Hera Resources Pty Ltd

# Federation Project

## Environmental Impact Statement

Chapter 8

Impact Assessment

# 8. Impact Assessment

## 8.1 Soils and Land Capability

### 8.1.1 Introduction

A Land and Soil Capability Assessment (LSCA) was prepared for the Project by Sustainable Soils Management (SSM) and is included as **Appendix E.** The LSCA involved soil and land capability classification through soil sampling undertaken across the Project area and a surrounding area, referred to as the study area in the LSCA and the 'soil study area' in this section, accompanied by laboratory testing for various soil parameters.

### 8.1.2 Assessment Requirements

The SEARs requirements relating to land and soil capability, and where these have been addressed, are provided in **Table 8-1**.

*Table 8-1 Land and Soil Capability SEARS Requirements*

| SEARs Requirement | Reference |
|---|---|
| The likely impacts of the development on the soils and land capability of the site and surrounds, and a description of the mitigation and management measures to prevent, control or minimise impacts of the development; | **Section 8.1.5.5**<br>**Section 7.1.6**<br>**Section 8.1.7** |
| Whether the soils in the area of the project are potentially contaminated or are acid forming (i.e., acid sulphate soils) and if so, identification of best practice mitigation measures and strategies or remedial and/or disposal actions that would be required/undertaken if applicable in accordance with relevant guidance/standards; | **Section 8.1.4.2**<br>**Section 8.1.5.1** |
| The likely agricultural impacts of the development, including biosecurity risks; | **Chapter 5**<br>**Section 8.1.6** |
| The likely impact of the development on landforms (topography), including the long-term geotechnical stability of any new landforms on site; and | **Chapter 5** |
| The compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements of Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*, paying particular attention to the agricultural land use in the region; | **Chapter 5**<br>**Section 8.1.6** |

### 8.1.3 Existing Environment

The northern half of the soil study area has been mapped as Yackerboon Rolling Downs and Lowlands Land System, and most of the southern half of the Project area as Kopyje Land Systems with undulating land surface (Walker, 1991). Lithosols (shallow rocky soil) dominate in the Kopyje Land System, while red earths dominate in the Yackerboon Land System. Walker mapped the area of the surface extraction area[1] and communication tower as Glenown Land System, in which the dominant soil is shallow sandy soil.

The dominant geology in the soil study area is Quaternary residual material that has either been washed down the hills (colluvium) or been deposited by wind (eluvium). Rock outcrops in the Project boundary have a range of geology, consisting of fine sandstone from the Burthong group, coarser sandstone in the Roset Sandstone, or interbedded siltstone and sandstone of the Lower Ampitheatre Group.

The background information indicates that the soil study area is expected to contain a mixture of shallow stony soil in elevated areas, and deep red soil on footslopes and in plains with a range in soil pH expected. The geology indicates that the soil is likely to be sandy or loamy rather than clayey. The land shape surfaces indicate that the majority of the soil study area is in an erosional rather than depositional part of the landscape.

### 8.1.4 Assessment Approach

The LSCA firstly divided the soil study area into soil mapping units, which are zones with consistent soil type and landscape properties. Each soil mapping unit was then assigned a Land and Soil Classification (LSC) class. The soil and landscape assessment was undertaken as a stratigraphic survey of soil within the soil study area. A stratigraphic soil survey is one in which properties at each location are assumed to be broadly correlated with the position in the landscape and broad scale variables such as geology and slope. This is an approach to correlate sediments based on soil-related criteria. Soil properties between each site observed are then expected to vary with covariates such as slope, soil colour or geology. These covariates are then used to map soil mapping unit boundaries.

#### 8.1.4.1 Soil Sampling Methodology

Sample sites were selected using different strategies for the Federation Site and solar farm at Hera Mine, and the narrow linear Services Corridor. The Federation Site (soil study area of 70 ha including 40 m buffer) was sampled with 7 pits and 2 observation sites giving a sampling intensity of one sample per 8 ha. The solar farm site (soil study area of 20 ha including 40 m buffer) was sampled with 5 pits giving a sampling density of one sample per 4 ha.

The sampling intensity of 14 pits and 1 observation site over the 17 km Services Corridor and access roads is considered medium to low intensity. The location of the soil mapping units is provided in **Figure 2-3.**

Selected soil properties in each pit were described according to the 'Australian Soil and Land Field Survey Handbook' (National Committee on Soil and Terrain , 2009). The soil properties described were:

- Depth of each horizon;
- Texture;

[1]Referred to as 'quarry' in the LSCA.

- Field pH using a kit based on the specifications of Raupach and Tucker;
- Dispersion;
- Root density;
- Proportion of soil occupied by gravel;
- Main colour and degree of mottling;
- Grade and type of structure and primary ped size;
- Size and type of concretions;
- Effervescence as an indication of the proportion of soft carbonates;
- Permeability and drainage were assessed for the profile as a whole; and
- Nature of surface 2 cm of soil, i.e., whether or not soil was hard setting.

Additional measurements taken were:

- Potential rooting depth for annual field crops was estimated from structure, texture, and pH;
- Volume of Readily Available Water (RAW) was calculated from rooting depth and standard estimates of available water for each texture class;
- Salinity was estimated by measuring the electrical conductivity of a suspension of 1 volume of soil in 5 volumes of water; and
- SOILpak score according to (McKenzie D. , 1998).

Each profile was classified to Suborder level of the Australian Soil Classification of Isbell (Isbell, 2002).

Soil samples were collected from standard depths of 0 to 5 cm, 5 to 15 cm, 15 to 30 cm, 30 to 60 cm and 60 to 100 cm for all sites unless the depth range covered the boundary between the A and B horizons of duplex profiles. The measured soil properties assess soil fertility, presence of toxic soil chemistry and the chemical indicators of likely soil structure.

Soil properties in the soil study area were assessed by examining soil profiles in backhoe pits dug at least 1.0m deep or to refusal when rock was encountered. The relatively shallow depth for this investigation was due to the small size of the excavator that was used to minimise the damage to vegetation and was considered adequate to provide a sound understanding of soil qualities.

Two sets of soil properties relevant to disturbance during the Project life were assessed at each detailed soil sampling site. The 'soil stripping suitability' rates and the suitability of soil for use as topdressing material (topsoil) during Project rehabilitation. The 'soil erodibility factor' is an estimate of the susceptibility of agricultural soil to water erosion.

The suitability of soil for use during rehabilitation was determined while assessing soil pits using the physical assessment method. The 8 step procedure is as follows:

- Step 1 Structure grade: Medium or strong structure grade has more than 30% peds, weak structure grade has less than 30% peds, massive structure has no peds (National Committee on Soil and Terrain , 2009);
- Step 2 Coherence wet: None or partial field slaking indicates some wet coherence, complete slaking indicates no wet coherence;

- Step 3 Mottle: Layers were classified as mottled if there was more than 5% mottle and the mottle type was not biological;
- Step 4 Macrostructure: Dimensions classified as greater than 10 cm if both the primary and secondary ped size were larger than 10 cm;
- Step 5 Force to disrupt peds: Not assessed because of wide range of subsoil moisture content during field assessment;
- Step 6 Texture: Texture and the proportion of coarse fragments and segregations were extracted from the field soil descriptions;
- Step 7 pH: pHH20 from field pH estimates; and
- Step 8 salinity: From measured electrical conductivity of 1:5 suspension converted to electrical conductivity of saturated extract using texture dependant factors.

Soil erodibility was determined through the calculation of the K factor. Using a standard equation, based on the following inputs: organic matter obtained by multiplying organic carbon of 0 to 5 cm layer by 1.72; soil texture estimated in the field or laboratory measured particle size for selected samples, surface soil structure; and profile permeability described in the field.

The land and soil capability was determined according to criteria in the *Land and Soil Capability Assessment Scheme: second approximation* (OEH, 2012). Capability assessment is based on slope, wind hazard, soil pH, surface structural stability, salinity, rock outcrop, waterlogging potential, and existing erosion (OEH, 2012). The LSC assessment classifies land into one of eight land and soil capability classes. These classes give an indication of the intensity of use the land can withstand without suffering land and soil degradation as shown in **Table 8-2** below.

*Table 8-2 Land and Soil Capability Classes*

| LSC class | Description |
|---|---|
| Land capable of wide variety of uses (cropping, grazing, horticulture, forestry, nature conservation). | |
| 1 | Extremely high capability land: Land has no limitations. No special land management practices required. Land capable of all rural uses and land management practices. |
| 2 | Very high capability land: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation. |
| 3 | High capability land. Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental limitations. |
| Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation). | |
| 4 | Moderate land capability land: Land has moderate to high limitations for high-impact land uses. Would restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment, and technology. |

| | |
|---|---|
| 5 | Moderate-low capability land: Land has high limitations for high-impact land uses. Would largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations would need to be carefully managed to prevent long-term degradation. |
| Land capable of a limited set of land uses (grazing, forestry, nature conservation and some horticulture). | |
| 6 | Low capability land: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation. |
| Land generally incapable of agriculture land use (selective forestry, nature conservation). | |
| 7 | Very low capability land: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation. |
| 8 | Extremely low capability: Limitations are so severe that land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation. |

#### 8.1.4.2 Contamination

A review of the EPA contaminated lands register was undertaken to identify the presence of recorded contamination within the Project boundary or in adjacent land. The search did not identify any recorded contaminated sites in the Project boundary, adjoining lands or within the Cobar Local Government Area (LGA).

Prior to the establishment of Hera Mine the site was used for grazing and agricultural purposes. The Federation Site is a greenfield site and has previously been used for low level grazing.

Discussion with the Hera Mine environmental manager confirmed there are no known areas of contamination at Hera Mine. The management of hazardous materials and fuels is undertaken in accordance with the Mine's Hazardous Materials Management Plan. Fuel areas are bunded and suitable spill equipment is strategically located at locations around the Hera Mine site. Furthermore, the soils sampling undertaken across the Project area did not identify any soils where odour or staining were present.

Given the nature of previous land use and current controls in place, the likelihood of contamination is considered negligible.

### 8.1.5 Results

The soil mapping units reflected variations from the soil theme across the soil study area of red, non-saline, slightly to moderately acidic clay loam to light clay, with large variation in gravel content and depth to rock. The resulting soil mapping units (refer **Figure 2-3**) are:

- Dermosol soil mapping unit was red with sandy clay loam topsoil trending to light clay with depth. Most pits had more than 1 m of soil, which appears to have been deposited during multiple cycles;
- Non-Calcic Dermosol soil mapping unit had red clay loam topsoil over red light clay subsoil. It was found in footslopes of hills in the soil study area and was constrained by low pH, elevated exchangeable aluminium, low nutrient levels and moderate rootzone depth;
- Rudosol soil mapping unit had red sandy clay loam topsoil, but layers with more than 50% gravel were encountered at an average depth of 20 cm. Rudosol occurred over the slopes and crests of hills in the soil study area;

- Acidic Rudosol soil mapping unit was characterised by shallow depth to layers with more than 50% gravel and an acidic layer that extends from at least 5 to 30 cm. The Acidic Rudosol soil mapping unit occurred on hills and parent material was logged as fine sandstone; and
- Tenosol soil mapping unit occupied the hill area of the telecommunications tower and gravel pit and access tracks. There was a thin layer of soil on this land.

Further details of the soil properties of each soil mapping unit are detailed in Section 4 of **Appendix E**.

#### 8.1.5.1 Acid Sulphate Soil Assessment

The soil study area was overlaid on the ASRIS Atlas of Australian Acid Sulphate Soils in, which showed there is extremely low probability of acid sulphate soil in the soil study area.

(McKenzie N. J., 2004) state that acid sulphate soils are "*derived from saline soil or sediment that have an accumulation of iron sulphides and whose stability is maintained by waterlogged or strongly reducing conditions*".

The soil study area is lacking 2 of the 3 criteria required for Acid Sulphate Soil to develop in that the whole profile was close to oven dry when inspected in 2020, and dry below 30 cm in 2021, and the soil inspected had very low salinity. Consequently, acid sulphate soil was not detected in the soil inspected in the soil study area.

#### 8.1.5.2 Land and Soil Capability Classification

The assessment of LSC classes for the soil study area was based on data collected during the field survey, laboratory analysis of soil samples and is supplemented with information collected during the desktop assessment in accordance with the methodology provided in **Section 8.1.4**. The Land and Soil Capability assessment resulted in 61ha or 23% of the soil study area being rated as suitable for restricted cultivation (LSC Class 4) and the remainder rated as unsuitable for cultivation. Seventy-six ha (24% of the soil study area) was rated as having severe limitations for cropping (LSC Class 5). One hundred and twelve ha (43% of the soil study area) was rated as suitable only for low impact agricultural uses such as grazing or forestry (LSC Class 6). The remaining 16 ha (6% of the soil study area) has little agricultural potential (LSC Class 7).

The distribution of LSC was strongly dissected because soil mapping units and LSC class were controlled by position on hills, slopes and valleys, with the rolling hills presenting large variations. In essence, LSC class 4 occurred in depositional areas or valley floors, while the LSC class became more restrictive (higher LSC class) with distance uphill slopes. LSC for the soil study area is provided in **Figure 8-1** below.

#### 8.1.5.3 Disturbed Soil Properties

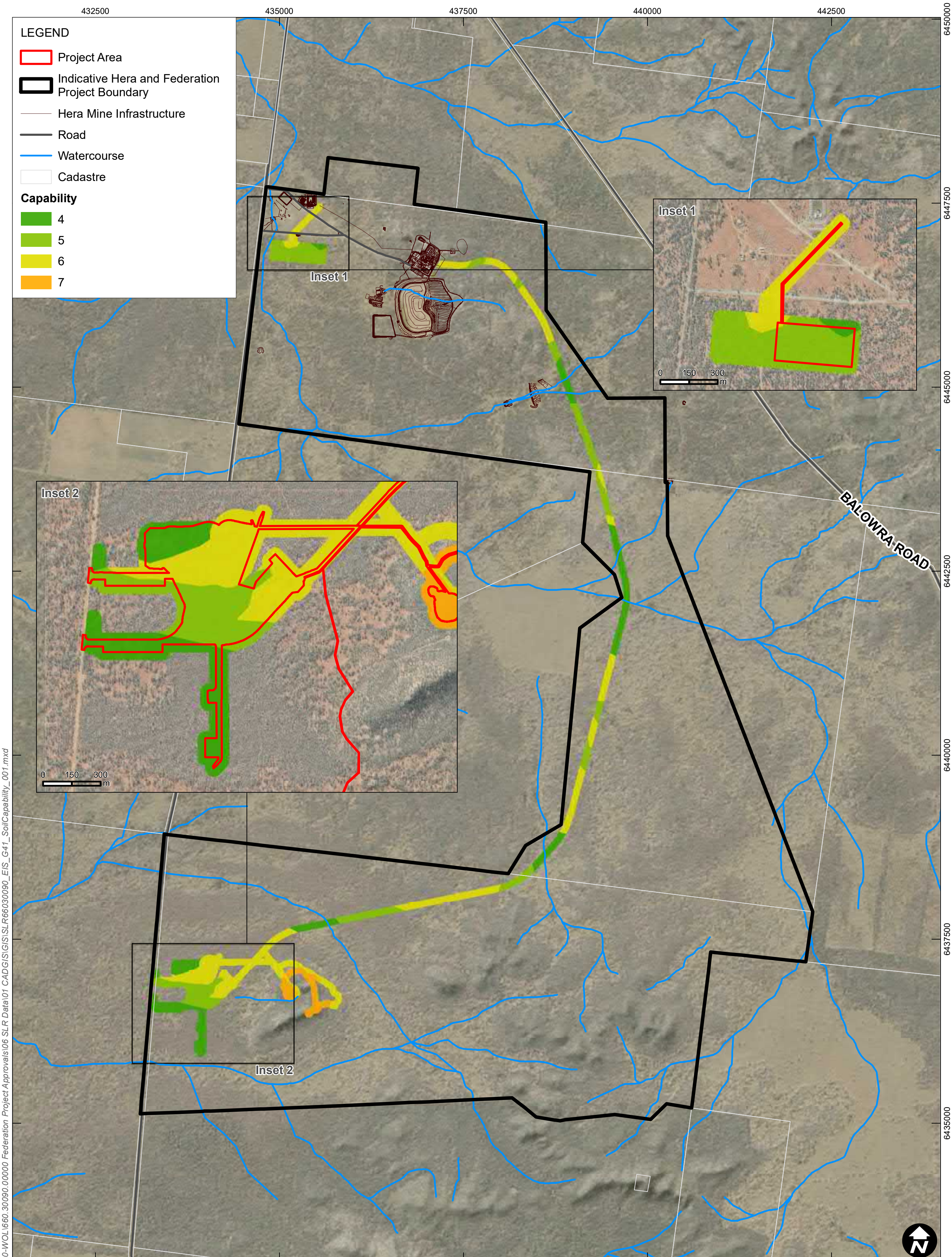
The Project would require stripping of soil, with future use for rehabilitation, which is more disruptive to soil than agricultural practices. Properties of the stripped soil are described below in **Table 8-3**. The depth of soil suitable for stripping was essentially inversely proportional to the LSC class. This is because the most limiting LSC hazard was shallow soil depth and the dominant limitation to soil stripping depth was depth to coarse fragments.

*Table 8-3 Depth of Soil Suitable for Use as Topsoil During Rehabilitation*

| Soil Mapping Unit | Average Stripping Depth (cm) | Stripping Depth Range (cm) | Dominant Limitation | Surface Soil Erodibility of tested sites |
|---|---|---|---|---|
| Dermosol | 75 | 35 to 135 | Coarse fragments in gravel layers | Highly erodible |
| NonCalcic Dermosol | 60 | 35 to 140 | Coarse fragments of weathered rock | Moderately erodible |
| Rudosol | 15 | 10 to 50 | Coarse fragments of weathered rock | Highly erodible |
| Acidic Rudosol | 30 | 15 to 50 | Coarse fragments of weathered rock | 50% moderately erodible, 50% highly erodible |
| Tenosol | Essentially zero | | Rock outcrop | Not assessed |

The depth of soil suitable for stripping is most relevant at the Federation Site. The pattern of stripping suitability in this area is complex (as per **Table 8-3**) as the depth to coarse fragments is shallower in locally high areas than low areas and along drainage lines, which are also depositional areas, that run from east to west across the Federation Site.

The soil was moderately to highly erodible (as per **Table 8-3**). This means that even though the soil study area experiences relatively low rainfall, care would be required to minimise erosion of disturbed soil.




Scale: 1:65,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

SLR

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
& Aerometrex Pty Ltd, 2019
Soil data supplied by Sustainable Soils Management Pty Ltd

**LAND AND SOIL CAPABILITY CLASSIFICATION**

**FIGURE 8-1**

#### 8.1.5.4 Soil Resources

The goal of soil management practices would be to minimise soil degradation in the forms of:

- Soil compaction associated with heavy vehicle and machinery use during soil stripping, stockpiling and respreading operations;
- Loss of soil resource when areas of soil, that have not been stripped, are disturbed during construction of infrastructure or buried beneath stockpiles;
- Soil sheet erosion when the stable topsoil is disturbed and when surface drainage is modified by reshaping the land;
- Soil gully erosion in drains constructed to divert surface water around the proposed mining operations; and
- Soil contamination from hydrocarbon spills.

The planned disturbance and rehabilitation in the Project area, as relevant to management of soils, is described in **Table 8-4** below.

*Table 8-4 Project Area Soil Management Summary*

| Zone | Planned Disturbance | Planned Rehabilitation |
|---|---|---|
| Federation Site | | |
| Whole Site | Clear and grub trees, strip topsoil and stockpile. Control regrowth. | Landform as required, replace stockpiled topsoil, allow regrowth of vegetation |
| Heavy vehicle access road, Site roads | Strip topsoil and stockpile. Import subgrade and road surface and compact. (including from other existing and proposed Project disturbance areas) | Rip road to create porosity, replace topsoil, allow regrowth of vegetation. |
| Topsoil stockpiles | Place topsoil stockpiles. | Remove stockpile, loosen surface that remains, allow regrowth of vegetation. |
| Infrastructure hardstand areas | Strip topsoil and stockpile, level site. Construct hard stand areas. | Remove infrastructure, demolish hardstand areas, loosen subgrade, replace topsoil, allow regrowth of vegetation. |
| Services Corridor | | |
| Whole corridor | Strip and stockpile topsoil from track, clear and grub trees, control regrowth. | Loosen track surface, replace stockpiled topsoil, allow regrowth. |
| Pipelines | On surface, minimal disturbance to soils | None. Remove and dispose of pipeline, allow regrowth. |
| HV powerline | Holes drilled for power poles and poles installed. | Remove poles, backfill holes, allow regrowth. |
| Track | Strip and stockpile topsoil. Level surface, provide drains to manage runoff. Import road surface (if required) and form track. | Loosen track surface, replace stockpiled topsoil, allow regrowth. |
| Access to surface extraction area and communications tower | | |
| Surface extraction area access road | Strip and stockpile topsoil. Level surface, provide drains to manage runoff. Import road surface and form road. | Loosen track surface, replace stockpiled topsoil, allow regrowth. |

| | | |
|---|---|---|
| Surface extraction area | Excavate gravel | Minimal |
| Communications tower access | Strip and stockpile topsoil. Level surface, provide drains to manage runoff. Import road surface (if required) and form track. | Loosen, track surface, replace stockpiled topsoil allow regrowth. |
| Solar farm and powerline | | |
| Whole site | Clear and grub trees. | None. |
| Solar farm | Manage regrowth and weeds | Remove infrastructure, allow regrowth |
| Solar panels | Piles driven into soil. | Piles extracted from soil, allow regrowth. |
| Internal power distribution | Power cable buried in trenches. | Cables removed (copper is valuable), surface levelled, allow regrowth. |
| Power line | Holes drilled for power poles and poles installed. | Remove poles, backfill holes, allow regrowth. |
| Bore water pipeline and bore pads | | |
| Pipeline paths | Use existing tracks and fence lines where possible to minimise disturbance. Elsewhere tracks on surface with limited vehicle use. | Add drains to manage runoff where needed, loosen surface of tracks remove pipelines, allow regrowth |
| Bore pad | Clear and grub footprint, then allow regrowth. | Decommission bore, allow regrowth. |

#### 8.1.5.5 Post Project Land and Soil Capability

The goal in the Project's rehabilitation strategy is to return disturbed land to a condition that is stable, non-polluting, and supports the proposed post mining landuse, which is rangeland grazing with mixed native vegetation. Rehabilitation practices would essentially be to provide favourable soil conditions for plant growth and allow recruitment of naturalised plants. Some infrastructure may be retained for the benefit of future landholders and hence will not be rehabilitated.

A secondary goal is to return the land to the same LSC class as existed before the Project. Soil requirements to achieve this are listed in **Table 8-5** below.

*Table 8-5 Soil Requirements to Achieve Selected LSC Class Based on OEH (2012)*

| Hazard | Region Specific Requirement | | |
|---|---|---|---|
| | LSC 4 (Dermosol) | LSC 5 (NonCalcic Dermosol) | LSC 6 (Rudosol, Acidic Rudosol) |
| Water erosion | Slope flatter than 5% | Slope flatter than 5% | Slope flatter than 33% |
| Wind Erosion | Any exposure with texture observed | | |
| Soil Structure Decline | Hardsetting or more stable structure | | |
| Acidification | $pH_{CaCl2}$ > 4.0 with observed texture | Any | |
| Salinity | Any | | |
| Shallow soil | Minimum soil depth of 50 cm | Minimum soil depth of 25 cm | |

| | |
|---|---|
| Mass movement | Mass movement not observed |

The volume of soil required to achieve the aim of restoring land to the LSC class that existed before the Project is shown in **Table 8-6** below. This indicates that there is sufficient soil available to provide the whole of the soil requirements. However, this will only be required in areas where soils are stripped prior to infrastructure establishment, such as the box cut and waste rock pads. In other areas, loosening the subgrade and replacing 15 cm topsoil should be adequate.

*Table 8-6 Post Project LSC class in the Project area.*

| Soil Mapping Unit | Area in Federation Site to be disturbed (ha) | Depth required (cm) | Volume required ($m^3$) |
|---|---|---|---|
| | | Soil | Soil |
| Dermosol | 10 | 50 | 48,000 |
| NonCalcic Dermosol | 13 | 25 | 31,000 |
| Rudosol | 12 | 25 | 29,000 |
| Acidic Rudosol | 5 | 25 | 12,000 |
| Total | | | 120,000 |

The LSCA concluded that land in the soil study area can be returned to the same LSC class that existed before the Project with the exception of 1.5 ha of roads that will be retained for use by a future landholder (noting that other infrastructure areas such as powerlines and dams may also be retained for use by a future landholder).

### 8.1.6 Potential Impact to Agricultural Productivity

- The main potential impact of the Project on agricultural productivity would be to remove an area from agricultural landuse for the duration of mining plus the time taken for the land to return to its current level of production. This was estimated based on the following assumptions:
- An area of 50 ha that would be removed from agricultural production (that portion of the Project area from which soils will be stripped prior to infrastructure establishment), reduced to LSC class 8 during the Project life;
- Productivity of the land removed from agriculture would be equivalent to the average for rangeland grazing in the Cobar LGA; and
- Land would return to its current level of agricultural productivity after the site is rehabilitated and criteria is met as per the rehabilitation strategy.

The Cobar LGA covers 4,557,535ha, west of the centre of NSW. The dominant agricultural land use is grazing. Australian Collaborative Land Use and Management Program (Australian Collaborative Land Use and Management Program, 2016) reports that 93% of the Cobar LGA is used for grazing, however, ABS (2017) indicates that 38% of this land returned an estimated value of agricultural operations (EVAO) less than $5,000 per holding. Consequently, the ACLUMP did not classify 1,700,579 ha of land used for agriculture as agricultural holdings as per **Table 8-7** below.

*Table 8-7 Land Use in Cobar Local Government Area*

| Zone | Total Area (ha) | Data source | Area of agricultural holdings (ha) | Land used mainly for grazing (ha and %) |
|---|---|---|---|---|
| Cobar Shire | 4,557,535 | ABS (2017)* | 2,649,421 | 2,467,066 (93%) |
| | | ACLUMP (2016) | 4,247,000 | 3,956,000 (93%) |

The gross value of grazing production in the Cobar LGA 2010-11 of $17.7 million (refer **Table 8-8** below) is equivalent to a little over $7/ha. Grain growing in the Cobar Shire in the same year returned an average gross of $338/ha.

*Table 8-8 Annual Value of Agricultural Production in Cobar LGA (ABS, 2012)*

| Product Type | Value ($ million) |
|---|---|
| Wool | 6.7 |
| Livestock sales | 11.0 |
| Grain and hay | 15.7 |

The primary aim of rehabilitation would be to create a stable, non-polluting landscape. An adjunct to this aim would be that the rehabilitated land should be able to support the existing stocking rate. This is because a relatively small mass of vegetation is harvested by grazing livestock.

Carrying capacity is a key driver of the expected returns from grazing enterprises. One method of comparing different animal enterprises is to use a standard animal. In NSW it is common to use Dry Sheep Equivalent (DSE). Stocking rates in 2010/11 from ABS were combined with standard conversion rates to estimate that the Cobar LGA carried 676,660 DSEs. This is equivalent to 0.27 DSE/grazed ha.

The vegetation harvested by 0.27 DSE/ha of livestock is equivalent to around 100 kg/ha/year of dry matter. This dry matter was calculated on the assumption that 1 DSE is equivalent to approximately 1 kg dry matter per day. As such, the vegetation established during rehabilitation should be able to supply the feed required by grazing animals if it is dense enough to provide the function of protecting the soil surface from wind erosion. As such, it is estimated that the carrying capacity of rehabilitated land would return to 0.27 DSE/ha stocking rate that is carried by land not disturbed by mining.

### 8.1.7 Mitigation and Management Measures

The following mitigation and management measures, as described in the LSCA, are proposed for soil management.

#### 8.1.7.1 Soil Stripping

The following soil stripping and handling techniques will be implemented where practicable to minimise soil deterioration:

- The area to be stripped will be clearly defined on the ground. The target depths of soil to be stripped at each location will be clearly communicated to machinery operators and supervisors;
- A combination of suitable equipment will be used for stripping and placing soil in stockpiles. Machinery circuits will be located to minimise compaction of both undisturbed and stockpiled soil;

- The soil material will be maintained in a slightly moist condition during stripping. Material should not be stripped in either an excessively dry or wet condition;
- All machinery brought onto the site for soil stripping will comply with weed management and biosecurity protocols established for the site;
- Trees present will be cleared and grubbed prior to soil stripping; and
- Handling and rehandling topsoil would be minimised as far as possible.

#### 8.1.7.2 Soil Stockpiling

The stripped soils will be stored in a way that minimises compaction of the whole stockpile and maximises biological activity. The following techniques will be implemented where practicable to achieve these goals:

- All soil stockpiles would have a batter slope of 1V:4H to limit erosion potential;
- Soil stockpiles would be designed and constructed to a depth not greater than 3 m in order to minimise the development of anaerobic conditions and to minimise the deterioration of biota and seed banks;
- The surface of soil stockpiles will be left in a rough condition to promote water infiltration rather than runoff. If required, sediment controls will be implemented downslope of stockpiles to capture eroded sediment;
- Overland flow onto and across stockpile sites will be kept to a practical minimum, and not allowed to concentrate to the extent that it causes visible erosion. This will be achieved by placing stockpiles on locally high areas;
- Stockpiles will be allowed to naturally re-seed under suitable climatic conditions to stabilise the surface, limit dust generation, minimise erosion and provide competition for weeds;
- After the stockpiles are established, machinery and vehicles will be excluded from general access. Stockpile locations would be marked on site maps to identify them so that they are protected from disturbance;
- Stockpiles will be surveyed and data recorded about the volumes and soil types present;
- Stockpiles will be monitored for the establishment of weeds and control programmes implemented as required; and
- Soil transported by dump trucks may be placed directly into storage. Soil transported by bottom dumping scrapers is best pushed to form stockpiles by other equipment (e.g., bulldozer or excavator) to avoid tracking by the scraper over previously laid soil.

#### 8.1.7.3 Soil Respreading

The aim of respreading is to construct a layered material with properties that can perform similar functions to the undisturbed soil. The recommended process for spreading of topsoil is as follows:

- A soil balance plan showing the depths and volumes of soil to be spread will be prepared before the soil is spread. The plan would take account of the erodibility of the stockpiled soil, with more erodible soil being placed on flatter areas to minimise the potential for erosion;
- Stockpiled soil will be tested to determine the required ameliorants;
- The land surface would be reshaped to appropriate landforms, then the resulting surface ripped;

- Ameliorants will be mixed with the soil as it is being spread if required;
- Soil should be moist to just moist, not wet or dry when being respread;
- Traffic patterns should minimise compaction of topsoiled areas;
- Soil would be lightly scarified to encourage rainfall infiltration;
- Pasture or appropriate vegetation types will be seeded as soon as possible after soil is respread; and
- Erosion and sediment controls will be implemented where necessary prior to vegetation establishment.

8.1.7.4 Monitoring and Reporting

Monitoring of stripping and stockpiling will ensure that the design depth of topsoil is stripped and that the subsoil is soil, rather than weathered rock. The volumes of topsoil and subsoil will be checked to ensure that there is sufficient soil to enable the planned rehabilitation. Maintenance of biological activity will require plants to be grown. The species and vigour of plants growing on the stockpiles will be monitored.

The soil stockpiles should be tested before the soil is spread to determine the ameliorants required to construct a fertile soil profile. It is likely that nutrients would be required in the topsoil, and some lime would be required in most soil that is spread.

Achieving the planned LSC class depends on accurate placement of the subsoil and topsoil. Achieving the desired soil thickness would in turn depend on accurate preparation of the subgrade. As such, an accurate survey of the thickness of the soil layer will be conducted.

### 8.1.8 Conclusion

The LSCA was prepared for the Project to identify the current soil properties and corresponding soil classification. This was undertaken through targeted soil sampling and laboratory testing. There were five soil mapping units identified across the Project area, which demonstrated a close correlation with land use classification.

Mapping indicated there is a very low probability of acid sulphate soils likely to the present in the Project area. Similarly the probably of contamination was concluded as unlikely given the previous low level agricultural use. With the proposed final rehabilitation of the Project area, the land would be capable of supporting the pre-existing LSC and similar stocking density, with the exception infrastructure areas that will be retained for use by the landholder.

## 8.2 Geochemistry

### 8.2.1 Introduction

An assessment of the geochemistry of waste rock and tailings was undertaken by Terrenus Earth Sciences and is included as **Appendix B**. The geochemical assessment provided the characterisation of both waste rock from Federation Site and tailings generated at Hera Mine from Federation ore processing. This information has been used in the design of waste rock pads, planning of mine operations and rehabilitation strategy.

### 8.2.2 Assessment Requirements

The SEARS required the characterisation of waste rock and tailings. The relevant requirements are provided in **Table 8-9**.

*Table 8-9 Geochemistry SEARS Requirements*

| SEARs Requirements | Reference |
|---|---|
| Details of the ore and waste rock, including mineralogy and deleterious elements and evidence of geological and grade (or quality) continuity of mineralization in the deposit; | **Section 8.2.3**<br>**Section 8.2.5.1** |

### 8.2.3 Existing Environment

Mineralisation at the Project is epigenetic (i.e. formed later than the host rocks) and structurally controlled within fine-grained sedimentary rocks. Mineralisation consists of several steeply dipping vein breccia and massive sulfide lenses developed in the centre of a broad northeast-southwest striking corridor of quartz–sulfide vein stockwork mineralisation.

Massive sulfide and sulfide breccia base metal mineralisation is typically zinc-rich and associated with intense cross-cutting black chlorite alteration in the lower parts of the known deposit, with silica-sulfide dominant infill in the upper parts. Moderate- to high-grade gold mineralisation is best developed in a steeply plunging shoot, which is located in the northeast of the deposit, with recent drilling also highlighting high grades in other parts of the deposit.

Host rock surrounding the deposit (i.e. potential waste rock) exhibits very low-grade mineralisation with relatively low sulfide and carbonate mineralisation.

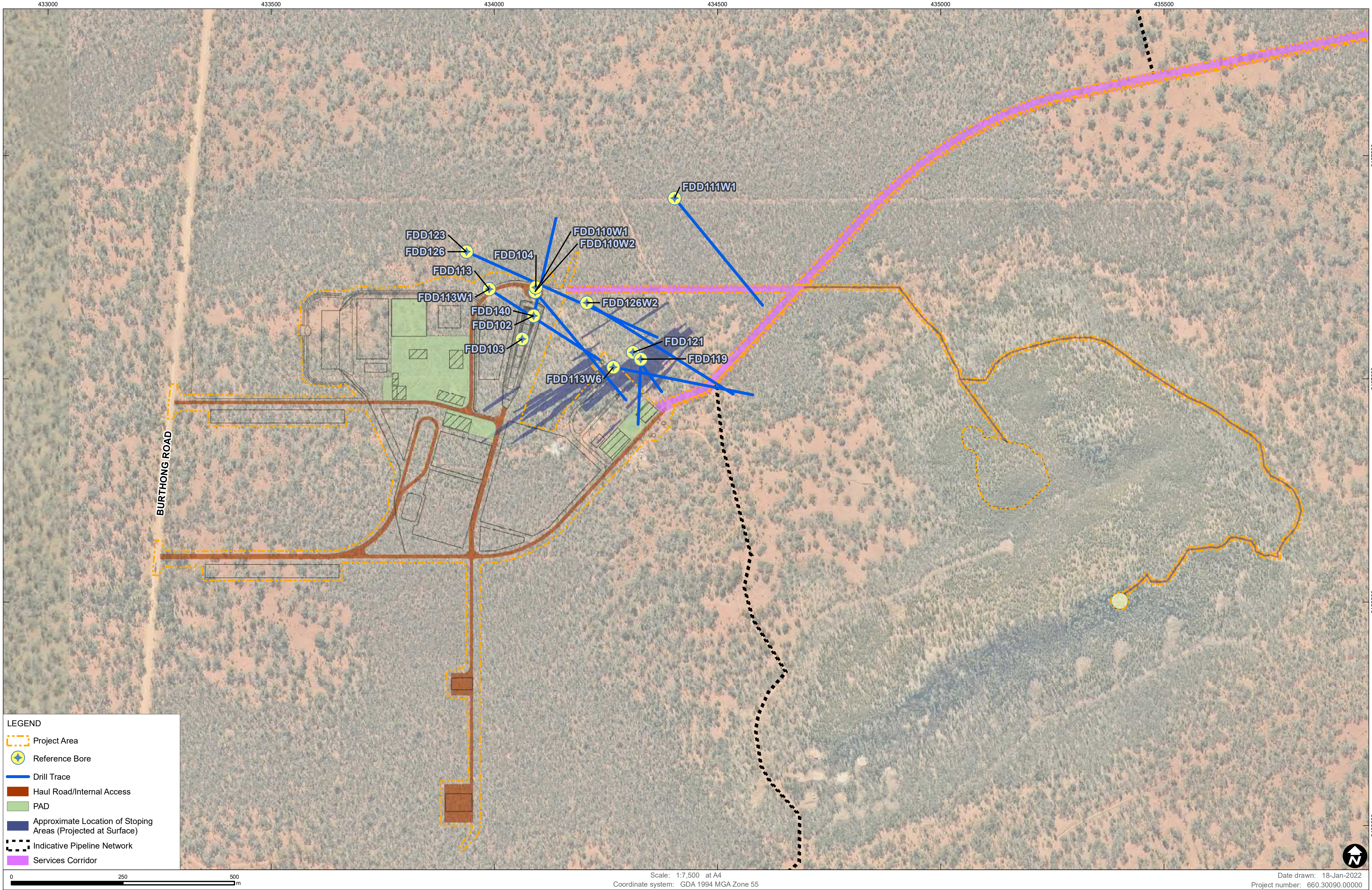
### 8.2.4 Assessment Approach

The geochemical assessment was undertaken to identify the potential of samples obtained to generate acid and metalliferous drainage (AMD). The term AMD is used to describe low-quality seepage or drainage that has been affected by the oxidation of sulfide minerals and/or by the dissolution of acid generating sulfate minerals. AMD, if generated, has the potential to impact on nearby surface waters by decreasing natural acidity if not appropriately managed.

A desktop review of available data and information was completed to provide a better understanding of the Project. The review included geological data, mineralogical and assay data associated with the ore, exploration drilling programs, mining methods and mine plan, ore handling and processing methods, and mineral waste disposal and management strategies.

The geochemical sampling and testing program developed for this assessment integrated with the exploration drilling program. This assessment is based on data that is relevant to assessing the environmental geochemical characteristics of mineral wastes to be produced by the Project.

Drill-core samples were selected from existing drill-holes by Project geologists and Terrenus. The drill-hole collar and trace locations are shown on **Figure 8-2** below, projected over the approximate location of the stoping areas. Geochemical data was available for 201 drill-core samples obtained from 15 drill-holes. This comprised of 52 weathered samples from the proposed box-cut and portal area and 149 fresh (unweathered) samples from a range of depths throughout the deposit. Drill-hole samples were selected to target the dominant waste rock sources, comprising the box-cut (weathered waste) and the decline (fresh rock) at various depths/locations.




Scale: 1:7,500 at A4
Coordinate system: GDA 1994 MGA Zone 55

Date drawn: 18-Jan-2022
Project number: 660.30090.00000

SLR

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
& Aerometrex Pty Ltd, 2019
Geochem Test Locations (Terrenus Earth Sciences)

**DRILL HOLE LOCATIONS**

**FIGURE 8-2**

H:\Projects-SLR\660-SrvWOL\660-WOL\660.30090.00000 Federation Project Approvals\06 SLR Data\01 CADGIS\GIS\SLR66030090_EIS_G17_GeochemTestLocations_001.mxd

Tailings geochemical data was obtained from three trial samples from a bench process, and comprised of:

- A master composite;
- A high talc and clay 'end member'; and
- A high sulfide 'end member'.

The 'master composite' is the most relevant of these three samples – as being broadly representative of tailings to be generated by the Project. Unlike waste rock, where a potentially wide range of geological and geochemical variability may be expected, tailings are relatively homogeneous.

The samples were characterised using a wide variety of detailed static geochemical test methods, which provide the fundamental geochemical characteristics of a sample. A summary of testing undertaken is provided in **Table 8-10** below.

*Table 8-10 Geochemical Testing*

| Analytical tests | Drill-hole samples | Tailing samples |
|---|---|---|
| pH and EC on 1:5 water extracts | 149 samples | All 3 samples |
| Total sulfur (S) | All 201 samples | All 3 samples |
| ANC | All 201 samples | All 3 samples |
| Sulfide (Scr) | 142 samples | All 3 samples |
| Total carbon (C) | All 201 samples | All 3 samples |
| NAG | 142 samples | 2 samples |
| NAG Sequential (S-NAG) | - | 1 sample |
| NAG Kinetic (K-NAG) | 12 samples | 2 samples |
| ABCC | 12 samples | All 3 samples |
| QXRD | 10 samples | 1 sample |
| Total elements in solids | 20 samples | All 3 samples |
| Soluble elements and major ions in 1:5 deionised water extract | 20 samples | All 3 samples |
| Exchangeable cations | 12 samples | - |

An assessment of element enrichment was also performed. This is performed to identify any elements (particularly metals and metalloids) present in a material at concentrations that may be of environmental concern with respect to surface and seepage water quality. Element solubility test were also conducted on 20 drill hole samples and all three tailings samples. These tests were undertaken to determine the immediate solubility and potential mobility of elements under highly agitated and solubility-inducing conditions.

Samples were classified to determine the acid classification, with respect to acid generation, using Net Acid Generation (NAG) and Net Acid Producing Potential (NAPP) data into three broad categories:

- Non-acid Forming (NAF);
- Uncertain - Those samples with inconclusive results, leading to a degree of uncertainty about their ability to generate acid; and

- Potentially Acid Forming (PAF).

Samples which are classified as ‘Uncertain’ remain so until further information becomes available. Depending on the level of risk, from a mineral waste management perspective ‘Uncertain’ samples are usually managed conservatively.

### 8.2.5 Results

#### 8.2.5.1 Waste Rock

*Acid and Metalliferous Drainage*

Waste rock, as a bulk material, which is comprised of weathered and fresh components, is expected to generate pH-neutral to alkaline contact water (run-off and seepage). The total sulfur (S) concentration of this material is generally low, with a modest 90$^{th}$ percentile total S concentration of 0.24 percent (%), of which most of this is present as sulfide. The weathered samples had much lower total S (and sulfide) compared to the fresh samples.

The acid neutralising capacity (ANC) values for potential waste rock are generally very low, with a median ANC value of 2.5kg $H_2SO_4$/t. Mineralogical analysis has revealed the carbonate mineralogy is dominated by dolomite and calcite, however further geochemical analysis has found that only about one quarter to one third of the ANC is likely to be ‘readily available’ (to neutralise acidity).

As such, the geochemical assessment has found most fresh waste rock (indicatively 85 %) is classified as PAF. However, all weathered waste rock, predominantly from the box cut, is classified as NAF.

Initial leachate from potential waste rock (i.e. under pH-neutral conditions) is expected to contain low concentrations of soluble metals and metalloids. Under acid generating conditions (i.e. PAF rock, when allowed to oxidise), leachate is likely to contain moderate to high concentrations of soluble metals and metalloids.

*Salinity of Waste Rock*

Potential waste rock has electrical conductivity (EC) values ranging from 30 to 511 microSiemens per centimetre (µS/cm), with median and 90$^{th}$ percentile values of 108 and 309 µS/cm, respectively. Waste rock is expected to generate low-salinity contact water (run-off and seepage). The potential for sulfate-derived salinity (from sulfide oxidation) from weathered waste rock is very low. The potential for sulfate-derived salinity from fresh waste rock is moderate to high.

*Sodicity and Dispersion Potential of Waste Rock from the Box-cut*

Weathered samples had very low cation exchange capacity (CEC) values and high exchangeable sodium percentage (ESP) values, resulting in most samples being classified as ‘strongly sodic’ or ‘sodic’ with the potential for dispersion.

#### 8.2.5.2 Tailings

Tailings is expected to generate pH-alkaline contact water (run-off and seepage) when initially produced/disposed. The total S concentration of potential tailings material is moderate to high (S = 1.4%), with a similarly moderate to high sulfide concentration, which produces moderate maximum potential acid (MPA) values. Consequently, when combined with ANC values that are generally lower than the MPA, the tailings sample was classified as PAF.

Soluble multi-element results indicate that initial leachate from tailings (ie. under pH-neutral conditions) is expected to contain low concentrations of soluble metals and metalloids. Under acid generating conditions (ie. once oxidised) leachate is likely to contain moderate to high concentrations of soluble metals and metalloids – and soluble $SO_4$ (due to sulfide oxidation).

Consistent with fresh waste rock, tailings are expected to generate low-salinity contact water (run-off and seepage). Due to the moderate to high total S (and sulfide) concentration, the potential for sulfate-derived salinity (from sulfide oxidation) is moderate to high.

### 8.2.6 Mitigation and Management Measures

The following management mitigation measures are proposed for the management of waste rock and tailings:

- Waste rock brought to the surface is to be segregated into PAF or NAF and stored within the one pad as separate waste rock stockpiles to allow differentiation and appropriate use with PAF going underground and NAF used in the final landform design;
- Weathered rock likely to be NAF will be stockpiled separately from fresh rock and used as backfill for the box cut for other rehabilitation and construction activities or transported to Hera Mine and disposed underground;
- Fresh rock from the underground will report to the waste rock stockpiles, where run-off and seepage (leachate) will be captured in lined leach ponds and treated if/as appropriate before use in the mine water management system;
- No PAF rock will remain at the surface at mine closure. PAF material will either be placed underground at Federation or disposed underground at Hera Mine below the groundwater table;
- Highly sodic and/or dispersive weathered waste rock when identified will not be used in construction or the final landform where practical. Where this is not practical the final waste rock landforms (where waste rock is used in rehabilitation of other areas) would need to be constructed with short and low (shallow) slopes to minimise erosion;
- Water in the lined leach pond will be monitored for water quality parameters including pH, EC, major anions, acidity, major cations, total dissolved solids (TDS) and a broad suite of soluble metals/metalloids;
- Tailings will be either placed into the Hera Mine TSF or returned to Federation for paste backfilling of underground stopes;
- Run of Mine (ROM) ore will be placed on the designated ROM stockpile, with surface run-off monitored for standard water quality parameters; and
- A Waste Rock Management Plan and Tailings Management Plan will be developed which will detail management of both waste rock and tailings for the Project.

### 8.2.7 Conclusion

Geochemical testing was undertaken to characterise the waste rock and tailings that will be generated from the Project. Waste rock was characterised through obtaining numerous samples from the box cut and from various depths within and surrounding the stoping footprint. Bench scale testing of tailings was undertaken from three trial samples. The assessment concluded that weathered rock sourced from the box cut was NAF. In contrast, fresh rock (~85%) was classified as PAF. Weathered rock had a low potential for sulfate-derived salinity whereas fresh rock had a high potential. Weathered rock also had a high CEC, leading to the potential for being dispersive. Similar to fresh rock, tailings is also classified as PAF.

Waste rock will be separated as PAF and NAF and stored separately to allow NAF to be used in the final landform design. PAF waste rock will be placed underground at Federation or Hera Mine during or post mine life. No PAF material will remain on the surface at mine closure. NAF waste rock will be used as either backfill in the box-cut, for other rehabilitation and construction activities or transported to Hera Mine and disposed underground. Runoff from waste rock and ROM stockpiles will drain to lined leach ponds. Water will be monitored for standard water quality parameters prior to use in the mine water management system.

Tailings will be placed into either the approved Hera Mine TSF or returned to Federation for paste backfilling of underground stopes.

## 8.3 Subsidence

### 8.3.1 Introduction

A Surface Subsidence Assessment was completed by Beck Engineering for the Project, which is included as **Appendix H**. The surface subsidence assessment included the use of a numerical model to simulate proposed mining and determine whether subsidence was likely to occur. The results of the modelling are discussed in this section.

### 8.3.2 Assessment Requirements

Provided in **Table 8-11** are the requirements of the SEARs relating to subsidence impacts and where these have been addressed.

*Table 8-11 Subsidence SEARs requirements*

| SEARs Requirement | Reference |
|---|---|
| Subsidence – including an assessment of the likely subsidence effects, and the potential consequences of these effects and impacts on the natural and built environment, paying particular attention to features that are considered to have significant economic, social, cultural or environmental value, and taking into consideration: | **Section 8.3.5** |
| Recorded regional and historic subsidence levels, impacts and environmental consequences; | **Table 8.11** |
| Geotechnical assessment that supports mining methods and mine design; | **Table 8.11** |
| The potential extent of fracturing of the strata above the underground mine; and | **Section 8.3.5** |
| The implementation of a comprehensive subsidence monitoring program, if required, which is capable of detecting vertical, horizontal and far-field subsidence movements; | **Not required due to the assessment of 'negligible impact' from surface subsidence predictions** |

### 8.3.3 Existing Environment

Topographic data was used to build the natural surface profile into the numerical model. The natural ground surface directly above the proposed mining footprint at Federation is predominantly flat or gently sloping. There is no significant topographical relief present within the spatial limits of the model.

### 8.3.4 Assessment Approach

Subsidence predictions were determined through the development of a numerical model of the underground mine to:

- Simulate near-surface stress, strain and displacement throughout the entire life of mine schedule;
- Forecast mine subsidence and surface deformation, including impacts to surface infrastructure and environmentally sensitive sites;
- Identify near-surface cavities (i.e. stopes) with chimneying potential, which may fail and impact the surface; and
- Provide recommendations for ensuring stope stability and additional future assessments required as the Project progresses from study phase to operation.

The model was developed in the following sequence:

- Initial mining engineering and rock mechanics appreciation of the Project including compilation of all relevant geometric data into a 3D CAD database using commercial software;
- Discontinuum finite element (FE) mesh construction using commercial software and in-house scripting tools. Higher-order finite elements were used for all volume elements;
- Assignment of the geotechnical domains, material properties, initial conditions, boundary conditions and the mining and fill sequence to the FE mesh;
- Solution of the stress, strain and displacement fields and released energy for each step in the modelled mining sequence using the Abaqus Explicit FE solver. Abaqus Explicit is a commercial, general purpose, 3D, non-linear, continuum or discontinuum FE analysis package designed specifically for analysing problems with significant plasticity, large strain gradients, high deformation levels and large numbers of material domains. Commercial software and in-house post-processing scripts were used to process the Abaqus output and visualise the results; and
- Forecasting of future behaviour for the current Life of Mine (LOM) plan.

Inputs into the model were sourced from site data, regional information and desktop assessments. A summary of model inputs is provided in **Table 8-12**.

*Table 8-12 3D Discontinuum Model Inputs*

| Model Inputs | Summary |
|---|---|
| Topography | The natural ground surface directly above the proposed mining footprint at Federation is predominantly flat or gently sloping. There is no significant topographical relief within the spatial limits of the model. |

| | |
|---|---|
| Stress Field | Stress regime applied to the numerical simulation was estimated due to lack of field data. An appropriate stress regime was determined considering the World Stress Map work by Lee (Lee, 2012), as well as stress measurements known from nearby mines in the Cobar district and central west region of NSW. Stress regime characterised by a WNW-ESE trending major principal stress, SSW-NNE trending intermediate principal stress and vertical minor principal stress was appropriate. |
| Geotechnical Domain Assignment | The material properties were applied according to the lithology. Boundaries between the near-surface weathered stratigraphy, including overburden, paleo sediments, oxidised and transitional material were provided by Hera Resources, based on the current geological interpretation of the site. All rock mass volume within stope voids was regarded as the orebody, and all other volume outside the stopes was regarded as the unweathered host rock (waste). |
| Anisotropic Rock Mass Behavior | Given prior mining experience of similar orebodies in the Cobar Shire it is anticipated that the Federation ore and host rock masses would exhibit anisotropic mechanical behavior during mining. This anisotropy would form an important control on local and global mine stability. |
| Hydrogeological conditions | No detailed information on the current hydrogeology or planned mine de-watering strategy was available at the time the model was developed. Beck therefore ignored potential groundwater effects for this analysis and applied a fully drained constitutive formulation. |
| Mining methods, geometry & sequence | The numerical model included the complete LOM geometry and current geological/structural model for the proposed Federation mine, comprising the following:<br>▪ Surface box cut and portal<br>▪ Main decline, production level accesses, ore drives and other miscellaneous tunnel development<br>▪ Production cavities (i.e. stopes)<br>▪ Ventilation shafts<br>▪ Major geotechnical/lithological domains and<br>▪ Major geological structures (thrust & cross faults). |
| Stope filling methodology & fill properties | Stopes are filled at the end of the frame by setting the elastic constants of the stope void to fill properties. In practice, the mine could leave stopes open for longer than modelled and may not always achieve tight filling. |
| Structural resolution of the model | AML provided a number of digital 3D CAD files which contained wireframes of several major geological structures that intersect the Federation deposit and adjacent host rock geotechnical domains. These geological structures were built into the model explicitly as discontinuum components using traction-separation based cohesive elements. Cohesive elements allow simulation of the discrete behaviour associated with faults and shears. |
| Rockmass damage scale | Rockmass damage is plotted on a logarithmic scale. This allows a wide range of plastic strain magnitudes to be plotted with a convenient linear colour scale. |

### 8.3.5 Predicted Impacts

A simulation of the proposed Federation underground mining plan was conducted using a non-linear, strain-softening, discontinuum finite element numerical model.

The main findings of the assessment are summarised below:

- The numerical simulation of mine-scale subsidence for the entire duration of the mine plan indicates that total cumulative 3D surface displacements above the mining footprint will be within the range of 1-2 cm. This includes both horizontal and vertical components of displacement;
- It was concluded from experience with other underground mining operations worldwide with significant surface features such as buildings, roads, energy and transport infrastructure and other sensitive sites such as glaciers, national parks etc that mining-induced surface subsidence displacements of the same magnitude as those numerically forecast at the Federation mine fall into the 'Negligible Impact' category;
- Forecast displacements throughout the entire vertical extent of the mine are dominated by sub-horizontal movements oriented perpendicular to the orebody strike (i.e. transverse closure). The vertical component of the 3D displacement vector is relatively small in most locations, although it is moderately inclined towards the vertical at the surface;
- The small magnitude of the surface displacements is considered to be within the limits of precision of the numerical model, given the current understanding of the geology and material properties of the Federation deposit. The modelling forecasts assume that all underground excavations remain stable within their design dimensions throughout the complete mining process;
- The proposed Federation mine plan contains some access tunnels and open stopes within the geotechnical domain of transitional rock mass weathering. That is, above the interpreted elevation of the top of fresh rock. Further geotechnical investigation will be required to determine the rock mass characteristics within this zone and its spatial extents;
- The empirical assessments indicate that all crown pillar geometries for the top level of stopes (~ 70 m below surface) will remain stable. These assessments would be updated and confirmed with more detailed data from the Federation geotechnical characterisation once this becomes available;
- Open stoping mines with near vertical and relatively narrow-width orebodies, such as the proposed Federation mine, are generally regarded as having negligible subsidence impact on the surface. However, this is dependent upon the stopes remaining stable and design dimensions being maintained;
- The surface collar region of two shafts to the south of the mine (one large diameter and another small diameter shaft) are indicated to intersect the paleochannel domain, which contains weak and unconsolidated material. The affected infrastructure is the upper 10-15 m of each shaft. The paleochannel feature would be inherently unstable during shaft construction. Hera Resources plan to relocate these shafts out of the paleochannel once further geological information is available; and
- There was inconsistent information concerning the depth of oxide and transitional weathering at the Federation deposit at the time of the assessment. The 3D CAD wireframes supplied defined the base of complete oxidation (as being 23 m below the box cut and decline portal entrance). In reality, this is likely to be highly variable in elevation, with deeper weathering present along any faults.

The subsidence assessment report also identified three main geotechnical risks at the Federation Site (however, see proposed mitigation measures to manage these risks). These included:

- The potential for the top-level of stopes to become unstable and chimney or cave to surface, creating a sinkhole expression was the principal risk;

- A secondary risk relevant to surface impact is instability of the decline, should it be located in poorer ground conditions than expected, such as oxide weathering, with inadequate ground support; and
- Two vertical shafts to the south of the mine infrastructure are located within the Paleochannel domain. This geological domain consists of weak, weathered and unconsolidated material that would be adverse to shaft stability.

### 8.3.6 Mitigation and Management Measures

Based on the results of the modelling the following recommendations were provided by Beck Engineering with reference to the mine design and operation, which are proposed to be adopted for the Project:

- The uppermost stopes at the mine are recommended to be placed below the base of complete oxidation horizon, with a cable-bolt reinforced competent rock crown pillar to maximum stope span ratio of 2:1;
- Characterisation of the rock strength and geological structure of the near-surface zone should be undertaken prior to mining excavations to determine the limits of weathering and lithology domains, all significant fault locations and their condition, block-forming minor joint set parameters and rock mass strength properties and their spatial distribution. This will enable a detailed geotechnical model for this area;
- The following control measures were recommended for the upper-level stopes as needed, in order to mitigate the potential for chimneying and surface subsidence impacts:
    i. Identification and characterisation of zones of poor ground in planned crown pillars via geotechnical drilling and visual observation during development;
    ii. Review and adjustment of stable stope span, strike length and height dimensions, following acquisition of additional geotechnical data;
    iii. A comprehensive crown pillar stability assessment for every stope on the upper levels of the mine, using industry-accepted empirical methods and updated site-specific input parameters, as a minimum;
    iv. Development of an overcut drive for the uppermost stoping level, located centrally with respect to the crown position, in order to provide direct development access to the top-of-mine stope crown pillar for ground support installation purposes, as well as immediate backfilling, tight to the stope crown;
    v. Excavate the narrowest span stopes on the upper level first, in order to assess hangingwall and footwall rock mass conditions on the level, prior to excavating the wider span stopes there;
    vi. Down-hole blasting of the uppermost stoping level of the mine following overcut drive completion and limiting the stope span width of the top level to the width of the zone that can be reinforced with ground support;
    vii. Reinforcement of stope crowns with cable-bolts as well as surface support (i.e. shotcrete and/or mesh) to prevent unravelling;
    viii. Mining of upper-level stopes via single lifts only. Multi-lift stoping increases the potential for instability;

ix. Extraction of ore and tight backfilling of all stopes in as short a timeframe as possible, and prioritising those stopes with wider spans or known to be located in or close to zones of poor ground or faults etc;
x. Trigger action response plan (TARP) procedures for prompt management and backfilling of any stopes observed to become unstable;
xi. Managing extraction sequencing to minimise the risk of unravelling on faults. For example, avoiding stoping through faults in neighbouring ore lenses on the same or adjacent levels at the same time;
xii. Avoiding large span excavations in the upper-level stopes, especially wherever there are known zones of poor ground, faults or confluences of multiple faults, which may be defined by future geotechnical investigations;

- Undertake a comprehensive rock mass characterisation of the depth of weathering of the box cut region and initial portion of the decline, to confirm the presence or absence of oxide weathering material along the planned decline route;
- If found to be necessary after the rock mass characterisation and further geotechnical assessment, modification of the box cut and portal design may be required to place the portal backs below the boundary of oxide-to-transitional weathering; and
- Re-design of the location of the southern-most ventilation shaft and egress shaft, such that they no longer intersect the paleochannel zone.

### 8.3.7 Conclusion

A surface subsidence assessment was undertaken through the development of a numerical model of the underground mine to determine the potential surface impacts. The model was a 3D discontinuum model, which sourced model inputs from site data, regional information and desktop assessments. The numerical simulation of mine-scale subsidence for the entire duration of the mine plan indicates that total cumulative 3D surface displacements above the mining footprint will be within the range of 1-2 cm. This level of displacement was determined to be negligible and highly unlikely to have any impact on surface features.

Risks identified included the potential for the top-level of stopes to become unstable and chimney or cave to surface, and instability of the decline, should it be located in poorer ground conditions than expected. Lastly, the two vertical shafts to the south of the mine infrastructure are located in a weak geological domain.

To mitigate such risks a number of design and operational recommendations were provided., which will be adopted for the Project These included further characterisation of the rock strength, upper stope control measures and a rock mass characterisation.

## 8.4 Surface Water

### 8.4.1 Introduction

A Surface Water Impact Assessment (SWIA) was prepared by GHD for the Project and is included in **Appendix I**. The SWIA assessed describes the design of the proposed water management system at Hera Mine, the current water management practices at Hera Mine, and the integration of the Federation Site and Hera Mien water management systems to develop a water balance for the Project.

### 8.4.2 Assessment Requirements

Provided in **Table 8-13** are the SEARs requirements as they relate to surface water and where they have been addressed.

*Table 8-13 Surface Water SEARs Requirements*

| SEARs Requirement | Reference |
|---|---|
| An assessment of the likely impacts of the development on the quantity and quality of surface, and groundwater resources, having regard to the NSW Aquifer Interference Policy; | **Section 8.4.5** |
| An assessment of the hydrological characteristics of the site and downstream; | **Section 8.4.3.2**<br>**Section 8.4.3.3** |
| An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure and systems and other water users, including impacts to water supply from dams, and riparian and licensed water users; | **Section 8.4.5** |
| A detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply and transfer infrastructure and water storage structures, and measures to minimise water use; | **Section 8.4.4** |
| Demonstration that water for the construction and operation of the development, for the life of the project, can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP), and include an assessment of the current market depth where water entitlement is required to be purchased; | **Section 8.4.4** |
| A description of the measures proposed, including monitoring activities and methodologies, to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; | **Section 8.4.6** |
| A detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts; | **Section 4.11**<br>**Section 8.4.6** |
| An assessment of the potential flooding impacts of the project; | **Section 8.4.5** |

### 8.4.3 Existing Environment

#### 8.4.3.1 Climate

Climate records were obtained from SILO for the Nymagee (Balowra) (station 49117), which is located approximately 17 km ESE of the Federation Site for the period from 1 January 1889 to 1 January 2021.

The historic annual rainfall totals were:

- Minimum 153 mm (2019);
- Maximum of 902 mm (1956);
- Median of 396 mm.

Annual evaporation totals have an average of 2001 mm, corresponding to an average annual moisture deficit (the difference between rainfall and evaporation) of 1575 mm. A comparison with measured data from Hera Mine weather data confirmed that the SILO dataset provided adequate representation.

**Figure 8-3** below shows that evaporation varies seasonally, having higher records in summer compared in winter. The site has an average monthly net rainfall deficit in all parts of the year.

#### 8.4.3.2 Hydrology

The Project is located in the Murray Darling Basin within the catchment area of Sandy Creek. The main creek systems in the vicinity of the Project are westerly flowing ephemeral streams that ultimately drain to the Darling River, and include Box Creek to the north, and Sandy Creek to the south. Watercourse locations are shown in **Figure 2-4**. Due to their position in the upper catchment and highly ephemeral nature, there is no data regarding creek water levels and flow in the vicinity of the Project.

Watercourses were classified in terms of stream ordering following the Strahler stream classification system where waterways are given an 'order' according to the number of additional tributaries associated with each waterway (Strahler, 1952). Watercourses that are local to the Project Area were classified by stream order and are shown in **Figure 8-4**. The tributaries of Box Creek are second and third order stream near Hera Mine and tributaries of Sandy Creek are first and second order near the Federation Site.

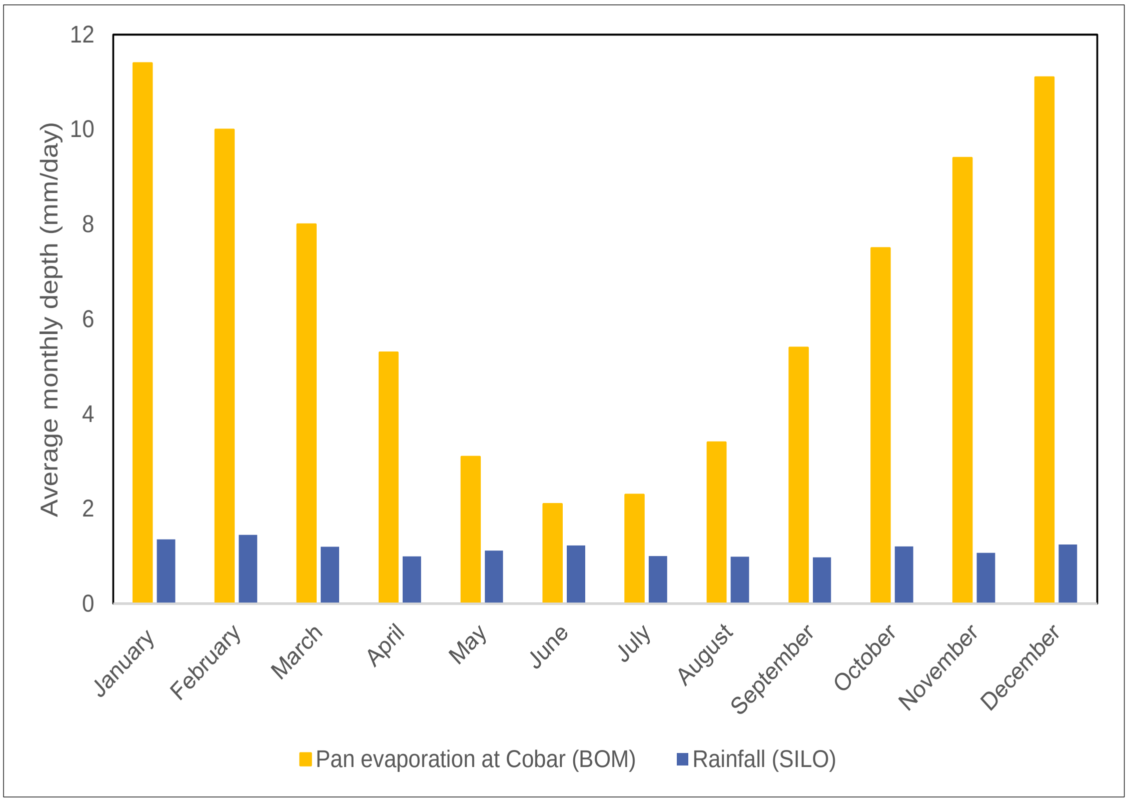
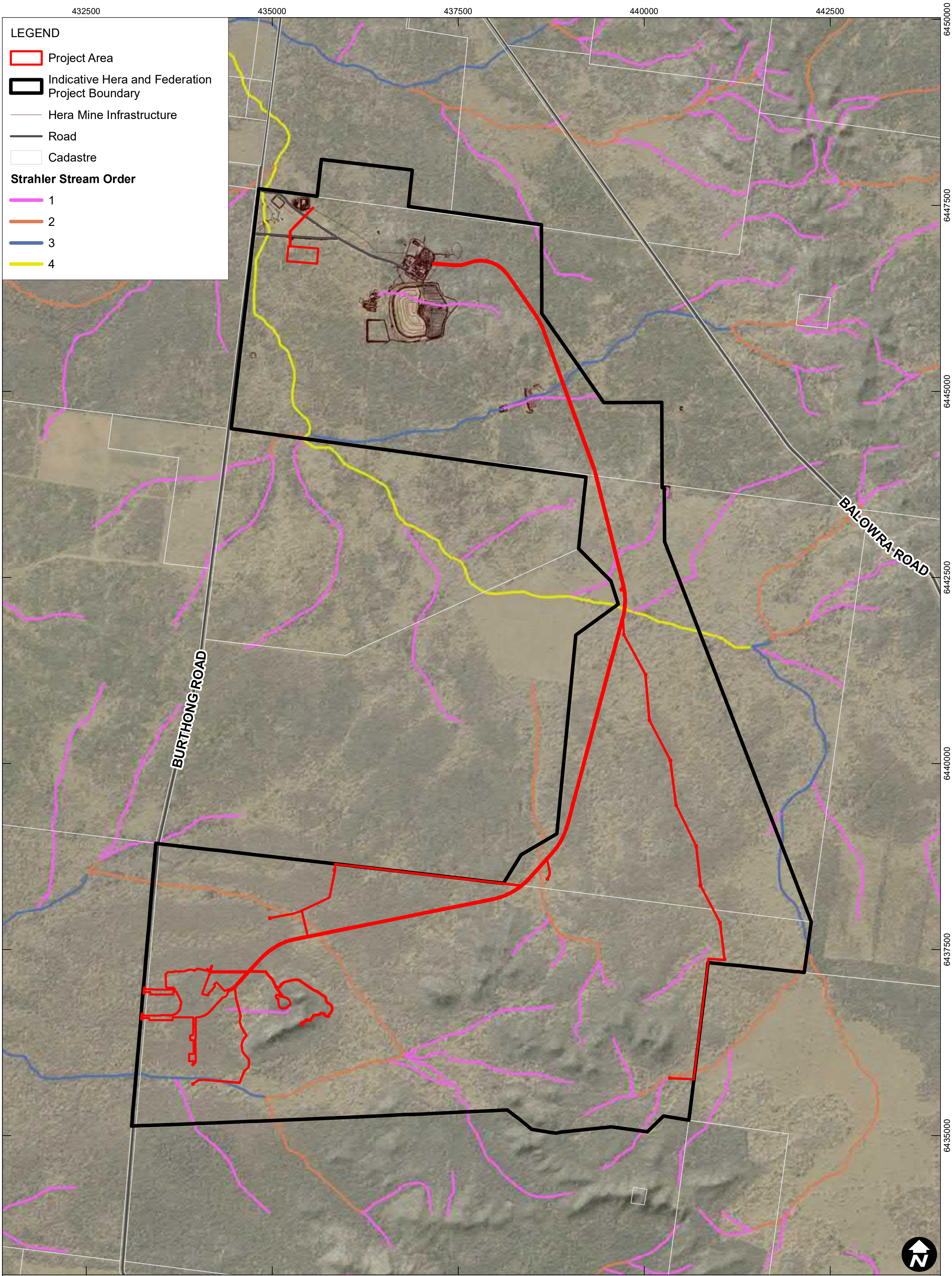



*Figure 8-3 Monthly Evaporation Recorded at BOM Station Cobar*

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Date Drawn: 18-Jan-2022
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Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
PUBLIC/StreamOrder (MapServer), WaterNSW

**STREAM ORDER**

**FIGURE 8-4**

#### 8.4.3.3 Downstream Licenced Water Users

Licensed surface water users were identified by searching the NSW Water Register (WaterNSW, 2021) for licences and works approvals within 10 km of the Sandy Creek downstream of Federation Site and Box Creek downstream of Hera Mine to the confluence with the downstream regulated Darling River. No surface water users were identified downstream of the Project.

### 8.4.4 Assessment Approach

The site water management system for the Project is described in **Section 4.10.** A site water balance was prepared to quantify the potential impacts under a range of rainfall conditions. A summary of the modelling methodology undertaken to develop the water balance is provided below.

#### 8.4.4.1 Modelling Methodology

GOLDSIM software was used to determine the site water balance for the Project. Two conditions were modelled comprising:

- Existing conditions: this represents the existing operations at Hera Mine, nominally for calendar year 2021. This does not represent actual conditions in the calendar year 2021, but rather is representative of approved operations. This scenario adopted the predicted groundwater inflows into Hera Mine underground workings for 2021 based on the Groundwater Impact Assessment (refer **Appendix J** and **Section 8.5**); and
- Proposed conditions: this represents the proposed operations as part of the Project, including the proposed water transfers from Federation Site to Hera Mine, and adopted groundwater flow predictions for Federation underground workings. The year 2028 was selected for the purpose of comparison between existing and proposed conditions, as this corresponded to peak annual total groundwater inflows and therefore represents the proposed operational phase of the Project that is expected to be most different relative to existing conditions.

#### 8.4.4.2 Groundwater Inflows

For the purpose of the assessment, it was assumed that inflows required to be dewatered from Hera Mine underground workings were to remain similar to that currently observed, which is approximately 100m$^3$ /day until mining ceases at Hera Mine in last quarter of 2022. Continued dewatering of the Hera Mine underground workings may continue after this period, however, as this would be for the purpose of ongoing water supply for the Project, this is considered equivalent to extraction of the same volume of water from production bores for the purpose of this assessment (and therefore provides a conservative over-estimate of the requirement for water supply from production bores but is equivalent in terms of total groundwater take).

Dewatering from Federation Site underground workings will cease in the second quarter of 2034 when forecast ore production falls under 20,000t/mth.

#### 8.4.4.3 Modelling Results

Provided in **Table 8-14** below is a summary of the water balance for the Project for both conditions detailed in **Section 8.4.4.1.**

*Table 8-14 Annual Average Water Balance*

| Water management element | Existing conditions (2021) (ML/year) | Proposed conditions (2028) (ML/year) |
|---|---|---|
| INPUTS | | |
| Direct Rainfall | 15 | 44 |
| Catchment runoff | 109 | 164 |
| Groundwater inflows | 35 | 122 |
| Extraction from production bores | 176 | 338 |
| Import from Nymagee Mine | 0 | 0 |
| TOTAL INPUTS | 335 | 668 |
| OUTPUTS | | |
| Evaporation | 49 | 122 |
| Water entrained in tailings | 289 | 469 |
| Dust suppression | 12 | 48 |
| Wastewater irrigation | 21 | 33 |
| Discharge to Box Creek | 0 | 0 |
| Discharge to Sandy Creek | 0 | 0 |
| TOTAL OUTPUTS | 370 | 672 |
| CHANGE IN STORAGE | | |
| Surface water storages | -35 | -5 |
| Underground Storage | 0 | 0 |
| TOTAL CHANGE IN STORAGE | -35 | -5 |
| BALANCE | | |
| Inputs – outputs – change in storage | 0 | 0 |

Key outputs of the water balance for the Project included:

- Direct rainfall, catchment runoff and evaporation are expected to increase in proposed conditions due to the additional catchment area of the Federation Site;
- Total extraction from production bores for both Hera Mine and Federation Site are simulated to increase under proposed conditions reflecting the increase in water demand for ore processing production rate for the year 2028;
- Due to an increase in production from 40,000 t/mth to 60,000 t/mth water loss entrained in tailings is simulated to increase;
- The additional footprint at the Federation Site will increase water use for dust suppression;
- Additional personnel will result in an increase in wastewater irrigation;
- There will be no discharge to Sandy Creek or Box Creek as a result of the Project. There is a potential for discharge to Sandy Creek due to a rare to extreme rainfall event that exceeds the design criteria of the water management system; and

- As the model is simulated continuously over the Project life, small average changes in the volume of water stored in water storages within the water management system are expected.

8.4.4.4 Water Security

The site water balance model simulated the range of annual extraction from all production bores for the Project for proposed conditions, as shown in the cumulative probability distribution in **Figure 8-5**. The simulated extraction from production bores is representative of the peak water demand during the Project and includes extraction from the Hera Mine underground workings following the completion of mining at Hera Mine, thereby conservatively over-estimating the potential extraction from production bores required.

**Figure 8-5** indicates that total production bore usage to satisfy operational requirements for both Hera Mine and Federation Site over proposed conditions is expected to range from 250 ML to 408 ML annually. Considered in combination with the forecast groundwater inflows in that year of 122 ML/year, the maximum groundwater extraction forecast by the site water balance model is 530 ML/year. This is within the groundwater entitlement held by Aurelia for the Project under water access licence (WAL) 43173 equivalent to 543 ML/year. Therefore, Aurelia holds sufficient WAL entitlement for the Project.

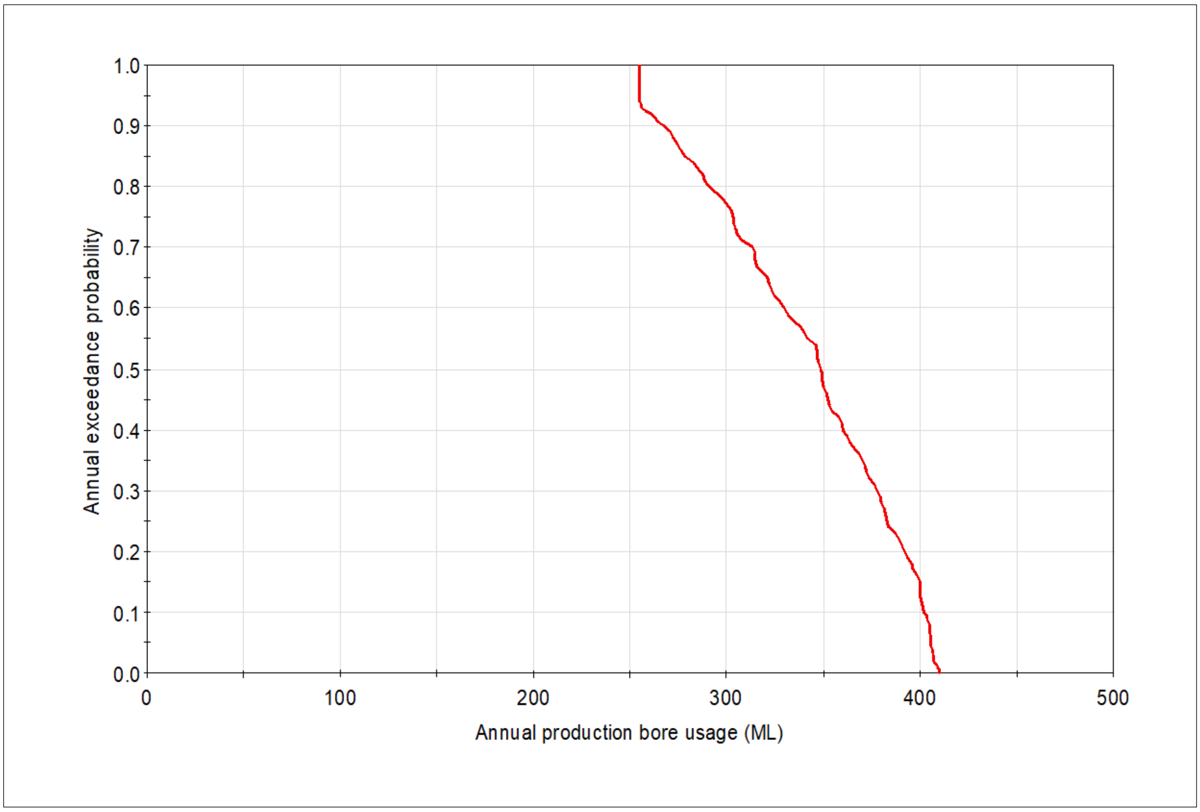



*Figure 8-5 Annual Production Bore Usage*

8.4.4.5 Contaminated Water Inventory

The volume of water within the TSF decant pond was simulated over the Project life, assuming that contaminated water storages were dewatered following rainfall events and that the approved Water

Management Dam was constructed at Hera Mine by mid-2022. Forecast TSF decant pond storage volume over the Project life is shown in **Figure 8-6.**

As shown below in **Figure 8-6**, years 2023, 2024, 2025 and 2035 there is a 5% chance of exceeding approximately 170 ML in the winter months. These years correspond to lower production rates when compare to the period of 2026 to 2034, where the model forecasts a 5% likelihood of exceeding approximately 50 ML in the TSF decant pond during winter.

In reality, the actual volumes of water in the TSF decant pond will depend on rainfall, groundwater inflows to the underground workings and actual ore processing rates. The timing of approved lifts of the TSF will consider the potential water volumes that may be required to be stored to minimise the likelihood of future discharge from the decant pond.

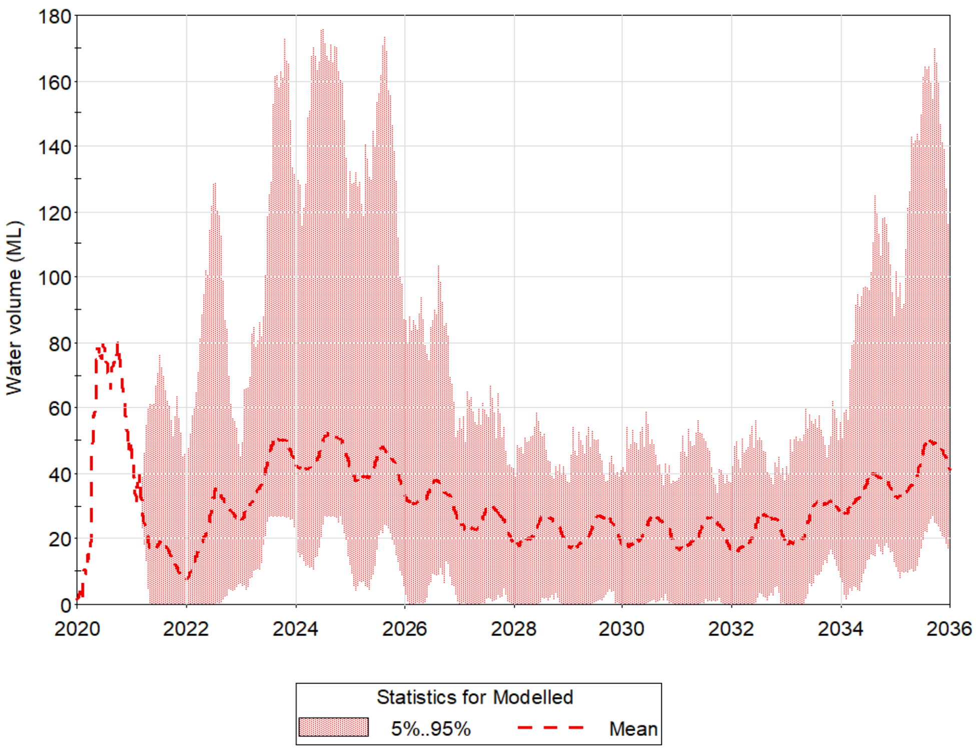



*Figure 8-6 Forecast Water Stored in TSF Decant Pond*

#### 8.4.4.6 Off Site Discharge

The site water balance model was used to estimate the likelihood of off-site discharge from Sediment Basins 1 and 2 at Hera Mine and the Stormwater Retention Pond at the Federation Site. As shown in **Table 8-15** there is no discharge predicted at the Federation Site. At the Hera Mine there is no change in the likelihood of discharge (which is authorised) between the existing and proposed conditions. Discharge at Hera Mine would occur as a result of above average or rare rainfall events and does not represent a regular off-site discharge of water.

*Table 8-15 Forecast Likelihood of Off-site Discharge*

| | Forecast likelihood of off-site discharge Existing conditions | Forecast likelihood of off-site discharge Proposed conditions |
|---|---|---|
| Hera Mine – Sediment Basin | 8% AEP | 8% AEP |
| Federation Mine – Stormwater Retention Pond | NA | 0% (equivalent to rarer than 1% AEP) |

### 8.4.5 Predicted Impacts

#### 8.4.5.1 Surface Water Flow

Mining operations have the potential to impact on flow regimes in watercourses due to changes to surface water runoff and baseflow contributions. Potential impacts on flow regimes in Box Creek and Sandy Creek were assessed by comparing total catchment areas for each reporting location per scenario. Three scenarios were considered:

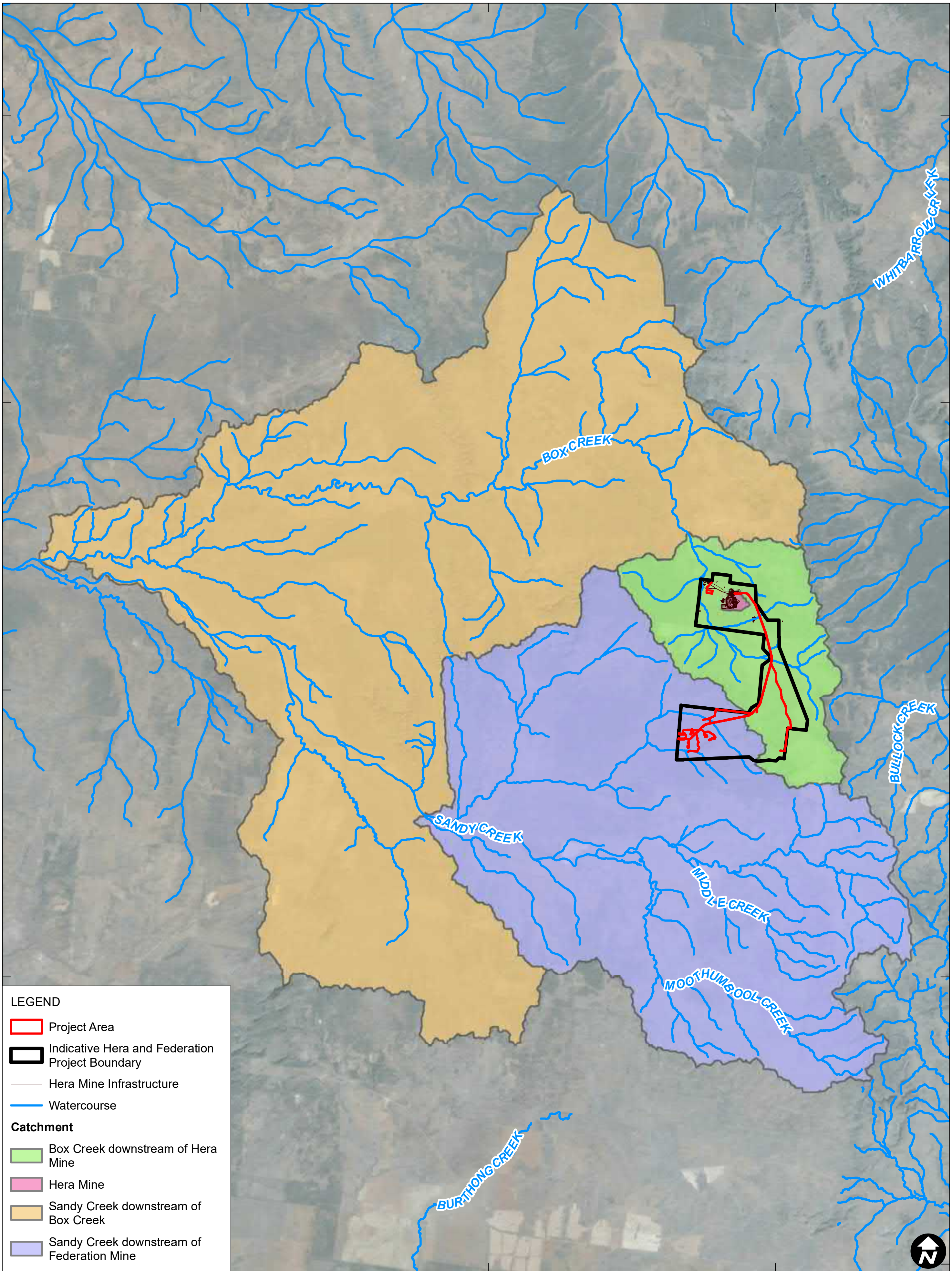
- Pre-development conditions – all catchments are undisturbed prior to Hera Mine. This is for the purpose of cumulative assessment;
- Existing conditions - reflects the existing approved water management system at Hera Mine; and
- Proposed conditions – reflects the existing and proposed water management system for the Project.

The catchment areas of the reporting locations are summarised in **Table 8-16** below. The catchments for proposed conditions are shown in **Figure 8-7** below.

*Table 8-16 Change in Catchment Area*

| Catchment | Pre development catchment area ($km^2$) | Existing catchment area ($km^2$) | Proposed catchment area ($km^2$) |
|---|---|---|---|
| Box Creek downstream of Hera Mine | 155.4 | 153.7 | 153.7 |
| Sandy Creek downstream of Federation Site | 699.9 | 699.9 | 699.6 |
| Sandy Creek downstream of Box Creek | 1198.5 | 1196.8 | 1196.5 |
| Hera Mine – water management system catchment | 0 | 1.7 | 1.7 |
| Federation Site – water management system catchment | 0 | 0 | 0.3 |

The relatively small disturbance areas and the clean water diversions surrounding both Hera Mine and the proposed Federation Site has resulted in a predicted reduced catchment of Sandy Creek downstream of Federation Site and reduced catchment for the combined Sandy Creek and Box Creek downstream of both sites by less than 1% of the respective pre-development catchments.




Scale: 1:340,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

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Data Source: Watercource: LPI, 2015
Aerial imagery supplied by © Department of Customer Service 2020
GHD Surface Water Impact Assessment, 2021 (Figure 6-1)

**CATCHMENTS PROPOSED CONDITIONS**

**FIGURE 8-7**

#### 8.4.5.2 Flooding

The proposed Federation Site has the potential to result in localised changes to flow patterns and itself be affected by flooding. No changes to the catchment of Hera Mine are proposed.

The change in catchments as discussed in **Section 8.4.5.1** shows that the proposed Federation Site has a relatively small catchment area compared to the catchment of Sandy Creek located immediately downstream. These changes may be considered minor and are not expected to have a significant impact on the extent and depth of flooding. The detailed design of the proposed Federation Site will include consideration of cross drainage so that the flood immunity of Burthong Road is not changed as a result of the Project.

Overall, there is not expected to be significant change in the extent of flooding and the stability of downstream watercourses, through changes to the catchment area, as a result of the Project.

Due to the elevated topography of the Federation Site and the inclusion of clean water diversion drains designed to convey the 1% AEP design flow from the upslope catchment around the site, the Federation Site is not expected to be subject to regional or localised flooding.

#### 8.4.5.3 Surface Water Quality

Due to the arid nature of the environment and infrequent surface water flow, opportunities for surface water quality monitoring Hera Mine are very limited. Surface water samples were therefore obtained from two dams upstream from the Federation Site as part of the SWIA. Samples obtained were analysed for the following analytes (refer **Table 8-17** below) by a NATA accredited laboratory.

*Table 8-17 Laboratory Analytical Suite*

| Suite | Analytes |
|---|---|
| Physicochemical parameters | EC, pH, salinity, total suspended solids (TSS), total hardness, turbidity |
| Metals (dissolved and total) | Arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver (dissolved only), vanadium, zinc |
| Nutrients | Total nitrogen (TN), nitrate and nitrite ($NO_x$), total Kjeldahl nitrogen (TKN), total phosphorus (TP) |
| Other analytes | Free cyanide, total cyanide, weak acid dissociable cyanide, biochemical oxygen demand (BOD), oil & grease |

Surface water samples were assessed against the adopted default value guidelines (DGV) which were sourced from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018). Those parameters that exceeded the DGV are highlighted in **Table 8-18** below.

*Table 8-18 Water Quality Results*

| Analyte | Unit | LOR | Middle Dam | Far Dam | DGV |
|---|---|---|---|---|---|
| **Physico-chemical parameters** | | | | | |
| pH | pH unit | 0.01 | 6.89 | 6.83 | 6.5-8.0 |
| EC | µS/cm | 1 | 64 | 88 | 30-350 |
| Salinity | g/kg | 0.01 | 0.04 | 0.05 | NA |
| TSS | mg/L | 5 | 7 | 20 | NA |

| | | | | | |
|---|---|---|---|---|---|
| Turbidity | NTU | 0.1 | 6.6 | 69.5 | 2-25 |
| Total hardness | mg/L | 1 | 25 | 18 | NA |
| **Dissolved metals** | | | | | |
| Arsenic | mg/L | 0.001 | <0.001 | <0.001 | 0.013 |
| Barium | mg/L | 0.001 | 0.013 | 0.010 | NA |
| Beryllium | mg/L | 0.001 | <0.001 | <0.001 | NA |
| Boron | mg/L | 0.05 | <0.05 | <0.05 | 0.37 |
| Cadmium | mg/L | 0.0001 | <0.0001 | <0.0001 | 0.0002 |
| Chromium | mg/L | 0.001 | <0.001 | <0.001 | 0.001 |
| Cobalt | mg/L | 0.001 | <0.001 | <0.001 | NA |
| Copper | mg/L | 0.001 | <0.001 | <0.001 | 0.0014 |
| Lead | mg/L | 0.001 | <0.001 | <0.001 | 0.0034 |
| Manganese | mg/L | 0.001 | 0.012 | <0.001 | 1.9 |
| Mercury | mg/L | 0.0001 | <0.0001 | <0.0001 | 0.0006 |
| Nickel | mg/L | 0.001 | <0.001 | <0.001 | 0.011 |
| Selenium | mg/L | 0.01 | <0.01 | <0.01 | 0.011 |
| Silver | mg/L | 0.01 | <0.01 | <0.01 | 0.00005 |
| Vanadium | mg/L | 0.01 | <0.01 | <0.01 | NA |
| Zinc | mg/L | 0.005 | <0.005 | <0.005 | 0.008 |
| **Total metals** | | | | | |
| Arsenic | mg/L | 0.001 | <0.001 | 0.001 | NA |
| Barium | mg/L | 0.001 | 0.014 | 0.020 | NA |
| Beryllium | mg/L | 0.001 | <0.001 | <0.001 | NA |
| Boron | mg/L | 0.05 | <0.05 | <0.05 | NA |
| Cadmium | mg/L | 0.0001 | <0.0001 | <0.0001 | NA |
| Chromium | mg/L | 0.001 | <0.001 | 0.003 | NA |
| Cobalt | mg/L | 0.001 | <0.001 | <0.001 | NA |
| Copper | mg/L | 0.001 | 0.002 | 0.006 | NA |
| Lead | mg/L | 0.001 | 0.007 | 0.016 | NA |
| Manganese | mg/L | 0.001 | 0.035 | 0.086 | NA |
| Mercury | mg/L | 0.0001 | <0.0001 | <0.0001 | NA |
| Nickel | mg/L | 0.001 | <0.001 | 0.003 | NA |
| Selenium | mg/L | 0.01 | <0.01 | <0.01 | NA |
| Vanadium | mg/L | 0.01 | <0.01 | <0.01 | NA |
| Zinc | mg/L | 0.005 | 0.018 | 0.037 | NA |
| **Nutrients** | | | | | |
| Nitrite + nitrate | mg/L | 0.01 | 0.06 | 0.15 | 0.015 |
| TKN | mg/L | 0.1 | 0.8 | 0.8 | NA |

| | | | | | |
|---|---|---|---|---|---|
| TN | mg/L | 0.1 | 0.9 | 1.0 | 0.25 |
| TP | mg/L | 0.01 | 0.04 | 0.07 | 0.02 |
| **Other parameters** | | | | | |
| Oil and grease | mg/L | 5 | <5 | <5 | NA |
| Biochemical oxygen demand | mg/L | 2 | 2 | 2 | NA |
| Free cyanide | mg/L | 0.004 | <0.004 | <0.004 | 0.007 |
| Total cyanide | mg/L | 0.004 | <0.004 | <0.004 | 0.007 |
| Weak acid dissociable cyanide | mg/L | 0.004 | <0.004 | <0.004 | 0.007 |

Concentrations of all dissolved metals were below the laboratory limit of reporting (LOR) at Far Dam, with the exception of dissolved barium, for which no DGV exists. In Middle Dam, only dissolved barium and manganese were observed in concentrations above the LOR, though no exceedances of the DGVs were recorded. Copper, lead and zinc were present for total metals as particulate matter not observed in dissolved metals. All metals were either below LOR or the DGV.

Nutrients were elevated at both sites, with NOx, TN and TP exceeding the respective DGVs. All nutrient concentrations were highest in the Far Dam sample. Elevated nutrient concentrations are expected to occur in farm dams such as these, as animals wastes and other organic materials enter the dams in runoff during periods of high rainfall, and become concentrated during dry conditions.

Concentrations of oil and grease, BOD and all forms of cyanide were low at both sites, with all results at or below the LOR. Although no silver above the LOR was detected, the LOR of the test used exceeded the DGV and therefore it cannot be verified that the concentration was below the DGV.

### 8.4.6 Mitigation and Management Measures

#### 8.4.6.1 Surface Water Quantity

For the purpose of validating the site water balance model, flow meters will be installed at the following locations at the Federation Site:

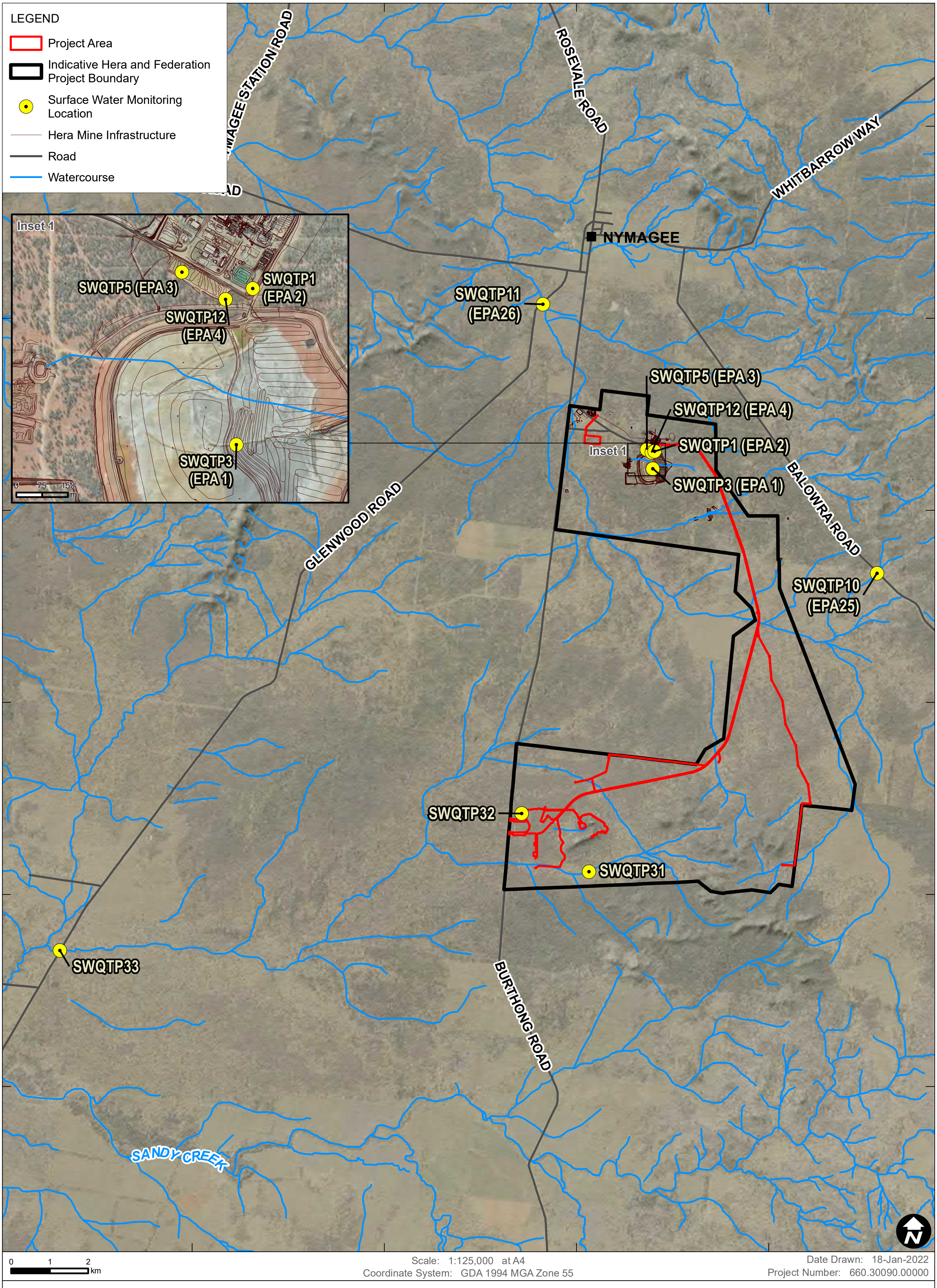
- Transfer from the leachate ponds to the Mine Dewatering Dam;
- Transfer from the Stormwater Retention Pond to the Mine Dewatering Dam; and
- Transfer from the Mine Dewatering Dam to Hera Mine.

Level sensors measuring the water level in the Stormwater Retention Pond water storage will be installed to estimate discharge quantities in the unlikely event of discharge.

#### 8.4.6.2 Surface Water Quality

Surface water quality at Hera Mine will continue to be monitored in accordance with the approved Hera Mine Water Management Plan.

Two additional (one upstream and one downstream) surface water quality monitoring locations will be nominated for the Federation Site and be added to the surface water quality monitoring program. These two locations are located on watercourses and would only be sampled during rainfall events sufficient to cause runoff. Proposed surface water monitoring locations are presented in **Figure 8-8** -.




Scale: 1:125,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020 & Aerometrex Pty Ltd, 2019
GHD Surface Water Impact Assessment, 2021 (Figure 9-1)

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**PROPOSED SURFACE WATER MONITORING LOCATIONS**

**FIGURE 8-8**

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The consolidated surface water quality monitoring program including the existing surface water monitoring locations for Hera Mine and the proposed additional locations for the Project are summarised in Table 8-19.

*Table 8-19 Recommended Surface Water Monitoring Program*

| EPA Point, Location | Frequency | Parameters |
|---|---|---|
| SWQTP3 Discharge to TSF<br>SWQTP1 Discharge to PWD | Daily during any discharge | Cyanide (weak acid dissociable) |
| SWQTP5 / SWQTP12 | Daily during discharge | EC, pH, TSS, Cyanide (weak acid dissociable), Al, As, B, Cd, Cu, Pb, Mn, Ni, N (total), Oil and grease, Ag, Total P (filtered), Zn |
| SWQTP10 Surface Quality Monitoring Point Upstream<br>SWQTP11 Surface Quality Monitoring Point Downstream | | |
| SWQTP31 Federation upstream<br>SWQTP32 Stormwater Retention Pond discharge<br>SWQTP33 Federation downstream | | |

#### 8.4.6.3 Management Plans

Hera Mine currently operate in accordance with an approved water management plan (WMP). An updated water management plan for the Project will be developed to include the water management requirements of the Project, including Hera Mine. The updated WMP will be reviewed at a minimum every three years or as a result of any regulatory requirements, or any significant changes to water management practices.

Any construction activities associated with the Project will have a detailed Erosion and Sediment Control Plan (ESCP) prepared based on specific construction methodologies. The objective of the ESCP is to ensure that appropriate structures and programs of work are in place to:

- Identify activities that could cause erosion and generate sediment;
- Describe the location, function and capacity of erosion and sediment control structures required to minimise soil erosion and the potential for transport of sediment downstream;
- Ensure erosion and sediment control structures are appropriately maintained;
- Fulfil the statutory conditions of the Project approval;
- Consider industry standard practice, specifically:
- Landcom 2004. Managing Urban Stormwater – Soils and Construction, Volume 1, 4th Edition; and
- Department of Environment and Climate Change (DECC) 2008. Managing Urban Stormwater – Soils and Construction, Volume 2E – Mines and Quarries.

#### 8.4.6.4 Water Balance

The water balance model will be reviewed and revised annually. The average predicted water balance for the Project will be included in the water management plan and the results for each year will be reported in the Annual Review for the Project.

### 8.4.7 Conclusion

The SWIA was prepared to determine the potential impacts to surface water as a result of the Project. The Project is located in the Murray Darling Basin within the catchment area of Sandy Creek. The main creek systems in the vicinity of the Project are westerly flowing ephemeral streams that ultimately drain to the Darling River, and include Box Creek to the north, and Sandy Creek to the south.

GOLDSIM software was used to develop the water balance for the Project, integrated with Hera Mine. The water balance demonstrated that under the proposed conditions there would be both greater inputs and outputs compared to the current Hera Mine. However, the water requirements of the Project are expected to be within the entitlements already held for Hera Mine.

Impact to the local catchments will be minimal, comprising a reduction of less than 1% of its respective pre-development catchments. The Federation Site is not expected to be subject to regional or localised flooding due to the elevated topography and the establishment of diversion drains.

Upstream water quality was assessed through sampling of two dams. The majority of analytes were below the default value guidelines or limit of detection with the exception of nutrients. Future surface water quality monitoring has been proposed for the Project. The Hera Mine WMP will be updated to include the Project.

## 8.5 Groundwater

### 8.5.1 Introduction

A Groundwater Impact Assessment (GWIA) was prepared by GHD and is included in **Appendix J**. The GWIA provides an assessment of current, approved groundwater conditions in the model domain including Hera Mine. The GWIA then provides an assessment of groundwater conditions in the model domain inclusive of the Project (mining at Federation and the proposed borefield) and current, approved activities. Comparison of the respective model outputs allows for the assessment in changes in groundwater conditions as a result of the Project, as well as an assessment of cumulative impacts.

### 8.5.2 Assessment Requirements

Provided in **Table 8-20** below are the SEARs requirements as they relate to groundwater impacts and where these have been addressed.

*Table 8-20 Groundwater SEARs Requirements*

| Requirement | Reference |
|---|---|
| An assessment of the likely impacts of the development on the quantity and quality of surface, and groundwater resources, having regard to the *NSW Aquifer Interference Policy*; | **Section 8.4.5**<br>**Section 8.5.5** |
| An assessment of the hydrological characteristics of the site and downstream; | **Section 8.4.3.2** |
| An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure and systems and other water users, including impacts to water supply from dams, and riparian and licensed water users | **Section 8.4.5**<br>**Section 8.5.5** |

| | |
|---|---|
| Demonstration that water for the construction and operation of the development, for the life of the project, can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant *Water Sharing Plan* (WSP), and include an assessment of the current market depth where water entitlement is required to be purchased; | **Section 8.4.4.3**<br>**Section 8.4.4.4** |
| A description of the measures proposed, including monitoring activities and methodologies, to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; | **Section 8.4.6**<br>**Section 8.5.7** |
| A detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts. | **Section 8.4.6.1**<br>**Section 8.4.6.2**<br>**Section 8.4.5.1**<br>**Section 8.4.5.3**<br>**Section 8.5.7**<br>**Section 4.11** |

### 8.5.3 Existing Environment

#### 8.5.3.1 Hydrogeology

The aquifer in the Project area is located within the indurated Palaeozoic sediments that constitute a fractured rock aquifer where groundwater is stored and transmitted via fractures, joints and other discontinuities within the rock mass. The fractured rock groundwater source is classified as 'less productive' in accordance with the criteria specified in the NSW Aquifer Interference Policy (i.e. the yield is typically less than 5L/s and/or the total dissolved solids concentration is typically greater than 1,500 mg/L).

The fractured and porous groundwater sources are managed under the water sharing plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources. Groundwater levels at the site are deep at 45 m to 75 m below ground level (bgl) at Hera Mine and Nymagee Copper Mine, and from 75 m to 90 m bgl at Federation. Based on monitoring data collected at the Nymagee Copper Mine, Hera Mine and Federation, groundwater flow is east north-east to west south-west.

#### 8.5.3.2 Groundwater Receivers

*Landholder Bores*

A search of the Australian Groundwater Explorer (BoM 2019a) and Water NSW Real Time Data (Water NSW 2019) was undertaken to identify registered bores near the Project. The search identified 34 bores within an approximate 20 km radius. Registered bore details are provided in **Table 8-21** below and shown in **Figure 8-9.**

Of the 34 bores, 18 are registered as monitoring or mining purposes, and form part of the monitoring network and production bore network for Hera Mine. Three of these monitoring bores are reported to be abandoned.

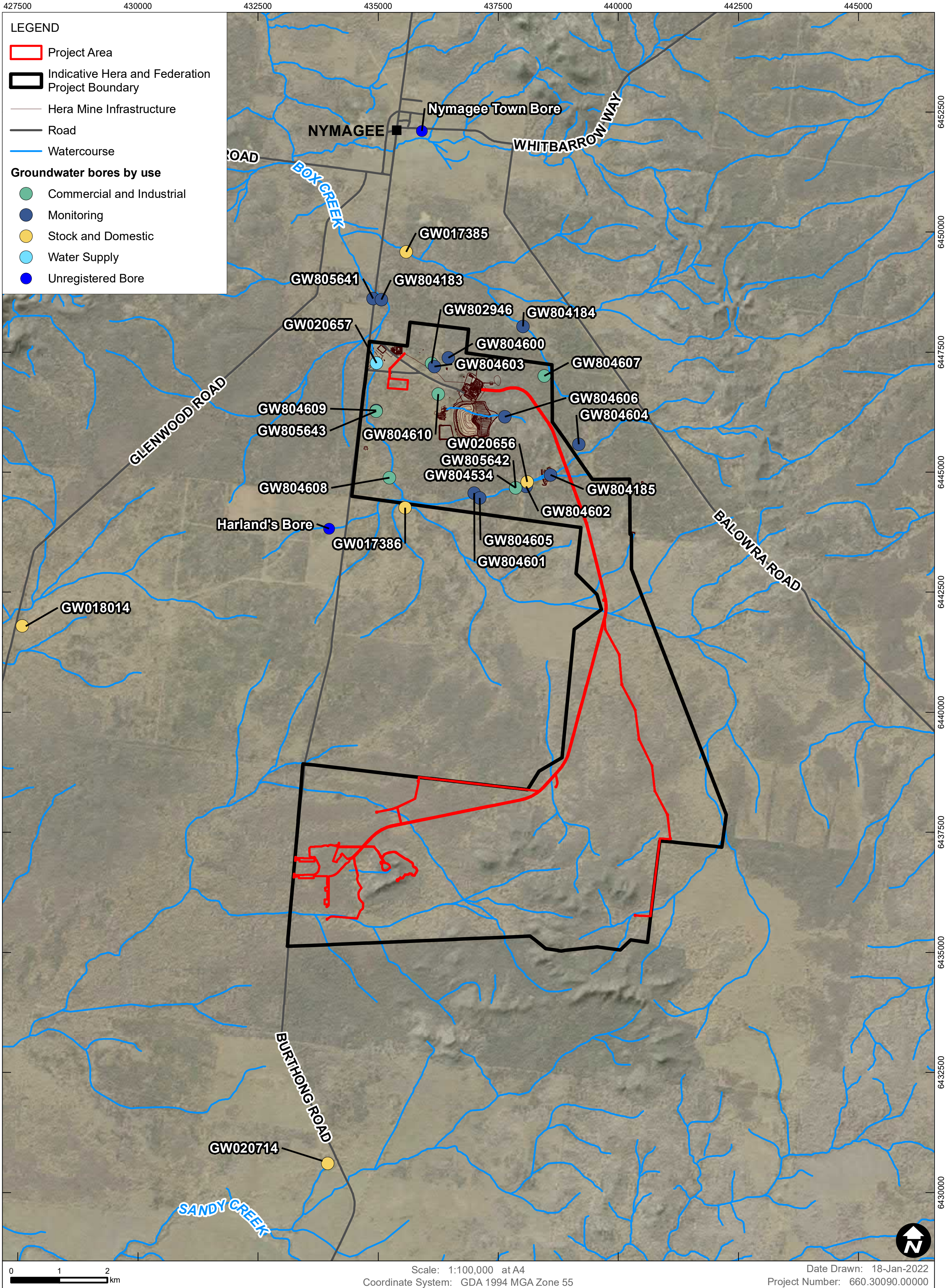
The Nymagee Town Bore was not identified in the searches. This bore was reported by (Aquade, 2017) to be located approximately one kilometre east of Nymagee Mine. The approximate location of Nymagee Town Bore is shown **Figure 8-9**. Records of extraction and water level monitoring at the Nymagee Town Bore were not available. The unregistered Harland's Bore is located approximately 3.9 km south west of Hera Mine and is also shown on **Figure 8-9**.

*Table 8-21 Registered Bores*

| Bore | Depth (m) | Purpose | SWL (m) | Yield (L/s) | Salinity | Strata | Radial distance from Federation (km) | Radial distance from Hera Mine (km) | Hera bore name/ notes |
|---|---|---|---|---|---|---|---|---|---|
| GW014111 | 54.3 | Stock | 39.6 | 0.13 | Brackish | Limestone, granite | 20.4 | 30.1 | |
| GW014217 | 55.5 | Stock | – | – | Brackish | Slate | 20.3 | 30.2 | |
| GW015819 | 25.9 | Unknown | – | – | – | Sandstone | 17.7 | 24.3 | |
| GW015820 | 50.3 | Stock | – | – | – | – | 18.9 | 25.1 | |
| GW017183 | 91.4 | Stock | 48.8 | 0.73 | Over 14000 ppm | Sandstone, slate | 12.7 | 18.3 | |
| GW017385 | 61 | Stock | 46.6 | 0.51 | 501-1000 ppm | Schist, slate | 12.7 | 3.0 | |
| GW017386 | 100.9 | Stock | 58.2 | 0.25 | 1001-3000 ppm | Slate | 7.4 | 2.5 | |
| GW017469 | 100.9 | Stock | 58.2 | 0.25 | 1001-3000 ppm | Slate | 18.8 | 22.3 | |
| GW018014 | 82.9 | Stock | 15.2 | 0.51 | 3001-7000 ppm | Quartzite | 8.2 | 9.7 | |
| GW020656 | 74.1 | Stock | 55.8 | 0.63 | 1001-3000 ppm | Slate, quartzite bands | 8.7 | 2.8 | Back Bore |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| GW020657 | 74.1 | Stock, domestic | 54.3 | 0.63 | – | Slate, quartzite bands | 10.3 | 1.2 | House Bore |
| GW020714 | 109.73 | Stock | 36.6 | 0.21 | Salty | Quartzite | 6.4 | 16.3 | |
| GW021543 | 75.6 | Stock | 45.7 | 0.59 | Over 14000 ppm | Slate | 13.4 | 18.8 | |
| GW022674 | 90.8 | Stock, domestic | 45.7, 39.6 | 0.63 | 10001-14000 ppm | Slate | 12.7 | 21.6 | |
| GW802946 | 85 | Stock, industrial | 65 | 1.1 | – | Siltstone | 10.5 | 0.6 | Skirkas Bore (abandoned) |
| GW804183 | 108 | Monitoring bore | 100 | 2.5 | – | Siltstone | 11.6 | 2.2 | |
| GW804184 | 108 | Monitoring bore | – | 0.6 | – | Siltstone | 11.7 | 2.4 | WB3 |
| GW804185 | 120 | Monitoring bore, test bore | 52.78 | 1 | – | Siltstone | 9.1 | 3.1 | WB4 |
| GW804534 | 116 | Mining | 70.66 | 3.5, 2.5 | – | Sandstone, siltstone, minor quartz veins | 8.5 | 2.7 | |
| GW804600 | 150 | Monitoring bore, test bore | – | – | – | Sandstone, siltstone | 10.6 | 0.9 | Obs Bore 3 |
| GW804601 | 120 | Monitoring bore, test bore | – | – | – | Sandstone, siltstone | 8.1 | 2.3 | Obs Bore 2 |
| GW804602 | 120 | Monitoring bore, test bore | – | – | – | Sandstone, siltstone | 8.6 | 2.9 | Obs Bore 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| GW804603 | 150 | Monitoring bore, test bore | – | 0.5 | Slightly salty | Siltstone | 10.4 | 0.6 | Decline Bore |
| GW804604 | 103 | Monitoring bore, test bore | – | – | – | Shale, siltstone, sandstone | 9.9 | 3.3 | Abandoned |
| GW804605 | 140 | Monitoring bore, test bore | 70 | 7.5 | – | Sandstone, siltstone | 8 | 2.5 | WB8 |
| GW804606 | 115 | Monitoring bore, test bore | – | – | – | Shale, siltstone, sandstone | 9.8 | 1.7 | Abandoned |
| GW804607 | 90 | Mining | 58 | 0.6 | – | Shale, siltstone, sandstone | 10.9 | 2.5 | WB10 |
| GW804608 | 122 | Mining | 63 | 5 | – | Sandstone, siltstone | 8 | 1.9 | WB21 |
| GW804609 | 96 | Monitoring bore, test bore | 60 | 0.4 | – | Sandstone, siltstone | 9.3 | 1.1 | WB12/WB17 |
| GW804610 | 108 | Mining | 72 | 3.5 | 3001-7000 ppm | Sandstone, siltstone | 9.9 | 0.3 | WB13 |
| GW805641 | 117 | Monitoring bore | 78 | 0.3 | – | Siltstone | 11.7 | 2.3 | WB15 |
| GW805642 | 120 | Mining | 75 | 4.2 | – | Sandstone, siltstone | 8.5 | 2.7 | |
| GW805643 | 135 | Industrial | 66 | 3 | – | Siltstone | 9.3 | 1.1 | WB12/WB17 |
| GW850057 | - | Stock | - | - | - | - | 10.4 | 1.1 | FWB030 |

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Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
Bore locations © WaterNSW (June, 2021)

SLR

**GROUNDWATER BORES**

**FIGURE 8-9**

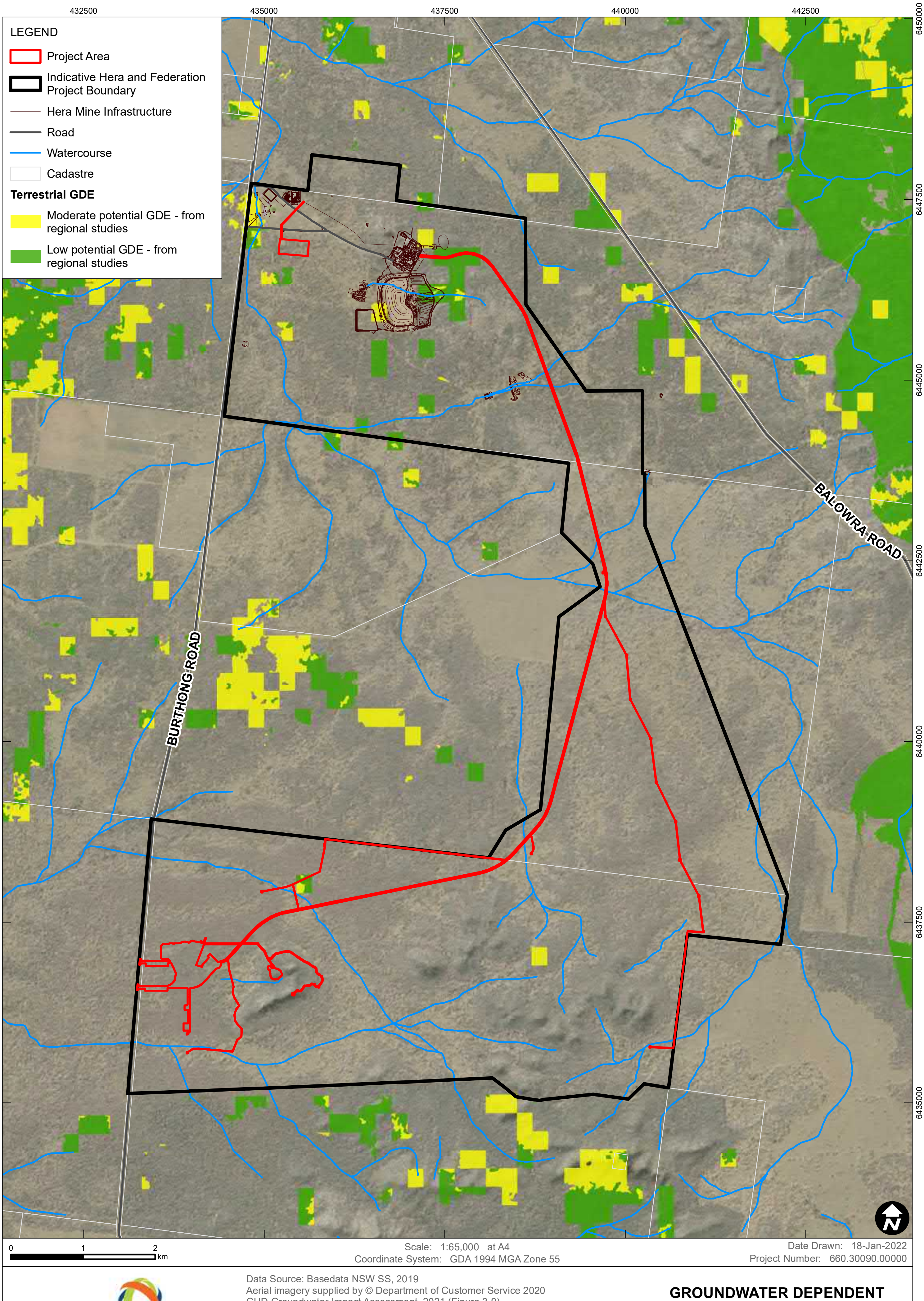
### *Groundwater Dependent Ecosystems*

A groundwater dependent ecosystem (GDE) is an ecosystem, which has its species composition and natural ecological processes determined by groundwater. That is, GDEs are natural ecosystems that require access to groundwater to meet all (obligatory), or some (facultative) of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services. If the availability of groundwater to GDEs is reduced, or if the quality is allowed to deteriorate, these ecosystems will be impacted.

A search of the Groundwater Dependent Ecosystem Atlas (BoM 2019b) was undertaken to identify potential GDEs within 20 kms of the Project. Potential GDEs mapped for the Project area are provided in **Figure 8-10**. Potential GDEs are identified based on regional assessments of groundwater levels, remote sensing of vegetation and surface topography. The search identified a number of potential terrestrial GDEs in the vicinity of Federation. The location of these potential GDEs are shown in **Figure 8-10** –. Its shows that the Project lies in a low potential GDE – national assessment occurrence zone.

The background document for the Murray-Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan (Department of Primary Industries, 2012) was also reviewed to identify any high priority GDEs within the Lachlan Fold Belt groundwater source. There were no listed high priority GDEs within or near Federation Site.

It is considered unlikely that there are any GDEs in the vicinity of Hera Mine, Federation and proposed production bores due to the depth to water table. The depth to water table varies from 45 m to 75 m bgl at Hera Mine and Nymagee Copper Mine, and 75 m to 90 m bgl at Federation, which is well below the expected depth of any root systems. There are no high priority GDEs or culturally significant sites listed in the relevant water sharing plan within 20 km of Federation Site. Therefore, potential impacts on high priority GDEs and culturally significant sites are within the Level 1 minimal impact considerations for GDEs from the NSW AIP.




Scale: 1:65,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

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Project Number: 660.30090.00000

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Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 3-9)

**GROUNDWATER DEPENDENT ECOSYSTEMS (GDE's)**

**FIGURE 8-10**

### 8.5.3.3 Groundwater Monitoring Program

*Hera Mine*

The groundwater monitoring program at Hera Mine includes a number of groundwater monitoring bores and production bores. All production bores are fitted with meters to monitor the volume extracted. Monitoring has ceased at a number of production bores at Hera Mine after becoming dry.

Groundwater monitoring at Hera Mine is undertaken in accordance with EPL 20179. The groundwater bores which comprise the monitoring program at Hera Mine are provided in **Figure 8-11** with required monitoring parameters included in **Table 8-22**.

*Table 8-22 EPL Groundwater Monitoring Requirements*

| Location | Frequency | Parameter |
|---|---|---|
| EPL monitoring points | | |
| WB4 (EPA 7) | Quarterly | Standing water level (SWL), Electrical conductivity (EC), pH, Total dissolved solids (TDS), Sb, As, $HCO_3$, B, Cd, Ca, CO3, Cl, Cr, Cu, Cyanide (free, total & WAD), Fe, Pb, Mg, Hg, Mo, Ni, K, Ag, Na, Sn, Zn |
| WB8* (EPA 9) | | |
| House bore* (EPA 19) | | |
| WB15 (EPA 27) | | |
| WB16 (EPA 28) | | |
| WB18 (EPA 29) | | |
| WB20 (EPA 30) | | |
| WB21* (EPA 31) | | |
| WB24* (EPA 32) | | |
| WB25* (EPA 33) | | |
| WB10 (EPA 40) | | |
| **SWL not required to be measured in production bores* | | |

*Federation Site*

The groundwater monitoring program at Federation Site includes seven groundwater monitoring bores, with most of these being installed in mid-2020. The groundwater monitoring network includes one bore installed for the purposes of exploration (FWB030/GW850057). Groundwater monitoring bore details are included in **Table 8-23** and locations shown in **Figure 8-11 –.** The monitoring bores are monitored monthly for groundwater levels and quality.

*Table 8-23 Federation Site Groundwater Monitoring Network*

| Bore | TOC (m AHD) | Depth (m bgl) | Screened interval (m bgl) | Gravel pack interval (m bgl) | MGA Zone 55 Co-ordinates | | Monitoring period |
|---|---|---|---|---|---|---|---|
| | | | | | Easting | Northing | |
| FMB001 | 323.754 | 120 | 111-117 | 96-120 | 434361 | 6437163 | Jul 2020 – current |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| FMB002 | 328.115 | 180 | 162-174 | 88-180 | 434511 | 6437027 | Jul 2020 – current |
| FMB003 | 316.734 | 120 | 105-109, 114-117 | 103-120 | 433780 | 6436947 | Aug 2020 – current |
| FMB004 | 327.118 | 120 | 111-117 | 88-120 | 434339 | 6436818 | Jul 2020 – current |
| FMB005 | 323.248 | 120 | 111-117 | 88-120 | 434146 | 6437092 | Jul 2020 – current |
| FMB006 | 312.228 | 150 | 100-103, 144-147 | 98-150 | 433476 | 6436614 | Oct 2020 – current |
| FWB030/ GW850057 | 321.463 | 114 | 102-108 | 100-114 | 434136 | 6436866 | Jul 2020 – current |

### *Nymagee Copper Mine*

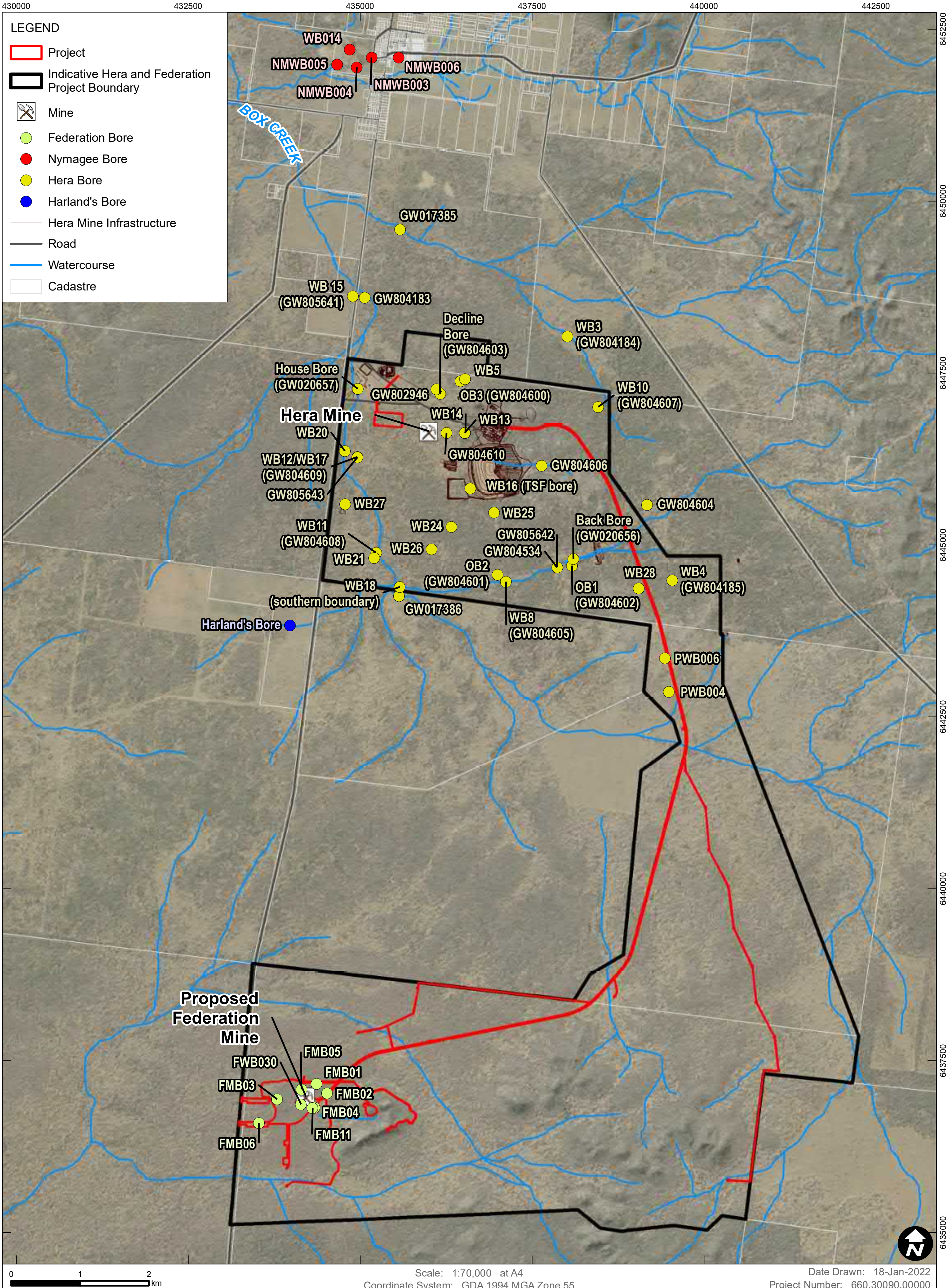
A groundwater monitoring program has been implemented at Nymagee Copper Mine (Nymagee Mine) with four monitoring bores installed around the Nymagee Mine (NMWB003, NMWB004, NMWB005 and NMWB006). Monitoring data is also collected at production bore WB014. The monitoring details are summarised in **Table 8-24** and the location of these bores are shown in **Figure 8-11**.

All monitoring bores and the production bore at Nymagee Mine are installed in the fractured rock aquifer.

*Table 8-24 Nymagee Mine Monitoring Bore Details*

| Bore | Easting (MGA zone 55) | Northing (MGA zone 55) | Monitoring period | Elevation (m RL) | Depth (m) | Screen intervals (m) |
|---|---|---|---|---|---|---|
| WB014 | 434846.59 | 6452207.09 | Apr 2013 – current | 321.6 | 102 | 1 – 102 |
| NMWB003 | 435163.83 | 6452088.42 | Sep 2018 – current | 308.0 | 140 | 50 – 62, 128 – 134 |
| NMWB004 | 434945.22 | 6451947.44 | Sep 2018 – current | 306.0 | 142 | 57 – 63, 124 – 136 |
| NMWB005 | 434661.40 | 6451986.69 | Sep 2018 – current | 309.0 | 125 | 60 – 66, 97 – 109 |
| NMWB006 | 435556 | 6452090 | Oct 2020 – current | 309.125 | 150 | 56 – 62, 102 – 108, 138 – 144 |

Groundwater monitoring commenced at NMWB003, NMWB004 and NMWB005 in September 2018. NMWB006 is located between the Nymagee Mine workings and the Nymagee Town Bore. NMWB006 was installed in mid-2020 to monitor for potential impacts of extraction of water from the Nymagee Mine workings on the Nymagee Town Bore. Monitoring at WB014 commenced in April 2013.




Scale: 1:70,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

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Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 3-11)

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**GROUNDWATER MONITORING LOCATIONS**

**FIGURE 8-11**

8.5.3.4 Groundwater Levels

Groundwater levels are very deep at Hera Mine, Federation Site and Nymagee Mine. Depth to groundwater typically ranges from 45 m to 75 m bgl at Hera Mine and Nymagee Mine, and from 75 m to 90 m bgl at Federation. At Hera Mine and Nymagee Mine the groundwater table appears to generally lie within the partially weathered strata, while at Federation Site, the water table is approximately equal to, or approximately 10 m below, the base of the partially weathered strata.

At Hera Mine drawdown in groundwater levels has been observed with decline development in early 2013 and groundwater extraction from production bores. Groundwater monitoring data indicates that the radius of drawdown from the Hera Mine workings has increased over time. At the Federation Site, a review of the groundwater hydrograph indicates that groundwater levels do not display any response to periods of rainfall. This is to be expected given the low recharge rates and the depth to groundwater.

At Nymagee Mine there was groundwater extraction between 2018 and 2020. This resulted in a reduction of groundwater levels of 21 m at WB14, which is the closest of the Nymagee monitoring bores to the Nymagee workings.

8.5.3.5 Groundwater Quality

Groundwater quality data was obtained for Hera, Federation Site and Nymagee. Groundwater at Hera Mine monitoring bores and production bores is circumneutral and slightly brackish to brackish (generally 2,000 µS/cm to 8,000 µS/cm), whereas at Federation Site it is varies from slightly brackish to saline (2,000 µS/cm to 10,000 µS/cm).

Dissolved metal concentrations in groundwater at Hera Mine and Federation Site are generally low. There was some one-off spikes recorded at Hera Mine for dissolved Boron, Iron, Nickel and Zinc. At Federation there was some variation in dissolved iron and manganese.

Groundwater quality at Federation Site has been compared with groundwater quality at Hera Mine in a piper diagram, shown in **Figure 8-12** below. As shown in the piper diagram groundwater quality at Hera Mine is relatively similar to groundwater quality at Federation Site.

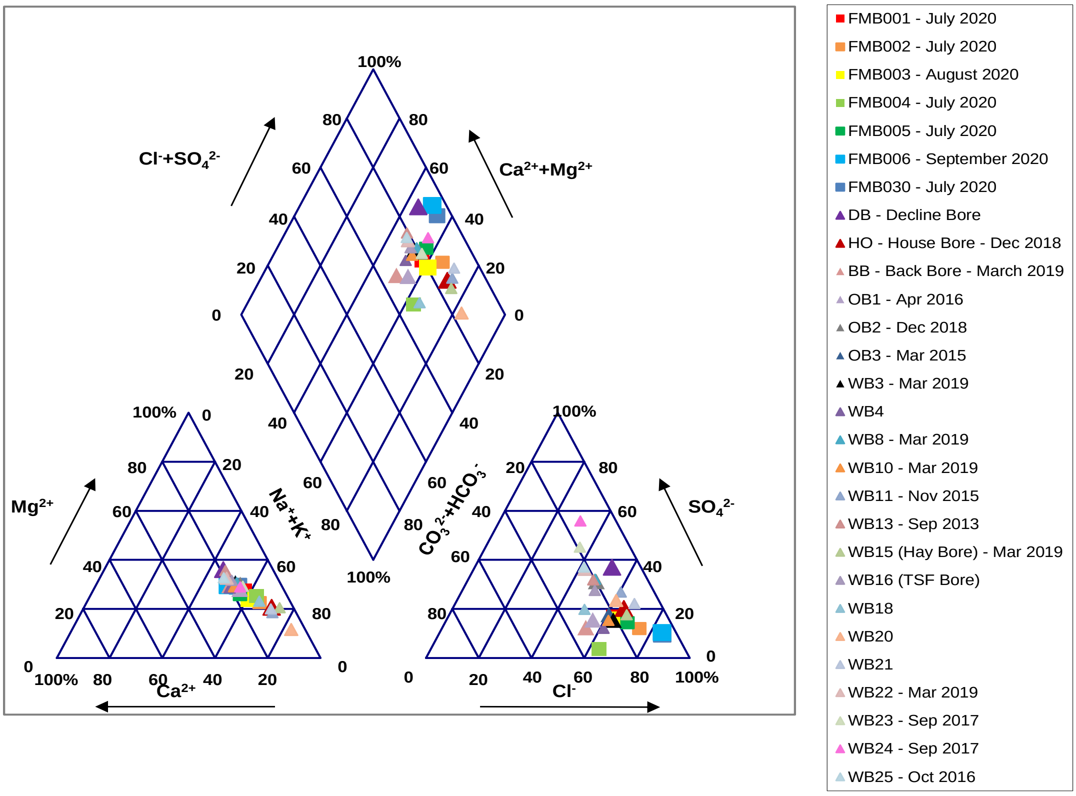



*Figure 8-12 Hera Mine and Federation Site Water Quality Piper Diagram*

Groundwater pH and EC are the only measures of groundwater quality available at Nymagee Mine which is summarised in **Table 8-25.**

*Table 8-25 Nymagee Groundwater Quality*

| Bore | Average pH | Range pH | Average EC (mS/cm) | Range EC (µS/cm) |
|---|---|---|---|---|
| NMWB003 | 7.0 | 6.9 – 7.0 | 4.9 | 3,620 – 6,010 |
| NMWB004 | 7.4 | 7.2 – 7.6 | 3.1 | 2,560 – 3,810 |
| NMWB005 | 8.4 | 7.0 – 10.8* | 3.6 | 2,930 – 4,050 |
| WB014 | 5.3 | 3.3 – 6.7 | 1.69 | 1,500 – 1,840 |

Compared to groundwater quality data at Federation Site and Hera Mine, groundwater at Nymagee bores NMWB003 and NMWB004 is generally consistent in terms of physiochemical parameters. However, the average pH and EC are considerably lower at WMB014, in comparison to the data at both Federation Site and Hera Mine bores. NMWB005 average pH is more alkaline in comparison to available data at Federation Site and Hera Mine bores. The recorded EC is slightly lower than the average at both Federation Site and Hera Mine bores.

8.5.3.6 Groundwater Inflows

The daily average groundwater inflow at Hera Mine was calculated on a monthly basis and is presented in **Figure 8-13** below. The depth of the Hera Mine workings is also shown in **Figure 8-13**. The decreasing trend inflow between 2019 and 2021 may be due to the mine workings extending into areas that have already been dewatered by the existing workings. The rate of decreasing inflows is in accordance with the conceptualisation of the aquifer that fracturing of the aquifer decreases with depth. This decreasing fracturing would result in lower hydraulic conductivity and lower rate of groundwater inflow.

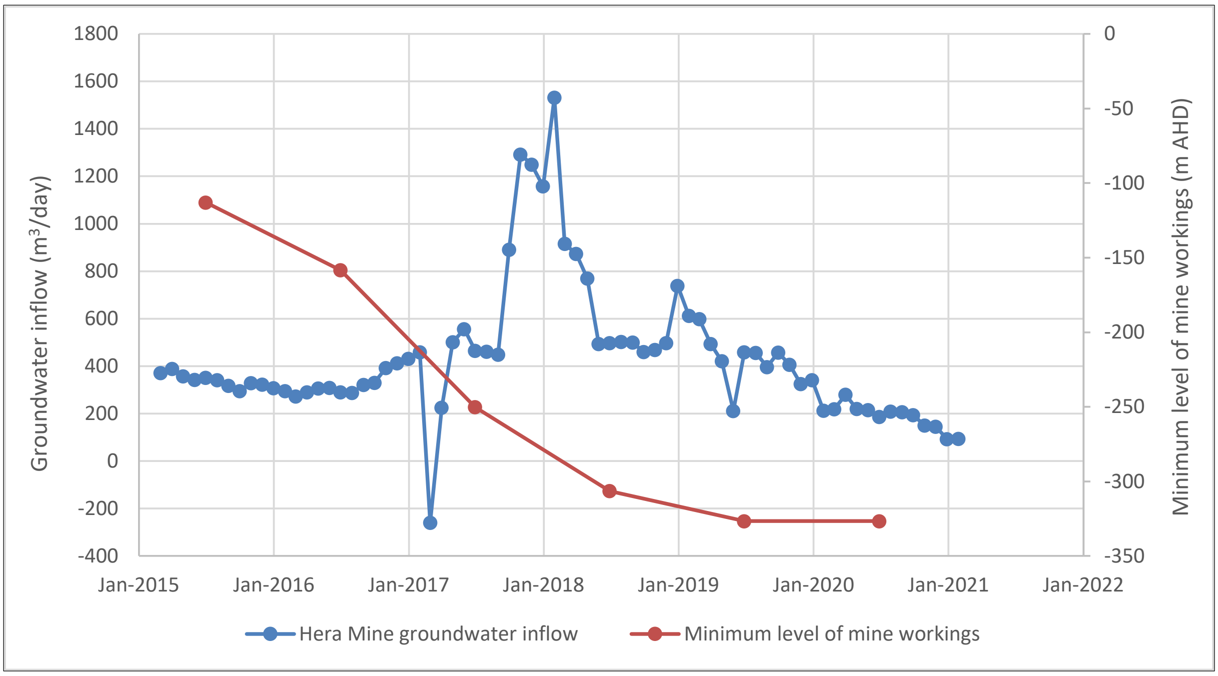



*Figure 8-13 Hera Mine Monthly Groundwater Inflows*

Over the period of monitoring, groundwater inflows into the mine workings are typically 300 $m^3$/day to 500 $m^3$/day (3.5 L/s to 5.8 L/s).

8.5.3.7 Groundwater Extraction

Metered extraction from the production bores at Hera Mine is available from March 2015 onwards. From October 2013 to March 2015 some groundwater extraction data was available from previous reporting. Aquade (2015) undertook a review of extraction from production bores from October 2013 to June 2015. The results of the review of extraction from the production bores are summarised in **Table 8-26**.

*Table 8-26 Volumes Pumped from Production Bores October 2013 to June 2015 (Aquade, 2015)*

| Bore | Cumulative volume pumped between October 2013 and June 2015 inclusive (ML) | Maximum sustained (days to weeks) pumping rate between October 2013 and June 2015 ($m^3$/day) | Nearby observation bore | Maximum drawdown in nearby observation bore between October 2013 and June 2015 (m) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| WB8 | 53 | 250 | OB2 | 6.3 |
| WB11 | 34 | 180 | WB18 | Insufficient data – WB18 installed during this monitoring period |
| Back Bore | 36 | 64 | OB1 | 9.4 |
| House Bore | 1.2 | 26 | N/A | N/A |
| WB10 | 0.4 | 20 | N/A | N/A |

Details of production bores in operation from March 2015 are summarised in **Table 8-27**. In addition to the bores listed in Table 8-26, PWB004 and PWB006 are production bores at Hera Mine.

*Table 8-27 Production Bores – March 2015 to December 2020*

| Bore | Period of operation | Cumulative volume pumped between March 2015 and December 2020 (ML) | Maximum monthly pumping rate between March 2015 and December 2020 ($m^3$/day) |
|---|---|---|---|
| Back Bore | May 2015 – May 2019 | 23.7 | 236 |
| House Bore | Nov 2019 – current | 6.4 | 26.7 |
| WB8 | Mar 2015 – current | 295.1 | 241 |
| WB10 | Apr 2020 – current | 2.3 | 12 |
| WB17 | Apr 2020 – current | 3.0 | 17 |
| WB21 | Nov 2015 – current | 146.6 | 162 |
| WB24 | Mar 2016 – current | 40.0 | 119 |
| WB25 | Feb 2016 – current | 153.6 | 321 |
| WB26 | May 2020 – current | 12.0 | 59 |
| WB27 | May 2020 – current | 18.4 | 107 |
| WB28 | Apr 2020 – current | 23.8 | 108 |
| Nymagee Mine Workings | Apr 2019 – July 2020 | 24.3 | 124 |
| FWB030 | Oct 2020 – current | 39.4 | Unknown – manual meter reading only |

Hydrographs for production and monitoring bores were plotted and included in Appendix C of the GWIA. Review of the hydrographs indicates that groundwater drawdown at a number of monitoring bores (OB2; NMWB003 to NMWB006; FMB001 to FMB006) is due to extraction from the production bores.

Review of extraction data indicates that groundwater yields may be gradually decreasing at a number of the production bores including WB8, WB21, WB24 and WB25. This decrease started to occur between 12 months and 4 years of operation at the Hera Mine.

#### 8.5.3.8 Recharge and Evapotranspiration

Given the depth to water in the bedrock and low annual rainfall volumes, recharge rates are likely to be very low, and potentially have some lag, owing to the long migration pathway through the unsaturated zone. Groundwater level monitoring data does not show any influence from rainfall recharge, with groundwater levels very constant at bores that are not impacted by mining and groundwater extraction.

Considering the deep groundwater levels at Federation Site and Hera Mine, evapotranspiration is likely to be negligible.

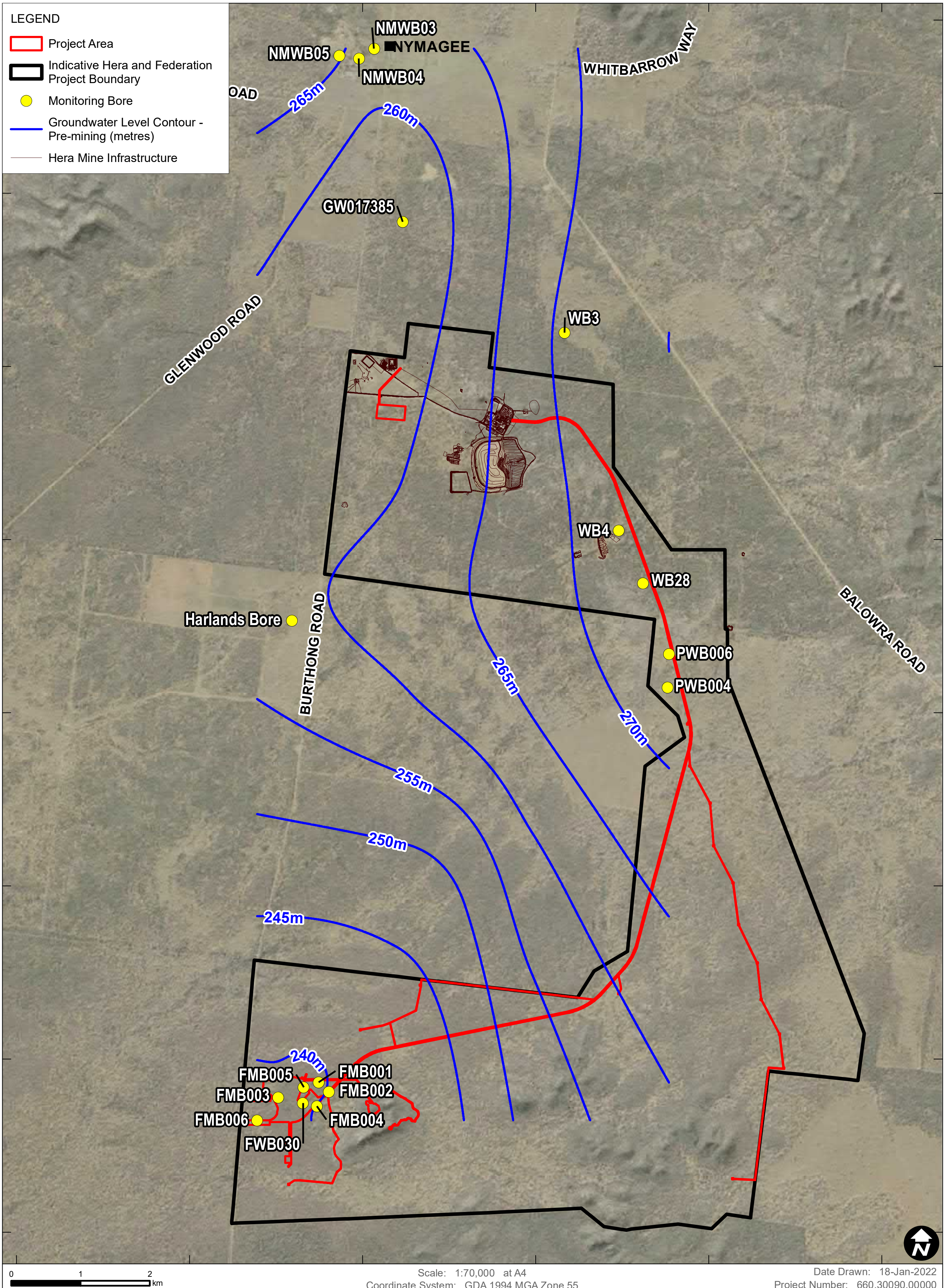
#### 8.5.3.9 Groundwater Flow Directions

Groundwater levels at Nymagee Mine, Hera Mine and Federation Site were reviewed to determine groundwater flow directions in the vicinity of Federation Site. Groundwater contours have been plotted for pre-mining conditions (i.e. pre Hera Mine commencement) and for current conditions (i.e. with Hera Mine but pre Federation deposit mining) in **Figure 8-14** and **Figure 8-15** respectively. Pre-mining contours were plotted using data collected from monitoring bores that commenced monitoring prior to mining at Hera Mine; and at Nymagee Mine and Federation bores as they were considered unlikely to be impacted by operations at Hera Mine. Groundwater contours for current conditions were plotted using the latest available monitoring data at each bore.

The pre-mining groundwater contours show that the groundwater flow direction is generally east north-east to west south-west. The groundwater contours for current conditions display the impact of mining and groundwater extraction at Hera Mine. The groundwater contours show drawdown in groundwater levels centred on the OB3 (Hera Mine workings) and WB22 (due to groundwater extraction).

#### 8.5.3.10 Schematic Conceptual Model

A conceptual groundwater model has been developed for the Project and is provided as Figure 3.18 in the GWIA. The conceptual model displays the deep groundwater levels at Federation Site discussed in **Section 8.5.3.4** and the east to west groundwater flow direction indicated by the groundwater monitoring data. The conceptual model indicates that the highest yielding portion of the aquifer is near the water table and the fracturing of the strata reduces with depth. The reduced fracturing with depth is conceptualised to result in reduced hydraulic conductivity as depth increases.

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**GROUNDWATER CONTOURS PRE-MINING**

**FIGURE 8-14**

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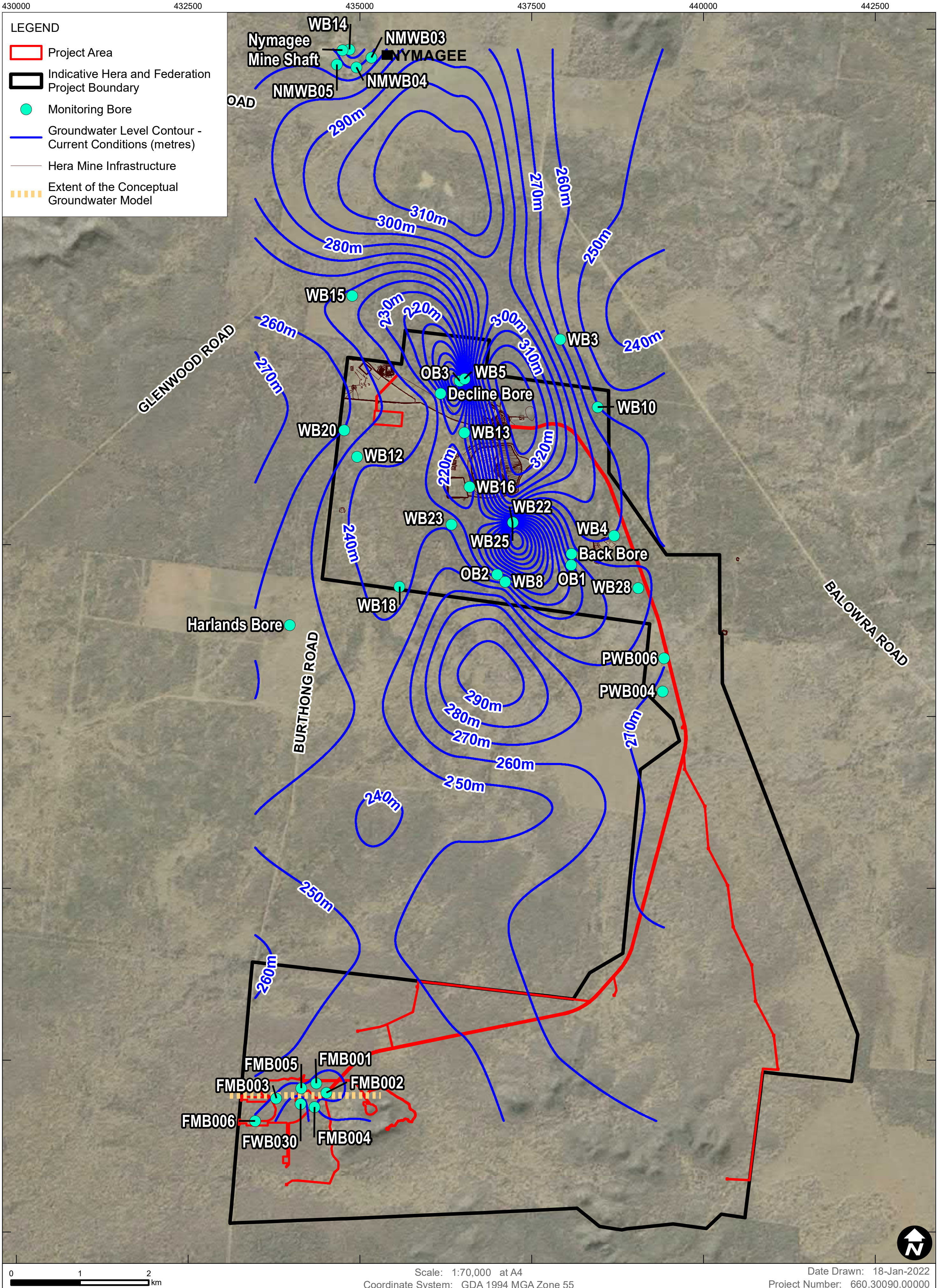


Scale: 1:70,000 at A4
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Data Source: Basedata NSW SS, 2019
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# GROUNDWATER CONTOURS HERA MINE PRE-FEDERATION PROJECT

FIGURE 8-15

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### 8.5.4 Assessment Approach

#### 8.5.4.1 Groundwater Model

Mining at Federation and extraction from proposed production bores will depressurise the adjacent strata, inducing changes to groundwater flow in the vicinity of the mining area and the production bores. Groundwater modelling was undertaken at a scale commensurate with the scale of the mine and the expected area of influence. In tight rocks of Western NSW, groundwater typically flows along discrete fractures. At a regional scale modelling is not feasible to explicitly simulate discreet fracture flows without adequate supporting data. The generally accepted approach is therefore to represent hydrostratigraphic units as zones of equivalent porous medium (EVP) with spatially averaged hydrogeological properties consistent with the scale of the model.

The model chosen for the study was MODFLOW- USG (MF-USG), as it is considered as the most appropriate model available for this type of study. Advantages of MF-USG include flexible meshing for efficient refinement of model cells in the area of interest and robust handling of saturation and desaturation of model cells for tracking the location of the water table.

The boundary for the MF-USG is defined as the hydrogeological domain. For the study, the hydrogeological domain placed Hera Mine and Federation Site approximately in the centre. The eastern boundary follows a regional anticline as shown in regional geological mapping (MacRae 1988). The western boundary follows the Woorara Fault as shown in regional geological mapping (MacRae 1988). The eastern and western boundaries are both over 8 km from Hera Mine and Federation Site. The northern and southern boundaries are located arbitrarily so as to be at least 10 km from Hera Mine and Federation Site. This is shown in **Figure 8-16** below**.**

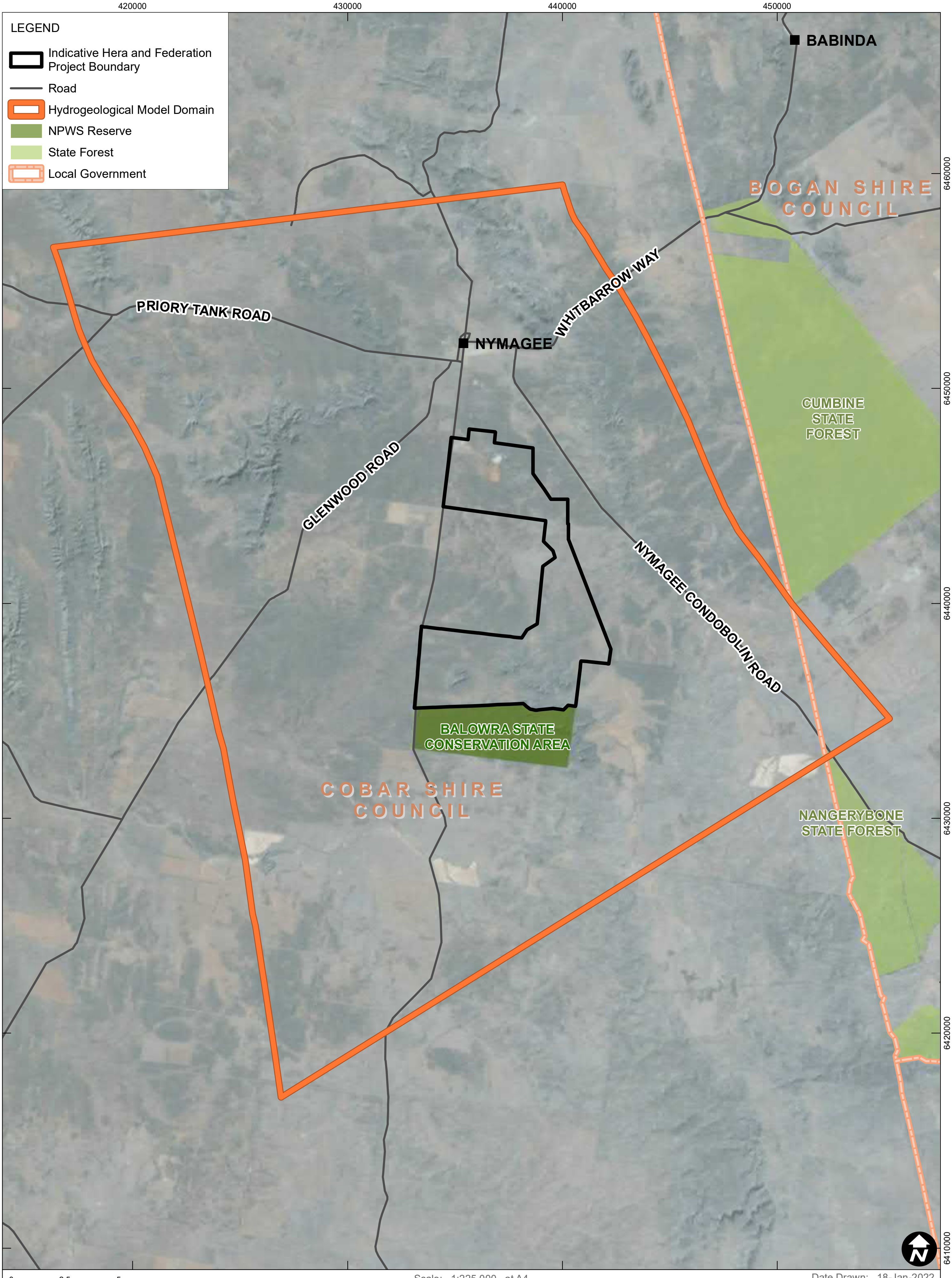
#### 8.5.4.2 Model Boundary Conditions

Boundary conditions were applied according to the following:

- General head boundaries (GHBs) were applied to the Palaeozoic rocks commensurate with the pre-mining observed head extrapolated to the model boundaries;
- No flow boundary conditions are assumed elsewhere including the northern and southern boundaries, where the boundary is parallel to the expected groundwater flow direction;
- The mine workings at Hera Mine were represented using drain cells; and
- Pumping from Hera Resources production bores was represented using the WEL package.

Pumping from landholder bores is not simulated in the model as there are a limited number of landholder bores in the vicinity of the Project and potential pumping from these bores is assumed to have negligible effect on model flow budgets.

Rainfall recharge in the vicinity of the Project is very low, therefore rainfall recharge within the model domain was assumed to be zero. The water table within the model domain is very deep, typically greater than 60 m. Therefore, as the water table is so deep and as plant root systems will not reach the water table, evapotranspiration within the model domain was assumed to be zero.

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Data Source: Basedata NSW SS, 2019, DPIE
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 4-1)

HYDROGEOLOGICAL DOMAIN

FIGURE 8-16

Drain cells were utilised to simulate historical mining at Hera Mine within the calibration model. Drain cells were assigned based on the extent, depth and progression of mining provided by Hera Resources.

Production bores at Hera Mine, Nymagee Mine workings and Federation Project area have been included in the calibration model using the WEL package. The pumping rate was determined based on a review of available extraction data, summarised in **Section 8.5.3.7.** For the majority of production bores, extraction data was available from March 2015 onwards. For the model boundary the pumping rate was calculated as the average pumping rate for each stress period.

#### 8.5.4.3 Model Calibration

Model calibration involves changing the values of model parameters within bounds until the model outputs fit historical measurements, such that the model can be accepted as a reasonable representation of the physical system of interest. The calibration targets are observed groundwater levels (heads) and groundwater drawdown (head change). The calibration implemented a two-stage process of running the steady state model first, to obtain a sensible set of initial heads, followed by the transient model to simulate temporal variations in groundwater levels. The transient model period was selected as January 2010 through to December 2020 as monitoring data from bores was available for this period.

Steady state calibration has been undertaken using a manual calibration process. The steady state calibration included modifying hydraulic conductivity values and also varying GHB values. These parameters were varied manually to improve the fit between observed and modelled groundwater heads. The steady state model is intended to represent pre-mining groundwater levels, to obtain a sensible set of starting heads for the transient calibration model.

Transient calibration was undertaken using a manual calibration process. The transient calibration included modifying hydraulic conductivity values, vertical anisotropy, specific yield and specific storage values. These parameters were varied manually to improve the fit between observed and modelled groundwater heads and between observed and modelled inflows into the Hera Mine workings.

- On the basis of the calibration results, the model was considered suitably calibrated. The model provides a good replication of groundwater level and mine inflow trends at Hera Mine. Therefore, on the basis that the geological environment at Federation Site is similar to Hera Mine, the model is considered to be able to provide a good prediction of impacts from mining at Federation.

#### 8.5.4.4 Peer Review

HydroAlgorithmics were engaged to undertake an independent peer review of the GWIA and associated modelling. Two reference documents were used as guidance for the peer review: *Murray-Darling Basin Commission Groundwater Flow Modelling Guideline*, issued in 2001 (Murry Darling Basin Commission (2001) , 2001), and guidelines issued by the National Water Commission (NWC) in June 2012. The methodology utilised a series of checklists to undertake the peer review. These included a compliance checklist and a checklist for data analysis and conceptual design. The third was used to review model calibration, verification, prediction, sensitivity analysis and uncertainty analysis.

### 8.5.5 Predicted Impacts

#### 8.5.5.1 Overview

As part of impact assessment, the following scenarios were assessed:

- Approved predictive model – the operational phase model includes life of mining at Hera Mine and Hera production bores (PWB004 and PWB006), followed by a post mining model for approved conditions. Note under approved conditions, the post closure model starts in 2023 when mining at Hera is complete; and
- Proposed predictive model – includes life of mining at Hera Mine and Hera production bores, proposed mining at Federation, continued dewatering of Hera workings throughout mining at Federation, and proposed Federation production bores; followed by a post mining model for proposed conditions. Note under proposed conditions, the post closure model starts in 2036 when mining at Hera is complete.

#### 8.5.5.2 Groundwater Assessment Criteria

The potential impacts have been assessed in accordance with the NSW Aquifer Interference Policy (AIP). The AIP requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the policy. If the predicted impacts meet the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. Impact considerations for Less Productive Fractured Rock Water Sources were adopted for the groundwater impact assessment based on the existing hydrogeological environment of the Project. Further details are provided in Section 7.2 of the GWIA.

*Flow Budget*

The key aspects of the flow budget for the operational and post-closure models have been summarised in **Table 8-28** according to year.

*Table 8-28 Predictive Model Flow Budget*

| Flow term | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2028 | 2035 | 2046 | 2136 | 3036 |
| Approved conditions | | | | | | | |
| Inflow | | | | | | | |
| Storage | 803.6 | 792.4 | 123.9 | 62.6 | 39.8 | 11.4 | 1.1 |
| External boundary inflow | 331.1 | 331.5 | 333.7 | 331.1 | 330.6 | 330.5 | 330.8 |
| Total | 1134.8 | 1123.8 | 457.6 | 393.7 | 370.4 | 341.9 | 331.9 |
| Outflow | | | | | | | |
| Storage | 128.2 | 49.2 | 126.4 | 63.5 | 40.2 | 11.7 | 1.8 |
| External boundary outflow | 330.4 | 330.4 | 331.3 | 330.3 | 330.2 | 330.2 | 330.1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mine inflow – Hera | 480.9 | 485.0 | 0 | 0 | 0 | 0 | 0 |
| Mine inflow – Federation | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0 |
| Wells | 195.3 | 259.2 | 0 | 0 | 0 | 0 | 0 |
| Total | 1134.8 | 1123.8 | 457.6 | 393.7 | 370.4 | 341.9 | 331.9 |
| Proposed conditions | | | | | | | |
| Inflow | | | | | | | |
| Storage | 803.6 | 904.1 | 1480.2 | 1531.2 | 276.5 | 32.9 | 1.8 |
| External boundary inflow | 331.1 | 331.5 | 334.8 | 335.9 | 334.0 | 331.5 | 332.4 |
| Total | 1134.8 | 1235.6 | 1814.9 | 1867.1 | 610.5 | 364.4 | 334.2 |
| Outflow | | | | | | | |
| Storage | 128.2 | 46.9 | 19.3 | 221.8 | 286.1 | 41.1 | 5.7 |
| External boundary outflow | 330.4 | 330.4 | 331.1 | 328.5 | 324.4 | 323.2 | 328.5 |
| Mine inflow – Hera | 480.9 | 485.0 | 476.4 | 471.0 | 0 | 0 | 0 |
| Mine inflow – Federation | 0.0 | 114.1 | 338.3 | 295.8 | 0 | 0 | 0 |
| Wells | 195.3 | 259.2 | 649.8 | 550.0 | 0 | 0 | 0 |
| Total | 1134.8 | 1235.6 | 1814.9 | 1867.1 | 610.5 | 364.4 | 334.2 |

Table notes:

2021 relates to current conditions. 2022 is first year of approved Exploration Decline Program activities at Federation, with mining commencing following approval in early 2023. 2028 is the year of modelled maximum mine inflow to Federation, 2035 the last year of mining. 2046, 2136 and 3036 relate to 10, 100 and 1000 years post-closure.

Units are in $m^3/d$.

**Table 8-29** summarises the changes to the flow budget presented in **Table 8-28** above, presenting incremental changes.

*Table 8-29 Changes to Flow Budget – Incremental Change*

| Flow term | Year | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2028 | 2035 | 2046 | 2136 | 3036 |
| **Incremental changes** | | | | | | | |
| **Inflow** | | | | | | | |
| Storage | 0 | 0 | 1356.3 | 1468.6 | 236.7 | 21.5 | 0.7 |
| External boundary inflow | 0<br>0% | 0<br>0% | 1.1<br>0.3% | 4.8<br>1.4% | 3.4<br>1.0% | 1<br>0.3% | 1.6<br>0.5% |

| Outflow | | | | | | | |
|---|---|---|---|---|---|---|---|
| Storage | 0 | 0 | -107.1 | 158.3 | 245.9 | 29.4 | 3.9 |
| External boundary outflow | 0<br>0% | 0<br>0% | -0.2<br>-0.06% | -1.8<br>-0.5% | -5.8<br>-1.8% | -7<br>-2.1% | -1.6<br>-0.5% |

Table notes:

2021 relates to current conditions. 2022 is first year of approved Exploration Decline Program activities at Federation, with mining commencing approval in early 2023. 2028 is the year of modelled maximum mine inflow to Federation, 2035 the last year of mining. 2046, 2136 and 3036 relate to 10, 100 and 1000 years post-closure.

Incremental impacts refers to proposed conditions flow budget minus the approved conditions flow budget

Units are in $m^3/d$ unless marked as %.

The flow budget indicates the following:

- During the period of mining under both approved and proposed conditions, outflow is dominated by mining at Hera Mine, Federation and extraction from production bores. During mining, outflow from mining and production bores varies from approximately 60% to 65% of outflows under approved conditions; and varies from approximately 60% to 80% of outflows under proposed conditions; and
- The most notable impacts on the modelled water budget due to mining are associated with changes in storage.

### *Groundwater Drawdown*

Contours for the maximum predicted drawdown of the water table for approved and proposed conditions are presented in **Figure 8-17** and **Figure 8-18** respectively.

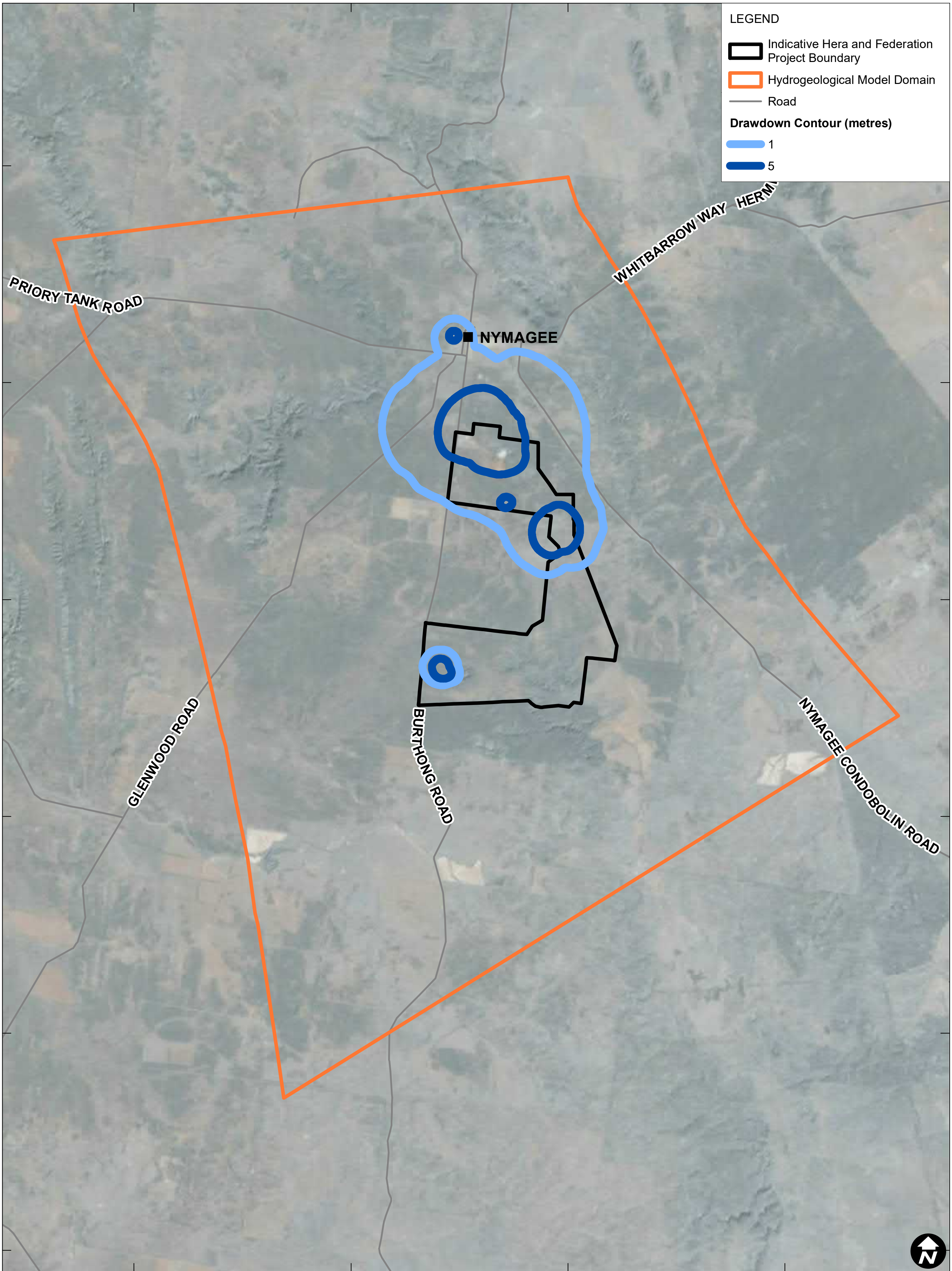
Under approved conditions as presented in **Figure 8-17**, the largest drawdown is predicted at Hera Mine, with steep hydraulic gradients along the edge of the mine, due to the low horizontal hydraulic conductivity of the strata. Drawdown is also centred around the Nymagee Mine workings and at Federation, due to groundwater extraction from the Nymagee Mine workings and production bore FWB030 at Federation. Drawdown is also centred around Hera Mine production bores PWB004 and PWB006 due to extraction from these bores. Under approved conditions, the 1m drawdown contour extends approximately 4.5 km from Hera Mine.

Under proposed conditions, the largest drawdown (composite) is predicted at Hera Mine, Federation Site and at proposed production bores. Comparison of modelled drawdown in **Figure 8-17** and **Figure 8-18** indicates maximum drawdown at the Hera Mine workings is larger under proposed conditions due to the continued dewatering of the Hera Mine workings after the completion of mining. Similarly, the radius of drawdown around the Hera Mine workings is larger, with the 1 m drawdown contour extending up to 6.2 km from Hera Mine. However, as shown in **Figure 8-19**, the magnitude of incremental drawdown (drawdown under proposed conditions minus drawdown under approved conditions) is less than 1 m at Hera Mine. This indicates that while drawdown at Hera Mine is greater under proposed conditions, the magnitude of the additional drawdown is less than 1 m.

Under proposed conditions, drawdown extends to the model boundary. This is considered to be due to the low storage and hydraulic conductivity of the strata. Modelled drawdown at the end of proposed mining at Federation is shown in **Figure 8-20**. Drawdown at the model boundaries occurs after the end of proposed mining and is low at 2 m.

Modelled drawdown 20 years after the end of proposed mining at Federation is shown in **Figure 8-21** which demonstrates that within 20 years of the end of mining the 10 m drawdown contour will have reduced in size, to the immediate extent of the Federation Site and Hera Mine workings, however the 2 m drawdown contour will have decreased in size around Hera Mine and the proposed borefield, but will have extended in size to the south and west of Federation Site.

Within 100 years of the end of mining the 2 m drawdown contour is isolated to the immediate extent of the Federation Site and Hera mine workings. The model results indicate that at 100 years of the end of mining the 1 m drawdown contour associated with the Federation workings has increased in extent to the south of the Federation Site. Following 1,000 years after the end of mining the drawdown associated with mining has largely recovered. Refer to **Figure 8-22** and **Figure 8-23.**




Scale: 1:225,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

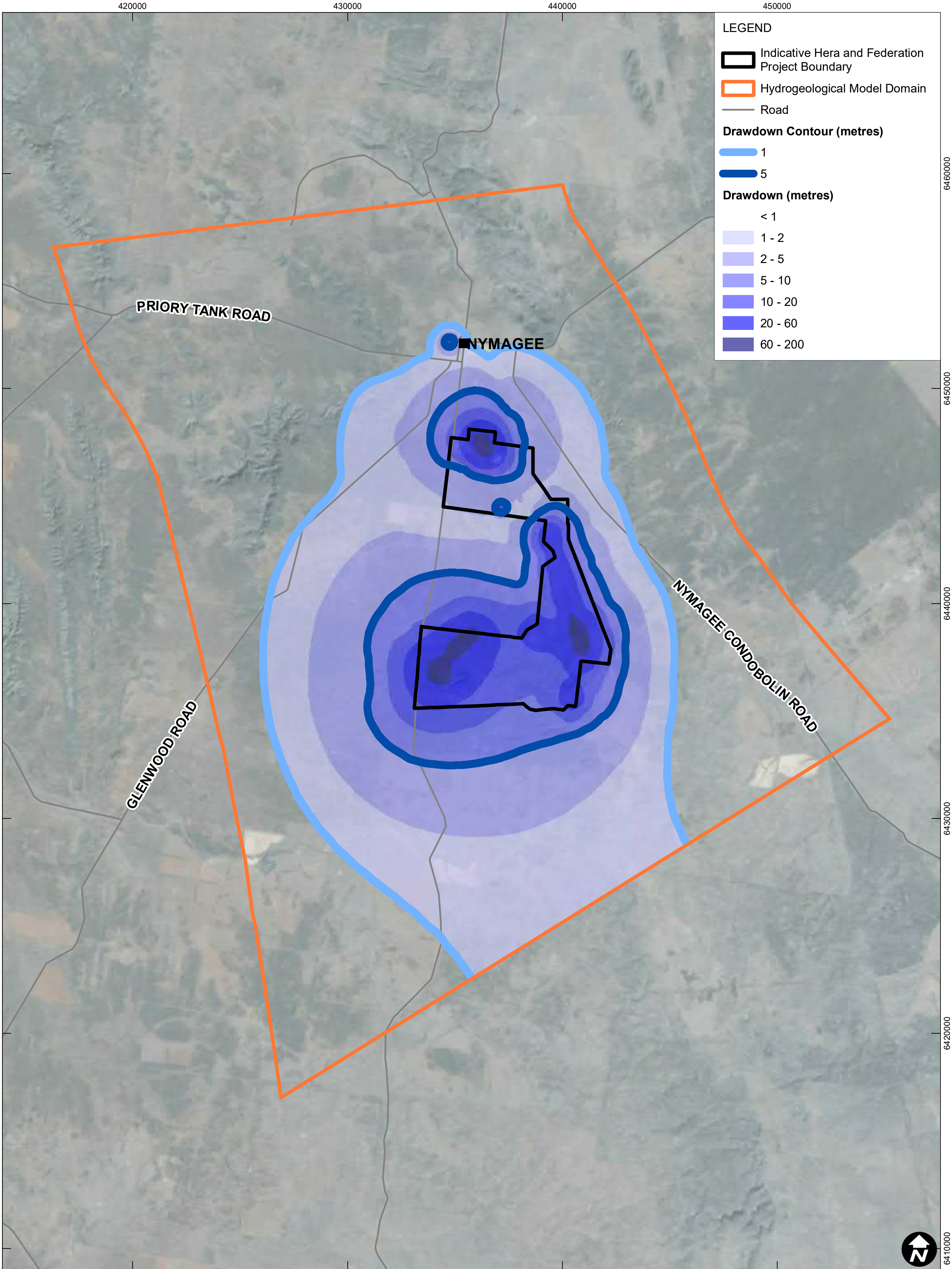
Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

Data Source: Basedata NSW SS, 2019, DPIE
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 7-1)

**MAXIMUM DRAWDOWN WATER TABLE APPROVED CONDITIONS**

**FIGURE 8-17**

H:\Projects-SLR\660-SrvWOL\660-WOL\660.30090.00000 Federation Project Approvals\06 SLR Data\01 CADGIS\GIS\SLR66030090_EIS_G28_MaxDrawdown_Approved_002.mxd




0 2.5 5 km

Scale: 1:225,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

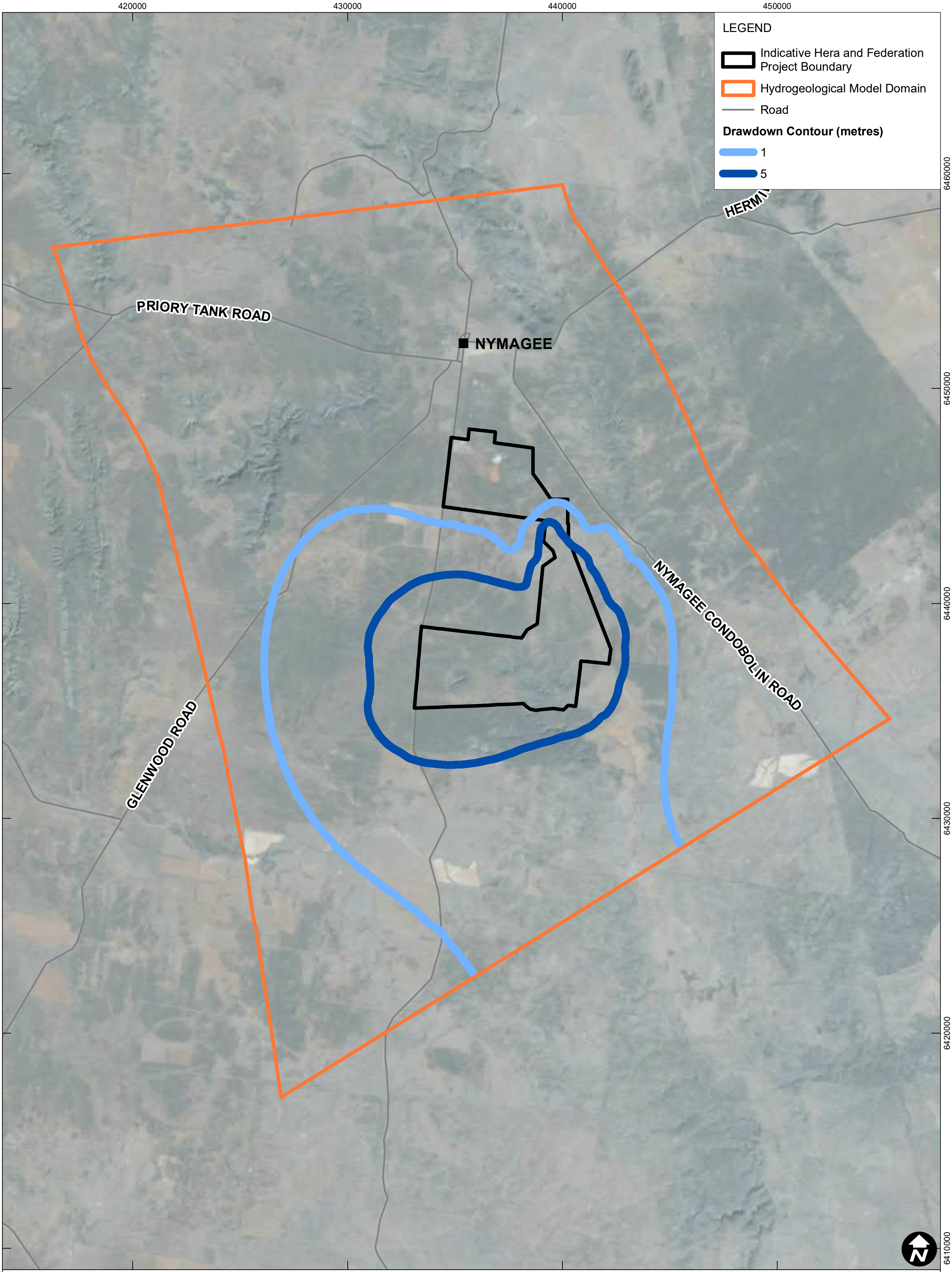
H:\Projects-SLR\660-SrvWOL\660-WOL\660.30090.00000 Federation Project Approvals\06 SLR Data\01 CADGIS\GIS\SLR66030090_EIS_G29_MaxDrawdown_Proposed_002.mxd

SLR

Data Source: Basedata NSW SS, 2019, DPIE
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 7-2)

**MAXIMUM DRAWDOWN WATER TABLE PROPOSED CONDITIONS**

**FIGURE 8-18**

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Scale: 1:225,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

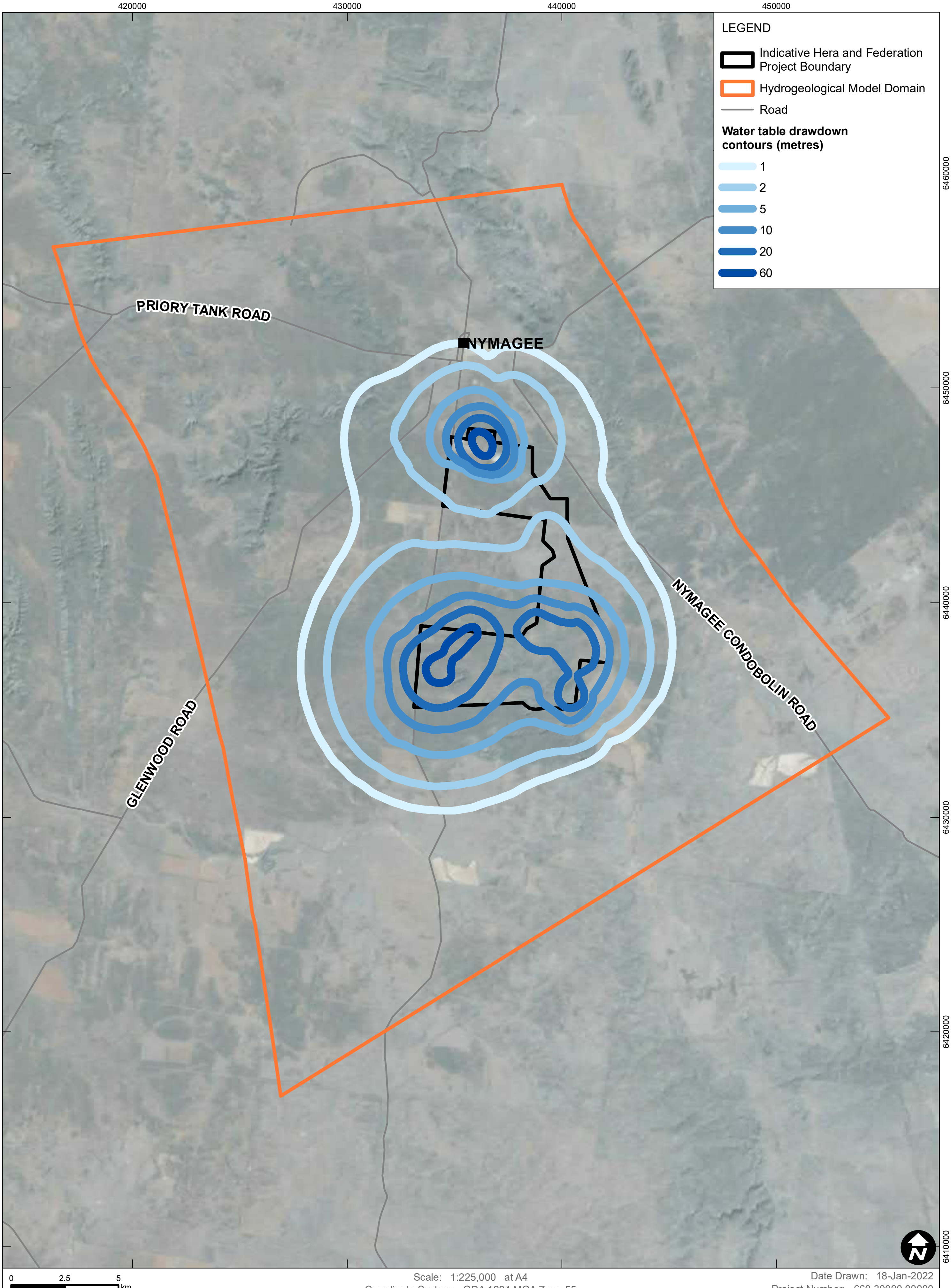
Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

Data Source: Basedata NSW SS, 2019, DPIE, Watercource: LPI, 2015
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 7-3)

SLR

**MAXIMUM DRAWDOWN WATER TABLE INCREMENTAL CONDITIONS**

**FIGURE 8-19**




Scale: 1:225,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

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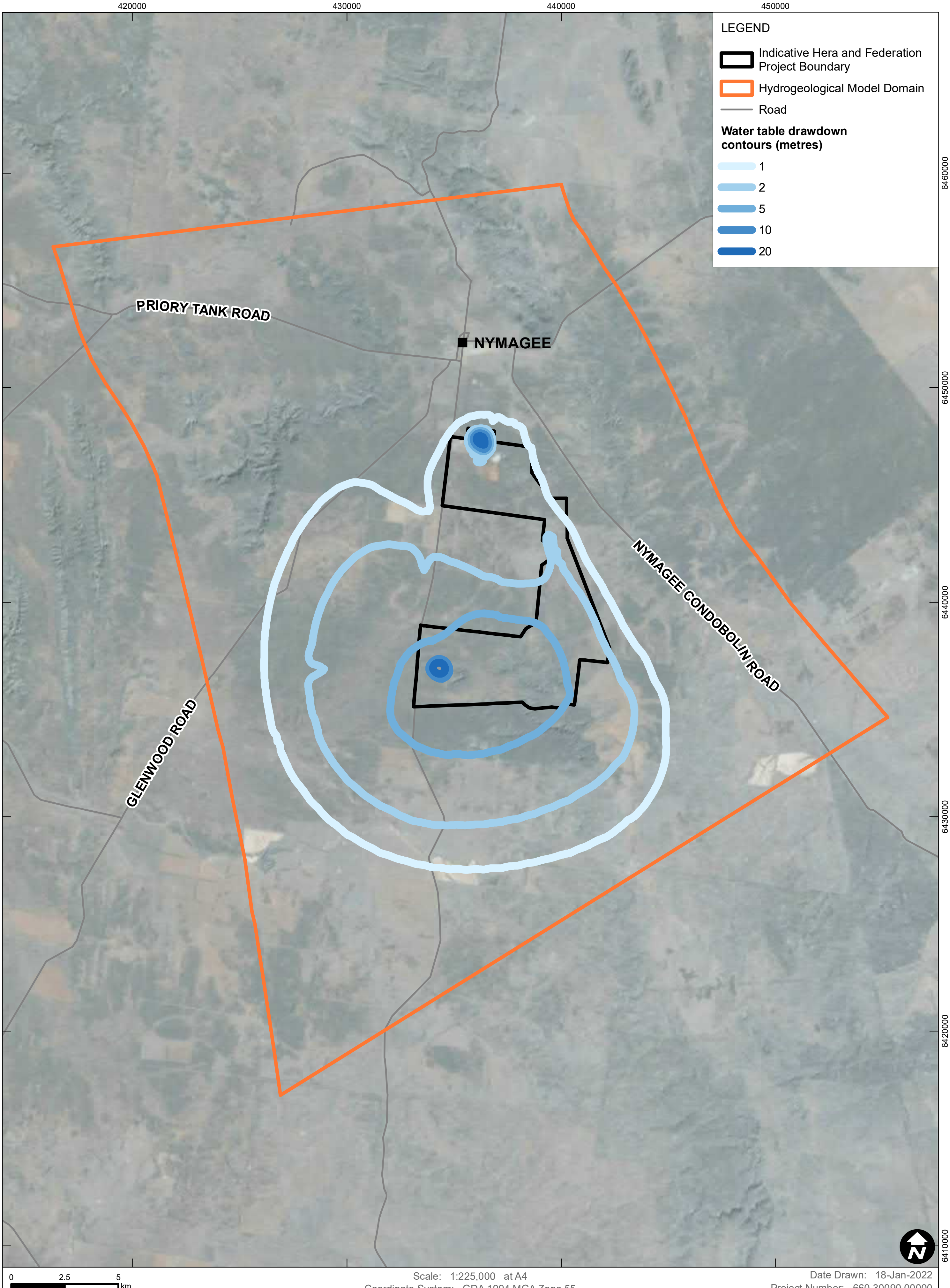
Data Source: Basedata NSW SS, 2019, DPIE, Watercource: LPI, 2015
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 7-4)

SLR

**DRAWDOWN AT END OF MINING AT FEDERATION WATER TABLE PROPOSED CONDITIONS**

**FIGURE 8-20**




Scale: 1:225,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

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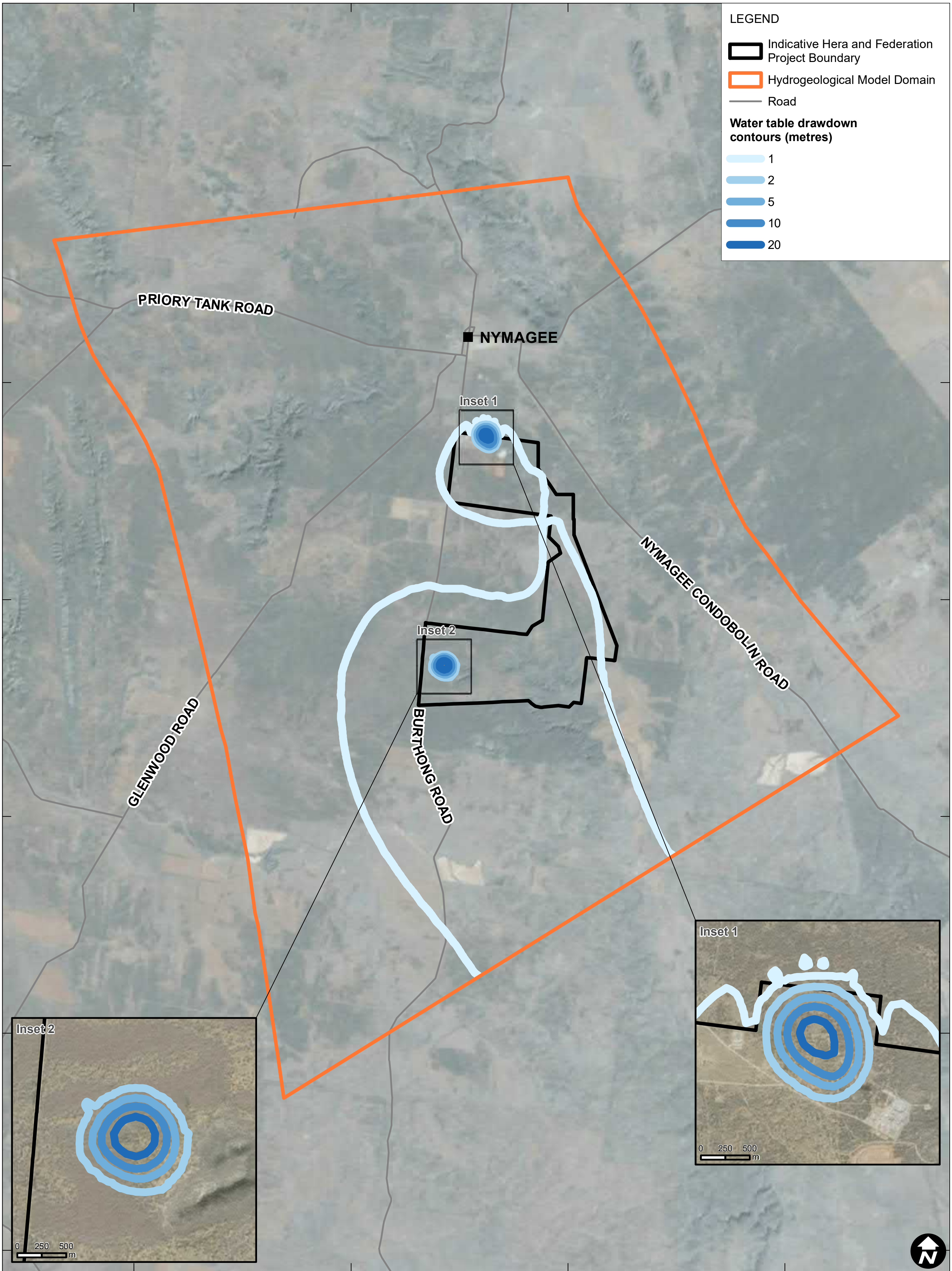
SLR

Data Source: Basedata NSW SS, 2019, DPIE, Watercource: LPI, 2015
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 7-5)

**DRAWDOWN 20 YEARS FOLLOWING END OF MINING AT FEDERATION**

**FIGURE 8-21**




Scale: 1:225,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

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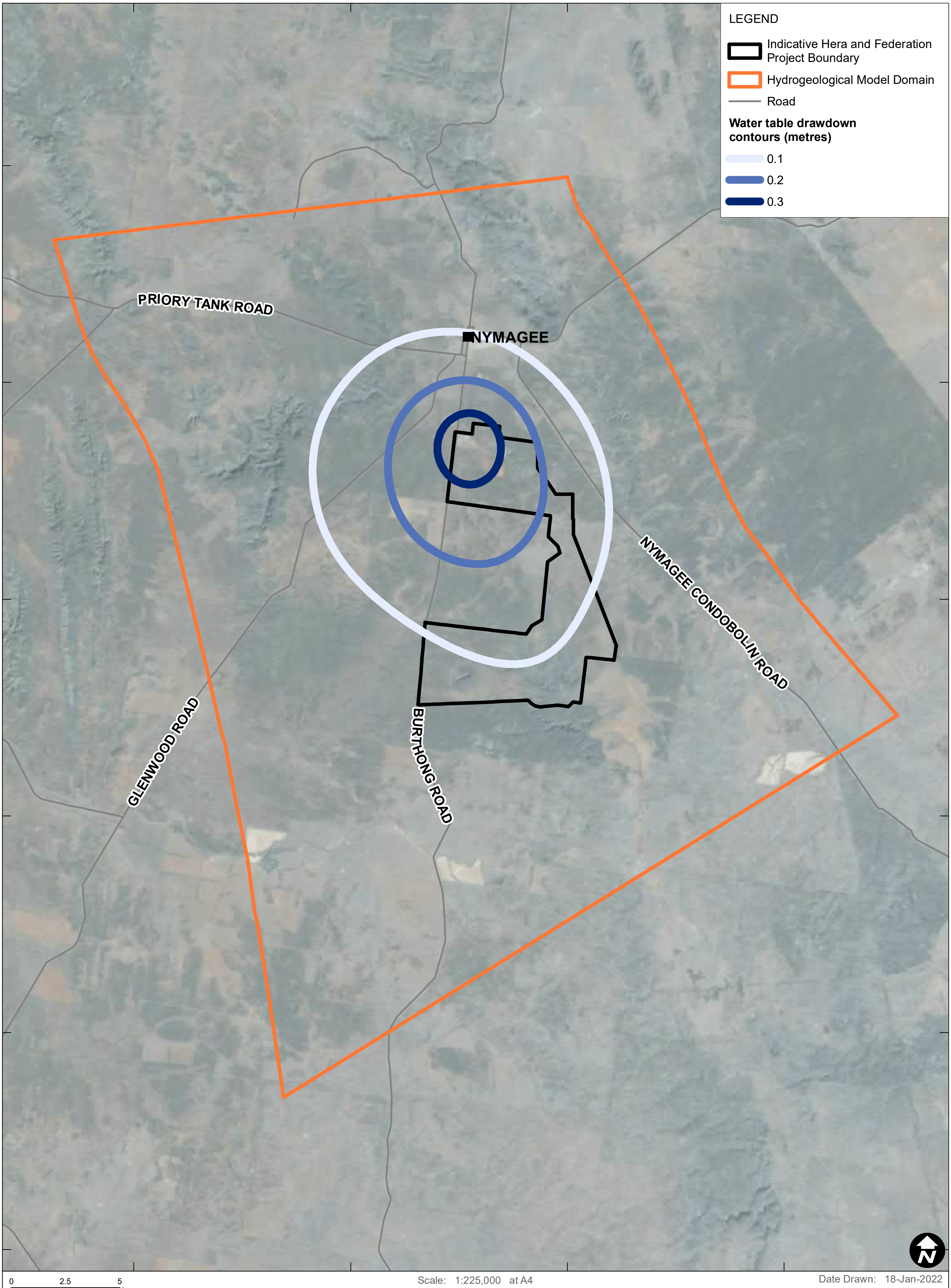
Data Source: Basedata NSW SS, 2019, DPIE, Watercourse: LPI, 2015
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 7-6)

SLR

**DRAWDOWN 100 YEARS FOLLOWING END OF MINING AT FEDERATION**

**FIGURE 8-22**

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Scale: 1:225,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

Data Source: Basedata NSW SS, 2019, DPIE, Watercource: LPI, 2015
Aerial imagery supplied by © Department of Customer Service 2020
GHD Groundwater Impact Assessment, 2021 (Figure 7-7)

SLR

**DRAWDOWN 1000 YEARS FOLLOWING END OF MINING AT FEDERATION**

**FIGURE 8-23**

### *Mine Inflow*

The predicted mine inflows at both Hera and Federation for approved and proposed conditions are presented graphically in **Figure 8-24** below The predicted mine inflow rate into the Hera Mine workings remains constant throughout the operational mining period. Modelled groundwater inflows into Federation are predicted to increase throughout 2022 and 2023 (first two years of exploration decline activities and mining), with groundwater inflows relatively constant between approximately 300 $m^3$/day and 340 $m^3$/day for the remainder of mining. Groundwater inflows into Federation are predicted to peak in 2027 (year 6 of proposed mining) at 340$m^3$/day.

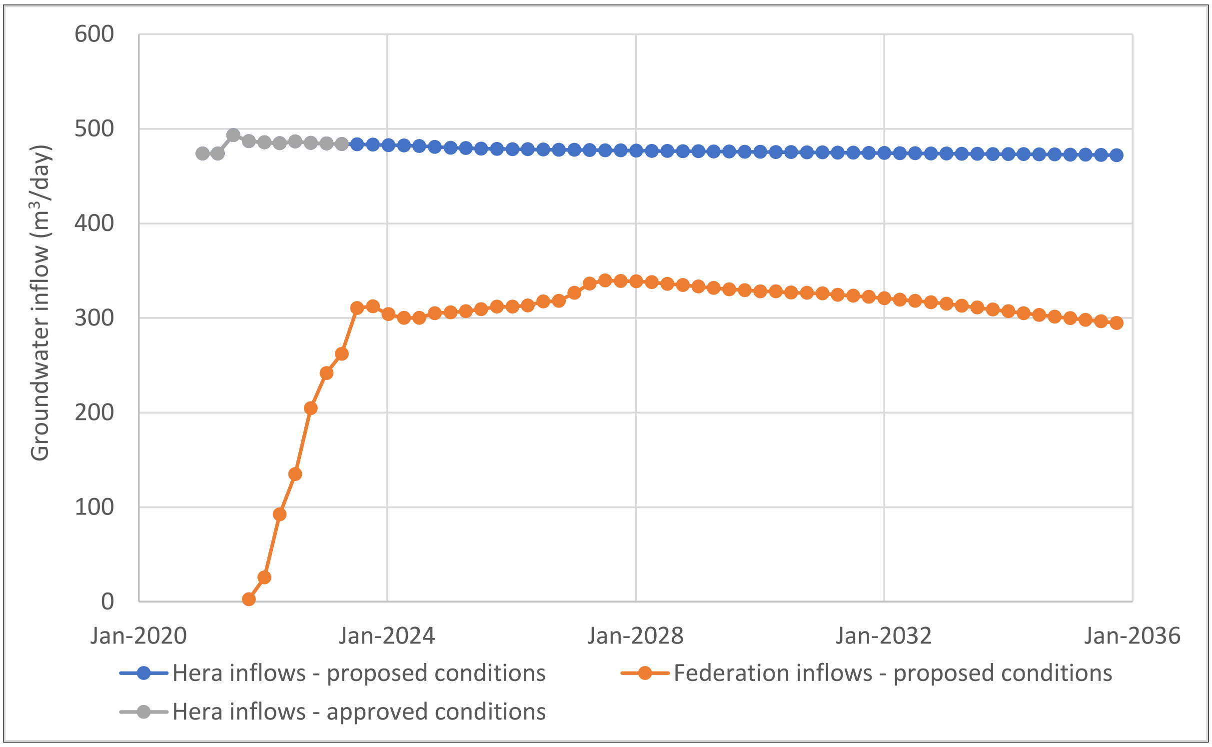



*Figure 8-24 Predicted Mine Inflows*

### *Landholder Bores*

There are 12 registered stock and domestic bores within a 20 km radius of Hera Mine and Federation Site that are not associated with operations at Hera Mine. Of these bores, the closest stock and domestic bores to Federation are GW020714 and GW017386 which are located 6.4 km south and 7.4 km north from Federation respectively. The majority of these bores were outside the model boundary, therefore groundwater drawdown plots have been prepared for those identified bores (GW017385, GW017386, GW018014, GW020714, Harland's Bore and Nymagee Town Bore) within the model boundary only.

Modelled drawdown at all landholder bores is less than 2 m with the exception of bores GW017385 and GW020714. Modelled drawdown is less than 2 m at the Nymagee Town Bore under approved and proposed conditions. The maximum modelled drawdown at GW017385 is approximately 3.5 m under approved conditions and approximately 4 m under proposed conditions. Drawdown at GW017385 is attributable to mining at Hera

Mine. The additional drawdown at GW017385 under proposed conditions is attributable to the continued dewatering of the Hera Mine workings.

The maximum modelled drawdown at GW020714 is 2.7 m under proposed conditions. Drawdown at GW020714 is negligible (less than 0.1m) under approved conditions. Drawdown at GW020714 is attributable to mining at Federation. Per advice from the landholder this bore has never been used as the salinity level is too high for stock watering.

As drawdown at GW017385 and GW020714 is greater than 2 m, make good provisions will apply at these bores under the Level 1 minimal impact considerations outlined in the NSW AIP.

*Water Quality*

Potential water quality impacts were qualitatively assessed and were not determined through the model.

The available groundwater quality data indicates that the groundwater at Federation Site is slightly brackish to saline (2,000µS/cm to 10,000µS/cm).  The review indicates groundwater at Federation Site is suitable for stock watering or industrial use.

A review of the groundwater quality data obtained from Federation Site was compared to the water extracts from potential tailings and water extracts from potential waste rock as determined by the geochemical analysis undertaken as detailed in **Section 8.2.5.** It concluded that leachate from the tailing paste backfill (forming a permanently cemented matrix where oxidation of sulfide minerals is significantly limited) or the potentially acid forming rock is considered unlikely to change the beneficial use category of groundwater at Federation.

As the potential impacts on groundwater quality attributable to the Project will not lower the beneficial use category of the groundwater source; impacts on groundwater quality will meet the Level 1 minimal impact considerations for groundwater quality from the NSW AIP.

*Groundwater Dependent Ecosystems*

As identified in **Section 8.5.3.2,** a review of the Groundwater Dependent Ecosystem Atlas (BoM, 2019) identified the study area as having a low potential for GDEs. Given the depth to groundwater at the Project area, the presence of GDEs is considered to be highly unlikely.

### 8.5.6 Peer Review

The peer review concluded groundwater assessment is consistent with best practice and concludes that the model is fit for purpose, where the primary purpose is prediction of incremental groundwater impacts of the Project and the secondary purpose is estimation of water licensing requirements. The peer review stated that the assessment was of good quality and concurred with the predicted impacts.

### 8.5.7 Mitigation and Management Measures

With the exception of potential impacts on landholder bores GW017385 and GW020714, all groundwater impacts attributable to the Project have been assessed to be within the Level 1 impact considerations in the NSW AIP and are therefore considered acceptable. Therefore, ongoing measures will focus on monitoring for potential impacts on landholder bores, and monitoring to validate groundwater model predictions and provide observation data for future model calibration.

The existing flow monitoring program at Hera Mine will be continued. In addition, the flow monitoring program will be expanded as required to include:

- Metering of water transfers into and out of the Federation workings. This will allow the rate of groundwater inflow into the Federation workings to be calculated. The rate of groundwater inflow into the Federation workings will be approximately equal to the difference between water transferred out and water transferred into the Federation workings; and
- Metering of groundwater extraction from all proposed production bores.

The existing groundwater monitoring program at Hera Mine, Federation Site and Nymagee Mine would be continued. The existing groundwater monitoring program at Hera Mine, Federation Site and Nymagee Mine is discussed in **Section 8.5.3.3.** The monitoring bores at Federation are all located within approximately 500m of the proposed Federation workings. It is proposed that an additional three bores are located at a greater radial distance from the proposed Federation workings. These additional bores will enable monitoring of the radius of groundwater drawdown due to dewatering of the mine workings. Their proposed location is provided in the GWIA.

The predictions of the hydrogeological model will be reviewed following two years of mining at Federation. The review of the hydrogeological model will include a comparison of modelling results against groundwater monitoring data and mine dewatering volumes. If required, the model will be revised to improve the fit between observed and modelled dewatering volumes and groundwater levels.

### 8.5.8 Conclusion

A GWIA was prepared for the Project to determine the potential impacts to groundwater, including impacts to nearby landholder bores. An extensive review was undertaken to establish the current groundwater characteristics. Groundwater was found to be relatively deep, with depths of 45 – 90 m bgl at Federation Site and Hera Mine. Groundwater was slightly brackish and low in dissolved metals. There is no evidence of either a perched shallow aquifer or any alluvial aquifers in the vicinity of Federation, Hera Mine and proposed borefield. There are no GDEs present at the Project due to the depth to groundwater.

A groundwater model utilising MODFLOW- USG was prepared to determine the potential impact to groundwater. The predictive model assessed current conditions, being the mine operation at Hera Mine with closure in 2023, and the proposed condition, which is with the operation of the Project. The groundwater model was peer reviewed by HydroAlgorithmics. The peer review concluded groundwater assessment is consistent with best practice and concludes that the model is fit for purpose.

Predicted impacts have been compared to the Level 1 minimal impact considerations for less productive water sources in the NSW AIP. Predicted impacts are within the minimal impact considerations, with the exception of modelled impacts on two landholder bores (GW017385 and GW020714), where predicted drawdown at these bores exceeds 2 m (but is less than 4 m). Therefore, make good provisions will apply at these bores.

Groundwater monitoring will be undertaken to identify any potential impacts on landholder bores and to validate groundwater model predictions and provide observation data for future model calibration.

## 8.6 Biodiversity

### 8.6.1 Introduction

A Biodiversity Development Assessment Report (BDAR) was prepared by AREA Environmental and Heritage Consultants (AREA) for the Project (**Appendix K**). The BDAR was required as the Project exceeded the threshold for clearing under section 7.2 (2)(b) *Biodiversity Conservation Regulation 2017*. Extensive survey was undertaken across the Project area to inform the BDAR and document biodiversity values.

### 8.6.2 Assessment Requirements

The SEARS related to biodiversity are provided in **Table 8-30** .

*Table 8-30 Biodiversity SEARs Requirements*

| SEARs Requirement | Reference |
|---|---|
| An assessment of the biodiversity values and the likely biodiversity impacts of the development t hroughout its life, and impacts on biodiversity values in the region, in accordance with Section 7.9 of the *Biodiversity Conservation Act 2016* (NSW), the *Biodiversity Assessment Method* (BAM 2020) and documented in a Biodiversity Development Assessment Report (BDAR); and | **Section 8.6.6**<br>**Section 8.6.8** |
| The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM; | **Section8.6.6**<br>**Section 8.6.6.2**<br>**Section 8.6.7**<br>**Section 8.6.8** |

### 8.6.3 Study Context

The Project will occur on 92.52 ha of land, of which 35.69 ha within the Project area has been assessed and approved under the activity approval for the Exploration Decline Program (refer **Section 3.5**) and was not included in the assessment. The BDAR considered the disturbance to the remaining 56.83 ha of land, the majority of which (55.78 ha) is native vegetation. As the threshold of impact to native vegetation is two hectares or more, the Project triggers assessment using the Biodiversity Assessment Method 2020 (BAM).

For the purpose of clarity to differentiate between the exploration decline activities and the Project, the BDAR adopted the following definitions:

- The 'Project' is all activities and infrastructure required for mining under one or more future mining leases. Any use of the term 'the proposal' or 'the development' is synonymous with 'the Project';
- The 'Project area' is all areas where activities and infrastructure for mining will occur (i.e. 92.52 ha). This term is synonymous with 'Project footprint'. The Project area includes the 'exploration decline program disturbance area';
- The 'Project disturbance area' is all areas that require clearing for the Project (i.e. 56.83 ha). The 'Project disturbance area' includes 55.78 ha of native vegetation and 1.05 ha of pre cleared vegetation. Any use of the term 'development site' is synonymous with 'Project disturbance area';

- The ‘exploration decline program disturbance area’ is all areas already approved for clearing under the State activity approval for the Exploration Decline Program (i.e. 35.69 ha);
- The ‘study area’ for the purposes of the ecology assessment is the Project area and the broader area surrounding the Project area assessed through field surveys and desktop analysis, with information from the study area used to assess potential direct and indirect Project impacts; and
- The ‘Project boundary’ is the nominal extent of the State planning approval and associated ML boundaries, noting that ML applications have yet to be made for the Project. This term is synonymous with ‘subject land’.

This BDAR does not consider the exploration decline program disturbance area because the Proponent elected to voluntarily enter into the NSW Biodiversity Offsetting Scheme (BOS) with the Federation Exploration Decline BDAR (February 2021) and offsets have already been determined for this area.

The relationship between the exploration decline program disturbance area and the Project is provided in **Figure 8-25**.

### 8.6.4 Existing Environment

Nymagee township was founded in 1879 and the Nymagee Copper Mine was developed by 1888. As the mine had a wood-fired smelter, significant areas of timber were cleared from the surrounding country including within Hera Mine and the Federation Site, where historical tree removal (stumps) is still evident. As a result of historic widespread removal of eucalyptus trees from the region to fuel the Old Nymagee Copper Mine wood-fired smelter, and heavy and continuous grazing by sheep and goats, the pre-European vegetation composition in the study area has changed. The ground stratum was effectively stripped, and in some areas White Cypress Pine *Callitris glaucophylla* has dominated the landscape, which significantly suppresses biodiversity.

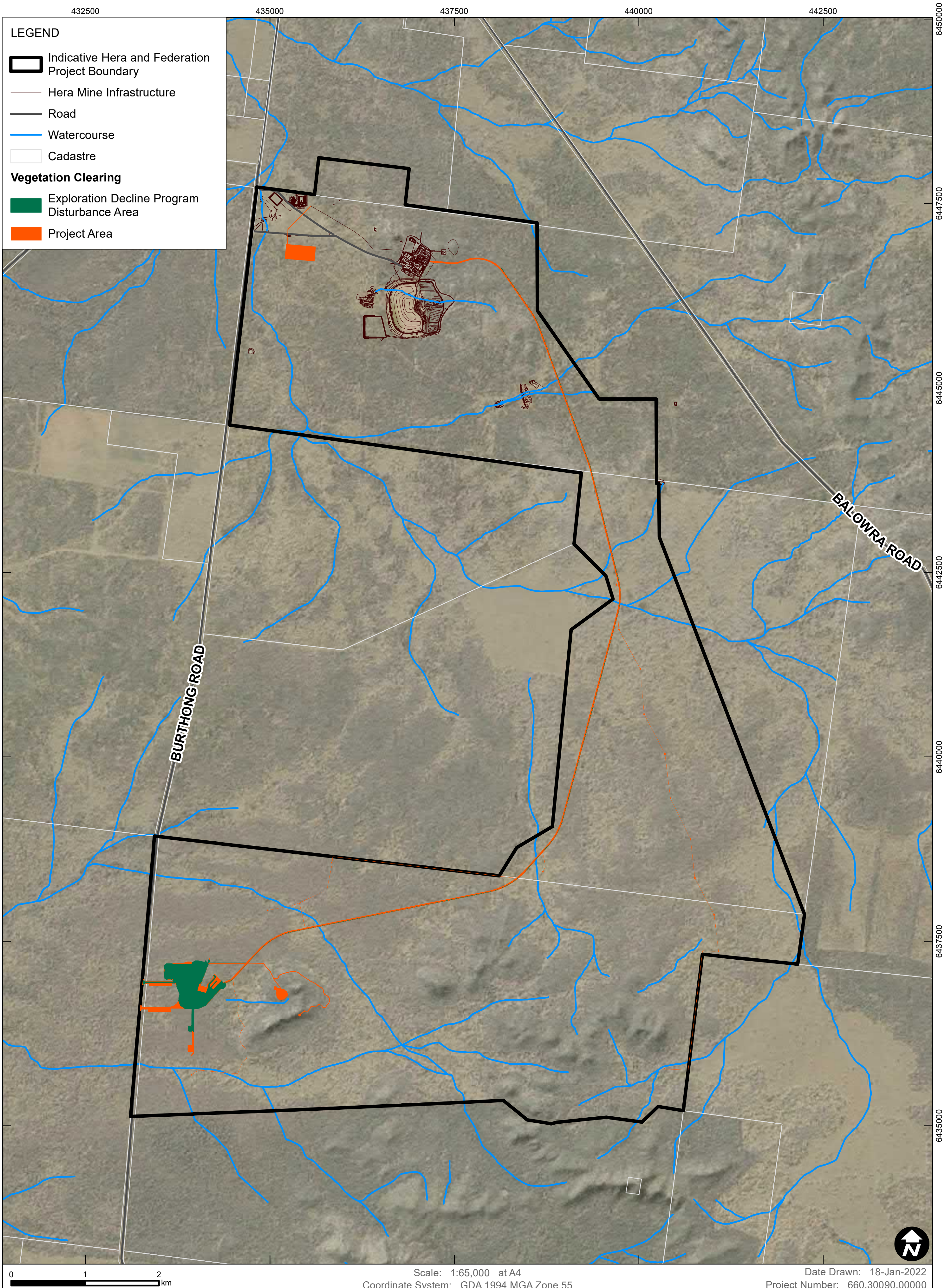
Vegetation cover is high with approximately 90%of the Project disturbance area covered in remnant or regenerating native vegetation, and approximately 93% cover within a 1,500m buffer. Existing and approved breaks in vegetation are the exploration decline program disturbance area, Burthong Road to the west, various farm/private roads, Hera mine and associated infrastructure, farm fence lines, exploration access tracks and natural breaks in vegetation. Habitat connectivity within the Project area is high. Remnant and regenerating woodland cover much of the Project area and surrounds. The Project area is well connected to native vegetation from all directions, there are no officially mapped wildlife corridors in the Project area. The Project will have a minor effect on connectivity in the immediate vicinity, but overall connectivity will not be reduced in any significant capacity

The mapped land uses of the subject land are ‘Grazing native vegetation’, ‘Other minimal use’ and ‘River’ (refer **Figure 8-26**).

### 8.6.5 Assessment Approach

#### 8.6.5.1 Project Staging

The Project includes a number of separate components, which will require offsetting under the NS*W Biodiversity Conservation Act 2016* (BC Act). All components are included in the BDAR. For the purposes of State offsetting requirements under the BC Act, these components are referred to as stages. Hera Resources has elected to separate the Project into components (or stages) as some components may occur in later years of mine life or may not occur at all, and therefore staging allows for State offsets to be provided as and when a disturbance is scheduled to occur. By including all potential components in the assessment, Hera Resources has adopted a conservative approach in estimating the Project disturbance area (i.e. overestimating the potential Project disturbance area).




Scale: 1:65,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

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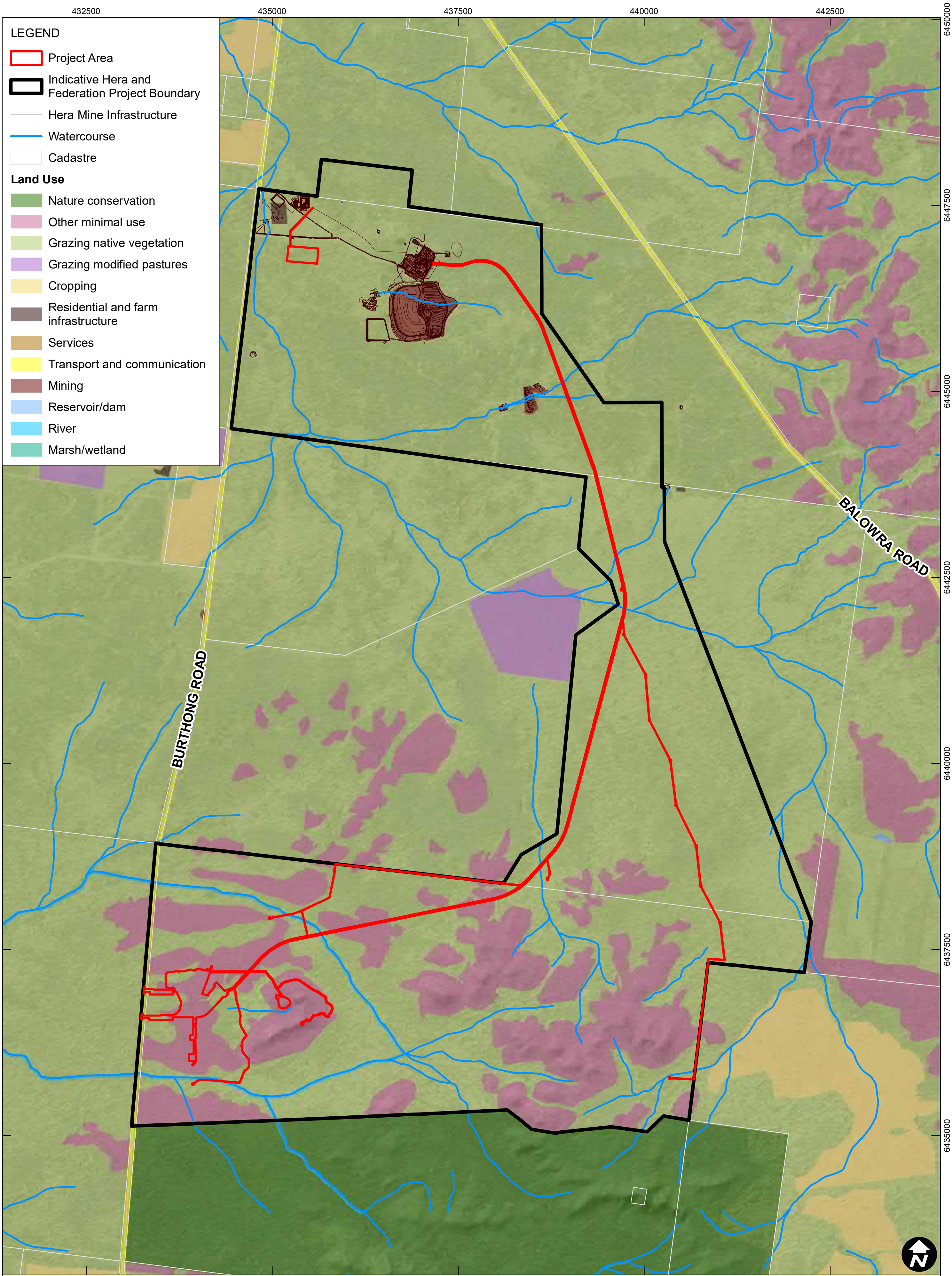
SLR

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020

**EXPLORATION DECLINE DISTURBANCE AND THE PROJECT AREA**

**FIGURE 8-25**




Scale: 1:65,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

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Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
Land Use © State Government of NSW and Department of Planning, Industry and Environment 2020

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LAND USE

FIGURE 8-26

The BDAR considers the impacts of each stage separately, so the proponent is only liable for offsets if a stage occurs. The metric for each stage will be recalculated when the obligation is required.

Proposed stages are as follows, and are illustrated in **Figure 4-2**:

- Stage 1: Federation Site, Services Corridor and Communications Tower;
- Stage 2: Solar Farm and Associated Powerline;
- Stage 3: Potential Tailings Pipeline and Return Water Pipeline;
- Stage 4a: Bore and Pipelines, eastern alignment (locations indicative only);
- Stage 4b: Bore and Pipelines, west and southern alignments (locations indicative only); and
- Stage 5: Surface Extraction Area (referred to as 'Quarry' in the BDAR).

The total offsetting requirement for all stages was determined. The offsetting requirement for each stage was calculated by working out the area of each native vegetation plant community type (PCT) impacted by each stage and converting that area to a percentage of the total impact to each PCT by the whole Project proposal. The percentage for each stage has then been applied to the total offsetting requirement, resulting in an allocation of the offsetting requirement for each stage.

#### 8.6.5.2 Survey Methodology

AREA conducted field survey in the Project disturbance area specific to this proposal over five days 12 to 16 July 2021 and three days 1 to 3 October 2021. Additional surveys to identify environmental constraints for other Hera Resources related projects have been previously undertaken by AREA in 2018, 2019, June 2020, October 2020 and January 2021 (including for the Exploration Decline Program), providing a comprehensive baseline of data, with results of these previous surveys contributing to the assessment. The survey was undertaken in accordance with BAM (2020) guidance materials.

The field assessment to map native vegetation was undertaken to ground truth map layer - *Western State Vegetation Plant Community Type Map 4492* aerial imagery and to correct any errors. Eighteen 20 by 20m (in 20 by 50m) plots, following BAM (2020), were used to inform the BDAR. These plots, collectively known as 'nested plots', were placed in and around the Project area, preferentially in an expected Project disturbance area. The 20 by 20m area measures biodiversity (plant composition or floral biodiversity, hence evidence to identify the PCT and its quality) and the 20 by 50m structure plot, including the 1 by 1m leaf litter plots, measures the function of the same area. Function includes an assessment of size classes of trees and tree hollows, which are both indicative of the age of trees assessed, ground logs and the amount of leaf litter.

#### 8.6.5.3 Plant Community Types

Field survey as described above identified six PCTs in the Project area, namely:

- PCT103 Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion;
- PCT104 Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion;
- PCT174 Mallee - Gum Coolabah woodland on red earth flats of the eastern Cobar Peneplain Bioregion;

- PCT180 Grey Mallee - White Cypress Pine woodland on rocky hills of the eastern Cobar Peneplain Bioregion;
- PCT258 Gum Coolabah - Mugga Ironbark - White Cypress Pine woodland on granite low hills in the eastern Cobar Peneplain Bioregion and central NSW South Western Slopes Bioregion; and
- PCT184 Dwyer's Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion.

Provided in **Figure 2-2** are PCTs that have been mapped for the Project area. **Table 8-31** below outlines the areas and zones of each PCT in the Project disturbance area.

*Table 8-31 Plant Community Types in the Project Disturbance Area*

| PCT ID | PCT name | Zone | Vegetation class | Vegetation formation | Est. % cleared in NSW | Extent in Project disturbance area (hectares) | Associated with TEC |
|---|---|---|---|---|---|---|---|
| 103 | *Poplar Box – Gum Coolabah – White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion* | 1 Dense | Western Peneplain Woodland | Semi-arid Woodlands (Shrubby sub-formation) | 50 | 33.48 | N/A |
| | | 2 Open | Western Peneplain Woodland | Semi-arid Woodlands (Shrubby sub-formation) | 50 | 0.32 | N/A |
| 174 | *Mallee – Gum Coolabah woodland on red earth flats of the eastern Cobar Peneplain Bioregion* | 3 | Sand Plain Mallee Woodlands | Semi-arid Woodlands (Shrubby sub-formation) | 56 | 14.46 | *Listed BC Act, E: Acacia loderi shrublands (Part)* |
| 104 | *Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion* | 4 | Inland Rocky Hill Woodlands | Semi-arid Woodlands (Shrubby sub-formation) | 25 | 3.86 | N/A |
| 180 | *Grey Mallee - White Cypress Pine woodland on rocky hills of the eastern Cobar Peneplain Bioregion* | 5 | Inland Rocky Hill Woodlands | Semi-arid Woodlands (Shrubby sub-formation) | 18 | 2.35 | N/A |
| 258 | *Gum Coolabah - Mugga Ironbark - White Cypress Pine woodland on granite low hills in the eastern* | 6 | Inland Rocky Hill Woodlands | Semi-arid Woodlands (Shrubby sub-formation) | 38 | 0.86 | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Cobar Peneplain Bioregion and central NSW South Western Slopes Bioregion* | | | | | | |
| 184 | *Dwyer's Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion* | 7 | Inland Rocky Hill Woodlands | Semi-arid Woodlands (Shrubby sub-formation) | 20 | 0.45 | N/A |
| **Total Native Vegetation** | | | | | | **55.78** | |
| 0 | No vegetation | - | - | - | - | 1.05 | - |
| | | | | | **Total** | **56.83** | |

One Threatened Ecological Community (TEC) listed as endangered under the BC Act, *Acacia loderi* Shrublands (part) is associated with PCT174. Ground truthing the native vegetation in the study area confirmed there is no *Acacia loderi*, nor associated species or ancillary attributes present in the Project disturbance area; and therefore this TEC is not present.

#### 8.6.5.4 Vegetation Zones

Vegetation zones are defined as a 'relatively homogeneous area of native vegetation within a proposal that is the same PCT and broad condition state'. Seven zones (**Table 8-32**) were mapped in the Project disturbance area (areas of native vegetation affected by the Project subject to this BDAR). An appropriate number of plots has been undertaken for each zone. Approximately 1.05 ha of 'no vegetation' is present in the Project disturbance area because of previous disturbance or clearing under previous exploration approvals. These areas are not included in the vegetation zones.

*Table 8-32 Vegetation Zones*

| Zone | PCT | PCT description | Area in Project disturbance area | Number of plots required by total area: number of plots done* |
|---|---|---|---|---|
| 1 | 103 | Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion | 33.48 | 4:7 |
| 2 | 103 cleared | Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion | 0.32 | 1:1 |
| 3 | 174 | Mallee - Gum Coolabah woodland on red earth flats of the eastern Cobar Peneplain Bioregion | 14.46 | 3:4 |

| | | | | |
|---|---|---|---|---|
| 4 | 104 | Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion | 3.86 | 2:2 |
| 5 | 180 | Grey Mallee - White Cypress Pine woodland on rocky hills of the eastern Cobar Peneplain Bioregion | 2.35 | 2:2 |
| 6 | 258 | Gum Coolabah - Mugga Ironbark - White Cypress Pine woodland on granite low hills in the eastern Cobar Peneplain Bioregion and central NSW South Western Slopes Bioregion | 0.86 | 1:1 |
| 7 | 184 | Dwyer's Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion | 0.45 | 1:1 |

A sufficient number of BAM vegetation plots were completed to satisfy the plots requirement for each stage. The area of each vegetation zone within each proposed stage of the Project (refer **Section 8.6.5.1)**, minimum BAM plot required, and the actual number of BAM plots completed are shown in **Table 8-33** below.

*Table 8-33 Areas and BAM Plot Requirement by Stage*

| | Zone 1 PCT 103 | Zone 2 PCT 103 (cleared) | Zone 3 PCT 174 | Zone 4 PCT 104 | Zone 5 PCT 180 | Zone 6 PCT 258 | Zone 7 PCT 184 | PCT 0 | Total Area (ha) |
|---|---|---|---|---|---|---|---|---|---|
| **Stage 1** Area (ha) | 19.07 | 0 | 10.89 | 2.95 | 0 | 0.67 | 0.45 | 0 | **34.03** |
| Plots Required | 3 | 0 | 3 | 2 | 0 | 1 | 1 | - | |
| **Stage 2** Area (ha) | 7.37 | 0.32 | 0 | 0 | 0 | 0 | 0 | 1.05 | **8.74** |
| Plots Required | 3 | 1 | 0 | 0 | 0 | 0 | 0 | - | |
| **Stage 3** Area (ha) | 4.22 | 0 | 1.79 | 0.91 | 0 | 0.19 | 0 | 0 | **7.11** |
| Plots Required | 2 | 0 | 1 | 1 | 0 | 1 | 0 | - | |
| **Stage 4a** Area (ha) | 1.32 | 0 | 0.77 | 0 | 0 | 0 | 0 | 0 | **2.09** |
| Plots Required | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | |
| **Stage 4b** Area (ha) | 1.5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **2.50** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Plots Required | 1 | 0 | 1 | 0 | 0 | 0 | 0 | - | |
| **Stage 5** Area (ha) | 0 | 0 | 0.01 | 0 | 2.35 | 0 | 0 | 0 | **2.36** |
| Plots Required | 0 | 0 | 1 | 0 | 2 | 0 | 0 | - | |
| **Total area of Zone (ha)** | **33.48** | **0.32** | **14.46** | **3.86** | **2.35** | **0.86** | **0.45** | **1.05** | **56.83** |
| **Minimum plot required** | **4** | **1** | **3** | **2** | **2** | **1** | **1** | | |
| **Total Plots done to compensate for staging** | **10** | **1** | **7** | **3** | **2** | **2** | **1** | | |

#### 8.6.5.5 Threatened Species Records

To determine the likely presence of threatened species, a number of databases were searched. These included:

- BAM credit calculator (BAM-C);
- DPIE NSW Atlas of Wildlife (BioNet);
- Matters of National Environmental Significance (MNES) Protected Matters Search Tool (DAWE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- DPIE Threatened Species Profile Database (TSPD).

A list of threatened species predicted to occur by the DPIE threatened species database search filtered by Interim Biogeographic Regionalisation for Australia (IBRA) subregion identified 66 threatened species, populations and ecological communities are predicted to occur in the Nymagee IBRA subregion (refer Appendix A of **Appendix K**).

A BioNet species record search was conducted for all listed species, including species listed under international bilateral agreements. These are provided in **Table 8-34**.

*Table 8-34 BioNet Atlas Threatened Species Records within 10km of the Project Area*

| Scientific Name | Common Name | NSW Status | Comm Status |
|---|---|---|---|
| **Bird** | | | |
| *Climacteris picumnus victoriae* | Brown Treecreeper (eastern subspecies) | V | - |
| *Cinclosoma castanotum* | Chestnut Quail-thrush | V | - |
| *Stagonopleura guttata* | Diamond Firetail | V | - |
| *Artamus cyanopterus cyanopterus* | Dusky Woodswallow | V | - |
| *Pachycephala inornata* | Gilbert's Whistler | V | - |

| | | | |
|---|---|---|---|
| *Pomatostomus temporalis temporalis* | Grey-crowned Babbler (eastern subspecies) | V | - |
| *Melanodryas cucullata cucullata* | Hooded Robin (south-eastern form) | V | - |
| *Lophochroa leadbeateri* | Major Mitchell's Cockatoo | V | - |
| *Leipoa ocellata* | Malleefowl | E | V |
| *Certhionyx variegatus* | Pied Honeyeater | V | - |
| *Chthonicola sagittata* | Speckled Warbler | V | - |
| *Circus assimilis* | Spotted Harrier | V | - |
| *Polytelis swainsonii* | Superb Parrot | V | V |
| *Neophema pulchella* | Turquoise Parrot | V | - |
| *Epthianura albifrons* | White-fronted Chat | V | - |
| **Mammal** | | | |
| *Saccolaimus flaviventris* | Yellow-bellied Sheathtail-bat | V | - |
| *Vespadelus baverstocki* | Inland Forest Bat | V | - |
| *Antechinomys laniger* | Kultarr | E | - |
| *Chalinolobus picatus* | Little Pied Bat | V | - |

The Commonwealth Protected Matters Search Tool was used to generate a report on MNES predicted to occur within a 1 km radius around the Project area. A summary of the report is provided in **Table 8-35**.

*Table 8-35 MNES Summary*

| MNES | Result | Is there an implication for this assessment? |
|---|---|---|
| World Heritage Properties | None | No |
| National Heritage Places | None | No |
| Wetlands of International Importance | 3 | No – all three are more than 500km upstream |
| Great Barrier Marine Park | None | No |
| Commonwealth Marine Area | None | No |
| Listed Threatened Ecological Communities | 3 | No – field assessment confirmed none of these communities occur in the Project disturbance area |
| Listed Threatened Species | 16 | No – assessed under NSW legislation or likelihood of presence considered (Table 4-4 of BDAR in **Appendix K**) |
| Listed Migratory Species | 7 | No –the Federation Project is unlikely to impact these 7 bird species (Section 4.1.4 of BDAR in Appendix K) |
| Commonwealth Land | None | No |
| Commonwealth Heritage Places | None | No |

| | | |
|---|---|---|
| Listed Marine Species | 13 | No - The Project will not impact these species |
| Whales and other Cetaceans | None | No |
| Critical Habitats | None | No |
| Australian Marine Parks | None | No |
| Commonwealth Reserves Terrestrial | None | No |
| State and Territory Reserves | 1 | Balowra State Conservation Area is within 1500 metres of the Project area, it will not be impacted by the Project. |
| Forest Regional Agreements | None | No |
| Invasive Species | 10 | No – species listed are either already present in the region or their presence will not be increased by this proposal, or they are unlikely to be introduced. |
| Nationally Important Wetlands | None | No |
| Key Ecological Features (Marine) | None | No |

An assessment of the likelihood of occurrence in the study area was undertaken for each of the 16 species identified in the MNES Protected Matters Report. In addition, the possible presence of one vulnerable EPBC listed bat species, Large-eared pied bat *Chalinolobus dwyeri* in the study area was included, as this was potentially indicated by bat echolocation call analysis during field survey. Furthermore, three EPBC listed species considered by the BAM-C were not highlighted by the MNES Protected Matters Report. These species were also assessed for likelihood of occurrence in the study area, and likelihood of impact from the Project.

Of the 20 species assessed, two species were identified as having potential to be present and impacted by the proposal; Malleefowl *Leipoa ocellata* and Superb Parrot *Polytelis swainsonii*. The assessments of significance prepared for the Project's Referral under the EPBC Act concluded there are unlikely to be significant impacts to these EPBC Act listed threatened species.

A referral for the Project was submitted to DAWE on 19 November 2021 (EPBC 2021/9100), supported by information providing evidence that the Project was not likely to have a significant impact on MNES and therefore should not be a 'controlled action'. On 7 January 2022 the delegate of the Minister for the Environment decided that the Project (the proposed action) was not a controlled action.

Seven migratory species listed under the EPBC Act may potentially occur within the Project area. None were recorded during the surveys following relevant guidance material. These migratory species are not expected to occur or be impacted by the Project.

#### 8.6.5.6 Field Survey Threatened Species

The vegetation in the Project disturbance area can provide habitat for a wide range of terrestrial fauna. Trees were inspected for hollows; fallen logs, rocks, crevices and shrubby habitat were observed, and the area was checked for infrastructure which may provide artificial habitat for microbats and other fauna species. AREA ecologists undertook threatened species survey specifically for this Project over five days 12 to 16 July 2021.

The targeted threatened species assessment focused on listed species highlighted by the BAM-C and the EPBC Act Protected Matters Report following all survey requirement identified on the BAM-C and BioNet data collection. The following survey effort was completed in July 2021:

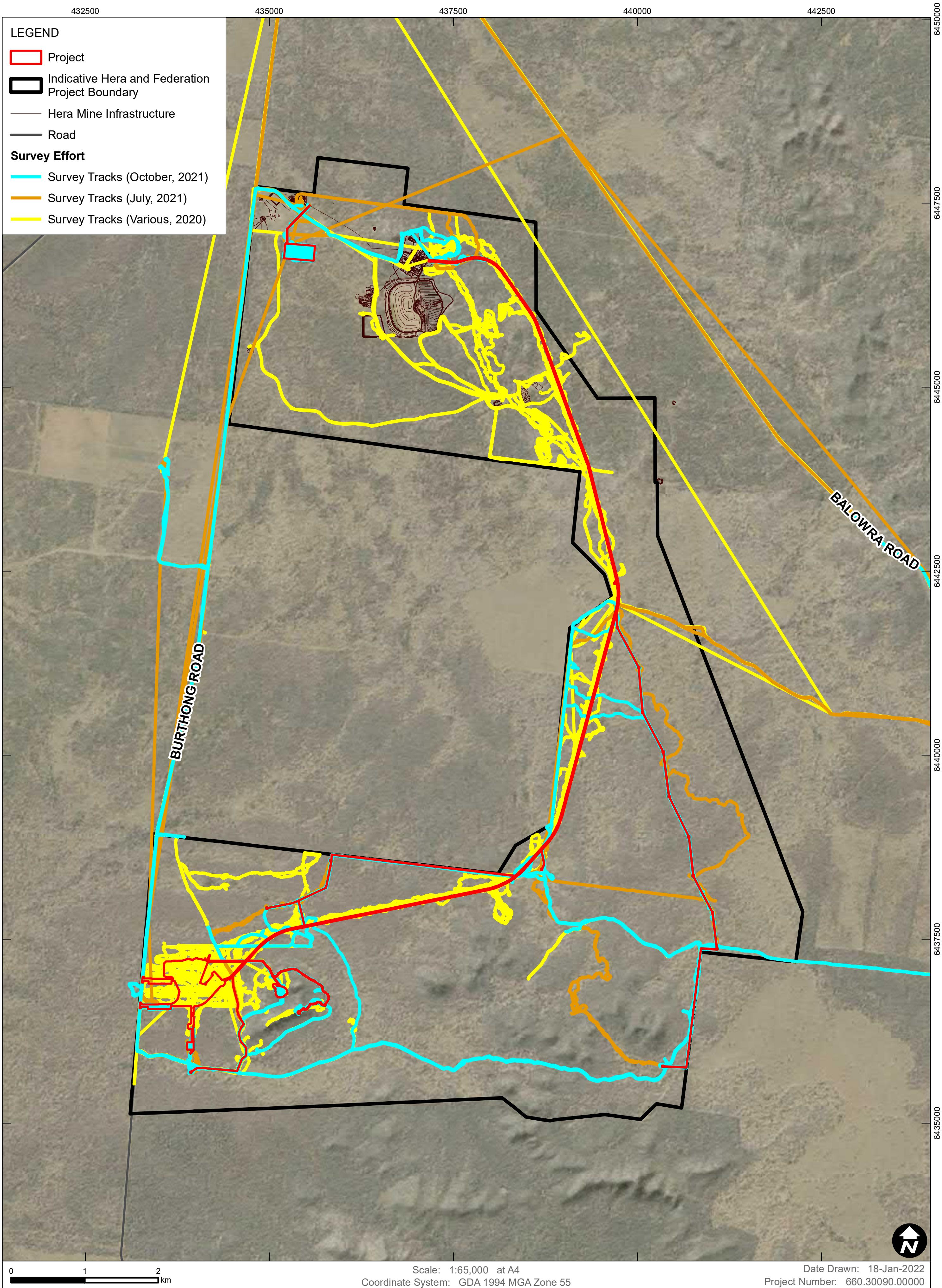
- Bat ultrasonic recorder (SM) and a Song Meter SM4BAT-FS bioacoustics recorder in place for four nights;
- Call playback and spotlighting over three nights;
- Threatened search transects throughout the Project disturbance area;
- Diurnal observation of hollows in and around the Project disturbance area;
- Bird searches; and
- Opportunistic observation.

Additional threatened species surveys (search transects) were undertaken in October 2021 to completely cover off on survey effort required.

Data collected from AREA's previous BDAR for the Exploration Decline Program activity approval has also been used to inform the BDAR for this EIS. To identify environmental constraints for the Exploration Decline Program, the following survey effort was completed in June (winter), October (spring) 2020 and January 2021:

- Call playback and spotlighting over six nights;
- Targeted bat ultrasonic assessments (2 x SM2+ and 1 x SM4) and a Song Meter SM4BAT-FS ultrasonic recorder in place for six nights in June 2020, 7 nights in October 2020;
- 50 Type A Elliot traps in place for a total of 350 trap nights (eight days/seven nights);
- Five cage traps for a total of 35 trap nights (seven nights);
- 14 camera traps positioned over baited lures containing rolled oats, peanut butter and honey in place for eight days/seven nights (98 trap nights);
- Threatened species search transects throughout the Project area;
- Mapping and observation of hollows in and around the Project area; and
- Opportunistic observation.

Monitoring points / trap sites used during the 2020 and 2021 surveys to inform the BDAR are shown on Figure 4-3 in **Appendix K**. **Figure 8-27** shows transects walked by the assessors. AREA has been assessing the area in and around the Project disturbance area since 2018 and within 10 kms since 2010. AREA's knowledge of the local biodiversity, previous survey of the region and preliminary reporting, as well as information held on government databases and archives were used to inform the assessment.




Scale: 1:65,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
AREA Environmental & Heritage Consultants Pty Ltd

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**BIODIVERSITY SURVEY TRANSECTS**

**FIGURE 8-27**

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No threatened species were recorded in the Project disturbance area during field survey in July or October 2021. Three threatened fauna species listed under the BC Act (not EPBC Act listed) known to occur adjacent to the Project disturbance area were sighted outside the Project disturbance area. An individual Hooded Robin (south-eastern form) *Melanodryas cucullata cucullate* was observed in habitat west of the Project disturbance area (where there is a known local population); Major Mitchell's Cockatoo *Lophochroa leadbeateri* was observed flying southwest over the Project disturbance area on two occasions and Grey-crowned babblers *Pomatostomus temporalis temporalis* were observed in the southeast of the Project disturbance area. All three species are commonly recorded in the area and are included in BAM calculations.

The assessment of bats followed ‘*Species credit’ threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method 2018*.

Bat echolocation calls, as per DPIE guidelines, were recorded over seven nights in June 2020 (Federation Site), seven nights of bat surveys were conducted at Hera in October 2020 and four nights in July 2021. These calls were assessed by AREA’s bat expert Dr Heidi Kolkert. The presence of three threatened bat species was indicated by bat echolocation call analysis in 2021 (**Table 8-36**), four (three confidently and one possibly) threatened species were recorded in 2020 (**Table 8-37**).

*Table 8-36 Bat Survey Results 2021*

| Scientific name | Common Name | Bat recordings July 2021 | | | |
|---|---|---|---|---|---|
| | | 12/07/2021 | 13/07/2021 | 14/07/2021 | 15/07/2021 |
| Chalinolobus picatus # | Little pied bat | | x | | |
| Miniopterus orianae oceanensis # | Eastern bentwing bat | x | x | | x |
| Saccolaimus flaviventris # | Yellow-bellied sheathtail bat | | P | | |
| # species listed under the *Biodiversity Conservation Act 2016* | | | | | |

*Table 8-37 Bat Survey Results 2020*

| Scientific name | Common Name | Bat recording session 1 Winter | | | | | | | | Bat recording session 2 Spring | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 12/06/2020 | 13/06/2020 | 14/06/2020 | 15/06/2020 | 16/06/2020 | 17/06/2020 | 18/06/2020 | 19/06/2020 | 19/10/2020 | 20/10/2020 | 21/10/2020 | 22/01/2020 | 23/10/2020 | 24/10/2020 | 25/10/2020 |
| Chalinolobus picatus # | Little pied bat | | | | | | | | x | x | | | | P | x | x |
| Miniopterus orianae oceanensis # | Eastern bentwing bat | | | x | x | | | x | | x | x | x | x | x | x | x |
| Saccolaimus flaviventris # | Yellow-bellied sheathtail bat | | | | | | | | x | x | x | x | x | x | | x |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Bat calls not positively identified to species* | | | | | | | | | | | | | | | | |
| Chalinolobus dwyeri #* | Large-eared pied bat | | | | | | | | | | | | 1P | | | |
| # species listed under the Biodiversity Conservation Act 2016 | | | | | | | | | | | | | | | | |
| • species listed under the Environment Protection and Biodiversity Act | | | | | | | | | | | | | | | | |

As they have been positively identified, the Eastern Bent-winged Bat *Miniopterus schreibersii oceanensis*, Yellow-bellied sheathtailed bat *Saccolaimus flaviventris* and the Little pied bat *Chalinolobus picatus* were taken into consideration as a predicted species in the BAM-C.

*Threatened Flora*

No threatened flora species were identified in the Project disturbance area.

During spring surveys in October 2021, specifically undertaken to detect threatened flora during the recommended survey period, 10 to 15 greenhood orchids were observed in an area approximately 500 $m^2$ within Stage 5 of the Project. The plants were at the highest point in the landform where the proposed surface extraction area is located. The orchids were positively identified as *Pterostylis boormanii* Borman's Rustyhood, which are not listed, through a sample provided to the Royal Botanic Gardens Sydney.

#### 8.6.5.7 Predicted Species

Predicted species (ecosystem credit species) are predicted to occur based on their known presence or predicted presence in the IBRA subregion, the known association with PCTs and the size and condition of the vegetation patches on the Project disturbance area, as determined by the BAM-C. Predicted species may be excluded from this list where they require particular habitat or geographic features (as prescribed by the BAM-C), which are not present.

Predicted species are assumed by the BAM-C to occur and be affected by the Project. Offset of the impact to these species is included in the ecosystem credit calculations. The BAM-C assessment tool identified 35 threatened species reliably predicted to use habitat present in the Project disturbance area and are listed in Table 4-9 of **Appendix K**. In addition, the three positively identified bat species as listed in **Section 8.6.5.6** were also added to the BAM-C. The Glossy Black Cockatoo *Calyptorhynchus lathami* and Painted Honeyeater *Grantiella picta* were excluded because the required habitat constraints are not present.

#### 8.6.5.8 Candidate Species

Candidate species (species credit species) are those that cannot be reliably predicted from the habitat surrogates and their presence is to be assessed through habitat assessment and targeted surveys.

When candidate species have habitat constraints within the Project disturbance area, they require targeted surveys. When a candidate species is known to occur or assumed to occur, they require offsetting. Table 4-12 of **Appendix K** provides the full list of the 19 candidate species. The Large Bent-winged Bat (Breeding) *Miniopterus orianae oceanensis* was added to the list of 19 candidate species based on site survey results. The list of 20 candidate species was then reduced to 14, with the exclusion of six species due to habitat constraints.

All 14 candidate species identified as needing targeted survey were able to be excluded from the BAM-C because field assessment determined they are:

- Not present or;
- Unlikely to be present or; and
- Unlikely to use the suitable habitat in the Project disturbance area.

Justification as to their exclusion is provided in **Table 8-38** below.

*Table 8-38 Species Excluded by Additional Survey*

| Species | Months of survey | Survey Effort |
|---|---|---|
| *Acacia curranii*<br>Curley-bark Wattle | All months | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys (including search transects and eighteen BAM plots) in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Search transects were conducted across the Project area in all surveys (during the BAM recommended survey period).<br>No Curly-bark Wattle was recorded during these surveys |
| *Ardeotis australis*<br>Australian Bustard | All months | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Search transects were conducted across the Project area in all surveys (during the BAM recommended survey period).<br>This species was not recorded. |
| *Burhinus grallarius*<br>Bush Stone-curlew | All months | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Search transects and were conducted in and around the Project area in all surveys (during the BAM recommended survey period).<br>This species was not recorded. |
| *Calyptorhynchus lathami*<br>Glossy Black-Cockatoo (Breeding) | All months | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Search transects and were conducted in and around the Project area in all surveys (during the BAM recommended survey period). During all surveys signs of breeding and trees were considered for nest tree / hollow suitability ((i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees and may be near-vertical or vertical.).<br>No birds, evidence of nesting or suitable nest trees were located.<br>This species was not recorded. |

| | | |
|---|---|---|
| *Calyptorhynchus lathami - E population*<br>Glossy Black-Cockatoo, Riverina population | All months | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Search transects were conducted in and around the Project area in all surveys (during the BAM recommended survey period). During all surveys signs of breeding and trees were considered for nest tree / hollow suitability ((i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees and may be near-vertical or vertical.).<br>No birds, evidence of nesting or suitable nest trees were located.<br>This species was not recorded. |
| *Diuris tricolor*<br>Pine Donkey Orchid | Sept and Oct | Field assessment followed *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method 2020*. AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. AREA Principal Consultant is a DPIE nominated expert for this species and participated in assessment for the species on the Project area and neighbouring properties and did not record it.<br>This species was not recorded during survey. |
| *Grevillea ilicifolia subsp. ilicifolia*<br>Holly-leaf Grevillea | All months | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys (including search transects and numerous BAM plots) in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021.<br>No Holly-leaf Grevillea was recorded during these surveys. |
| *Lophochroa leadbeateri*<br>Major Mitchell's Cockatoo<br>(Breeding) | Sept, Oct, Nov, Dec | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021 during which signs of breeding and trees were considered for nest tree suitability. Hollows in and around the Project area were observed and no Major Mitchell's Cockatoos were recorded using the hollows. Survey was within the BAM recommended survey period.<br>This species was observed adjacent to the Project area in Oct 2020 and 2021 but was not recorded utilising habitat in the Project area. |
| *Lophoictinia isura*<br>Square-tailed Kite<br>(Breeding) | Sept, Oct, Nov, Dec, Jan | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Search transects were conducted in and around the Project area in all surveys (during the BAM recommended survey period) during which signs of breeding and trees were considered for nest tree suitability. No individuals of this species, evidence of nesting or suitable nest trees were located.<br>This species was not recorded. |

| | | |
|---|---|---|
| Monotaxis macrophylla<br>Large-leafed Monotaxis | Jan, Feb, Aug, Sept, Oct, Nov, Dec | Field assessment followed Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004. AREA conducted surveys (including search transects and numerous BAM plots) in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Survey for this species is to be within 6 months of disturbance. The Project area has a history of historical and current disturbances, and this species has never been detected.<br>No Large-leafed Monotaxis was recorded during these surveys. |
| *Ninox connivens*<br>Barking Owl (Breeding) | May, Jun, Jul, Aug, Sept, Oct, Nov, Dec | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Search transects were conducted in and around the Project area in all surveys (during the BAM recommended survey period) during which signs of breeding and trees were considered for nest tree suitability. No individuals of this species, evidence of nesting or suitable nest trees were located.<br>This species was not recorded. |
| *Polytelis swainsonii*<br>Superb Parrot (Breeding) | Sept, Oct, Nov | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021, July 2021 and October 2021. Hollows in and around the Project area were observed during the BAM recommended survey period.<br>No Superb Parrots were recorded. No evidence of nesting Superb Parrots was recorded. |
| *Pterostylis cobarensis*<br>Greenhood Orchid (Cobar Greenhood) | Oct | Field assessment followed *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method 2020*. Search transects occurred in October 2020 and October 2021 during the required survey period. A greenhood orchid species was found in the Project disturbance area in October 2021, however Royal Botanic Gardens Sydney botanists confirmed the orchid found in the Project disturbance area was not Cobar Greenhood, it was positively identified as *Pterostylis boormanii* Borman's Rustyhood.<br>This species was not recorded. |
| *Tyto novaehollandiae*<br>Masked Owl (Breeding) | May, Jun, Jul, Aug | Field assessment followed *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004.* AREA conducted surveys in and around the Project area in November 2018, July 2019, June 2020, October 2020, January 2021 July 2021 and October 2021. Search transects were conducted in and around the Project area in all surveys (during the BAM recommended survey period).<br>This species was not recorded. |

### 8.6.6 Potential Impacts

Potential direct impacts that may result from Project activities. are considered in **Table 8-39.** Indirect impacts are those which are not a direct result of the Project, often produced away from or as a result of a complex impact pathway. The potential indirect Project impacts are considered in **Table 8-40**. **Section 8.6.6.2** and **Section 8.6.7** describe measures to avoid and manage potential impacts.

*Table 8-39 Potential Direct Impacts*

| Aspect | Potential Impact |
|---|---|
| Vegetation Clearance and Habitat Connectivity | Vegetation present in the Project disturbance area could provide suitable habitat for a range of threatened species. Hollow bearing trees are present in the Project disturbance area and will be impacted, as well as some areas of rocky habitat. As such, direct impact to habitat for threatened species could occur during vegetation clearance for construction. |
| Injury to Wildlife and Vehicle Strike | Injury to wildlife is possible during vegetation clearing for the construction phase of this proposal. The Project will lead to increased potential for vehicle strike to occur on access roads. |
| Groundwater Dependent Ecosystems (GDE's) | As stated in the GWIA (**Section 8.5.3.2**), groundwater in the study area is too deep to support GDEs therefore there will be no impact to groundwater dependent vegetation. |
| Surface Water | Impacts to surface water can occur when runoff from disturbed areas is allowed to enter watercourses. A water management system (refer Section **8.4.6**) will be implemented to prevent release of contaminated water, manage sediment affected water, and divert clean water around mining activities and infrastructure. There will be no change in flood behaviour or impacts of flooding on mine site infrastructure. |
| Aquatic Habitats | Aquatic habitats differ from terrestrial habitats and are more susceptible to degradation and loss, so potential impacts need to be carefully managed.<br>There are several unnamed ephemeral tributaries and topographic drainage lines (hydrolines) which intersect Project linear infrastructure, but not the Federation Site or Hera Mine. The Project will directly impact some drainage lines during construction through excavation, vegetation removal and other construction activities. |
| Exposed soil stockpiles | Soils would be disturbed where vegetation removal and construction will occur. Disturbed soils have the potential to move off the study area and impact waterways if not appropriately managed.<br>Stockpiles also have the potential to negatively impact the environment if not appropriately managed. Soil management measures are provided in Section **8.1.7**. |
| Subsidence | Biodiversity impacts are not considered to occur due to the negligible subsidence which has been predicted at the Federation Site (refer Section **8.3.5**). |

*Table 8-40 Potential Indirect Impacts*

| Aspect | Potential Impact |
|---|---|
| Introduction and spread of disease and pathogens | In NSW, there are infectious pathogens with potential to impact on biodiversity. Any activities involving the movement of soil and equipment over large areas are a potential risk for spread and infection. The following three pathogens are considered a negligible risk to the study area due to the low rainfall of the area:<br>▪ Phytophthora (Phytophthora cinnamomi)<br>▪ Infection by Psittacine Circoviral (beak and feather)<br>▪ Chytrid fungus (Batrachocytrium dendrobatidis). |
| Introduction and spread of weeds and pests | An increase in the movement of people, vehicles, machinery, vegetation waste and soil during and following construction and mine operations will potentially alter the current exotic flora in the Project area and increase the prevalence of weeds elsewhere. |
| Edge Effects and Fragmentation | The construction of the Project will cause disturbance by reducing habitat quality in adjacent areas. This is related to the greater potential for edge effects, habitat fragmentation and barrier effects due to the high perimeter to area ratio of linear developments. Edge effects typically take the form of weed invasion, increased light levels, increased wind speeds, and greater temperature fluctuations.<br>The Project is in an area currently subject to existing edge effects from agricultural activity, the existing roadways and other development. Overall, connectivity will not be significantly reduced by the Project, nor fragmentation significantly increased as remaining vegetation will be no less connected to surrounding vegetation. |
| Dust, Noise and Vibration | Construction and operational activities will result in localised dust, noise and vibration impacts which may result in fauna temporarily avoiding habitats next to the activities. There is likely to be night-time working and artificial lighting may result in impact to nocturnal fauna. Nocturnal species such as possums and microbats may avoid the habitat adjacent to the Project area as temporary ‘daylight’ conditions would be created. Many Project areas will not be lit at night, for example linear infrastructure corridors. |

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#### 8.6.6.1 Prescribed Impacts

The prescribed impacts which may be associated with the Project are discussed below in **Table 8-41**.

*Table 8-41 Prescribed Impacts Relevant to the Project Disturbance Area*

| Feature | Present | Description of feature characteristics and location | Potential impact | Threatened species or community using or dependent on feature | Section of the BAR where prescribed impact is addressed |
|---|---|---|---|---|---|
| Karst, caves, crevices, cliffs or other geologically significant feature | ☒ Yes / ☐ No | No karsts, caves, crevices, cliffs or other geologically significant features are present in the Project disturbance area however the Project will impact some rocky habitat. | Disturbance to habitat for rock or crevice dependent species. | No candidate species identified. | See mitigation measures, Section **8.6.7.** |
| Rocks | ☒ Yes / ☐ No | The Project will impact some rocky habitat. | Disturbance to habitat for rock dependent species. | No candidate species identified. | See mitigation measures, Section **8.6.7.** |
| Human-made structure | ☐ Yes / ☒ No | N/A | No human-made structures will be impacted. | N/A | N/A |
| Non-native vegetation | ☐ Yes / ☒ No | N/A | There are some weeds in the Project disturbance area but no significant areas of non-native vegetation will be impacted. | N/A | N/A |
| Habitat Connectivity | ☒ Yes / ☐ No | N/A | The Project disturbance area is well connected to native vegetation from all directions, there are no corridors which will be impacted. | N/A | N/A |

| | | | | | |
|---|---|---|---|---|---|
| Hydrological process sustaining/interacting with rivers, streams or wetlands | ☒ Yes / ☐ No | Minor waterways/hydrolines intersecting the Project disturbance area. | The Project will result in changes to surface drainage and topography through excavation and extraction of materials.. Erosion and sediment control measures will be implemented (refer **Section 8.4.6.2**) Impacts to flooding are predicted to be negligible (refer **Section 8.4.5.2**). | N/A | N/A |
| Wind farm development | ☐ Yes / ☒ No | N/A | No wind farm proposed on the Project area | N/A | N/A |
| Vehicle Strike | ☒ Yes / ☐ No | The Project will result in increased vehicle movements in the area. | Potential for vehicle strike to occur on access roads. | No candidate species identified. | See mitigation measures, **Section 8.6.7.** |

#### 8.6.6.2 Avoid and Minimise Impact

During the design of the Project, feasible options to avoid impacts were sought. Where impacts were unavoidable, options to manage and minimise impacts were adopted. A summary of the avoidance and minimisation actions undertaken is provided below:

- Modifying earlier versions of the Project area by placing roads, tracks and ancillary infrastructure on areas cleared under previous approvals;
- Consulting with field ecologists to minimise the impact of the water pipeline and bore network which has been realigned to avoid ephemeral drainage lines not detectable by more coarser mapping initially used to inform the design and have also been realigned to use previously cleared roads and fence lines where possible. These actions significantly minimised impact to native vegetation;
- Condensing the Project area into the smallest area possible without compromising the functionality or its purpose;
- Haulage of ore and tailings between the Federation Site and Hera Mine using a public road, thereby avoiding vegetation clearance associated with an internal haul road on private land through remnant native vegetation;
- Utilising previously cleared surface infrastructure areas for the Exploration Decline Program to the maximum extent possible to minimise additional clearance attributable to the Project;
- Utilising existing infrastructure at the Hera Mine to minimise a need for extra for new replicate infrastructure;
- Locating the new process plant at Hera Mine within the existing approved disturbance footprint;
- Locating the proposed solar farm in a historically cleared and disturbed area in which White Cypress Pine regrowth is the predominant species in the mid and upper stratum (this species is known to significantly suppress biodiversity) and is located close to the existing mine accommodation village

infrastructure, so it utilises existing tracks and roads, and the powerline route is as short at possible which will reduce impact; and

- Staging the development into separate components will also mean the impact will be minimised by allowing fauna to vacate if present and will avoid unnecessary clearing if a stage does not go ahead.

### 8.6.7 Mitigation and Management Measures

The proposed mitigation measures for the Project are described in **Table 8-42**.

*Table 8-42 Biodiversity Management and Mitigation Measures*

| Impact | Mitigation Measures |
|---|---|
| General | Ensure all staff working on the Project are inducted on:<br>1. Site environmental procedures (i.e. vegetation management, sediment and erosion control, protective fencing, weeds, hygiene protocols, ethical procedures for handling fauna displaced on the site)<br>2. What to do in case of environmental emergency (chemical spills, fire, injured fauna)<br>3. Key contacts in case of environmental emergency<br>4. How to reduce the risk of vehicle strike to fauna. |
| Removal of native vegetation including:<br>- hollow bearing trees<br>- threatened species habitat<br>- other habitat features | Native vegetation removal will be minimised as far as possible using the following measures:<br>▪ Utilise existing disturbed and cleared areas for compound, parking and stockpiling to ensure there is not additional impact to vegetation.<br>▪ Before starting work, a physical vegetation clearing boundary at the approved clearing limit is to be identified and effectively communicated to personnel. The delineation of such a boundary may include the use of temporary fencing or parawebbing and marked as 'No-Go Zones'. Regular inspections should be undertaken to ensure all retained vegetation/fauna habitat is clearly marked and that fencing is in place, where appropriate<br>▪ Vegetation within the Project disturbance area will be removed in such a manner so as to avoid damage to surrounding vegetation. Groundcover disturbance should be kept to a minimum where possible.<br>▪ Some vegetation to be removed will be mulched on-site and re-used to stabilise disturbed areas where possible. |
| | A preclearing inspection will be undertaken by a qualified ecologist prior to the removal of vegetation. An ecologist or spotter/catcher should be present for the removal of hollow-bearing trees, logs or stags which could contain native fauna.<br>Avoid clearing native vegetation in Spring, when possible. Any fallen timber, dead wood and bush rock encountered on site will be left in situ where possible or relocated to a suitable place nearby. Rock will be removed with suitable machinery so as not to damage the underlying rock or result in excessive soil disturbance. |
| | Implement staged habitat removal to allow fauna to vacate if present so vegetation will be retained in the buffer area until future stages commence. Respond to (e.g. rescue, relocate only if required) fauna detected during the clearing process. |
| | Where tree removal is required, large trees, or part thereof, with hollows can be left in the remnant vegetation where possible to provide habitat or used in the waterway to create snags. Nest-boxes or creating tree hollows through pruning existing trees (in a 1:1 fashion) should be installed in suitable, retained trees to compensate for the loss of large hollows (>20cm) because of the Project. |

| | |
|---|---|
| | The Project has a finite life and post mining disturbed areas will be rehabilitated. The result will be a stable environment that is conducive to the establishment of vegetation characteristic to the area that is similar to the pre-mining vegetation composition. |
| Revegetation and Rehabilitation | Minor landscaping may be required. Where this occurs, there are two options 1) either allow the area to naturally regenerate or 2) to plant species. Natural regeneration in arid areas is typically more successful than planting vegetation.<br>If planting is chosen, then all species planted for any purpose should be consistent with those PCTs described in the BDAR. Shrubby vegetation layers can be planted on the Project boundaries to screen and provide habitat. |
| Fragmentation of habitat connectivity | Connectivity impacts will be mitigated post mining through rehabilitation. |
| Fauna management | Personnel will avoid handling wildlife, especially snakes. Fauna handling should only be done by a licenced fauna ecologist or wildlife carer.<br>In the case of injured fauna contact a nominated animal rescue agency / wildlife car group or veterinarian if an animal is injured as per the proponent's fauna handling and rescue procedure (or refer to Appendix G of the BDAR included as Appendix X). |
| Vehicle Strike | Low speed limits in place on mine site roads.<br>Install warning signs of known wildlife crossings.<br>Reporting requirements for any incidents of vehicle strikes.<br>Ensure staff are inducted on how to reduce risk to fauna from vehicle strike. |
| Changes to hydrology | A water management system will be implemented to prevent release of contaminated water, manage sediment affected water, divert clean water around mining activities and infrastructure.<br>The Project will have insignificant impacts on the hydrology of water courses. The Project is not at risk of experiencing flooding due to its location within the landscape. |
| Aquatic impacts | Follow relevant legislation guidelines regarding impact to waterways<br>Identify and mitigate potential risks to water quality (e.g. sediment from construction, importation of clean fill). Rehabilitation of waterways will occur post mining.<br>Construction to occur during dry periods, as far as possible.<br>Do not refuel, store or decant chemicals within 50m of a waterway. |
| Soil Management and Stockpiles | Provide sediment and erosion controls to manage exposed soil surfaces and stockpiles to prevent sediment discharge into vegetation and fauna habitat.<br>Clearly identify stockpile and storage locations and provide erosion and sediment controls around stockpiles.<br>Stockpile and compound sites will be located using the following criteria:<br>▪ At least 40 m away from the nearest waterway<br>▪ On relatively level ground<br>▪ Outside the one in 10 year Average Recurrence Interval (ARI) floodplain<br>▪ Stockpiling materials and equipment and parking vehicles will be avoided within the dripline (extent of foliage cover) of any tree. |

| | |
|---|---|
| Invasion and spread of weeds | Any priority weeds in the Project area should be sprayed and managed as far as possible. Application of a native grass mix or sterile exotic grass mix in areas disturbed by the Project post construction will assist in bank stabilisation and preventing further invasion and spread of weeds.<br>Construction machinery (bulldozers, excavators, trucks, loaders and graders) should be cleaned using a high-pressure washer (or other suitable device) before entering and exiting work sites.<br>Weed-free fill should be used for on-site earthwork.<br>All chemicals should be used in accordance with the requirements on the label. Any person carrying out herbicide application will be trained to do so and have the proper certificate of completion/competency or statement of attainment issued by a registered training organisation. |
| Invasion and spread of pests, pathogens and disease | All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent providing forage habitats for foxes, rats, dogs and cats.<br>Any roadkill in close proximity to or caused by the Project is to be relocated away from the site to prevent bird species which eat carrion from being injured by traffic.<br>Pathogens such as *Phytophthora cinnamomi* will be managed by implementing precaution such as washing down equipment prior to commencing the Project.<br>Handling of frogs encountered during construction will be done only if necessary, and always in accordance with safe frog handling procedures to prevent the spread of Chytridiomycosis (Amphibian Chytrid Fungus Disease). |
| Edge effects on adjacent native vegetation and habitat | Exclusion zones will be set up at the limit of clearing. |
| Noise, light and vibration | Noise, dust vibration and artificial light impacts will be minimised by strategic Project planning to reduce the creation of noise, light, dust and vibration impacts |
| New or evolving impacts | Adaptive management is recommended to be able to respond to changing circumstances. |

### 8.6.8 Biodiversity Credit Summary

Biodiversity offsetting is triggered by this proposal. The offsetting requirement for the Project has been determined by the BAM-C. Biodiversity offsetting requirements for impacts to PCT103, PCT104, PCT174, PCT180, PCT258 and PCT184 are provided in **Table 8-43** and **Table 8-44**.

*Table 8-43 Ecosystem Credit Summary from BAM-C*

| Zone | BAM item number | Matter requiring offsetting | Change is vegetation integrity | Area | Sensitivity to Potential Gain | Number of credits |
|---|---|---|---|---|---|---|
| 1 | 1 | PCT103 | 85.2 | 33.48 | High sensitivity to potential gain | 1282 |
| 2 | 2 | PCT103_cleared | 36.4 | 0.32 | High sensitivity to potential gain | 5 |
| 3 | 3 | PCT174 | 94.7 | 14.46 | High sensitivity to potential gain | 574 |
| 4 | 4 | PCT104 | 68.8 | 3.86 | High sensitivity to potential gain | 100 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | 5 | PCT180 | 58.8 | 2.35 | High sensitivity to potential gain | 52 |
| 6 | 6 | PCT258 | 79.9 | 0.86 | High sensitivity to potential gain | 26 |
| 7 | 7 | PCT184 | 35.7 | 0.45 | High sensitivity to potential gain | 6 |
| | | | | | Total | 2045 |

*Table 8-44 Ecosystem Credit Summary (number and class of biodiversity credits to be retired)*

| Zone | PCT | TEC | Area of impact | HBT Cr | No HBT Cr | Total credits to be retired |
|---|---|---|---|---|---|---|
| 1 and 2 | 103 Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion (Zone 3 and 4 combined) | Not a TEC | 33.8 | 1282 | 5 | 1287 |
| 3 | 174 Mallee - Gum Coolabah woodland on red earth flats of the eastern Cobar Peneplain Bioregion (Zone 1) | Not a TEC | 14.5 | 574 | 0 | 574 |
| 4 | 104 Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion (Zone 2) | Not a TEC | 3.9 | 100 | 0 | 100 |
| 5 | 180 Grey Mallee - White Cypress Pine woodland on rocky hills of the eastern Cobar Peneplain Bioregion | Not a TEC | 2.4 | 0 | 52 | 52 |
| 6 | 258 Gum Coolabah - Mugga Ironbark - White Cypress Pine woodland on granite low hills in the eastern Cobar Peneplain Bioregion and central NSW South Western Slopes Bioregion | Not a TEC | 0.9 | 26 | 0 | 26 |
| 7 | 184 Dwyer's Red Gum - White Cypress Pine - Currawang low shrub-grass woodland of the Cobar Peneplain Bioregion | Not a TEC | 0.5 | 0 | 6 | 6 |

As discussed in **Section 8.6.5.1**, the Project has been separated in different components (or stages). The BDAR will consider the impacts of each stage separately, so the proponent is only liable for offsets if a stage occurs.

Proposed stages are as follows:

- Stage 1: Federation Site, Services Corridor and Communications Tower;
- Stage 2: Solar Farm and Associated Powerline;
- Stage 3: Potential Tailings Pipeline and Return Water Pipeline;
- Stage 4a: Bore and Pipelines, eastern alignment (locations indicative only);
- Stage 4b: Bore and Pipelines, west and southern alignments (locations indicative only); and
- Stage 5: Surface extraction area.

The total offsetting requirement for all stages has been determined. The offsetting requirement for each stage has then been calculated by working out the area of each native vegetation PCT impacted by each stage and converting that area to a percentage of the total impact to each PCT by the whole Project proposal. The percentage for each stage has then been applied to the total offsetting requirement, resulting in an allocation of the offsetting requirement of each stage.

A summary of credits required for each stage is provided in **Table 8-45**.

*Table 8-45 Credit Summary*

| Stage | Total Credits Required |
|---|---|
| 1 | 1265 |
| 2 | 287 |
| 3 | 262 |
| 4a | 81 |
| 4b | 97 |
| 5 | 53 |
| **Total** | **2045** |

Further detail on credit breakdown per stage and PCT is provided in **Appendix K**.

It is understood a requirement of the BAM (2020) is that the credit liability will need to be recalculated for each stage immediately before the offsetting liability is to be honoured, therefore the obligation for each stage may differ.

### 8.6.9 Conclusion

A BDAR was prepared by AREA for the Project as required under section 7.2 (2)(b) *Biodiversity Conservation Regulation 2017*. Following on from a review of available databases and mapping, the Project area was extensively surveyed over the course of 2020 and 2021.

Vegetation surveys identified six PCTs in the Project area, none of which are classified as a TEC. No threatened flora species were recorded in the Project area. Three State listed threatened bat species were positively identified through bat surveys.

Opportunities were sought through the Project design to avoid and minimise impacts to vegetation. This included utilising cleared or disturbed areas for placement of infrastructure, use of an existing public road rather than internal haul road and condensing the Project area where feasible. Management and mitigation measures have been proposed to further minimise potential impacts to biodiversity. The Project is to be undertaken across a series of stages, which will minimise impacts by allowing fauna to vacate if present and will avoid unnecessary clearing if a stage does not go ahead.

Biodiversity offsets, under the BC Act, will be required for the Project to compensate for residual impacts. The offset requirements has been determined in accordance with BAM-C.

## 8.7 Indigenous Heritage

### 8.7.1 Introduction

An Aboriginal Cultural Heritage Assessment (ACHA) and Archaeological Survey Report (Archaeological Report) were prepared by AREA Environmental and Heritage Consultants (AREA) to assess the potential for impacts to items of Indigenous heritage as a result of the Project. The ACHA and Archaeological Report are provided in **Appendix L.**

### 8.7.2 Assessment Requirements

The specific requirements associated with Indigenous heritage identified within the issued SEARs and where they are addressed are provided in **Table 8-46.**

*Table 8-46 Indigenous Heritage SEARs Requirements*

| SEARs Requirement | Reference |
|---|---|
| An assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with Aboriginal stakeholders having regard to the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010), and documented in an Aboriginal Cultural Heritage Assessment Report (ACHAR) including the significance of cultural heritage values for Aboriginal people who have a cultural association with the land; | **Section 8.7.5**<br>**Section 8.7.4.2** |
| Include results of a surface survey (and test excavations, if required) undertaken by a qualified archaeologist to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record; and | **Section 8.7.5.1** |
| Demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes, including mitigation measures and procedures for accidental finds at any stage of the project; and | **Section 8.7.6** |

### 8.7.3 Existing Environment

#### 8.7.3.1 Cultural Heritage

The archaeological record demonstrates that Aboriginal people have been present in Australia for approximately 60,000 years and provides evidence of a dynamic culture coupled with a long occupation of the land. The Project is within the traditional lands of the Ngiyampaa Wangaaypuwan people who lived in the dry region between the three rivers: the Darling-Barwon to the north, the Bogan River to the east, and the Lachlan River to the south (Beckett 1959; Beckett et al. 2003). They are often associated with the dry backcountry and only visited the Darling-Barwon and Bogan rivers in times of extreme drought (Beckett et al. 2003).

The Ngiyampaa Wangaaypuwan speak the Ngiyampaa language the Wangaaypuwan way. According to Smart et al (2000) they are the people who use the word wangaay for 'no' and puwan means 'having' or 'with'. This language can be more fully referred to as Ngiyampaa–Ngemba Wangaaypuwan, which reflects the 'heavy tongue' spoken in the north and 'light tongue' spoken in the south. The Wailwan people to the east also use Ngiyampaa as the name of their language (NPWS. 2015). Within the Ngiyampaa Wangaaypuwan people there were local groupings recognised and named geographically according to the type of Country they occupied. The people who camped in the north around Mount Grenfell are Karulkiyalu or 'Stone Country' People. Other language groups are the Pilaarrkiyalu or 'Belah Tree' People in the south and the Nhiilyikiyalu or 'Nelia Tree' People to the west.

The Ngiyampaa Wangaaypuwan had cultural ties with their neighbours, with shared Country along their boundaries. The shared Country was used by other Aboriginal people in times of drought, for ceremony, for marriage or for trade. To the east is Wailwan Country, to the south Wiradjuri Country and to the north and west, Paakantji/Baakantji Country. The Project is located along the eastern edge of the Ngiyampaa Wangaaypuwan Country and neighbours the adjoining Wiradjuri Country.

### *Local Aboriginal Heritage Context*

AREA conducted a search of existing databases within 20 km of the Project area to identify previous archaeological studies. The results of this search are summarised in **Table 8-47**.

*Table 8-47 Summary of Database Searches for Aboriginal Heritage*

| Database | Date of Search | Parameters | Results |
|---|---|---|---|
| Aboriginal Heritage Information Management System (AHIMS)<br><br>Client ID: 539539 | 2/10/2020 | GDA Zone 55<br>417320 – 457320 mE<br>6420727 – 6460727 mN | 4 sites (3 stone artefacts, 1 culturally modified tree) were recorded with the search area and are approximately 11 km north-east of the Project. |
| Cobar LEP 2012 | 30/09/2020 | Schedule 5: Environmental Heritage | No sites of Aboriginal Heritage are on the database nearby to the Project. |
| Native Title Vision | 30/09/20 | NSW | The following application covering the Project have been accepted for registration:<br>Name: **Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan**<br>Tribunal No: NC2011/006<br>Fed Court No: NSD38/2019<br>Type Claimant<br>Status: Active |
| State Heritage Register | 30/09/20 | Cobar LGA | Mt Drysdale, approximately 130 km north of the Project is recorded in this register. |

### 8.7.4 Assessment Approach

#### 8.7.4.1 Predictive Model

A predictive model combines the archaeological context for the Project with landscape information to propose likely site types, distributions, and intactness within the area.

Areas of archaeological potential are regarded as any sensitive landform with a reasonable level of intactness (i.e. little to no disturbance or minor ground surface disturbance only and in areas not on self-mulching soils). The definition of disturbance used here follows that of the *National Parks and Wildlife Regulation 2009* (Clause 80B, Subclause 4). Sensitive landforms follow the definitions supplied in the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010):

- Within 200 m of waters;
- Located within a sand dune system;
- Located on a ridge top, ridge line or headland;
- Located within 200 m below or above a cliff face; and
- Within 20 m of or in a cave, rock shelter, or a cave mouth.

Areas of marginal water security such as that of the Project would have been exploited for resources during periods of more secure precipitation. Based on the regional geology it is likely that any stone artefacts would have been imported to the Project area. Other artefacts made of wood, shell or bones are not as resilient in surviving archaeological records. Culturally modified trees can occur amongst old growth trees, producing suitable bark to create carrying dishes (commonly known as *coolamons*), canoes and other items. Trees may also be modified as markers or used for other types of communication.

#### 8.7.4.2 Consultation

AREA contacted a range of organisations on 22 May 2020 to request potential Registered Aboriginal Parties (RAPs) for consultation regarding the Project. The following organisations were contacted:

- Native Title Services Corporation Limited (NTS Corp);
- NSW Department of Planning, Industry and Environment (DPIE);
- Cobar Local Aboriginal Land Council (Cobar LALC);
- Cobar Shire Council;
- Aboriginal Land Rights Act 1983 (ALRA);
- Local Land Services – Cobar (LLS); and
- National Native Title Tribunal (NNTT).

This process resulted in 13 potential RAPs for the Project. These potential RAPs were contacted with an invitation to consult regarding the Project. In addition, an advertisement was placed in the Cobar Weekly on 27 May 2020 requesting expressions of interest for consultation regarding the Project.

After Stage 1 of consultation seven individuals registered their interest, one name has been withheld at the request of the individual. At various stages between mid/late 2020 and mid-2021, a further 3 people registered to become RAPs (**Table 8-48**).

In November 2020 AREA were notified that Condobolin LALC were active once again and requested to be included in the consultation process. Condobolin LALC have been involved in the consultation process since this time.

*Table 8-48 Registered Aboriginal Parties*

| Contact | Organisation |
|---|---|
| Rena Clements | Cobar LALC |
| Elaine Olsen | Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Native Title Claimants |
| Hilary Williams | Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Native Title Claimants |
| Barry Williams | Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Native Title Claimants |
| Peter Harris | Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Native Title Claimants |
| Mark Saddler | Bundyi Cultural Tours |
| Joshua Clarke | Ngiyampaa traditional owner |
| Shantelle Ohlsen | Cobar LALC |
| Braydn Davis | Condobolin LALC |
| Louise Davis | Condobolin LALC |
| Isabel Goolagong | Condobolin LALC |
| Tim Gumbleton | RSM Australia Pty Ltd[2] |

The RAPs were sent a request for cultural knowledge and were supplied more detailed information on 11 June 2020. No specific comments were received.

In September 2020 'the project' for the purpose of consultation with RAPs, was amended to the 'Aurelia Metals Projects' as the scope of the proposal was altered. The name change reflected that there were additional smaller projects (related to Hera Mine) being managed under the one consultation process, not just limited to the Federation Project. The updated methodology was sent to all RAPs on 24 September 2020 asking for comments. No comments were received.

All RAPs were invited to attend an Aboriginal Focus Group Meeting (AFGM), held online on 2 September 2021. The aims of the AFGM were to present a summary of the Project and the archaeological assessments, gain an understanding of the cultural values of the Project, come to an agreement on the management and mitigation measures, and identify the next steps and timeframes. The attendees for the meeting are outlined in **Table 8-49**.

*Table 8-49 AFGM Attendees*

| Contact | Organisation |
|---|---|
| Amy Pagett | Acting CEO, Cobar LALC |
| Mark Saddler | Bundyi Cultural Tours |
| Joshua Clarke | Ngiyampaa traditional owner |
| Braydn Davis | Condobolin LALC |

[2]Administrator appointed for Condobolin LALC

| | |
|---|---|
| Louise Davis | CEO, Condobolin LALC |
| Isabel Goolagong | Board Member, Condobolin LALC |
| Tim Gumbleton | RSM Australia Pty Ltd[3] |

The following recommendations were agreed upon during the AFGM:

- The communications tower area was originally surveyed without representation from the RAPs and would be re-surveyed by AREA and RAPs (re-survey completed 20 September 2021);
- The Cultural Heritage section of the Hera online induction be reviewed by the RAPs;
- The ongoing maintenance and management of the Aboriginal sites be conducted by a member of the Condobolin LALC on a casual basis, for the lifetime of the mine;
- The continuation of onsite cultural heritage inductions conducted by the archaeologists and the RAPs; and
- RAPs were pleased to hear that if there was potential for Aboriginal sites were recorded to be impacted by the proposed works, designs and locations were amended to avoid impacting sites.

A draft copy of the ACHA was provided to the RAPs for their comment. No comments were received, with one RAP requesting copies of the Aboriginal site cards which were provided.

#### 8.7.4.3 Field Survey

A series of archaeological surveys have been undertaken across the Project area. Initial surveys undertaken were associated with the Exploration Decline Program. Additional surveys were undertaken to target impact areas associated with the Project which were not covered in the initial surveys.

The primary archaeological survey was conducted on Saturday 13 to Monday 15 June 2020 and focused on the Federation Site and the exploration decline program disturbance area. It was attended by three representatives of the Aboriginal community and two staff members from AREA.

A secondary site inspection was undertaken on Friday 23, Saturday 24 October and Tuesday 27 October 2020. The purpose of this site inspection was to inspect the Exploration Decline Program pipeline route and the proposed Services Corridor route. The survey was assessed in conjunction with two members of the Aboriginal Community.

Surveys conducted between Tuesday 13 July and Thursday 15 July 2021 targeted previously unsurveyed sections of the proposed activity and infrastructure area for the Federation Project. The survey was assessed in conjunction with the three members of the Aboriginal Community. A secondary survey requested by the Registered Aboriginal Parties (RAPs) during the Aboriginal focus group meeting (AFGM) of the Communications Tower was conducted on 20 September 2021 and attended by one Aboriginal Community member.

#### 8.7.4.4 Methodology

The Project footprint was surveyed through a series of transects, with a spacing of 20 m between personnel. The survey was intensified in areas of higher archaeological potential. Survey coverage and the location of any items

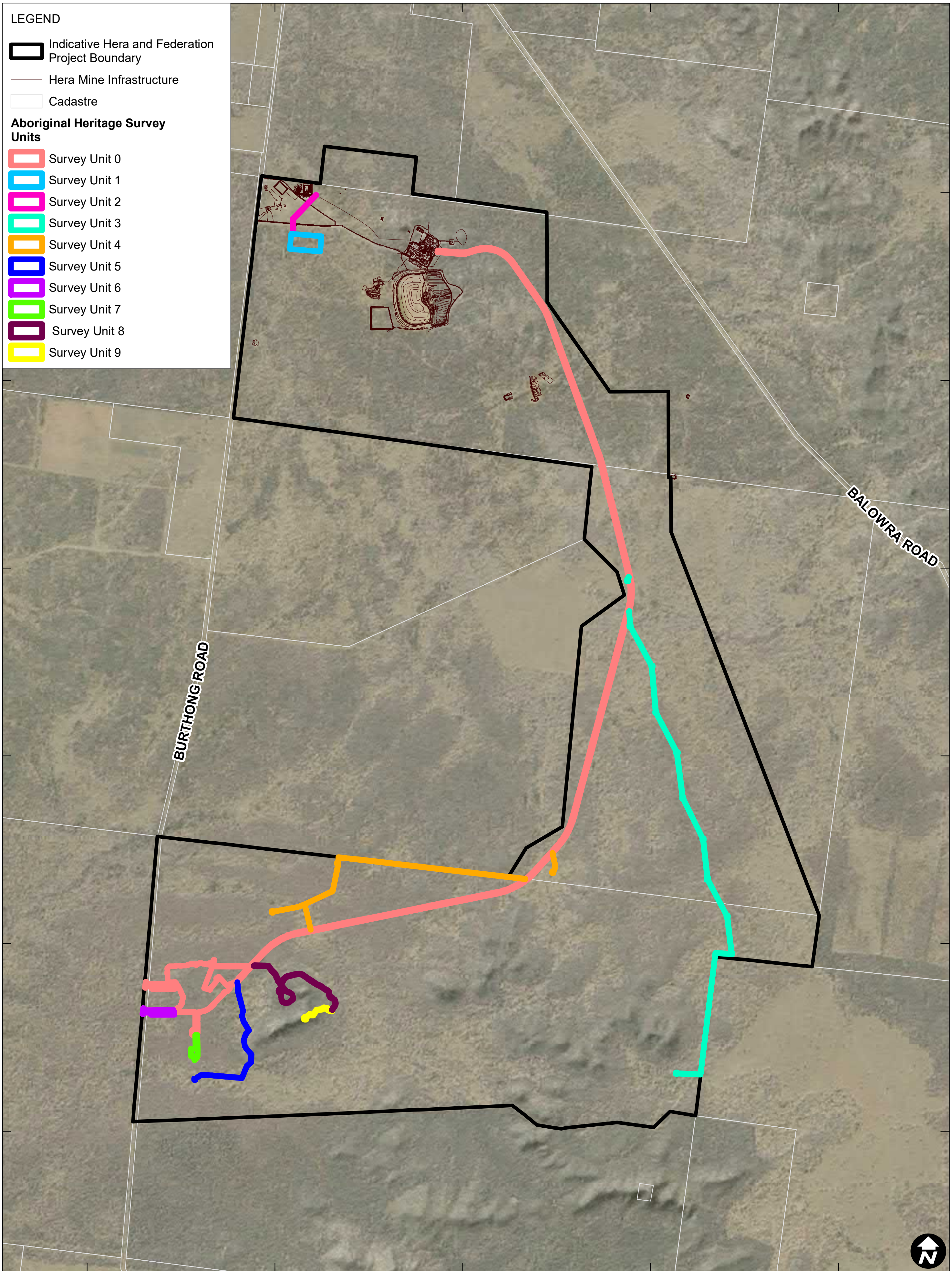
[3]Administrator appointed for Condobolin LALC

of Aboriginal heritage were recorded through a handheld GPS unit. Photographic and written records were made of the landscape features relevant to archaeological potential. These features include disturbance levels, ground surface visibility (GSV) and landforms of higher archaeological potential.

To ensure consistency between the field surveys undertaken at different times, the Aboriginal sites were recorded continuing the nomenclature from previous assessments. The Project was surveyed in sections defined by the proposed activity, with the survey units within the sections defined arbitrarily. The Project was divided into the following sections:

- Exploration Decline Program (SU0);
- Solar farm and powerline easement (SU1 and SU2);
- Pipeline network and production bores (SU3 to SU5);
- Federation Project southern access road and second magazine location areas (SU6 and SU7);
- Surface extraction area (SU8) (referred to as 'Quarry' in ACHA); and
- Communications Tower (SU9).

The location of each Survey Unit is provided in **Figure 8-28.**




Scale: 1:65,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

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Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
Heritage data supplied by AREA Environmental & Heritage Consultants Pty Ltd

**ABORIGINAL HERITAGE SURVEY UNITS**

**FIGURE 8-28**

### 8.7.5 Predicted Impacts

#### 8.7.5.1 Survey Results

*Exploration Decline Program - Survey Unit 0 (SU0)*

The landscape within the SU0 is comprised of a flat plain with remnant mallee vegetation that has been cleared to make access tracks for the purpose of exploration drilling. Twelve sites, five culturally modified trees, five stone artefact sites (one with evidence of quarrying), a quarry and a hearth (fireplace), were recorded during the survey. All sites were recorded outside of the Project area and will not be impacted.

*Solar Farm - Survey Unit 1 (SU1)*

GSV within the Survey Unit varies from moderate to high due to the ground cover. Disturbance within SU1 is moderate with exploration drilling observed in one location, a track connecting the drilling pad to the haulage road, and topsoil stockpiles and rubbish piles in the north of the survey unit.

One culturally modified tree (The Peak CMT 6) was recorded during the survey and is outlined in **Section 8.7.5.2**.

*Powerline Easement Solar Farm – Survey Unit 2 (SU2)*

SU2 is comprised of a flat landform and crosses the two mine access roads. The Survey Unit has evidence of moderate to high levels of disturbance due to the two roads, the topsoil stockpiles and historic vegetation clearing.

No Aboriginal objects or areas of archaeological deposits were observed during the survey within SU2.

*Eastern Pipeline Network and Production Bores – Survey Unit 3 (SU3)*

The northern end of the Survey Unit joins with the Services Corridor and the pipeline extends for approximately 14.5 kms and includes 11 drill pad sites. Minimal disturbance was observed associated with grazing and other low impact farming activities. GSV also varied within each of the vegetation types. Areas of Bimble Box grassy woodland within the northern section of SU3 contained low GSV (20%) due to dense ground cover of grasses and broad leaf weeds. The middle and southern portions contained high GSV due to the lack of ground cover. Within the Mallee and Gum Coolabah Woodland GSV also varied due to the amount of ground cover. Natural resources in the form of yams, Quandong trees, and Kurrajong trees were observed. Several small drainage lines were observed at the southern portion of the survey unit.

Three culturally modified scar trees (Federation Deposit CMT 7, Federation Deposit CMT 13, and Federation Deposit CMT 14), and four hearths (Federation Deposit H2, Federation Deposit H3, Federation Deposit H4, and Federation Deposit H5) were recorded during the survey and are outlined in **Section 8.7.5.1**

*Northern Pipeline Network and Production Bores – Survey Unit 4 (SU4)*

Survey Unit 4 (SU4) encompasses the northern segment of the proposed production bore and pipeline network (**Figure 8-28**). SU4 contains two production bore pads and approximately 4.5 kms of pipeline. The northern section of SU4 runs along a section of fence line that has been extensively cleared and has started to revegetate. The remainder of the survey unit contains minimal disturbance. SU4 is within a flat landform with vegetation consisting of Mallee and Gum Coolabah Woodland with moderate to high GSV.

Three culturally modified scar trees (Federation Deposit CMT 10, Federation Deposit CMT 11, and Federation Deposit CMT 12), and a hearth (Federation Deposit H6) were recorded during the survey and are outlined in Section 6.6.

*Western Pipeline Network and Production Bores – Survey Unit 5 (SU5)*

Survey Unit 5 (SU5) encompasses the proposed western production bore and pipeline network, it contains one bore pad and approximately 2 kms of pipeline. The majority of the pipeline network follows the existing access track (**Figure 8-29**). Vegetation within SU5 consists of Gum Coolabahs with a shrubby understory. GSV was high along the track and moderate within the proposed bore pad.

One culturally modified tree (Federation Deposit CMT 9) was recorded during the survey and is outlined in Section 6.6 of **Appendix L**.

*Federation Site Southern Access Road – Survey Unit 6 (SU6)*

Survey Unit 6 (SU6) encompasses the southern access road into the Federation Site and measures 415 m long, 230 m at its widest and is approximately 2.5 ha in area. GSV was high along the track and moderate (50%) throughout the rest of the survey unit.

One culturally modified tree (Federation Deposit CMT 8) was recorded during the survey and is outlined in Section 6.6 of **Appendix L**.

*Federation Site Second Magazine – Survey Unit 7 (SU7)*

Survey Unit 7 (SU7) encompasses the proposed second magazine and is located north of the existing access track to the Federation Project. SU7 is 340 m long, and 90 m at its widest. GSV was moderate (40%) with some large exposures occurring.

No Aboriginal objects or areas of archaeological deposits were observed during the survey within SU7. The access track is a moderate to steep slope, with rocky soils and outcroppings of jagged sandstone at the crest.

*Surface Extraction Area – Survey Unit 8 (SU8)*

Survey Unit 8 (SU8) encompasses of the proposed surface extraction area located on a small crest north of the communication tower and the access track connecting the surface extraction area to the Services Corridor (refer **Figures 1-3**). The access track follows an existing mine track approximately five metres wide. SU8 is predominately on a moderate slope with vegetation consisting of juvenile Cyprus Pines and the occasional mallee. GSV was high (90%) within the existing access track and moderate (40%) across the remainder of the survey unit.

No Aboriginal objects or areas of archaeological deposits were observed during the survey within SU8.

*Communications Tower - Survey Unit 9 (SU9)*

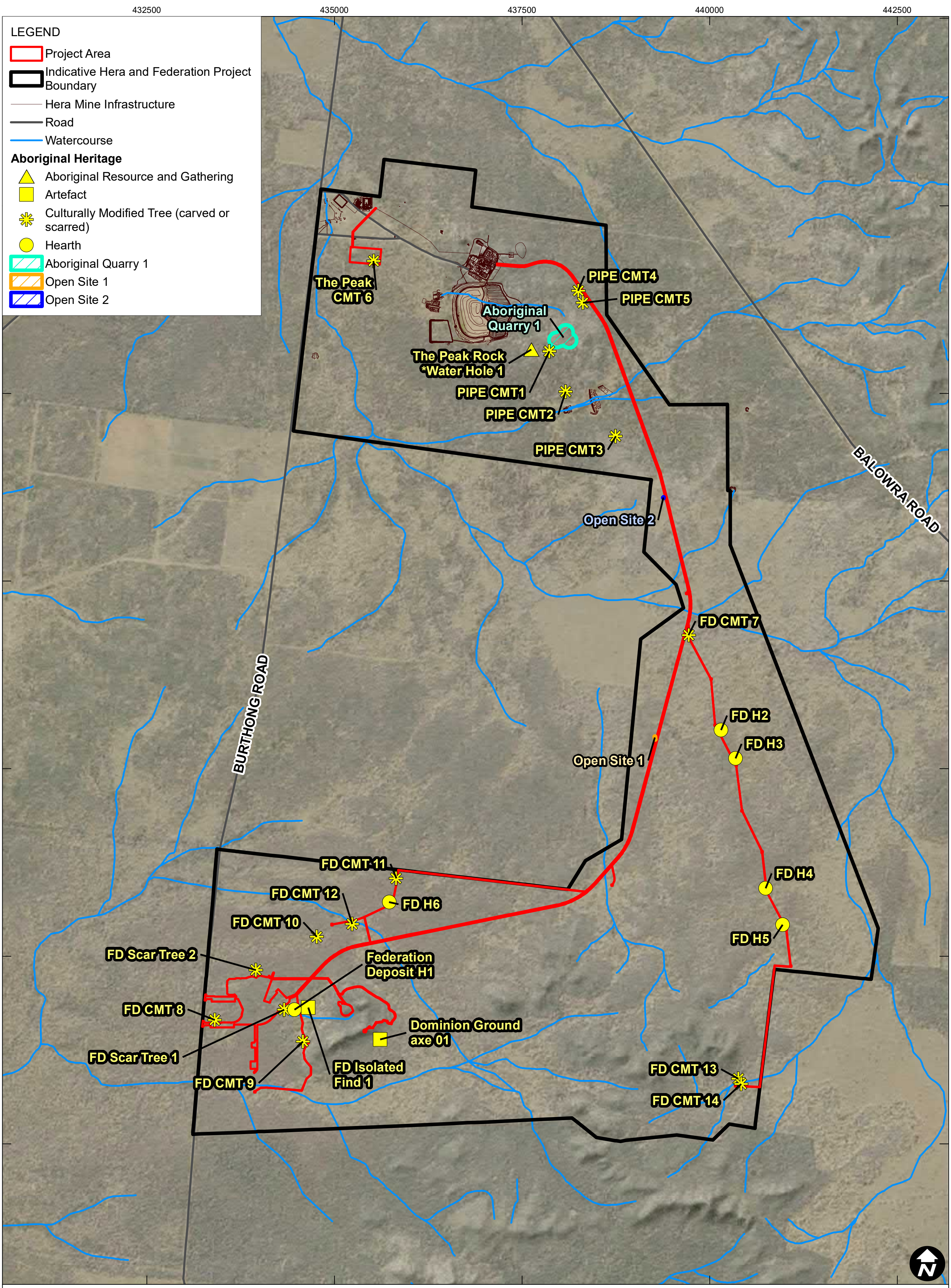
Survey Unit 9 (SU9) encompasses the proposed communications tower, access track and the ridge line of the crest. GSV was high (80%) within the Survey Unit as much of the area contained heavy browsing and degraded soils due to the presence of goats. No Aboriginal objects or areas of potential archaeological deposit were identified within the study area. However, intangible cultural heritage values were noted. The south western end of the crest provides 360° views across the landscape for a wide area. This crest would have been utilised by the Aboriginal people as a lookout. Small scouting parties would position themselves at the crest to keep a lookout for approaching tribes, the location of natural resources such as mobs of Kangaroo and Emu, and to observe weather patterns such as approaching rains.

#### 8.7.5.2 Recorded Sites

Table 8-50 and **Table 8-51** provide a summary of the recoded sites identified in the field surveys detailed in **Section 8.7.5.1.**

In addition, there was one archaeological site, Dominion Ground Axe 1 which was previously recorded during a survey nearby to a drill line, at the base of the eastern side of the communications tower. The axe was made from a dark grey volcanic stone that is not found among the geology of the region, and measures 64 mm long, 23 mm wide and ground at one end. Despite its relatively small size, there was no evidence of hafting present.

The location of the recorded sites is provided in **Figure 8-29.** Further information is provided in Section 6.8 of the ACHA in **Appendix L**.




Scale: 1:65,000 at A4
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SLR

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
Heritage data supplied by AREA Environmental Consultants & Communication

**RECORDED ABORIGINAL SITES**

**FIGURE 8-29**

*Table 8-50 Recorded Sites Project Disturbance Area and Surrounds*

| Site Number | Description | Photograph |
|---|---|---|
| The Peak CMT 6 | Located within the southeast portion of the proposed solar farm. The scar is located on the western face of a dead Bimble box and measures 60cm long, 10cm wide and 4cm deep. |  *Photo 8-1 Peak CMT 6* |

| | | |
|---|---|---|
| Federation Deposit CMT 7 | The tree is a living Bimble box with multiple branches with scars. The cultural scar is located on the east face of the lower limb and measures 30cm long, 10cm wide and 5cm deep |  *Photo 8-2 Federation Deposit CMT7* |
| Federation Deposit CMT 8 | The Aboriginal site is located 100m east of Burthong Road and 40m north of the southern access road. The tree contains two scars on the northeast and southwest faces of a living Gum Coolabah. Largest scar is on the northeast side and measures 1.9m long, 0.88m wide and 0.15m deep (Figure 6 39 within the ACHA). The bark from this scar was most likely utilised as a shelter. The smaller scar on the southwest face measures 1.7m long, 0.25 m wide, and 0.27m deep (Figure 6 40 within the ACHA). The bark from this scar could have been utilised for a shield. |  *Photo 8-3 Federation Deposit CMT 8* |

| | | |
|---|---|---|
| Federation Deposit CMT 9 | Federation Deposit CMT 9 is located 73m west of the existing track and proposed pipeline network. The scar is on the southern side of a dead tree, possibly a Gum Coolabah | <br>*Photo 8-4 Federation Deposit CMT 9* |

| | | |
|---|---|---|
| Federation Deposit CMT 10 | Located 42m south of the proposed production bore pipeline. The scar is on the southern side of the living Gum Coolabah and measures 150cm long, 40cm wide and 10cm deep |  *Photo 8-5 Federation Deposit CMT 10* |
| Federation Deposit CMT 11 | comprised of two scars on the eastern and southern sides of a dead tree. The southern scar is approximately 1.7m above the ground and measures 70cm long, 24 centimetres wide and 4cm deep. The scar on the western side is 50cm above the ground and measures 100cm long, centimetres wide and 10cm deep |  *Photo 8-6 Federation Deposit CMT 11* |

| | | |
|---|---|---|
| Federation Deposit CMT 12 | Contains a scar high off the ground that has mostly closed over. The scar measures 100cm long, 10cm wide and the depth could not be measured as it was more than 2m above the ground |  *Photo 8-7 Federation Deposit CMT 12* |

| | | |
|---|---|---|
| Federation Deposit CMT 13 | Located within a Bimble Box and Gum Coolabah grassy woodland. The scar is located on the southeast side of a dead Cyprus Pine, and measures one metre long, 12cm wide and 6cm deep. The scar is 85cm above the ground with a tree circumference of 1.43m |  *Photo 8-8 Federation Deposit CMT 13* |

| | | |
|---|---|---|
| Federation Deposit CMT 14 | Located 10m west of an existing track, 70m north east of the proposed production bore pad and 80m south east of Federation Deposit CMT 13. The tree is a dead Cyprus Pine that has fallen and currently being held up by a Gum Coolabah to the east. Federation Deposit CMT 14 is comprised of two cultural scars on the north and south sides of the tree. |  *Photo 8-9 Federation Deposit CMT 14* |
| Federation Deposit H2 | Located within a clearing of Mallee scrub. The site is within a flat landform context and measures approximately 12m by 15m (Figure 6 54 within the ACHA). The site contains several clumps of bake clay balls, approximately 80mm by 60mm (Figure 6 55 within the ACHA) and has been interpreted as a hearth |  *Photo8- 10 Federation Deposit H2* |

| | | |
|---|---|---|
| Federation Deposit H3 | Located 80m north of a proposed bore FWB044 and consists of several clusters of baked clay clumps. The site has been interpreted as a hearth. The clusters are scattered amongst the Mallee and Cyprus pine, the site measuring 20m north-south and 15m east-west |  *Photo 8-11 Federation Deposit H3* |

| | | |
|---|---|---|
| Federation Deposit H4 | This site is located within a proposed bore track alignment and 35m north of the proposed location of bore FWB047. The site is possibly a campsite with contains clusters of clay clumps with charcoal observed within the baked clay |  *Photo 8-12 Federation Deposit H4* |

| | | |
|---|---|---|
| Federation Deposit H5 | This Aboriginal site is located 15m west of the indicative pipeline network to a proposed bore, and 10m east of quartz vein on the surface. The site has been interpreted as a hearth and contains one cluster of baked clay balls and measure five metres long and five metres wide |  *Photo 8-13 Federation Deposit H5* |

| | | |
|---|---|---|
| Federation Deposit H6 | Located 20m east of an indicative pipeline network and measure 5m by 5m. The site has been interpreted as a hearth and contains a single cluster of baked clay balls with charcoal inclusions. No stone tools or natural resources were observed. |  *Photo 8-14 Federation Deposit H6* |

| | | |
|---|---|---|
| The Peak Rock Water Hole 1 | A depression was observed within an outcropping of rock approx. 260m southwest of the Aboriginal quartz quarry (AHIMS ID 34-2-0026). The hole measures 300 mm long, 250mm wide and 100mm deep, and appears to be naturally made. |  *Photo 8-15 The Peak Rock Water Hole 1* |

*Table 8-51 Previously Surveyed Sites – Exploration Decline Program and Surrounds*

| Site ID | Description | Photograph |
|---|---|---|
| Federation Deposit Scar Tree 1 | Federation Deposit ST1 is a north-facing scar on a Bimble box at the edge of a small clearing. There are no other site features nearby, so the site boundary includes the tree canopy with a 3m buffer. There is minor-moderate ground surface disturbance in the clearing to the north of the tree.<br>The tree is approximately 25m high. There are two scars on this tree, one is from lighting strike and the other is cultural in origin. It is easy to overlook the cultural scar due to the placement of the lightning strike scar which partially overlaps it.<br>There is a large epicormic growth at the base of the scar which, along with significant regrowth and weathering, suggests that the scar is relatively old. The scar is 291cm long, 45cm wide and 15cm deep. Regrowth is approximately 10 cm. | <br>*Photo 8-16 Federation Deposit Scar Tree 1* |

| | | |
|---|---|---|
| Federation Deposit Scar Tree 2 | Federation Deposit ST2 is on a c.200-year old Bimble box tree in an open woodland context. There are no other site features nearby, so the site boundary includes the tree canopy with a 3m buffer. There has been little ground surface disturbance in the vicinity of the tree.<br>The tree is approximately 25m high. The has been significant regrowth and the scar is nearly closed over. The scar is 96cm long, 7cm wide and 20cm deep. Regrowth is approximately 20 cm. | <br>*Photo 8-17 Federation Deposit Scar Tree 2* |

| | | |
|---|---|---|
| Federation Deposit Isolate Find 1 | Federation Deposit IF1 is an anvil fragment made from quartzose sandstone. It was recorded among a low-density patch of trees approximately 60m east of the Development Site. The anvil has been broken but the other piece(s) were not found. It exhibits pecking where the split has occurred.<br>GSV was very high in the location of the artefact and it is therefore very likely to be an isolated find. Therefore, the site boundary is a circle with a radius of 5m around the position of the artefact. There was no ground disturbance in the location of the artefact.<br>The site was recorded near a (very) ephemeral drainage line. | <br>*Photo 8-18 Federation Deposit Isolate Find 1* |

| | | |
|---|---|---|
| Federation Deposit H1 | Federation Deposit H1 is a probable hearth or fireplace in a small clearing among low-density woodland. It consists of an area of hardened, baked soil with a baked clayey ball nearby. The Traditional Owners had recently participated in targeted ground oven training sessions run by a renowned archaeologist at Mt Grenfell and provided guidance on its positive identification.<br>The site is not accompanied by other artefacts. However, it is in the general vicinity of two other sites (Federation Deposit ST1 & IF1) in the southeast of the Site. | <br>*Photo 8-19 Federation Deposit H1* |
| PIPE Aboriginal Quarry 01 | This site is located on the eastern to southern slope of a hill. Four outcroppings of high quality quartz were observed within a 500 $m^2$ area. A scatter of quartz fragments was observed around each outcropping with the largest scatter containing many worked flakes.<br>This Aboriginal quartz quarry is known to the Ngiyampaa People and has ties to Sandy Creek Aboriginal trading route. The Ngiyampaa People have not visited the quarry in recent years however it is part of their stories (pers. Comm. Mr Joshua Clarke) | <br>*Photo 8-20 PIPE Aboriginal Quarry 01* |

| | | |
|---|---|---|
| PIPE OS1 | This open site contains an outcropping of high quality quartz with evidence of mining and a quartzite complete flake. The flake measures 55 mm long, 40 mm wide and 4 mm thick and contains 2 negative scars the on distal side with evidence of retouch along the edge. The sites measures approximately 60 m by 30 m. |  *Photo 8-21 PIPE OS1* |
| PIPE OS2 | PIPE OS2 contains an outcropping of high quality quartz and a core made of quartzite. The core measure 50 mm long, 40 mm wide and 20 mm thick. |  *Photo 8-22 PIPE OS2* |

| | | |
|---|---|---|
| PIPE CMT1 | PIPE CMT1 is located within a flat grassy woodland landscape context. The scar is located on a dead Bimble Box on the southern side of the tree. The tree and the scar show evidence of ringbarking.<br>The tree is approximately 10 m high and with a circumference of 1.9 m. The scar measures 79 cm long, 13 cm wide, 10 cm deep, with 19 cm of regrowth. The scar is approximately 30 cm above the ground. | <br>*Photo 8-23 PIPE CMT1* |

| | | |
|---|---|---|
| PIPE CMT2 | PIPE CMT2 is located within a flat grassy woodland landscape context and is approximately 5 m east of a drainage line. The scar is located on the south west side of a dead Bimble Box tree that is approximately 10 m high and with a circumference of 1.7 m.<br>The scar measures 1.1 m long, 23 cm wide, 10 cm deep and with a regrowth of 30 cm. | <br>*Photo 8-24 PIPE CMT2* |

| | | |
|---|---|---|
| PIPE CMT3 | PIPE CMT3 is located within a flat grassy woodland landscape context. The scar is located on the southern side of the tree. The dry face is extremely weathered and mostly missing.<br><br>The scar measures 1.1 m long, 17 cm wide, and 15 cm deep with 10 cm of regrowth. The tree a dead Bimble Box that is approximately 22 m high. | <br>*Photo 8-25 PIPE CMT3* |

| | | |
|---|---|---|
| PIPE CMT4 | PIPE CMT4 is located 20 m south of a drainage line. The tree is a dead Gum Coolabah that has been historically ringbarked and measures 170 cm in circumference. The scar is 110 cm long, 10 cm wide and 2 cm deep. The scar has 15 cm of regrowth. |  *Photo 8-26 PIPE CMT4* |

| | | |
|---|---|---|
| PIPE CMT5 | PIPE CMT5 is a possible marker tree. The tree is a living Gum Coolabah that is approximately 3.7 m in circumference. It contains one large scar on the south side and two smaller scars on the west and northern sides.<br>The south scar is 210 cm long, 26-10 cm wide, 23 cm deep and has 30 cm of regrowth. The scar is located 20 cm from the ground.<br>The west scar is 90 cm long, 19 cm wide, 30 cm deep and has 10 cm of regrowth. The scar is 150 cm from the ground.<br>The north scar is 70 cm long, 12 cm wide, 30 cm deep and has approximately 10 cm of regrowth. The scar is approximately 150 cm from the ground.<br>The tree is also approximately 500 m north east of Federation Services Corridor Aboriginal Quarry 01 | <br>*Photo 8-27 PIPE CMT5* |

8.7.5.3 Discussion

In total there were 28 Aboriginal sites recorded during the archaeological surveys. It was concluded that this was somewhat unexpected given the predictive model determined there was a low likelihood of sites to be present in the Project area, although it was possible for there to be evidence of sporadic occupation. The sites fell into two types; culturally modified trees (carved or scarred), and hearths. No stone artefacts were observed surrounding the hearths indicating that the camps could have been used for a short term before the parties moved on. The recorded site types were typical of the region and are consistent with the predictive model. The fact that all sites consisted of few, or isolated features is in line with the observation that less intense occupation is expected at increased proximity from a reliable water source.

Extensive or significant Aboriginal sites, if they occurred, would almost certainly have been detected due to the high GSV and all mature trees were inspected for modification. The necessary environmental features were not present for other Aboriginal site types.

### 8.7.6 Mitigation and Management Measures

All 28 Aboriginal sites, except for The Peak CMT 6, are outside the proposed impact footprint for the Project. The proponent has committed that The Peak CMT 6 will remain in situ and be surrounded by a 10 m buffer. The following Aboriginal sites are within 100 m of the Project and will require some management of Project activities to avoid inadvertent impact:

- PIPE OS1;
- PIPE OS2;
- Federation Deposit Scar Tree 1;
- Federation Deposit Scar Tree 2;
- Federation Deposit H1;
- Federation Deposit H2;
- Federation Deposit H3;
- Federation Deposit H4;
- Federation Deposit H5;
- Federation Deposit H6;
- PIPE CMT 4;
- PIPE CMT 5;
- Federation Deposit CMT 7;
- Federation Deposit CMT 8;
- Federation Deposit CMT 9;
- Federation Deposit CMT 11;
- Federation Deposit CMT 12;
- Federation Deposit CMT 13; and
- Federation Deposit CMT14.

The remaining eight Aboriginal sites are further than 100m of the Project and will require some management of Project activities to avoid inadvertent impact.

Discussion with the RAPs at the AFGM determined the favored method of management is for the Aboriginal sites within 100 m of the Project to be re-identified with the assistance of a qualified archaeologist and the Aboriginal community. Fencing and/or signage should be erected around each site. A buffer of 10 m should be between the trunk of the culturally modified trees and the fencing, or 5 m from the boundaries of the other sites.

To avoid inadvertent impact to Aboriginal sites the following measures will be undertaken:

- The locations of the cultural heritage sites will be provided to the relevant supervisors responsible for the construction and operation of the Project. They will be informed that cultural heritage sites are protected under the NPW Act and no harm is to come to them. The presence of the cultural heritage sites will be made clear to the workforce as part of a Project induction;
- Potentially re-identify with the assistance of a qualified archaeologist and the Aboriginal community any Aboriginal sites within 100 m of proposed impacts and install fencing and/or signage around each with a buffer of ten metres from the trunk of the culturally modified trees and five metres from the boundaries of the open sites
- If changes are made to the proposed works which could impact locations outside of the current Project area, further archaeological investigation would be required;
- If any objects of suspected Aboriginal heritage origin are encountered during the proposed works, work in the area of the find would cease. An unexpected finds protocol will be developed and implemented for the Project; and
- If suspected human remains are located during any stage of the proposed works, work must stop immediately, and the NSW police must be notified.

### 8.7.7 Conclusion

The ACHA was prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW 2010).* The Project was surveyed on a number of occasions in 2020 and 2021. Twenty-eight Aboriginal sites were recorded during the archaeological survey, one within the Project area, nineteen within 100 m of the Project area and the remaining eight further than 100 m from the Project area. All sites were outside the impact footprint, with the exception of Peak CMT 6, which will remain in situ within a 10 m buffer. Management measures have been proposed for the ongoing protection of identified Aboriginal sites, and an unexpected finds protocol will be developed and implemented for the Project.

Consultation with the RAPs was undertaken throughout the assessment. A draft copy of the ACHA was provided to the RAPs for their comment, with no comments received.

## 8.8 Historic Heritage

### 8.8.1 Introduction

This section provides an assessment of the potential impacts to items of historic heritage. The assessment methodology and proposed management measures are detailed.

### 8.8.2 Assessment Requirements

The SEARS issued for the Project, as they relate to historic heritage, are provided in **Table 8-52.**

*Table 8-52 Historic History SEARS Requirements*

| SEARS Requirement | Reference |
|---|---|
| An assessment of the impact on historic heritage, including heritage conservation areas and State and local heritage items within and near the site; | **Section 8.8.5** |

### 8.8.3 Existing Environment

Copper was discovered in the Cobar region in 1870 by three itinerant tank sinkers. A number of new discoveries were made by pastoral workers, who had the opportunity to traverse and closely examine the landscape. One such discovery was made at Nymagee by two shepherds, partly assisted by a knowledgeable boundary rider. The discovery was inspected and purchased by Russell Barton, one of the major investors in the Cobar copper mines. A private company was quickly formed and mining rapidly developed (McQueen, 1917).

Nymagee at its peak had a population of 2,200 people, of which almost half were Chinese. The Nymagee Copper mine was established in 1880 and continued sporadically until 1917. Nymagee Copper Mine was located approximately 750 m south west from the centre of Nymagee. With the lack of railway infrastructure and falling copper prices the mine was deemed unviable and mining subsequently ceased (McQueen, 1917). Nymagee Mine is regarded as one of the oldest mines in NSW (McQueen, 1917).

The Federation Site is currently undeveloped and covered in predominantly native woodland. There has been some minor disturbance due to exploration drilling and limited pastoral activities. The Hera Mine was established in 2012 and commissioned in 2013. All infrastructure on site has been established as part of mine operations. This is with the exception of an old farmhouse and out houses located south of the current Hera Mine accommodation village which are used for storage and core analysis.

### 8.8.4 Assessment Approach

The following databases were searched on 22 September 2021 to identify heritage-listed items within or in close proximity to the Project area:

- National Heritage List;
- NSW State Heritage Inventory;
- *Cobar Local Environmental Plan 2012*; and
- *Bogan Local Environment Plan 2011*.

There are no heritage items of local, state or national significance recorded in the vicinity of the Project including within Nymagee. Items of local significance were listed both on the Bogan and Cobar Local Environment Plans. Within Cobar there was one State heritage listing, which is the Cobar railway station and yard. Within Bogan Shire there are two items listed on the State heritage register within Nyngan, these being the Courthouse and the Chinese graves and burner at Nyngan Cemetery.

### 8.8.5 Predicted Impacts

Given the lack of any known items of listed historic heritage within proximity to the Project, potential impacts are considered negligible. Given Nymagee is 15 km from the Federation Site, any potential impacts associated with items of heritage in Nymagee, are also considered negligible. It is considered that the continuation of mining in the area would benefit the township into the future both economically and culturally, with the historic mining heritage reflected through the Project.

### 8.8.6 Mitigation and Management Measures

The following management measures are proposed for historic heritage:

- Development of and adherence to an unanticipated finds protocol;
- Development of and adherence to an encountered human remains protocol; and
- Continued engagement with the local community through the Hera Mine Community Consultative Committee (CCC).

### 8.8.7 Conclusion

The township of Nymagee was established to support copper mining, which was developed in the late 1800's and was operational until 1912. A search of public databases was undertaken to identify any items of historical heritage in proximity to the Project. There are no items of historic heritage located within or adjacent to the Project, therefore potential impacts are considered to be negligible. An unexpected finds protocol will be developed and implemented for the Project.

## 8.9 Noise and Vibration

### 8.9.1 Introduction

A Noise and Vibration Impact Assessment (NVIA) was prepared by Muller Acoustic Consulting (MAC) and is included as **Appendix M**.

### 8.9.2 Assessment Requirements

The SEARS issued for the Project as they relate to noise and vibration are provided in **Table 8-53.**

*Table 8-53 Noise and Vibration SEARS Requirements*

| SEARS Requirement | Reference |
|---|---|
| Identification of representative noise monitoring locations for determining compliance with applicable noise goals and where relevant noise goals would be set as representative limits. | **Section 8.9.6** |
| An assessment of the likely construction and operational noise impacts of the development in accordance with the *Noise Policy for Industry NSW*, and the *Voluntary Land Acquisition and Mitigation Policy*. | **Section 8.9.5** |

| | |
|---|---|
| If a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities in accordance with the *Interim Construction Noise Guideline.* | **Not Applicable** |
| An assessment of the likely road noise impacts of the development in accordance with the *NSW Road Noise Policy*. | **Section 8.9.4.4**<br>**Section 8.9.5.3** |
| An assessment of the likely blasting impacts of the development on people, animals, buildings and infrastructure, and significant natural features, having regard to the relevant ANZECC guidelines. | **Section 8.9.5.4** |

### 8.9.3 Existing Environment

The region surrounding the Project is described as a sparsely populated rural environment. **Table 8-54** presents a summary of the potentially sensitive receivers within the locality of the Project Area. **Figure 8-30** provides a locality plan showing the position of these receivers in relation to the Project.

*Table 8-54 Sensitive Receiver Locations*

| Receiver Locations | | | | |
|---|---|---|---|---|
| Receiver ID | Address | Receiver Type | Coordinates (GDA94/MGA55) | |
| | | | Easting | Northing |
| R1 | 1245 Burthong Road | Residential | 433606 | 6444043 |
| R2 | 688 Burthong Road | Residential | 434127 | 6444330 |
| R3 | 224 Burthong Road | Residential | 434809 | 6448305 |
| R4 | 39 Burthong Road | Residential | 435319 | 6450718 |
| R5 | Nymagee Village | Residential | 435485 | 6452163 |
| R6[1] | Mining Accommodation | Hera Mine Accommodation Village | 435210 | 6447568 |
| R18 | 2781 Balowra Road | Residential | 442772 | 6427557 |
| R19 | 2120 Burthong Road | Residential | 433736 | 6430509 |

Note 1: Project related receiver. Excluded from assessment.

It is noted that receiver R6 represents the Hera Mine mining accommodation village. Therefore, as the receiver is deemed to be Project related, it is excluded from further assessment.

### 8.9.4 Assessment Approach

The NVIA was undertaken with reference to the following guidelines and policies:

- Noise Policy for Industry (NPI) 2017;
- Voluntary Land Acquisition and Mitigation Policy (VLAMP) 2018;
- Road Noise Policy (RNP) 2011;
- Australian and New Zealand Environment Council (ANZEC) – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration; and
- Interim Construction Noise Guideline (ICNG) 2009.

#### 8.9.4.1 Assessment Criteria

*Operational Noise Criteria*

The Project Intrusive Noise Levels (PINL) are presented in **Table 8-55** and have been determined based on the minimum Rating Background Level (RBL) +5dBA and only applies to residential receivers. RBL is an overall single figure background level representing each assessment period (day, evening and night) over the noise monitoring period.

*Table 8-55 Project Intrusive Noise Levels*

| Receiver Type | Period[1] | Adopted RBL (dB LA90) | PINL (dB LAeq(15min)) |
|---|---|---|---|
| Residential | Day | 35 | 40 |
| | Evening | 30 | 35 |
| | Night | 30 | 35 |

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

The Project Amenity Noise Levels (PANL) is relevant to a specific land use or locality. PANL for residential receivers and other receiver types (i.e. non-residential) potentially affected by the Project are presented in **Table 8-56**.

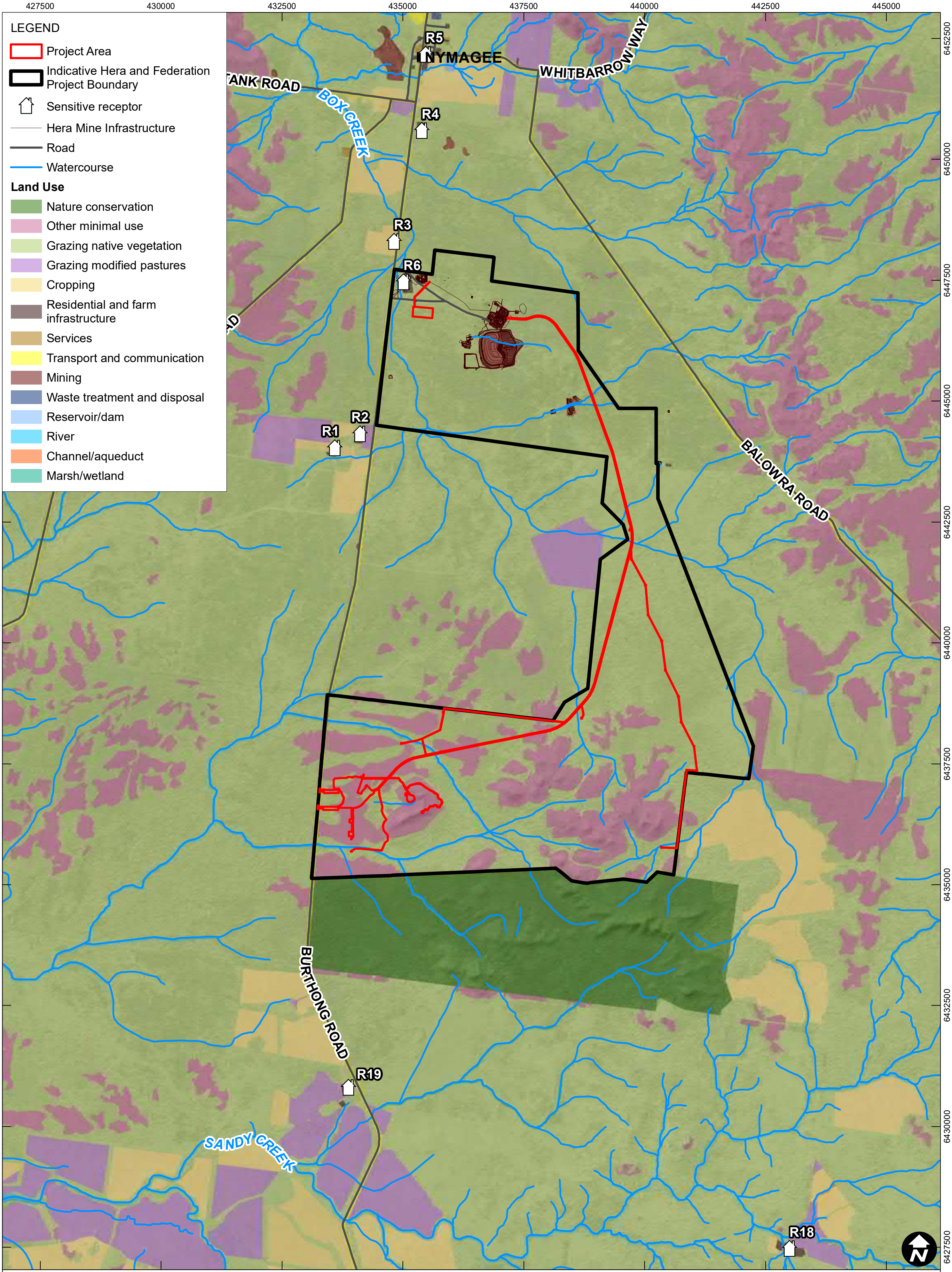
*Table 8-56 Project Amenity Noise Levels*

| Amenity Noise Levels and Project Amenity Noise Levels | | | | | |
|---|---|---|---|---|---|
| Receiver Type | Noise Amenity Area | Assessment Period[1] | NPI Recommended ANL dB LAeq(period) | ANL dB LAeq(period)[2] | PANL dB LAeq(15min)[3] |
| Residential | Rural | Day | 50 | 45 | 48 |
| | | Evening | 45 | 40 | 43 |
| | | Night | 40 | 35 | 38 |

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Project Amenity Noise Level equals the Amenity Noise Level -5dB as there is other industry in the area.

Note 3: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.




Scale: 1:100,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

H:\Projects-SLR\660-SrvWOL\660-WOL\660.30090.00000 Federation Project Approvals\06 SLR Data\01 CADGIS\GIS\SLR66030090_EIS_G8_SensitiveReceptors_002.mxd

SLR

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
Land Use © State Government of NSW and Department of Planning, Industry and Environment 2020

**SENSITIVE RECEPTOR LOCATIONS**

**FIGURE 8-30**

The Project Noise Trigger Levels are the lower of either the PINL or the PANL. **Table 8-57** presents the derivation of the PNTLs in accordance with the methodologies outlined in the NPI.

*Table 8-57 Project Noise Trigger Levels*

| Receiver Type | Noise Amenity Area | Assessment Period[1] | PINL dB LAeq(15min) | PANL dB LAeq(15min) | PNTL dB LAeq(15min) |
|---|---|---|---|---|---|
| Residential | Rural | Day | 40 | 48 | 40 |
| | | Evening | 35 | 43 | 35 |
| | | Night | 35 | 38 | 35 |

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

The potential for sleep disturbance from maximum noise level events from a Project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages. The maximum noise trigger levels shown in **Table 8-58** are based on night time RBLs and trigger levels as per Section 2.5 of the NPI. The trigger levels will be applied to transient noise events that have the potential to cause sleep disturbance.

*Table 8-58 Maximum Noise Trigger Level*

| Maximum Noise Trigger Level | | | |
|---|---|---|---|
| Residential Receivers | | | |
| LAeq(15min) | | LAmax | |
| 40dB LAeq(15min) or RBL + 5dB | | 52dB LAmax or RBL + 15dB | |
| Trigger | 40 | Trigger | 52 |
| RBL +5dB | 35 | RBL +15dB | 45 |
| **Highest** | **40** | **Highest** | **52** |

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays Night 10pm to 8am.

The Voluntary Land Acquisition Mitigation Policy (VLAMP) significance criteria applicable to the Project are presented in **Table 8-59.**

*Table 8-59 Voluntary Land Acquisition Mitigation Policy Criteria*

| VLAMP Project Specific Significance Criteria | | | | |
|---|---|---|---|---|
| Catchment | Period | PNTL dB LAeq(15min) | VLAMP Significant Impact Thresholds | |
| | | | Voluntary Acquisition[1] | Vacant Lands Acquisition[2] |

| | | | Recommended ANL dB LAeq(period) | PNTL+5dB<br>dB LAeq(15min) | Recommended ANL +5dB<br>dB LAeq(period) |
|---|---|---|---|---|---|
| All receivers | Day | 40 | 48 | 45 | 53 |
| | Evening | 35 | 43 | 40 | 48 |
| | Night | 35 | 38 | 40 | 43 |

Note 1: Voluntary acquisition rights where the Project Noise Level (PNL) exceeds the PNTL by more than 5dB.

Note 2: Project Noise Levels (PNL) exceed the relevant criteria on more than 25% for any privately-owned land parcels.

In accordance with the Road Noise Policy (RNP), the NVIA has adopted the 'Freeway/arterial/sub-arterial road' category for the designated inbound and outbound transport routes. This classification is for roads which support major regional and inter-regional traffic movement. This is consistent with the classification of the haulage route as a 'principal haulage route' and supporting inter-regional travel. Table 8-60 below reproduces the road traffic noise assessment criteria relevant for this road type.

In addition to the assessment criteria in **Table 8-60,** any increase in the total traffic noise level at a location due to a proposed traffic generating development must be considered. In accordance with Section 2.4 of the RNP, residences experiencing increases in total traffic noise above the relative increase criteria of Existing traffic LAeq(15hr) + 12dB should be considered for mitigation.

*Table 8-60 Road Noise Criteria*

| Road category | Type of Project/development | Assessment Criteria - dB(A) | |
|---|---|---|---|
| Freeway/arterial/sub-arterial road | Existing residences affected by additional traffic on existing freeways/sub-arterial/roads generated by land use developments | Day (7am to 10pm) | |
| | | 60dB(A) LAeq(15hr) | Night (10pm to 7am) |

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

The ANZEC blasting limits for air-blast overpressure and ground vibration are presented in **Table 8-61.**

*Table 8-61 ANZEC Blasting Limits*

| ANZEC Guideline Blasting Limits | | |
|---|---|---|
| | Overpressure<br>dB (Linear Peak) | Ground Vibration<br>PPV (mm/s) |
| Recommended Maximum (95% of all blasts) | 115 | 5 |
| Level not to be exceeded | 120 | 10 |
| Long term goal for ground vibration | N/A | 2 |

#### 8.9.4.2 Construction Noise Criteria

Noise Management Levels (NMLs) for construction activities for all residential receivers are 45dB LAeq(15min) (RBL +10dB). Construction activities are typically planned for standard hours, however, some activities may be required outside standard construction hours under exceptional circumstances. The relevant NMLs for standard construction hours and out of hours periods are summarised in **Table 8-62** below.

*Table 8-62 Noise Construction Management Levels*

| Location | Assessment Period | RBL dB LA90 | NML dB LAeq(15min) |
|---|---|---|---|
| All Residential Receivers | Day (Standard Hours) | 35 | 45 (RBL+10dBA) |
| | Evening (OOH Period 1) | 30 | 35 (RBL+5dBA) |
| | Night (OOH Period 2) | 30 | 35 (RBL+5dBA) |

*Department of Environment and Conservation (DEC) 2006, Assessing Vibration: A Technical Guideline (the 'Guideline')* provides guidance on determining effects of vibration on buildings occupants. The guideline does not address vibration induced damage to structures, blast induced vibration effects or structure borne noise effects. A qualitative assessment of potential vibration impacts has been completed. Due to the nature of the works proposed and distances to potential vibration sensitive receivers (i.e. more than 1.5 km to the nearest receivers to construction activities), vibration impacts from the construction of the Project would be negligible, and were not considered further in the assessment.

#### 8.9.4.3 Operational Modelling Methodology

A computer model was developed to quantify Project noise emissions to neighbouring receivers using DGMR (iNoise, Version 2021.1) noise modelling software. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The operational noise modelling considered the following activities as being noise generating:

- Movement of haul trucks from box cut and extraction area to the ROM Pad;
- Loading of A-double road trucks from ROM Pad by front-end loader, and haulage to Hera Mine;
- Operation of new process plant at Hera;
- Haulage of concentrate from the Hera Mine;
- Haulage of tailings from the Hera Mine to the Federation Site;
- Operation of the shotcrete batch plant and paste plant at the Federation Site;
- Backfilling of stopes from tailings paste plant located adjacent to stoping footprint;

- Operation of the surface extraction area[4] at the Federation Site;
- Use of power generator during the initial stages of the Federation Project; and
- Management of waste rock stockpiles from the lateral and vertical developments.

Additionally, a surface extraction area will be located to the east of the Federation Site infrastructure, with conventional drilling and blasting methods employed to excavate material. The existing and new processing plants are likely to operate simultaneously. Hence, the assessment has assumed both processing plants operating simultaneously as a worst-case scenario.

Mining activities will be undertaken 24 hours per day, however, surface extraction area activities and transportation of ore and tailings between Federations Site and Hera Mine will occur during daylight hours (7 am to 7 pm) only.

*Metrological Conditions*

Noise emissions from industry can be significantly affected by prevailing weather conditions. Wind has the potential to increase noise at a receiver when it is at low velocities and travels from the direction of the noise source. To determine the prevailing conditions for the Project, weather data during the period September 2017 to September 2019 was obtained from the Bureau of Meteorology Cobar Airport Automatic Weather Station (AWS). The data was analysed using the EPA's Noise Enhancement Wind Analysis (NEWA) program in order to determine the frequency of occurrence of winds speeds up to 3 m/s in each seasonal period.

A wind analysis was undertaken which includes the dominant wind direction and percentage occurrence during each season for each assessment period. Based on the results of this analysis, prevailing winds are not applicable for the assessment and the relevant meteorological conditions adopted for the assessment are summarised in **Table 8-63**.

*Table 8-63 Modelled Site-Specific Meteorological Parameters*

| Assessment Condition | Temperature | Wind Speed /Direction | Assessment Condition | Temperature |
|---|---|---|---|---|
| Daytime - Calm | 25°C | 0.5m/s / all directions | 50% | D |
| Evening - Calm | 15°C | 0.5m/s / all directions | 60% | D |
| Night - Inversion | 5°C | 1.0m/s / all directions | 70% | G |

#### 8.9.4.4 Road Noise Assessment Methodology

The United States (US) Environment Protection Agency's road traffic calculation method is used to predict the LAeq noise levels from Project related trucks travelling past existing receivers adjacent to the haul routes. This method is an internationally accepted theoretical traffic noise prediction model and is ideal for calculating road traffic noise where relatively small traffic flows are encountered. The proposed haulage routes and

[4] Referred to as 'quarry' in the NVIA

corresponding traffic volumes were sourced from the Traffic Impact Assessment prepared by Transport Planning Partnership (TTPP) for the Project and included as **Appendix C.**

A review of aerial imagery was undertaken to identify the nearest residential receivers to the carriageway along each of the haulage routes. The closest offset distances are provided in **Table 8-64**.

*Table 8-64 Closest Offset Distance – Road Traffic Assessment*

| Road | Receiver ID | Address | Offset Distance (m) |
|---|---|---|---|
| Federation Site to Hera Mine | | | |
| Burthong Road | R1 | 1245 Burthong Road, Nymagee | 750m |
| Burthong Road | R2 | 688 Burthong Road, Nymagee | 260m |
| Hera Mine to Peak Gold Mine | | | |
| Burthong Road | R3 | 224 Burthong Road, Nymagee | 75m |
| Burthong Road | R4 | 39 Burthong Road, Nymagee | 110m |
| Priory Tank Road | N/A | 2082 Glenwood Road, Nymagee | 25m |
| Kidman Way | N/A | 5826 Wallace Vale Road, Nymagee | 220m |
| Hera Mine to Hermidale Rail Siding | | | |
| Burthong Road | R3 | 224 Burthong Road, Nymagee | 75m |
| Hartwood Street | R5 | 2 Grahams Street, Nymagee | 25m |
| Nymagee – Hermidale Road | N/A | 15 Nymagee Street, Hermidale | 15m |

#### 8.9.4.5 Construction Noise Modelling Scenarios

The Project will involve site establishment and installation of surface infrastructure at the Federation Site, amendments to infrastructure at Hera Mine, and the construction of a Services Corridor between the Federation Site and Hera Mine.

Based on the Project activities, the following modelling scenarios were adopted for the assessment:

- Scenario 1 - (Federation Site) – Site establishment;
- Scenario 2 - Construction of Services Corridor between the Federation Site and Hera Mine; and
- Scenario 3 - (Hera Mine) – Construction of solar farm and construction and installation of new processing plant.

It is anticipated that construction activities will typically be undertaken during daylight hours over a period of six to twelve months. It is noted that some activities, including long concrete pours for the new processing plant at Hera Mine and the paste plant at the Federation Site may occur during out of hours work periods.

### 8.9.5 Predicted Impacts

#### 8.9.5.1 Operational Noise Results

The predicted noise levels for the operation of the Project at each receiver location are provided in **Table 8-65**. The results are presented separately for the Federation Site and the Hera Mine, as well as the cumulative noise levels from the two sites. It is predicted that operational noise levels will be below the applicable noise criteria at all receivers.

*Table 8-65 Predicted Operational Noise Levels*

| Receiver | Period[1] | Noise Level, dB LAeq(15min) | | | PNTL |
|---|---|---|---|---|---|
| | | Federation Site | Hera Mine | Cumulative | |
| R1 | Day (Calm) | <30 | <30 | <30 | 40 |
| | Evening (Calm) | <30 | <30 | <30 | 35 |
| | Night (Inversion) | <30 | <30 | <30 | 35 |
| R2 | Day (Calm) | <30 | <30 | <30 | 40 |
| | Evening (Calm) | <30 | <30 | <30 | 35 |
| | Night (Inversion) | <30 | <30 | <30 | 35 |
| R3 | Day (Calm) | <30 | 34 | 34 | 40 |
| | Evening (Calm) | <30 | <30 | <30 | 35 |
| | Night (Inversion) | <30 | <30 | <30 | 35 |
| R4 | Day (Calm) | <30 | <30 | <30 | 40 |
| | Evening (Calm) | <30 | <30 | <30 | 35 |
| | Night (Inversion) | <30 | <30 | <30 | 35 |
| R5 | Day (Calm) | <30 | <30 | <30 | 40 |
| | Evening (Calm) | <30 | <30 | <30 | 35 |
| | Night (Inversion) | <30 | <30 | <30 | 35 |
| R18 | Day (Calm) | <30 | <30 | <30 | 40 |
| | Evening (Calm) | <30 | <30 | <30 | 35 |
| | Night (Inversion) | <30 | <30 | <30 | 35 |

| | | | | | |
|---|---|---|---|---|---|
| R19 | Day (Calm) | <30 | <30 | <30 | 40 |
| | Evening (Calm) | <30 | <30 | <30 | 35 |
| | Night (Inversion) | <30 | <30 | <30 | 35 |

#### 8.9.5.2 Maximum Noise Level Assessment

In assessing the potential for sleep disturbance, a typical LAmax noise source of 117dB was used to represent transient events from the dumping of material from haul truck to NAF and PAF waste rock storage areas, and material handling at the Hera Mine processing plant, to the nearest residential receivers, under G Class stability conditions (i.e. worst case).

The results of the analysis identify that maximum noise trigger levels will not be exceeded for all residential receivers, hence no further assessment or detailed analysis is required. Predicted noise levels from LAmax events are presented in **Table 8-66.**

*Table 8-66 Predicted Maximum Noise Levels*

| Receiver | Period | Noise Predictions dB LAmax | Trigger Level dB LAmax |
|---|---|---|---|
| R1 | Night | <30 | 52 |
| R2 | | <30 | 52 |
| R3 | | <30 | 52 |
| R4 | | <30 | 52 |
| R5 | | <30 | 52 |
| R18 | | <30 | 52 |
| R19 | | <30 | 52 |

The results of the operational noise assessment demonstrate that noise emissions associated with the operation of the Project would not exceed the PNTL at any of the assessed receiver locations. Therefore, as per the VLAMP definitions, there are no receivers that fall under voluntary acquisition rights.

#### 8.9.5.3 Traffic Noise Results

The results of the traffic noise calculations for operational road traffic volumes are presented in Table 8-67 for the closest residential receivers to the road along each of the haul routes. The traffic noise contribution from the Project is predicted to remain below the assessment criteria at dwellings adjacent to the haulage routes.

*Table 8-67 Operational Road Traffic Noise Levels – Residential Receivers*

| Receiver | Offset Distance (m) | Assessment Criteria[1] | Traffic Noise dB LAeq(period) | | |
|---|---|---|---|---|---|
| | | | Existing Traffic Noise | Future Traffic Noise | Total Change |
| Federation Site to Hera Mine | | | | | |
| 1245 Burthong Rd (R1) | 750m | Day 60 dB LAeq(15hr) | 10.3 | 14.6 | +4.3dB |
| 688 Burthong Rd (R2) | 260m | | 19.4 | 25.3 | +6.9dB |
| Hera Mine to Peak Gold Mine | | | | | |
| 224 Burthong Rd (R3)[2] | 75m | Day 60 dB LAeq(15hr) | 30.8 | 36.4 | +5.6dB |
| 39 Burthong Road (R4) | 110m | | 27.0 | 32.6 | +5.6dB |
| 2082 Glenwood Rd | 25m | | 38.9 | 44.2 | +5.3dB |
| 5826 Wallace Vale Rd | 220m | | 24.7 | 25.9 | +1.2dB |
| Hera Mine to Hermidale Rail Siding | | | | | |
| 2 Grahams St (R5) | 25m | Day 60 dB LAeq(15hr) | 42.1 | 45.0 | +2.9dB |
| 15 Nymagee St | 15m | | 56.3 | 57.3 | +1.0dB |

#### 8.9.5.4 Blasting Results

Blast overpressure and vibration have been calculated to the nearest receivers to the Federation Site, adopting a maximum probable MIC of up to 50kg for surface blasting within the surface extraction area. Additionally, ground vibration from underground blasting with a maximum probable MIC of up to 450 kg has been considered.

Calculated levels for overpressure and vibration have been compared to the relevant ANZECC criteria and are presented in **Table 8-68**. Results identify surface blasts of MICs up to 50 kg and underground blasts of MICs up to 450 kg would satisfy relevant ANZEC overpressure and vibration criteria.

*Table 8-68 Blasting Emissions*

| Receiver ID | Distance to Charge (m) | Surface Blasting | Underground Blasting | |
|---|---|---|---|---|
| | | Airblast Overpressure dBZ Peak | Ground Vibration mm/s | Ground Vibration mm/s |
| R1 | 6,890 | 87 | 0.02 | 0.11 |
| R2 | 7,160 | 86.5 | 0.02 | 0.10 |
| R3 | 11,160 | 81.0 | 0.01 | 0.05 |
| R4 | 13,605 | 78.5 | 0.01 | 0.04 |
| R5 | 15,060 | 77.2 | 0.01 | 0.03 |
| R18 | 12,955 | 79 | 0.01 | 0.04 |
| R19 | 6,670 | 87.5 | 0.02 | 0.19 |

#### 8.9.5.5 Construction Phase Noise Results

The results of the analysis show that noise emissions from construction activities are predicted to satisfy the relevant noise management levels at all receiver locations during standard and out of hours construction periods as shown below in **Table 8-69.**

*Table 8-69 Predicted Construction Phase Noise Levels*

| Predicted Construction Phase Noise Levels | Predicted Noise Level, dB LAeq(15min) | | | NML, dB LAeq(15min) | | | Compliant |
|---|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | OOHW | Standard Hours | Out of Hours | |
| R1 | <30 | <30 | <30 | <30 | 45 | 35 | ✓ |
| R2 | <30 | <30 | 30 | <30 | 45 | 35 | ✓ |
| R3 | <30 | <30 | 30 | <30 | 45 | 35 | ✓ |
| R4 | <30 | <30 | <30 | <30 | 45 | 35 | ✓ |
| R5 | <30 | <30 | <30 | <30 | 45 | 35 | ✓ |
| R18 | <30 | <30 | <30 | <30 | 45 | 35 | ✓ |
| R19 | <30 | <30 | <30 | <30 | 45 | 35 | ✓ |

### 8.9.6 Mitigation and Management Measures

As described in **Section 8.9.5,** noise and vibration levels are predicted to meet the relevant noise and vibration criteria and no further mitigation measures are required, to proactively address any potential residual noise impacts. Never-the-less a noise management plan (NMP) may be considered for the Project that would guide, manage, quantify and control noise emissions through the implementation of feasible and reasonable best management practices. These may include:

- Strictly adhering to the proposed hours of operation;
- Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area;
- Keeping equipment well maintained and operating it in a proper and efficient manner;
- Employing ‘quiet’ practices when operating equipment, for example, positioning idling trucks in appropriate areas;
- Running staff-education programs and regular toolbox talks on the effects of noise and the use of quiet work practices; and
- Maintain roads to ensure a smooth surface to reduce the incidence of impact noise including body rattles.

The NMP may also address the use of best available technology including alternatives to tonal reversing alarms and efficient muffler design.

#### 8.9.6.1 Noise Monitoring

The NMP would include a provision for attended noise monitoring within the community in response to received complaints if they arise. The operator attended noise measurements and recordings would be conducted to quantify noise emissions from the Project, as well as the overall level of ambient noise.

When required, the operator would quantify and characterise the energy equivalent (LAeq) intrusive noise level from the Project over a 15-minute measurement period. In addition, the operator would quantify and characterise the overall levels of ambient noise over the 15 minute measurement interval.

All acoustic instrumentation used as part of the attended monitoring program must be designed to comply with the requirements of AS IEC 61672.1-2019, Electroacoustics - Sound level meters -Specifications and would have current calibration certificates. All instrumentation would be programmed to record statistical noise level indices in 15-minute intervals including LAmax, LAmin and LAeq.

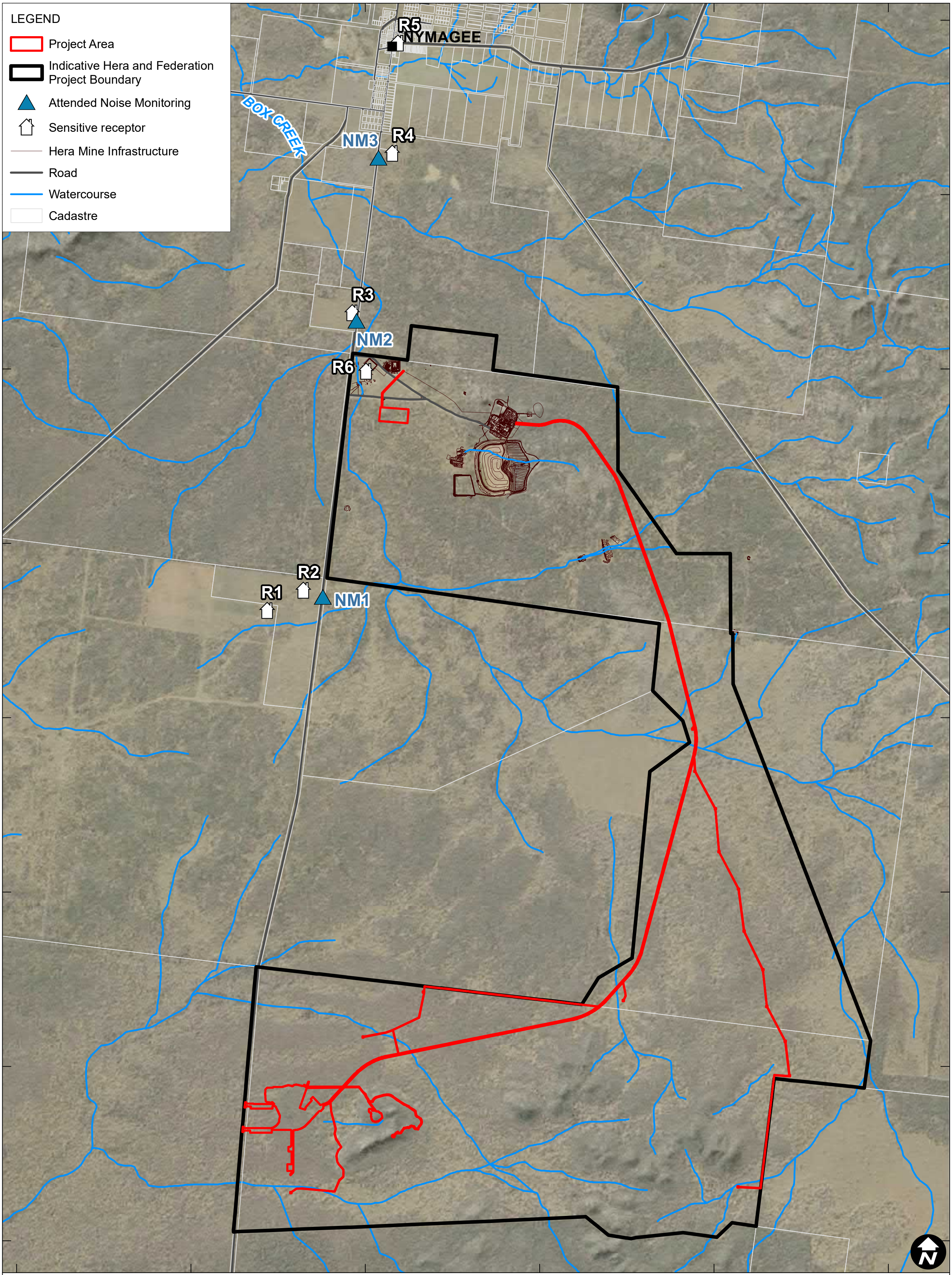
Provided in **Figure 8-31** below are the locations of attended noise monitoring which is undertaken as required.

### 8.9.7 Conclusion

A NVIA was prepared by MAC to determine the potential impact of the Project to identified sensitive receivers. The assessment quantified potential construction noise emissions associated with site establishment and construction of new infrastructure, and operational noise emissions associated with mining operations, material handling and transport operations.

The results of the NVIA concluded that operational noise levels would achieve the relevant NPI criteria for all assessment periods at each assessed receiver location. The assessment considered operations at both the Federation Site and the Hera Mine, including the simultaneous operation of the existing and new processing plants.

The road traffic noise assessment demonstrates that the road noise criteria as specified in the RNP will be satisfied for the nearest residential receivers adjacent to each of the proposed haul routes. It is noted that haulage vehicle movements are restricted to the day period only.




Scale: 1:70,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

H:\Projects-SLR\660-SrvWOL\660-WOL\660.30090.00000 Federation Project Approvals\06 SLR Data\01 CADGIS\GIS\SLR66030090_EIS_G38_AttendedNoiseMonitoring_001.mxd

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020

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**CURRENT ATTENDED NOISE MONTORING LOCATIONS**

**FIGURE 8-31**

Airblast overpressure and ground vibration levels are predicted to meet the criteria at all assessed receivers for surface blasts for the maximum probable MIC of 50 kg during surface extraction area activities. Additionally, ground vibration levels are predicted to meet the criteria at all assessed receivers for the maximum probable MIC of 450 kg for underground blasting.

## 8.10 Air Quality

### 8.10.1 Introduction

An Air Quality Impact Assessment (AQIA) was prepared by ERM and is included as **Appendix N**. The AQIA has been prepared to determine the potential impacts to air quality resulting from the construction and operation of the Project. The assessment was prepared following the procedures outlined in the NSW EPA document titled "*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*" (Approved Methods) (NSW EPA, 2016).

### 8.10.2 Assessment Requirements

The SEARs issued relating to the air quality impacts and where they have been addressed are identified in **Table 8-70.**

*Table 8-70 Air Quality SEARs Requirements*

| SEARs Requirement | Reference |
|---|---|
| An assessment of the likely air quality impacts of the development, including cumulative impacts from nearby developments, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016), and having regard to the NSW Government's Voluntary Land Acquisition and Mitigation Policy. | **Section 8.10.3**<br>**Section 8.10.6** |
| Demonstrated ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the Protection of the Environment Operations (Clean Air) Regulation 2010. | **Section 8.10.3**<br>**Section 8.10.3.1** |
| Identification of strategies to minimise point and/or fugitive and/or odour emissions/impacts (with proposed timing), including monitoring, in line with relevant guidance/standards. | **Section 8.10.5**<br>**Section 8.10.7** |
| An assessment of the likely greenhouse gas impacts of the development. | **Section** 8.11 |
| A description of the feasibility of measures that would be implemented to monitor and report on the emissions (including fugitive dust and greenhouse gases) of the development. | **Section 8.10.7** |

### 8.10.3 Impact Assessment Criteria

Air quality impact criteria in NSW are derived from the adopted National Environmental Protection (Ambient Air Quality) Measure (AAQ NEPM) which provides a national standard for six criteria pollutants (National Environment Protection Council, 2016). This has recently been reviewed, with criteria for Particulate Matter $_{2.5}$ ($PM_{2.5}$) being reduced to 7 µg/m$^3$ annual average and 20 µg/m$^3$ 24-hour respectively. This is yet to be adopted; however, it has been included in **Table 8-71** for completeness, providing a more rigorous assessment.

*Table 8-71 NSW Impact assessment criteria and pending NEPM AQ standards*

| Pollutant | Maximum concentration | | Averaging Period |
|---|---|---|---|
| | Criterion (NSW EPA, 2016) | Pending NEPM AAQ standards | |
| Total Suspended Particles (TSP) | 90 µg/m$^3$ | No change | Annual |
| $PM_{10}$ | 25 µg/m$^3$ | No change | Annual |
| | 50 µg/m$^3$ | | 24-hour |
| $PM_{2.5}$ | 8 µg/m$^3$ | 7 µg/m$^3$ | Annual |
| | 25 µg/m$^3$ | 20 µg/m$^3$ | 24-hour |

Table 8-72 below shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust fallout levels are set to protect against nuisance impacts (NSW EPA, 2016).

*Table 8-72 NSW EPA air quality criteria for deposited dust*

| Pollutant | Averaging period | Maximum increase in deposited dust level | Maximum total deposited dust level |
|---|---|---|---|
| Deposited dust | Annual | 2 g/m$^2$/month | 4 g/m$^2$/month |

Note: g/m$^2$/month = grams per square metre per month.

#### 8.10.3.1 Voluntary Land Acquisition and Management Policy (VLAMP)

The VLAMP relates to mining, petroleum production and extractive industries and includes the identification of voluntary mitigation and land acquisition criteria for air quality and noise and is identified within the Mining SEPP at Clause 12A. The VLAMP sets out voluntary mitigation and land acquisition rights where it is not possible to comply with the NSW EPA impact assessment criteria even with the implementation of all reasonable and feasible avoidance and/or mitigation measures.

The DPIE voluntary mitigation and acquisition criteria are summarised in **Table 8-73** and **Table 8-74** respectively. The Project has been assessed against these criteria, in addition to the NSW EPA impact assessment criteria stated above.

*Table 8-73 DPIE Particulate Matter Mitigation Criteria*

| Pollutant | Criterion | Averaging Period | Application |
|---|---|---|---|

| | | | |
|---|---|---|---|
| $PM_{2.5}$ | 8 µg/m$^3$<br>25 µg/m$^3$ | Annual<br>24-hour | Total impact*<br>Incremental impact** |
| $PM_{10}$ | 25 µg/m$^3$<br>50 µg/m$^3$ | Annual<br>24-hour | Total impact*<br>Incremental impact** |
| TSP | 90 µg/m$^3$ | Annual | Total impact |
| Deposited dust | 2 g/m$^2$/month<br>4 g/m$^2$/month | Annual<br>Annual | Incremental impact**<br>Total impact* |

Notes:

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources)

**Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.

*Table 8-74 DPIE Particulate Matter Acquisition Criteria*

| Pollutant | Criterion | Averaging Period | Application |
|---|---|---|---|
| $PM_{2.5}$ | 8 µg/m$^3$<br>25 µg/m$^3$ | Annual<br>24-hour | Total impact*<br>Incremental impact** |
| $PM_{10}$ | 25 µg/m$^3$<br>50 µg/m$^3$ | Annual<br>24-hour | Total impact*<br>Incremental impact** |
| TSP | 90 µg/m$^3$ | Annual | Total impact |
| Deposited dust | 2 g/m$^2$/month<br>4 g/m$^2$/month | Annual<br>Annual | Incremental impact**<br>Total impact* |

Notes:

* Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources)

**Incremental impact (i.e. increase in concentrations due to the development alone), with up to five allowable exceedances of the criteria over the life of the development.

Voluntary acquisition rights apply where the Project contributes to exceedances of the acquisition criteria at any residence or workplace on privately-owned land, or, on more than 25% of any privately-owned land, and a dwelling could be built on that land under existing planning controls.

At Clause 12AB(4), the Mining SEPP also sets a non-discretionary development standard of cumulative annual average $PM_{10}$ concentration for private dwellings of 30 µg/m3.

In summary the Project's potential for impacts associated with air quality have been assessed against all relevant criteria, with draft criteria also considered where relevant to provide a thorough assessment.

### 8.10.4 Existing Environment

#### 8.10.4.1 Sensitive Receivers

Sensitive receivers within the immediate vicinity of the Hera Mine and along haul routes between the Federation Site and Hera Mine are identified in **Figure 8-30**. The closest sensitive receivers to Hera Mine are receivers R3 and R2/R1, which are located approximately 2.5 km north west of the mine infrastructure area and 3.0 – 3.5 km south west of the mine infrastructure area, respectively. The closest receiver to the Federation Site is R19 which is located approximately 5.5 km south.

#### 8.10.4.2 Dispersion Meteorology

The primary meteorological parameters influencing plume dispersion for ground based, non-buoyant sources are wind direction and wind speed.

The closest BoM meteorological station to the Project is the Cobar MO Automatic Weather Station (AWS) 048027, located approximately 90 km to the northwest. Due to concerns regarding the validity of weather data recorded at Hera Mine in terms of wind direction, BoM data was used for the assessment. The Cobar MO AWS data has still been used to understand the inter-annual variability meteorological data. Annual wind roses from the previous six years confirmed that the wind direction was predominantly from the south/south west and east. As would be expected there is seasonal and annual variations in the data. **Table 8-75** presents the average wind speeds and percentage calms showing that the average wind speed is consistent across all analysed years. Taking into consideration the annual and seasonal wind roses, the average wind speeds and percentage calms, it was considered that 2017 was the representative year for modelling.

*Table 8-75 Average Wind Speeds and Percentage Calms at Cobar MO AWS from 2015 to 2020*

| Year | Average wind speed (m/s) | Calms (%) |
|---|---|---|
| 2015 | 3.8 | 0.2 |
| 2016 | 3.7 | 0.5 |
| 2017 | 3.8 | 0.3 |
| 2018 | 3.9 | 0.3 |
| 2019 | 3.8 | 1.2 |
| 2020 | 3.7 | 0.4 |
| Period average | 3.8 | 0.5 |

With the meteorological year chosen, meteorological modelling was first undertaken using the Weather Research and Forecasting model (WRF). WRF is a three-dimensional numerical meteorological model which can be used to generate three-dimensional gridded meteorological data through the treatment and assimilation of available surface/upper air/precipitation observations in addition to very specific and local land use characteristics.

Through the post processing as described in Section 4.2.7 of the AQIA, annual and season wind roses were produced which are provided in **Figure 8-32** and **Figure 8-33** below.

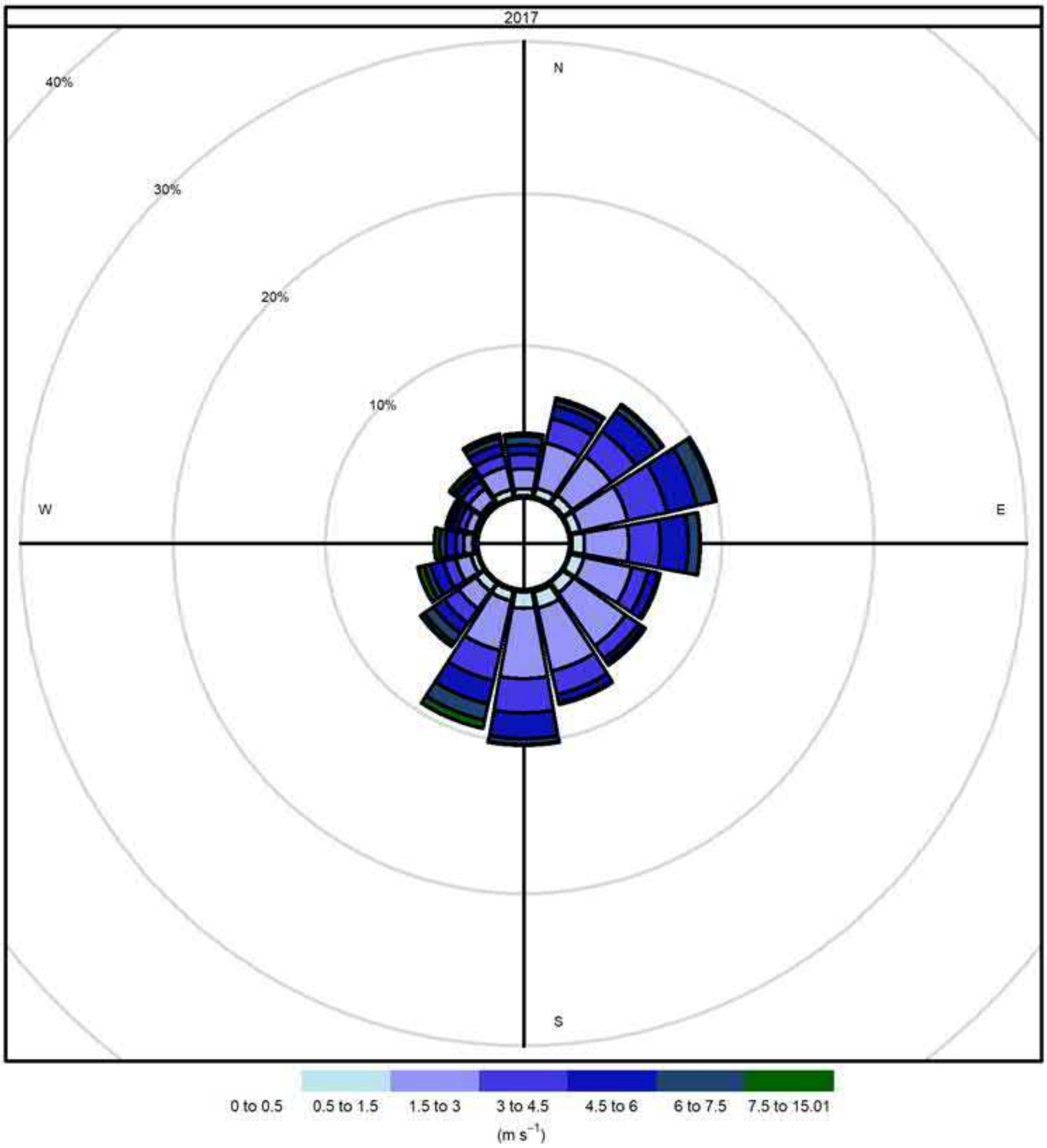



*Figure 8-32   Annual Wind Rose for WRF Output for 2017*

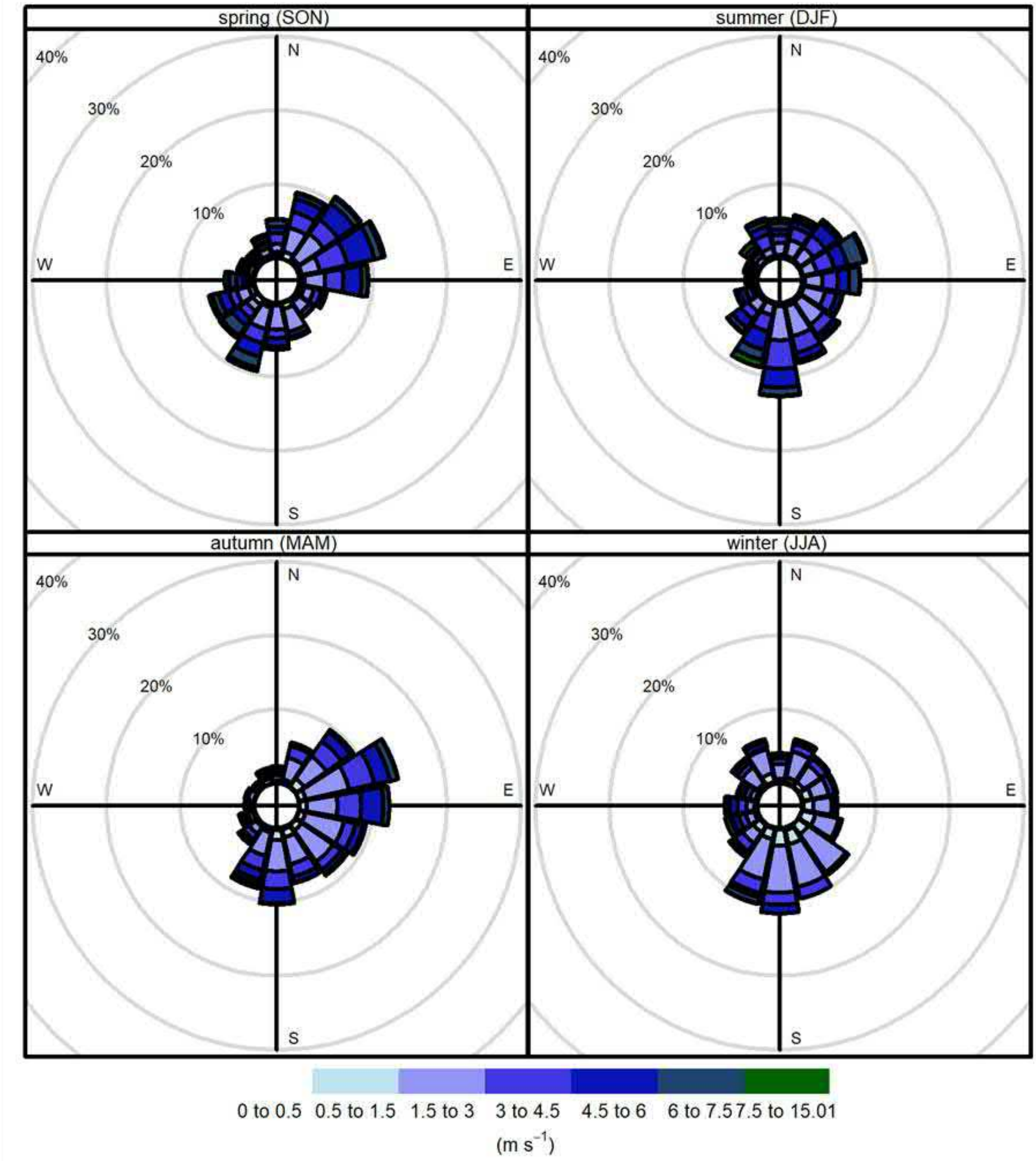
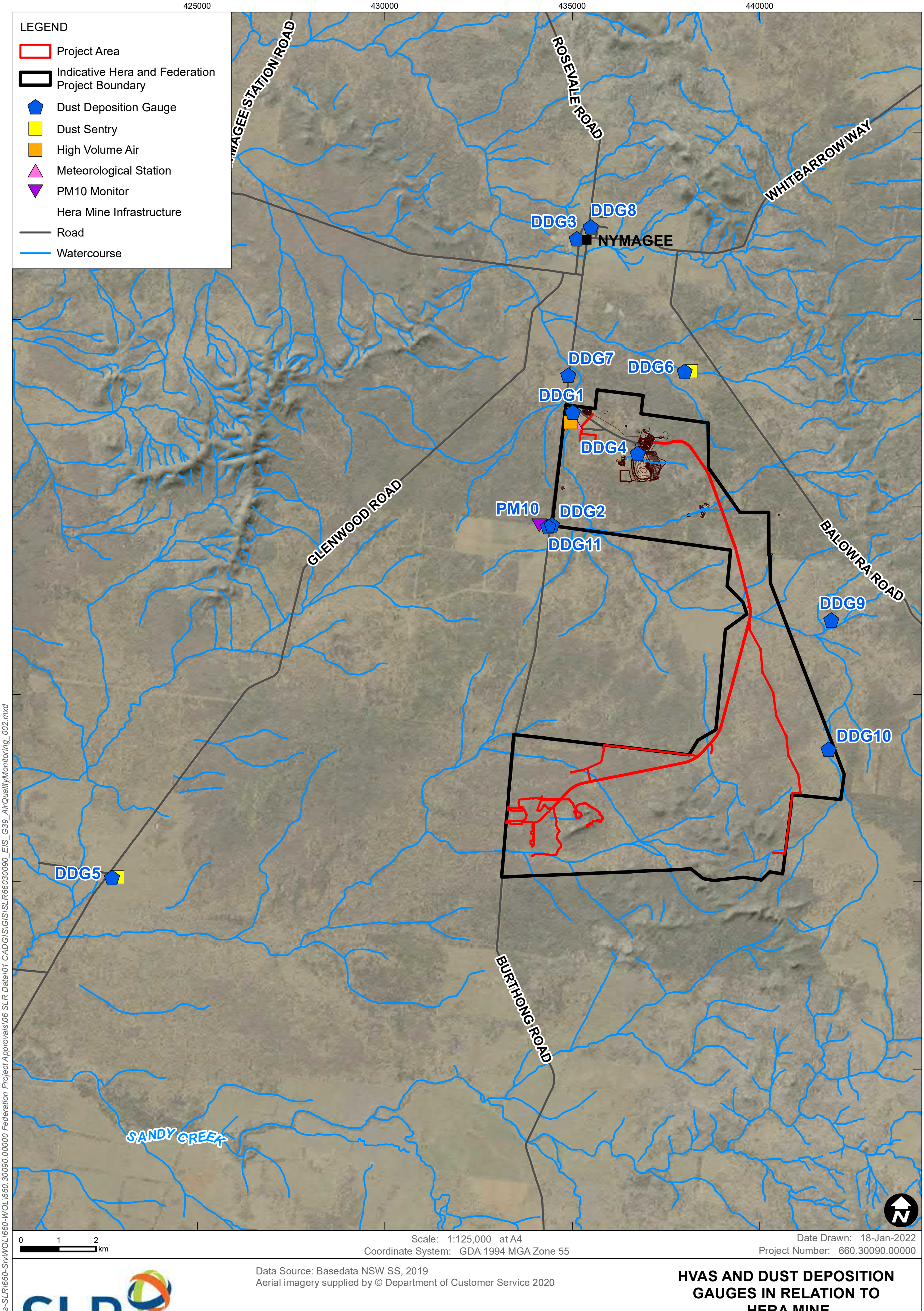



*Figure 8-33 Seasonal Wind Rose for WRF Output for 2017*

### 8.10.4.3 Existing Air Quality

Hera Mine has one High Volume Air Sampler (HVAS), which measures Total Suspended Particles (TSP) and $PM_{10}$ concentrations, along with two dust deposition gauges. Each of these instruments are located within the mine site in proximity to the haul road, and therefore cannot be used to establish background concentrations. The location of the HVAS and dust deposition gauges is provided in **Figure 8-34** below.




Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020

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**HVAS AND DUST DEPOSITION GAUGES IN RELATION TO HERA MINE**

**FIGURE 8-34**

In the absence of site-specific or local data, a review of all regional data from the DPIE's rural monitoring stations located in Tamworth, Bathurst, Albury and Wagga Wagga North was undertaken. These monitoring locations, whilst rural, are located within urbanised areas and are therefore likely to have higher PM (particularly $PM_{2.5}$) results than that experienced in the study area. Consequently, once Project PM emissions are added to the background the results are likely to be artificially higher, as discussed further below.

Provided in **Table 8-76** below is a summary of background air quality data obtained from the DPIE rural monitoring stations.

*Table 8-76 Annual Average $PM_{10}$ Concentrations at DPIE Stations from 2015 to 2020*

| Year | Tamworth (µg/m³) | Albury (µg/m³) | Bathurst (µg/m³) | Wagga Wagga Nth (µg/m³) | All sites average (µg/m³) | Criterion (µg/m³) |
|---|---|---|---|---|---|---|
| 2015 | 14.1 | 14.6 | 13.4 | 19.9 | 15.5 | 25 |
| 2016 | 15.3 | 15.1 | 13.3 | 20.6 | 16.1 | |
| 2017 | 15.3 | 15.8 | 14.1 | 20.6 | 16.5 | |
| 2018 | 20.1 | 19.8 | 18.8 | 27.4 | 21.5 | |
| 2019 | 33.7 | 23.4 | 27.4 | 35.3 | 30.0 | |
| 2020 | 16.8 | 20.1 | 17.0 | 23.2 | 19.3 | |
| **Period Average (excluding 2019)** | **16.2** | **16.3** | **14.9** | **22.1** | **17.8** | |
| **Period Average (2015-2020)** | **19.2** | **18.1** | **17.3** | **24.5** | **19.8** | |

The highest annual average concentration for all the DPIE stations was recorded in 2019. Years 2018 and 2019 were affected by higher prevalence of both dust storms and bushfires leading to higher annual average concentrations. The year 2019 was highly affected by intense bushfires during the last quarter of the year. The year 2020 was affected by the bushfires from 2019 during the first months of the year.

The annual average $PM_{10}$ concentration across all four data sets for 2017 is 16.5µg/m³ and has been adopted as a conservative representation of the annual average $PM_{10}$ background for the assessment. This value is deemed representative of a regional -rural location such as the Project Site. As previously stated, given the small population of Nymagee compared to the large regional towns from where this data is obtained, this dataset is deemed to be a conservative estimation of background $PM_{10}$, even when considering the more arid environment within the Project locality.

Table 8-77 presents the annual average $PM_{2.5}$ concentrations recorded at DPIE monitoring stations at Tamworth, Albury, Bathurst, and Wagga Wagga North monitoring stations from 2015 to 2020.

*Table 8-77 Annual Average PM2.5 Concentrations at DPIE Stations from 2015 to 2020*

| Year | Tamworth (µg/m³) | Albury (µg/m³) | Bathurst (µg/m³) | Wagga Wagga Nth (µg/m³) | All sites average (µg/m³) | Criterion |
|---|---|---|---|---|---|---|
| 2015 | No data | No data | No data | 7.6 | 7.6 | 8 |
| 2016 | 7.6 | No data | 5.9 | 7.4 | 7.0 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2017 | 7.8 | 7.3 | 6.1 | 8.1 | 7.3 | |
| 2018 | 8.3 | 7.3 | 7.0 | 8.4 | 7.8 | |
| 2019 | 14.4 | 10.1 | 11.3 | 11.3 | 11.8 | |
| 2020 | 6.8 | 11.1 | 7.6 | 10.7 | 9.1 | |
| **Period Average (excluding 2019)** | **7.6** | **8.6** | **6.7** | **8.4** | **7.8** | |
| **Period Average (2015-2020)** | **9.0** | **9.0** | **7.6** | **8.9** | **8.6** | |

The annual average of $PM_{2.5}$ for all sites was highest in 2019, similar to that reported for $PM_{10}$ , resulting from wide spread bushfires across NSW. The year 2020 was affected by the bushfires from 2019 and was also affected by the COVID outbreak during the next three quarters of the year.

When excluding 2019, the combined average is reduced to 7.8 µg/m$^3$. The combined average when excluding both the exceptional years 2019 and 2020, is 7.4 µg/m$^3$. This is also similar to the combined average for 2017 which is 7.3 µg/m$^3$. The value of 7.3 µg/m$^3$ is therefore likely to be more representative of the annual average $PM_{2.5}$ concentration for a regional -rural location such as the Project Site.

The 24-hour $PM_{2.5}$ background dataset was developed by taking an average of all four regional DPIE stations for every day of the modelled year (2017) to develop a daily varying profile for that year.

A common approach to estimating TSP background values has been applied using the assumption that ~40% of TSP comprises $PM_{10}$. This assumption is based on long term monitoring data where co-located TSP and $PM_{10}$ monitors have been operated (NSW Minerals Council, 2000). Using this approach and based on the assumption that background annual average $PM_{10}$ concentrations are 16.5 µg/m$^3$, it assumed that background annual average TSP concentrations are thus 41 µg/m$^3$.

As the on-site dust deposition gauges will not be used to provide background concentrations, it is assumed that existing annual dust deposition rates are 2.0 g/m$^2$/month, which is typical of arid rural areas.

#### 8.10.4.4 Summary

A summary of the adopted background criteria and relevant assessment criteria is provided in **Table 8-78**.

*Table 8-78 Adopted Background Concentrations and Assessment Criteria*

| Air Quality Parameter | Averaging Period | Adopted Background Concentration | Cumulative NSW EPA Assessment Criteria |
|---|---|---|---|
| TSP | Annual | 41 µg/m$^3$ | 90 µg/m$^3$ |
| $PM_{10}$ | Annual | 16.5 µg/m$^3$ | 25 µg/m$^3$ |
| | 24-hour | Daily varying | 50 µg/m$^3$ |
| $PM_{2.5}$ | Annual | 7.3 µg/m$^3$ | 8 µg/m$^3$ |
| | 24-hour | Daily varying | 25 µg/m$^3$ |

| | | | |
|---|---|---|---|
| Dust deposition | Annual | 2 g/m$^2$/month | 2 g/m$^2$/month*<br>4 g/m$^2$/month |

It is noted that the goals for $PM_{2.5}$ have recently been adopted in the NEPM, reducing from 25 µg/m$^3$ to 20 µg/m$^3$ for the maximum 24-hour average and from 8 µg/m$^3$ to 7 µg/m$^3$ for annual average. They are not yet adopted into the Approved Methods as assessment criteria, but are noted here for completeness.

### 8.10.5 Assessment Approach

The air dispersion modelling conducted for the AQIA represents an advanced modelling system using the AERMET/AERMOD modelling scheme. AERMOD is the American Meteorological Society/Environmental Protection Agency Regulatory Model and AERMET is the meteorological data pre-processor. AERMOD was chosen as a suitable dispersion model due to the source type, location of nearest receiver and nature of local topography.

The focus of the assessment was the ore production rates and the corresponding tailings and concentrate production. Analysis of the data identified financial year 2028 (FY28) had the highest quantities of ore mined (and therefore also highest quantities of tailings and concentrate) and therefore was the focus on the air quality assessment.

Emission sources were determined through consideration of activities undertaken at both the Hera Mine and Federation Site for the worst-case year, FY28. Conservatively, the air quality emission estimation assumed concurrent operation of the following which are the major dust generating activities:

- Transportation of material from the Federation Site to the Hera Mine along the sealed Burthong Road;
- Processing of Federation deposit ore at the processing plant at Hera Mine;
- Disposal of approximately 40% of the tailings at the Hera Mine TSF;
- Transportation of approximately 60% of the tailings to the Federation Site for paste backfill of underground stopes; and
- Transportation of concentrate to Hermidale Siding via Hermidale Nymagee Road.

A detailed emission inventory was prepared for the assessment and is included as Appendix B of the AQIA.

Emission rates of TSP, $PM_{10}$ and $PM_{2.5}$ were calculated using emission factors developed both within NSW and by the United States Environmental Protection Agency (US EPA). Modelling was completed for three particle size categories; TSP, $PM_{10}$ and $PM_{2.5}$. The particle mass mean diameters were determined from particle size distribution data for various mining activities (presented in (SPCC, 1986)).

Estimates of emissions for each source (refer Table 8-79 below) were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source and for each hour, an emission rate was determined which depended on the level of activity and the wind speed. Dust generating activities were represented by a series of volume sources situated according to the location of activities for the modelled scenarios. There are four potential ventilation rises at the Federation Site (including escapeway and fresh air intake, and 2 potential return air rises) and only one of these is an operational exhaust air rise at any one time. **Table 8-79** provides the ventilation rise parameters.

*Table 8-79 Ventilation Rise Parameters*

| Parameter | Value for Ventilation Rise 1 | Units |
|---|---|---|
| Stack height | Ground level | - |
| Stack diameter | 5.0 | m |
| Flow rate | 390 | $m^3/s$ |
| Exit temperature | 295.15 | Kelvin |
| Coordinates | 434273, 6436960 | - |
| Emission rates | | |
| TSP | 0.867 | g/s |
| $PM_{10}$ | 0.433 | g/s |
| $PM_{2.5}$ | 0.289 | g/s |

Estimated emissions of TSP, $PM_{10}$ and $PM_{2.5}$ by each activity of the Project is provided in **Table 8-80**.

*Table 8-80 Estimated TSP, PM10 and PM2.5 Emissions for the Project*

| Activity | TSP Emissions (kg/y) | $PM_{10}$ Emissions (kg/y) | $PM_{2.5}$ Emissions (kg/y) |
|---|---|---|---|
| Hauling of underground ore to ROM pad (unsealed roads) | 13,605 | 3,360 | 336 |
| Unloading of underground ore to ROM pad | 325 | 154 | 23 |
| Loading of ore at ROM pad | 325 | 154 | 23 |
| Hauling of ore to Federation Site boundary (unsealed roads) | 72,560 | 17,919 | 1,792 |
| Hauling of ore from Federation Site boundary to Hera Mine boundary (sealed roads) | 101,585 | 25,087 | 2,509 |
| Hauling of underground waste rock to PAF stockpile (unsealed roads) | 5,271 | 1,302 | 130 |
| Unloading of underground waste rock at PAF stockpile | 94 | 45 | 7 |
| Grader at Federation Site unsealed roads | 5,515 | 1,927 | 171 |
| Hauling of ore from Hera Mine boundary to Processing Plant (unsealed roads) | 136,051 | 33,598 | 3,360 |
| Unloading of ore at Processing Plant | 325 | 154 | 23 |
| Crushing of ore at Processing Plant | 2,031 | 902 | 902 |
| Screening of crushed material at Processing Plant | 9,401 | 3,234 | 3,234 |
| Front End Loader at Processing Plant | 3,161 | 544 | 332 |

| | | | |
|---|---|---|---|
| Loading of concentrate at Processing Plant into trucks | 62 | 29 | 4 |
| Hauling of concentrate from Hera Mine Processing Plant to Hera Mine Site boundary (unsealed roads) | 25,767 | 6,363 | 636 |
| Hauling of concentrate from Hera Mine Site Boundary to Hermidale by truck (sealed roads) | 9,448 | 2,333 | 233 |
| Loading of tailings at Processing Plant for trip to the TSF | 105 | 50 | 8 |
| Hauling of tailings from Processing Plant to TSF (unsealed roads) | 26,468 | 6,536 | 654 |
| Unloading of tailings at TSF | 105 | 50 | 8 |
| Front End Loader at TSF | 3,161 | 544 | 332 |
| Loading of tailings at Processing Plant to return to Federation Site | 158 | 75 | 11 |
| Hauling of tailings from Hera Mine Processing Plant to Hera Mine Site boundary (unsealed roads) | 66,171 | 16,341 | 1,634 |
| Hauling of tailings from Hera Mine Site boundary to Federation Site boundary via Burthong Road (sealed roads) | 49,407 | 12,201 | 1,220 |
| Hauling of tailings from Federation Site boundary to underground | 37,497 | 9,260 | 926 |
| Grader at Solar Farm unsealed roads | 5,515 | 1,927 | 171 |
| Grader at Services Corridor unsealed roads | 5,515 | 1,927 | 171 |
| Wind Erosion (WE) - ROM Pad | 213 | 106 | 16 |
| WE - PAF waste rock stockpile | 765 | 383 | 57 |
| WE - Topsoil stockpile 1 (west of boxcut) | 170 | 85 | 13 |
| WE - Topsoil stockpile 2 (south of internal access road) | 213 | 106 | 16 |
| WE - Topsoil stockpile 3 (south of internal haul road) | 213 | 106 | 16 |
| WE - Tailings Storage Facility | 446 | 223 | 33 |
| **Total Emissions** | **581,645** | **146,741** | **18,959** |

The assessment included the assumption that standard dust control measures would be implemented for the Project. These included:

- Use of additional water application, if required, on active unsealed haul roads (50% control applied);
- Use of additional water sprays, if required, on activities such as loading, unloading, front end loader operations, stockpiles and pads, tailings storage facility (50% control applied); and
- Use of sealed road, Burthong Road (90% control applied).

### 8.10.6 Predicted Impacts

This section provides details on predicted impacts to sensitive receivers as identified in **Figure 8-30**.

The predicted annual average Project contribution and cumulative concentrations at the selected sensitive receivers are provided in **Table 8-81** below. There are no predicted exceedances of the annual average TSP criterion of 90 µg/m$^3$ or the annual average $PM_{10}$ criterion of 25 µg/m$^3$. For $PM_{2.5}$, there are no predicted exceedances of the NSW EPA impact assessment criterion of 8 µg/m$^3$, however there are exceedances of the pending NEPM AAQ standard of 7µg/m$^3$. It should be noted that the exceedance would be due to the background concentration, which is already exceeding 7µg/m$^3$, irrespective of the Project. When considering the Project contribution, these concentrations are low and range between 0.1% and 2.7% of the cumulative concentration.

*Table 8-81 Predicted Annual Average Project Contribution and Cumulative Concentrations at Sensitive Receivers for TSP, PM10 and PM2.5*

| Receptor ID | TSP (µg/m$^3$) | | $PM_{10}$ (µg/m$^3$) | | $PM_{2.5}$ (µg/m$^3$) | |
|---|---|---|---|---|---|---|
| | Project contribution | Cumulative | Project contribution | Cumulative | Project contribution | Cumulative |
| R1 | 3.6 | 44.6 | 0.8 | 17.3 | 0.1 | 7.4 |
| R2 | 6.3 | 47.3 | 1.3 | 17.8 | 0.2 | 7.5 |
| R3 | 5.3 | 46.3 | 1.1 | 17.6 | 0.2 | 7.5 |
| R4 | 2.4 | 43.4 | 0.5 | 17.0 | 0.1 | 7.4 |
| R5 | 1.9 | 42.9 | 0.4 | 16.9 | 0.1 | 7.4 |
| R18 | 0.2 | 41.2 | <0.1 | 16.5 | <0.1 | 7.3 |
| R19 | 0.5 | 41.5 | 0.1 | 16.6 | <0.1 | 7.3 |

The predicted maximum 24-hour average concentrations for the Project contribution and cumulative concentrations at sensitive receivers for $PM_{10}$ and $PM_{2.5}$ are provided in **Table 8-82**. There is one predicted exceedance of the maximum 24-hour average criterion for $PM_{10}$ of 50 µg/m$^3$ at all receivers. The exceedance is due to a high background concentration, on a single day, of 53.8 µg/m$^3$. There are no additional exceedances caused by the Project. For $PM_{2.5}$, there are no predicted exceedances of the maximum 24-hour average NSW impact assessment criteria of 25 µg/m$^3$ or the pending NEPM AAQ standards of 20µg/m$^3$.

*Table 8-82 Predicted Maximum 24-hour Average Concentrations for Project Contribution and Cumulative Concentrations at Sensitive Receivers for $PM_{10}$ and $PM_{2.5}$*

| Receptor ID | $PM_{10}$ (µg/m³) | | | $PM_{2.5}$ (µg/m³) | | |
|---|---|---|---|---|---|---|
| | Maximum Project contribution | Maximum Cumulative | Days of additional exceedances | Maximum Project contribution | Maximum Cumulative | Days of additional exceedances |
| R1 | 4.5 | 54.6 | 0 | 0.9 | 17.0 | 0 |
| R2 | 7.2 | 55.8 | 0 | 1.2 | 17.1 | 0 |
| R3 | 10.2 | 56.6 | 0 | 1.6 | 17.1 | 0 |
| R4 | 3.4 | 55.5 | 0 | 0.7 | 16.8 | 0 |
| R5 | 2.9 | 55.2 | 0 | 0.7 | 16.6 | 0 |
| R18 | 0.7 | 53.8 | 0 | 0.2 | 16.2 | 0 |
| R19 | 2.0 | 53.8 | 0 | 0.7 | 16.3 | 0 |

Table 8-82 above shows that the highest $PM_{10}$ (24-hour) concentrations are predicted at R3. Time series plots prepared for 24-hour average $PM_{10}$ and $PM_{2.5}$ concentrations at R3 are provided in **Figure 8-35** and **Figure 8-36.** There is one predicted exceedance for 24-hour average $PM_{10}$ concentrations, and no exceedances of the 24-hour average $PM_{2.5}$ concentrations, with this one exceedance caused by the high background concentration and is not caused by the Project.

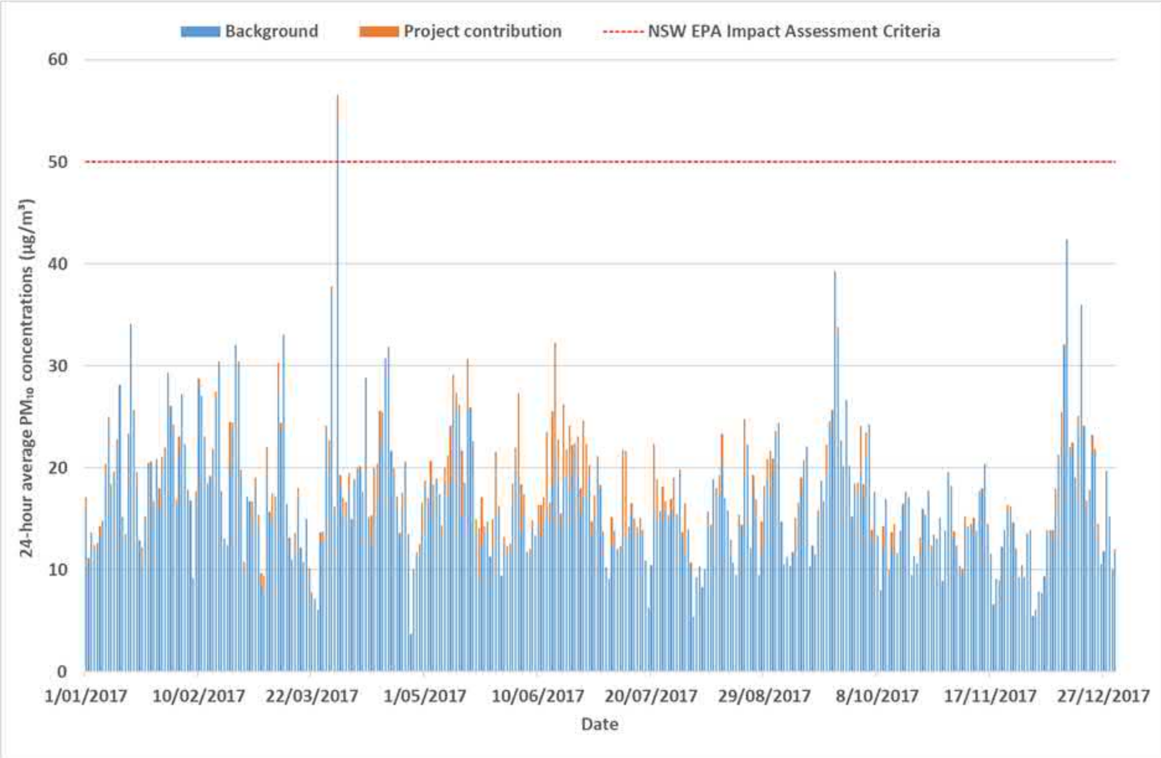



*Figure 8-35 Time Series Results for 24-hour Average $PM_{10}$ at R3*

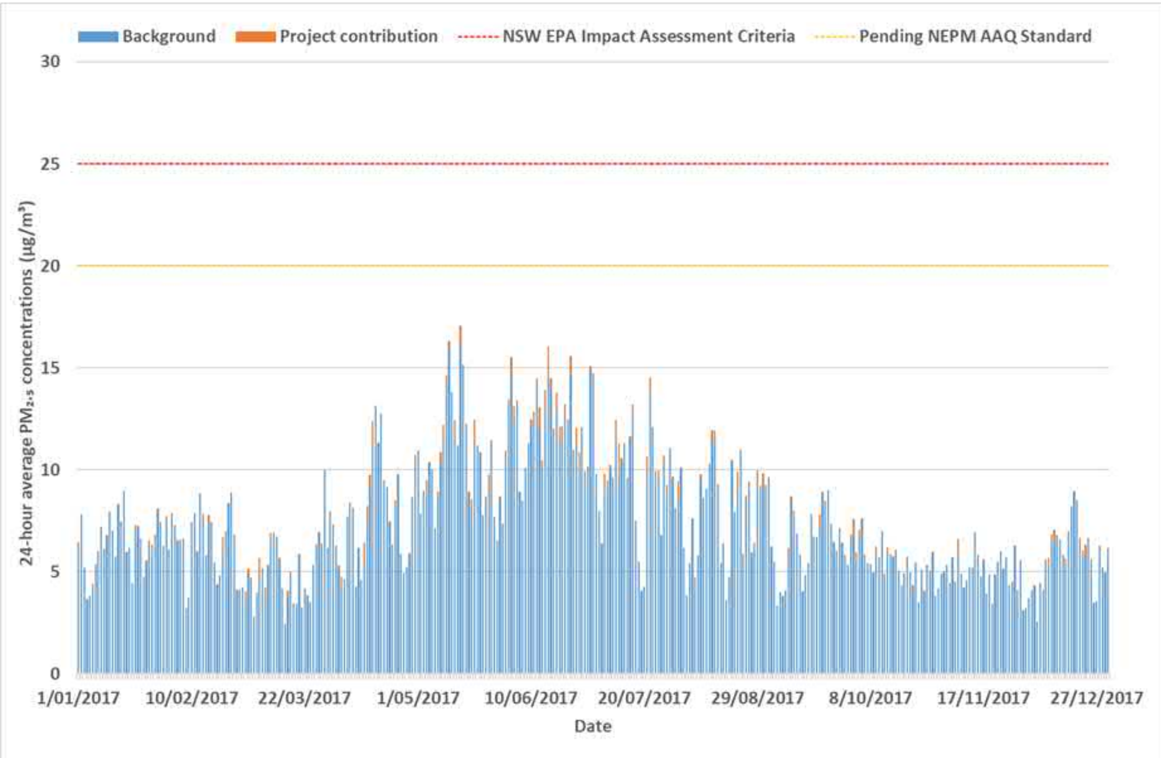



*Figure 8-36 Time Series Results for 24-hour Average $PM_{2.5}$ at R3*

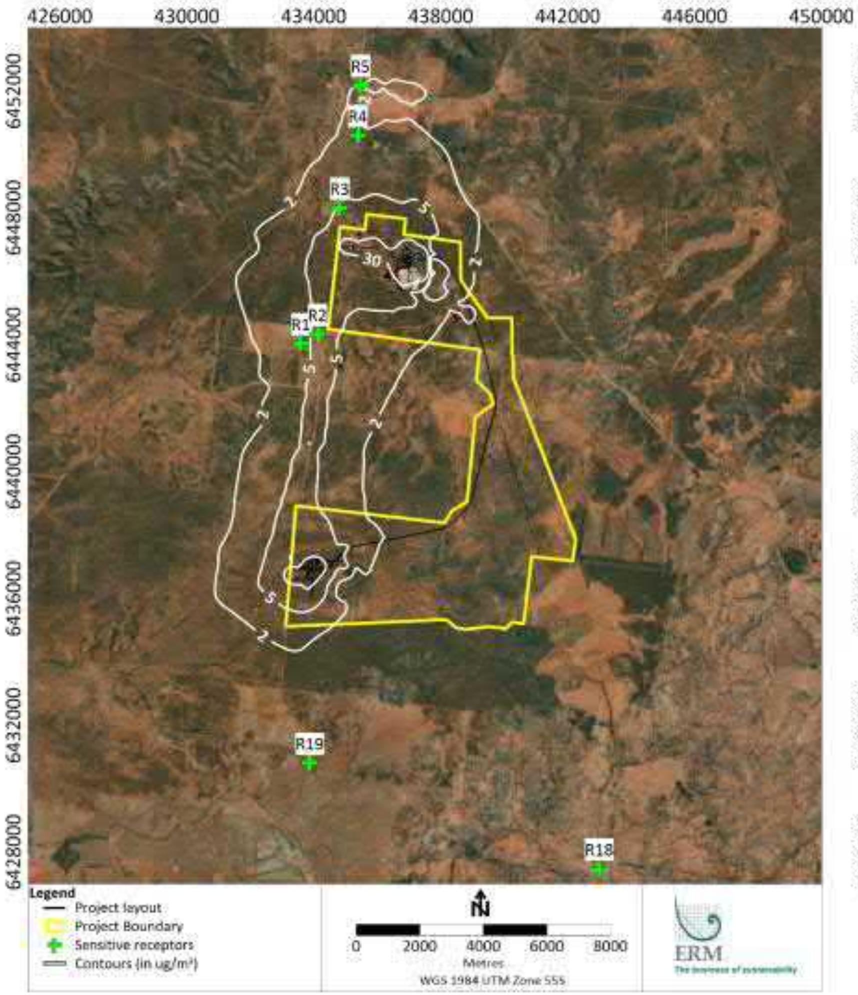
Table 8-83 below presents the predicted monthly average Project contribution and cumulative dust deposition levels. There are no predicted exceedances of the NSW EPA impact assessment criteria.

*Table 8-83 Predicted Monthly Average Project Contribution and Cumulative Dust Deposition Levels*

| Receptor ID | Dust deposition ($g/m^2/month$) | |
|---|---|---|
| | Project contribution | Cumulative |
| R1 | 0.1 | 2.1 |
| R2 | 0.2 | 2.2 |
| R3 | 0.1 | 2.1 |
| R4 | 0.1 | 2.1 |
| R5 | 0.1 | 2.1 |
| R18 | <0.1 | 2.0 |
| R19 | <0.1 | 2.0 |

**Figure 8-37** to **Figure 8-40** present the annual average Project contribution and cumulative concentrations for TSP, $PM_{10}$, $PM_{2.5}$ and dust deposition.

**Figure 8-41** and **Figure 8-42** present the maximum 24-hour average $PM_{10}$ and $PM_{2.5}$ concentrations, for the Project contribution.



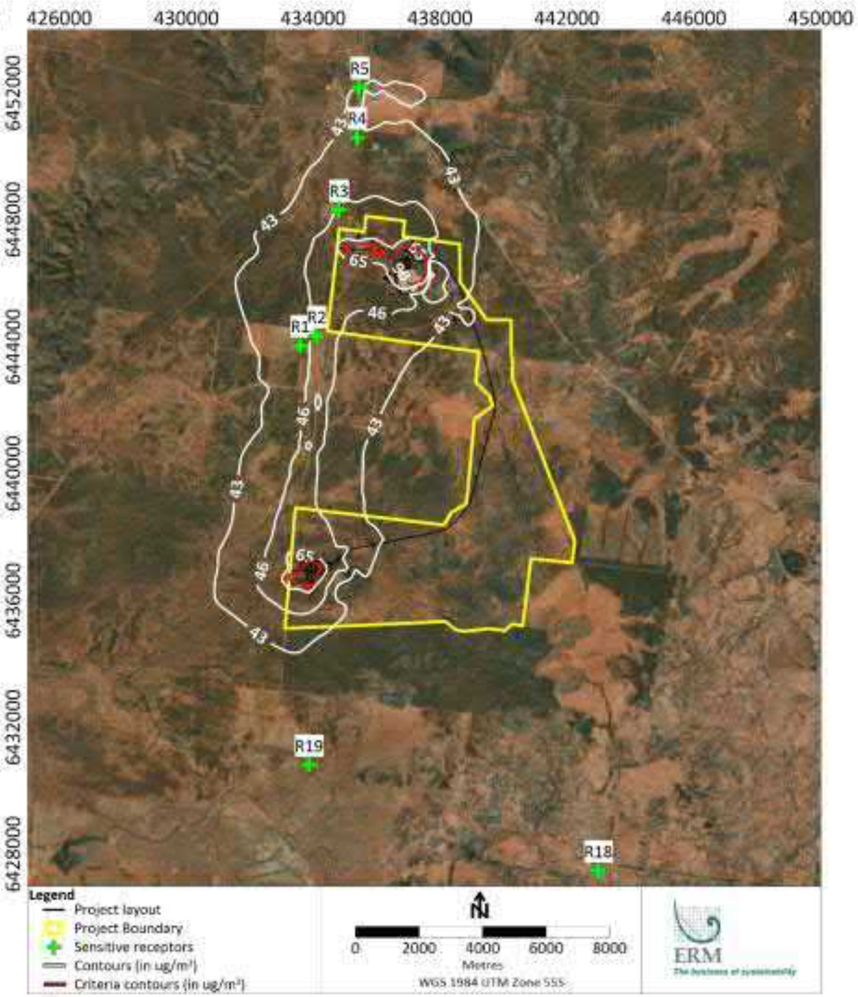




*Figure 8-37 Predicted Annual Average TSP Concentrations (µg/m3) Project Contribution (left) and Cumulative (right)*

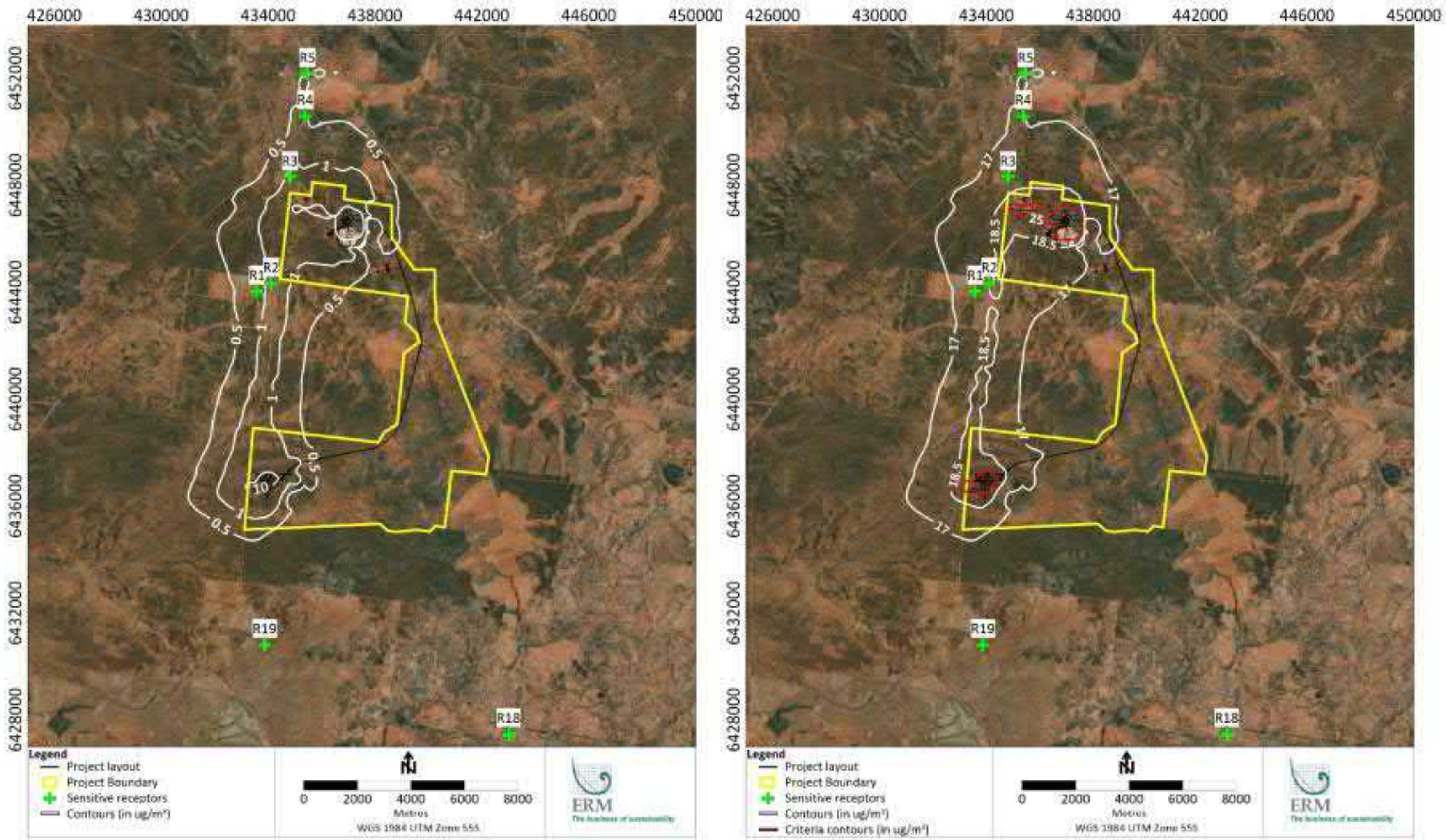


*Figure 8-38 Predicted Annual Average PM10 Concentrations (µg/m3) Project Contribution (left) and Cumulative (right)*

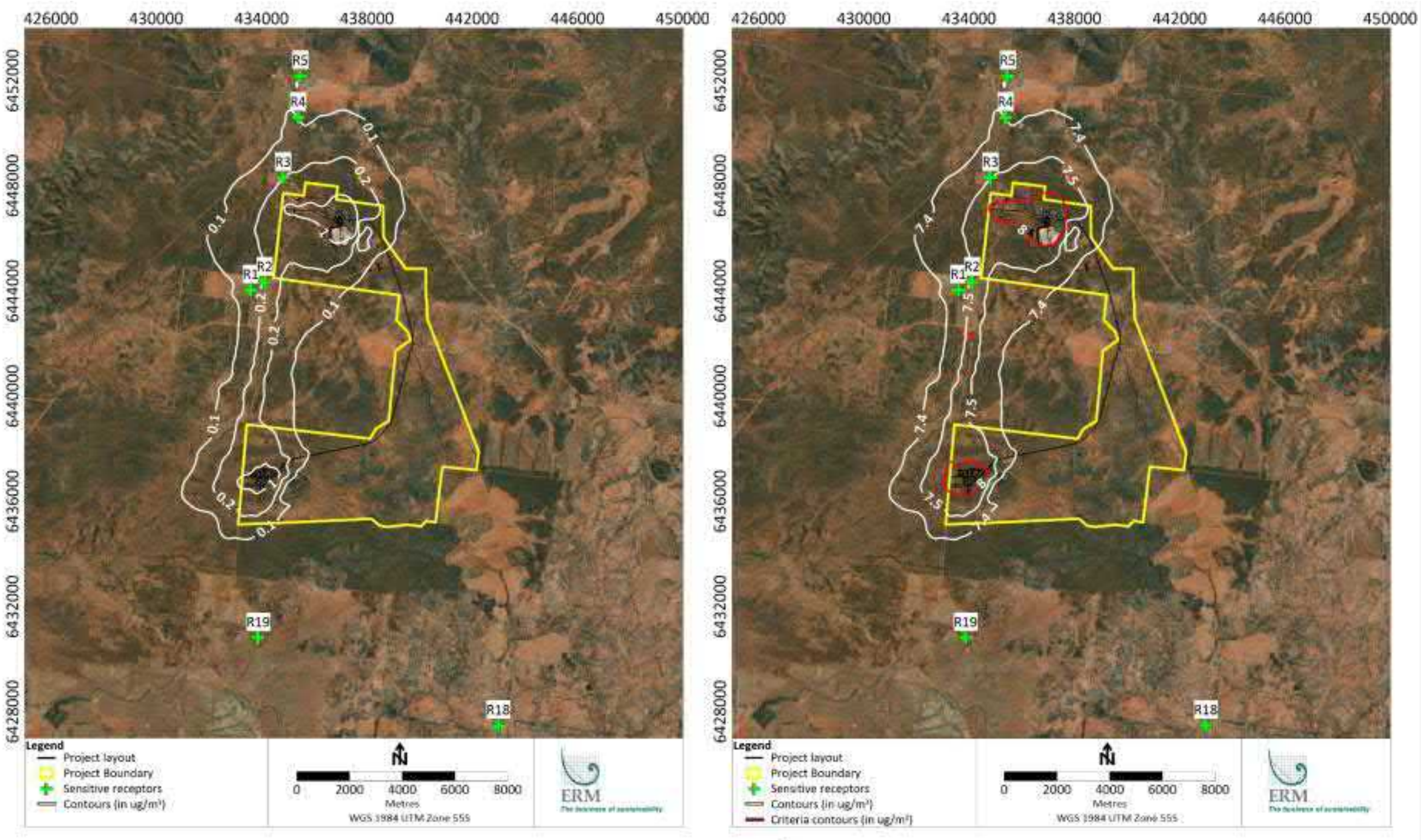



*Figure 8-39 Predicted Annual Average $PM_{2.5}$ Concentrations (µg/m3) Project Contribution (left) and Cumulative (right)*

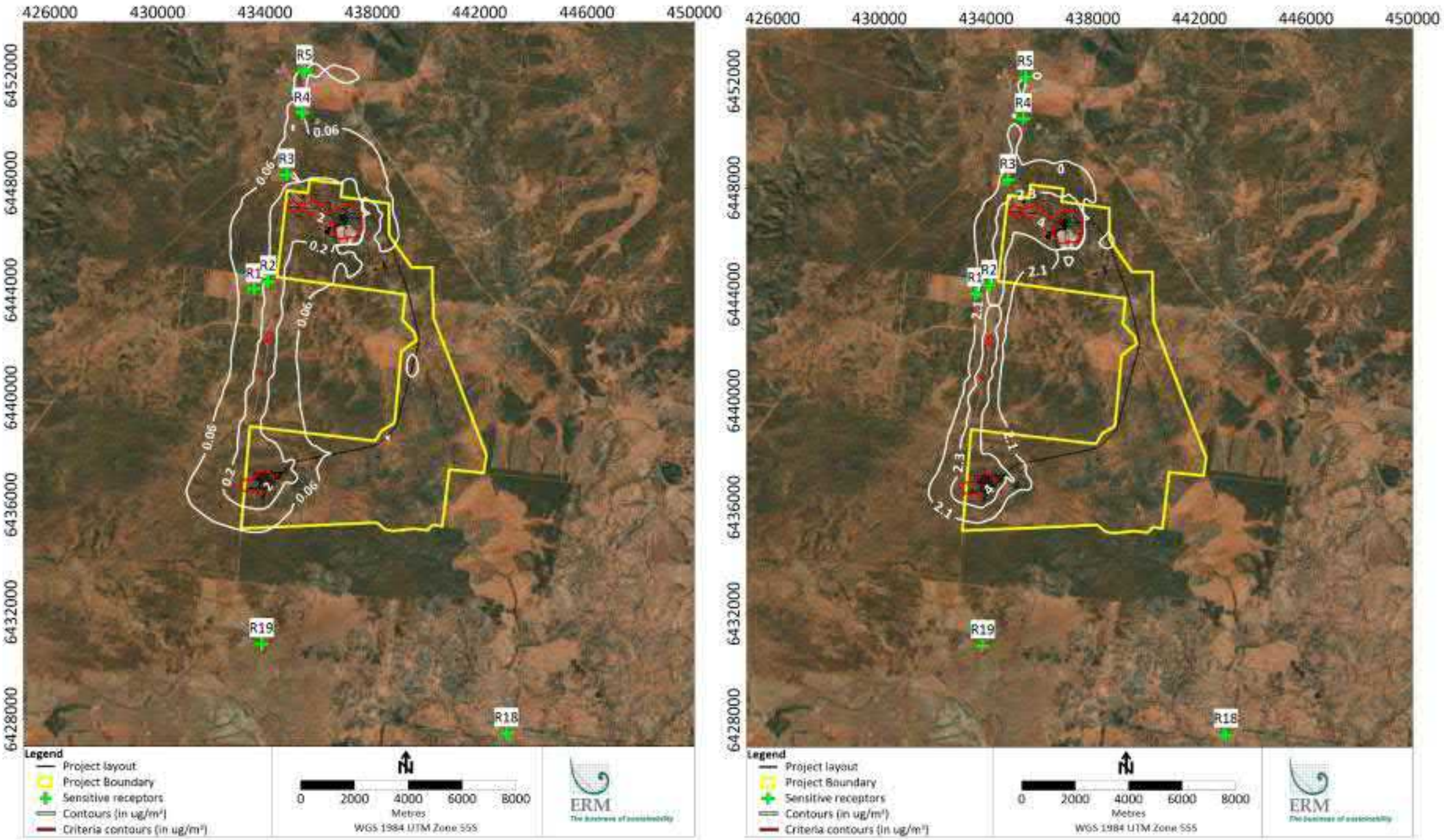



*Figure 8-40 Predicted Monthly Average Dust Deposition Levels (g/m²/month) Project Contribution (left) and Cumulative (right)*

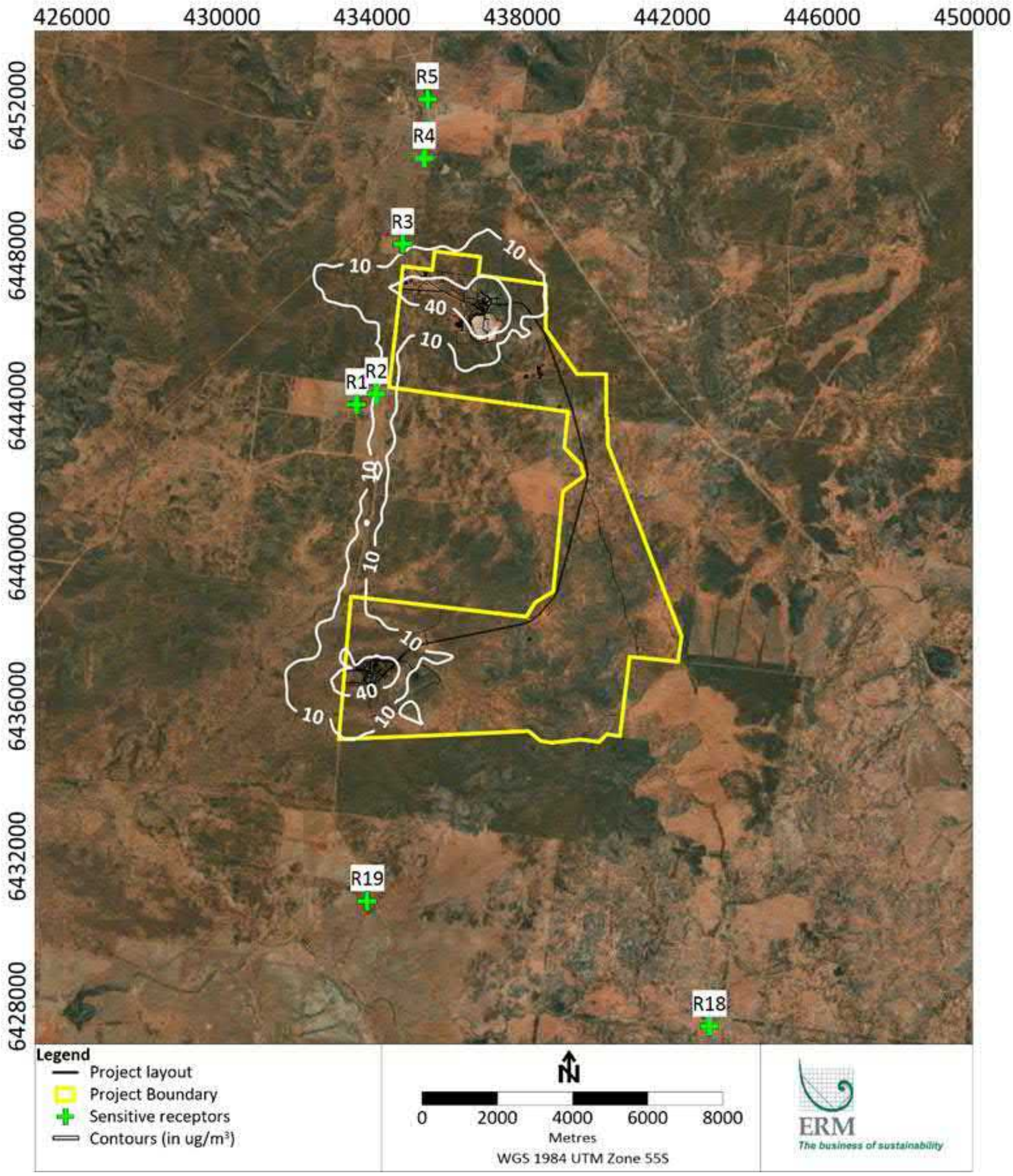



*Figure 8-41 Predicted 24-hour Average PM10 Concentrations (µg/m$^3$) Project Contribution*

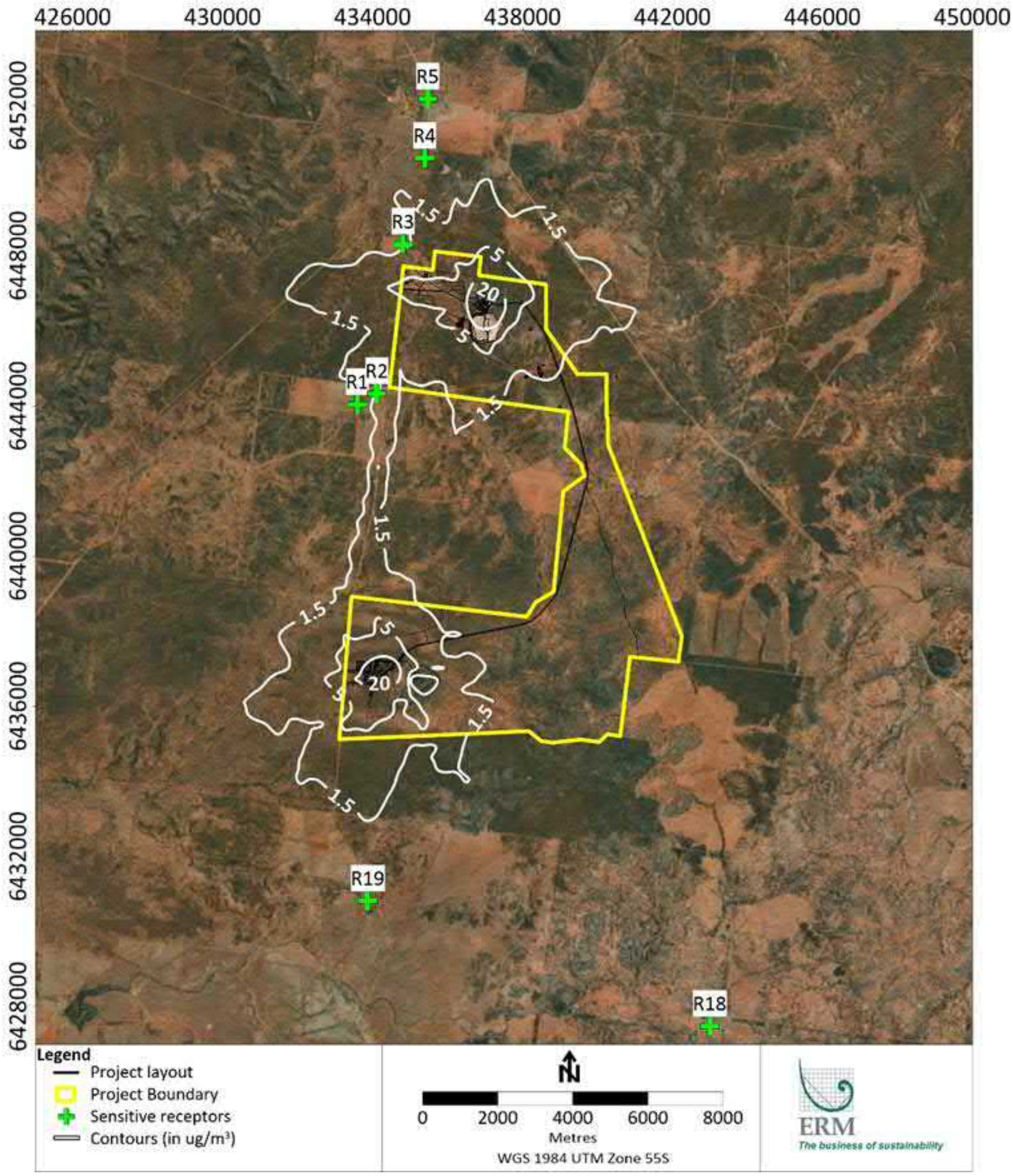



*Figure 8-42 Predicted 24-hour Average $PM_{2.5}$ Concentrations ($\mu g/m^3$) Project Contribution*

### 8.10.7 Mitigation and Management Measures

The following air quality management and mitigation measures will be undertaken for the Project:

- Preparation of an Air Quality Management Plan (AQMP) to detail any proposed mitigation and monitoring at the Project. These may include:
    i. Minimisation of areas of disturbance where feasible;
    ii. Minimise dust generating impacts during adverse meteorological conditions and extraordinary events;
    iii. Encourage vegetative cover to non-operational exposed surfaces, e.g. sediment pond edges, water diversion drains (where necessary);
    iv. Maintain ore handling areas/stockpiles in a moist condition by using water carts to water down areas affected by wind-blown and traffic-generated dust;
    v. Allow for natural re-vegetation cover (under suitable climatic conditions) over all long-term topsoil stockpiles not regularly used,;
    vi. Use conveyors within the processing plant to transport crushed ore material;
    vii. Install suitable dust control measures within the process plant such as water sprays to ensure that the required level of dust suppression is achieved;
    viii. Ensure vehicles only drive on designated roads;
    ix. If possible, maintain approximately 75% of the TSF area as wet, with emissions restricted to 25% of the surface area of the TSF. Dust suppressants may be considered if required;
- Spray unsealed access roads and other trafficked areas with water carts at a rate of 2L/m2/hour, as required, when visible dust is generated. Restrict speed limit to 40 km/hr on all internal access roads to minimise dust generation;
- Air quality monitoring (refer **Section 8.10**) will continue at the site measuring concentrations and deposition levels reported annually and will include the following:
    i. High Volume Air Sampler (HVAS) to monitor TSP and/or $PM_{10}$ concentrations;
    ii. Dust deposition gauges to monitor the monthly dust deposition levels; and
    iii. Truck loads will be covered for both ore and tailings between Hera Mine and the Federation Site (i.e along Burthong Rd), as well as loads ore between Federation Site and PGM.

### 8.10.8 Conclusion

An AQIA was prepared for the Project to determine the potential impacts to nearby sensitive receivers to the Project. The air dispersion model represented an advanced modelling system using the AERMET/AERMOD modelling scheme. Emission estimates were determined for a series of potentially dust generating activities undertaken at Hera Mine and the Federation Site, which were used as inputs into the model. The assessment follows a conventional approach using the procedures outlined in the NSW EPA document titled "*Approved*

*Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW"* (Approved Methods) (NSW EPA, 2016).

The modelling results were compared against the adopted air quality criteria, which was derived from the NEPM. The results showed that there were no predicted exceedances at sensitive receptor locations of the NSW EPA impact assessment criteria for any of the annual average parameters. For 24-hour average $PM_{2.5}$, there were no predicted exceedances at sensitive receptor locations of the NSW EPA impact assessment criteria. For 24-hour average $PM_{10}$, there is one predicted exceedance of the NSW EPA impact assessment criteria, experienced at all sensitive receptor locations. This exceedance is due to background concentrations already exceeding the criteria. There are no additional exceedances at sensitive receptor locations of the 24-hour average $PM_{10}$ criterion caused by Project contributions.

## 8.11 Greenhouse Gas

### 8.11.1 Introduction

A Greenhouse Gas Assessment (GHGA) was prepared by ERM and is included in **Appendix N**. The GHGA was prepared for the Project with reference to the GHG Protocol and other relevant guidelines. The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Organisation for Standardisation endorsed GHG initiatives and is compatible with existing GHG trading schemes.

The GHGA was prepared based on the data provided by Hera Resources regarding anticipated GHG emissions.

### 8.11.2 SEARs Requirements

The SEARS requirements relating to GHG are provided in **Table 8-84**.

*Table 8-84 GHG SEARs Requirements*

| SEARS Requirement | Reference |
|---|---|
| An assessment of the likely greenhouse gas impacts of the development; and | **Section 8.11.5**<br>**Section 8.11.6** |
| A description of the feasibility of measures that would be implemented to monitor and report on the emissions (including fugitive dust and greenhouse gases) of the development; | **Section 8.11.7** |

### 8.11.3 Methodology

Quantification of GHG emissions has been completed in accordance with the GHG Protocol, Intergovernmental Panel on Climate Change (IPCC) and Australian Government GHG accounting/classification systems.

This GHGA is also guided by the emission estimation methodologies endorsed under the *National Greenhouse and Energy Reporting Regulations 2008* (the NGER Regulations) (as amended in 2019). These describe the detailed requirements for reporting under the NGER framework and also provide a basis for estimating emissions from proposed activities.

The *Technical Guidelines for the Estimation of Greenhouse Gas Emissions by Facilities in Australia* (the NGER Guidelines) (Department of Environment and Energy , 2019) support reporting under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act). They have been designed to assist corporations in understanding and applying the National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Measurement Determination). The Measurement Determination provides methods, criteria and measurement standards for calculating greenhouse gas emissions and energy data under the NGER Act, covering scope 1 and scope 2 emissions and energy production and consumption, as discussed in **Section 8.11.4** below.

The NGER Guidelines report on a year specific basis, and outline calculation methods, as well as criteria for determining GHG emissions, energy production, energy consumption and potential GHG emissions embodied in combusted fuels.

### 8.11.4 The GHG Protocol

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Organization for Standardisation, endorsed by GHG initiatives (such as the Carbon Disclosure Project) and is compatible with existing GHG trading schemes.

Under this protocol, three "scopes" of emissions (scope 1, scope 2 and scope 3) are defined for GHG accounting and reporting purposes. This terminology has been adopted in Australian GHG reporting and measurement methods and has been employed in this assessment. Reporting of scope 3 is not required so scopes 1 and 2 are addressed. The definitions for scope 1 and scope 2 are provided in the following sections.

*Scope 1: Direct greenhouse gas emissions*

Direct GHG emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct GHG emissions are those emissions that are principally the result of the following types of activities undertaken by an entity. For example:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources;
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials, e.g., the manufacture of cement, aluminium, etc;
- Transportation of materials, products, waste and employees. These emissions result from the combustion of fuels in entity owned/controlled mobile combustion sources, e.g., trucks, trains, ships, aeroplanes, buses and cars; and
- Fugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; hydrofluorocarbons emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

*Scope 2: Energy product use indirect greenhouse gas emissions*

Scope 2 emissions are a category of indirect emissions that accounts for GHG emissions from the generation of purchased energy products (principally, electricity, steam/heat and reduction materials used for smelting) by the entity.

Scope 2 covers purchased electricity defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity. Scope 2 emissions physically occur at the facility where electricity is generated. Entities report the emissions from the generation of purchased electricity that is consumed in its own or controlled equipment or operations as scope 2.

The Project will not generate any scope 2 emissions as there will be no electricity purchased from the grid. All electricity will be generated onsite from either the solar farm or the liquefied natural gas (LNG) power plant.

### 8.11.5 Greenhouse Gas Emission Estimates

Inventories of GHG emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as global warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The estimated emissions are referred to in terms of carbon dioxide equivalent, or CO2-e, emissions by applying the relevant global warming potential.

Project related GHG sources included in the assessment are all for Scope 1 for fuel consumption and are as follows.

- LNG;
- Diesel;
- Lubricants/oil;
- Liquefied petroleum gas (LPG);
- Diesel (light duty vehicles); and
- Diesel (heavy duty vehicles).

The mining operations will last 14 years (FY23 to FY36). Fuel usage values have been provided by Hera Resources. It is assumed that fuel consumption will be fairly consistent across all years of operation relative to extraction and production rates.

A summary of annual average GHG emissions is provided in **Table 8-85.** The method for presenting emissions is for an annual average. Detailed information on the calculation of greenhouse gas emissions from the Project are provided in **Appendix N.**

*Table 8-85 Summary of Estimated Annual Average $CO_2$-e (tonnes)*

| Type of Fuel | Scope 1 |
|---|---|
| LNG | 13,299 |
| Diesel | 7,688 |
| Lubricants/oil | 55 |
| LPG | 130 |
| Diesel (light duty vehicles) | 25 |
| Diesel (heavy duty vehicles) | 1,186 |
| **Total** | **22,382** |

The Project's contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions. Average annual scope 1 emissions from the Project (approximately 0.02 Mt $CO_2$-e) would represent approximately 0.005% of Australia's commitment under the Paris Agreement.

### 8.11.6 Greenhouse Gas Emission Savings

Electricity at Federation Site will be provided by the power plant at Hera Mine (75% of the total power requirements) and the solar farm at Hera Mine (25% of the total power requirements). To calculate emission savings, GHG emissions have been calculated based on electricity being provided by the grid compared with emissions from the LNG used for the power plant (this notes 25% of power is provided by the solar farm, which therefore displaces the requirement for gas consumption at the power plant). **Table 8-86** presents the comparison of total (life of Project) GHG emissions for power sourced from the grid and the proposed combination of the power plant and solar farm. **Table 8-87** presents the comparison of total GHG emissions if 100% of electricity was generated from the power plant and the savings that are achieved from the solar farm providing 25% of electricity needs.

*Table 8-86 Summary of Estimated Greenhouse Gas Savings from Using the Power Plant and Solar Farm Compared with the Grid (t $CO_2$-e)*

| Scope 2 emissions (t $CO_2$-e) if generated from grid | Scope 1 emissions (t $CO_2$-e) from LNG (used for power plant at 75%) | t $CO_2$-e savings from power plant and solar farm |
|---|---|---|
| 278,476 | 186,180 | 92,296 |

*Table 8-87 Summary of Estimated Greenhouse Gas Savings from the Solar Farm (t $CO_2$-e)*

| Scope 1 emissions (t $CO_2$-e) from LNG (if 100% from power plant) | Scope 1 emissions (t $CO_2$-e) from LNG (used for power plant at 75%) | t $CO_2$-e savings from solar farm |
|---|---|---|
| 248,240 | 186,180 | 62,060 |

It can be seen from **Table 8-86** that by using the on-site power plant and solar farm, rather than taking electricity from the grid, has reduced emissions by 92,296 t CO2-e over the life of the Project. **Table 8-87** shows that by having the power plant provide 75% of electricity needs and the solar farm provide 25%, compared with 100% production by the power plant, has saved 62,060 t CO2-e over the life of the Project. Overall, the combination of solar farm and power plant will make a significant saving to GHG emissions for the Project.

### 8.11.7 Greenhouse Gas Emissions Reporting

GHG emissions will be reported as part of the NGER Act. The reports are required to be submitted to the Clean Energy Regulator by 31 October each year. The reports will detail the following from the operation of facilities under the operational control of the corporation and entities that are members of the corporation's group, during that financial year:

- GHG emissions;
- Energy production;
- Energy consumption; and

- Energy savings from use of renewable sources.

### 8.11.8 Management and Mitigation Measures

The following management and mitigation measures will be implemented to minimise the generation of GHG as a result of the Project:

- Use of a renewable energy source (i.e. the proposed solar farm) to displace energy supply from the onsite gas fired power plant;
- Progressively optimise the underground mine design to minimise travel distances for mining equipment and re-handling of waste and ore material;
- Use mining equipment which is regularly maintained and serviced to maximise efficiency;
- Adopt the use of energy efficient lighting technologies and hot water and air conditioning systems wherever practical;
- Maximise the recovery of recyclable materials where practicable, including:
    i. Waste hydrocarbons;
    ii. Polyethylene;
    iii. Scrap metals;
- Minimise waste sent to landfill through the development of appropriate purchasing and waste management plans;
- Progressively review and implement energy efficiency measures throughout the life of the Mine; and
- Emissions and abatement strategies will be reported annually.

## 8.12 Waste Management

### 8.12.1 Introduction

This section provides details about waste management practices which will be implemented during both construction and operation of the Project. This includes waste rock, tailings, effluent, chemicals, operational and construction related wastes. Waste management will be undertaken in accordance with the waste hierarchy and applicable legislation and guidelines. This section also provides a summary of the findings of the TSF risk assessment.

### 8.12.2 Assessment Requirements

The SEARs associated with waste management are provided in **Table 8-88.**

*Table 8-88 Waste Management SEARS Requirements*

| SEARs Requirement | Where Addressed |
|---|---|
| A waste (overburden, tailings, etc.) management strategy | **Section 4**<br>**Section 8.2.5.1**<br>**Section 8.2.5.2**<br>**Section 8.12.5** |

| | |
|---|---|
| Identification of all waste types that will be generated during construction and operation, their classification and the ways in which they can be legally handled, stored, transported, reused, recycled or disposed of, including sampling/monitoring, record keeping, waste tracking, contingency measures and any other verification practice, in accordance with relevant guidelines/standards; | **Section 8.12.4** |
| Assessment of how the project would comply with the EPA's *Sodium Cyanide Policy – Limits for gold mine tailings storage facilities* (EPA, 2012) | **Section 8.12.3** |
| Identify strategies for waste minimisation during construction and operation | **Section 8.12.7** |
| A tailings risk assessment based on the tailings composition and identification, quantification and classification of the potential waste streams likely to be generated during construction and operation, including and not limited to non-production wastes, reagent materials and cyanide compounds | **Section 8.12.5** |
| Description of onsite sewerage system construction/upgrade, implementation, performance and management measures including a supporting comment on how the system would service all sewage generated during the construction and operational periods; and | **Section 8.12.5.2** |
| Description of the measures to be implemented to store, manage, reuse, recycle and safely dispose of these materials including and not limited to operational water by-products, adequate spill detection and clean up systems, suitable locations for disposal or reuse of spoil generated during construction. | **Section 8.12.6**<br>**Section 8.12.7**<br>**Chapter 5** |

### 8.12.3 Legislative Context

#### 8.12.3.1 Protection of the Environment Operations Act 1997

The POEO Act which is discussed in **Chapter 6** is administered by the EPA. Waste type classifications are provided in Schedule 1, Part 3, Clause 49 of the POEO Act. These include general solid waste (non-putrescible), general solid waste (putrescible), hazardous waste, liquid waste, restricted solid waste and special waste. The different types of waste that will be generated by the Project have been classified as per the POEO Act (and the Waste Classification Guidelines – Part 1: Classification of waste (EPA 2014b)) and are further discussed in **Section 8.12.4**.

#### 8.12.3.2 Waste and Resource Recovery Strategy 2014 - 2021

The Waste and Resource Recovery Strategy 2014-21 (EPA, 2014) provides a clear direction for a range of priority waste management areas and aligns with the NSW Government's waste reforms. The strategy provides guidance on how to improve the wellbeing of the environment and community by reducing the environmental impact of waste and using resources efficiently. The strategy sets a number of targets which are focused on, among other aspects, increase in the recycling rates and the diversion of waste from landfill.

Wastes generated through both the construction and operational phase of the Project will be managed in accordance with the strategy. Measures to reduce, reuse and recycle will continue to be implemented and areas of improvement sought.

#### 8.12.3.3 Waste Classification Guidelines

The *Waste Classification Guidelines* (EPA, 2014a) classifies wastes into groups that pose similar risks to the environment and human health and facilitates their management and appropriate disposal. The Guidelines provides a systematic approach to the classification of waste through a five part guideline series.

Waste generated from the Project will be classified in accordance with Waste Classification Guidelines: Part 1 Classifying Waste (EPA 2014b) and as defined in Schedule 1, Part 3, Clause 49 of the POEO Act.

#### 8.12.3.4 Sodium Cyanide Policy – Limits for gold mine tailings storage facilities

The *Sodium Cyanide Policy – Limits for gold mine tailings storage facilities* was developed by the NSW EPA in 2012, to identify risk management strategies to minimise exposure to wildlife from sodium cyanide, associated with tailings facilities of gold mine operations. The policy sets out two risk management strategies: reduce the concentration of sodium cyanide and reduce exposure.

The policy sets a guideline value for facilities to maintain a weak acid dissociable (WAD) concentration of 50 mg/L. Hera Mine project approval currently stipulates a limit of WAD in tailings discharged from the discharge point to the TSF, and the discharge from the process water dam, as no greater than 20 mg/L (90th percentile) and 30mg/L (maximum). Therefore, Hera Mine is currently compliant with the policy. The new process plant is predicted to remain compliant with the current Hera mine project approval WAD limits, and will therefore also be compliant with the policy. Furthermore, regular monitoring and inspection of the TSF is undertaken in accordance with the approved hazardous materials management plan and TSF maintenance operations plan (refer **Section 8.12.5**), which includes fencing and netting of the process water dam.

### 8.12.4 Waste Management at Hera Mine and for the Project

Hera Resources currently implement waste management practices on site in accordance with the relevant guidelines as discussed in **Section 8.12.3**. Waste management follows the waste hierarchy which includes, in order of priority:

1. Reduce;
2. Re-use;
3. Recycle or compost; and
4. Dispose.

Source segregation is undertaken where possible on site to achieve the waste management goals. The advantages of source segregation for waste management includes:

- Reducing the potential for contamination of general waste streams;
- Improving the ease of waste storage, handling, disposal and tracking;
- Educating employees of the importance of waste stream segregation and recycling;

- Potentially generating an income from recyclable waste streams; and
- Reducing the potential disposal costs for some items.

**Table 8-89** below identifies those wastes currently managed at Hera Mine including their relevant waste classification, handling and disposal location. These practices will continue for the Project, which will have the same types of waste

*Table 8-89 Waste Classification, Source, Handling Transport and Disposal*

| Waste Type | Waste Classification | Major source | Handling | Transport / disposal |
|---|---|---|---|---|
| Office waste and packaging waste | General solid waste (non-putrescible) | General office activities | Waste collected on site | Removed from site by licenced waste contractor and taken to Cobar landfill |
| Scrap metal | General solid waste (non-putrescible) | Construction site waste and process plant building waste | Waste segregated in fit for purpose bins or stockpiled in the designated scrap metal pile | Removed from site by licenced waste contractor |
| Drained/crushed oil/fuel filters | General solid waste (non-putrescible) | Mining fleet | Segregated and stored on site in bunded area | Removed by licenced waste contractor as required |
| Used absorbents – no free liquid | General solid waste (non-putrescible) | Spills associated with maintenance of mining fleet | Segregated and stored on site in bunded area | Removed by licenced waste contractor as required |
| Pesticide/ herbicide containers (water based | General solid waste (non-putrescible) | Rehabilitation/weed control | None generated. Licenced contractor performs this task and removes their own waste | |
| Material contaminated with hydrocarbons | General solid waste (putrescible) | Minor spills | Segregated and stored on site in bunded area | Removed by licenced waste contractor as required |
| Domestic Waste | General solid waste (putrescible) | Waste food scraps and other general domestic waste | Stored on site in designated bins | Removed by licenced waste contractor as required |

| | | | | |
|---|---|---|---|---|
| Liquid waste from sewage system | Liquid | Office, Kitchen and Bathrooms | Waste collected on site | Treated effluent irrigated in nominated irrigation area |
| Lubricating oils and hydraulic oils | Liquid | Mining fleet | Segregated and stored on site in bunded area | Removed by licenced waste contractor as required |
| Used lead acid batteries | Hazardous | Mining fleet | Stored on site in concrete bunded area | Removed by licenced waste contractor as required |
| Degreasing fluids, diesel and other petroleum fluids | Hazardous | Mining fleet | Segregated and stored on site in bunded area | Removed by licenced waste contractor as required |
| Used oil/fuel filters | Hazardous | Mining fleet | Segregated and stored on site in bunded area | Removed by licenced waste contractor as required |
| Used absorbents – free liquid | Hazardous | Spills associated with maintenance of mining fleet | Segregated and stored on site in bunded area | Removed by licenced waste contractor as required |
| Pesticide/ herbicide containers (solvent based) | Hazardous | Rehabilitation/weed control | None generated. Licenced contractor performs this task and removes their own waste | |
| Used/empty bulk chemical containers | Hazardous | Used on site. | Segregated and stored on site | Removed by licenced waste contractor as required |
| Laboratory wastes | Hazardous | Used on site | Segregated and stored on site in bunded area | Removed by licenced waste contractor as required |
| Used Tyres | Special Waste | Mining fleet | Segregated and stored on site in designated tyre storage area. Used on site if required | Removed by licenced waste contractor as required |

### 8.12.5 Waste Rock and Tailings Management Strategy

The SEARS requires the development of a waste (overburden, tailings, etc.) management strategy as part of the EIS. The following sections provide a high level summary of how tailings and waste rock will be managed for the Project.

Refer to **Chapter 4** and **Section 8.2** which provide more detail on waste management, summarised as:

- Waste Rock Classification**:** A geochemical assessment has been completed to understand the geochemical properties of waste rock – refer to **Section 8.2.** Additional geochemical testing (e.g. NAG, NAPP and ANC tests) will be undertaken during Project operations to confirm these findings.
- Waste Rock Storage at Surface**: T**here will be a PAF waste rock pad and a combined PAF and NAF waste rock pad at the Federation Site. Each pad will have lined leachate ponds to capture any surface run-off.
- PAF Material Management**:** PAF waste rock that is brought to surface will either be transported back underground (during or post mining operations) for use as backfill, or transported to Hera Mine and disposed underground. No PAF waste rock is proposed to remain at the surface at closure.
- NAF Material Management**:** All weathered rock excavated for the box cut is expected to be NAF. Weathered waste rock may be crushed prior to use in construction activities. It will be used to backfill the box-cut, for other rehabilitation and construction activities or transported to Hera Mine and disposed underground.
- Leach Pond Monitoring**:** Water quality monitoring and visual inspections of the leach ponds will be undertaken following heavy rainfall events during the life of the emplacement to identify any issue with the proposed management measures. All water monitoring (surface and groundwater) will be in accordance with the Water Management Plan developed for the operation.
- TSF: Details regarding the operation of the TSF are provided in **Section 4.18** and **Section 4.19**. Details on the geochemical classification of tailings are provided in **Section 8.2.** Hera Mine currently follow a TSF Operation and Maintenance Manual. The manual provides details on the design elements of the TSF, operational details and surveillance and monitoring requirements. The operating manual includes the following, which will continue to apply for the Project:
    i. A description of structures and systems including water management and embankments;
    ii. Standard operating procedures for filling of the TSF, water management and maintenance;
    iii. Inspection and monitoring requirements including record keeping; and
    **iv.** Emergency response procedures.

#### 8.12.5.1 Tailings Risk Assessment

A Tailings Risk Assessment was prepared as required by the SEARS and is included as **Appendix O**, inclusive of an evaluation of existing controls and their adequacy. In summary the findings for the risk assessment were:

- Fifteen (15) risks were identified for the risk assessment. These risks were assigned to aspects including stability, settlement, capping, monitoring, rehabilitation, water quality, transport and safety;

- Of the 15 risks identified, 11 were assessed as posing a moderate risk; and
- The remaining 4 risks were classified as low risk.

The continued implementation of the current management and controls in place at the TSF will go to maintaining these risks in a low to moderate ranking.

#### 8.12.5.2 Sewage Treatment

A package sewage treatment plant is currently installed at the Hera Mine site servicing the mine accommodation village, office and ablutions. The sewage plant is a modular self-contained system imported to site. The current system has been approved and designed to have sufficient capacity to accommodate the workforce associated with the Project.

A similar system will be installed at the Federation Site designed for the appropriate treatment volume required (noting that the system will be materially smaller than at Hera Mine, as it there is no accommodation at the Federation Site). The plant will be provided by a third party and will be designed in accordance with the predicted demand. The plant would be transported to site and assembled by third parties.

The main sewage treatment processes are:

- Preliminary Treatment: This is the first stage of sewage treatment plant process and its main objective is the removal of coarse solids and other large materials often found in raw wastewater;
- Primary Treatment: The main purpose of this treatment is to reduce any heavy solids (organic & inorganic) that settle to the bottom by sedimentation while oil, grease & lighter solids float to the surface by skimming. Primary treatment generally removes about 60% of suspended solids from wastewater;
- Secondary Treatment: The prime objective is the further treatment of the effluent from primary treatment to remove dissolved and suspended biological matter. The biological solids removed during secondary sedimentation, called secondary or biological sludge, are normally combined with primary sludge for sludge processing. Secondary treatment removes more than 90% of suspended solids; and
- Tertiary/Advanced Treatment: Tertiary treatment generally follows secondary treatment and aids the removal of those wastewater constituents which cannot be removed in secondary treatment. Tertiary treated effluent will be irrigated to land at the Federation Site in a dedicated irrigation area. Maintenance or the sewage treatment plant will be undertaken by qualified third parties to ensure optimal operation.

### 8.12.6 Impact Assessment

#### 8.12.6.1 Construction Waste

Construction activities for the Project will generate various wastes which will be managed and disposed of appropriately. Provided in **Table 8-90** are wastes likely to be generated by construction activities and how they will be managed for the Project.

*Table 8-90 Construction Wastes*

| Waste Type | Classification | Source | Disposal |
|---|---|---|---|
| Office waste – putrescible | General Solid (putrescible) | General office, workshop | Landfill off site |
| Office waste – non-putrescible | General Solid (Non-putrescible) | General office, workshop | Recycled and disposed off site |
| Scrap Metal | General Solid (Non-putrescible) | Excess construction material | Recycled and disposed off site |
| Concrete | General Solid (Non-putrescible) | Foundations, piles | Returned to batch plant |
| General Packaging (cardboard / plastic) | General Solid (Non-putrescible) | Construction related packaging | Recycled and disposed off site |
| Sewage | Liquid | Office, Kitchen and Bathrooms | On site Irrigation or taken off-site to a licensed facility |
| Timber Pallets | General Solid (Non-putrescible) | Construction material bulk deliveries | Segregated and recycled, |
| Degreasing fluids, diesel and other petroleum fluids | Hazardous | Construction Fleet | Off site licensed facility |
| Vegetation | General Solid (Non-putrescible) | Vegetation clearing | Mulched on site |

8.12.6.2 Operations Wastes

Wastes which are generated from operational activities are anticipated to be the same as that currently managed at the Hera Mine. Wastes will continue to be segregated and stored in an appropriate location prior to disposal. Refer to **Table 8-91** for details regarding operational waste management.

Waste rock and tailings will be managed in accordance with the strategy provided in **Section 8.12.5**

### 8.12.7 Mitigation and Management Measures

Opportunities to reduce waste generation will be sought to minimise disposal to landfill. This may include:

- Continued correct classification and labelling of waste materials to ensure they are disposed of correctly;
- Waste binds and disposal areas will be in designated areas accompanied with correct labelling;
- Wastes to be segregated accordingly and recycled where feasible;
- Volumes of wastes generated and disposed will be tracked and collated monthly, with monthly site inspections continuing to identify any additional waste that needs separation or disposal;
- Regular waste audits to be undertaken to identify opportunities for waste reduction or other initiatives to manage waste; and
- Waste disposal off site will be conducted by relevant appropriately licenced contractors, depending on the waste type.

A waste management plan (WMP) will be developed for the Project. The WMP is to include the following:

- Waste management principles including legislative and relevant waste management guidelines;
- Document processes and strategies to minimise waste generation on site;
- Identification and classification of wastes managed on site;
- Waste signage and storage requirements;
- Reporting and tracking of waste volumes on a monthly basis;
- Waste disposal requirements offsite and licencing requirements;
- Roles and responsibilities; and
- Process of review and continuous improvement.

Hera Mine currently operates in accordance with an approved waste rock management plan. It is proposed that a new waste rock management plan be developed to reflect the operations of the Project and the specifics of the waste rock geochemistry relevant to the Federation Site.

### 8.12.8 Conclusion

Waste management for the Project will continue practices currently in place at Hera Mine. Wastes will be managed, segregated, stored and labelled in accordance with relevant guidelines and best waste management practices. Waste records will be kept with all waste transported off site by a licensed contractor. A WMP will be developed for the Project covering both construction and operation.

Waste rock will be managed in accordance with a Waste Rock Management Plan. Waste rock will be tested and segregated on site between NAF and PAF. All waste rock pads will drain to a lined leach pond. No PAF material will remain on site at the end of mining and all PAF will be placed underground. Tailings management will continue to be in accordance with the Hera Mine TSF Operation and Maintenance Manual. The tailings risk assessment concluded that when appropriate management and mitigation measures were applied, the majority of risks were ranked low to moderate.

## 8.13 Traffic and Transport

### 8.13.1 Introduction

A Road Transport Assessment (RTA) was prepared by The TTPP for the Project (TTPP, 2021) and is included as **Appendix C.**

### 8.13.2 Assessment Requirements

The SEARS required the assessment of Project impacts associated with traffic and transport. These are provided in **Table 8-91**.

*Table 8-91 Traffic and Transport SEARS Requirements*

| SEARS Requirement | Reference |
|---|---|
| Traffic and Transport – including an assessment of:<br>-the likely traffic and transport impacts of the development on the capacity, condition, safety and efficiency of the road and rail network and any cumulative impacts of other developments in the locality, | **Section 8.13.5**<br>**Section 8.13.5.8** |

| | |
|---|---|
| documented in a Transport Assessment prepared in accordance with relevant guidelines and including a description of: | |
| The site access routes and site access points in accordance with the *Roads Act 1993*; and | **Figure 8-43** |
| Of measures, including upgrade works, that would be implemented to mitigate and / or manage potential traffic impacts developed in consultation with the relevant road authority; | **Section 8.13.5.5**<br>**Section 8.13.5.6**<br>**Section 8.13.5.7** |

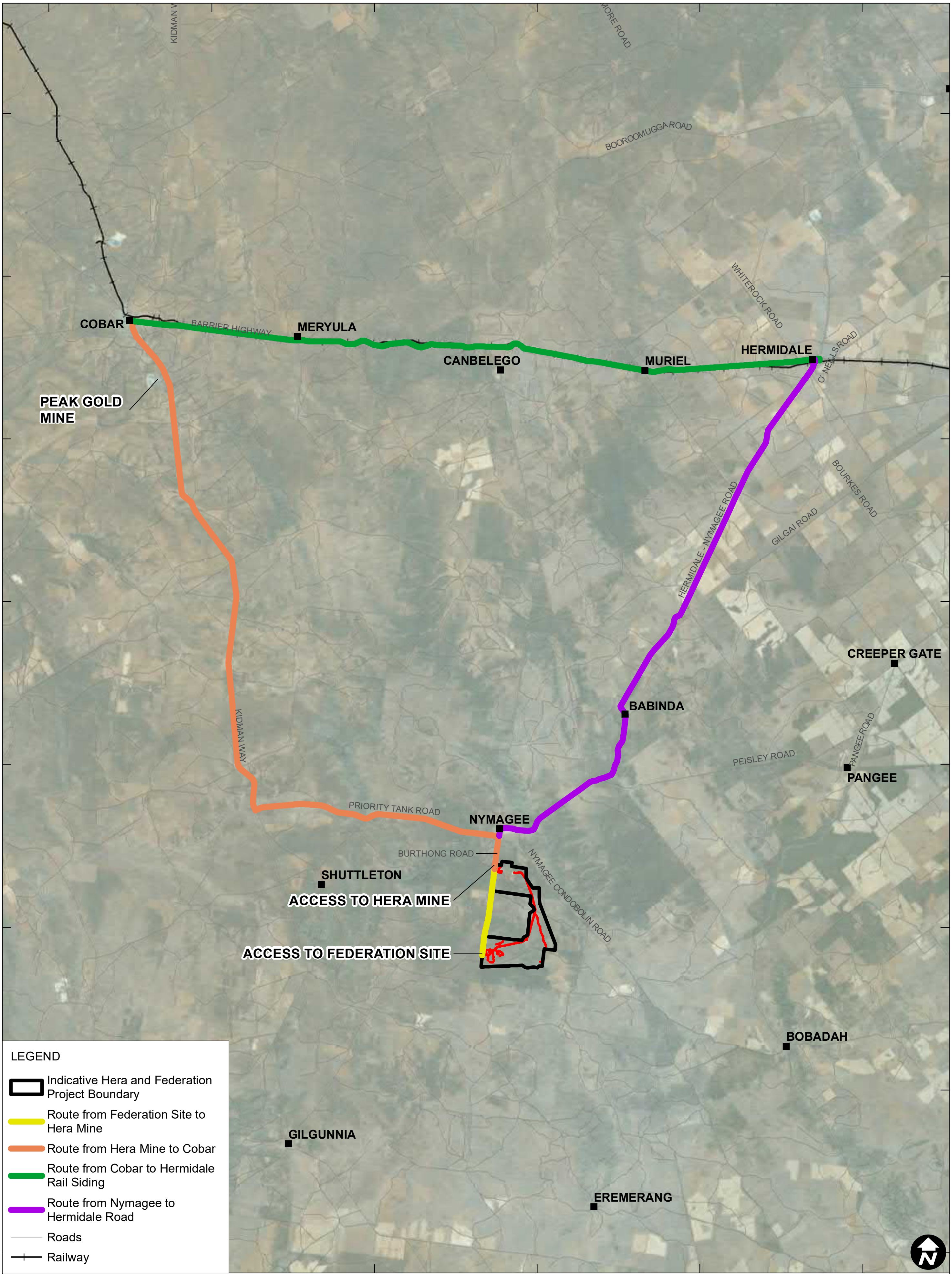
### 8.13.3 Existing Environment

**Table 8-92** provides an overview of the existing road network relevant to the Project as presented in **Figure 8-43.** Further information on the existing road network is provided in Section 4.1 of **Appendix C.**

*Table 8-92 Existing Road Network Summary*

| Road | Status | Description |
|---|---|---|
| Burthong Road | Local (Shire Road 19) | ▪ Connects Nymagee in the north to Tallebung Road at Eremerang in the south.<br>▪ Provides light and heavy vehicle access to Hera Mine with satisfactory clear sight lines<br>▪ Sealed for approximately 6 km south of Nymagee and unsealed over the remaining 48 km. Sealed section is ~ 7 m wide. Posted speed limit of 100 km/h<br>▪ Unsealed section starts 2.2 km south of Hera Mine with wide gravel surface. At 3 km south road narrows to a single lane gravel road suitable for speeds of approximately 80 – 90 km/h |
| Hartwood Street and Milford Street | Local Roads | ▪ The posted speed limits along both roads within the vicinity of Nymagee village centre are 50 km/h with a 100 km/h speed limit outside of the village |
| Whitbarrow Way | Main Road (MR 228) | ▪ Provides a connection between Nymagee in the southwest and Hermidale in the northeast.<br>▪ Posted speed limit of 100 km/h – reduces to 50 km/h within Hermidale |
| Nyamgee Hermidale Road | Main Road (MR 228) | ▪ Provides a connection between Nymagee in the southwest and Hermidale in the northeast<br>▪ Posted speed limit of 100 km/h<br>▪ Recently upgraded over 7 km length to improve safety and provide all-weather access to the Hermidale Rail Siding on the Narromine to Cobar rail line |

| | | |
|---|---|---|
| Priory Tank Road | Regional Road (MR 461) | ▪ Provides an east-west link between Kidman Way and Nymagee.<br>▪ Has a single travel lane in each direction across a carriageway of approximately 6.6 m.<br>▪ The intersection of Priory Tank Road with Kidman Way is a priority-controlled T-intersection, at which Priory Tank Road forms the minor road.<br>▪ Sight distances in both directions for vehicles on the Priory Tank Road (minor road) approach at the intersection are satisfactory |
| Kidman Way | State road (MR 461) | ▪ Forms part of a regional link through western NSW between Mitchell Highway at Bourke and Newell Highway<br>▪ Typically has a single travel lane in each direction, with either solid double centrelines or a single broken centreline, with sealed shoulders<br>▪ Posted speed limit of 100 km/h |
| Barrier Highway | State Highway (HW8) | ▪ Provides a link between Mitchell Highway at Nyngan and the South Australian border at Cockburn<br>▪ Forms part of the approved Hera Mine Secondary Concentrates Transport Route<br>▪ One travel lane in each direction, separated by either double white lines or a broken white line and a posted speed limit of 110 km/h |




Scale: 1:600,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020

SLR

**EXISTING ROAD NETWORK**

**FIGURE 8-43**

H:\Projects-SLR\660-SrvWOL\660-WOL\660.30090.00000 Federation Project Approvals\06 SLR Data\01 CADGIS\GIS\SLR66030090_EIS_G12_TransportRoutes_002.mxd

#### 8.13.3.1 Traffic Volumes

TfNSW collects and publishes traffic volume data online from selected locations on its roads (TfNSW, 2020). Available data on roads in the vicinity of Hera Mine were reviewed and collated, with a summary below:

- Hermidale Nymagee Road 1.8 km south of Currans Road (station 96552). The most recent data is from 2008, which shows that at that time, it carried an average of 1,025 vehicles per day, of which 20.6 percent were heavy vehicles;
- Kidman Way 3.95 km south of East Parade, Cobar (station 96089). The most recent data is from 2008, which shows that at that time, it carried an average of 201 vehicles per day, of which 30.4 percent were heavy vehicles;
- Kidman Way 170 m south of Nyngan Road (Barrier Highway) (station 96088). The most recent data is from 2008, which shows that at that time, it carried an average of 832 vehicles per day, of which 13.9 percent were heavy vehicles; and
- Nyngan Road (Barrier Highway) 50 m west of Hartman Street (station 96001). The most recent data is from 2009, which shows that at that time, it carried an average of 546 vehicles per day, of which 22.3 percent were heavy vehicles. Data from 2008 shows that at that time, it carried an average of 604 vehicles per day, of which 20.7 percent were heavy vehicles.

TTPP were also provided data from Cobar Shire Council, which is summarised **Table 8-93**.

*Table 8-93 Traffic Volumes*

| Road | Location | Year | Vehicles per Day | Percent Heavy Vehicles |
|---|---|---|---|---|
| Barrier Highway | 10 km west of Cobar | 2013 | 441 | 53 |
| Barrier Highway | 3 km east of Cobar | 2013 | 710 | 30 |
| Kidman Way | 10 km south of Cobar | 2013 | 851 | 28.2 |
| Kidman Way | 20 km south of Cobar | 2013 | 248 | 47.9 |
| Priory Tank Road | 5 km east of Kidman Way | 2013 | 58 | 27.3 |
| Whitbarrow Road | 4 km east of Nymagee | 2014 | 73 | 27.6 |
| Hartwood Street (Burthong Road) | 50 m south of Pub | 2016 | 126 | 25.5 |
| Milford Street | 50 m east of Pub | 2016 | 90 | 35.5 |

### 8.13.4 Assessment Approach

The assessment was undertaken to determine whether the Project had the potential to result in a negative impact to the road network. The following analysis was undertaken which considered impacts from both construction and operation. The assessment included:

- Establishment of the existing road conditions as described in **Section 8.13.3;**

- Collation of current traffic volume data, which included consideration of proposed developments in the vicinity of the Project;
- A review of available road safety data;
- Documenting construction activity trip generation including the workforce and deliveries;
- Identifying non haulage operational activity trip generation including operational workforce and deliveries;
- Detailing Project haulage activity including:
  i. Ore transport;
  ii. Concentrate transport;
  iii. Tailings transport;
  iv. An assessment of road network efficiency by establishing the current Level of Service (LOS) for the existing road network; and
  v. An assessment of intersection performance by the use of the SIDRA INTERSECTION 9 modelling.

The results of the assessment are discussed in the following section.

### 8.13.5 Predicted Impacts

#### 8.13.5.1 Construction Traffic Generation

Construction workforce would travel between the accommodation village located at Hera Mine and either the new processing plant site at Hera Mine or the Federation Site at the start and end of shifts. The Project's construction workforce of up to 100 people would work 20 days on and 8 days off, such that approximately three-quarters of the workforce would be expected to be present on any one day. On this basis, it is estimated that approximately 75 construction workers would work each day, of which approximately 75% would be working at the processing plant site at Hera Mine, and 25% would be working at the Federation Site. Workers travelling to the Federation Site would be in one shuttle bus and up to five other vehicles, generating 12 vehicle trips per day on that part of Burthong Road.

It has been assumed that outside of the shift changeover days, the Project construction workforce is expected to generate very few vehicle trips on the wider road network beyond those trips between the accommodation village and Federation Site. At the start and end of their roster period, the construction workers would travel by private car or a chartered bus to or from a regional centre such as Dubbo. **Table 8-94** provides a summary of workforce trips on shift changeover days.

*Table 8-94 Project Construction Workforce Trips on Shift Changeover Days*

| Road and Location | Daily Travel to/from Work | | Shift Change Travel | | General Travel | Total Vehicle Trips |
|---|---|---|---|---|---|---|
| | Cars | Buses | Cars | Buses | Cars | |
| Daily Trips (vehicles per day) | | | | | | |
| Burthong Road<br>Hera Mine to Priory Tank Road | 0 | 0 | 20 | 2 | 18 | 40 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Burthong Road<br>Federation Site to Hera Mine | 10 | 2 | 0 | 0 | 0 | 12 |
| Federation Site Access Roads | 10 | 2 | 0 | 0 | 0 | 12 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 0 | 0 | 18 | 2 | 0 | 20 |
| Hera Mine Access Roads | 10 | 2 | 20 | 2 | 18 | 52 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 0 | 0 | 2 | 0 | 18 | 20 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 0 | 0 | 2 | 0 | 18 | 20 |
| **Peak Hourly Trips (vehicles per hour)** | | | | | | |
| Burthong Road<br>Hera Mine to Priory Tank Road | 0 | 0 | 10 | 1 | 2 | 13 |
| Burthong Road<br>Federation Site to Hera Mine | 5 | 1 | 0 | 0 | 0 | 6 |
| Federation Site Access Roads | 5 | 1 | 0 | 0 | 0 | 6 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 0 | 0 | 9 | 1 | 0 | 10 |
| Hera Mine Access Roads | 5 | 1 | 10 | 1 | 2 | 19 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 0 | 0 | 1 | 0 | 2 | 3 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 0 | 0 | 1 | 0 | 2 | 3 |

**Table 8-94** above indicates that the construction workforce can be expected to generate up to 52 vehicle trips per day on a shift changeover day. Of those, 12 vehicle trips would be contained to that part of Burthong Road between Hera Mine and Federation Site, with up to 20 vehicle trips to Hermidale, and 20 vehicle trips per day to Cobar.

Construction activity would require deliveries of materials and consumables, using a range of vehicles including semitrailers, B-doubles and road trains. An average of approximately 25 deliveries would be required each week. Deliveries would typically occur during daylight hours only, and would be spread across seven days per week. To allow for the variation in trips from day-to-day, and for ongoing deliveries associated with the accommodation village, the assessment assumed six deliveries may occur per day, and that at least one delivery to each site (Hera Mine or Federation Site) from each source would occur during the peak hours.

The resulting contribution of delivery vehicle trips to daily and peak hour traffic on the road network is summarised in **Table 8-95** below.

*Table 8-95 Construction Project Deliveries*

| Road and Location | Daily Trips (vehicles per day) | | | Peak Hour Trips (vehicles per hour) | | |
|---|---|---|---|---|---|---|
| | Hera Mine | Federation Site | Total | Hera Mine | Federation Site | Total |
| Burthong Road<br>Hera Mine to Priory Tank Road | 8 | 4 | 12 | 2 | 2 | 4 |
| Burthong Road<br>Federation Site to Hera Mine | 0 | 4 | 4 | 0 | 2 | 2 |
| Federation Site Access Roads | 0 | 4 | 4 | 0 | 2 | 2 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 4 | 2 | 6 | 1 | 1 | 2 |
| Hera Mine Access Roads | 8 | 0 | 8 | 2 | 0 | 2 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 4 | 2 | 6 | 1 | 1 | 2 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 4 | 2 | 6 | 1 | 1 | 2 |

The total daily and peak hourly traffic expected to be generated during the six-to-12-month construction period and its distribution on the road network is summarised in Table 8-96.

*Table 8-96 Total Construction Traffic*

| Road and Location | Daily Trips (vehicles per day) | | | | Peak Hour Trips (vehicles per hour) | | | |
|---|---|---|---|---|---|---|---|---|
| | Cars | Buses | Heavy | Total | Cars | Buses | Heavy | Total |
| Burthong Road<br>Hera Mine to Priory Tank Road | 38 | 2 | 12 | 52 | 12 | 1 | 4 | 17 |
| Burthong Road<br>Federation Site to Hera Mine | 10 | 2 | 4 | 16 | 5 | 1 | 2 | 8 |
| Federation Site Access Roads | 10 | 2 | 4 | 16 | 5 | 1 | 2 | 8 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 18 | 2 | 6 | 26 | 9 | 1 | 2 | 12 |
| Hera Mine Access Roads | 48 | 4 | 8 | 60 | 17 | 2 | 2 | 21 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 20 | 0 | 6 | 26 | 3 | 0 | 2 | 5 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 20 | 0 | 6 | 26 | 3 | 0 | 2 | 5 |

### 8.13.5.2 Non Haulage Operational Traffic Generation

Similar to the existing operational workforce at Hera Mine, the Project's operational workforce of up to 239 people would be made up of people working principally a roster of seven days on and seven days off, with some working an eight day/six day roster. On a day-to-day basis, the operational workforce would travel between the accommodation village and the Federation Site at the start and end of shifts. Similar to the construction workforce, a shuttle bus service would be implemented to transport the operational workforce between the accommodation village and Federation Site, using Coaster-style shuttle buses. **Table 8-97** provides a summary of peak operational workforce trips.

*Table 8-97 Peak Operational Workforce Trips on Shift Changeover Days*

| Road and Location | Daily Travel to/from Work | | General Travel | Shift Change Travel | Total Vehicle Trips |
|---|---|---|---|---|---|
| | Cars | Buses | Cars | Cars | |
| Daily Trips (vehicles per day) | | | | | |
| Burthong Road<br>Hera Mine to Priory Tank Road | 0 | 0 | 42 | 106 | 148 |
| Burthong Road<br>Federation Site to Hera Mine | 20 | 12 | 21 | 0 | 53 |
| Federation Site Access Roads | 20 | 12 | 21 | 0 | 53 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 0 | 0 | 4 | 96 | 100 |
| Hera Mine Access Roads | 20 | 12 | 21 | 106 | 159 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 0 | 0 | 38 | 10 | 48 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 0 | 0 | 38 | 10 | 48 |
| Peak Hourly Trips (vehicles per hour) | | | | | |
| Burthong Road<br>Hera Mine to Priory Tank Road | 0 | 0 | 4 | 27 | 31 |
| Burthong Road<br>Federation Site to Hera Mine | 10 | 6 | 2 | 0 | 18 |
| Federation Site Access Roads | 10 | 6 | 2 | 0 | 18 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 0 | 0 | 0 | 24 | 24 |
| Hera Mine Access Roads | 10 | 6 | 2 | 27 | 45 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 0 | 0 | 4 | 3 | 7 |

| | | | | | |
|---|---|---|---|---|---|
| Priory Tank Road<br>Kidman Way to Burthong Road | 0 | 0 | 4 | 3 | 7 |

The assessment also assumes the Project would generate approximately 20 heavy vehicle trips per day for deliveries, of which 12 trips are assumed to be associated with the operational activities and accommodation village at Hera Mine, and eight are assumed to be associated with operational activities at Federation Site. These are provided in **Table 8-98** below**.**

*Table 8-98 Project Operational Delivery Trips*

| Road and Location | Daily Trips (vehicles per day) | | Peak Hour Trips (vehicles per hour) | |
|---|---|---|---|---|
| | Hera Mine | Federation Site | Hera Mine | Federation Site |
| Burthong Road<br>Hera Mine to Priory Tank Road | 12 | 8 | 2 | 3 |
| Burthong Road<br>Federation Site to Hera Mine | 0 | 8 | 0 | 3 |
| Federation Site Access Roads | 0 | 8 | 0 | 3 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 2 | 2 | 1 | 2 |
| Hera Mine Access Roads | 12 | 0 | 2 | 0 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 10 | 6 | 1 | 1 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 10 | 6 | 1 | 1 |

The total daily and peak hourly traffic expected to be generated by the operational activity of the Project, excluding haulage of ore, concentrates and tailings, and its distribution on the road network is summarised in **Table 8-99.**

*Table 8-99 Daily and Peak Hour Project Peak Operational Non-Haulage Trips*

| Road and Location | Daily Trips (vehicles per day) | | | | Peak Hour Trips (vehicles per hour) | | | |
|---|---|---|---|---|---|---|---|---|
| | Cars | Buses | Heavy | Total | Cars | Buses | Heavy | Total |
| Burthong Road<br>Hera Mine to Priory Tank Road | 148 | 0 | 20 | 168 | 31 | 0 | 5 | 36 |
| Burthong Road<br>Federation Site to Hera Mine | 41 | 12 | 8 | 61 | 12 | 6 | 3 | 21 |
| Federation Site Access Roads | 41 | 12 | 8 | 61 | 12 | 6 | 3 | 21 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 100 | 0 | 4 | 104 | 24 | 0 | 3 | 27 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Hera Mine Access Roads | 147 | 12 | 12 | 171 | 39 | 6 | 2 | 47 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 48 | 0 | 16 | 64 | 7 | 0 | 2 | 9 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 48 | 0 | 16 | 64 | 7 | 0 | 2 | 9 |

#### 8.13.5.3 Haulage Operational Traffic

*Ore*

Based on the forecast ore processing (refer **Section 4.3.1**), the average daily trips generated by the transport of ore have been determined and are summarised in **Table 8-100.** It is reasonable to expect that the number of ore haulage trips on any one day varies from the average, and for the purposes of assessing the road network capacity, a higher than average haulage level was considered.

*Table 8-100 Project Ore Transport and Daily Vehicle Trips*

| Year | Project Ore Processed at Hera Mine | | | Project Ore Processed at Peak Mine | | |
|---|---|---|---|---|---|---|
| | tpa | Daily Vehicle Trips | | tpa | Daily Vehicle Trips | |
| | | Average | Maximum | | Average | Maximum |
| FY2023 | - | 0.0 | 0 | 0 | 0 | 0 |
| FY2024 | 170,120 | 18.6 | 30 | 150,000 | 16.4 | 23 |
| FY2025 | 359,909 | 39.4 | 60 | 200,000 | 21.9 | 30 |
| FY2026 | 364,507 | 39.9 | 60 | 200,000 | 21.9 | 30 |
| FY2027 | 482,977 | 52.9 | 90 | 200,000 | 21.9 | 30 |
| FY2028 | 752,055 | 82.4 | 120 | 0 | 0 | 0 |
| FY2029 | 750,000 | 82.2 | 120 | 0 | 0 | 0 |
| FY2030 | 720,193 | 78.9 | 120 | 0 | 0 | 0 |
| FY2031 | 749,892 | 82.2 | 120 | 0 | 0 | 0 |
| FY2032 | 732,302 | 80.3 | 120 | 0 | 0 | 0 |
| FY2033 | 644,407 | 70.6 | 90 | 0 | 0 | 0 |
| FY2034 | 337,413 | 37.0 | 60 | 0 | 0 | 0 |
| FY2035 | 98,108 | 10.8 | 30 | 0 | 0 | 0 |
| FY2036 | 34,631 | 3.8 | 30 | 0 | 0 | 0 |

*Concentrate*

Based on the forecast concentrates production (refer **Section 4.17**) the average daily trips generated by the transport of concentrates has been determined and are summarised in **Table 8-101** throughout the life of the Project. This assumes the Project haulage is undertaken with vehicles similar to those currently in use at Hera Mine, i.e., Type 1 A-double road trains and modular B-triple road trains with a payload of 50 tonnes. For a conservative assessment, a design day representing double the average daily haulage trips was assumed.

*Table 8-101 Project Concentrates Transport and Daily Vehicle Trips*

| Year | Concentrate Production at Hera Mine | Daily Vehicle Trips | |
|---|---|---|---|
| | | Average | Design Day |
| FY2023 | - | 0.0 | 0 |
| FY2024 | 18,891 | 2.1 | 5 |
| FY2025 | 51,573 | 5.7 | 12 |
| FY2026 | 70,487 | 7.7 | 16 |
| FY2027 | 86,011 | 9.4 | 19 |
| FY2028 | 142,432 | 15.6 | 32 |
| FY2029 | 154,470 | 16.9 | 34 |
| FY2030 | 105,350 | 11.5 | 24 |
| FY2031 | 120,009 | 13.2 | 27 |
| FY2032 | 145,588 | 16.0 | 32 |
| FY2033 | 95,496 | 10.5 | 21 |
| FY2034 | 41,342 | 4.5 | 10 |
| FY2035 | 10,237 | 1.1 | 3 |
| FY2036 | 4,334 | 0.5 | 1 |

### *Tailings*

Based on the forecast tailings demand at Federation Site (refer **Section 4.18**), the average daily trips generated by the transport of tailings has been determined and are summarised in **Table 8-102** throughout the life of the Project. This assumes the Project haulage is undertaken with vehicles similar to those currently in use at Hera Mine, i.e., Type 1 A-double road trains and modular B-triple road trains with a payload of 50 tonnes.

*Table 8-102 Project Tailings Transport and Daily Vehicle Trips*

| Year | Tailings Demand by Federation Site | Daily Vehicle Trips | |
|---|---|---|---|
| | | Average | Maximum |
| FY2023 | - | 0.0 | 0 |
| FY2024 | 170,744 | 18.7 | 32 |
| FY2025 | 287,806 | 31.5 | 64 |
| FY2026 | 273,208 | 29.9 | 64 |
| FY2027 | 336,809 | 36.9 | 64 |
| FY2028 | 365,774 | 40.1 | 64 |
| FY2029 | 357,318 | 39.2 | 64 |
| FY2030 | 368,906 | 40.4 | 64 |
| FY2031 | 377,930 | 41.4 | 64 |
| FY2032 | 352,029 | 38.6 | 64 |
| FY2033 | 329,346 | 36.1 | 64 |
| FY2034 | 177,642 | 19.5 | 32 |

| | | | |
|---|---|---|---|
| FY2035 | 52,723 | 5.8 | 32 |
| FY2036 | 18,178 | 2.0 | 32 |

Taking into consideration the routes used by the haulage trucks transporting ore, concentrates and tailings on the public road network, the distribution of the Project haulage truck trips on the road network has been determined throughout the life of the Project, as presented in **Table 8-103.**

*Table 8-103 Project Ore, Concentrates and Tailings Transport Daily Trips*

| Year | Burthong Road between Federation Site and Hera Mine | | Burthong Road between Hera Mine and Priory Tank Road | | Principal Concentrates Transport Route between Priory Tank Road and Hermidale | | Secondary Concentrates Transport Route between Burthong Road and Peak Mine | |
|---|---|---|---|---|---|---|---|---|
| | Average | Maximum | Average | Maximum | Average | Maximum | Average | Maximum |
| FY2023 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0.0 |
| FY2024 | 53.8 | 85 | 18.5 | 28 | 2.1 | 5 | 16.4 | 23 |
| FY2025 | 92.9 | 154 | 27.6 | 42 | 5.7 | 12 | 21.9 | 30 |
| FY2026 | 91.8 | 154 | 29.6 | 46 | 7.7 | 16 | 21.9 | 30 |
| FY2027 | 111.8 | 184 | 31.3 | 49 | 9.4 | 19 | 21.9 | 30 |
| FY2028 | 122.5 | 184 | 15.6 | 32 | 15.6 | 32 | 0.0 | 0 |
| FY2029 | 121.3 | 184 | 16.9 | 34 | 16.9 | 34 | 0.0 | 0 |
| FY2030 | 119.4 | 184 | 11.5 | 24 | 11.5 | 24 | 0.0 | 0 |
| FY2031 | 123.6 | 184 | 13.2 | 27 | 13.2 | 27 | 0.0 | 0 |
| FY2032 | 118.8 | 184 | 16.0 | 32 | 16.0 | 32 | 0.0 | 0 |
| FY2033 | 106.7 | 154 | 10.5 | 21 | 10.5 | 21 | 0.0 | 0 |
| FY2034 | 56.4 | 92 | 4.5 | 10 | 4.5 | 10 | 0.0 | 0 |
| FY2035 | 16.5 | 62 | 1.1 | 3 | 1.1 | 3 | 0.0 | 0 |
| FY2036 | 5.8 | 62 | 0.5 | 1 | 0.5 | 1 | 0.0 | 0 |

**Table 8-103** demonstrates that the peak (shaded) cumulative haulage of ore, tailings and concentrates associated with the Project would occur at different times on different parts of the road network.

#### 8.13.5.4 Future Combined Traffic Volumes

*Construction*

For the purpose of the assessment of the construction impacts of the Project, the following scenario for cumulative traffic generation (refer **Table 8-104**) has been adopted to provide a conservative outcome:

- Background (non-Aurelia) traffic during year 2023;
- Hera Mine (inclusive of approved activities under Modification 6) operating, with design day traffic generation including average day waste rock haulage; and
- Project construction traffic on a shift change day.

*Table 8-104 Forecast Traffic Volumes During Project Construction*

| Road and Location | Daily Trips (vehicles per day) | | | | Peak Hour Trips (vehicles per hour) | | | |
|---|---|---|---|---|---|---|---|---|
| | Light | Buses | Heavy | Total | Light | Buses | Heavy | Total |
| Burthong Road<br>Hera Mine to Priory Tank Road | 169 | 2 | 86 | 257 | 40 | 1 | 13 | 54 |
| Burthong Road<br>Federation Site to Hera Mine | 111 | 2 | 78 | 191 | 18 | 1 | 11 | 30 |
| Federation Site Access Roads | 10 | 2 | 44 | 56 | 5 | 1 | 6 | 12 |
| Hartwood Street – Milford Street – Whitbarrow Way – Nymagee Hermidale Road | 123 | 2 | 50 | 175 | 24 | 1 | 8 | 33 |
| Hera Mine Access Roads | 78 | 4 | 88 | 170 | 32 | 2 | 10 | 44 |
| Kidman Way<br>Priory Tank Road to Barrier Highway | 189 | 0 | 167 | 356 | 34 | 0 | 19 | 53 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 93 | 0 | 53 | 146 | 22 | 0 | 8 | 30 |

*Operations*

For the purpose of the assessment of the operational impacts of the Project, the following cumulative traffic has been considered over the life of the Project to provide a conservative outcome:

- Background (non-Aurelia) traffic;
- Hera Mine (inclusive of approved activities under Modification 6) operating to the end of 2025, with design day traffic generation ;
- Project operational non-haulage traffic on a shift change day, robustly assuming that the operational workforce remains at its peak level throughout the life of the Project; and
- Project operational haulage traffic on a design day.

**Table 8-105** indicates that peak conditions with the Project may occur between 2027 and 2032 at different locations on the road network.

*Table 8-105 Maximum Daily Traffic During Project Operations (vehicles per day)*

| Road and Location | Peak Year | Light | Buses | Heavy[A] | Haulage | Total |
|---|---|---|---|---|---|---|
| Burthong Road<br>Hera Mine to Priory Tank Road | 2027 | 253 | 0 | 56 | 49 | 358 |
| Burthong Road<br>Federation Site to Hera Mine | 2032 | 151 | 12 | 46 | 184 | 393 |
| Federation Site Access Roads | 2032 | 41 | 12 | 8 | 184 | 245 |
| Hartwood Street<br>south of Nymagee | 2032 | 210 | 0 | 42 | 32 | 284 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Hera Mine Access Roads | 2029 | 147 | 12 | 12 | 218 | 389 |
| Kidman Way<br>Priory Tank Road to Peak Mine | 2027 | 196 | 0 | 153 | 30 | 379 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 2027 | 97 | 0 | 34 | 30 | 161 |

[A] excluding materials haulage

**Table 8-106** summarises the forecast peak hourly traffic volumes on a design day during the Project operations.

*Table 8-106 Maximum Peak Hourly Traffic During Project Operations (vehicles per hour)*

| Road and Location | Peak Year | Light | Buses | Heavy[A] | Haulage | Total |
|---|---|---|---|---|---|---|
| Burthong Road<br>Hera Mine to Priory Tank Road | 2027 | 44 | 0 | 10 | 5 | 59 |
| Burthong Road<br>Federation Site to Hera Mine | 2032 | 55 | 12 | 13 | 18 | 98 |
| Federation Site Access Roads | 2032 | 12 | 6 | 3 | 18 | 39 |
| Hartwood Street<br>south of Nymagee | 2032 | 38 | 0 | 8 | 3 | 49 |
| Hera Mine Access Roads | 2029 | 39 | 6 | 2 | 22 | 69 |
| Kidman Way<br>Priory Tank Road to Peak Mine | 2027 | 25 | 0 | 19 | 3 | 47 |
| Priory Tank Road<br>Kidman Way to Burthong Road | 2027 | 13 | 0 | 5 | 3 | 21 |

[A] excluding materials haulage

**Table 8-106** indicates that traffic volumes on the public roads would remain below 100 vehicles per hour throughout the life of the Project.

#### 8.13.5.5 Road Network Efficiency

Level of Service (LOS) is defined as a qualitative measure describing the operational conditions within a traffic stream as perceived by drivers and/or passengers. A LOS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. LOS A provides the best traffic conditions, with no restriction on desired travel speed or overtaking. LOS B to D describe progressively worse traffic conditions. LOS E occurs when traffic conditions are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre in the traffic stream. In rural situations, LOS C is generally considered to be acceptable.

The forecast peak hourly traffic volumes have been assessed using the Highway Capacity Model (HCM) model. **Table 8-107** summarises the results of the assessment of midblock LOS with and without the Project construction and operational activity during 2024 on the surveyed roads during the peak hours for the direction of travel with the worst result.

*Table 8-107 Indicative Peak Hour Midblock Level of Service in Peak Travel Direction*

| Road | During Project Construction | | | During Peak Project Operations | | | |
|---|---|---|---|---|---|---|---|
| | ATS (km/h) | PTSF (%) | LOS | Year | ATS (km/h) | PTSF (%) | LOS |
| Burthong Road<br>Hera Mine to Priory Tank Road | 105 | 24.3 | A | 2025 | 104 | 24.7 | A |
| Burthong Road<br>Federation Site to Hera Mine | 105 | 22.2 | A | 2031 | 105 | 26.3 | A |
| Hartwood Street<br>south of Nymagee | 105 | 22.1 | A | 2032 | 105 | 23.6 | A |
| Kidman Way<br>Priory Tank Road to Peak Mine | 105 | 24.7 | A | 2025 | 105 | 24.5 | A |
| Priory Tank Road<br>Kidman Way to Burthong Road | 105 | 21.8 | A | 2025 | 105 | 21.0 | A |

The results indicate that during the peak hours with the Project a LOS of A would be achieved equating to the best traffic conditions, with drivers experiencing freedom to travel at their desired speed or overtake.

#### 8.13.5.6 Intersection Operations

With the Project, both Kidman Way and Priory Tank Road would experience peak volumes during 2027. On a design day in 2027, Kidman Way is forecast to carry up to 47 vehicles per hour, and Priory Tank Road is forecast to carry 21 vehicles per hour. The peak hour trips generated by vehicles associated with the Project are summarised in **Table 8-108.**

*Table 8-108 Cumulative Aurelia Traffic – Priory Tank Road and Kidman Way Intersection 2025*

| | Total Peak Hour Trips (vehicles per hour) | Estimated Trips in Peak Direction | Estimated Trips in Contrapeak Direction |
|---|---|---|---|
| Project Workforce | 7 | 5 | 2 |
| Project Deliveries | 2 | 1 | 1 |
| Project Haulage | 3 | 2 | 1 |
| **Total** | **12** | **8** | **4** |

An indicative assessment of the operation of the intersection was conducted using SIDRA INTERSECTION 9 software. The analysis indicates that the movement with the highest average delay per vehicle would be the right turn exit from Priory Tank Road to Kidman Way, which would experience an average delay per vehicle of 13.2 seconds per vehicle. This is consistent with LOS A based on the standard level of service criteria adopted by TfNSW.

#### 8.13.5.7 Intersection Treatments

The geometry of the existing intersections along the routes that would be used by Project vehicles were reviewed with regard to its use by the additional Project-generated vehicles including road trains. The general minimum preferred treatment at rural road intersections are Basic Auxiliary Left (BAL) and Basic Auxiliary Right (BAR) treatments, which provide widened shoulders on the major road to allow additional space for through vehicles to pass around vehicles which have slowed to turn.

*Kidman Way and Priory Tank Road*

At the intersection of Kidman Way and Priory Tank Road, the Project would generate additional road train movements turning left from Kidman Way into Priory Tank Road, which would warrant a BAL treatment on Kidman Way.

*Priory Tank Road, Burthong Road and Hartwood Street*

At the intersection of Burthong Road, Hartwood Street and Priory Tank Road, the Project would generate additional road train movements turning left and right between Burthong Road and Priory Tank Road and additional road train movements travelling northbound and southbound between Burthong Road and Hartwood Street. With the forecast conditions with the Project traffic, the Austroads guidelines warrant a BAL treatment in Burthong Road.

*Burthong Road and Federation Site Accesses*

The Project proposes two access roads from Burthong Road, with the northern intersection being the main site access used by the workforce and delivery vehicles, and the southern intersection being a haul road used by haulage vehicles only. The forecast volumes on Burthong Road and the proposed access roads warrant BAL treatment on Burthong Road at each intersection, with the southern intersection treatment designed to accommodate the swept path of the A-double road trains expected to turn left into and right out of the access road without crossing the centreline of Burthong Road. It is proposed that the intersections each be constructed as a road intersection, with BAL and BAR treatments, designed to accommodate the swept path of the relevant design vehicles.

*Burthong Road Treatment*

Burthong Road is sealed for approximately 6 km south of Nymagee and unsealed over its remaining length. Burthong Road between the Federation Site and Hera Mine is expected to carry up to 393 vehicles per day on a design day in 2031. It was considered that Burthong Road would be considered a Class 4A unsealed road, which are used for major movements between population centres, on which high volumes occur, and which can carry heavy vehicles. Class 4A roads typically carry greater than 150 vehicles per day (average daily traffic), and are constructed as an all-weather road with an operating speed of 50 to 80 km/h. On flat terrain, a minimum formation width including verges of 11 m would be required, including two 3.5 m wide travel lanes, two 1.0 m wide shoulders and two 1.0 m wide verges.

The ARRB Class 4A road standard would be suitable to accommodate the Project traffic on that part of Burthong Road north of the Project that remains unsealed. To minimise road safety risks, it is recommended that the unsealed length of Burthong Road be maintained at a suitable standard to accommodate road trains throughout the life of the Project. Despite the findings, it is proposed that Burthong is sealed and constructed to a suitable standard.

#### 8.13.5.8 Rail Impacts

Currently concentrate from Hera Mine is railed to Newcastle as follows:

- 26t containers trucked to Hermidale rail siding where they are stored at the siding until placement onto the freight trains;
- Each train can accommodate approximately 54 containers per train;

- Approximately one train per week leaves Hermidale for the Port of Newcastle;
- The containers are unloaded at the Port of Newcastle and concentrate stored in a licensed shed prior to being loaded onto the ship;
- The bulk lead/zinc concentrate is then conveyed from shed to ship for export when a ship is available; and
- The empty containers are then railed back to Hermidale and trucked to site for re-loading.

Up to 60,000 t per annum on concentrate can be transported, which equates to approximately 40% the concentrate which will be generated by the Project, at its peak. During the initial 2 – 3 years of Project operations, it is expected that tonnes of concentrate transported will be similar to the approved maximum transport tonnage for Hera Mine. The Project would generate approximately 2 train movements per week, and it is Aurelia's understanding that there is sufficient rail and Port capacity for the increase in concentrate volumes that will be generated by the Project at its peak.

### 8.13.6 Mitigation and Management Measures

The RTA concluded that no specific measures would be required to provide additional capacity to accommodate the Project traffic. In addition to specific intersection upgrades previously recommended to be implemented as part of Hera Mine's operations and the Exploration Decline Program, it is proposed that:

- The intersections of Burthong Road with the proposed Federation Site access roads be constructed as road intersections, with BAL and BAR treatments, designed to accommodate the swept path of the relevant design vehicles;
- Signage be installed to alert drivers to the presence of the Federation Site access and of trucks turning at the intersection;
- The drivers of heavy vehicles associated with the Project be bound by a Driver's Code of Conduct, consistent with that at Hera Mine, and including behavioural expectations for regular drivers associated with the Project;
- Additional signage and guideposts be provided along Burthong Road between Hera Mine and the Federation Site, including at the existing stock grid (if retained) to meet the requirements of AS1742.2;
- A Traffic Management Plan be prepared in consultation with Cobar Shire Council and Bogan Shire Council to address the use of public roads by Project traffic, including:
- Restricting the transport of ore, concentrates and tailings to daylight hours only; and
- Should Burthong Road remain unsealed, restricting the transport of materials during heavy rainfall to prevent damage and to minimise the risk of road crashes due to wet conditions;
- Should Burthong Road remain unsealed, the unsealed length be maintained at a suitable standard consistent with ARRB Class 4A unsealed roads to accommodate road trains throughout the life of the Project;
- Should Burthong Road be sealed, it be constructed to a standard to meet the requirements of Cobar Shire Council or Austroads (2016) for heavy vehicle routes;

- Hera Resources renegotiate the Planning Agreement with Cobar Shire Council regarding annual contributions for road maintenance and repairs on the relevant length of Burthong Road over the life of the Project to reflect the increased heavy vehicle movements;
- Review and update the Planning Agreement between Hera Resources and Bogan Shire Council for annual road repair and maintenance contributions relating to the Principal Concentrates Transport Route to Hermidale;
- Hera Resources investigate opportunities for use of higher capacity vehicles for haulage of ore, tailings and/or concentrates, which would reduce the number of Project-generated trips on the public road network; and
- Hera Resources will investigate the potential to combine ore and tailings haulage fleets between Federation Site and Hera Mine, which would reduce the number of haulage vehicle trips.

### 8.13.7 Conclusion

It is concluded that the existing road network and intersections have adequate capacity to accommodate the Project-generated traffic together with unrelated traffic changes in the region, while maintaining the efficiency and safety of the road network operations at good standards. It is proposed that the mitigation measures outlined in **Section 8.13.6** be implemented to manage impacts on the road network.

## 8.14 Human Health Risk Assessment

### 8.14.1 Introduction

A Human Health Risk Assessment (HHRA) was prepared by Environmental Risk Sciences Pty Ltd (EnRisks), with a summary provided below and the HHRA provided in **Appendix P**.

### 8.14.2 SEARs Requirements

The SEARs for the Project do not include a specific requirement to conduct a HHRA for the EIS. However as impacts of the proposed Project on health is of concern to the community surrounding the Project, as discussed within the SIA, an HHRA has been prepared to assess potential impacts on the community relevant to the Project, including from air emissions and noise.

### 8.14.3 Existing Environment

### 8.14.4 Assessment Approach

The estimation of risk within the HHRA follows the general principles outlined in the enHealth document *Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards* (enHealth, 2012). The HHRA considers both the potential health impacts relating to air emissions and noise emissions, which are deemed the primary potential human health impacts associated with the Project.

#### 8.14.4.1 Air Emissions

The HHRA drew upon the results of the AQIA as summarised in **Section 8.10** and included as **Appendix N.**

Dust or particulate matter is a wide spread air pollutant which can be generated from anthropogenic sources such as combustion or industrial emissions, as well as natural sources such as pollens or mould. The potential for particulate matter to result in adverse health effects is dependent on the size and composition of the particulate matter. The size of particulates is important as it determines how far from an emission source the particulates may be present in air (with larger particulates settling out close to the source and smaller particles remaining airborne for greater distances) and also the potential for adverse effects to occur as a result of exposure (how far the particles can infiltrate into the human respiratory system).

The common measures of particulate matter that are considered in the assessment of air quality and health risks are:

- Total Suspended Solids (TSP): This refers to all particulates with an equivalent aerodynamic particle2 size below 50 µm in diameter;
- $PM_{10}$, particulate matter below 10 µm in diameter, $PM_{2.5}$, particulate matter below 2.5 µm in diameter, $PM_1$, particulate matter below 1 µm in diameter and $PM_{0.1}$, particulate matter below 0.1 µm in diameter ($PM_1$ and $PM_{0.1}$ are termed ultrafine particles): These particles are small and have the potential to penetrate beyond the body's natural filter mechanisms of cilia and mucous in the nose and upper respiratory system, with the smaller particles able to further penetrate into the lower respiratory tract and lungs.

It is well accepted nationally and internationally that monitoring for $PM_{10}$ is a good method of determining the community's exposure to potentially harmful dust (regardless of the source) and is most commonly measured in local and regional air quality monitoring programs. Smaller particles such as $PM_{2.5}$, however, are seen as more significant with respect to evaluating health effects, as a higher proportion of these particles penetrate into the lungs.

The main source of particulate matter in the study area includes agriculture, and emissions from local anthropogenic activities such as motor vehicle exhaust, domestic wood heaters, and bushfire activity. An assessment of existing air quality and dust emissions from the Project are detailed in **Section 8.10** and were incorporated into the HHRA.

### 8.14.5 Predicted Impacts

The HHRA assessed the potential health impacts relating to both particulate size and particulate composition. Provided in this section is a summary of the findings. Further detail can be found in Sections 5.4 and 5.5 of **Appendix P**.

#### 8.14.5.1 Particulate Size

There is strong evidence to conclude (USEPA, 2012) (World Health Organisation, 2003) (World Health Organisation, 2013) that fine particles (<2.5µm, $PM_{2.5}$) are more hazardous than larger ones, primarily on the basis of studies conducted in urban air environments where there is a higher proportion of fine particles and other gaseous pollutants present from fuel combustion sources, as compared to particles derived from crustal origins. For the purpose of the HHRA, the health effects of exposure to particulate matter have been evaluated as being the same from all sources.

Particulate matter has been strongly linked to adverse health effects after both short term exposure (days to weeks) and long term exposure (months to years). The health effects vary widely (with the respiratory and cardiovascular systems most affected) and include mortality and morbidity effects.

The vulnerability of populations must also be considered such as older populations, children and those with underlying health conditions.

The assessment of cumulative exposures to $PM_{2.5}$ and $PM_{10}$ is based on a comparison of the predicted cumulative concentrations to the current air quality standards and goals presented in the NEPM (NEPC, 2021). Table 5.1 of the HHRA (refer **Appendix X)** presents a comparison of the current NEPC standards and goals with those established by the WHO (World Health Organisation, 2021).

The AQIA modelled and evaluated total concentrations for $PM_{2.5}$ and $PM_{10}$. As outlines in **Section 8.10.6**, the AQIA concluded the following:

- There are no predicted exceedances of the annual average TSP criterion of 90µg/m3;
- There are no predicted exceedances of the annual average $PM_{10}$ criterion of 20µg/m3;
- For 24-hour average $PM_{10}$, there is one predicted exceedance of the maximum 24-hour average criterion for $PM_{10}$ of 50µg/m3 at all receivers, which is due to a high background concentration of 53.8µg/m3. There are no additional exceedances caused by the Project;
- For annual average $PM_{2.5}$, there are no predicted exceedances of the criterion of 8µg/m3, however there are exceedances of the pending NEPM AAQ standard of 7µg/m3. It should be noted that the exceedance would be due to the background concentration which is already exceeding 7µg/m3, and not due to the Project; and
- For 24-hour average $PM_{2.5}$, there are no predicted exceedances of the maximum 24-hour average assessment criteria of 25 µg/m3 or the pending NEPM AAQ standards of 20µg/m3.

Risk calculations relevant to exposures to $PM_{2.5}$ and $PM_{10}$ by the community were undertaken utilising concentration-response functions relevant to the most significant health effect associated with exposure for all members of the community, namely mortality. The calculation of a relative risk based on the change in relative risk exposure concentration from baseline/existing (i.e. based on incremental impacts from the Project). Data from 2028 as assessed in the AQIA was used in the calculation as determined as the year with the highest emissions.

Exposure to $PM_{10}$ and $PM_{2.5}$ for FY28 was calculated as follows (rounded to 1 significant figure):

- PM10: Risk=$\beta \times \Delta X \times B = 0.0006 \times 1.3 \times 0.005946 = 5 \times 10^{-6}$; and
- PM2.5: Risk=$\beta \times \Delta X \times B = 0.0058 \times 0.2 \times 0.005946 = 7 \times 10^{-6}$.

These risk levels are considered to be negligible or acceptable, as per guidance from enHealth and NEPC (enHealth, 2012) (NEPC, 2011) and NSW EPA (NSW EPA, 2017).

The calculated risks relate to the maximum impacted offsite residential receptor location. Risks are lower at all other residential receivers assessed. On the basis of the above, incremental changes in $PM_{10}$ and $PM_{2.5}$ derived from the Project are considered to have a negligible impact on the health of the off-site community.

#### 8.14.5.2 Particulate Composition

The proposed mining operations involve the handling of ore that is mineralised. In particular, the ore comprises silver, arsenic, cadmium, cobalt, copper, mercury, lead and zinc. As a result, particulate matter released to air from Project emissions will comprise metals. Based on geochemical testing (refer **Section 8.2**), maximum percentage of each metal has been assumed to be present in all dust released to air from the Project activities, and is as follows:

- Silver = 0.0001%;
- Arsenic = 0.03%;

- Cadmium = 0.01%;
- Cobalt = 0.0025 %;
- Copper = 0.04%;
- Mercury = 0.000002%;
- Lead = 0.14%; and
- Zinc = 0.21%.

For the assessment of potential exposure to metals in dust the following model outputs were utilised:

- Metal concentrations present in air as $PM_{10}$ which is the dominant size fraction relevant to the emissions from the Project, that may be inhaled, and which may penetrate into the lungs where it is assumed to be 100% available to be absorbed into the body following exposure. The assessment of exposure has addressed:
    i. Peak short-term or acute exposures, based on the maximum modelled 1 hour average concentration;
    ii. Long-term exposures based on the maximum annual average concentration; and
- Metal concentration present on TSP that is deposited to the ground (as dust deposition) where the metals may accumulate and influence soil concentration, be taken up into homegrown or agricultural produce or deposited onto residential roof areas and washed into rainwater tanks, potentially affecting drinking water quality.

Chemical exposure to members of the community may be through either inhalation of particulate matter or direct contact such as dermal absorption or ingestion. The assessment of risk, relevant to the presence of metals follows the principles outlined in the enHealth document *Environmental Health Risk Assessment: Guidelines for Assessing Human Health Risks from Environmental Hazards* (enHealth, 2012). This approach requires assessment of:

- How people may be exposed to the emissions to air over short-term (acute) and long-term (chronic) (i.e. exposure assessment, as noted above);
- The hazards posed by (or toxicity of) the chemicals present in the emissions (i.e. hazard or toxicity assessment); and
- Calculation of potential risks to health or risk characterisation.

The assessment of acute exposures is based on comparing the maximum predicted 1-hour average exposure concentration with health-based criteria relevant to an acute or short-term exposure, also based on a 1-hour average exposure time. Consistent with guidance provided by enHealth (enHealth, 2012), risks associated with acute exposures are considered to be acceptable where the individual and total Hazard Index (HI)are less than or equal to 1. HIs are the ratio of the maximum predicted concentration to the acute guideline, which relates to the health based toxicity reference value. The calculated acute exposure for the particulate composition is provided in **Table 8-109** below.

*Table 8-109 Review of Acute Exposure Risks*

| Metal | Acute air guideline health ($mg/m^3$) | Air Concentration ($PM_{10}$) – Maximum 1 hour average (($mg/m^3$) | | Calculated HI | |
|---|---|---|---|---|---|
| | | Max anywhere outside the project | Max residential receivers | Max anywhere outside Project | Maximum residential receivers |
| Silver | 0.0025 | 1.2E-06 | 9.4E-08 | 0.00049 | 0.000037 |
| Arsenic | 0.0099 | 3.5E-04 | 2.7E-05 | 0.036 | 0.0027 |
| Cadmium | 0.00055 | 8.2E-06 | 6.3E-07 | 0.015 | 0.0011 |
| Cobalt | 0.00069 | 2.6E-05 | 2.0E-06 | 0.038 | 0.0029 |
| Copper | 0.1 | 4.3E-04 | 3.3E-05 | 0.0016 | 0.00033 |
| Mercury | 0.0006 | 2.0E-08 | 1.5E-09 | 0.000033 | 0.0000026 |
| | | | Total HI | 0.091 | 0.0072 |
| | | | Acceptable HI | ≤ 1 | ≤1 |

Review of **Table 8-109** above indicates all maximum predicted concentrations of chemicals in air are below the health-based criteria protective of acute effects. On the basis of the above assessment there are no acute risk issues of concern in relation to inhalation exposures to emissions from the Project.

For the assessment of chronic exposures, all the chemicals evaluated have a threshold guideline value that enables the predicted annual average concentration to be compared with a health based, or acceptable, guideline. For the assessment of chronic effects, the assessment has also considered potential intake of these chemical substances from other sources, i.e. background intake. Risks associated with chronic exposures are considered to be negligible (or acceptable) where the individual and total HI's are less than or equal to 1.

**Table 8-110** presents the calculated individual HI and the incremental lifetime cancer risk relevant to the assessment of chronic inhalation exposures for the maximum impacted residential receptor.

*Table 8-110 Review of Chronic Inhalation Risks*

| Metal | Air Concentration ($PM_{10}$) – Maximum annual average ($mg/m^3$) | | Calculated HI | |
|---|---|---|---|---|
| | Max anywhere outside the project | Max residential receivers | Max anywhere outside Project | Maximum residential receivers |
| Silver | 1.8E-08 | 1.6E-09 | 0.00000019 | 0.000000078 |
| Arsenic | 5.1E-06 | 4.5E-07 | 0.033 | 0.013 |
| Cadmium | 1.2E-07 | 1.0E-08 | 0.013 | 0.0052 |
| Cobalt | 3.8E-07 | 3.3E-08 | 0.0010 | 0.00042 |
| Copper | 6.2E-06 | 5.5E-07 | 0.0000069 | 0.0000028 |
| Mercury | 2.9E-10 | 2.6E-11 | 0.00000053 | 0.00000021 |

| | | | | |
|---|---|---|---|---|
| Lead | 2.1E-05 | 1.8E-06 | 0.013 | 0.00053 |
| Zinc | 3.1E-05 | 2.8E-06 | 0.000020 | 0.0000079 |
| | | Total HI | 0.049 | 0.020 |
| | | Acceptable HI | ≤ 1 | ≤1 |

Review of **Table 8-110** indicates all individual and the total HI relevant to chronic inhalation exposures are less than 1. On the basis of the above assessment there are no chronic risk issues of concern in relation to inhalation exposures to emissions from the Project.

#### 8.14.5.3 Multiple Pathway Exposures

Where pollutants may be bound to particulates (as TSP), are persistent in the environment and have the potential to bioaccumulate in plants or animals, it is relevant to also assess potential exposures that may occur as a result of particulates depositing to the environment where a range of other exposures may then occur. These include:

- Deposition to water specifically rainwater tanks, where water may be used as potable/drinking water where ingestion and dermal contact is relevant;
- Deposition to soil:
- Incidental ingestion and dermal contact with soil (and dust indoors that is derived from outdoor soil or deposited particulates);
- Ingestion of homegrown fruit and vegetables where chemicals may deposit onto the plants and is also present in the soil where the plants are grown, and where chemicals are taken up into these plants;
- Ingestion of eggs where chemicals may deposit onto pasture and be present in soil (which the soil present where backyard chickens are kept and ingested during feeding), and the chemicals are taken up into the eggs; and
- Ingestion of other produce at a rural residential property, that may include milk (from dairy cows), beef from cattle and lamb.

The HHRA calculated risks associated with the most multiple pathway exposures relevant to both adults and children. These risks have been calculated on the basis of the maximum predicted deposition rate for all of the sensitive residential receivers in the surrounding community.

All calculated risks associated with each individual exposure pathway, as well as a combination of multiple exposure pathways, were below the target risk levels considered representative of negligible/acceptable risks. The calculated HI is dominated by inhalation exposures, with the multi-pathway exposures contributing less to the total HI. On the basis of the assessment undertaken there were no chronic risk issues of concern in relation to multiple pathway exposures that may be relevant to the off-site community.

*Residential Drinking Water Exposure*

Where there may be deposition of persistent chemicals in areas where rainwater tanks are used for collecting and storing water used for drinking/potable water, there is the potential for these chemicals to accumulate and impact on water quality. For many of the residential and rural properties surrounding the Project, drinking water may be sourced from rainwater tanks. Hence it is important to evaluate potential impacts of the Project on the quality of water in rainwater tanks.

Predicted concentrations in rainwater tanks were compared with drinking water guidelines, which are protective of all exposures relevant to potable water use including ingestion, dermal contact, bathing and irrigation of produce that may be consumed. These guidelines are also protective of the health of pets who may also consume water from rainwater tanks.

Provided in **Table 8-111** is the maximum predicted concentrations in rainwater tanks with comparison against drinking water guidelines. The table also presents a calculated HI, which is the ratio of the exposure concentration to the drinking water guideline.

*Table 8-111 Summary and Review of Exposures to Chemicals in Drinking Water (maximum residential receptor)*

| Metal | Calculated maximum concentration in rainwater tanks (mg/L) | | Drinking water guidelines (mg/L) | HI (ratio of dissolved concentration to drinking water guidelines) |
|---|---|---|---|---|
| | Dissolved – relevant to exposure | Total (particulate and dissolved) – highly conservative (assumes sediment is stirred up in tank) | | |
| Silver | 2.3E-07 | 1.2E-06 | 0.1 | 0.0000023 |
| Arsenic | 1.9E-05 | 2.9E-04 | 0.01 | 0.0019 |
| Cadmium | 1.7E-07 | 6.5E-06 | 0.002 | 0.000085 |
| Cobalt | 9.0E-07 | 2.1E-05 | 0.006 | 0.00015 |
| Copper | 1.2E-06 | 2.1E-05 | 2 | 0.00000058 |
| Mercury | 7.8E-07 | 2.1E-05 | 0.001 | 0.00078 |
| Lead | 4.5E-08 | 2.0E-05 | 0.01 | 0.0000045 |
| Zinc | 6.6E-07 | 2.1E-05 | 6 | 0.00000011 |
| | | Total HI | | 0.0029 |
| | | Acceptable HI | | ≤1 |

Review of **Table 8-111** indicates that the predicted water concentrations in rainwater tanks are all well below drinking water guidelines. Based on the assessment undertaken, there are no risk issues of concern in relation to potential exposures of persistent and bio accumulative chemicals that may be present in rainwater tanks surrounding the site.

### *Assessment of risk issues relevant to crops*

Where rural properties in the surrounding areas are used for the growing of crops such as grains (e.g., wheat, barley), these crops would not be home consumed. The crops, however would be sold to the market for use in a range of products. An evaluation was undertaken if the grain produced would remain in compliance with the maximum residue limits (MRLs) in the Food Standards Code (refer **Table 8-112** below).

*Table 8-112 Review of Concentrations in Grain (and similar) Crops – maximum sensitive receptor*

| Pollutant | Estimated max concentration in grain (mg/kg) | Food Standards Code – MRL for cereals, grains, wheat etc or equivalent (mg/kg) | Range of mean concentrations reported in cereal products evaluated in dietary surveys in Australia (mg/kg) |
|---|---|---|---|
| Silver | 0.000015 | - | No data available |
| Arsenic | 0.0011 | 1 | - |
| Cadmium | 0.000036 | 0.1 | - |
| Cobalt | 0.0000012 | - | 0.0054 to 0.071 |
| Copper | 0.00081 | - | 0.67 to 4.1 |
| Mercury | 0.00028 | - | 0.005 |
| Lead | 0.000015 | 0.2 | - |
| Zinc | 0.00032 | - | 4.5 to 38 |

**Table 8-112** indicates that that the maximum predicted concentrations of arsenic, cadmium and lead are well below the MRLs relevant to these pollutants. The maximum predicted concentrations of other pollutants are below the range of mean concentrations reported in food products comprising these products. Hence emissions from the Project are considered to be negligible in terms of their contribution to existing background levels in grain (or similar) crop products consumed in the market.

#### 8.14.5.4 Health Impacts from Noise

Environmental noise has been identified (WHO, 2011) (WHO, 2018) (I-INCE, 2011) as a growing concern because it has negative effects on quality of life and wellbeing and has the potential for causing harmful physiological health effects. With increasingly urbanised or developed societies, impacts of noise on communities have the potential to increase over time.

Sound is a natural phenomenon that only becomes noise when it has some undesirable effect on people or animals. Unlike chemical pollution, noise energy does not accumulate either in the body or in the environment, but it can have both short-term and long-term adverse effects on people. These health effects include (WHO 1999, 2011c, 2018):

- Sleep disturbance (sleep fragmentation that can affect psychomotor performance, memory consolidation, creativity, promote risk-taking behaviour and increase risk of accidents);
- Annoyance;
- Cardiovascular health;
- Hearing impairment and tinnitus; and
- Cognitive impairment (effects on reading and oral comprehension, short and long-term memory deficits, attention deficit).

Often, annoyance is the major consideration because it reflects the community's dislike of noise and their concerns about the full range of potential negative effects, and it affects the greatest number of people in the population. There are many possible reasons for noise annoyance in different situations. Noise can interfere with speech communication or other desired activities. Noise can contribute to sleep disturbance, which has the potential to lead to other long-term health effects. Sometimes noise is just perceived as being inappropriate in a particular setting without there being any objectively measurable effect at all. Different individuals have different sensitivities to types of noise and this reflects differences in expectations and attitudes more than it reflects any differences in underlying auditory physiology.

Noise criteria was established for the Project and is outlined in **Section 8.9.4.1 .** The criteria adopted as Project Noise Trigger Levels (PNTL) for the residential receivers evaluated in the NVIA are as follows:

- Day: 40 dBA as LAeq,15min;
- Evening: 35 dBA as LAeq,15min; and
- Night: 35 dBA as LAeq,15min with a maximum noise trigger levels established to protect against sleep disturbance issue set as 40 dBA as LAeq,15min and 52 dBA as LAmax.

Road traffic noise has been evaluated on the basis of the noise criteria as outlined in the Road Noise Policy (NSW DECCW 2011). For the principal haulage route proposed the noise criteria are 60 dBA as LAeq,15min during the day and evening and 55 dBA as LAeq,15min during the night.

The noise criteria adopted are sufficiently low to be protective of health, based on available guidance from the WHO (WHO 1999, 2011c). The Noise Policy for Industry (NPfI) provides guidance on the interpretation of noise impacts in relation to these trigger levels, particularly in relation to predicted/estimated changes in noise levels.

Based on the assessment presented in the NVIA in relation to construction activities, the following was determined:

- Predicted noise levels at all residential receivers as a result of activities during each of the 3 scenarios evaluated were below the construction noise guidelines relevant to works that may be conducted during both standard hours and out of hours periods.

On this basis, there are no health issues of concern in relation to noise generated during construction activities associated with the Project.

Similarly, the NVIA concluded that all criteria would be met when operational and that a noise management plan would be implemented. On that basis, there are no health issues of concern in relation to noise generated during operation of the Project.

With consideration of the noise guidelines adopted and the assessment of noise impacts from Project construction and operations, the potential for adverse health impacts from noise during the day, evening and night at off-site receivers is considered to be negligible.

### 8.14.6 Conclusion

The HHRA considered the potential impacts of the proposed Project on community health in relation to air quality (including drinking water and crops) and noise, drawing upon the results of the NVIA (**Appendix M**) and AQIA (**Appendix N**). Based on the available information, and with consideration of the uncertainties identified, no health risk issues of concern have been identified for the off-site community.

## 8.15 Preliminary Hazard Assessment

### 8.15.1 Introduction

A Preliminary Hazard Analysis (PHA) was prepared for the Project (**Appendix Q**). The PHA estimates the cumulative risks from the existing and proposed development, to determine the level of risk to people, property and the environment at the proposed location and in the presence of controls.

### 8.15.2 SEARS Requirements

The SEARS requirements as they relate to hazards are provided in **Table 8-113.**

*Table 8-113 Hazard Analysis SEARs Requirements*

| SEARs Requirement | Reference |
|---|---|
| Preliminary risk screening in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* and the Department's Applying SEPP 33 with clear indication of class, quantity and location of all dangerous goods and hazardous materials associated with the development. If the preliminary risk screening indicate that the development is 'potentially hazardous', a Preliminary Hazard Analysis (PHA) must the prepared in accordance with the Department's *Hazardous Industry Planning Advisory Paper No. 6, 'Hazard Analysis'* and *Multi-Level Risk Assessment* | **Section 8.15** |

### 8.15.3 Assessment Methodology

The PHA was prepared in accordance with the Department's Hazardous Industry Planning Advisory Paper No. 6, 'Hazard Analysis' (HIPAP 6) and Multi-Level Risk Assessment (MLRA).

HIPAP 6 provides guidance on the general approach recommended for hazard analysis. The objective of hazard analysis is to develop a comprehensive understanding of the hazards and risks associated with an operation or facility and of the adequacy of safeguards. The hazard analysis process may include qualitative and quantitative methods. Consideration should include:

- The nature and quantities of hazardous materials stored and processed on the site;
- The type of plant and equipment in use;
- The adequacy of proposed technical, operational and organisational safeguards;
- The surrounding land uses or likely future land uses; and
- The interactions of these factors.

The MLRA provides guidance on the criteria for using the results of the screening, classification and prioritisation steps to determine which of three levels of further analysis is appropriate.

Level 1 is an essentially qualitative approach based on comprehensive hazard identification to demonstrate that the activity does not pose a significant off-site risk. Level 2 supplements the qualitative analysis by sufficiently quantifying the main risk contributors to show that risk criteria will not be exceeded. Level 3 is a full quantitative analysis.

The MLRA guidance states a Level 1 qualitative assessment may suffice provided all or most of the following conditions are met:

- Screening and risk classification and prioritisation indicate there are no major off-site consequences and societal risk is negligible;
- The necessary technical and management safeguards are well understood and readily implemented; and
- There are no sensitive surrounding land uses.

The current PHA study for the Project met the MLRA criteria for a Level 1 assessment as that the activity does not pose a significant off-site risk.

It further states the following three stages are used in the assessment process:

- Preliminary screening;
- Risk classification and prioritisation; and
- Risk analysis and assessment.

The overall MLRA approach can be seen in **Figure 8-44**.

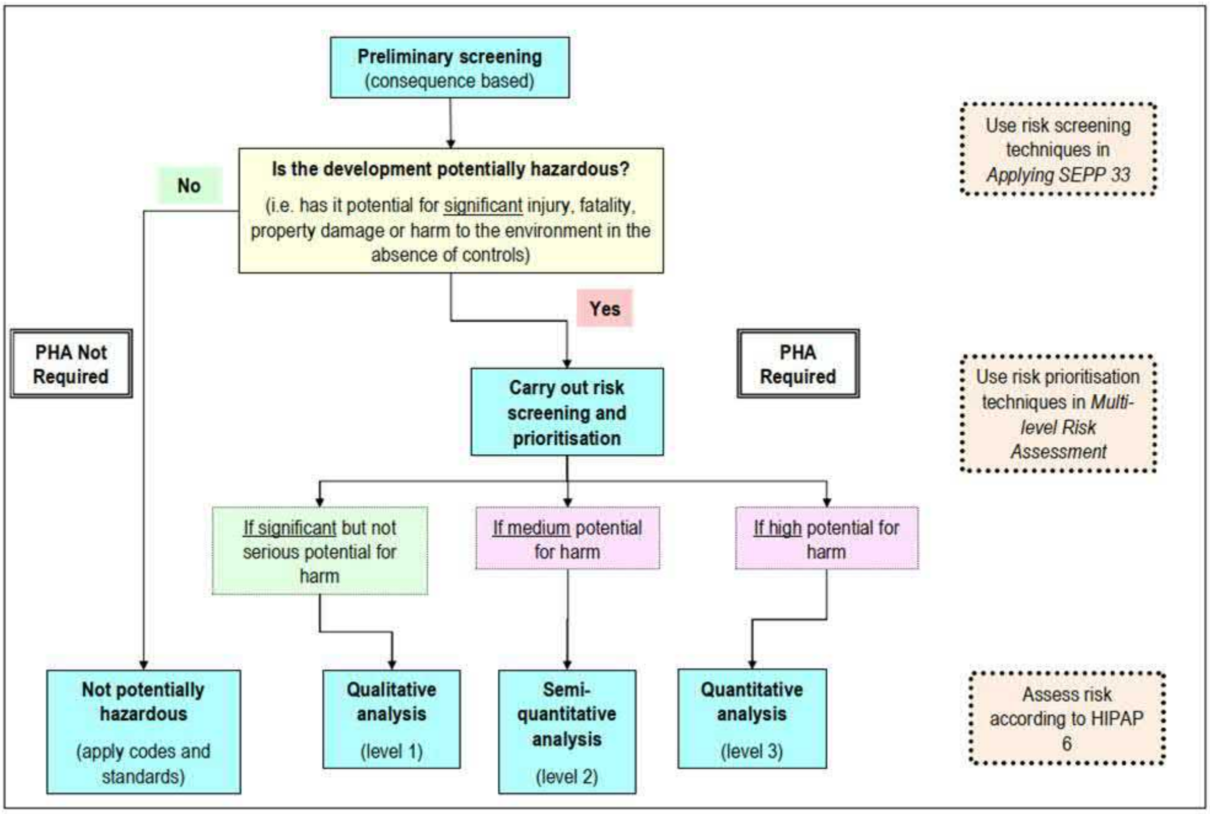



*Figure 8-44 Multi Level Risk Assessment Approach*

### 8.15.4 Existing Environment

There are sensitive receptors within the vicinity of the Hera Mine and along haul routes between Federation Site and Hera Mine. The closest sensitive receptors to Hera Mine are receptors R3 and R2/R1, which are located approximately 2.5 km north west of the mine infrastructure area and 3.0 – 3.5 km south west of the mine infrastructure area, respectively. Location of sensitive receivers is provided in **Figure 8-30.**

### 8.15.5 Predicted Impacts

#### 8.15.5.1 <u>Preliminary Risk Screening</u>

Preliminary risk screening of the proposed development Project is required under SEPP 33 to determine the need for a PHA. The preliminary screening assesses the storage of specific dangerous goods classes that have the potential for significant, off-site effects. Specifically, the assessment involves the identification of classes and quantities of all dangerous goods to be used, stored or produced on site with respect to storage depot locations as well as transported to and from the site.

*Dangerous Goods Storage*

The proposed inventory of Dangerous Goods (DG) in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code) is provided in **Table 8-114** for Hera Mine and **Table 8-115** for the Federation Site below.

The information contained in the table compares the total storage quantity of the required dangerous goods classes against the storage screening threshold in **Table 8-116** and **Table 8-117**, and Figure 9 of Applying SEPP 3 (Department of Planning, 2011).

The dangerous goods to be stored on the site were grouped into their respective ADG classes. If more than one packaging group was present in an ADG class it was assumed that the total amount for that class was the more hazardous packing group.

Diesel fuel to be stored on site, is not classed as a Dangerous Goods, but is classed as a C1 Combustible Liquid provided no flammable liquids are stored with the diesel. SLR has been advised that no flammable liquids will be stored with the diesel. Therefore, for the Project, diesel will be classed as a C1 Combustible Liquid.

*Table 8-114 Dangerous Good in Storage– Processing Plant (Hera Mine)**

| Substance | Hazardous Class | Packing Group | Total Storage on Site | SEPP 33 Threshold Quantity | SEPP 33 Threshold Level Findings |
|---|---|---|---|---|---|
| LPG | Dangerous Goods 2.1 | | 7.5m$^3$ (Elgas storage) | 10 t or 16m$^3$ | Below |
| Methyl Isobutyl Carbinol (MIBC) | Dangerous Goods 3 | III | 4.2 t | 9 m separation from other uses | Below |
| Sodium Isobutyl Xanthate | Dangerous Goods 4.2 | III | 4.9 t | 1 t | Above |
| Hydrogen peroxide (50% w/w sol) | Dangerous Goods 5.1 | II | 20,000 L (24 t) | 5 t | Above |

| | | | | | |
|---|---|---|---|---|---|
| Sodium cyanide | Dangerous Goods 6.1 | II | 3.8 t | 2.5 t | Above |
| Nitric acid | Dangerous Goods 8 | II | 2,000 L (2.4 t)[1] | 25 t | Below |
| Sodium hydroxide (50% w/w sol) | Dangerous Goods 8 | III | 0.8 t[2] | 50 t | Below |
| Copper Sulphate Pentahydrate | Dangerous Goods 9 | III | 34 t | Not applicable | Not applicable |
| Diesel | C 1 | | 250,000 L (212 t)[3] | Manifest Quantity Safework NSW 100,000kg or litres<br><br>PEOP Act 2,000 t | Safework NSW notification required<br><br>Environmental Protection Licence under (POEO Act) not required from NSW EPA |
| Sodium Metabisulphite | Poison S5 | | 93.8 t | Not applicable | Not applicable |

Note: * Information supplied by Aurelia Metals Ltd
1 Based on density of 1.2g/ml
2 Based on density of 1.2g/ml
3 Based on density of 1,182 L per tonne for automotive diesel

The following dangerous goods to be stored at the processing plant (Hera Mine) are above the screening thresholds and therefore are considered potentially hazardous:

- Sodium Isobutyl Xanthate;
- Hydrogen peroxide (50% w/w sol); and
- Sodium cyanide.

*Table 8-115 Dangerous Good in Storage – Federation Site**

| Substance | Hazardous Class | Packing Group | Total Storage on Site | SEPP 33 Threshold Quantity | SEPP 33 Threshold Level Findings |
|---|---|---|---|---|---|
| ANFO | Dangerous Goods 1.1 | | Up to 40 t | 550 m separation from all uses | Below, but requires further explanation of design in PHA |
| ANE | Dangerous Goods 5.1 | | Up to 10 t | 5 t | Above |

| | | | | | |
|---|---|---|---|---|---|
| Diesel | C 1 | | 160,000 L (135 t)[1] | Manifest Quantity Safework NSW 100,000kg or litres<br><br>PEOP Act 2,000 t | Safework NSW notification required<br><br>Environmental Protection Licence under (POEO Act) not required from NSW EPA |

Note: * Information supplied by Aurelia Metals Ltd
1 Based on density of 1,182 L per tonne for automotive diesel

### *Dangerous Goods Transport*

In applying SEPP 33 a proposed development may be deemed potentially hazardous if the numbers of generated traffic movements for significant quantities of dangerous goods entering and leaving the site are above the cumulative vehicle movements shown in the SEPP 33 guideline (Table 2). The levels of maximum proposed annual movements at the site are provided below in **Table 8-116** for Hera Mine and **Table 8-117** for the Federation Site.

*Table 8-116 Dangerous Goods Transport– Processing Plant (Hera Mine)*

| Substance | Hazardous Class | Packing Group | Predicted Vehicle Movements per Year | SEPP 33 Transportation Screening Thresholds | Approximate Load Size | Threshold Level Findings |
|---|---|---|---|---|---|---|
| LPG | Dangerous Goods 2.1 | | 26 | >500 | 7.5m$^3$ | Below |
| Methyl Isobutyl Carbinol (MIBC) | Dangerous Goods 3 | III | 26 | >1000 | 1.9 t | Below |
| Sodium Isobutyl Xanthate | Dangerous Goods 4.2 | II | 26 | >100 | 2.3 t | Below |
| Hydrogen peroxide (50% w/w sol) | Dangerous Goods 5.1 | II | 26 | >500 | 11.1 t | Below |
| Sodium cyanide | Dangerous Goods 6.1 | II | 6 | All | 7.5 t | Above |
| Nitric acid | Dangerous Goods 8 | II | 26 | >500 | 1.1 t | Below |
| Sodium hydroxide (50% w/w sol) | Dangerous Goods 8 | III | 26 | >500 | 0.4 t | Below |
| Copper Sulphate Pentahydrate | Dangerous Goods 9 | III | 26 | >1000 | 15.5 t | Below |
| Diesel | C 1 | | Not applicable | Not applicable | Not applicable | Not applicable |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sodium Metabisulphite | Poison S5 | | Not applicable | Not applicable | Not applicable | Not applicable |

*Table 8-117 Dangerous Goods Transport– Federation Site **

| **Substance** | **Hazardous Class** | **Packing Group** | **Predicted Vehicle Movements per Year** | **SEPP 33 Transportation Screening Thresholds** | Approximate Load Size | **Threshold Level Findings** |
|---|---|---|---|---|---|---|
| ANFO | Dangerous Goods 1.1 | | 26 | All | All | Above |
| ANE | Dangerous Goods 5.1 | | 26 | > 500 | 1 t | Below |
| Diesel | C 1 | | Not applicable | Not applicable | 25,000 L | Not applicable |

Note: * Information supplied by Aurelia Metals Ltd.

#### 8.15.5.2 Preliminary Hazard Analysis

A Preliminary Hazard Analysis must be prepared in accordance with Hazardous Industry '*Planning Advisory Paper No. 6 - Guidelines for Hazard Analysis'* (Department of Planning, 2011). The Preliminary Hazard Analysis should estimate the cumulative risks from the existing Hera Mine operations and the Project related activities.

Where SEPP 33 identifies a development as potentially hazardous and/or offensive, developments are required to undertake a PHA analysis to determine the level of risk to people, property and the environment at the proposed location and in the presence of controls.

The procedures adopted by this study for assessing hazardous impacts involved the following steps:

- Step 1: Hazard identification;
- Step 2: Hazard analysis (consequence and probability estimations); and
- Step 3: Risk evaluation and assessment against specific criteria.

Hazard identification involves the identification of all theoretically possible hazardous events as the basis for further quantification and analysis. To identify hazards, a survey of operations was carried out to isolate the events which are outside normal operating conditions and which have the potential to impact outside the boundaries of the site. These events do not include occurrences that are a normal part of the operation cycles of the site but rather the atypical and abnormal.

After a review of the events identified in the hazard identification stage and the prevention/protection measures incorporated into the design of the site, any events which are considered to have the potential to result in impacts off-site or which have the potential to escalate to larger incidents are carried to the next stage of analysis.

Consequence estimation is then undertaken, which involves the analysis and modelling of the credible events carried forward from the hazard identification process in order to quantify their impacts outside the boundaries of the site.

The risk analysis includes the consequences of each hazardous event and the frequencies of each initiating failure. The results of consequence calculations (radiation and overpressure contours, and toxic exposure levels) together with the probabilities and likelihood's estimated are then compared against the accepted criteria, as specified by the HIPAP series applicable for the site.

The risk assessment in the current study was based on hazard identification, consequence assessment and likelihood assessment, to create an overall risk assessment. Descriptors for the qualitative risk assessment at the various levels of consequence of a particular event, and the likelihood (or probability) of such an event occurring are presented in **Table 8-118** and **Table 8-119.**

*Table 8-118 Qualitative Likelihood Rating*

| Level | Descriptor | Description |
|---|---|---|
| A | Almost certain | Is expected to occur in most circumstances |
| B | Likely | Will probably occur in most circumstances |
| C | Possible | Could occur |
| D | Unlikely | Could occur but not expected |
| E | Rare | Conceivable, but only in exceptional circumstances |

*Table 8-119 Qualitative Consequence Rating*

| Level | Descriptor | People | Environment | Asset / Production |
|---|---|---|---|---|
| 5 | Catastrophic | Multiple fatality | Extreme environmental harm, eg. widespread catastrophic impact | More than $5M ($5 million) loss or production delay |
| 4 | Major | Permanent total disabilities, single fatality | Major environmental harm, eg. Widespread substantial impact | $1M to $5M loss or production delay |
| 3 | Moderate | Major injury or health effects, eg. major lost workday case/permanent disability | Serious environmental harm, eg. widespread and significant impact | $500k ($500k thousand) to $1M loss or production delay |
| 2 | Minor | Minor injury or health effects, eg. restricted work or minor lost workday case | Material environmental harm, eg. localised and significant impact | $50k to $500k loss or production delay |
| 1 | Insignificant | Slight injury or health effects, eg. first aid/minor medical treatment level | Minimal environmental harm, eg. interference or likely interference to an environmental value | Less than $50k loss or production delay |

The risk ratings are defined as the following:

- Tolerable – The risk is acceptably low;

- ALARP – As Low As Reasonably Practical, the risk has been reduced to as low a level as possible and all feasible controls and mitigation strategies are implemented; and
- Intolerable - The risk cannot be reduced to an acceptable level with residual impacts likely to have significant impact on the local environment or stakeholders. Intolerable risk would preclude the development of the Project.

Th risk rating matrix has been set out below in **Table 8-120.**

*Table 8-120 Risk Matrix*

| **Likelihood** | **Risk Rating** | | | | |
|---|---|---|---|---|---|
| | | | **Consequence** | | |
| | **Insignificant** | **Minor** | **Moderate** | **Major** | **Catastrophic** |
| **Almost certain** | ALARP | ALARP | Intolerable | Intolerable | Intolerable |
| **Likely** | Tolerable | ALARP | ALARP | Intolerable | Intolerable |
| **Possible** | Tolerable | Tolerable | ALARP | ALARP | Intolerable |
| **Unlikely** | Tolerable | Tolerable | Tolerable | ALARP | ALARP |
| **Rare** | Tolerable | Tolerable | Tolerable | Tolerable | ALARP |

### *Risk of Property Damage and Accident Propagation*

The siting of an installation must account for the potential for propagation of an accident causing a "domino" effect on adjoining premises. This risk would be expected within an industrial estate where siting of hazardous materials on one site may potentially cause hazardous materials on an adjoining premises to further develop the size of the accident.

The PHA considered the risk of property damage and accident propagation to adjoining property outside the site is considered unlikely. Based on the significant distances between the site and the nearest sensitive receivers.

### *Criteria for Risk Assessment to the Biophysical Environment*

The suggested criteria for sensitive environmental areas relate to the potential effects of an accidental release or emission on the long-term viability of the ecosystem or any species within it and are expressed as follows:

- Industrial developments should not be sited in proximity to sensitive natural environmental areas where the effects or consequences of the more likely accidental emissions may threaten the long-term viability of the ecosystem or any species within it; and
- Industrial developments should not be sited in proximity to sensitive natural environmental areas where the likelihood or probability of impacts that may threaten the long-term viability of the ecosystem or any species within it is not substantially lower than the existing background level threat to the ecosystem.

In the current study, the risk of biophysical damage outside the Project area is considered unlikely, based on the engineering and design controls that will be in place and the nature of the surrounding environment.

### 8.15.6 Potential Hazardous Incidents Identified for Further Discussion

Following a review of surrounding land use a series of potentially hazardous events or scenarios were considered to identify if further comprehensive qualitative analysis is required. Each event or scenario shall be discussed in detail.

The following dangerous goods storage and transport listed below exceeded SEPP 33 Preliminary Risk Screening as such required more comprehensive analysis:

Processing Plant (Hera Mine Site):

- Sodium Isobutyl Xanthate;
- Hydrogen peroxide (50% w/w sol);
- Sodium cyanide (storage and transport); and

Federation Site:

- ANFO (storage and transport).

#### 8.15.6.1 ANFO Storage – Federation Site

The proposed ANFO storage consist of two purpose built explosive facilities set out as Pad 1 and Pad 2. Both facilities will be designed to be licensed by SafeWork NSW. The combined storage of Pad 1 and Pad 2 will be 40t of ANFO /ANE.

The Pad 1 storage is located 550 m from Protected Works – Class B. Accordingly in the current location, the Pad 1 storage may be limited to 17 t of ANFO to ensure adequate separation distances from Protected Works – Class B. If Pad 1 storage is to include 20 t of ANFO then the separation distance will need to be increased to 603 m from Protected Works – Class B.

The Pad 2 storage will be located at a distance greater than 200 m from Pad 1 storage and approximately 760 m from Protected Works – Class B. This will facilitate the storage of an additional 20 t of ANFO or ANE and an additional 5 t of boosters and/or Explosive, Blasting, Type E (Powergel or equivalent).

The risks associated with the proposed ANFO storage, in two purpose built explosive facilities, Pad 1 and Pad 2 are considered to be “Tolerable” (i.e. the risk is acceptably low).” with control measures in place.

The controls measures to instigated will include the following:

- The technical and management safeguards required are standard industry practice and readily implemented as part of safety engineering;
- Both facilities will be designed to be licensed by SafeWork NSW; and
- The separation distances from Protected Works – Class B to meet requirements set out in AS2187.1.

### 8.15.7 Incident Scenarios and Control Measures

The control measures, provided below, are designed to maintain and contain the risks within the boundaries of the Federation Site and Hera Mine and reduce the risk to areas outside the boundaries. The technical and management safeguards required are self-evident and readily implemented as part of plant safety engineering. Following these safeguards, including codes and standards will ensure the risk level is ALARP and that the Project design meets the principles of:

- The avoidance of all avoidable risks;
- The risk from a major hazard should be reduced wherever practicable, even where the likelihood of exposure is low;
- The effects of significant events should, wherever possible be contained within the site boundary; and
- Where the risk from an existing installation is already high, further development should not pose any incremental risk.

Major incidents possible at both sites along with potential outcomes, consequences and control measures and residual risk after the implementation of control measures have been outlined the Hazard Identification Word Diagram can be found in **Table 8-121**.

*Table 8-121 Summary of Potential Major Incident Scenarios & Residual Risk after Implementation of Controls*

| Location / Hazard | Incident | Scenario | Controls | Likelihood | Consequence | Residual Risk |
|---|---|---|---|---|---|---|
| **Sodium Isobutyl Xanthate** | | | | | | |
| Storage Facility | Accident | Accident within the storage area | Storage of material only in manufacturer's original packaging.<br>Storage of material in an appropriately designed facility under cover and with adequate access for vehicles and personnel.<br>Storage of appropriate spill-clean up and equipment and materials in the vicinity of the storage location.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Environmental inspections and reporting completed regularly.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Hazardous Materials Management Plan implemented. | Unlikely | Moderate | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| Storage Facility | Spill | Inadequate maintenance and/or design resulting in spillage.<br><br>Handling error by personnel. | Storage of material in an appropriately designed facility under cover and with adequate access for vehicles and personnel.<br>Storage of appropriate spill-clean up and equipment and materials in the vicinity of the storage location.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Environmental inspections and reporting completed regularly.<br>Operational personnel to have completed relevant training in routine handling of chemical.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Hydrocarbon, Chemical and Reagent Management Plan<br>implemented.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area<br>– Advise senior site management of the spill. | Unlikely | Minor | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ore Treatment and Processing | Accident | Accident within the Processing Plant area resulting in spillage | Restricted access to the Processing Plant area enforced.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area<br>– Advise senior site management of the spill. | Rare | Minor | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ore Treatment and Processing | Spill | Inadequate maintenance and/or design resulting in spillage.<br><br>Operator error by personnel. | Processing Plant contained within a bunded area capable of retaining any spill<br>Restricted access to the Processing Plant area enforced.<br>Regular inspections of the plant completed and any maintenance requirements reported and enacted.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area<br>– Advise senior site management of the spill. | Unlikely | Minor | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Hydrogen peroxide (50% w/w sol)** | | | | | | |
| Storage Facility | Accident | Accident within the storage area | All hydrogen peroxide solution stored within adequately bunded and ventilated area.<br>Bunding constructed to relevant construction standard.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Environmental inspections and reporting completed regularly.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Hazardous Materials Management Plan implemented. | Unlikely | Minor | Tolerable |
| Storage Facility | Spill | Inadequate maintenance and/or design resulting in spillage.<br><br>Handling error by personnel. | Bunding constructed of impermeable material.<br>Bunding constructed to relevant construction standard.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Environmental inspections and reporting completed regularly.<br>Operational personnel to have completed relevant training in routine handling of chemical. | Unlikely | Minor | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Hazardous Materials Management Plan implemented.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area<br>– Advise senior site management of the spill. | | | |
| Ore Treatment and Processing | Accident | Accident within the Processing Plant area resulting in spillage | Restricted access to the Processing Plant area enforced.<br>Processing Plant contained within a bunded area capable of retaining any spill.<br>Maintenance and monitoring of containment capacities.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area | Rare | Minor | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | – Advise senior site management of the spill. | | | |
| Ore Treatment and Processing | Spill | Inadequate maintenance and/or design resulting in spillage.<br><br>Operator error by personnel. | Processing Plant contained within a bunded area capable of retaining any spill<br>Restricted access to the Processing Plant area enforced.<br>Regular inspections of the plant completed and any maintenance requirements reported and enacted.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area<br>– Advise senior site management of the spill. | Unlikely | Minor | Tolerable |

| Lead Nitrate | | | | | | |
|---|---|---|---|---|---|---|
| Storage Facility | Accident | Accident within the storage area | Storage of material only in manufacturer's original packaging.<br>Storage of material in an appropriately designed facility under cover and with adequate access for vehicles and personnel.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Environmental inspections and reporting completed regularly.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Hazardous Materials Management Plan implemented. | Unlikely | Minor | Tolerable |
| Storage Facility | Spill | Inadequate maintenance and/or design resulting in spillage.<br><br>Handling error by personnel. | Storage of material in an appropriately designed facility under cover and with adequate access for vehicles and personnel.<br>Storage of appropriate spill-clean up and equipment and materials in the vicinity of the storage location.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Environmental inspections and reporting completed regularly. | Unlikely | Minor | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Operational personnel to have completed relevant training in routine handling of chemical.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Hazardous Materials Management Plan implemented.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area<br>– Advise senior site management of the spill. | | | |
| Ore Treatment and Processing | Accident | Accident within the Processing Plant area resulting in spillage | Restricted access to the Processing Plant area enforced.<br>Processing Plant contained within a bunded area capable of retaining any spill.<br>Maintenance and monitoring of containment capacities.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT. | Rare | Minor | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area<br>– Advise senior site management of the spill. | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ore Treatment and Processing | Spill | Inadequate maintenance and/or design resulting in spillage.<br><br>Operator error by personnel. | Processing Plant contained within a bunded area capable of retaining any spill<br>Restricted access to the Processing Plant area enforced.<br>Regular inspections of the plant completed and any maintenance requirements reported and enacted.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area<br>– Advise senior site management of the spill. | Unlikely | Minor | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sodium Cyanide** | | | | | | |
| Transport to the Project Site | Accident | Traffic accident resulting in spillage and possible pollution. | Driver Code of Conduct implemented.<br>Only designated transport route to be followed by driver.<br>UN number and Dangerous Goods Class information for sodium cyanide clearly displayed on the Integrated Bulk Container (IBC).<br>Material Safety Data Sheet (MSDS) and other relevant information on sodium cyanide from ChemAlert retained by driver and relevant Project Site personnel.<br>Effective communication between driver and site personnel established.<br>Transport Management Plan implemented.<br>Emergency Management Plan for dealing with cyanide spill developed and implemented. The Plan will include the following.<br>– Advise emergency services of the spill.<br>– Isolate the spill area (if possible).<br>– Evacuate (or assist in evacuation) all persons within 1.3 km of the spill (as per current Hera Mine management procedure). | Rare | Major | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| Transport to the Project Site | Spill | Operator error/poor maintenance leading to leak or spill. | MSDS and ChemAlert information retained by driver and Proponent's staff.<br>Driver to have completed relevant training in emergency response or HAZMAT.<br>Effective communication between driver and site personnel established.<br>Transport Management Plan implemented.<br>Emergency Management Plan for dealing with cyanide spill developed and implemented. The Plan will involve the following.<br>– Advise emergency services of the spill.<br>– Isolate the spill area (if possible).<br>– Evacuate (or assist in evacuation) all persons within 1.3 km<br>of the spill. | Unlikely | Moderate | Tolerable |
| Transport to the Project Site | Fire | Accident resulting in fire resulting in the generation of hydrogen cyanide (HCN) gas. | MSDS and ChemAlert information retained by driver and relevant Project Site personnel.<br>UN number and Dangerous Goods Class information for sodium cyanide clearly displayed on the IBC.<br>Only designated transport route to be followed by driver. | Rare | Major | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Driver to have completed relevant training in emergency response or HAZMAT.<br>Effective communication between driver and site personnel established.<br>Transport Management Plan implemented.<br>Emergency Management Plan for dealing with fire developed and implemented. The Plan will include the following.<br>– Advise emergency services of the fire and toxic nature of sodium cyanide and HCN.<br>– Evacuate the area.<br>– Evacuate (or assist in evacuation) all persons within 1.3 km of the incident. | | | |
| Storage Facility | Accident | Accident within the storage area | Storage of material only in manufacturer's original packaging.<br>Storage of material in an appropriately designed facility under cover and with adequate access for vehicles and personnel.<br>All cyanide solution stored within adequately bunded and ventilated area.<br>Bunding constructed to relevant construction standard.<br>MSDS and ChemAlert information retained by Project Site personnel. | Unlikely | Moderate | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Environmental inspections and reporting completed regularly.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Hazardous Materials Management Plan implemented. | | | |
| Storage Facility | Spill | Inadequate maintenance and/or design resulting in spillage.<br><br>Handling error by personnel. | Storage of material in an appropriately designed facility under cover and with adequate access for vehicles and personnel.<br>Storage of appropriate spill-clean up and equipment and materials in the vicinity of the storage location.<br>All cyanide solution stored within adequately bunded and<br>ventilated area.<br>Bunding constructed to relevant construction standard.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Environmental inspections and reporting completed regularly.<br>Operational personnel to have completed relevant training in routine handling of chemical.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT. | Unlikely | Moderate | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Hydrocarbon, Chemical and Reagent Management Plan<br>implemented.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>Advise emergency services of the spill.<br>– Evacuate the area.<br>– Evacuate (or assist in evacuation) all persons within 1.3 km of the spill. | | | |
| Storage Facility | Fire | Fire resulting in the generation of hydrogen cyanide (HCN) gas. | Appropriate design of storage locations, including limitation of ignition sources and separate storage of flammable materials.<br>Installation of appropriate fire management facilities, including sprinklers, extinguishers and fire hoses in accordance with relevant design standards. MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following. | Rare | Moderate | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Advise emergency services of the spill.<br>– Evacuate the area.<br>– Evacuate (or assist in evacuation) all persons within 1.3 km of the spill. | | | |
| Ore Treatment and Processing | Accident | Accident within the Processing Plant area resulting in spillage | Restricted access to the Processing Plant area enforced.<br>Processing Plant contained within a bunded area capable of retaining any spill.<br>Maintenance and monitoring of containment capacities.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Advise emergency services of the spill.<br>– Evacuate the area.<br>– Evacuate (or assist in evacuation) all persons within 1.3 km of the spill. | Unlikely | Moderate | Tolerable |
| Ore Treatment and Processing | Spill | Inadequate maintenance and/or design resulting in spillage. | Processing Plant contained within a bunded area capable of retaining any spill | Unlikely | Moderate | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Operator error by personnel. | Restricted access to the Processing Plant area enforced.<br>Regular inspections of the plant completed and any maintenance requirements reported and enacted.<br>MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>– Evacuate the area.<br>– Advise senior site management of the spill.<br>– Consider evacuation of the site and communication with emergency services (on advice from senior site management and dependent on the nature of the material spilled). | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ore Treatment and Processing | Fire | Fire resulting in the generation of hydrogen cyanide (HCN) gas. | Appropriate design of storage locations, including limitation of ignition sources and separate storage of flammable materials.<br>Installation of appropriate fire management facilities, including sprinklers, extinguishers and fire hoses in accordance with relevant design standards. MSDS and ChemAlert information retained by Project Site personnel.<br>Operational personnel to have completed relevant training in emergency response and/or HAZMAT.<br>Emergency Management Plan for dealing with spill developed and implemented. The Plan will include the following.<br>Advise emergency services of the spill.<br>– Evacuate the area.<br>– Evacuate (or assist in evacuation) all persons within 1.3 km of the spill. | Rare | Moderate | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| **ANFO** | | | | | | |
| Transport to the Project Site | Accident | Traffic accident resulting in spillage and possible pollution. | Driver Code of Conduct implemented.<br>Only designated transport route to be followed by driver.<br>UN number and Dangerous Goods Class information for ANFO clearly displayed.<br>Material Safety Data Sheet (MSDS) and other relevant information on ANFO from ChemAlert retained by driver and relevant Project Site personnel.<br>Effective communication between driver and site personnel established.<br>Transport Management Plan implemented.<br>Emergency Management Plan for dealing with ANFO spill developed and implemented. The Plan will include the advising emergency services of the spill. | Unlikely | Moderate | Tolerable |
| Transport to the Project Site | Fire | Accident resulting in fire | MSDS and ChemAlert information retained by driver and relevant Project Site personnel.<br>UN number and Dangerous Goods Class information for ANFO clearly displayed. | Rare | Moderate | Tolerable |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Only designated transport route to be followed by driver.<br>Driver to have completed relevant training in emergency response or HAZMAT.<br>Effective communication between driver and site personnel established.<br>Transport Management Plan implemented.<br>Emergency Management Plan for dealing with fire developed and implemented. The Plan will include advising emergency services of the fire. | | | |

### 8.15.8 Conclusion

The Preliminary Hazard Analysis has found that the main dangerous goods potential hazards associated with the Federation Site and processing plant (Hera Mine) were the following:

Processing Plant (Hera Mine):

- Sodium Isobutyl Xanthate;
- Hydrogen peroxide (50% w/w sol);
- Sodium cyanide (storage and transport); and

Federation Site:

- ANFO (storage and transport).

The residual risks associated with these hazards once controls are implemented were rated as tolerable (i.e. the risk is acceptably low). The technical and management safeguards required are standard industry practice and readily implemented as part of safety engineering. The implementation of controls including adherence to technical and management guidelines will be verified in the final detailed design.

It is the conclusion of this PHA that the proposed development (including Federation Site and processing plant at Hera Mine) would be identified as potentially hazardous but the risks associated with both would be considered tolerable, with suitable engineering controls, operational controls and management controls in place.

## 8.16 Landscape and Visual Assessment

### 8.16.1 Introduction

A Landscape and Visual Impact Assessment (LVIA) was prepared by SLR and is included as **Appendix R**. The LVIA provided an objective assessment of the Project and examined the Project's potential impacts on visual amenity.

### 8.16.2 SEARs Requirements

The SEARS requirements which relate to impacts on visual amenity are provided in **Table 8-122**.

*Table 8-122 Landscape and Visual SEARs requirements*

| SEARS Requirement | Reference |
|---|---|
| Visual assessment of the likely visual and landscape impacts of the development on private land in the vicinity of the development, paying particular attention to any temporary and permanent modification of the landscape e.g. overburden dumps, bunds, tailings facilities". | **Section 8.16.8** |

### 8.16.3 Existing Environment

The baseline description outlines the current state of the Project area (being the location where proposed mining activities and infrastructure will occur) (and its surrounds) as it would likely function in the absence of change resulting from the introduction of the Project.

The Project boundary is an area of approximately 5,356ha that is characterised typically as rangeland. For the purposes of the LVIA, the 'subject site' comprises the Federation Site in the south of the Project area, and the existing Hera Mine in the north of the Project area, which is proposed to feature a new solar farm on the western periphery.

The Federation Site is located at an elevation of approximately 320m above mean sea level (AMSL) with topography rising gradually in an easterly direction and contains a prominent peak of 380m immediately east of the Federation Site. The existing Hera Mine is at a similar elevation with a difference in height of between 10 to 20m. Both locations are characterised by gently undulating and rounded ridges with broad drainage flats. They also demonstrate undulating ridges with long low slopes and broad level plains.

Vegetation adjacent to Burthong Road is mature to semi-mature with a mix of species that reflect the PCTs present in the Project area. These species are at moderate heights characteristic of their form and structure, reaching approximately 10-15m. The canopies range from closed to mostly open with a concentration of closed canopy along verges. Mostly open canopies within the Project boundary are outside the existing Hera Mine. It is noted that all vegetation within the Project area and surrounding context is significantly less dense than the adjacent Balowra State Conservation area where the same vegetation communities are present.

Structures within the landscape are characterised with rural residential dwellings, agricultural/ rural sheds and structures. In relation to the relevant mining industry in the area this would be characterised with major structures such as process plants, workshops, power generation, accommodation facilities, stockpiles, batching plants, surface extraction area and ancillary operational and administration structures.

The existing rural setting of the subject sites' regional context does not feature many notable structures within the landscape when viewed from Burthong Road. In relation to the existing Hera Mine, major and minor structures are not highly visible from the Burthong Road and are limited to a few distant roofs, fences, gates with minimal signage only at the existing entrance.

For the purposed of the LVIA, infrastructure refers to the main utilities and access corridors. This is characterised by roads, powerlines, transmission lines, pipes and associated cleared corridors and fencing.

The existing rural setting of the subject sites' regional context does not feature many notable infrastructure elements when viewed from Burthong Road. This is also evident at Balowra Road approximately 3km northeast of the subject site.

### 8.16.4 Methodology

The LVIA generally applies the assessment techniques set out in the *'Guidelines for Landscape and Visual Impact Assessment, Third Edition'* (2013) prepared by The Landscape Institute and the Institute for Environmental Management and Assessment (UK).

The assessment includes the following:

- Review of the proposal (scale, bulk, height, technical specifications, and landscape);
- Analysis of the subject site (visual exposure, visual qualities, and landscape values);

- Mapping of Theoretical Visual Catchment, visual receptors, and sensitive receptor groups;
- Identification of potential impacts on key receptors including the rating of magnitude for each receptor group;
- Rating of impact significance for each receptor group. The significance is evaluated as a product of the sensitivity or value of the receptor, and the magnitude of impacts on the receptor; and
- Potential mitigation measures to meet the necessary planning requirements and any community expectations.

The assessment included a desktop analysis and a detailed site investigation prepared in October 2021. The desktop analysis and site investigation included the following:

- Data review;
- Aerial photography review;
- Onsite image capture at key receptor points; and
- GIS modelling of the topography and the proposal.

The visual receptor points were selected by first analysing aerial photography to identify areas that may have impact significance. These included both public and private receptor points. Several points were nominated, and a site visit conducted where photographs were taken at each point with a general 55 degrees bearing in the direction of the subject site. Fifty-five (55) degrees is selected as it replicates the same angle of view that observers perceive. The visual receptors points were analysed and reduced to demonstrate key locations that may, or may not, have perceived significant impact from the subject site and its proposed infrastructure. Once these receptors, at key locations, were determined a visibility model was run to ascertain the likelihood of the proposed infrastructure at the subject site to be seen from these receptor points. This is referred to as the 'zone of theoretical visibility'.

A 5m Digital Terrain Model (DTM), 5m Digital Surface Model (DSM) and 5m Canopy and Building Height Model (CHM) was derived from point cloud data supplied by Aerometrex, 2019 (LiDAR (Light Detection and Ranging)), Department of Finance, Services and Innovation Spatial Services/DFSI-SS, 2014 (Airbourne Digital Sensor(ADS)) and contours provided by Hera Resources.

The visibility model is then analysed in comparison with the key receptor points to see if, or to what significance, the proposed infrastructure could be observed. These key receptor points are then assessed for the potential visual impacts and given a sensitivity and magnitude rating to ascertain objectively the potential visual impact. The height of the proposed infrastructure is provided in **Table 8-123**.

*Table 8-123 Height of the Proposed Infrastructure Features*

| Site Locations | Description | Height |
|---|---|---|
| Federation Site | Topsoil Stockpiles | 3m |
| | Ablution, Office, Crib, Admin | 4m |
| | Workshop and store | 13m |
| | Diesel Power and Tanks | 3m |

| | | |
|---|---|---|
| | Waste Rock Dump | 20m |
| | Batch Plant/ Paste Plant | 10m |
| | Substation | 4m |
| | Telecommunication Tower | 15m |
| Hera Mine | Proposed overhead transmission line | 10m |
| | Proposed solar farm | 4m |
| | New Process Plant | 25m |

### 8.16.5 Predicted Impacts

Visual receptor are people or groups of people that may be affected by the Project. Described below are a list of potential visual receptors that are often identified based on a number of key parameters. Depending on the site, proposed use and future anticipated impacts, not all of these may be selected as receptors. These parameters could include:

- Proximity of the receptor – most effected visual receptors are anticipated to be located within a 3km radius of the Project (unless in an elevated position);
- Drivers or passengers of vehicles travelling past, through or alongside the subject site;
- Workers on or near the site that visit or work in one of the mine sites and associated infrastructure;
- Members of the general public accessing adjoining public areas (conservation areas) for recreational or visual purposes; and
- Permanent residents living near the subject site.

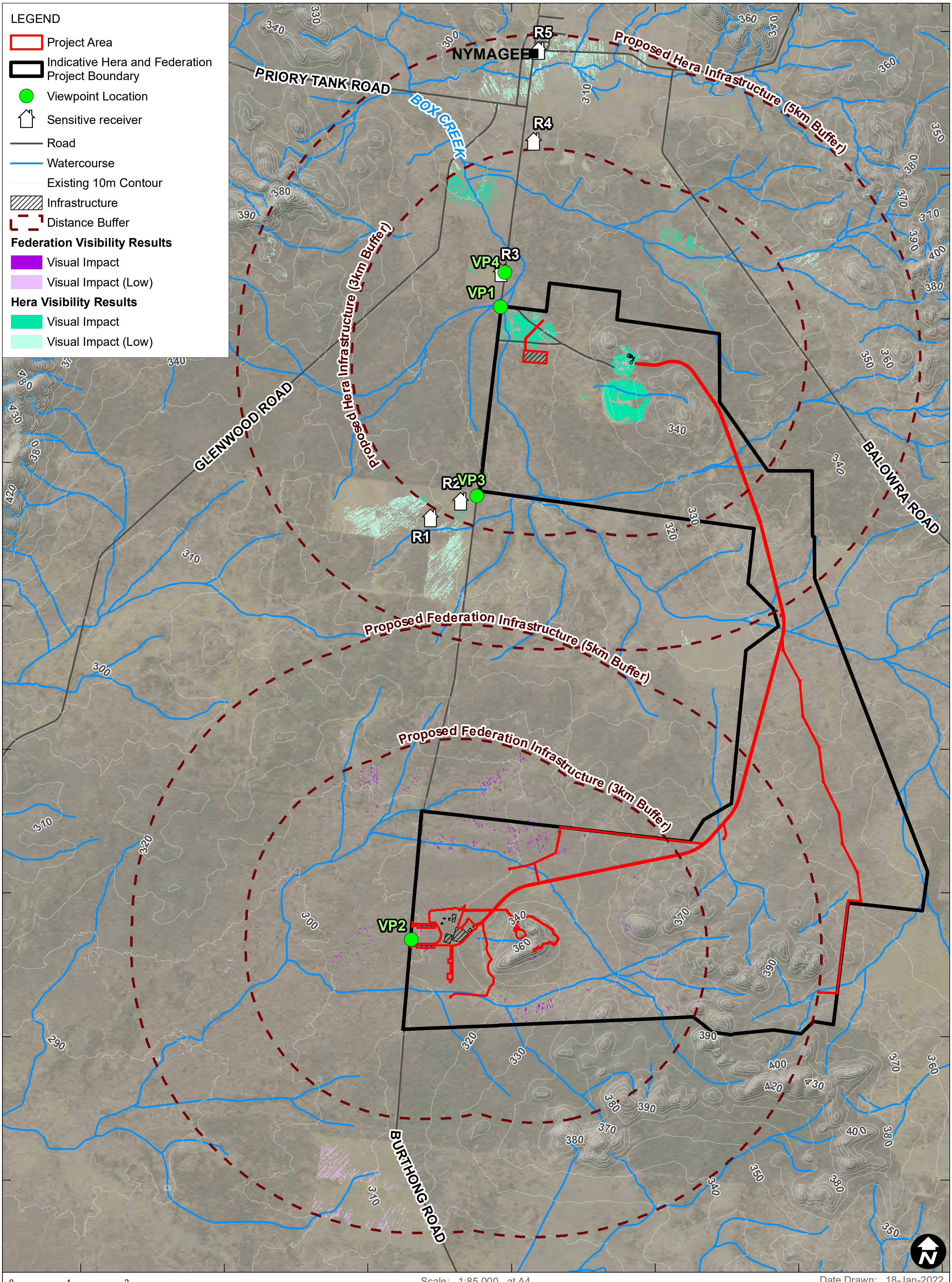
Visual receptor points were initially identified through desktop assessment including the review of aerial photography and GIS data sets as well as the 'zone of theoretical visibility' map as shown in **Figure 8-43** below.

These included several locations that may have a likelihood of being impacted by the proposed infrastructure on the subject site. Other image capture locations were removed from the assessment as it clearly showed no potential visual impacts. These view points were discounted due to the following reasons:

- Relative distances from the site were too great;
- Views blocked or hindered due to presence of existing vegetation or topography; and
- Limited viewing opportunities along roads due to relative road speeds and location of the subject site in relation to direction of travel.

The remaining visual receptor points, as illustrated in **Figure 8-45** where selected due to the higher likelihood of visual impact. The image captures included multiple photos that have been stitched together to demonstrate a view to match what is perceived by an observer. Visibility modelling is overlaid with the selected viewpoints to assess the visibility results.

The private receptors were selected from positive cells being identified on the visibility modelling within the 3 km buffer from the centre proposed infrastructure.




Scale: 1:85,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 18-Jan-2022
Project Number: 660.30090.00000

H:\Projects-SLR\660-SrvWOL\660-WOL\660.30090.00000 Federation Project Approvals\06 SLR Data\01 CADGIS\GIS\SLR66030090_EIS_G54_FederationProjectVisibilityResults_001.mxd

SLR

Data Source: Basedata NSW SS, 2019
Aerial imagery supplied by © Department of Customer Service 2020
Elevation data & Contours supplied by Aurelia Metals
DFSI-SS (DFSI-SS, August 2014) & Aerometrex Pty Ltd, 2019
Positive visibility results occur within the Project Footprint a mask has been applied so these results are not displayed.

VISIBILITY ANALYSIS - 5KM

FIGURE 8-45

### 8.16.6 Receptor Sensitivity

The receptor sensitivity is derived from a combination of factors including:

- Receptors interest in the visual environment (high, medium or low interest in their everyday visual environment and the duration of the effect);
- Receptors viewing opportunity (prolonged, regular viewing opportunities); and
- Number of viewers and their distance/ angle of view from the source of the effect, extent of screening/ filtering of view.

The receptor sensitivity rating is described as being high, medium, low or negligible as described in **Table 8-124.**

*Table 8-124 Receptor Sensitivity Rating*

| Receptor Sensitivity | Description |
|---|---|
| High | ▪ Visitors to heritage sites, regionally important locations, scenic routes, lookouts within 2.5km with quality views, important views of the site and surrounding areas where landscape is the specific focus.<br>▪ High numbers of visitors<br>▪ Views to landscape that are rare and or unique and are possibly vulnerable to change<br>▪ Views from residences within 1km of the site or are representative of high-quality views |
| Medium | ▪ Travellers/visitors along roads or rail routes that are not scenic routes but offer quality views within 2.5km of the site<br>▪ Medium numbers of visitors/ residents (rural communities or townships)<br>▪ Views that are representative of local character or sense of place but are not rare or unique<br>▪ Views from residences beyond immediate vicinity (1km-5km) of the site or are representative of moderate quality views<br>▪ Recreational users/ viewers beyond 2.5km from the site with moderate interest in their surrounds. |
| Low | ▪ Travellers/visitors along roads or rail routes that are not scenic routes but offer reasonable views within 4km of the site<br>▪ People at place of work where setting or views not important to quality of working environment<br>▪ Recreational users not dependent on views or scenic quality of landscape<br>▪ View experienced take in broad context with which site is visible but not an important element.<br>▪ Small numbers of visitors with passing interest in their surroundings (those travelling along mid-level roads)<br>▪ Viewers whose interest is not specifically focused on landscape or scenic qualities (commuters, workers). |
| Negligible | ▪ Very occasional or low level of users with passing interest in their surrounds (those travelling along minor roads or views from the air)<br>▪ Travellers/visitors along unsealed roads offering views greater than 4km of the site. |

### 8.16.7 Magnitude of Landscape Change

The magnitude of change to the landscape character depends on the nature, scale, intensity, extent and duration of the impacts/ change due to infrastructure proposed on the subject site. The magnitude of change for each viewpoint is described as being high, medium, low or negligible as described in **Table 8-125**.

*Table 8-125 Magnitude of Change*

| Magnitude of Change | Description |
|---|---|
| High | Dominant Change<br>▪ Major change in view at close distances, affecting substantial part of the view continuously visible for a long duration or obstructing a substantial part or important elements of the view<br>▪ Overwhelming loss or additional features in the view such as the nature of view or character of landscape fundamentally changed<br>▪ Views to key landscape features affected<br>▪ Visual amenity of local residents or road users substantially diminished<br>▪ Substantial change to the landscape due to loss of and or change to elements, features or characteristics of the landscape creating an overall worsening of landscape quality. |
| Medium | Considerable Change<br>▪ Clearly perceptible changes in views at intermediate distances resulting in either distinct new element in a significant part of the view or a more widely ranging, less concentrated change across a wider area<br>▪ Significant loss or addition of features in the view, such that nature of view or character of landscape is altered<br>▪ Noticeable contrast of any new features in the view such that the nature of the view or landscape character is changed<br>▪ Noticeable contrast of any new features or changes compared to existing landscape<br>▪ Views to key landscapes partially obstructed but views remain intact. |
| Low | Noticeable Change<br>▪ Minor memorable change to the landscape or views<br>▪ Temporary or reversible impact<br>▪ Landscape dominant element and built form / development well integrated within it<br>▪ Little permanent change or no fundamental change to local landscape character. |
| Negligible | Barely perceptible change<br>▪ No memorable or rarely perceptible change to landscape character or key views. |

The impact significance is evaluated according to the two key criteria which is reflected in Table 8-126 below**.** The process of assessment and the use of the ratings tables reflects typical outcomes for visual impacts. This includes:

Impacts on receptors that are particularly sensitive to change in views and visual amenity are more likely to be significant and;

Impacts that constitute a substantial change to the visual environment are likely to be more significant than the impacts that do not cause substantial change.

*Table 8-126 Impact Significance*

| Receptor Sensitivity | Magnitude of Change in Landscape | | | | |
|---|---|---|---|---|---|
| | | High (Dominant Change) | Medium (Considerable Change) | Low (Noticeable Change) | Negligible (Barely Perceptible Change) |
| | High | High | Moderate-High | Moderate | Minor-Moderate |
| | Medium | Moderate-High | Moderate | Minor-Moderate | Minor |
| | Low | Moderate | Minor-Moderate | Minor | Minor - Negligible |
| | Negligible | Minor-Moderate | Minor | Minor - Negligible | Negligible |

### 8.16.8 Summary of Landscape Impacts

The following summarises the assessment of impacts on each of the identified visual receptor points. Four representative viewpoints were identified and include both public and private receptor points.

*View Point 1*

View Point 1 is at the entrance of Hera Mine as shown in **Photo 8-28**. The zone of theoretical visibility is provided in **Figure 8-46** and a summary of impacts provided in **Table 8-127.**

*Photo 8-28 View Point 1 - Existing Hera Mine Entrance*


*Figure 8-46 Zone of Theoretical Visibility for Viewpoint 1 (VP1)*

*Table 8-127 Receptor VP1 – Summary of Visual Impact Assessment*

| Receptor - VP1 | Summary of Visual Impact Assessment |
|---|---|
| Receptor Location | Burthong Road – travelling southbound at Hera Mine site access road (views to the east). Receptor is described as vehicular users/ travellers using a public road.<br>Coordinate Location: Latitude 32° 6' 18.16" S, Longitude 146° 18' 32.59"E |
| Visual Baseline Description | Views/ glimpses southeast travelling south along Burthong Road.<br>Represents typical views of travellers/ road users in vehicles.<br>Views in the foreground are typically closed, very gently undulating, rural land with patches of vegetation evident in both foreground and middle ground. The background typical is highly vegetated with limited glimpses of existing woodland.<br>Views of the subject site and proposed works are moderately visible in the mid-ground showing a heavily vegetated ridgeline. Existing Hera Mine in the foreground and the trees along the boundary are the most prominent landscape elements in the view.<br>Glimpses of existing Hera Mine site is visible however only as green undulating landscape with stands of vegetation. |
| Sensitivity Rating | This viewpoint represents the visual experience standing adjacent to the mine entrance at Burthong Road. From here the road continues towards the Federation Site entrance where generally the site is perceived as a green backdrop to that buffers the cleared rangeland beyond. Although travelling south, the vegetation on the rural properties north of the site is sparse, the canopy cover and vegetation still prevents open and clear views of the site to the public.<br>Views of the rural landscape and vegetated undulating hills are typical of the local character in the region. The viewpoint shows rural land in the foreground with natural forested areas in the middle and background.<br>At 60-80km/h any views are expected to be generally short term (few seconds and at this distance). As sealed state classification road, a low number of vehicles would travel along it during the day. This would include local residents, heavy vehicles servicing the local industries.<br>In general, this viewpoint provides encumbered views of the eastern mine site located within the subject site, which the receptor could perceive to be a minor landscape element at this point.<br>The overall sensitivity of the receptors at this viewpoint would be Low. |
| Impact Magnitude Rating | The existing vegetated character of the subject site is moderately visible from this viewpoint. The subject site is part of a broader surrounding vegetated area that forms the landscape character from this location.<br>The subject site is not of significance (e.g. State Conservation Area) within the local context but plays a role in forming the vegetated backdrop character typical of the region.<br>As the views from this location encompass a range of natural, infrastructural, and disturbed landscapes it could be considered to have a high degree of resilience to change. This would be demonstrated in the removal of the visible vegetation exposing a clearing in the background. However, the natural bushland character of the site complements the views to the east of the broader uncleared subject site. |

| | |
|---|---|
| | Generally, the elements of the proposed works which consist mainly of intensification of infrastructure will be a perceptible change from this viewpoint and appear to contrast with the existing landscape character (colours, textures, forms).<br>The impact magnitude rating for this receptor would be Low. |
| Impact Significance | The impact of significance for receptors at this viewpoint would be considered Minor. |
| Mitigation Measures | Mitigation measures recommended would be to maintain and extend the native vegetation buffer that aligns Burthong Road. All proposed infrastructure, etc would be set well within the site boundary maintaining a 500m minimum clearance zone. |

### *View Point 2 Burthong Road*

View Point 2 is along Burthong Road is shown in **Photo 8-29**. The zone of theoretical visibility is provided in **Figure 8-47** and a summary of impacts provided in **Table 8-128.**

*Photo 8-29 View Point 2 - Burthong Road*

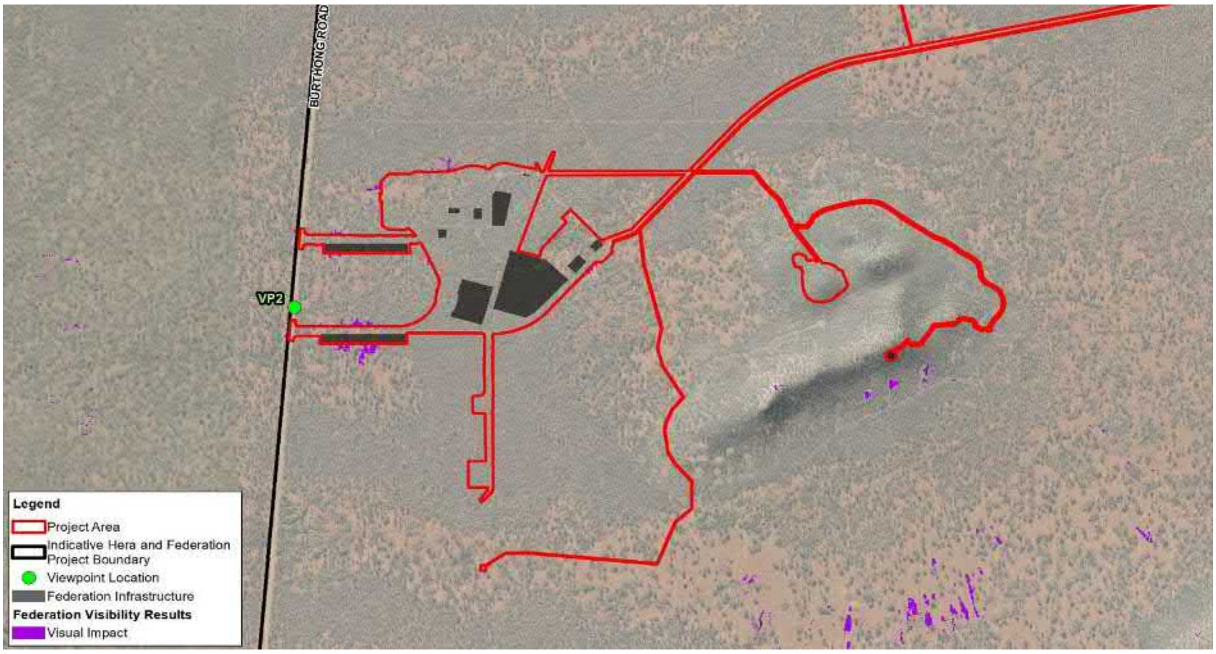



*Figure 8-47 Zone of Theoretical Visibility for Viewpoint 2 (VP2)*

*Table 8-128 Receptor VP2 – Summary of Visual Impact Assessment*

| Receptor – VP2 | Summary of Visual Impact Assessment |
|---|---|
| Receptor Location | Burthong Road – travelling northbound approx. below proposed Federation Site heavy vehicle haul road (views to the northeast). Receptor is described as vehicular users/ travellers using a public road.<br><br>Coordinate Location: Latitude 32° 15' 35.04" S, Longitude 146° 17' 28.43"E |
| Visual Baseline Description | Views/ glimpses southeast travelling north along Burthong Road.<br><br>Represents typical views of travellers/ road users in vehicles.<br><br>Views in the foreground are typically semi - closed, very gently undulating, with medium height woodland of endemic vegetation.<br><br>Views typical of Burthong Road that surrounds subject site where visibility is moderate due to semi-closed character of the vegetation. |
| Sensitivity Rating | This viewpoint represents the visual experience along Burthong Road. From here the road continues toward Balowra State Conservation Area.<br><br>Views of the multi-trunk (mallee) forest with closed to semi-closed views on flat rangelands.<br><br>At 60-80km/h any views are expected to be generally short term (few seconds and at this distance). As an unsealed local classification road, a low number of vehicles would travel along it during the day. This would include local residents, heavy vehicles servicing the local industries.<br><br>Proposed clearly would allow views into Federation site with low vegetative screening.<br><br>The overall sensitivity of the receptors at this viewpoint would be low. |
| Impact Magnitude Rating | The impact magnitude rating for this receptor would be Medium. This is based on the potential clearly that is proposed for the new entry point. This would only be a glimpse or a short term view when traversing at approximately 60-80km/h. |
| Impact Significance | - The impact of significance for receptors at this viewpoint would be considered Minor Moderate. |
| Mitigation Measures | Mitigation measures recommended would be to maintain and extend the native vegetation buffer that aligns Burthong Road. All proposed infrastructure, etc would be set well within the site boundary maintaining a 250 - 1000m minimum clearance zone. |

### *View Point 3*

View Point 3 is along Burthong Road is shown in **Photo 8-30**. The zone of theoretical visibility is provided in **Figure 8-48** and a summary of impacts provided in **Table 8-129.**

*Photo 8-30   View Point 3 - Burthong Road Private Receptor*

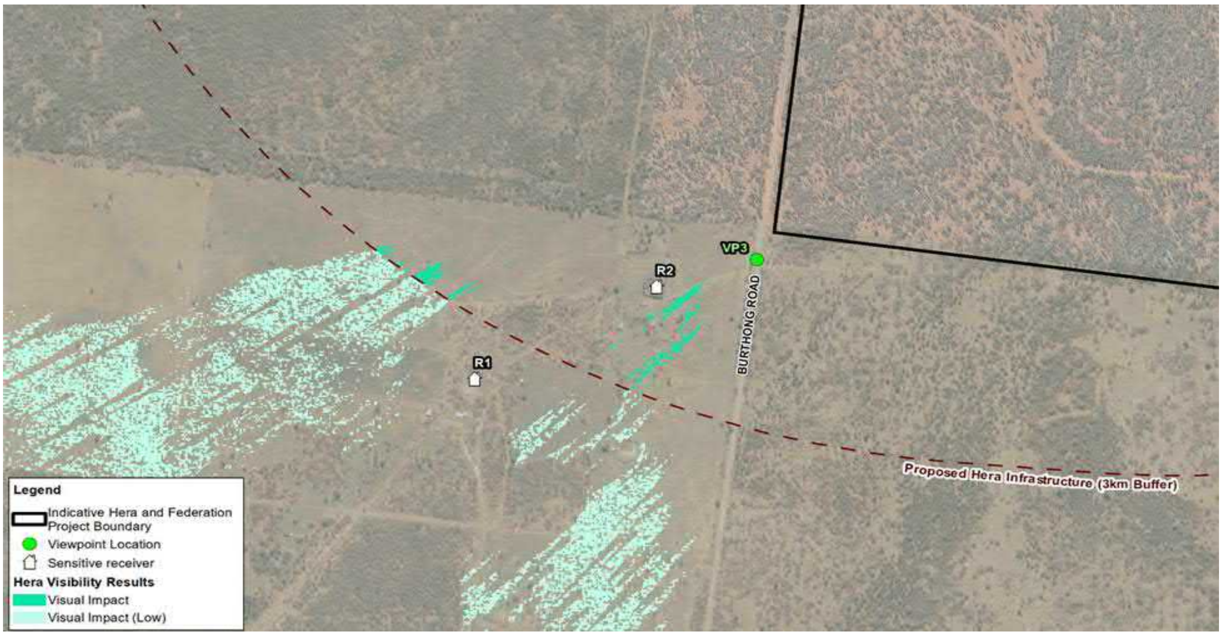



*Figure 8-48*  Zone of Theoretical Visibility for Viewpoint 3 (VP3)

*Table 8-129 Receptor VP3 – Summary of Visual Impact Assessment*

| Receptor – VP3 | Summary of Visual Impact Assessment |
|---|---|
| Receptor Location | Burthong Road Private Receptor – Accessed from Burthong Road. Property entrance approximately 3.3km south of the Hera Mine entrance and approximately 8km north of proposed Federation Site. Receptor is described as private users/ resident accessing property and viewing from existing dwelling.<br><br>Coordinate Location: Latitude 32° 8′ 5.24″ S, Longitude 146° 18′ 16.11″E |
| Visual Baseline Description | Views/ glimpses northeast travelling south along Burthong Road.<br><br>Represents typical views of travellers/ road users in vehicles and vegetation conditions adjacent to residential property.<br><br>Views in the foreground are typically semi - open, very gently undulating, with medium height woodland of endemic vegetation.<br><br>Views typical of Burthong Road that surrounds subject site where visibility is moderate due to semi-open character of the vegetation.<br><br>Visibility modelling has no positive visibility results near the residence. |
| Sensitivity Rating | This viewpoint represents the visual experience along Burthong Road. From here the road continues north toward Hera Mine Entrance.<br><br>Views of the cypress forest with semi-open views on flat rangelands.<br><br>The overall sensitivity of the receptors at this viewpoint would be Low. |
| Impact Magnitude Rating | The impact magnitude rating for this receptor would be Negligible. |
| Impact Significance | - The impact of significance for receptor at this viewpoint would be considered Minor - Negligible. |
| Mitigation Measures | Mitigation measures recommended would be to maintain and extend the native vegetation buffer that aligns Burthong Road. All proposed infrastructure, etc would be set well within the site boundary maintaining a 3000m clearance zone. |

### *View Point 4*

View Point 4 is along Burthong Road - Private Receptor location is shown in **Photo 8-31.** The zone of theoretical visibility is provided in **Figure 8-49** and a summary of impacts provided in **Table 8-130.**

*Photo 8-31 View Point 4 - Burthong Road Private Receptor*

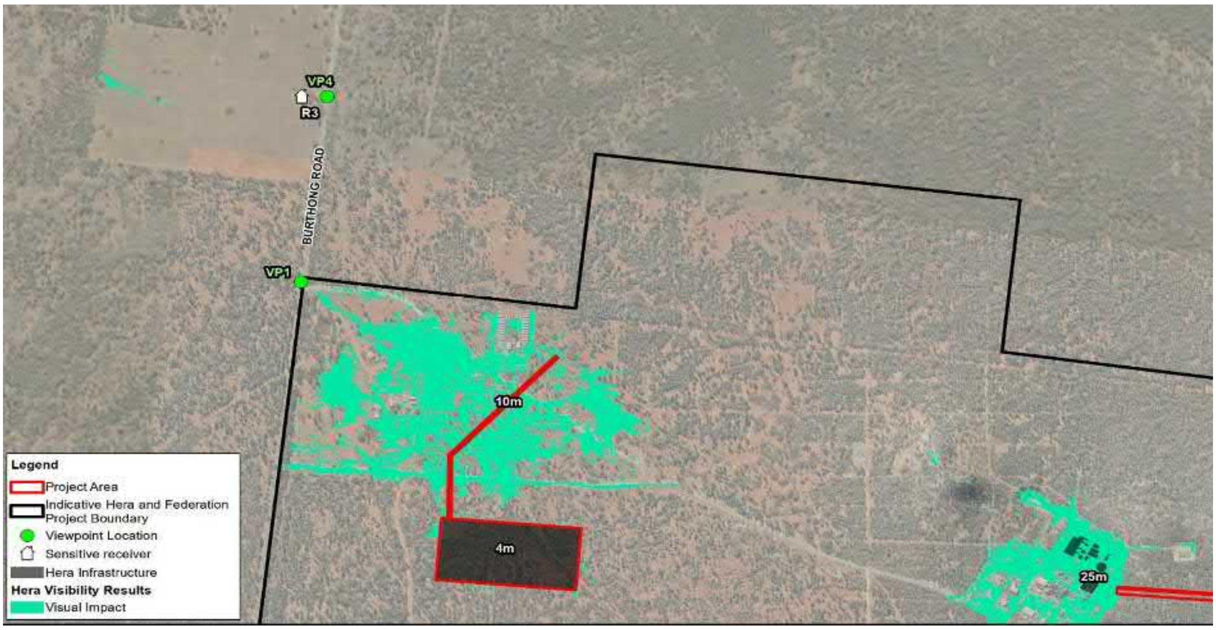



*Figure 8-49 Zone of Theoretical Visibility for Viewpoint 4 (VP4)*

*Table 8-130 Receptor VP4 – Summary of Visual Impact Assessment*

| Receptor – VP4 | Summary of Visual Impact Assessment |
|---|---|
| Receptor Location | Burthong Road Private Receptor – Accessed from Burthong Road. Property entrance approximately 0.6km north of the Hera Mine entrance and approximately 11km north of proposed Federation Site. Receptor is described as private users/ resident accessing property and viewing from existing dwelling.<br>Coordinate Location: Latitude 32° 5' 58.61" S, Longitude 146° 18' 35.88"E |
| Visual Baseline Description | Views/glimpses southeast travelling south along Burthong Road.<br>Represents typical views of travellers/road users in vehicles and vegetation conditions adjacent to residential property.<br>Views in the foreground are typically semi - open, very gently undulating, with medium height woodland of endemic vegetation.<br>Views typical of Burthong Road that surrounds subject site where visibility is moderate due to semi-open character of the vegetation.<br>Visibility modelling has no positive visibility results near the residence. |
| Sensitivity Rating | This viewpoint represents the visual experience along Burthong Road. From here the road continues south toward Hera Mine Entrance.<br>Views of the cypress forest with semi-open views on flat rangelands.<br>The overall sensitivity of the receptors at this viewpoint would be Low. |
| Impact Magnitude Rating | The impact magnitude rating for this receptor would be Negligible. |
| Impact Significance | - The impact of significance for receptors at this viewpoint would be considered Minor - Negligible. |
| Mitigation Measures | Mitigation measures recommended would be to maintain and extend the native vegetation buffer that aligns Burthong Road. All proposed infrastructure, etc should be set well within the site boundary maintaining a 1000m minimum clearance zone. |

### *Summary of Impacts*

The assessment identified that in all 4 viewpoints the receptor sensitivity was rated as low. This resulted from the receptor points being located along Burthong Road and at the entrances of private residences along Burthong Road, within a 3km distance of the Project area from the centre of the proposed infrastructure.

With regard to the magnitude of change, this was considered to be negligible to medium due to the Project infrastructure and activities being relatively hidden by adjoining vegetation and landform that would remain unaffected by the works.

**Table 8-131** below provides a summary of the visual assessment for the proposed Project works for the respective viewpoints.

*Table 8-131 Summary of Visual Assessment*

| Receptor | Receptor Sensitivity | Magnitude of Change | Effect Significance |
|---|---|---|---|
| VP1 | Low | Low | Minor |
| VP2 | Low | Medium | Minor - Moderate |
| VP3 | Low | Negligible | Minor - Negligible |
| VP4 | Low | Negligible | Minor - Negligible |

### 8.16.9 Mitigation Measures

It is proposed to maintain and protect existing vegetation during the operation of the Project and to rehabilitate the site to a similar condition as existed prior to mining operations.

A Rehabilitation Strategy (refer **Appendix D**) has been prepared for the Project which outlines the rehabilitation objectives and outcomes. The land will be rehabilitated back to a stable landform and will be revegetated with suitable native vegetation and grassland with consideration given to the existing PCTs in the Project area.

### 8.16.10 Conclusion

A LVIA was prepared for the Project to determine potential impacts on visual amenity. The LVIA was undertaken through a combination of site visit and desktop analysis. The assessment developed a visibility model to analyse whether proposed infrastructure could be observed from key receptor points. Four viewpoints were adopted as being representative of public and private views. The LVIA combined an assessment of receptor sensitivity and magnitude of change to determine the significance of potential impacts. The significance of impacts at selected viewpoints ranged from 'minor – negligible' to 'minor – moderate'. Retention of existing vegetation screens and rehabilitation of the mine site to a similar landscape as existed pre-mining will mitigate impacts to visual amenity.

## 8.17 Social

### 8.17.1 Introduction

A Social Impact Assessment (SIA) was prepared by Element Environmental and is included in **Appendix G.** The SIA was prepared in accordance with the *Social Impact Assessment Guideline For State Significant Projects* (DPIE, 2021) (the Guideline).

### 8.17.2 SEARs Requirements

The SEARs requirements and where they have been addressed are provided below in **Table 8-132.**

*Table 8-132 Social Impacts SEARS Requirements*

| SEARs Requirement | Reference |
|---|---|
| An assessment of the social impacts of the project, prepared in accordance with the Department's *Social Impact Assessment Guideline For State Significant Developments* (July 2021) (subject to transitional arrangements), including the likely impacts of the development on the local community, cumulative impacts (considering other mining developments in the locality), and consideration of construction and operational workforce accommodation; | **Section 8.17.6** |

### 8.17.3 Methodology

The social locality for the Project was selected by considering the Project features and their potential impact for people in Nymagee, points of interest near to Nymagee (including residences) and Cobar Shire more broadly. It recognises the Project haulage routes. The social locality includes Nymagee suburb, which is a wider area than Nymagee township. The SIA was undertaken over two phases, with Phase One being the scoping stage followed by the Phase Two impact assessment phase.

Phase One scoping included the following:

- Literature review of comparable projects in the regional locality;
- Completion of the SIA Scoping tool (as per the previous Guideline, which was current at that time)
- Completion of semi-structured interviews;
- Online community values survey distribution; and
- Determination of the social locality.

Phase Two of the SIA sought to determine the existing social baseline as well as the existing social infrastructure. Ethnographic content analysis (ECA) was selected and adapted as the method to assess impacted social matters identified during the scoping exercise. ECA is a qualitative media analysis method used to obtain, categorise and analyse different media documents (such as newspapers and magazines) in addition to other forms of media delivered online and via television. The ECA conducted for the Project sourced business papers from Cobar shire Council (CSC) as their media.

### 8.17.4 Consultation

Stakeholder engagement was undertaken to inform the SIA process. The first step in this process was to identify stakeholders relevant to the Project. The locally specific stakeholders are known to Hera Resources courtesy of their long-term local presence and relationships derived from Hera Mine and Peak Mine. As part of scoping the SIA, a high-level stakeholder analysis was initially undertaken by leveraging the knowledge held by Hera Resources staff in attendance at the scoping meeting.

Stakeholder engagement was undertaken using a number of methods. A community hotline and email were established providing a means for stakeholders to contact the Project team. The Federation Project webpage (https://www.aureliametals.com/projects/federation/federation-project) was established at the start of the SIA Phase One and updated as the Federation Project progressed through the EIS. The website included a link to the online community values survey. Three email blasts to the Federation Project stakeholder database were sent throughout the course of the SIA. The blasts were used to distribute communications such as the EIS community updates and details of community information sessions.

Two community information sessions were held, the first in March 2021 and the second in September 2021. The sessions provided an opportunity for stakeholders to meet the Project team, provide feedback, and raise any queries or issues. Issues raised in the first session were used as inputs to the scoping tool. Due to COVID-19 restrictions the September 2021 session was held online.

Further information on stakeholder engagement is provided in **Chapter 7.**

### 8.17.5 Existing Environment

The SIA assessed the existing social baseline, which is the nominated set of social indicators for communities potentially affected by the Project. It provides a point of comparison; it can be used as reference data against which to measure the impacts of the Project as it develops.

*Nymagee*

Nymagee is a small regional town in NSW, within the Cobar LGA. It was shown in the 2016 Census (at the State Suburb scale) to support a population of approximately 100 people. Nymagee is located approximately 618 km north west of Sydney, 130 km south west of Nyngan, 98 km south-east of Cobar and 15 km north of Federation Site. Nymagee falls within the Shire of Cobar, the State government area of Barwon and the Federal government area of Parkes.

Nymagee township is located at the intersection of Milford Street and Hartwood Street. The town contains a police station, sports oval, community hall and library and Rural Fire Service station. Nymagee airport is located approximately 1 km to the north-west, and the racecourse is located on Rosevale Road on the northern outskirts of the town. The area is dominated by agricultural land uses and native semi-arid woodland.

*Population – Cobar LGA*

The 2016 census shows Cobar Shire having a resident population of 4,969, which was reduced from 2006. The 2016 census outlined the following population statistics of Cobar Shire:

- 51.5% males and 48.5% females with a median age of 36 years;
- 62% are aged between 18 and 64 years;
- 36% of residents are currently renting;
- There were 2,313 dwellings in the Shire; and
- 46% of the population was earning an average weekly household income of $1,000 per week or more.

According to the ABS (2016), Cobar's population has been reasonably steady for the past ten years (Cobar Shire Council, 2013). However, anecdotal evidence derived from consultation with local residents suggests that the population of Cobar is in decline and school student numbers are similarly reducing annually in recent years.

At a local level, Nymagee has a small population of approximately 100 people (Australian Bureau Statistics, 2016), of which 54% were male and 46% were female. The median age is 48 years and the number of people per household was 2.3.

### *Employment – Cobar LGA*

The Shire's economy is built around mining (copper, lead, silver, zinc and gold), pastoral / agricultural industries (Cobar Shire Council, 2013) and the local tourism industry, thus Cobar has enjoyed a relatively low unemployment rate.

Mining is the largest employer in the Cobar LGA, with an employment rate of 32%. The second largest employer is agriculture, forestry and fishing industry accounting for 12% of employment in the LGA. According to 2016 ABS data, the unemployment rate (looking for work) in the Cobar LGA which includes the township of Nymagee is 6.9% and total rate of people not in the labour force is 11.9% (ABS, 2016). The NSW unemployment rate during the 2016 census was also 6.9% and 11% of the population above the age of 15 were not active in the workforce.

### *Income – Cobar LGA*

The median weekly personal income for people aged 15 years and over in Cobar LGA was $706 (ABS, 2016). This data is broken down further in **Table 8-133**.

The NSW median weekly earnings are lower compared with the Cobar LGA population (ABS, 2021). **Table 8-133** shows this is true for individuals, families and households. These measurements are likely associated with mining, which is the largest employer in the Cobar LGA (Dickinson & Evans, 2021).

*Table 8-133 Weekly Income*

| Median weekly income of people aged 15+ years | Cobar LGA | NSW |
|---|---|---|
| Personal | $706 | $664 |
| Family | $1,923 | $1,780 |
| Household | $1,495 | $1,486 |

### *Education – Cobar LGA*

Of the people aged 15 years and over in Cobar LGA, 10.4% reported having completed Year 12 as their highest level of educational attainment, 20.8% had completed a Certificate III or IV and 4.8% had completed an Advanced Diploma or Diploma.

### *Socio-Economic Index – Cobar LGA*

Socio Economic Indexes for Areas (SEIFA) is a suite of indexes that have been created by the ABS from social and economic Census information (ABS, 2016). Each index ranks geographic areas across Australia in terms of their relative socio-economic advantage and disadvantage. The Index of Relative Socioeconomic Disadvantage (IRSD) is a general socio-economic index that summarises a range of information about the economic and social conditions of people and households within the Cobar Shire. This index includes only measures of relative disadvantage; a low SEIFA score indicates relatively greater disadvantage in general.

The SEIFA score for Nymagee in 2016 was 922, which ranks in the first quintile and can be described as a relatively disadvantaged area when considering access to material and social resources and the ability to participate in society.

*Existing Social Infrastructure*

Social infrastructure refers to facilities and services that enhance the social capacity of communities and may include infrastructure related to health, housing, youth, aged care, leisure, community safety facilities and road safety. The social infrastructure in the social locality will provide a reference point against which social impacts may be measured if the Project proceeds. Such impacts can take the form of a decrease in the quantity, diversity, or capacity of the existing social infrastructure, courtesy of demand from an expanded workforce and their relatives relocating to an area.

The following key social infrastructure was identified, which underpin the social wellbeing of the population:

- Nymagee Racecourse;
- Nymagee Hotel;
- Brigade Station;
- Nymagee Police Station; and
- Nymagee Park.

*Community Values*

Mining was identified as a positive feature of the social locality. The environmental attributes were also implied as a strongly held value. Watercourses and groundwater were highlighted as being important to people around the Project.

In addition, one participant lamented the decline of the general population since the foundation of Nymagee township, coinciding with the start of mining in the area. The survey response implied that mining attracts population and business to the area and that this is a positive value in the community. Conversely, the survey response could be implying that resident workforces (a feature of historic mines) are more valued than non-resident workforces which are more synonymous with modern day mines in the Cobar LGA.

Participants nominated the following potential challenges for the social locality:

- Water shortage;
- Attracting skilled people to work in the mining industry;
- Lack of people in the area on properties; and
- Keeping revenue generated in the area.

### 8.17.6 Impact Assessment

As stated in **Section 8.17.3**, the SIA was undertaken over two phases. Phase One involved scoping of key issues which would be further considered in Phase Two of the SIA. A summary of issues identified in Phase One and the proposed assessment approach is provided in **Table 8-134.**

*Table 8-134 Potential Project Impacts Identified in SIA Phase 1 for Further Investigation*

| Social Impact Category (and Predicted Impact to People) | Level of Assessment (Adapted from Scoping Tool) | Aspect Outline | Assessment Methodology |
|---|---|---|---|
| Positive Impacts | | | |
| Community<br><br>(Community cohesion) | Standard | Hera Mine contributes financially to the town by maintaining or resealing roads (e.g., Whitbarrow Way), public facilities such as the tennis courts and providing breakfast at the accommodation village on ANZAC day.<br><br>Hera Resources contributes $20K-$50K per annum on average to community projects such as yarning circles, the Miner's Memorial and gifts for the local Christmas party. Hera Resources has in the past provided in-kind support to the local Country Women's Association (CWA) and flower show.<br><br>If the Project does not proceed, there would be less financial and in-kind support available to the community. | ECA<br><br>Semi-structured interviews with residents and business owners in the social locality |
| Livelihood<br><br>(Peoples capacity to sustain themselves - business and employment) | Standard | Hera Mine staff provide custom to the Nymagee pub, which provides economic benefit to the proprietor and community cohesion given the venue acts as a drawcard for visitors and a host of cultural events. This pub also has 12 rooms that accommodates staff when the Hera Mine is short of accommodation.<br><br>If the Project is to proceed, the hotel expects to garner more business by way of sales at the pub, poker machines and accommodation. | Semi-structured interviews with residents and business owners in the social locality |

| | | | |
|---|---|---|---|
| | | Residents also expect to benefit from the Project by either gaining direct employment or providing contracting services to the Project.<br><br>Some Nymagee residents suggest that the supply of raw water from on-farm dam water storages to the Project would generate positive social impact. It would allow farmers to generate an income stream (not available currently) by selling this resource. Residents commented that such an income stream could offset revenue losses that might occur from other factors (e.g., environmental or commercial constraints in relation to family farming operations). | |
| Health and well-being<br><br>(Physical and mental health) | Standard | Some Nymagee residents suggested the Project would create a positive social impact on physical and mental health in the area. The Project would create a larger population in the area and subsequently, a higher volume of vehicles operating on the local road network which is comparatively remote compared to elsewhere in the Cobar LGA.<br><br>People stranded on private roads (through vehicle breakdown for example) would be more likely to be recognised and obtain assistance if the Project proceeds, by virtue of the larger volume of 'passers-by' being in the area. Similarly, a degree of comfort and mental health benefits would arise knowledge that because of the Project, 'more people are around'. | Community values survey<br><br>Semi-structured interviews with residents and business owners in the social locality |
| Cultural<br><br>(Employment of Aboriginal people) | Standard | If the Project were to proceed, it would create an opportunity to realise positive social impacts in relation to a potential LALC/Hera Resources partnership. This opportunity would not exist without the Project.<br><br>The LALC indicated its interest in forming a partnership with Hera Resources and supporting development of a Reconciliation Action Plan. | Semi-structured interviews with LALC representatives<br><br>AFGM |
| Negative Impacts | | | |

| | | | |
|---|---|---|---|
| Way of life<br><br>(How people play) | Standard | With FIFO and DIDO staff not living in Nymagee, the community will not experience a way of life benefit that Project employees might otherwise contribute; however, it was recognised that Nymagee cannot support a mining workforce. | Dialogue with Hera Resources about rostering and FIFO / DIDO policy<br><br>Desktop research<br><br>Semi-structured interviews |
| Accessibility<br><br>(How people access and use infrastructure) | Not relevant (see section 6.2.2 for justification) | Telecommunications (e.g., mobile phone and internet) are poor in the area at present and increased demand from Project workers could potentially exacerbate the issue.<br><br>This accessibility issue was raised as a precaution during SIA Phase 1 for further investigation. It was subsequently evaluated to be immaterial to the SIA due to the new proposed telecommunications infrastructure proposed for the Project. | N/A |
| Accessibility<br><br>(Services and facilities) | Standard | The community's water supply (currently boreholes) may not be sustainable. The concern relates to both water availability and contamination, and how it may be impacted by the Project's requirement for this resource.<br><br>This accessibility issue was raised as a precaution during SIA Phase 1 for further investigation. | Review of technical study commissioned for the EIS (e.g., hydrogeology study) |
| Culture<br><br>(Connection to country, land and waterways, places and buildings) | Standard | The Cobar LALC suggested that there are potentially scar trees and important cultural areas near the Project.<br><br>There is potential disconnection to country if the Cobar LALC cannot assess bore site area to check for artefacts before drilling. | Review of technical study commissioned for the EIS (e.g., Indigenous cultural heritage study) |
| Health and wellbeing<br><br>(Physical and mental health) | Standard | The community is concerned about dust generated by TSF at Hera Mine, Run of Mine (ROM) operations and the movement of heavy vehicles on unsealed roads (i.e. Burthong Road) which could be used by Project vehicles. Dust has the potential to create health concerns (e.g. | Review of technical studies commissioned for the EIS (e.g., air quality study traffic impact |

| | | | |
|---|---|---|---|
| | | deposition of dust on rooftops used to harvest rainwater) and mental stress that could be exacerbated by the Project. | assessment and human health risk assessment)<br><br>Semi-structured interviews and dialogue between Hera Resources and property owners<br><br>Community values survey |
| Surroundings<br><br>(Public safety and security) | Standard | Speeding heavy vehicles have been experienced on the local roads, which could impact the safety of other motorists or pedestrians. This impact could increase with additional heavy vehicle movements. | Review of technical study commissioned for the EIS (e.g., traffic impact assessment) |
| Surroundings (noise and vibration) | Standard | Impacts from blasting operations at Hera Mine have been experienced and noted in existing community consultation documentation. | Review of technical study commissioned for the EIS (e.g., noise and vibration study) |
| Livelihood<br><br>(Distributive equity of impacts and benefits) | Detailed | Any short-term increase in workers (i.e. during the construction phase), and the extension of the period of operations (i.e. the operational workforce numbers shift from mining at Hera Mine to mining at the Federation Site) has the potential for a disproportionate burden to be placed on medical (or other) services in Cobar. | Semi-structured interviews with service providers |
| Decision-making systems<br><br>(Access to complaint, remedy and grievance mechanisms) | Standard | Additional direct engagement with Hera Resources representatives is desired by the community. | Dialogue with Hera Resources staff |

For each predicted impact in **Table 8-134,** Phase Two evaluation considered the impact likelihood and magnitude. The predicted impacts are summarised below in **Table 8-135** and explained in further detail in Section 6.2 of the SIA in **Appendix G**.

*Table 8-135 Positive and Unmitigated Negative Social Impacts*

| Social Impact Category | Impact |
|---|---|
| Positive Impacts | |
| Community cohesion | The ECA method was applied to assess this predicted positive social impact. The ECA results supported the SIA Phase 1 finding that the Project would positively impact community cohesion in the social locality if it proceeds.<br>Results of the semi-structured interviews were also relied upon to further assess the positive community cohesion impacts predicted to arise if the Project proceeds. The positive impact of financial donations made by Hera Resources, and the revenue for local businesses created by Hera Resources staff was evident in the interview transcripts.<br>Based on the results, it is logical to suggest that if the Project does not proceed, there would be less financial and in-kind support available to the community. Subsequently, without enhancement, it is predicted that the Project would have a high positive impact significance (almost certain to occur, with a moderate magnitude) for community cohesion in the social locality if it receives planning approval. |
| Livelihoods | Semi-structured interviews were relied upon to further investigate the predicted positive impact of the Project on the livelihoods of people in the social locality. Commentary of the interview participants made it clear that the capacity of people to sustain themselves would be positively influenced if the Project proceeds.<br>Business owners described a positive impact from expenditure of Hera Resources employees, which would flow on to benefit business employees through wages. Comments were also made with regard to a positive impact on property prices in Nymagee due to the proximity to the Project.<br>On this basis and acknowledging the proposed workforce transition from Hera Mine to the Project, it is predicted that if the Project proceeds, it would have a high positive impact significance (almost certain to occur, with a major magnitude) on the capacity of people in the social locality to sustain themselves through business and employment. |
| Health and well being | In the context of the Project, interview participants referred to the positive social impact that these mining related activities would have on physical and mental health. It was suggested that the Project would enable a mental health benefit by giving the local population some confidence that someone 'would be around' in the event of an emergency on otherwise less utilised roads. This would also translate to a physical health benefit in the event of physical harm. |

| | |
|---|---|
| | Considering the interview and survey results, it is predicted that the Project would create a positive impact on health and wellbeing in the social locality if it proceeds. The impact would have high significance being likely to occur, with moderate magnitude. |
| Cultural (Employment of Aboriginal people) | A potential positive Project impact for the employment prospects of Aboriginal people was identified in the interviews with Aboriginal stakeholders.<br><br>Using interview results and AFGM outcomes, the Project's potential positive impact on Aboriginal employment was predicted to be small. If the Project proceeds, it is estimated that the significance of any positive Aboriginal employment impact would be low (possible with minimal magnitude). |
| Unmitigated Negative Impacts | |
| Way of Life | A potential negative way of life impact for people in the social locality was identified as being a possible consequence of the Project. FIFO and DIDO staff that would be associated with the Project were described by some research participants as being a driver of this negative impact. The basis of this prediction is that FIFO and DIDO staff would stay at the Hera Mine accommodation village during their shifts and return home afterwards, without contributing fully to community (e.g., sporting and cultural events).<br><br>Around 15% of Hera Mine staff live in the social locality. Approximately half the workforce lives either in the social locality or around a two-hour drive from Nymagee.<br><br>A low social impact significance (unlikely and minor magnitude) is the outcome of the way of life impact evaluation. This outcome does not dismiss the idea that the FIFO/DIDO employment model influences the way of life. The outcome recognises that the FIFO/DIDO employment model proposed for the Project does negatively impact way of life in the social locality. However, the overriding consideration is that a workforce transition from Hera Mine to the Project would not exacerbate the situation that currently exists in the social locality |
| Accessibility (How people access and use infrastructure) | Some community members raised concerns that the telecommunication network near the Federation Site is poor. It was predicted that an influx of additional mine workers required to service the Project would weaken mobile phone and internet connections locally. During SIA Phase 2 the Project design was refined to incorporate a telecommunications service that would be dedicated to Project workforce. Subsequently, the accessibility (how people access and use infrastructure) social impact category has been 'designed out' of the Project and is evaluated as being immaterial to the SIA. |
| Accessibility (Services and facilities) | A GWIA (refer **Section 8.5**) was commissioned for the Project's EIS. The GWIA results were relied upon for the evaluation of issues raised by the community at the first community information session. The issues raised included the ground water availability and contamination, and how these characteristics would be impacted by the Project's water requirements. |

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| | The potential unmitigated impact of the Project on groundwater accessibility is considered to be medium (likely to occur and a minor magnitude). The significance of the impact recognises the GWIA results and the small number of landholders that would be affected by drawdown of bores. |
| Culture<br><br>(Connection to country,) | Results of semi-structured interviews, and the ACHA (refer Section 8.7) were used to evaluate the potential cultural impacts of the Project. Twenty eight Aboriginal sites were recorded during the archaeological / cultural heritage surveys. All sites except for a scar tree within the southeast portion of the proposed solar farm are outside the proposed impact footprint for the Project.<br><br>Without mitigation measures in place during construction and operation of the Project, there remains a potential for negative cultural impacts for the Aboriginal community. The unmitigated Project impact on Culture (connection to country) is predicted to be of **High** significance (possible and major magnitude ). |
| Health and well being | A small number of Nymagee residents cited health and wellbeing (physical and mental health) issues as being a potential negative impact of the Project.<br><br>The AQIA and the HHRA both conclude there is no predicted exceedance of air quality criteria, with the exception of 24hr average $PM_{10}$ on a single day which was due to high background levels. The HRRA (refer **Section 8.14**) concluded that all risks to human health due to dust from the Project are considered negligible. It was also recognised the issues raised by people in the social locality, and that those concerns are held by a small number of people and not widespread. On this basis the Project's predicted health and wellbeing impact is determined to have a medium social impact significance ranking (possible and moderate magnitude). |
| Surroundings (Public safety and security) | Semi-structured interview and the Projects RTA results were used to evaluate the predicted negative impact the Project would have on public safety and security.<br><br>Interview participants from Hermidale made it clear that the community have concerns about the current and potential future volume of heavy vehicles passing through Hermidale where a new park is being developed. The local community is concerned with the number of trucks and the speed at which they pass through the town centre.<br><br>The RTA conducted for the Project concludes that the existing road network and traffic patterns can accommodate the Project generated traffic changes in the region while maintaining sufficient safety and efficiency of the road network. The Project is predicted to have a **medium** social impact significance (possible likelihood and minor magnitude) on surroundings (public safety and security), specifically at the Hermidale intersection. |
| Surroundings (noise and vibration) | Semi-structures interviews, along with the NVIA and the HHRA were used to evaluate the potential negative impacts. |

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| | During semi-structured interviews, commentary from Hermidale and Nymagee interview participants focussed on mine operations other than blasting and did not identify noise and vibration impacts associated with the Nymagee Mine (in caretaker mode) or Hera Mine being a concern. The NVIA and HHRA found that the influence of traffic noise on nearby receivers is expected to remain below the assessment criteria.<br><br>Based on the NVIA and semi-structured interview results, noise and vibration-related issues are not predicted to negatively influence people in the social locality. Therefore, the Project's noise and vibration impact on people is expected to be medium (possible with moderate magnitude). |
| Livelihood (Distributive equity of impacts and benefits) | A combination of approaches from semi-structured interviews, media and literature analysis, and the Hera Mine workforce survey were used to evaluate the Project's predicted negative impact of FIFO / DIDO workers on local medical services.<br><br>During SIA Phase 1 some research participants had a perception that medical services in Cobar would be less accessible due to the increase of FIFO/DIDO workers in recent years. The study titled Cobar Surviving and Thriving (Balmoral Australia Group, 2021) commissioned by CSC investigated this perception. When asked how the infrastructure of Cobar could be improved, some residents indicated removing or reducing the FIFO/DIDO model in mining. Aside from this perception and as described earlier, one of the reports six recommendations was for the town to 'Embrace FIFO and DIDO Workers' to achieve a thriving economy, improved infrastructure, and a strong sense of community.<br><br>A survey of the Federation workforce was conducted to understand their use of local medical facilities and services. There were 13 responses to the survey and of these, all workers stated that they visit local health services less than once a year while on site. These responses do not give confidence to the statements that non-local mining employees place a burden on medical services in Cobar.<br><br>Acknowledging the proposed workforce transition from Hera Mine, publicly available medical service data, and the primary data collected in SIA Phase 2, it is considered unlikely that the Project would create negative accessibility changes to local hospitals and medical services in Cobar. Subsequently, the impact of the Project on Livelihood (distributive equity of impacts) is predicted to be of low significance (unlikely and minimal magnitude). |
| Decision- making Systems | Feedback from Project stakeholders suggested that the accessibility of Hera Resources staff and their capacity to respond to issues or information requests could be improved. Some Nymagee residents also suggested that decisions about Hera Mine have in the past been made without a local influence.<br><br>It was acknowledged that some issues which would give rise to this issue was a relatively high turnover of key staff as well as the size of Aurelia Metals and the location of the corporate office. |

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| | A low social impact significance (unlikely and minor magnitude) is the outcome of the decision making systems. This outcome acknowledges issues raised by the community about access to Hera Resources decision making and complaint, remedy and grievance mechanisms. However, the overriding consideration is that the Project would not exacerbate the situation that currently exists in the social locality. |

### 8.17.7 Mitigation and Management Measures

This section provides a summary of proposed positive impact enhancements and measures to mitigate those potential negative impacts identified in **Table 8-135**. Further detail is provided in Section 7 of the SIA.

#### 8.17.7.1 Enhancement of Positive Impacts

There is an opportunity for the Project's positive community cohesion impact to be enhanced. As Hera Resources progresses the Project's social planning, creating a social investment strategy (or similar) would formalise the benefits it provides to the community. A strategic approach would enable a review of Hera Resources' current contributions and ensure they align with emerging community needs and the priorities of Hera Resources. This would strengthen the social value already created and provide a clear link between the Project and those social values.

Given the remoteness of Nymagee and the local residents, a positive health and well-being impact of the Project is predicted on the basis that it would give the local population some confidence that someone 'would be around' in the event of an emergency. The same can be said for a physical health benefit in the event of physical harm.

The Project impacts on the mindset of the community in this regard, particularly for those residents in more remote areas. There is an opportunity to enhance this positive impact by more deliberately influencing the community mindset through targeted communications and engagement activities. The development of a dedicated Project communications and engagement (C&E) plan would guide such activities. A C&E plan with activities tailored to remote area residents (e.g. letter-drop to advise of key staff or Project changes, or annual door knock to select properties) would enable more regular communication and enhance the mental reassurance the Project provides to those residents.

The predicted positive impact that the Project would provide for the employment of Aboriginal people could be enhanced via employment policy/strategy development. Hera Resources is an equal opportunity employer and intends to employ Aboriginal people on the Project should it proceed. This intention could be formalised by developing an Aboriginal employment policy and supporting strategy dedicated to the Project. Representatives from both the Condoblin LALC and Cobar LALC have expressed their interest in the development of such a policy and expressed their desires for a partnership with Hera Resources.

#### 8.17.7.2 Mitigation of Negative Social Impacts

The influence of FIFO/DIDO workers on reducing the social cohesion in the Project's social locality is predicted to be minimal, as the Project will not introduce a substantial number of new workers to the area. One option to respond to the community perception about community cohesion would be to adopt a Project employment model favouring a residential workforce. It was concluded however this was not a feasible option due to the low unemployment rate in Cobar, as well as the limitations on local housing and infrastructure.

The groundwater impacts were assessed to be within the Level 1 considerations in the NSW Aquifer Interference Policy (AIP) and therefore under the grading system. Consequently, the Project is deemed acceptable to proceed from a groundwater perspective. Make good provisions would apply for two privately-owned bores predicted to experience drawdown greater than 2m (but less than 4m), and the ongoing monitoring of groundwater would continue. Following two years of operations, a review of the hydrogeological model predictions would take place. If required, the model would be revised to improve the fit between modelled and observed dewatering at the site. Clear and targeted messaging is proposed to address the potential discrepancy between the community's perception of groundwater impact and the reality that groundwater impacts would be largely negligible.

Hera Resources has committed to protecting the culturally sensitive sites identified during the cultural heritage survey, in accordance with mitigation measures proposed (refer **Section 8.7.6**). The Project area has avoided all cultural sites, except one. Hera Resources has agreed to protect this one site (a scar tree) located within the solar farm by erecting a 10 m buffer, providing protection from potential harm.

If any objects of suspected Aboriginal heritage origin are encountered during the proposed works, that have not previously been identified through surveys, work in the area of the find would cease and an unexpected finds protocols would be implemented. A rehabilitation strategy has been prepared for the Project which would, at the completion of the Project, provide measures to rehabilitate the land subject to mining activities to a similar land suitability and use as existing pre-mining. If the proposed precautions are implemented, the Project is predicted to have a medium impact significance (possible with a magnitude reduced to moderate). Clear and directed communications with the community is proposed to ensure transparency and minimise the potential for misunderstanding.

Current dust suppression measures at Hera Mine will be continued for the Project along the proposed sealing of Burthong Road, and ongoing dust monitoring and reporting. To assist with transparency of the monitoring program and to address any anxiety held by residents in the social locality, Hera Resources could volunteer monitoring results to the nearest sensitive receivers on a more regular basis. This would be most valuable to the sensitive receiver known to Hera Resources who is most interested in the Project's potential health and well-being impacts related to dust.

The proposed mitigation measures relating to noise and vibration (refer **Section 8.9.6**) and those for traffic (refer **Section 8.13.6**) would result in impacts to public safety, security and noise amenity being assessed as low.

The development of a dedicated Project communications and engagement (C&E) plan is proposed as a mitigation measure to address predicted negative health and well-being impacts. The same C&E plan would serve as a mitigation measure for predicted decision-making systems impacts. If a dedicated Project C&E plan was developed, which catered to the above issues, then the Projects predicted negative impacts on decision-making systems would be reduced. On this basis the impact significance would be considered low (unlikely and minimal).

### 8.17.8 Residual Impacts

Based on the proposed mitigation measures and enhancements as detailed above, the residual social impacts are summarised in **Table 8-136** below.

*Table 8-136 Social Impacts Summary*

| Impact to people | Social impact category | Affected parties | Likelihood and magnitude of impact | Impact significance rating (non-enhanced/ unmitigated) | Project aspect | Project-specific enhancement / mitigation measures | Likelihood and magnitude of impact | Residual impact significance |
|---|---|---|---|---|---|---|---|---|
| **Predicted positive impacts** | | | | | | | | |
| Financial and in-kind donors to community programs and initiatives in the social locality | Community (community cohesion) | Nymagee residents, businesses and community groups<br>Hermidale residents, businesses and community groups<br>CSC and constituents | Almost certain / moderate | High | Construction and operation | Developing a social investment strategy (or similar) would formalise the benefits Hera Resources provides to the community | Almost certain / moderate | High |
| Maintained revenue for businesses, and income for individuals and families employed by the Project. Also increased equity for property owners | Livelihood (People's capacity to sustain themselves – business and employment) | Project employees residing in the social locality<br>Nymagee and Hermidale property owners | Almost certain / major | Very high | Construction and operation | None suggested | Almost certain / major | Very high |

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| Mental health benefits by giving people reassurance that people 'would be around' in the event of an emergency on quiet rural roads | Health and well-being (Physical and mental) | Residents in remote areas | Likely / moderate | High | Construction and operation | Developing a dedicated Project C&E plan would provide a means to give regular reminders to the community about the presence of people in remote areas near the Project | Almost certain / moderate | High |
| Employment opportunity for Aboriginal people | Cultural (Employment of Aboriginal people) | Individual Aboriginal people<br>LALCs | Possible / minimal | Low | Construction, operation and rehabilitation | Developing a dedicated Aboriginal employment policy and supporting strategy | Likely / moderate | High |
| **Predicted negative impacts** | | | | | | | | |
| Employees of the mine do not actively participate and contribute to the community | Way of life | Residents and community groups<br>Businesses owners in local community centres | Unlikely / minor | Low | Construction and operation | None suggested | Unlikely / minor | Low |

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| Groundwater accessibility and contamination | Accessibility (Services and facilities) | Property owners surrounding the Project who use groundwater | Likely / minor | Medium | Operation | Implement measures in GIA and communicate groundwater monitoring to residents upon their request | Unlikely / minor | Low |
| Interference with culturally significant sites and/or mining leading to long-term changes to country, causing a loss of connection to country for local Aboriginal people | Culture (Connection to country, land and waterways) | Aboriginal people in the social locality and future generations<br>Condoblin LALC | Possible / major | High | Construction and operation | Identified significant sites would be avoided and / or protected in accordance with the measures described by AREA (2021).<br>A rehabilitation strategy has been prepared for the Project which would, at the completion of the Project, provide measures to rehabilitate the land subject to mining activities | Possible / moderate | Medium |

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| Dust generated by the TSF, ROM operations and the movement of heavy vehicles on unsealed roads which could be used by Project vehicles | Health and wellbeing (Physical and mental health) | Sensitive receivers | Possible/moderate | Medium | Operation | Dust impacts would be mitigated via the measures described by ERM Australia Pacific (2021), including the seal of Burthong Road.<br>Regularly (e.g., quarterly) volunteer monitoring results to the nearest sensitive receivers | Unlikely / minor | Low |
| The current and potential future volume of heavy vehicles passing | Surroundings (Public safety and security) | Hermidale residents and business owners | Possible / minor | Medium | Operation | Development of a TMP and Drivers Code of Conduct emphasising traffic | Unlikely / minor | Low |

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| through Hermidale where a new park is being developed. Also the number of trucks and the speed at which they pass through the Nymagee Road and Nyngan Street intersection) | | Park users including young children | | | | concerns in Hermidale<br>Realisation of the potential reduction of Project-generated heavy vehicle volumes. | | |
| Noise and vibration impacts during Project construction and operations (including blasting) (precautionary) | Surroundings (Noise and vibration) | Sensitive receivers | Possible / moderate | Medium | Operation | Implement measures in NVIA (refer Muller Acoustic Consulting, 2021) | Unlikely / minor | Low |
| A perception that medical services in | Livelihood (Distributive equity of | Residents in the Cobar LGA | Unlikely / minimal | Low | Operation | None suggested | Unlikely / minimal | Low |

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|---|---|---|---|---|---|---|---|---|
| Cobar would be less accessible due to the increase of FIFO/DIDO workers employed by the Project | impacts and benefits) | | | | | | | |
| Accessibility of Hera Resources staff to the Nymagee community, and their capacity to respond to issues or information requests could be improved | Decision-making systems (Access to complaint, remedy and grievance mechanisms) | Nymagee residents | Unlikely / minor | Low | Construction and operation | A dedicated Project C&E plan responding to the issues raised by some people in Nymagee | Unlikely / minimal | Low |

### 8.17.9 Conclusion

The Project SIA was prepared in accordance with the *Social Impact Assessment Guideline For State Significant Projects.* It was prepared in consultation with a number of stakeholders who were identified through a comprehensive scoping exercise undertaken in accordance with the Guideline applicable at the time. These stakeholders were engaged through various mechanisms including community information sessions, emails, semi-structured interviews newsletters and surveys.

Using an ECA approach and the outcomes of the engagement, a number of positive and unmitigated negative social impacts were identified, which may occur as a result of the Project. Consequently, a number of mitigation and management measures were proposed to enhance benefits and mitigate impacts. The Project is predicted to have high to very high positive impacts to the livelihoods of individuals, the cohesion of communities (principally Nymagee and Hermidale), the mental health of regional landholders, and the employment of Aboriginal people, with the adoption of the proposed enhancements. The Project is predicted to have a majority of low, and one medium, negative impact after the implementation of mitigation measures. Therefore the residual negative social impacts do not overshadow the predicted positive social impacts.

## 8.18 Economic

### 8.18.1 Introduction

An Economic Impact Assessment (EIA) was prepared for the Project by Gillespie Economics and is included as **Appendix S**.

### 8.18.2 SEARs Requirements

The SEARs requirements relating to economic impacts of the development and where these have been addressed are provided in **Table 8-137.**

*Table 8-137 Economic SEARs Requirements*

| SEARs Requirement | Reference |
|---|---|
| An assessment of the likely economic impacts of the development, paying particular attention to: | **Section 8.18.4.1**<br>**Section 8.18.4.2** |
| The significance of the resource; | **Section 4.5.1** |
| Economic benefits of the project for the State and region | **Section 8.18.4.1** |
| The demand for the provision of local infrastructure and services; and | **Section 8.18.4.2** |
| A Voluntary Planning Agreement in relation to the demand for the provision of local infrastructure and services | **Section 2.5** |

### 8.18.3 Assessment Methodology

The EIA was prepared in accordance with the NSW Government (2015) Guideline for the economic assessment of mining and coal seam gas proposal and NSW Government (2018) Technical Notes supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals. This section provides a summary of the assessment methodology undertaken.

#### 8.18.3.1 Key Economic Assumptions

The EIA was based on a detailed financial model of the Project provided by Hera Resources. This financial model is commercial-in-confidence. However, the key assumptions are summarised in **Table 8-138**. It should be noted that economic costs and benefits are discounted to today's (2021) values.

*Table 8-138 Key Economic Assumptions*

| Item | Assumption |
|---|---|
| Mining Methods | Underground mine stoping method |
| Resources and Reserves | Total potential mineralization of 6.9 Mt |
| Total Saleable Product | 94,954 oz gold<br>298,243 oz silver<br>229,319 t lead<br>347,772 t zinc<br>8,596 t copper |
| Life of Analysis | 16 years comprising:<br>1 years pre construction<br>15 years Project life including 13 years of operation |
| Workforce | *Construction*<br>Average annual construction workforce of 100 FTE)<br>*Operations*<br>Average annual operational workforce – 200 to 250 FTE |
| Price | Gold – USD 1,438/oz<br>Silver – USD 19/oz<br>Lead – USD 1,994/t<br>Zinc – USD 2,596/t<br>Copper - USD 6,646/t |
| AUD:USD Exchange Rate | 0.70 |

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|---|---|
| Capital Expenditure | Life of Project capital expenditure, including sustaining capital, rehabilitation, biodiversity offsets, land compensation payments - $258M |
| Average annual operating costs (net of royalties) | AUD113M |
| State Royalties | 4% ex-mine value (value less allowable deductions) |

#### 8.18.3.2 Cost Benefit Analysis

Cost Benefit Analysis (CBA) is a standard technique used to determine the changes in aggregate community welfare, associated with alternative resource use patterns. CBA provides a comparison of the present value of aggregate benefits to society, resulting from a project, policy or program, with the present value of the aggregate costs. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs, a project is considered to improve the well-being of society and hence relative to the 'without project' scenario is desirable from an economic efficiency perspective.

To undertake a CBA key areas are defined and considered as follows:

- Definition of society: CBA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government**;**
- Definition of Project scope: The definition of the project for which approval is being sought. For mining projects, typically only the costs and benefits from mining and delivery to port or domestic customers, are relevant;
- Net production benefits: CBA of mining projects invariably involves a trade-off between:
    i. The net production benefits of a project to society including royalties, company tax and net producer surplus and any economic benefits to existing landholders, workers, and suppliers; and
    ii. The environmental, social and cultural impacts including net public infrastructure costs;
- Environmental, social and cultural impacts: The consideration of externality impacts in CBA relies on the assessment of other experts contributing information on the biophysical impacts. At its simplest level, CBA may summarise the consequences of the environmental, social and cultural impacts of a project. The next level of analysis, attempts may be made to value some of the environmental, social and cultural impacts;
- Consideration of net social benefits: The consideration of the net social benefits of a project combines the value estimate of net production benefits and the qualitative and quantitative estimates of the environmental, social and cultural impacts**;**
- Consideration of the distribution of costs and benefits: CBA undertaken at different scales, can provide qualitative and quantitative information on how costs and benefits are distributed. However welfare economics and CBA are explicitly neutral on intra and

intergenerational distribution of costs and benefits. Judgements about intra and intergenerational equity are subjective and are therefore left to decision-makers.; and

- Consideration of other objectives of government: Decision-makers need to consider the economic efficiency implications of a project, as indicated by CBA, alongside the performance of a project in meeting other conflicting goals and objectives of the EP&A Act and government policy more widely.

The key steps in the CBA process are summarised in **Table 8-139.**

*Table 8-139 Key Steps in CBA*

| Step | Action |
|---|---|
| Step 1: Establish the base case | Against which to assess the potential economic, social and environmental impacts of changes due to the project. |
| Step 2: Define the project | Including all significant inputs required to achieve the project's objectives. |
| Step 3: Quantify the changes | From the base case resulting from the project. This will focus on the incremental changes to a range of factors (for example, environmental, economic, social) resulting from the project. |
| Step 4: Estimate the monetary value of these changes | Aggregate these values in a consistent manner to assess the outcomes. Where market prices exist, they are a starting point for valuations of both outputs and of inputs used for production. For non-market goods, as for many environmental impacts and some social impacts, the aim is to value them as they would be valued in monetary terms by the individuals who experience them. |
| Step 5: Estimate the Net Present Value (NPV) | Of the project's future net benefits, using an appropriate discount rate |
| Step 6: Undertake sensitivity analysis | On the key range of variables, particularly given the uncertainties related to specific benefits and costs. |
| Step 7: Assess the distribution of costs and benefits | Across different groups. |
| Step 8: Report CBA results, including all major unquantified impacts | The appraisal addresses and incorporates all material relevant to the decision maker. |

#### 8.18.3.3 Local Effect Analysis

Local Effect Analysis (LEA) aims to address the consequences of the proposal in its 'locality' as required by Section 4.15 of the EP&A Act. LEA is intended to inform the scale of change rather than being representative of costs and benefits to the local community.

LEA prepared for the Project considered the following aspects:

- Direct effects relating to local employment: Employment of people ordinarily resident in the region at the time of the proposal. The incremental full time equivalent direct employment from a project to the locality is estimated as the increase in net income divided by the average net income in the mining industry;
- Estimating effects related to non-labour project expenditure: This accounts for non-labour expenditure;
- Second round/flow-on effects: Input output (IO) analysis which provides a framework to analyse the interdependence of industries in an economy;
- Effects on other local industries: Including consideration of displacement of other land uses, impact to tourism and businesses; and
- Environmental and social impacts on the local community (externalities): Assess positive and negative externalities created by the proposed project on the locality.

An IO analysis essentially involves two steps:

- Construction of an appropriate IO table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- Identification of the initial impact or stimulus of the project (construction and/or operation) in a form that is compatible with the IO equations so that the IO multipliers and flow-on effects can then be estimated.

IO analysis identifies the economic activity of a project on the economy in terms of four main indicators:

- Gross regional output – the gross value of business turnover;
- value-added – the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output. These costs exclude income costs;
- Income – the wages paid to employees including imputed wages for self-employed and business owners; and
- Employment – the number of people employed (including self-employed, full-time and part-time).

### 8.18.4 Impact Assessment

#### 8.18.4.1 Cost Benefit Analysis

The first action for the CBA was to establish the base case for the Project, which is essentially the 'without Project' scenario. This was assumed as the cessation of mining at Hera and the continuation of existing rural production. CBA also considers feasible alternatives to the base case, which for this assessment is the Project which maximises resource recovery and minimises impacts to the environmental, cultural and social aspects.

The potential economic cost and benefits of the Project are summarised in **Table 8-140.** The main potential economic benefit is the producer surplus (net production benefits) generated by the Project and any wage benefits to employment, nonmarket benefits to employment, economic benefits to existing landholders or benefits to suppliers; while the main potential economic costs relate to any environmental, social and cultural costs. Each cost and benefit relevant to the Project is discussed in further details in the EIA included as **Appendix G.**

*Table 8-140 Potential Economic Costs and Benefits of the Project*

| Category | Costs | Benefits |
|---|---|---|
| Net production benefits | ▪ Opportunity costs of capital equipment from Hera Mine in 2024<br>▪ Opportunity cost of Hera Mine land in 2024<br>▪ Development costs including land, labour, capital equipment, sustaining capital, and acquisition costs for impacted properties and biodiversity offsets<br>▪ Operating costs, including administration, mining, processing, transportation to port, labour costs and mitigation, offsetting and compensation measures<br>▪ Decommissioning and rehabilitation costs of both Hera Mine site and Federation mine site at cessation of the Project | ▪ Avoided decommissioning of Hera Mine in 2024<br>▪ Value of metal doré and concentrates<br>▪ Residual value of capital and land at the cessation of the Project |
| Potential environmental, social and cultural impacts | ▪ Surface water<br>▪ Groundwater impacts<br>▪ Air quality impacts<br>▪ Noise and vibration impacts<br>▪ Ecology and biodiversity impacts<br>▪ Aboriginal heritage impacts<br>▪ Historic heritage impacts<br>▪ Traffic and transport impacts<br>▪ Visual amenity impacts<br>▪ Greenhouse gas generation<br>▪ Agricultural impacts<br>▪ Net public infrastructure costs<br>▪ Loss of surplus to other industries. | ▪ Wage benefits to employment<br>▪ Non-market benefits of employment<br>▪ Economic benefits to existing landholders<br>▪ Economic benefits to suppliers |

An analysis of all costs and benefits of the for each category was calculated by adopting a 7% discount rate in accordance with the NSW Guidelines (NSW, 2015). The analysis period is 16 years, coinciding with the Project life of 15 years (plus one year's pre-Project commencement). Any impacts that occurred after this period were included in the final year of the analysis as a terminal value.

As shown in **Table 8-141**, the net production benefit is calculated at $70M to NSW and $147 M to Australia. This assumes all royalties accrue to NSW and all Australian residual net production benefits and company tax benefits accrue to NSW based on its population share. The estimated net production benefits that accrue to Australia and NSW can be used as a minimum threshold value or reference value against which the relative value of the residual environmental impacts of the Project, after mitigation, may be assessed.

*Table 8-141 Net Production Benefits of the Project ($M Present Values at 7% Discount Rate)*

| Category | $M |
|---|---|
| **Costs** | |
| Opportunity cost of land | $0 |
| Opportunity cost of capital equipment | $2 |
| Capital costs | $191 |
| Operating cost (ex royalties), including rehabilitation and decommissioning | $865 |
| Rehabilitation and decommissioning costs | Included in operating costs |
| ***Sub-total*** | ***$1,058*** |
| **Benefits** | |
| Avoided decommissioning costs at Hera | $11 |
| Revenue | $1,208 |
| Residual value of land | $0 |
| Residual value of capital equipment | $0 |
| ***Sub-total*** | ***$1,219*** |
| **Global Net Production Benefits** | **$162** |
| Royalties to NSW Govt | $34 |
| Royalties to third party | $3 |
| Company Tax | $61 |
| Residual Net Production Benefits | $63 |
| ***Global Net Production Benefits*** | ***$162*** |
| Royalties to NSW Govt | $34 |
| Royalties to third party | $0 |
| Company Tax | $61 |

| | |
|---|---|
| Residual Net Production Benefits | $51 |
| ***Australian Net Production Benefits*** | ***$147*** |
| Royalties to NSW Govt | $34 |
| Royalties to third party | $0 |
| Company Tax | $20 |
| Residual Net Production Benefits | $16 |
| ***NSW Net Production Benefits*** | **$70** |

The net social benefits to Australia are provided in **Table 8-142**, which are expressed in Net Present Value (NPV). NPV is the present value of benefits less the present value of costs. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the Project, because the community as a whole would obtain net benefits from the Project.

*Table 8-142 Net Social Benefits of the Project*

| Benefits | Australia | NSW |
|---|---|---|
| Net Production Benefits | | |
| Royalties to Government | $34 | $34 |
| Company Tax | $61 | $20 |
| Residual Net Production Benefits | $51 | $16 |
| Sub-total | $147 | $70 |
| Other Benefits | | |
| Wage benefits to employment | $31 | $31 |
| Nonmarket benefits of employment | $64 | $64 |
| Economic benefits to existing landholders | $0 | $0 |
| Economic benefits to suppliers | Unquantified | Unquantified |
| Sub-total | $96 | $96 |
| Total Benefits (with and without empl benefits) | $147M to $243M | $70M to $166M |
| Costs | | |

| | | |
|---|---|---|
| Greenhouse gas emissions (Scope 1 and 2) | $0.018 | $0.006 |
| Agricultural impact | Agricultural impacts included in net production costs | |
| Operational noise | Impacted property owners compensated - No material residual impact* | |
| Road transport | Road maintenance costs and upgrades included in net production costs - No material residual impact* | |
| Air quality | No material impact* | |
| Groundwater | Opportunity costs of WALs - $1 | |
| Surface water | No material impact* | |
| Biodiversity | Impacts offset - No material residual impact* | |
| Aboriginal heritage | No material impact* | |
| Historic heritage | No material impact* | |
| Visual | No material impact* | |
| Net public infrastructure costs | No material impact* | |
| *Sub-total* | *$1* | *$1* |
| Net Social Benefits (with and without employment benefits) | $146M to $242M | $69M to $165M |

Overall, the Project is estimated to have net social benefits to both Australia ($146M to $242M) and NSW($69M to $165M) relative to both the base case, and hence is desirable and justified from an economic efficiency perspective.

#### 8.18.4.2 Local Effects Analysis

LEA assumes there is no additional employment provided to the local area by the Project i.e. the local area economy is at full employment and additional employment simply displaces employment from where it would otherwise be employed.

The LEA undertaken for the Project considered the direct effects related to employment of existing residents only. This accounted for both the construction workforce of 100 and an average operational workforce of 200. Stimulus to the local area from the Project comes from both income expenditure and non-labour expenditure (operating costs of the Project after subtraction of wages). It is noted that not all expenditure will be kept within the region. An IO analysis undertaken estimates that 33% of expenditure will remain in the region.

The LEA also considers the effect on other industries and infrastructure. In terms of the Project, impacts to wages was not determined to be significant, as the incremental direct employment (of residents) and income impacts (of residents) of the Project operation, represent less than 2% of employment and income of the regional economy. Similarly, the demand on housing and local infrastructure was determined not to be significant, as 85% of employees reside outside of the LGA and local roads are maintained by the local council.

A summary of the LEA, with the consideration of the environmental, social and cultural externalities is provided in **Table 8-143.**

*Table 8-143 LEA Summary*

| | Project Direct | Project Direct: Local | Net Direct Effect |
|---|---|---|---|
| Construction (Peak Year) | | | |
| Employment | 100 | 10 | 1 |
| Net income (M) | | | $0.08 |
| Operation (Average Annual) | | | |
| Employment | 200 | 30 | 12 |
| Net income (M) | | | $1.1 |
| Net non-labour expenditure (M) | $33 Mpa | | |
| Second round and flow-on effects | Refer to Section 6 of EIA | | |
| Contraction in other sectors | No material impact | | |
| Displaced activities | No material impact | | |
| Wage impacts | No material impact | | |
| Housing impacts | No material impact | | |
| Externality impacts | Incidence of Impacts | Magnitude of Impact | |
| Agricultural impacts | Farmers whose land is required for the Project | Impacted farmers compensated. No material residual impact | |
| Surface water | Local surface water users | No surface water WALs required for the Project | |
| Groundwater | Local groundwater users | Hera Resources bear the opportunity cost of holding WALs and the cost of make good agreements for any water users impacted by drawdown | |

| | | |
|---|---|---|
| Air quality impacts | Adjoining landholders | No properties impacted by exceedances. No material residual impact |
| Noise impacts | Adjoining landholders | Impacted landholders compensated. No material residual impact. |
| Ecology and biodiversity | Local and NSW households | Some loss of non-use values but offset by provision of biodiversity offsets. No net loss requirement. |
| Aboriginal heritage | Aboriginal people and other local and NSW households | No material impacts |
| Historic heritage impacts | Local and NSW households | No material impacts. |
| Transport and traffic | Local residents | Road upgrade and maintenance costs borne by Hera Resources. No material residual impacts. |
| Visual amenity | Adjoining landholders | No material impacts. |

Supplementary LEA was conducted on the Project through an IO analysis. IO analysis assumes there is not full employment, allows for job chain effects and in-flow of labour to the region. Using this approach, the total annual impact of the peak year of construction on the regional economy is estimated at up to:

- $65M in annual direct and indirect regional output or business turnover;
- $27M in annual direct and indirect regional value added;
- $16M in annual direct and indirect household income; and
- 130 direct and indirect jobs.

The Project operation is estimated to make up to the following contribution to the regional economy:

- $214M in annual direct and indirect regional output or business turnover;
- $98M in annual direct and indirect regional value-added;
- $41M in annual direct and indirect household income; and
- 350 direct and indirect FTE jobs.

The actual regional impact of the Project operation is likely to lie between that assessed in the LEA and the supplementary LEA (i.e. the IO analysis).

### 8.18.5 Conclusion

The EIA prepared for the Project undertook a LEA and CBA to determine the net economic impact in accordance with the NSW Government (2015) *Guideline for the economic assessment of mining and coal seam gas proposa*l. The EIA was based on a number of base key economic assumptions relating to the Project which were provided by Hera Resources.

The CBA concluded that the Project would provide a net economic value to NSW and Australia in the order of $70M and $147M respectively. The CBA also concluded the net social benefits expressed in terms of NPV would be between $146M - $242M to Australia and $69m - $165M to NSW. The EIA through the LEA also concludes that the local externality impacts are not considered material. Through supplementary LEA using IO analysis, positive contributions to the regional economy were predicted both directly and indirectly for both the construction and operation phases.

## 8.19 Cumulative Impacts

The potential for cumulative impacts to occur due to concurrent or proposed developments either adjacent or in proximity to the Project has been assessed. Relevant projects/proposals are described in **Section 2.7**. Six existing and proposed projects have been identified, the closest being the Western Slope Pipeline located approximately 50 km to the south of the Project, and the next closest being existing and proposed mining near Cobar.

The cumulative impacts of activities at Hera Mine and Federation Site have been assessed in all impact assessments for the Project.

Cumulative impacts were assessed as part of the air quality, GHG, noise, traffic, social and economic impact assessments as they had the potential to result in impacts when considered with other externalities. Project specific impacts, incorporating the Federation Site and Hera Mine impacts, were assessed for groundwater, surface water, biodiversity, Aboriginal heritage, historical heritage, visual amenity, hazards, human health, and waste management, as they do not have the potential to result in cumulative impacts beyond Federation Site and Hera Mine. The subsidence assessment focussed on Federation Site..

The AQIA assessment considered cumulative impacts by including background concentrations to the predicted contributions from the Project. The assessment adopted the “Cumulative NSW EPA Assessment Criteria” as the basis for the assessment (refer **Section 8.10.3**). The AQIA concluded that there is one predicted exceedance of the maximum 24-hour average criterion for $PM_{10}$ of 50 µg/m$^3$ at all receivers. The exceedance is due to a high background concentration, on a single day, of 53.8 µg/m$^3$. There are no additional exceedances caused by the Project.

The Projects GHG emissions were compared to Australia’s commitment under the Paris Agreement. The Project’s contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions. Average annual scope 1 emissions from the Project (approximately 0.02 MtCO2-e) would represent approximately 0.005% of Australia’s commitment under the Paris Agreement. In addition, using the on-site power plant and solar farm, rather than taking electricity from the grid, saved 92,296t$CO_2$-e over the life of the Project.

The results of the NVIA (refer **Section 8.9**) concluded that operational noise levels would achieve the relevant NPI criteria for all assessment periods at each assessed receiver location. The assessment considered operations at both the Federation Site and the Hera Mine, including the simultaneous operation of the existing and new processing plants. Noise generated from traffic was also assessed and no exceedances of the criteria were predicted. Due the lack of other noise generating activities in the study area, cumulative noise impacts with other projects were not considered.

The GWIA (refer **Section 8.5**) assessed the cumulative impacts to the groundwater environment (including adjacent landholder bores) from Hera Mine, Federation Site and the proposed borefield. Cumulative impacts with other projects were not assessed as part of the GWIA due to the other projects being too far removed to result in any cumulative impacts. Predicted impacts for Hera Mine and Federation Site have been compared to the Level 1 minimal impact considerations for less productive water sources in the NSW AIP. Predicted impacts are within the minimal impact considerations, with the exception of modelled impacts on two landholder bores (GW017385 and GW020714). As predicted impacts at these bores exceeds 2 m, make good provisions will apply at these bores.

The SWIA focussed on water management and water balance for the combined Hera Mine and Federation Site. The Project is expected to have minimal impact on catchments, flood behaviour and water quality. With the separation distance to other projects, the Project is will have insignificant impact cumulative impacts on surface waters.

The biodiversity and heritage assessments focussed on the proposed disturbance area for the Project. Other projects are too far removed from the Project, to result in cumulative impacts to biodiversity and heritage.

The LVIA assessed visual impacts from Hera Mine and Federation. All other projects are too far removed from the Project, to result in cumulative impacts to visual amenity and landscape character.

The PHA assessed the potential hazards from the Project. All other projects are too far removed from the Project, to result in cumulative impacts from hazardous materials.

The HHRA prepared for the Project drew upon the findings of the AQIA and NVIA to determine whether there was a potential risk to off site communities. The HHRA did not consider cumulative impacts with other projects due to the remote nature of the Project. The HHRA did not identify any health risk issues of concern for the off-site community.

The TIA (refer **Section 8.13**) prepared for the Project assessed cumulative impacts on the road network during both construction and operations using several scenarios that factored in background traffic combined with Project generated traffic. The TIA considered proposed projects which may utilise the road network, including the proposed Cobar Biohub located east of Cobar and north of the Barrier Highway. Furthermore the TIA took into account traffic growth over time that was unrelated to Aurelia's operations in the region. Future traffic volumes on the key routes were forecast by applying a background traffic growth rate of 1.0 percent per annum above the surveyed volumes supplied by CSC for the TIA. It was concluded that the existing road network and intersections have adequate capacity to accommodate the Project-generated traffic together with existing and predicted non-Project related traffic in the region, while maintaining the efficiency and safety of the road network operations at good standards.

The SIA (refer **Section 8.17**) considered both the potential for positive and negative impacts as a result of the Project, with mitigation measures applied. To determine the cumulative social impact, the social locality relevant to the Project was identified. The social locality for the SIA considered the Project features and their potential impact for people in Nymagee, points of interest near to Nymagee (including residences) and Cobar Shire more broadly. It recognised the Project haulage routes (including to Peak Gold Mine near Cobar) and supply of concentrate to Hermidale. Defining the social locality was an integral component of the SIA as people may not perceive social impacts created by a project to be those felt exclusively in or immediately adjacent to the Project boundary, or at a time when the site is operating. The Project is predicted to have high to very high positive impacts to the livelihoods of individuals, the cohesion of communities (principally Nymagee and Hermidale), the mental health of regional landholders, and the employment of Aboriginal people, with the adoption of the proposed enhancements. The Project is predicted to have a majority of low, and one medium, negative impact after the implementation of mitigation measures.

The EIA (refer **Section 8.18**) concluded that there would be an overall net positive economic impact to the NSW and Australian economy if the Project was to proceed. Cumulative economic impacts of the Project are assessed through undertaking both CBA and LEA. The CBA which was prepared as part of the EIA, includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government. The CBA is initially undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to, and then truncated to assess whether there are net benefits to Australia and NSW. The LEA undertaken for the Project aimed to address the consequences of the proposal in its 'locality'. It is intended to complement CBA by translating effects at the NSW level to impacts on the communities located near the Project site. It was also concluded that local externality impacts were not considered material and that positive contributions to the regional economy were predicted both directly and indirectly for both the construction and operation phases.