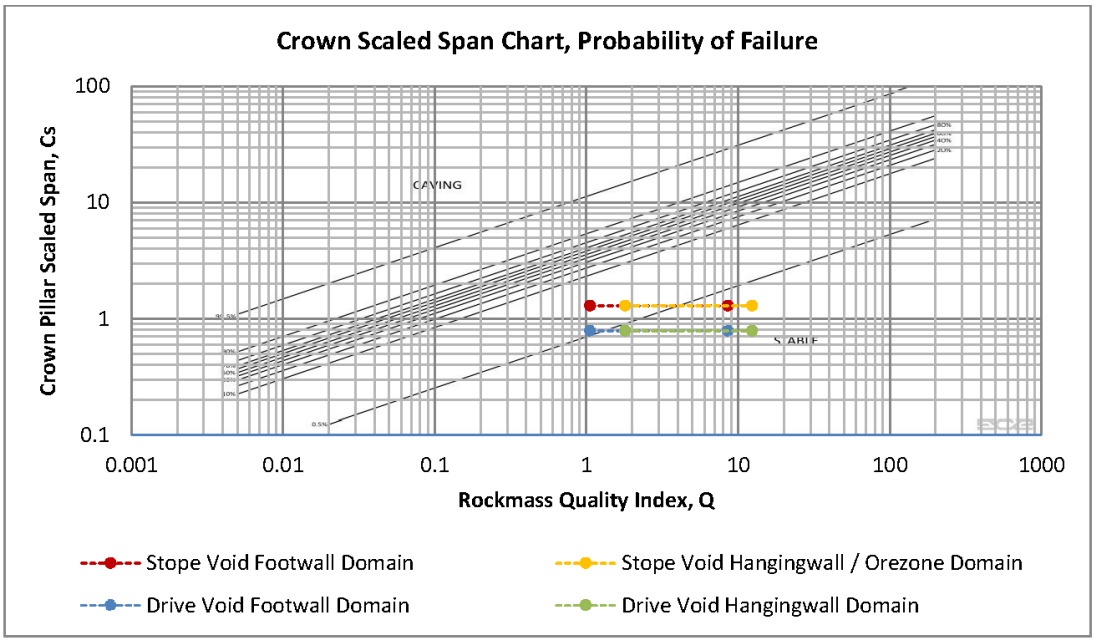


Figure 13. Predicted stability range for anticipated Northern Pod crown ground conditions

Carter et al 2008, developed a risk exposure guideline based on the comparative significance of crown pillar failures in the case history database. The guideline is based on failure probability intervals from the Scaled Span Chart according to the service life requirements and public exposure criteria summarised in table 9.

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| Class | Probability of Failure % | Minimum Factor of Safety | Maximum Scaled Span, Cs (= Sc) | ESR (Barton et al. 1974) | Design Guidelines for Pillar Acceptability/Serviceable Life of Crown Pillar | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Expectancy | Years | Public Access | Regulatory position on closure | Operating Surveillance Required |
| A | 50 – 100 | <1 | $11.31Q^{0.44}$ | >5 | Effectively zero | < 0.5 | Forbidden | Totally unacceptable | Ineffective |
| B | 20 – 50 | 1.0 | $3.58Q^{0.44}$ | 3 | Very, very short-term (temporary mining purposes only ; unacceptable risk of failure for temporary civil tunnel portals | 1.0 | Forcibly Prevented | Not acceptable | Continuous sophisticated monitoring |
| C | 10 – 20 | 1.2 | $2.74Q^{0.44}$ | 1.6 | Very short-term (quasi-temporary stope crowns ; undesirable risk of failure for temporary civil works) | 2 – 5 | Actively prevented | High level of concern | Continuous monitoring with instruments |
| D | 5 – 10 | 1.5 | $2.33Q^{0.44}$ | 1.4 | Short-term (semi-temporary crowns, e.g.under non-sensitive mine infrastructure) | 5 – 10 | Prevented | Moderate level of concern | Continuous simple monitoring |
| E | 1.5 – 5 | 1.8 | $1.84Q^{0.44}$ | 1.3 | Medium-term (semi-permanent crowns, possibly under structures) | 15–20 | Discouraged | Low to moderate level of concern | Conscious superficial monitoring |
| F | 0.5 – 1.5 | 2 | $1.12Q^{0.44}$ | 1 | Long-term (quasi-permanent crowns, civil portals, near-surface sewer tunnels) | 50–100 | Allowed | Of limited concern | Incidental superficial monitoring |
| G | <0.5 | >>2 | $0.69\ Q^{0.44}$ | 0.8 | Very long-term (permanent crowns over civil tunnels) | >100 | Free | Of no concern | None required |

Table 9. Exposure Risk Guidelines (after Carter et al 2008)

The probability of failure for the Northern Pod crown illustrated in figure 13, plotted against the classes shown in table 10 is presented in figure 14. This plot indicates a predicted stable crown service life of 15 to >100 years (Class E to Class G).

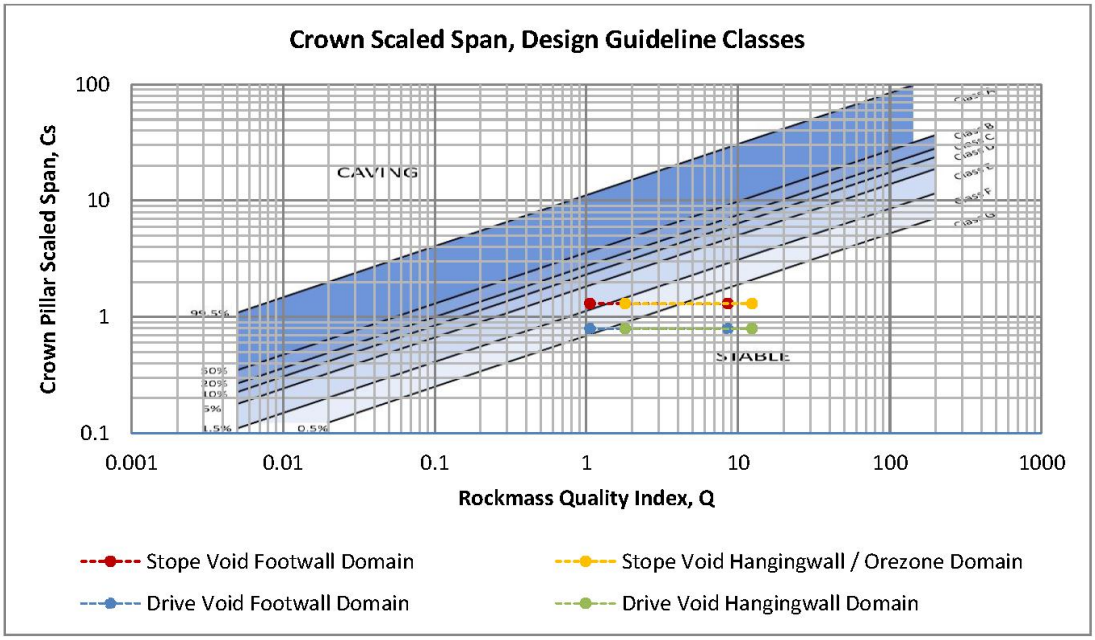


Figure 14. Northern Pod crown design guideline classes

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## 5.2 Bulking & Failure Propagation

As the planned crown voids will comprise filled stopes up to RL10010 and an unfilled blind up-hole above this RL, the plausible vertical extent of long term remnant void propagation has been reviewed for both scenarios. Long term progressive unravelling and slabbing of the jointed rockmass is the most likely mode of failure. Plug subsidence associated with hangingwall and footwall shears is considered less likely, however these zones of weakness may influence the migration of unravelling failure.

For the purposes of this assessment, a bulking factor range of 20% to 30% has been used to determine choking heights in fresh rock. These values are considered representative of the lower end of the likely range of bulking for strong but jointed rockmasses. Choke heights based on this range of bulking factors are summarised in table 10.

| Remnant Void | Anticipated choking height via rockmass bulking |
|---|---|
| Blind uphole stope (10m wide 26m high) | 87m – 130m (148mbs - 191mbs) |
| Stope crown development (6m x 6m) | 20m – 30m (248mbs – 258mbs) |

Table 10. Remnant void choking heights

Anticipated choking heights indicate void migration will arrest within the fresh rock unit below RL 10253 (114mbs). Choking heights have been calculated assuming simple deterioration and unravelling block failure of the rockmass over the lateral footprint of the voids. Any lateral expansion of the crown due to failure will increase the potential volume of failure material with increasing propagation, and may result in choking heights further below the surface than those presented in table 10.

For surface subsidence to occur, an average bulking factor of <10% would be required. Bulking factors of <10% are typically observed only in very heavily jointed rockmasses or highly weathered weak rock units.

Negligible bulking of the rockmass above the base of highly weathered rock at RL10253 (57mbs) should be assumed.

## 5.3 Interpretation and Assumptions

The use of the footwall domain in the assessment is based on the proposed mining of a blind uphole stope which would remain unfilled. Long term deterioration of the footwall zone (in the wall of the stope) cannot therefore be discounted and up-dip void migration may be possible through this footwall domain.

Bulking factors used are estimates based on average anticipated conditions. Variations in bulking factors over the area of the plausible upward migration of an open stope void are not readily quantifiable with the resolution of data available. Adjustment to the mining strategy whereby all crown stopes are backfilled will significantly reduce exposure to bulking factor variability or uncertainty and also exposure of the footwall zone resulting in a scenario where up-dip or vertical void migration would be more likely to occur in the hangingwall domain. Based on the data shown in figure 14, reducing exposure to the footwall domain using backfill would increase the likelihood of long term stability, corresponding with a likely estimated stability classification of 'G' – 'Of no concern' (see table 9). This prediction corresponds with the deep estimated extents of plausible void choking.

The weathering profile in the crown area is assumed to be consistent with depths logged to the East and West of the crown area, and is interpreted to be horizontal. Possibly increased depths of weathering from those assumed, associated with sub-vertical structures has as not been confirmed with shallow drilling.

It is assumed that the upper and lower stoping panels are completely backfilled with mullock below the 10010RL development floor. Incomplete filling of voids will increase the estimated terminal choking heights presented in table 10.

### 5.4 Subsidence Assessment Results

This assessment indicates that the likelihood of surface subsidence associated with the proposed mining plan is very-low for an open remnant uphole stope scenario, and negligible for a scenario with crown level stopes backfilled to floor level.

Based on case history data, the estimated probability of failure is <5% for a scenario comprising an unfilled blind uphole stope at the base of the crown. Backfilling of stopes, limiting remnant voids to development geometries reduces this estimated probability of failure to <1.5%, and more likely <0.5%.

Long term deterioration of the crown and upward migration of unfilled voids is possible. Using conservative bulking estimates, choking of the remnant voids for average anticipated conditions would be likely to occur no less than ≈148 metres below surface as summarised in table 10.

### 5.5 Recommendations

This assessment indicates that the likelihood of surface subsidence associated with the proposed mining plan is low. GCE recommend however, that blind up-hole stopes not be mined. In a bottom-up production sequence, all but the crown level stopes will be completely filled. The crown level stopes should be backfilled to the floor level of the uppermost drive resulting in a remnant void comprising the development geometry only. This will reduce this likelihood of instability and void propagation commensurate with a subsidence risk ' Of no concern' (after Carter et al 2008)

Mapping of Northern pod development should be undertaken as it is mined, and any future drilling in the crown region should be logged for geotechnical parameters. The occurrence of any regional structures within the crown region identified from future drilling must be documented, and where possible used to develop a structural model. Such a model and measured parameters from development or drilling should be reviewed against data used in this assessment to further validate predictions of stability and subsidence likelihood.

## 6 CLOSURE

We thank Aurelia Metals Ltd for the opportunity to participate in this project and trust that this geotechnical assessment meets your requirements.

Please contact the author should you require further clarification.

Yours sincerely,

**GROUND CONTROL ENGINEERING PTY LTD**

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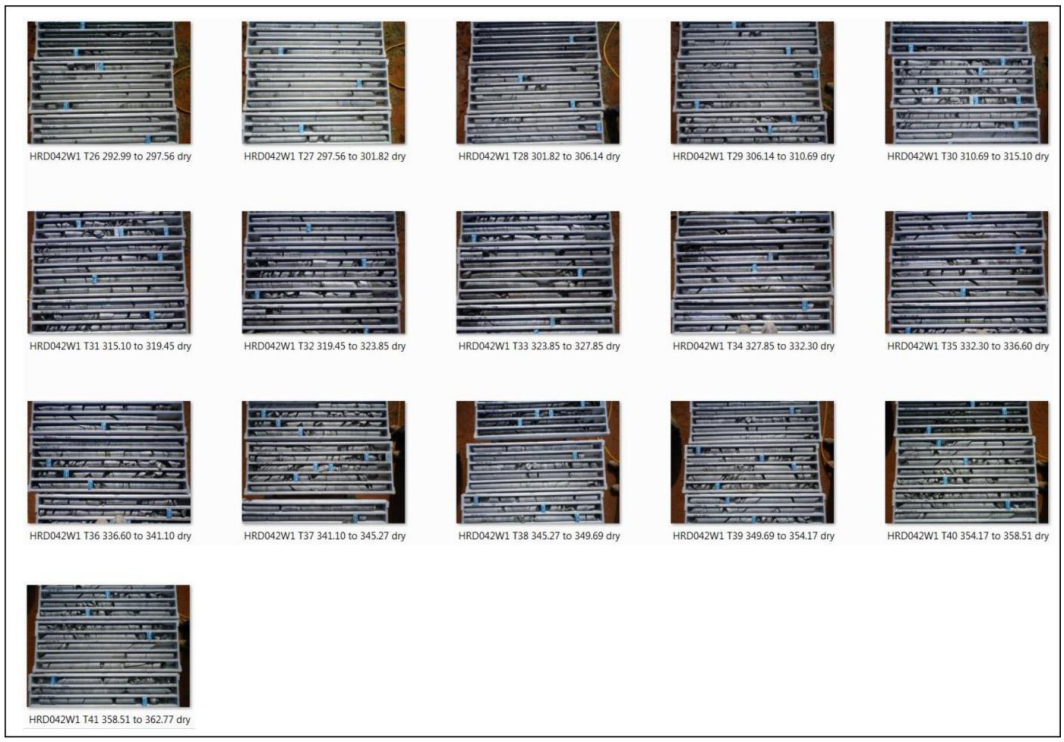
AURELIA METALS LTD. HERA MINE NORTHERN POD SUBSIDENCE REVIEW

## 7 APPENDIX 1 – CORE PHOTOGRAPHS

### CNYD019 – CROWN INTERVAL CORE PHOTOGRAPHS

**AURELIA METALS LTD. HERA MINE NORTHERN POD SUBSIDENCE REVIEW**

**HRD042W1 – CROWN INTERVAL CORE PHOTOGRAPHS**



AURELIA METALS LTD. HERA MINE NORTHERN POD SUBSIDENCE REVIEW

HRD048 – CROWN INTERVAL CORE PHOTOGRAPHS

**AURELIA METALS LTD. HERA MINE NORTHERN POD SUBSIDENCE REVIEW**

**HRD049 – CROWN INTERVAL CORE PHOTOGRAPHS**

# Appendix 2
# Aquade (2016); Assessment of Potential Groundwater Impacts due to North Pod Expansion of Hera Project, Nymagee NSW

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29 January 2016

Jonathon Thompson
Environmental Officer
Aurelia Metals Ltd
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NSW 2800

Dear Jonathon,

## Assessment of Potential Groundwater Impacts due to North Pod Expansion of Hera Project, Nymagee NSW

### Executive Summary

The proposed North Pod Expansion would extend the Hera underground mine to the north across the current northern lease boundary. The objectives of this assessment are to address the potential impacts that the expanded underground mining footprint would have on groundwater inflows to the underground mine, on neighbouring bores and on Groundwater Dependent Ecosystems (GDEs).

Comprehensive groundwater extraction data from the decline and nearby drawdown data collected by Aurelia has facilitated the evaluation of aquifer properties which can be used for predictive modelling of impacts. Due to the considerable duration of groundwater extraction from the underground to date, the aquifer properties are interpreted to be average properties over a significant area in the vicinity of the current northern boundary of the Hera Project. These properties are considerably more appropriate for long-term extrapolation of drawdowns than properties derived from pre-operational testing, due to the relatively large area of influence.

The pre-mining expectation that significant fracture permeability would be limited to within 250 m of the ground surface has been confirmed by the current underground workings in which the most significant inflows took place less than 200 m below the ground surface. The proposed North Pod workings are all below a depth of 250 m, except for a new fresh air intake raise connecting the workings to the ground surface at the current northern lease boundary. Therefore, the intake raise is likely to be the primary conduit of inflows to the North Pod, rather than the working themselves.

Although inflows could temporarily increase when the new intake raise is constructed and/or the North Pod workings intersect existing exploration coreholes, total long-term inflows are not expected to change significantly due to the North Pod expansion. The area of dewatering associated with the underground mine will likely be extended 200-300 m to the northwest. Analytical modelling predicted the maximum drawdown at the closest potential receptor, neighbouring stock bore GW017385, could be as much as 3 m during the mine life. However, conservative input assumptions to this modelling regarding duration and rate of dewatering, lack of recharge, and the northern extent of the new inflows mean that drawdown is expected to be less than 3 m. There are no predicted impacts on GDEs as a result of the North Pod expansion. Current recommendations for trigger-level monitoring at WB015 remain appropriate to provide early warning of potential drawdown impacts at GW017385.

## 1.0 Introduction and Background

This document is based on a request for proposal (RFP) received from Aurelia Metals Ltd (Aurelia) on 7 October 2015. The RFP outlined a need for an assessment of the potential groundwater-related impacts of a proposed expansion of the existing Hera Mine to the north, into an area of mineralisation known as the North Pod. The North Pod extends beneath the northern lease boundary (see Figures 1 and 2). On consultation with the Department of Planning, Aurelia has been asked to prepare an Environmental Assessment for the Project expansion that specifically addresses the potential geotechnical and hydrogeological impacts of the expansion.

The RFP concerned the hydrogeology impacts only. It stated that the specific objectives of this assessment are to address the potential impacts that the expanded underground mining footprint would have on:

- Groundwater inflows to the underground mine
- Potential impacts on neighbouring bores
- Impacts on Groundwater Dependent Ecosystems (GDEs)

The assessment of impacts that follows is based on the author's current interpretation of the hydrogeology, which, in turn, is based on approximately two years of groundwater-extraction and drawdown data collected by Aurelia (Aquade, 2015a and 2015b).

Groundwater used in the Hera project is from two sources within the lease area, i.e.

1. the underground workings which are close to the northern lease boundary (Figure 1) and
2. water bores which are close to the southern lease boundary several kms to the south of the underground workings.

As the proposed expansion is beneath the northern boundary of the project, the potential off-site groundwater impact is to the north only. Therefore, to predict impacts of the expansion, it was necessary to update the conceptualisation in the vicinity of the underground workings, from the most recent conceptualisation which was undertaken in July 2015 (Aquade, 2015a). This involved consideration of the extraction data from the underground workings and the drawdown in the vicinity of those workings from the second half of 2015.

The conceptualisation in the southern part of the lease area was not updated from recent data because this is not relevant to the potential off-site impacts to the north. Also, this assessment does not consider potential changes to rates of groundwater extraction from bores or locations of groundwater extraction bores in the southern part of the project lease area as there is no change in water demand specifically associated with the North Pod expansion. Section 2 provides further context regarding the North Pod Expansion and previous modification to the original approval, MOD 3.

The letter report below is organised as follows:

- Description of the proposed mine project expansion.
- Analysis of groundwater extraction from the underground workings and associated drawdown, including best estimates of aquifer properties in the vicinity of the underground workings based on the latest observations.
- Summary of conceptual hydrogeology.
- Prediction of impacts, including:
  - Underground inflow rates resulting from expansion.
  - Drawdown at neighbouring bore to the north of the mine lease.
  - Impacts to GDEs.
  - Consideration of uncertainties, trigger levels.

It is intended that this letter report may be used in support of an Environmental Assessment of the proposed expansion and may be included as an appendix in the Environmental Assessment.

## 2.0 Description of North Pod Expansion

It is understood that ongoing mine planning and economic evaluation of the Hera orebody has determined the technical and economic viability of extending the mine to access recently discovered mineral resources to the north of the existing Hera Mine (referred to as the North Pod). These mineral resources are an extension along strike of those which formed the basis of the existing approval.

Access to the North Pod mineralisation is planned from an extension to the main Hera underground mine with the establishment of an internal decline, ventilation raise and mining area, with all ore hauled to the ground surface through the existing decline. Details are shown in Figures 1 and 2. The following are pertinent details shown in these figures:

- The internal decline access would begin approximately 250m below surface.
- Mining stopes would not be permitted to impact on the surface.
- A new fresh air intake raise would be required. The surface expression of the raise would occur within the existing Mining Lease. The base of it would be tens of metres north of the existing project boundary.
- The mineralisation identified is not yet fully defined and there is potential for discoveries adjacent to that already identified.

Aurelia is currently awaiting approval of MOD 3, which is a modification to the original approval to increase ore production rates to circa 500 ktpa and mine life out to December 2022. Additional water rights are being purchased to facilitate the higher water usage rate associated with MOD 3.

It is understood that no further change is proposed to the total duration of mining or the rate of production as part of the North Pod expansion. Therefore, there is no change to the project water demand specifically associated with the North Pod expansion.

## 3.0 Analysis of Groundwater Extraction from the Decline and Associated Drawdown

Figure 3 shows the net rate of groundwater extraction from the underground workings from the start of April to late December 2015. During this period, it is understood that the base of the mine workings has not changed, at approximately RL -100 m (personal communication, Stuart Jeffrey, Jan 2016). Figure 3 includes a linear trend line generated from the data. The rate declined slightly over this period, as would expected, and averaged approximately 340 $m^3$/day.

In the July 2015 assessment of groundwater availability (Aquade, 2015a), I reported that drawdown at bore WB005 was responding to groundwater extraction from the decline. The drawdown at WB005 began when the Decline reached the second corner (Aquade, 2015a). At that time, the most recent drawdown followed a linear trend when plotted semi-logarithmically such that aquifer properties of effective transmissivity, T, and specific yield, Sy, could be evaluated from the slope of the line using the Cooper-Jacob method (Cooper and Jacob, 1946 and Jacob, 1950). This is a simplification of the Theis analysis (Theis, 1935). In July 2015, the effective aquifer properties evaluated for the Decline area based on the WB5 drawdowns were T = 5.2 $m^2$/day and Sy = 0.0088 (Aquade, 2015a).

The drawdown data from WB5 (Figure 4) were revisited and re-analysed for this report (Figure 5). This analysis is considered to be more reliable than the analysis in July 2015 because the decline had been at a constant depth for a longer period. The software used in this analysis was Aqtesolv (Duffield, 2007). The drawdown continues to trend in a straight line when plotted semi-logarithmically, which indicates that the Cooper-Jacob method is a valid approach for evaluating aquifer properties (Cooper and Jacob, 1946 and Jacob, 1950). For the late-time period of drawdown where the straight-line method is used, the net extraction rate from the underground workings was reducing slightly but averaged approximately 340 $m^3$/day. Assuming this net extraction rate, the effective aquifer properties evaluated for the Decline area based on the most recent WB5 data are T = 3.8 $m^2$/day and Sy = 0.0088 (Figure 5). As these properties were evaluated from a long period of drawdown, they represent average properties over a significant area, with radius greater than 1 $km^2$.

Note that the Cooper-Jacob method applied for evaluating transmissivity above (and in July 2015) assumes the aquifer is homogeneous and unlimited in extent. In reality, the aquifer is likely to be heterogeneous and anisotropic such that the aquifer properties are averages over the area of influence.

## 4.0 Summary of Conceptual Hydrogeology

The local sedimentary rocks are steeply dipping, with evident jointing/cleavage. Groundwater storage in, and flow through, these rocks is controlled by the fractures and the local topography. The baseline (pre-mining) water table surface is shown in Figure 6. This water table surface was previously reported in Figure 1 of the Aquade letter report regarding recommended groundwater triggers (Aquade, 2015b).

The fracture permeability of the rocks varies with location and depth. Impax (2011) considered that the primary "water bearing zones", i.e. those rocks with significant fracture permeability, are likely to be encountered only within 250 m of the ground surface. This has been confirmed by the existing underground workings. Inflow rates of more than 1 ML/day were encountered when the decline went through its second corner approximately 130 m below the portal, but the inflow rate reduced thereafter with no further high inflow rates (Aquade, 2015a). From this and other drilling at the site, the most transmissive rocks are likely to be no more than approximately 100 m below the baseline water table, i.e. no lower than approximately RL 160 m in the vicinity of the underground workings. Although the Decline is approximately 260 m below this level, the groundwater produced is interpreted to originate from higher up and cascades down through the workings and open drill holes.

## 5.0 Assessment of Impacts

### 5.1 Likely Mechanism of Future Inflows and Drawdown Associated with North Pod

The shallowest part of the proposed North Pod workings is approximately 300 m below the ground surface at RL 040 m (mine elevation 10040 m in Figure 2). From the conceptual hydrogeology, the new North Pod workings are considered unlikely to intersect zones of significant fracture permeability due to their depth. However, the new fresh air intake raise which will connect the new workings to the ground surface is likely to intersect relatively high fracture permeability within 200 m of the ground surface, most likely in the zone RL 150 – 230 m (Figure 2). Thus, the fresh air intake raise is likely to have a more significant impact on local groundwater than the underground workings themselves.

Also, it is understood that angled exploration drilling has been undertaken into the North Pod area from within the mine lease west of the proposed air intake raise (personal communication, Stuart Jeffrey, 19 January 2016). This drilling may also impact on local groundwater by providing pathways for groundwater to cascade down from more permeable depths into the workings.

From Figures 1 and 2, the coordinates where the fresh air intake raise passes through elevations RL 150-230 m is effectively directly beneath the existing project boundary at Easting 436140, Northing 6447540. However, corehole information received from Stuart Jeffrey shows that the most north-westerly point where existing angled coreholes from within the existing project boundary could intersect relatively permeable fractures and indirectly become a source of drawdown is approximately 150 m to the west-northwest of the air intake raise, i.e. at Easting 436000, Northing 6447600.

From drawdown observed at WB5 (Figure 4), which is approximately 360 m from the second corner of the decline (and 27 m of drawdown observed at the Decline Bore up to May 2014), tens of metres of drawdown is already likely to have taken place above the North Pod at the time the new intake raise is constructed. However, it can be expected that there remains some groundwater in storage at this location.

## 5.2 Predicted Inflow Rate

When the intake raise is constructed through the RL 150-230 m zone, temporary increased inflows can be expected. The magnitude of the initial peak in the inflow rate cannot be accurately predicted without initial test drilling taking place first along the planned alignment of the intake. However, inflows can be estimated as follows.

It is understood that there were inflow rates of more than 1 ML/day at the second corner of the decline (Aquade, 2015a). Based on this, the inflow rate could be more than 1 ML/day for a few days via the air intake raise, or even when the North Pod workings intersect previous exploration coreholes. However, a temporary increase to several hundred $m^3$/day is more likely as some drawdown is likely to have already taken place and the effective cross-sectional area of the new fresh air intake is less than that of a decline. The impact on the long-term cumulative volume extracted from the underground workings is unlikely to be significant as the increase in inflow rate is not expected to last more than a few days to weeks. The direct effect of the North Pod extension will be to expand the area of dewatering associated with the underground 200-300 m to the northwest.

Aurelia is purchasing additional water rights to extract addition groundwater as part of Mod 3 (see Section 2). Even if the North Pod expansion were to intersect an extensive high transmissivity zone in comparison to the current workings such that there is a significant increase in the total volume produced from the underground, it is very unlikely that a change in the extraction licence would be required from MOD 3. If more water is produced from the underground in the long term, this would be balanced by less extraction from bores such that the total rate of groundwater extraction would not exceed the licenced amount.

## 5.3 Predicted Drawdown Impact

The closest potential receptor of drawdown impacts is stock bore GW017385, approximately 2 km north of the current project lease boundary. WB015 is a monitoring bore used for trigger level monitoring in this area. Locations of these bores are shown in Figure 6. Table 1 lists the distances and locations of these bores from the nearest possible location of drawdown associated with the North Pod works.

**Table 1. Distances from North Pod to Bores North of the Mine Project Boundary**

| Location of Receptor | Description | Closest Distance to North Pod |
|---|---|---|
| GW017385 | Neighbour's Stock Bore | 2.0 km |
| WB015 | Trigger Monitoring Point | 1.5 km |

Note: The closest distance is considered to be the distance from existing coreholes which penetrate the North Pod area.

Worst-case-scenario drawdown predictions were undertaken, using the aquifer properties interpreted in Section 3 above. Figure 7 is a distance-drawdown prediction for a point in time ten years after drawdown begins, assuming continuous constant rate extraction for the full ten years. The worst-case predicted drawdown after ten years is 3.0 m at a distance of 2.0 km. If a drawdown of 3.0 m were to be induced at GW017385, it would exceed the maximum 2 m drawdown which is considered the Level 1 Minimal Impact Consideration in the NSW Aquifer Interference Policy (DPI Water, 2013).

The worst-case-scenario drawdown prediction is based on several simplifying but conservative assumptions, which are all likely to result in over-prediction rather than under-prediction of drawdown. These assumptions are:

1. Ten years of dewatering in the North Pod area. In reality, the mine life is expected to be less than ten years. MOD 3 allows for mining up to the end of 2022 and the North Pod expansion does not change this (personal communication, Dean Frederickson, 26 January 2016).
2. The extraction rate was assumed to be a constant 340 $m^3$/day for the full 10 years. In reality, the rate can be expected to reduce to less than 300 $m^3$/day with time, even with the North pod expansion in place. The long-term inflow rate to the underground could be as low as 240 $m^3$/day (Aquade, 2015a). The estimated long-term inflow rate does not change as a result of the North Pod expansion.
3. In prediction of impacts, no recharge was assumed. Recharge would have the effect of attenuating drawdowns. Groundwater in Bore GW017385 has a relatively low Total Dissolved Solids concentration of 500-1000 ppm (Impax, 2011), which is evidence of local recharge.
4. The central point of drawdown was assumed to be the coreholes which have been drilled through the North Pod area. The new fresh air intake is more likely to be the central point of drawdown associated with the North Pod. This is further from GW017385.

As the above assumptions are all conservative, the drawdown induced to the north and, specifically at GW017385, is expected to be less than the 3.0 m predicted from Figure 7. However, the predictive modelling indicates that an induced drawdown of 3.0 m is feasible.

## 5.4 Groundwater Dependent Ecosystems

The original groundwater assessment for the project (Impax, 2011) did not identify any groundwater dependent ecosystems (GDEs). That report also observed that baseline depths to groundwater across the project were typically in the range 50-70 m below ground level (m bgl), which is too deep for ecosystems at the ground surface to be dependent on the local groundwater. The depth to water at GW017385 was reported to be 46.6 m bgl (Impax, 2011). This is also too deep for ecosystems at the ground surface to be dependent on the groundwater. Therefore, there are no known GDEs that could be impacted by the expansion of the mine to the North Pod.

## 5.5 Consideration of Uncertainties and Trigger Levels

It has been possible to evaluate average aquifer properties over a large area in the vicinity of the underground mine, from the net decline extraction rate from the underground workings and the long-term drawdown observed in WB5. Aquifer properties derived in this way, from long-term operational data, are considerably more reliable than those obtained from pre-mining pumping tests and, consequently, more reliable for predicting impacts. However, there remains uncertainty regarding the aquifer properties above the North Pod and to the north of the existing project boundary and how they may vary with location (heterogeneity) and direction (anisotropy). Therefore, there remains uncertainty regarding predicted drawdown impacts.

In general, the uncertainty has been allowed for in predicting drawdown impacts by making conservative assumptions which make it considerably more likely that drawdown impacts will be over-estimated rather than under-estimated.

Groundwater trigger monitoring is in place which would provide early warning of potential drawdown impacts on neighbouring properties due to project groundwater extraction. WB015 is currently being used as a trigger-level monitoring location to the north of the project area. In a recent document regarding trigger level locations and magnitudes, the trigger level recommended for WB015 was equivalent to 4.3 m of drawdown at that location

(Aquade, 2015b). This was based on the prediction that, if there was 4 m of drawdown at WB015 caused by extraction within the mine project area, drawdown at GW017385 would be less than 2 m at the same time. This has not changed as a result of the North Pod expansion. Therefore, WB015 remains appropriate as a trigger level monitoring location for early warning of drawdown impacts to the north of the Hera Project and the recommended trigger value at WB015 does not change as a result of the North Pod expansion.

The predicted impacts reported herein would not change if the North Pod is expanded further than illustrated in Figures 1 and 2, assuming any further mining takes place at the same level as the current North Pod proposal and assuming additional intake raises are not required.

## 6.0 Closure

This letter report is provided subject to the attached limitations. If you have any questions or comments regarding this document, please do not hesitate to contact me.

Yours sincerely,

**Alan Wade**
Principal Hydrogeologist
Aquade Groundwater
Services Pty Ltd

Attachments:

References
Glossary of Terms
Aquade General Limitations
Figure 1. Plan of the Hera Project as currently developed showing future approved UG workings and future North Pod Expansion.
Figure 2. Long Projection looking west along plane shown in Figure 1. North is to the right.
Figure 3. Daily Net Extraction Rate from Underground Workings.
Figure 4. WB005 Groundwater Levels
Figure 5. Updated Analysis of WB005 Drawdown
Figure 6. Baseline Water Table Surface at Hera Project
Figure 7. Worst-Case Distance-Drawdown after 10 Years, Extraction Rate 340 $m^3$/day.

## 7.0 References:

Aquade, 2015b, Recommended Groundwater Triggers at Aurelia Hera Project, letter report dated 14 December, 2015 to NSW Department of Primary Industries, NSW Office of Water.

Aquade, 2015a, Supplementary Assessment of Groundwater Availability, Hera Project, Nymagee, NSW, Letter Report prepared for Aurelia Metals Ltd, 4 August 2014.

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## 8.0 Glossary of terms:

**Anisotropy** condition in which one or more of the hydraulic properties of an aquifer vary according to the direction of flow.

**Aquifer.** Rock or sediment that is a geological formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

**Bore**. A hydraulic structure that facilitates the monitoring of groundwater level, collection of groundwater samples, or the extraction (or injection) of groundwater. Also known as a well.

**Drawdown.** Lowering of hydraulic head.

**Groundwater.** The water held in the pores in the ground below the water table.

**Permeability.** Property of porous medium relating to its ability to transmit or conduct liquid (usually water) under the influence of a driving force. Where water is the fluid, this is effectively the hydraulic conductivity.

**Piezometric or Potentiometric Surface.** A surface that represents the level to which water will rise in cased wells. The water table is the potentiometric surface in an unconfined aquifer.

**Recharge Area.** Location of the replenishment of an aquifer by a natural process such as addition of water at the ground surface, or by an artificial system such as addition through a well

**Saturated Zone.** Zone in which the rock or soil pores are filled (saturated) with water.

**Specific Yield.** The ratio of the volume of water a rock or soil will yield by gravity drainage to the volume of rock or soil.

**Total Dissolved Solids (TDS).** Total dissolved salts comprising dissociated compounds and undissociated compounds, but not suspended material, colloids or dissolved gases.

**Transmissivity.** The rate at which water is transmitted through a unit width aquifer or aquitard under a unit hydraulic gradient. It is a function of the properties of the water, the porous medium and the thickness of the porous medium.

**Unconfined aquifer**. An aquifer in which the water table forms the upper boundary.

**Water table.** The interface between the saturated zone and the unsaturated zone above it. The surface in an aquifer at which pore water pressure is equal to atmospheric pressure.

**Well**. A hydraulic structure that facilitates the monitoring of groundwater level, collection of groundwater samples, or the extraction (or injection) of groundwater. Also known as a bore.

# AQUADE GENERAL LIMITATIONS

**Scope of Services**

This document (the report) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and Aquade (scope of services). In some circumstances, the scope of services may have been limited by a range of factors such as time or budget constraints.

**Reliance on Data**

In preparing the report, Aquade has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, Aquade has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Aquade will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Aquade.

**Interpretations and Conclusions**

In accordance with the scope of services, Aquade has relied upon the data provided in the preparation of the report. The nature and extent of monitoring and/or testing conducted and reviewed is described in the report. The report only applies to the Hera Mine Site.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil, rock and/or groundwater conditions are encountered. Hence no monitoring can eliminate the possibility that the data obtained are not totally representative of ground and/or groundwater conditions encountered. The interpretations and conclusions herein are based upon the available data and are therefore merely indicative of the conditions from the available data at the time of preparing the report. Also, it should be recognised that the data reviewed are from a limited time period and that site conditions can change with time.

Within the limitations imposed by the scope of services, the analysis performed and the preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable hydrogeological consultants under similar circumstances. No other warranty, expressed or implied, is made.

**Report for Benefit of Client Only**

The report has been prepared for the benefit of the client and no other party. Aquade assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Aquade or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Parties other than the client should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

**Other limitations**

Aquade will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

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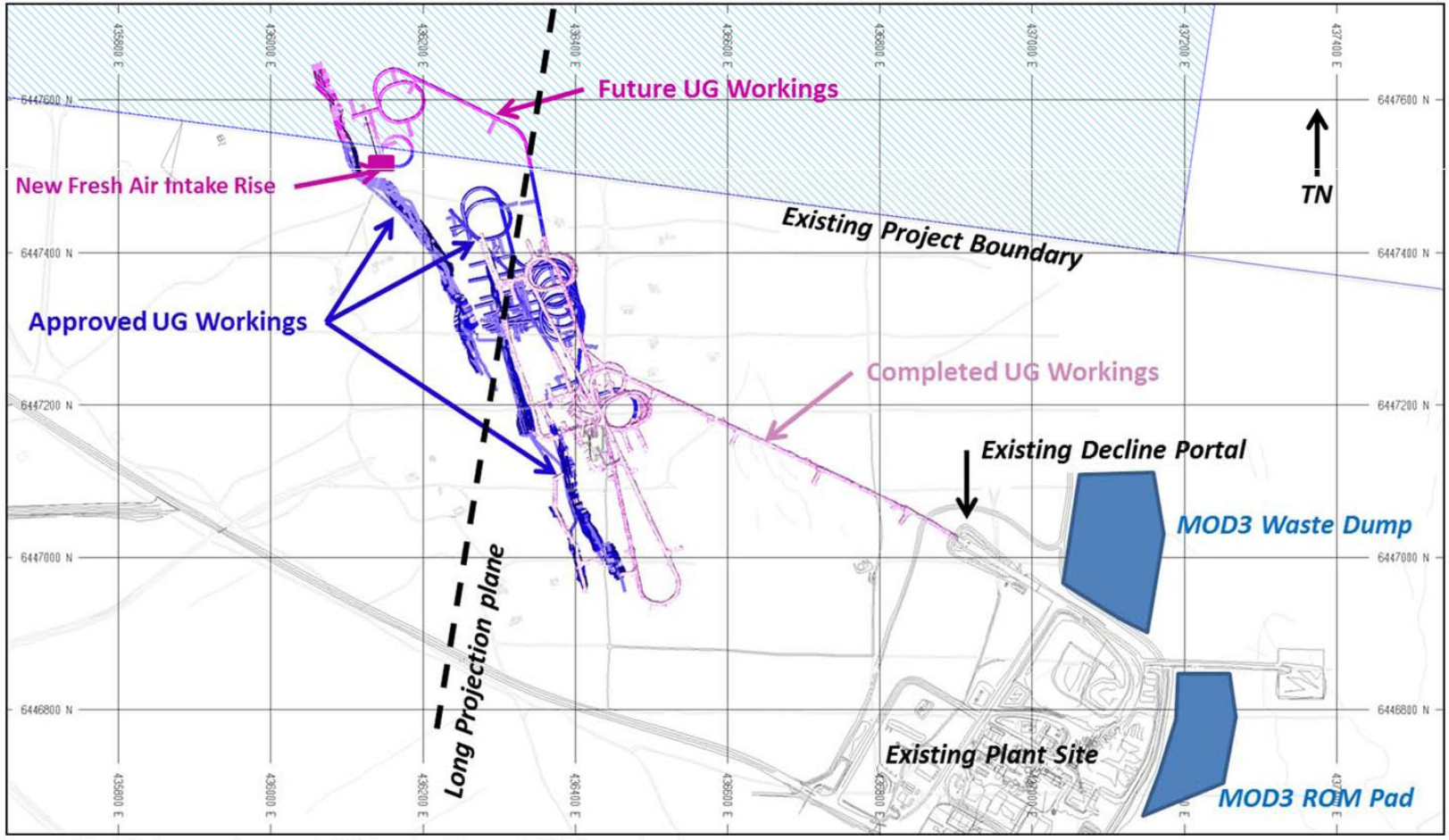
**Figure 1. Plan of the Hera Project as Currently Developed Showing Future Approved UG Workings and Future North Pod Expansion**




Notes: Modified waste dump and ROM pad subject to MOD 3 are also shown.
This figure is duplicated, with permission, from a letter from Aurelia Metals to DPI Water (Aurelia, 2015)

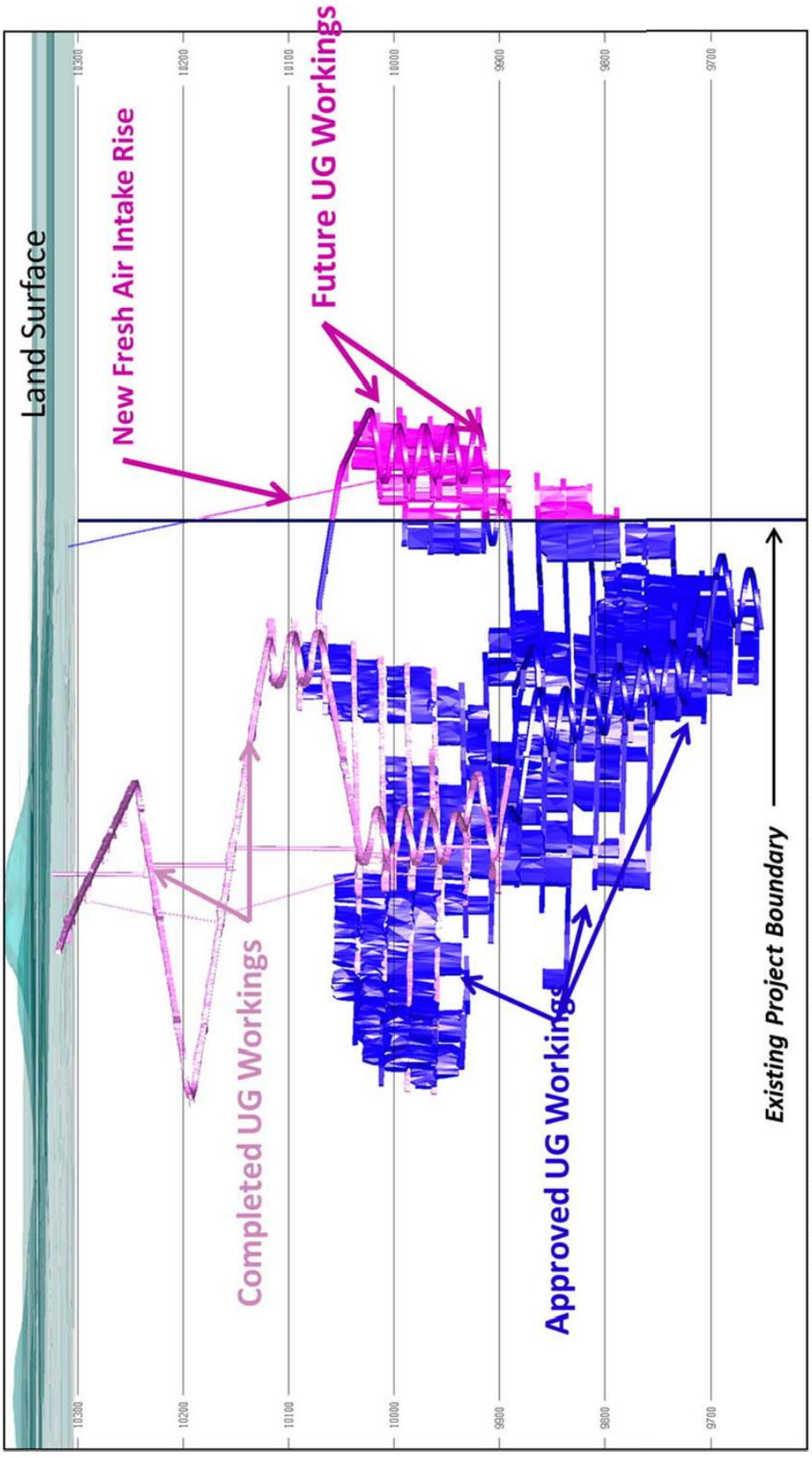



**Figure 2. Long Projection Looking West along Plane Shown in Figure 1. North is to the right.**

Note: This figure is duplicated, with permission, from a letter from Aurelia Metals to DPI Water (Aurelia, 2015)

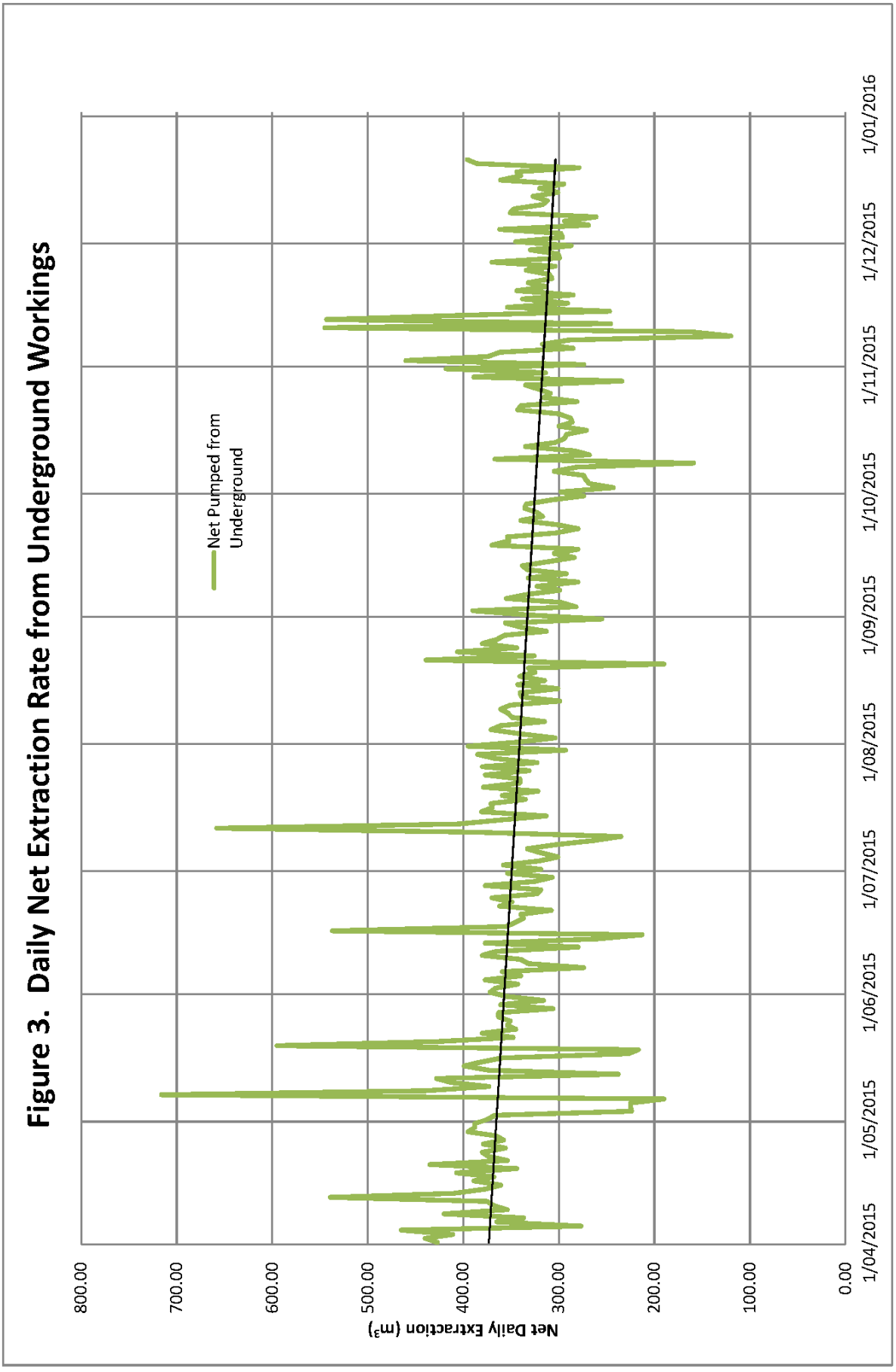


Figure 3. Daily Net Extraction Rate from Underground Workings
Net Pumped from Underground
Net Daily Extraction (m³)
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
1/04/2015
1/05/2015
1/06/2015
1/07/2015
1/08/2015
1/09/2015
1/10/2015
1/11/2015
1/12/2015
1/01/2016

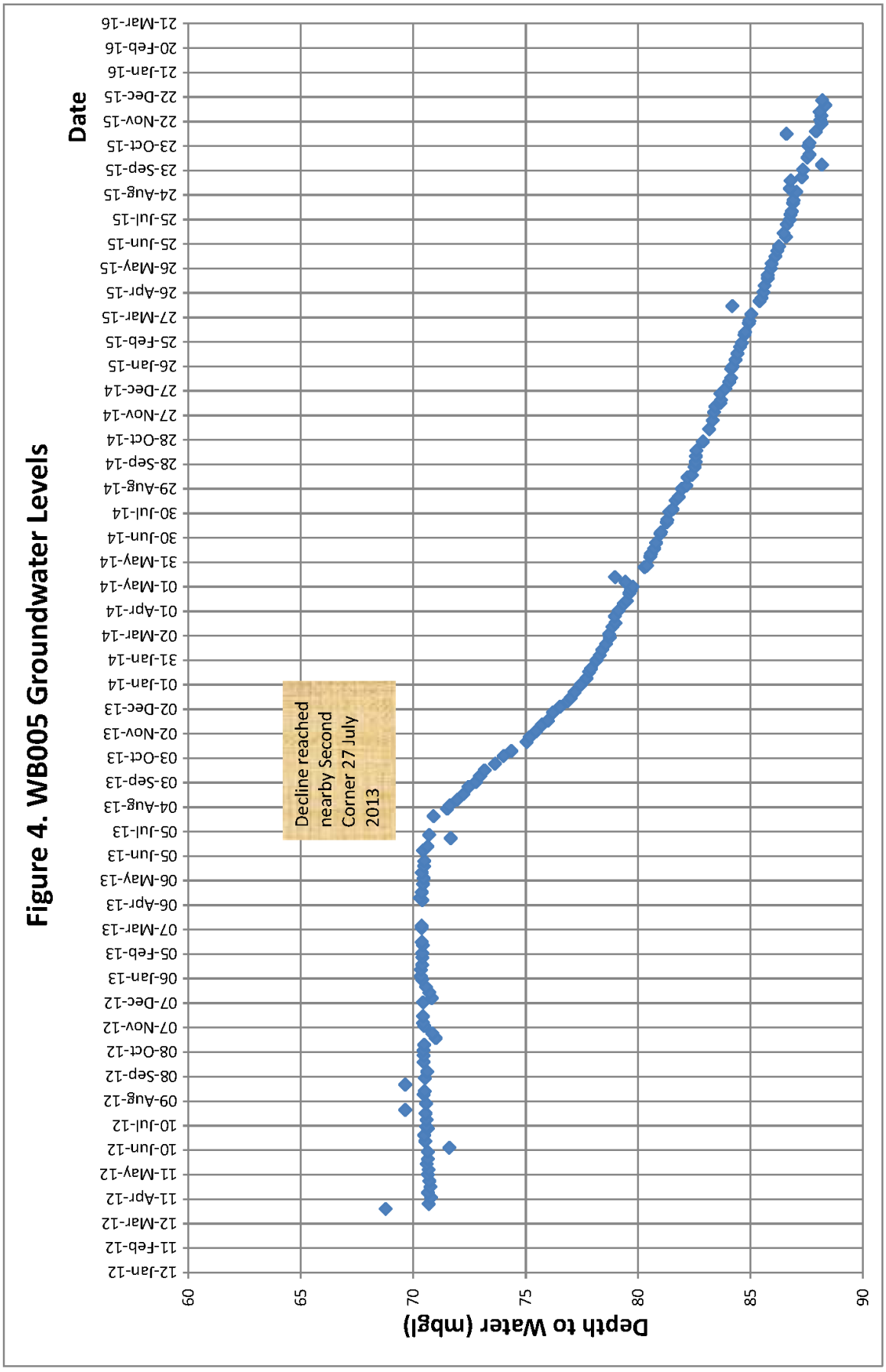


Figure 4. WB005 Groundwater Levels
Depth to Water (mbgl)
60
65
70
75
80
85
90
Date
12-Jan-12
11-Feb-12
12-Mar-12
11-Apr-12
11-May-12
10-Jun-12
10-Jul-12
09-Aug-12
08-Sep-12
08-Oct-12
07-Nov-12
07-Dec-12
06-Jan-13
05-Feb-13
07-Mar-13
06-Apr-13
06-May-13
05-Jun-13
05-Jul-13
04-Aug-13
03-Sep-13
03-Oct-13
02-Nov-13
02-Dec-13
01-Jan-14
31-Jan-14
02-Mar-14
01-Apr-14
01-May-14
31-May-14
30-Jun-14
30-Jul-14
29-Aug-14
28-Sep-14
28-Oct-14
27-Nov-14
27-Dec-14
26-Jan-15
25-Feb-15
27-Mar-15
26-Apr-15
26-May-15
25-Jun-15
25-Jul-15
24-Aug-15
23-Sep-15
23-Oct-15
22-Nov-15
22-Dec-15
21-Jan-16
20-Feb-16
21-Mar-16
Decline reached nearby Second Corner 27 July 2013

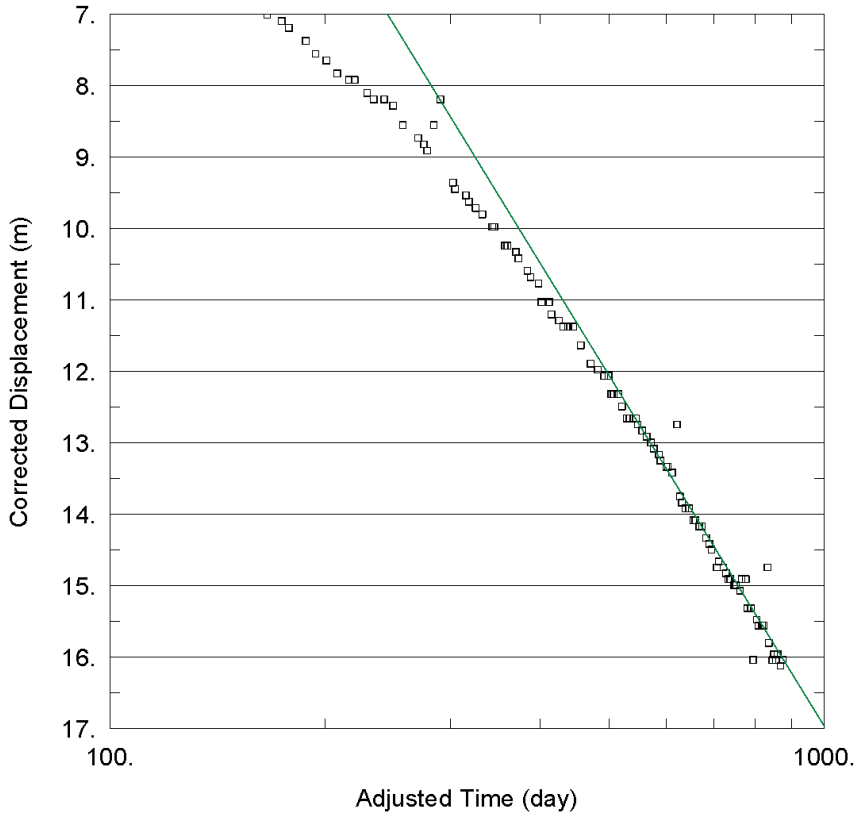



FIGURE 5. UPDATED ANALYSIS OF WB005 DRAWDOWN

Data Set: D:\...\WB5.1. DeclineWB5 Updated.aqt
Date: 01/29/16 Time: 12:10:15

PROJECT INFORMATION

Company: Aquade
Client: Aurelia Metals
Project: 2014273
Location: Nymagee
Test Well: Decline
Test Date: 2015

AQUIFER DATA

Saturated Thickness: 90. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

| Well Name | X (m) | Y (m) |
|---|---|---|
| Decline 2nd Corner | 6519 | 6938 |

Observation Wells

| Well Name | X (m) | Y (m) |
|---|---|---|
| ▫ WB5 | 6521 | 6640 |

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 3.822 $m^2$/day S = 0.008799

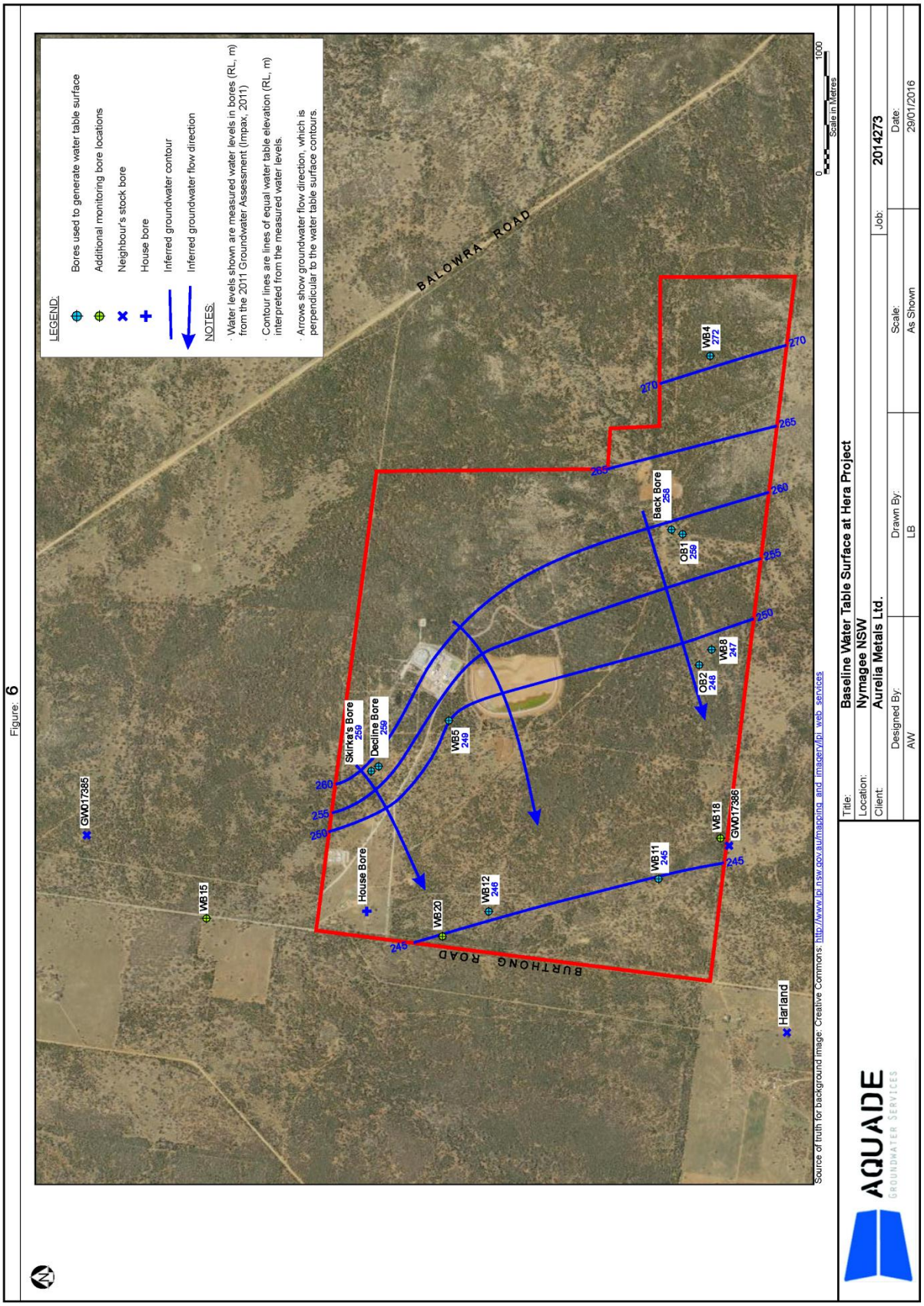


Figure: 6
LEGEND:
Bores used to generate water table surface
Additional monitoring bore locations
Neighbour's stock bore
House bore
Inferred groundwater contour
Inferred groundwater flow direction
NOTES:
· Water levels shown are measured water levels in bores (RL, m) from the 2011 Groundwater Assessment (Impax, 2011)
· Contour lines are lines of equal water table elevation (RL, m) interpreted from the measured water levels.
· Arrows show groundwater flow direction, which is perpendicular to the water table surface contours.
BALOWRA ROAD
BURTHONG ROAD
Skirka's Bore 259
Decline Bore 259
Back Bore 258
House Bore
Harland
GW017385
GW017386
WB15
WB20
WB12 246
WB11 245
WB18
WB5 249
WB8 247
WB4 272
OB1 259
OB2 248
270
265
260
255
250
245
0
1000
Scale in Metres
Source of truth for background image: Creative Commons: http://www.lpi.nsw.gov.au/mapping_and_imagery/lpi_web_services
Title: Baseline Water Table Surface at Hera Project
Location: Nymagee NSW
Client: Aurelia Metals Ltd.
Job: 2014273
Designed By: AW
Drawn By: LB
Scale: As Shown
Date: 29/01/2016
AQUADE
GROUNDWATER SERVICES

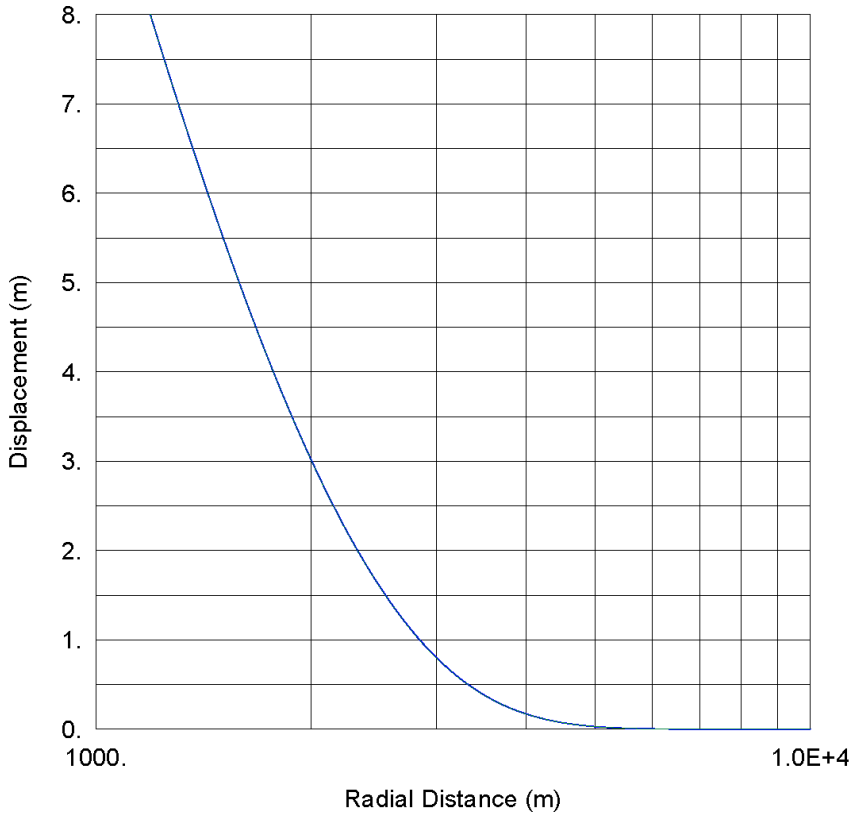



FIGURE 7. WORST-CASE DISTANCE-DRAWDOWN AFTER 10 YRS, EXTRACTION RATE 340 M3/DY

Data Set: D:\...\Dist DD 340 m3d.aqt
Date: 01/20/16 Time: 15:09:05

PROJECT INFORMATION

Company: Aquade
Client: Aurelia Metals
Project: 2014273
Location: Nymagee
Test Well: North Pod
Test Date: 2016

WELL DATA

Pumping Wells

| Well Name | X (m) | Y (m) |
|---|---|---|
| North Pod | 6000 | 7600 |

Observation Wells

| Well Name | X (m) | Y (m) |
|---|---|---|
| ▫ North Pod | 6000 | 7600 |
| ▫ WB15 | 4890 | 8620 |
| ▫ 17385 | 5579 | 9587 |

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 3.822 $m^2$/day
S = 0.008812
Kz/Kr = 1.
b = 120. m

# Appendix 3
# OzArk (2015); Ecology Field and Heritage Desktop Assessment: Proposed Air Vent at Hera Gold Mine

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# Ecology field and heritage desktop assessment for low risk proposals

# ECOLOGY FIELD AND HERITAGE DESKTOP ASSESSMENT: PROPOSED AIR VENT AT HERA GOLD MINE


**OCTOBER 2015**

# 1 Introduction

The purpose of this document is to describe the proposal, to document the likely impacts of the proposal on ecology and heritage, to detail mitigation measures to be implemented and to determine whether the project can proceed. For the purposes of these works (MOD4) Aurelia Metals is the proponent and the Department of Planning is the determining authority under Part 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The description of the proposed works and associated ecology and heritage impacts have been undertaken in the context of clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the *Threatened Species Conservation Act 1995* (TSC Act), the *Fisheries Management Act 1994* (FM Act) and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so the document helps to fulfil the requirements of section 111 of the EP&A Act, which Department of Planning examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment
- The significance of any impact on threatened species as defined by the TSC Act and/or FM Act
- The potential for the proposal to significantly impact a matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of Sustainability, Environment, Water, Population and Communities for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

# 2 The proposal

## 2.1 Description

**Title:** Ecology Field and Heritage Desktop Assessment: Proposed Air Vent At Hera Gold Mine

**Ozark Job number / Aurelia Metals PO:** #1300 / 507179-1

**Study area:** Hera Gold mine via Nymagee, NSW (**Figure 1-1 and 1-2**)

**Coordinates:** GDA z55 436140.43 East / 6447528 N

**Size of study area:** 20 x 20 m

**Local government area:** Cobar

**Description of works:** Aurelia Metals propose to:

- Build a new ventilation fan to support underground mining activities. Justification for project approval is centred on the health and safety of employees at Hera Gold Mine and the provision of a product for the people of NSW. Adequate ventilation must be provided for the mines underground employees. With adequate ventilation provided, the continuance of underground mining will allow the reliable extraction and supply of minerals, whilst providing direct employment for 110 mine employees and indirect employment for a plethora of other service providers (estimated to be 27 persons per day)
- The proposed design has been provided in the document for review cross section and the approximate length of works will be 18 months
- The footprint or area that would be disturbed is about 20 x 20 m
- Accesses tracks already exist, and land surrounding the proposal (circa 50m$^2$) has already been cleared under approval (during exploration drilling) and is suitable for set down / temporary for stockpile and parking areas etc
- No native vegetation will be cleared, hence no trees, shrubs need to be removed, and sparse ground cover will be affected

- Tree pruning or lopping is not anticipated however if required the impact has been considered
- 20 x 20 m of soil will be excavated
- drainage works are not required
- There will be no changes to pedestrian / vehicle movement.

**Objectives of works:**
Build a new ventilation fan to support underground mining activities.

**Figure 2-1: Locality**

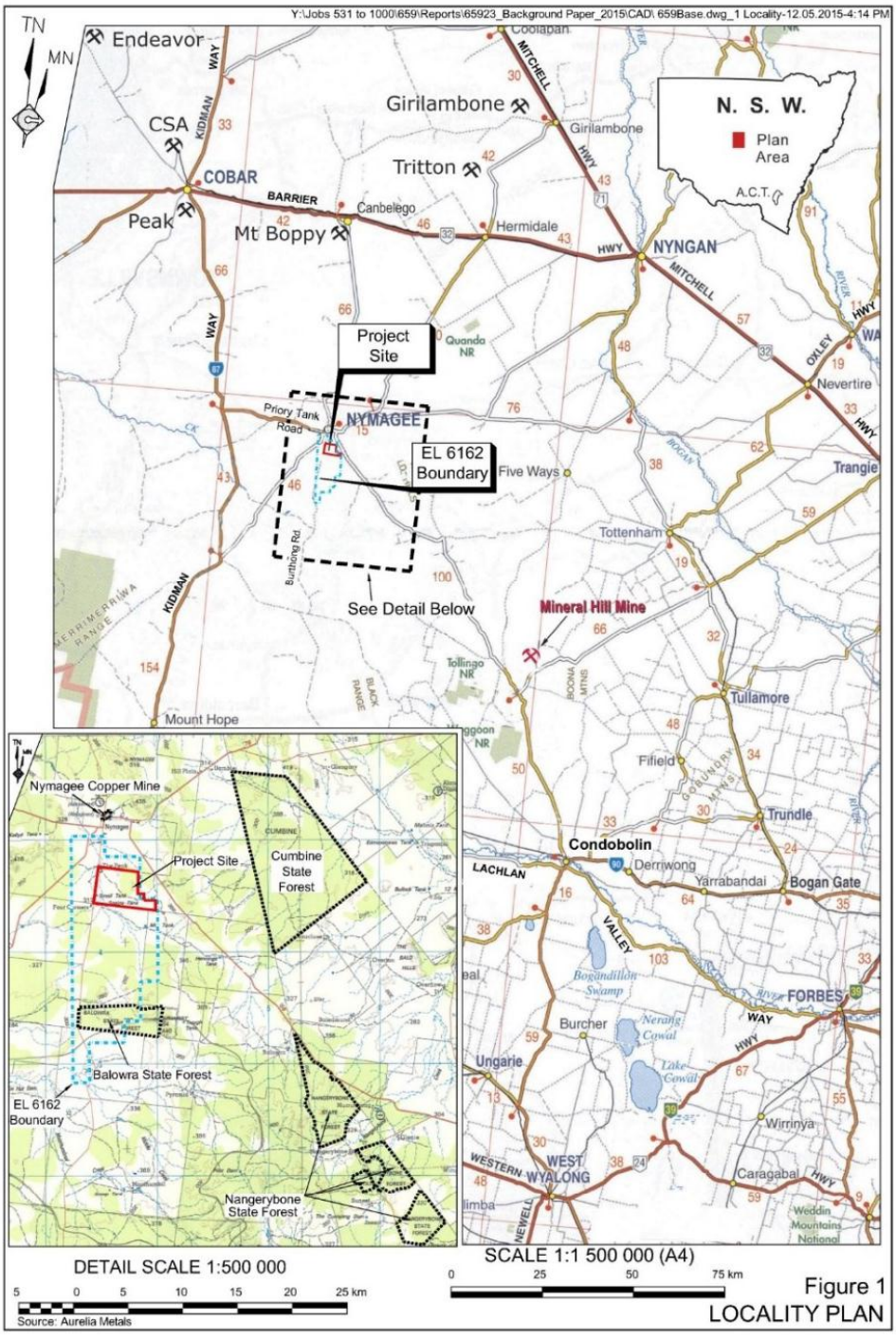
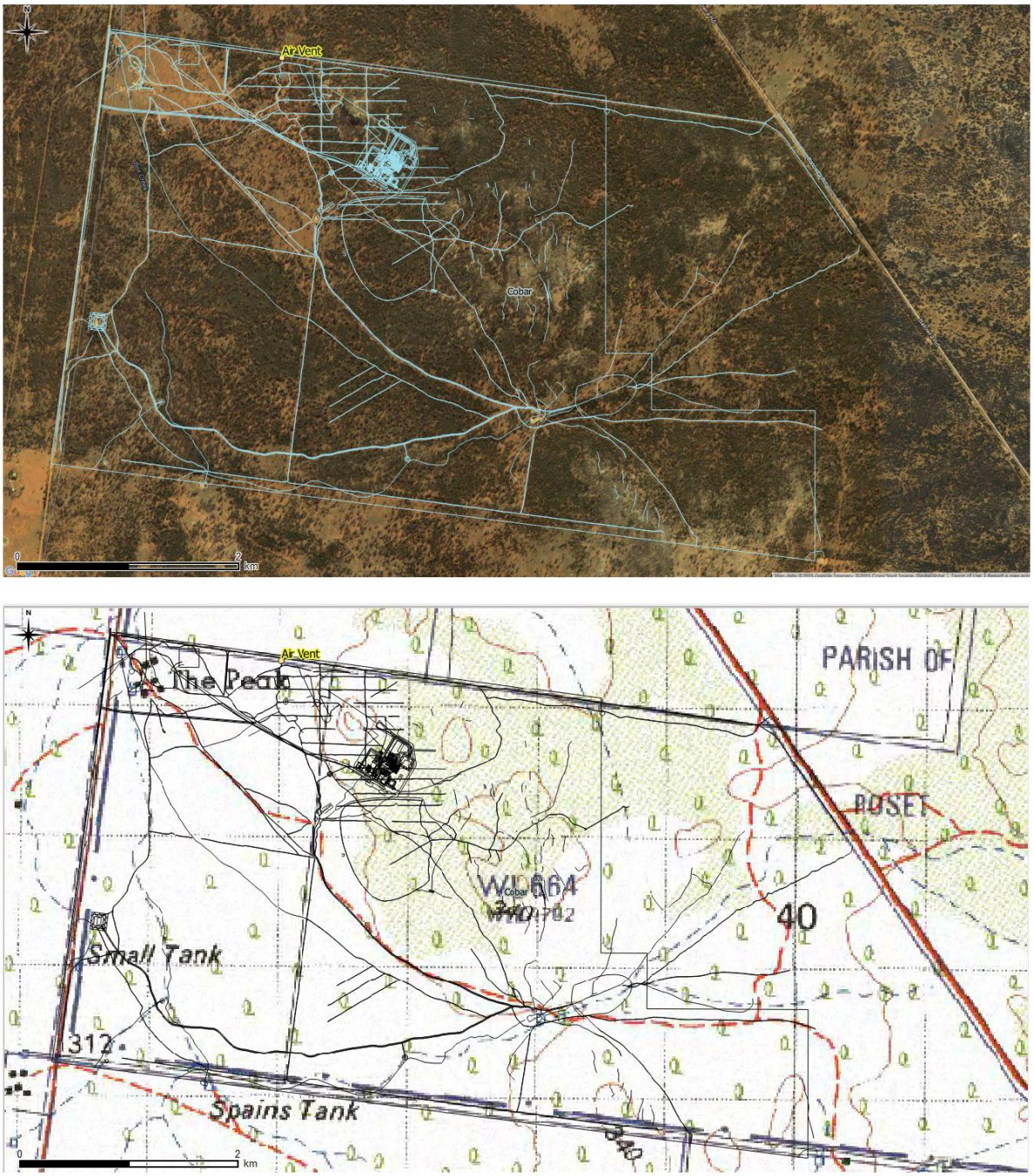


**Figure 2-2: Study area (yellow)**



# 3 Environmental assessment

The purpose of this section is to describe and assess the potential impacts (both positive and negative) of the proposal during construction and operation. For each environmental aspect, there are two subsections:

- Description of the existing environment and potential impacts
- Safeguards.

*Description of the existing environment and potential impacts*
A series of checkbox questions are provided. Under each question or group of questions, the report provides information on what additional information is to be provided for a 'yes' or 'no' response where relevant. The extent of information provided required reflects the sensitivity of the surrounding landscape, the extent of the proposal and the likely extent of the impacts.

## 3.1 Soil

*Description of existing environment and potential impacts:*

| | | |
|---|---|---|
| Are there any known occurrences of salinity or acid sulfate soils in the area? | ☐ Yes | ☑ No |
| Does the project involve the disturbance of large areas (eg >2ha) for earthworks? | ☐ Yes | ☑ No |
| Does the site have constraints for erosion and sedimentation controls such as steep gradients or narrow corridors? | ☐ Yes | ☑ No |
| Are there any sensitive receiving environments that are located in or nearby the likely project footprint or that would likely receive stormwater discharge from the project?<br>Sensitive receiving environments include (but are not limited to) wetlands, state forests, national parks, nature reserves, rainforests, drinking water catchments). | ☐ Yes | ☑ No |
| Is there any evidence within or nearby the likely footprint of potential contamination? | ☐ Yes | ☑ No |
| Is the likely project footprint in or nearby highly sloping landform? | ☐ Yes | ☑ No |
| Are the works likely to result in more than 2.5ha (area) of exposed soil? | ☐ Yes | ☑ No |
| There are no other soil and erosion issues or impacts of the works in construction and operation. | | |

***Safeguards***
Safeguards to be implemented are:

1. Erosion and sediment controls are required. An Erosion and Sediment Control Plan (ESCP), shall be prepared for the work and will be in line with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book. Landcom 2004).
2. All chemicals on site must be recorded on a chemical manifest, have up to date Material Safety Data Sheets (MSDS).
3. A suitable spill containment kit shall be available on-site at all times; all staff will be made aware of the location of the spill kit and trained in its use. If a spill occurs, the Proponents Environmental Incident Classification and Management Procedure are to be followed and the Proponents Environmental Manager notified as soon as practicable.
4. A copy of the ESCP shall be kept on-site and made available upon request. All erosion and sediment control measures must be maintained in a functional condition throughout the duration of the work.

## 3.2 Waterways and water quality

*Description of existing environment and potential impacts:*

| | | |
|---|---|---|
| Are the works located within, adjacent to or near a waterway? | ☐ Yes | ☑ No |
| Is the location known to flood or be prone to water logging? | ☐ Yes | ☑ No |
| Are the proposed works located within or immediately adjacent to the area managed by Sydney Catchment Authority covered by *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*?<br>Maps of the Sydney Water Drinking Water Catchment are available from:<br>http://www.legislation.nsw.gov.au/mapindex?type=epi&year=2011&no=28 | ☐ Yes | ☑ No |
| Are the works likely to require the extraction of water from a local water course (not mains)? | ☐ Yes | ☑ No |
| There are no other water quality issues or impacts of the works in construction and operation. | | |

***Safeguards***

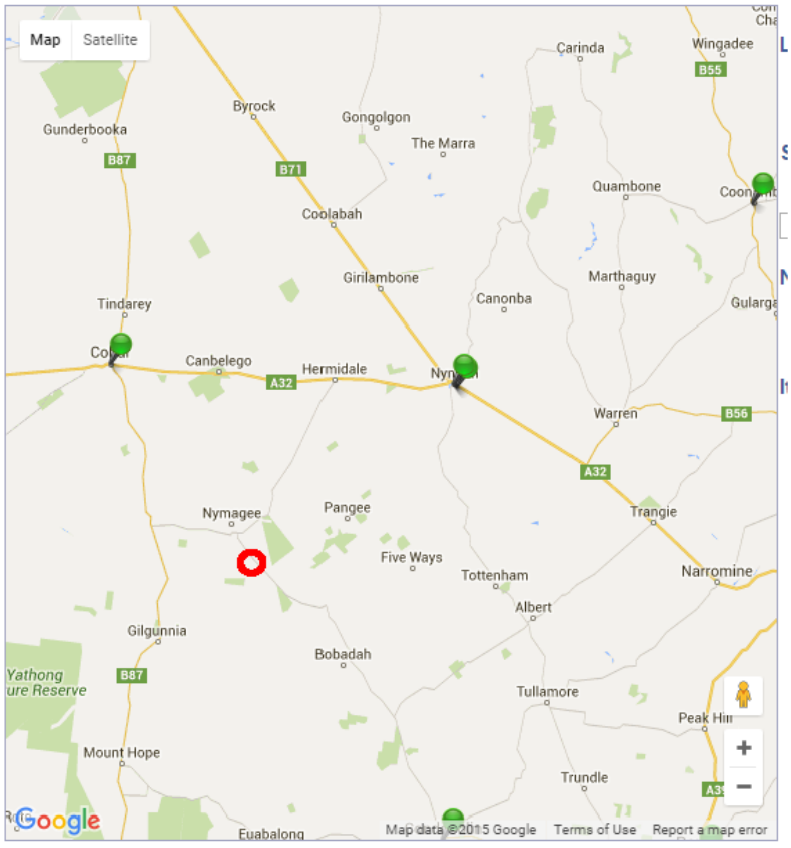
Safeguards to be implemented are:

1. Wastewater generated from the construction process (if generated) will be contained onsite, collected via a suction pump or wet industrial vacuum and/or treated in accordance with OEH specifications before its disposal. The release of dirty water into any waterways will be prohibited.
2. Ongoing maintenance will be carried out to ensure the road meets standards for safety and drainage and erosion control measures are in good working order.

## 3.3 Non-Aboriginal Heritage

*Description of existing environment and potential impacts:*

| | | |
|---|---|---|
| Have online heritage database searches been completed?<br>1. NSW Heritage database<br>2. Commonwealth EPBC heritage list<br>3. Australian Heritage Places Inventory<br>4. Local Environmental Plan(s) heritage items<br><br>No items or places are located within the Hera Gold Mine (search date 16.10.2015).<br><br>**NSW Heritage database and Heritage Places Inventory (also LEP by default). Pins show recorded heritage items.** | ☑ Yes | ☐ No |

| | | |
|---|---|---|
|  | | |
| Are there any items of non-Aboriginal heritage or heritage conservation areas located within the vicinity of the proposed works? | ☐ Yes | ☑ No |
| Are there any items of potential non-Aboriginal heritage significance within the vicinity of the works?<br>OzArk Hera Project Heritage Assessment (2011) did not record any potential non-Aboriginal heritage significance within the vicinity of the work. The OzArk project manager assessed the site in 2015 and confined no other items would be affected by the proposal. | ☐ Yes | ☑ No |
| Are works likely to occur in or near features that indicate potential archaeological remains? | ☐ Yes | ☑ No |
| There are no other non-Aboriginal heritage issues or impacts of the works in construction and operation. | | |

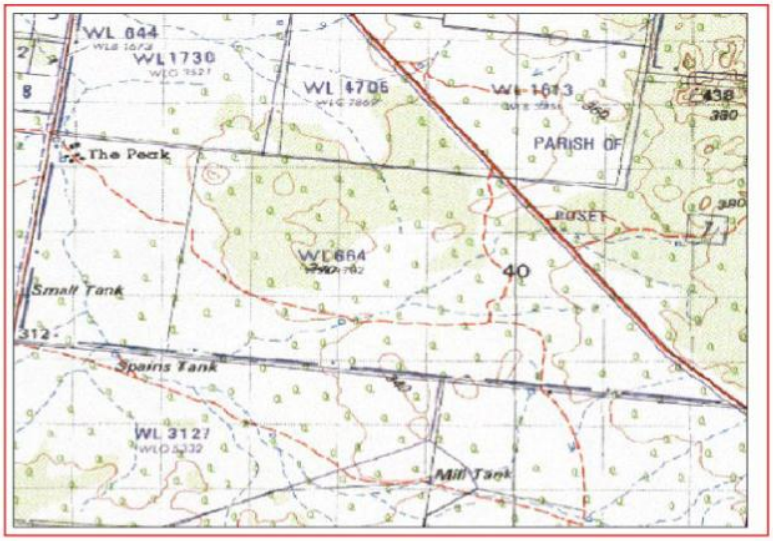
***Safeguards***
Safeguards to be implemented are:

1. All staff and operational contractors for the proposal would be provided with a heritage induction before start, informing them to stop work immediately and call Aurelia Metals environment staff in the event unanticipated relics are uncovered during the proposed work.

## 3.4 Aboriginal Heritage

*Description of existing environment and potential impacts:*

| | | |
|---|---|---|
| Would the works involve disturbance in any area that has not been subject to previous ground disturbances? | ☐ Yes | ☑ No |

| | | |
|---|---|---|
| Site cleared for mineral exploration activities. | | |
| Have online AHIMS search been completed?<br><br>A search the AHIMS database on 16.10.2015 using Lot664 DP761702 with a 0 m buffer did not return any Aboriginal sites.<br><br>**AHIMS Web Service search for the following area at Lot : 664, DP:DP761702 with a Buffer of 0 meters, conducted by Phillip Cameron on 17 October 2015.**<br><br>**The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.**<br><br>  <br><br>A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:<br><br>0 Aboriginal sites are recorded in or near the above location.<br>0 Aboriginal places have been declared in or near the above location. *<br><br>OzArk Hera Project Heritage Assessment (2011) did not record any potential Aboriginal heritage significance within the vicinity of the work. The OzArk project manager assessed the site in 2015 and confined no other items would be affected by the proposal. | ☑ Yes | ☐ No |
| Is there potential for the proposed works to impact on any items of Aboriginal heritage? | ☐ Yes | ☑ No |
| Would the works involve the removal of mature native trees? | ☐ Yes | ☑ No |
| Would the works impact on any features that may indicate any potential archaeological remains? | ☐ Yes | ☑ No |
| No other Aboriginal heritage issues or impacts of the works in construction and operation. | | |

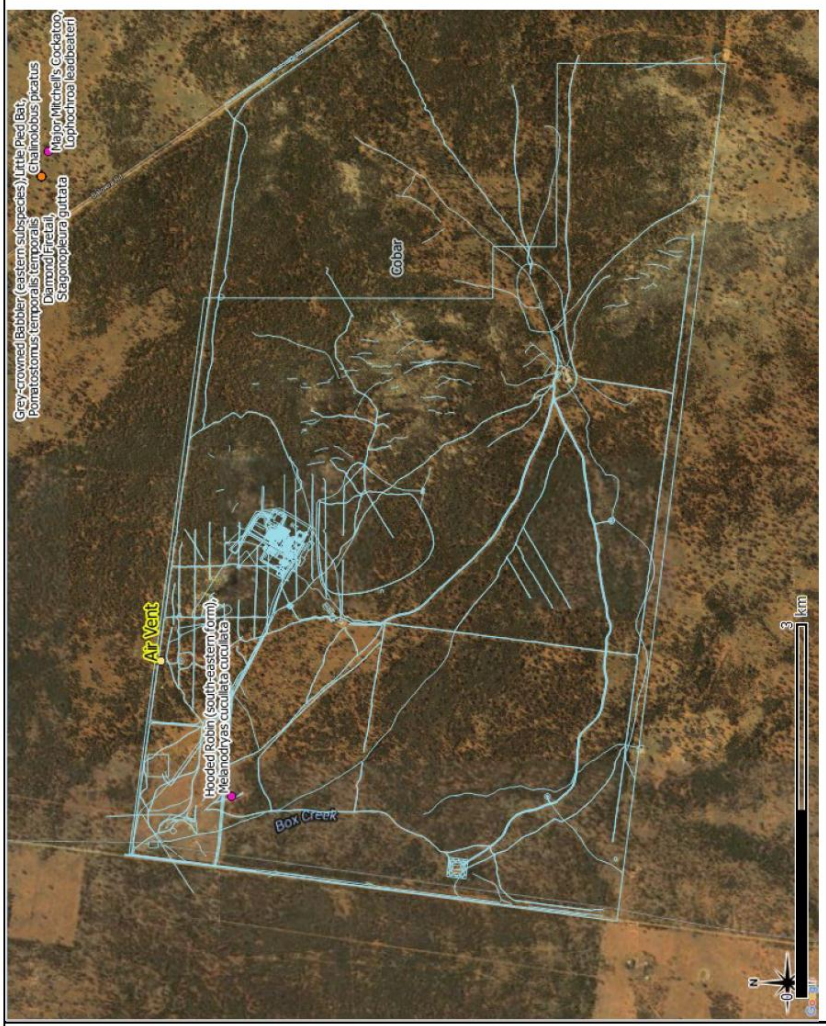
***Safeguards***

Safeguards to be implemented are:

1. All staff and operational contractors for the proposal would be provided with a heritage induction before start, informing them to stop work immediately and call Aurelia Metals environment staff in the event unanticipated relics are uncovered during the proposed work.

## 3.5 Biodiversity

*Description of existing environment and potential impacts:*

| | | |
|---|---|---|
| Have relevant database searches been carried out?<br>1. DECCW Wildlife Atlas<br>2. Commonwealth EPBC<br>A search using Western CMA (Nymagee) was submitted in 16.10.2015. No listed species plot within or immediate next to the Air Vent.<br>  <br> | ☑ Yes | ☐ No |
| Did the database searches identify any endangered ecological communities, threatened flora and/or threatened or protected fauna within the vicinity of the proposed works? | ☑ Yes | ☐ No |

| Species | Status (T, E,EEC,P)* | Type of listing | Distance from works | Impacted |
|---|---|---|---|---|
| Hooded Robin | T | TSC Act | 1.5 km | No |
| Grey-crowned babbler | T | TSC Act | 4 km | No |
| Diamond Firetail | T | TSC Act | 4 km | No |
| Major Mitchell Cockatoo | T | TSC Act | 4 km | No |
| Little Pied bat | T | TSC Act | 4 km | No |

| | | |
|---|---|---|
| Will the proposed works require the removal of any other vegetation? | ☐ Yes | ☑ No |
| Will the proposed works affect any tree hollows or hollow logs? | ☐ Yes | ☑ No |
| Are there any known areas of critical habitat, SEPP 14 wetland area or SEPP 26 littoral rainforest area within the vicinity of the proposed works? | ☐ Yes | ☑ No |
| Will the proposed works provide any additional barriers to the movement of wildlife? | ☐ Yes | ☑ No |
| Will the proposed works disturb any natural waterways or aquatic habitat? | ☐ Yes | ☑ No |
| Will the proposed works disturb any crevices or other locations (such as on bridges and culverts) for potential bat habitat? | ☐ Yes | ☑ No |
| Will there be impact on any vegetation or land that is part of an offset or is protected under a condition of approval from a previous project? | ☐ Yes | ☑ No |
| No other biodiversity issues or impacts of the works in construction and operation. | | |

***Safeguards***

Safeguards to be implemented are:

1. All personnel would be inducted and informed any stand of native vegetation outside the subject site has legislative consequences if deliberately or accidentally impacted without approval under the EP&A Act. Evidence of all personnel receiving an induction would be kept on file (signed induction sheets etc).
2. Before start of work build a physical vegetation clearing boundary at the approved clearing limit (temporary fencing, flagging tape, parawebbing or similar).
3. Vegetation would be removed in such a way to avoid damage to surrounding vegetation.
4. Erosion and sediment controls are required. An Erosion and Sediment Control Plan (ESCP), shall be prepared for the work and would be in line with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book. Landcom 2004).
5. Construction machinery (bulldozers, excavators, trucks, loaders and graders) would be cleaned using a high-pressure washer (or other suitable device) before mobilisation to the work site.
6. A pre-clearing process and unexpected threatened species finds procedure would be implemented before clearing begins.
7. Disturbed areas to be lightly ripped before vacating site to encourage revegetation of native flora species.

## 3.6 Trees

*Description of existing environment and potential impacts:*

| | | |
|---|---|---|
| Do the proposed works involve pruning, trimming or removal of any tree/s? | ☐ Yes | ☑ No |
| Do the trees form part of a streetscape, an avenue or roadside planting? | ☐ Yes | ☑ No |
| Have the trees been planted by a community group, landcare group or by council or is the tree a memorial or part of a memorial group eg. has a plaque? | ☐ Yes | ☑ No |
| Do the trees form part of a heritage listing or have other heritage value? | ☐ Yes | ☑ No |
| No other tree issues or impacts of the works in construction and operation. | | |

***Safeguards***

Safeguards to be implemented are:

1. Before start of work build a physical vegetation clearing boundary at the approved clearing limit (temporary fencing, flagging tape, parawebbing or similar).
2. Vegetation would be removed in such a way to avoid damage to surrounding vegetation.

# 4 Consideration of State and Commonwealth environmental factors

## 4.1 Environmental Planning and Assessment Regulation 2000 checklist

The purpose of this section is to consider the relevant factors in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000*. The following factors listed in clause 228(2) of the *Environmental Planning and Assessment Regulation, 2000* have also been considered to assess the likely impacts of the proposal on the natural and built environment. This consideration is required to comply with sections 111 and 112 of the *Environmental Planning and Assessment Act 1979*.

| Environmental Factor | Impacts |
|---|---|
| **(a) Any environmental impact on a community?** | No |
| **(b) Any transformation of a locality?** | No |
| **(c) Any environmental impact on the ecosystems of a locality?** | No |
| **(d) Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?** | No |
| **(e) Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present generations?** | No |
| **(f) Any impact on habitat of any protected fauna (within the meaning of the *National Parks and Wildlife Act 1974*)?** | No |
| **(g) Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air?** | No |
| **(h) Any long-term effects on the environment?** | No |
| **(i) Any degradation of the quality of the environment?** | No |
| **(j) Any risk to the safety of the environment?** | No |
| **(k) Any reduction in the range of beneficial uses of the environment?** | No |
| **(l) Any pollution of the environment?** | No |
| **(m) Any environmental problems associated with the disposal of waste?** | No |
| **(n) Any increased demands on resources, natural or otherwise which are, or are likely to become, in short supply?** | No |
| **(o) Any cumulative environmental effect with other existing or likely future activities?** | No |
| **(p) Any impact on coastal processes and coastal hazards, including those under projected climate change conditions?** | No |

## 4.2 Matters of national environmental significance checklist

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999*, the following matters of national environmental significance are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of Sustainability, Environment, Water, Population and Communities.

| Factor | Impact |
|---|---|
| a. Any impact on a World Heritage property? | Nil |
| b. Any impact on a National Heritage place? | Nil |
| c. Any impact on a wetland of international importance? | Nil |
| d. Any impact on a listed threatened species or communities? | Nil |
| e. Any impacts on listed migratory species? | Nil |
| d. Any impact on a Commonwealth marine area? | Nil |
| g. Does the proposal involve a nuclear action (including uranium mining)? | Nil |
| Additionally, any impact (direct or indirect) on Commonwealth land? | Nil |

## 4.3 Summary of safeguards and environmental management measures

This section provides a summary of the site specific environmental safeguards and management measures (**Table 4-1**). These safeguards will be implemented to reduce potential environmental impacts throughout construction and operation. A framework for managing the potential impacts is provided. Any potential licence and/or approval requirements required prior to construction are also listed.

**Table 4-1: Summary of site-specific safeguards for proposed works.**

| | |
|---|---|
| Soil | 1. Erosion and sediment controls are required. An Erosion and Sediment Control Plan (ESCP), shall be prepared for the work and will be in line with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book. Landcom 2004).<br>2. All chemicals on site must be recorded on a chemical manifest, have up to date Material Safety Data Sheets (MSDS).<br>3. A suitable spill containment kit shall be available on-site at all times; all staff will be made aware of the location of the spill kit and trained in its use. If a spill occurs, the Proponents Environmental Incident Classification and Management Procedure are to be followed and the Proponents Environmental Manager notified as soon as practicable.<br>4. A copy of the ESCP shall be kept on-site and made available upon request. All erosion and sediment control measures must be maintained in a functional condition throughout the duration of the work. |
| Non-Aboriginal Heritage | 5. All staff and operational contractors for the proposal would be provided with a heritage induction before start, informing them to stop work immediately and call Aurelia Metals environment |

| | |
|---|---|
| | staff in the event unanticipated relics are uncovered during the proposed work. |
| Aboriginal Heritage | 6. All staff and operational contractors for the proposal would be provided with a heritage induction before start, informing them to stop work immediately and call Aurelia Metals environment staff in the event unanticipated relics are uncovered during the proposed work. |
| Biodiversity | 7. All personnel would be inducted and informed any stand of native vegetation outside the subject site has legislative consequences if deliberately or accidentally impacted without approval under the EP&A Act. Evidence of all personnel receiving an induction would be kept on file (signed induction sheets etc).<br>8. Before start of work build a physical vegetation clearing boundary at the approved clearing limit (temporary fencing, flagging tape, parawebbing or similar).<br>9. Vegetation would be removed in such a way to avoid damage to surrounding vegetation.<br>10. Erosion and sediment controls are required. An Erosion and Sediment Control Plan (ESCP), shall be prepared for the work and would be in line with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book. Landcom 2004).<br>11. Construction machinery (bulldozers, excavators, trucks, loaders and graders) would be cleaned using a high-pressure washer (or other suitable device) before mobilisation to the work site.<br>12. A pre-clearing process and unexpected threatened species finds procedure would be implemented before clearing begins.<br>13. Disturbed areas to be lightly ripped before vacating site to encourage revegetation of native flora species. |
| Trees | 14. Before start of work build a physical vegetation clearing boundary at the approved clearing limit (temporary fencing, flagging tape, parawebbing or similar).<br>15. Vegetation would be removed in such a way to avoid damage to surrounding vegetation. |

## 4.4 Licensing and approvals

No licences or approvals (other than project approvals) are required or need consideration.

# 5 Certification, review and decision

## 5.1 Certification

This ecology and desktop heritage assessment provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

**Prepared by:**
Insert signature:
Insert name: Phillip CAMERON
Position title: Principal Ecologist / Senior Project Manager
Company details OzArk Environmental & Heritage Management Pty Limited
Date: 16.10.2015

**Report reviewed by:**
Insert signature
Insert name
Position title
Company details (if relevant)
Date:

## 5.2 Environment staff review

The ecology and desktop heritage assessment has been reviewed and considered against the requirements the *Environmental Planning and Assessment Act 1979*.

In considering the proposal this assessment has examined and taken into account to the fullest extent possible, all matters affecting or likely to affect ecology and heritage by reason of that activity as addressed in the ecology and desktop heritage assessment and associated information.

The assessment has considered the potential impacts of the activity on critical habitat and on threatened species, populations or ecological communities or their habitats for both terrestrial and aquatic species as defined by the *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994*.

## 5.3 Environment staff recommendation

It is recommended that the proposal to build a new air vent at Hera Gold mine as described in this report proceed subject to the implementation of all safeguards identified in the report and compliance with all other relevant statutory approvals, licences, permits and authorisations. The report has examined and taken into account to the fullest extent possible all matters likely to affect the environment by reason of the activity and established that the activity is not likely to significantly affect the environment. The report has concluded that there will be no significant impacts on matters of national environmental significance or any impacts on Commonwealth land.

**Recommended by:**

Name
Position

**Noted by:**

Name of Project Manager responsible for the proposal:
Position