APPENDIX 13

Noise Impact Assessment

ULAN COAL MINE MODIFICATION 6

Noise Impact Assessment

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Ulan Coal Mine Pty Limited

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	John Merrell	26 October 2022	Kirsty Davies	28 October 2022

Table of Contents

Figures

Tables

1.0 Introduction

1.1 Background

The Ulan Coal Complex (UCC) is located approximately 38 km north-north-east of Mudgee and 19 km north-east of Gulgong in New South Wales. Operations at the UCC are located approximately 1.5 km east of the village of Ulan and entirely within the Mid-Western Regional Council Local Government Area (LGA) (refer to **Figure 1.1**). Coal mining has been undertaken in the Ulan area since the 1920s.

Ulan Coal Mines Pty Limited (UCMPL) was granted its current Project Approval (PA) 08_0184 under the then Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) on 15 November 2010 for the Ulan Coal – Continued Operations Project (UCCO Project). Approved mining operations at the UCC consist of underground mining in the Ulan Underground and Ulan West Underground areas as well as open cut mining, and associated coal handling and processing, and transport through to 30 August 2033. The open cut operations are currently in care and maintenance.

UCMPL is proposing a modification to PA 08_0184 to maximise resource recovery from the existing underground mining operations by mining additional coal within existing mining lease and exploration lease areas. In addition to proposing to mine additional resources within existing mining lease areas, UCMPL has determined that there is a valuable mineable resource within Exploration Lease (EL) 7542 and is proposing to access this coal resource by extending the currently approved longwall panels into these areas. This Noise Impact Assessment (NIA) has been prepared by Umwelt for UCMPL as part of the Modification Report.

This NIA has been undertaken in accordance with the requirements of the NSW *Noise Policy for Industry* (Environment Protection Authority (EPA), 2017) (NPfI), *Interim Construction Noise Guideline* (Department of Planning and Environment, 2009) (ICNG) and in consideration of the *Voluntary Land Acquisition and Mitigation Policy* (NSW Government, 2018) (VLAMP) and the EPA's *Draft Construction Noise Guideline* (2020).

1.2 Proposed Modification

The Proposed Modification will extend the life of the approved UCC operation by approximately two years allowing mining to continue until August 2035 and allow for the extraction of an additional approximately 25 Mt of product coal. The UCC will continue to utilise the existing mine facilities, including the Coal Handling and Preparation Plant (CHPP) and train loading facilities.

The Proposed Modification is shown on **Figure 1.2** and generally comprises:

- extension of Ulan Underground longwall (LW) panels LWW9 to LWW11 to the west
- widening of Ulan Underground LWW11 by approximately 30 metres
- extension of Ulan West LW9 to LW12 to the north.

There is an area within exploration lease (EL) 7542 from which the coal may be extracted by either Ulan West Underground or Ulan Underground depending on timing of operations and mining conditions. The area referred to as the 'Longwall Option Area' is shown on **Figure 1.2**. The coal in the Longwall Option Area may be extracted by either a northern extension of Ulan West Underground LW9 or a western extension of Ulan Underground LWW9, 10 and 11 (refer to **Figure 1.2**). In relation to potential noise impacts this NIA has assumed extraction of the Longwall Option Area from Ulan West and the corresponding surface infrastructure.

UCMPL is also proposing some minor changes to surface infrastructure to support underground mining activities including the provision of:

- three ventilation shafts and associated infrastructure corridors
- five dewatering bores and associated infrastructure corridors
- an alternate access track
- an infrastructure corridor and service borehole to the south-west of Ulan West
- other association infrastructure required to service the approved and proposed underground mining operations.

It is noted that each ventilation fan installation replaces the previous fan installation. Therefore, operationally, noise levels from the ventilation fan installations is not cumulative but sequential.

A comparison between the approved development under PA 08_0184 and the Proposed Modification is provided in **Table 1.1**.

Table 1.1 Description of Modification 6 of UCMPL Project Approval 08_0184

Project Component	Approved Operations	Proposed Modification
Mine life	Mining operations until 30 August 2033	Extension of life-of-mine until 30 August 2035 (an additional 2 years)
Limits of Extraction	20 million tonnes of coal per annum (including a maximum of 4.1 Mtpa ROM from the Open Cut)	No change Additional 25Mt of product coal from the Proposed Modification
Operating Hours	24 hours per day, 7 days per week	No change
Project boundary	As per PA 08_0184	Extension of Project Approval Boundary to include the northern part of EL 7542 (refer to **Figure 1.2**)
Mine plan	As per PA 08_0184	Extension of Ulan Underground LWW9 to LWW11, and Ulan West LW9 to LW12 Widening of Ulan Underground LWW11 (refer to **Figure 1.2**).
Mining Method	Retreat longwall method	No change.
Surface Infrastructure	As per PA 08_0184	Minor changes to infrastructure including dewatering bores, ventilation shafts and associated infrastructure to accommodate the proposed mine plan.
Coal Handling and Preparation Plant	As per PA 08_0184	No change.

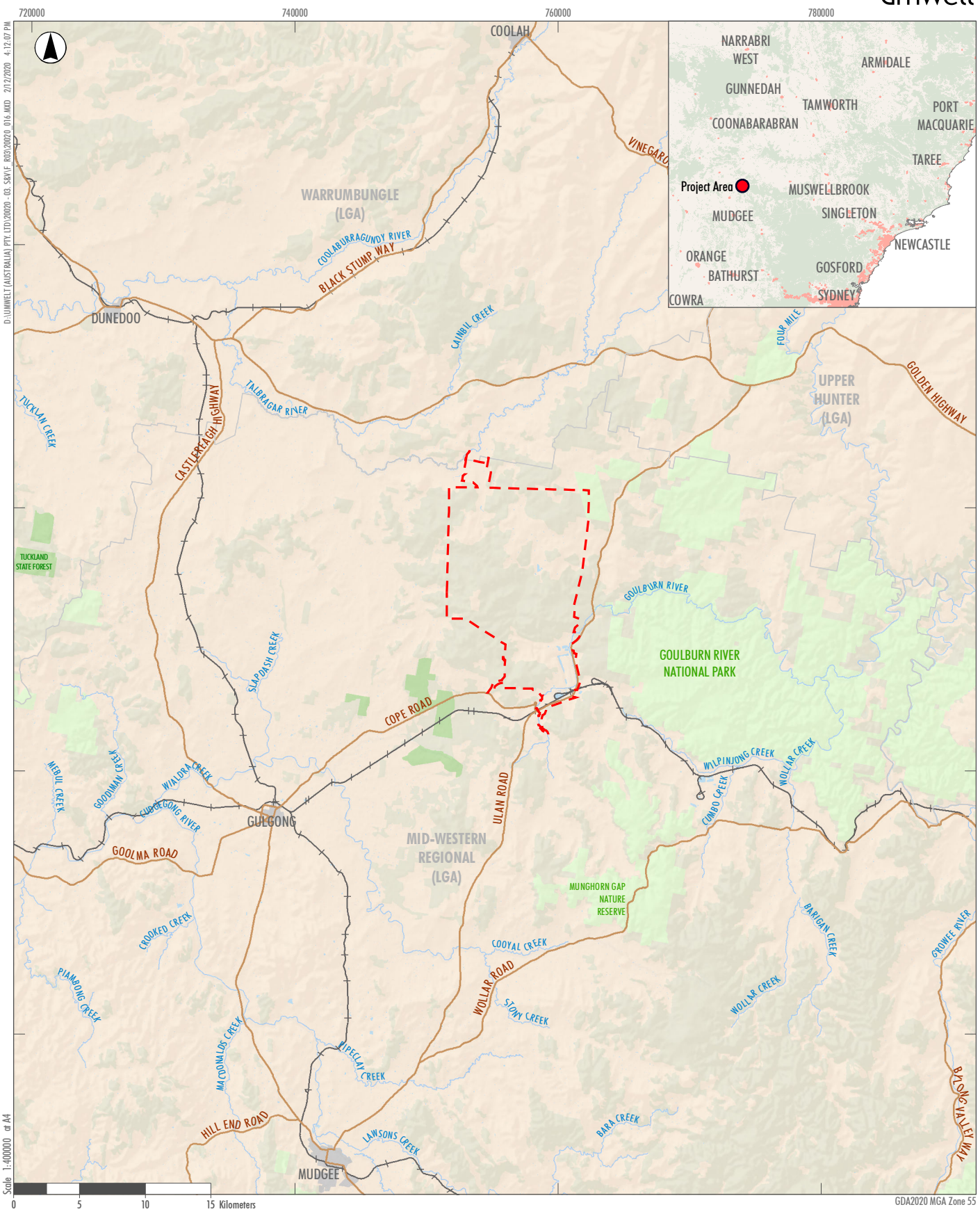
Project Component	Approved Operations	Proposed Modification
Coal Transportation	All coal transported from the site by rail. No more than 10 laden trains leave the site each day.	No change.
Workforce	Approximately 930 people (Ulan Coal Complex).	No change.

This report documents the predicted noise impacts resulting from the Proposed Modification. The Proposed Modification includes the construction and operation of ventilation and dewatering facilities to be constructed using downhole percussion drilling techniques, and associated access and infrastructure corridor(s). The construction of the surface facilities is part of the mining activities and therefore assessable under the NPfI. **Table 1.2** summarises the construction activities and the indicative duration of noise impacts during construction.

Table 1.2 Summary of Construction Activities

Construction Phase	Indicative Duration of Activities
Construction Phase 1 Site establishment including tree clearing, road construction and hardstand preparation	< 1 Month Day time activities only
Construction Phase 2 Drilling of borehole	1–6 months per borehole (minimum of 2 per site) 24 hour operation
Construction Phase 3 Casing installation	< 1 Month Day time activities only
Construction Phase 4 Grouting of casing	1 Week – 2 days per borehole Day time activities only

The ongoing operation associated with the Proposed Modification includes additional infrastructure that is closer to some of the surrounding residences than existing UCC noise sources and therefore requires assessment under the NPfI. This report assesses the noise impacts of both the construction activities and the operation of the additional infrastructure.



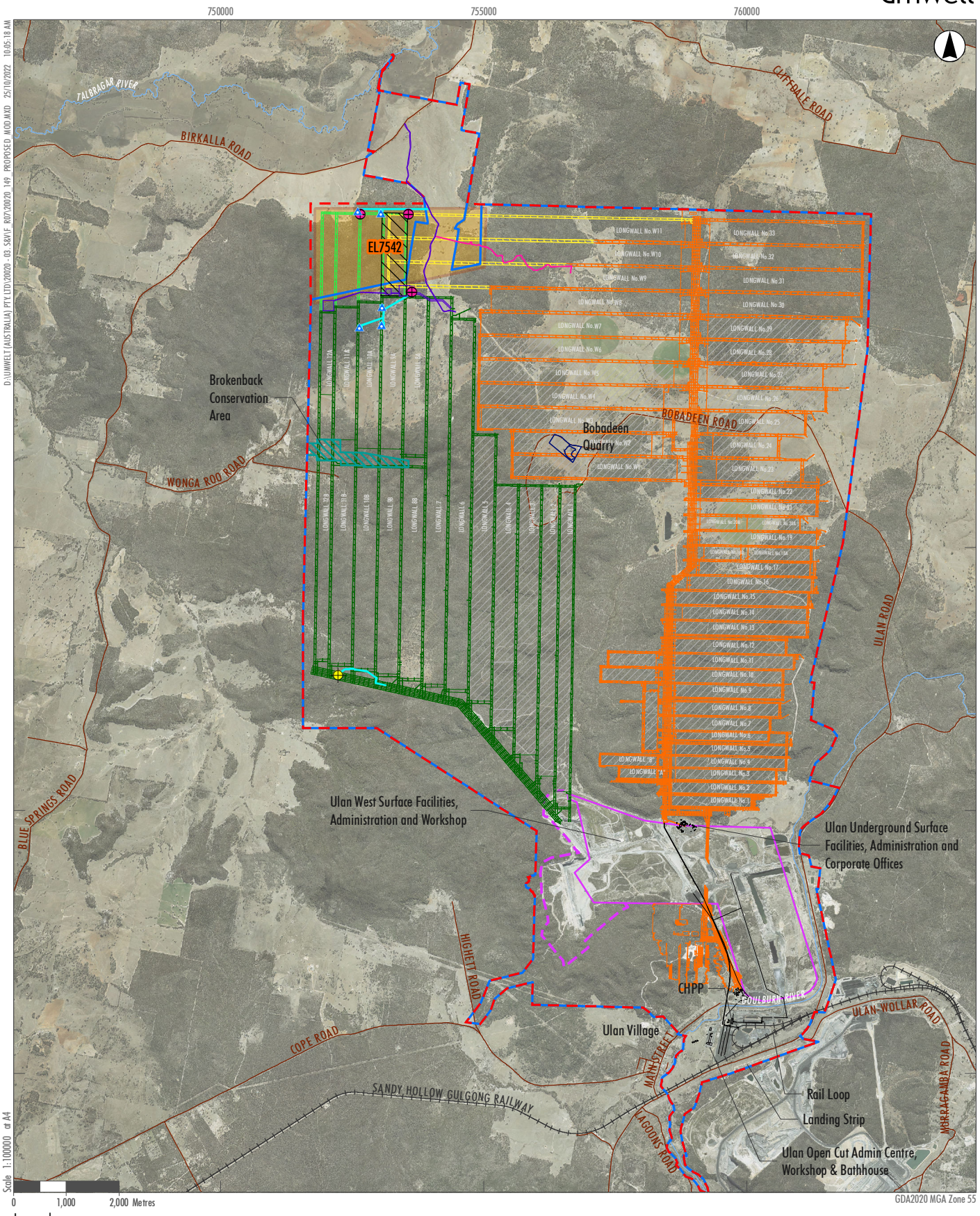
Legend

- Proposed Project Approval Boundary
- Local Government Area (LGA)
- Road
- Railway
- Watercourses
- State Forest
- NPWS Estate
- Native Vegetation

FIGURE 1.1

Locality Map

Image Source: ESRI Basemap Data source: NSW DFSI (2020), Ulan (2020)



Legend

- Project Approval Boundary
- Proposed Project Approval Boundary
- Brokenback Conservation Area
- Bobadeen Quarry
- Exploration Lease - EL7542
- Roads
- Railway
- Major Watercourses
- Approved Infrastructure related to Mod 6
- Approved Ulan Underground Mine Plan
- Approved Ulan West Mine Plan
- Previously Mined
- Previous Ulan Open Cut Area
- Approved Ulan Open Cut Extension
- Proposed Borehole
- Proposed Vent Shaft
- Proposed Dewatering Bores
- Proposed Infrastructure
- Proposed Access Track Corridor
- Proposed Ulan Underground Mine Plan Modification
- Proposed Ulan West Underground Mine Plan Modification
- Longwall Option Area

FIGURE 1.2

Proposed Modification

Image Source: Glencore (2018) Data source: Glencore (2020); NSW DFSI (2020)

2.0 Noise Assessment

2.1 Construction Phase Noise Criteria

The applicable construction noise assessment levels from Table 2 of the ICNG are summarised in **Table 2.1**.

Table 2.1 Noise Assessment Criteria (ICNG – Table 2)

Time of day	Noise Management Level (NML) LAeq,15minute
Recommended Standard Hours Monday to Friday - 7 am to 6 pm Saturday - 8am to 1pm No work on Sundays or Public Holidays	Noise affected Rating Background Level (RBL) + 10 dB
	Highly noise affected 75 dB(A)
Outside recommended standard hours	Noise affected RBL + 5 dB

The ICNG states that the Rating Background Level (RBL) is described in the *Industrial Noise Policy* (INP) (EPA, 2000). However, the INP has been superseded by the NPfI which defines the RBL as:

> *"the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period … The rating background level is the level used for assessment purposes. Where the rating background level is found to be less than 30 dB(A) for the evening and night periods, then it is set to 30 dB(A); where it is found to be less than 35 dB(A) for the daytime period then it is set to 35 dB(A)."*

As the Proposed Modification is in a rural region, it is assumed that the RBL at all receivers during the day will be less than 35 dB(A) and less than 30 dB(A) during the evening and night periods. On this basis, the minimum RBLs of 35 dB(A) for the day and 30 dB(A) for the evening and night periods as stipulated in the NPfI have been adopted for the Proposed Modification. The resulting Noise Management Levels (NML) for construction at all receivers are as shown in **Table 2.2**.

Table 2.2 Noise Management Levels

Time of day	Noise Management Level (NML) LAeq,15minute
Recommended Standard Hours Monday to Friday - 7 am to 6 pm Saturday - 8am to 1pm No work on Sundays or Public Holidays	Noise affected 35 + 10 = 45 dB(A)
	Highly noise affected 75 dB(A)
Outside recommended standard hours	Noise affected 30 + 5 = 35 dB(A)

2.2 Assessment of Predicted Operational Noise Levels

A two-step process has been considered in the assessment of the potential operational noise levels from the Proposed Modification.

- The first step involves the assessment of the potential operational noise levels against the existing approved noise limits in the consent and EPL, based on project noise trigger levels that would be established for a site upgrade or expansion, in accordance with Section 6 of the NPfI (refer to **Section 2.2.2**). If the Proposed Modification could not achieve the existing approved noise limits then a second step would also be required.

- The second step involves the assessment of the potential operational noise levels against project noise trigger levels established for a new development in accordance with Section 2 of the NPfI.

2.2.1 Approved Operational Noise Criteria

2.2.1.1 Operational Noise

The noise criteria from Table 2 of Schedule 3 of PA 08_0184 are reproduced in **Table 2.3**. The noise limits from section L5 of EPL 394 are reproduced in **Table 2.4**. It should be noted that some of the criteria listed in PA 08_0184 and EPL 394 are not applicable to this assessment, either because the property has since been purchased by UCMPL or because it will not be impacted by noise generated by the Proposed Modification (based on distance/topography and confirmed by noise monitoring data).

Table 2.3 PA 08_0184 Operational Noise Criteria dB(A)

Location	Day (LAeq,15minute)	Evening (LAeq,15minute)	Night (LAeq,15minute)	Night (LA1,1minute)
Condition 2 – Noise Criteria				
R254 (EPL Point 24, NM7)	38	38	37	45
R57 1 (EPL Point 25, NM8)	37	37	36	45
All privately-owned land	35	35	35	45
Ulan Public School 2 (EPL Point 26, NM4)	35	35	35	-
Condition 2A – Construction of the surface facilities associated MOD 4				
R39 (EPL Point 36)[3] **R40 (EPL Point 37)[3]**	41	38	38	52
All privately-owned land	40	35	35	52

Notes: 1 – Mine owned
2 – Noise criteria is internal and only applies when in use
3 – Noise limits only apply during the construction of the surface facilities associated with MOD 4.

PA 08_0184 specifies that in applying the above criteria, the noise levels are to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the INP.

Table 2.4 EPL 394 Noise Limits, dB(A)

Location	Day (LAeq,15minute)	Evening (LAeq,15minute)	Night (LAeq,15minute)	Night (LA1)
EPL Point 24 (NM7, R254)	38	38	37	45
EPL Point 25 [1] (NM8, R57)	37	37	36	45
EPL Point 26 [2] (NM6, Ulan Public School)	35	35	-	-
EPL Point 36 [3] (R39)	41	38	38	52
EPL Point 37 [3] (R40)	41	38	38	52
EPL Point 38 (All privately owned land)	35	35	35	45
EPL Point 39 [3] (All privately owned land)	40	35	35	52

Notes: 1 – Mine owned
2 – Noise limit is internal and only applies when in use
3 – Noise limits only apply during the construction of the surface facilities associated with MOD4.

The noise limits set out in EPL 394 apply under all meteorological conditions except wind speeds greater than 3 metres/second at 10 metres above ground level; or Class F stability conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or Class G stability conditions.

2.2.1.2 Noise Acquisition Criteria

The noise acquisition criteria provided in Table 3 of Schedule 3 of PA 08_0184 are reproduced in **Table 2.5**. These existing acquisition criteria apply should the operations exceed the criteria in **Table 2.5** at any residence on privately owned land or over more than 25 % of any privately owned land, and upon receiving a written request for acquisition from the landowner.

Table 2.5 PA 08_0184 Noise Acquisition Criteria, dB(A)

Location	Day (LAeq,15minute)	Evening (LAeq,15minute)	Night (LAeq,15minute)
All privately-owned land	40	40	40

2.2.1.3 Cumulative Noise Criteria

The cumulative noise criteria provided in Table 4 of Schedule 3 of PA 08_0184 are reproduced in **Table 2.6**. UCMPL must implement all reasonable and feasible measures to ensure that the noise generated by the approved operations combined with the noise generated by other mines in the area does not exceed these criteria at any residence on privately-owned land or on more than 25 % of any privately-owned land.

Table 2.6 PA 08_0184 Cumulative Noise Criteria, dB(A)

Location	Day (LAeq,period)	Evening (LAeq,period)	Night (LAeq,period)
All privately-owned land	50	45	40

2.2.1.4 Cumulative Noise Acquisition Criteria

Cumulative noise land acquisition criteria provided in Table 5 of Schedule 3 of PA 08_0184 are reproduced in **Table 2.7**. If noise generated by the approved operations combined with the noise generated by other mines in the area exceeds these criteria at any residence on privately-owned land or on more than 25 % of any privately-owned land, then upon receiving a written request for acquisition from the landowner, UCMPL must acquire the land on as equitable basis as possible with the relevant mines in accordance with the procedures in Conditions 6 to 7 of Schedule 4 of PA 08_0184.

Table 2.7 PA 08_0184 Cumulative Noise Land Acquisition Criteria, dB(A)

Location	Day (LAeq,period)	Evening (LAeq,period)	Night (LAeq,period)
All privately-owned land	55	50	45

2.2.2 Project Noise Trigger Levels established under Section 6 of the NPfI

An existing industry planning an upgrade or expansion to their site can use Section 6 of the NPfI to establish relevant project noise trigger levels based on the noise levels generated by the existing approved operations. Ideally, the project noise trigger level for a new/modified component of an existing operation would be set at 10 dB or more below existing noise levels. Under this approach, the summation of the new noise levels plus the existing noise levels should not increase the overall noise levels above that of the existing approved operations.

A review of the attended noise monitoring reports for 2017 to 2021 indicates the UCMPL contribution to the acoustic environment at NM7 (EPL Point 24, Receiver 254) ranges from inaudible and less than 20 dB(A) to 38 dB(A). The elevated noise levels reported for the daytime period were associated with the Longwall 6 ventilation fan and dewatering infrastructure construction. The attended noise monitoring reports also indicate that evening and night operational noise levels at NM7, ranging from 26 to 35 dB(A), are associated with the operation of the Ulan Coal ventilation fans in 2019, and the temporary fan that was installed at Ulan West Longwall 6 in early 2020. The temporary ventilation fan was a style of fan usually used underground. To mitigate noise, sound-absorbing mats and stacked shipping containers were placed around the vent fan, and a real-time noise monitor was placed close to NM7 to monitor noise levels. In November 2020, the temporary ventilation fan was swapped out for the permanent fan fitted with a silencer. Subsequent attended noise monitoring indicated the new fan had low audibility and there have been no periods of non-compliance recorded since.

If UCMPL is operating at the noise limits described in **Table 2.3** and **Table 2.4** the project noise trigger levels derived for the Proposed Modification would range from 25 to 28 dB(A). It would not be feasible for the Proposed Modification to achieve these project noise trigger levels derived from the existing approval noise criteria/limits. However, it is noted that noise impacts from the sequential ventilation fan installations are not cumulative. Each fan installation replaces the previous fan installation. Therefore, the operational noise levels in the region of Ulan West, which are primarily associated with the fan installations, should be designed, if feasible, to meet the existing consent and EPL noise limits. If this cannot be achieved, new project noise trigger levels would need to be established based on the existing amenity and background noise levels and achievable noise limits quantified in this NIA.

2.2.3 Project Noise Trigger Levels established under Section 2 of the NPfI

2.2.3.1 Methodology

Section 2 of the NPfI sets out a process for industrial noise management involving the following main steps:

1. Determining the project noise trigger levels for a development (NPfI Section 2); these are the benchmark levels above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment (NPfI Section 2.3) and maintaining the noise amenity of an area (NPfI Section 2.4). Measurement of existing background levels, using procedures outlined in NPfI Fact Sheets A and B are required for this step if trigger levels greater than the minimum assumed levels are proposed.

2. Predicting or measuring the noise levels produced by the development (NPfI Section 3.3), having regard to the presence of annoying noise characteristics (NPfI Fact Sheet C) and meteorological effects such as temperature inversions and wind (NPfI Fact Sheet D).

3. Comparing the predicted (or measured noise level if the Project is operational) with the project noise trigger level and assessing impacts and the need for noise mitigation and management measures (NPfI Section 3.4).

4. Considering residual noise impacts, that is, noise levels that exceed the project noise trigger levels after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant (NPfI Sections 3.2 and 4).

5. Setting statutory compliance levels that reflect the best achievable and agreed noise limits for the development (NPfI Section 5).

6. Monitoring and reporting environmental noise levels from the development (NPfI Section 7).

The project noise trigger levels (PNTL) derived in accordance with the NPfI provide a benchmark or objective for assessing a proposal or site. They are not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response; for example, further investigation of mitigation measures.

The project noise trigger level, feasible and reasonable mitigation, and consideration of residual noise impacts are used together to assess noise impacts and manage the noise from a proposal or site.

The project noise trigger level is the lower (that is, the more stringent) value of the project intrusiveness noise level (PINL) and project amenity noise level (PANL) determined in the NPfI Sections 2.3 and 2.4. Neither the intrusiveness noise levels or the amenity noise levels are used directly as regulatory noise limits.

2.2.3.2 SentineX 73 and SentineX 120 noise levels

The continuous noise monitoring results from 2019 have been used to determine the mean LAeq(period) noise levels, assessment background levels (ABLs) and rating background levels (RBLs) for the Project Area. The locations of SentineX 73 and SentineX 120 are shown on **Figure 3.1**. All data analysed was 15-minute interval data.

Data from the 2019 calendar year was filtered for appropriate meteorological conditions as per the procedures outlined in the NPfI (EPA, 2017) Fact Sheet B to determine the RBLs. The first step of this procedure is to determine the ABLs using the 10 th percentile method for each period. The second step is to derive the RBLs as the median ABL value for each period.

Mean LAeq(period) noise levels and RBLs determined from 2019 Sentinex data are shown in **Table 2.8.**

Table 2.8 Summary of 2019 data from SentineX Units

Sentinex Unit	LAeq(15min) dB(A)			RBLs dB(A)		
	Day	Evening	Night	Day	Evening	Night
SentineX 73	58	47	38	23	20	19
SentineX 120	58	42	42	23	19	15

In order to understand the nature of the noise environment over a long term period the one-third LAeq data from 2019 winter nights from both SentineX 73 and SentineX 120 were reviewed. The data shows dominant frequencies in the 1 kHz and 1.25 kHz bands associated with natural sources in the environment such as insects. Industrial noise sources typically have noise profiles dominant in frequencies lower than 1 kHz. The results of the analysis of the one-third LAeq data suggest industrial noise is not a dominant contributor to the acoustic environments at SentineX 73 or SentineX 120.

2.2.3.3 Project Noise Trigger Levels

The background noise levels measured by the SentineX units likely include existing UCMPL operations. In accordance with the NPfI, where an existing industry has been in operation for more than 10 years it is considered a normal part of the acoustic environment.

Despite potentially already including the acoustic contribution of existing UCMPL operational noise, background noise levels determined through an analysis of SentineX data, shown in **Table 2.8**, demonstrate that the existing noise environment is typical of a quiet rural area and that minimum NPfI criteria will likely apply to the Proposed Modification.

In accordance with the NPfI, where the rating background noise level is found to be less than 30 dB(A) for the evening and night periods, then it is set to 30 dB(A); where it is found to be less than 35 dB(A) for the daytime period, then it is set to 35 dB(A). The results shown in **Table 2.8** indicate that minimum RBLs would be adopted for the Project. The derived project intrusiveness noise levels based on the minimum RBLs plus 5 dB(A) are shown in **Table 2.9**.

The LAeq(period) project amenity noise levels in **Table 2.9** are defined as the acceptable amenity noise levels for the receiver location (NPfI Table 2.2) minus 5 dB. In order to derive the project noise trigger levels, the period-based project amenity noise levels are converted to equivalent 15-minute levels (LAeq, 15minute) by the addition of 3 dB.

The project noise trigger level is the lower or most stringent value of the project intrusiveness noise level and the project amenity noise level.

The project amenity noise levels that would apply for residential receivers surrounding a new development are shown in **Table 2.9**.

Table 2.9 Project Noise Trigger Levels (PNTL) LAeq(15 minute) dB(A) for a New Development

Time of day	Minimum RBLs	Project Intrusiveness Noise Level	Project Amenity Noise Level (period)	Project Amenity Noise Level (15 minute)	Project Noise Trigger Level (15 minute)
Day period (7 am–6 pm Monday to Saturday; 8 am–6 pm Sunday and Public Holidays)	35	40	45	48	40
Evening Period (6 pm–10 pm)	30	35	40	43	35
Night period (10 pm to commencement of day period)	30	35	35	38	35

2.2.3.4 Cumulative Noise Criteria

The NPfI notes that where a project can achieve the project amenity noise level no additional consideration of cumulative industrial noise is required. The minimum project amenity noise level that would apply to the Project Area is the LAeq,night level of 35 dB(A). The equivalent 15-minute project amenity noise level is 38 dB(A).

3.0 Noise Prediction Methodology

3.1 Assessment Approach

This NIA recognises that the original assessment of the operational noise impacts for the approved operations was completed under the NSW *Industrial Noise Policy* (EPA, 2000) (INP). The assessment of operational noise impacts in this NIA has been undertaken following the requirements of the NPfI. The key differences between the two policies, as they relate to this assessment, include the assessment of modifying factors associated with low-frequency noise, the establishment of minimum background noise during the daytime and the setting of noise goals for sleep disturbance.

The NIA was undertaken by predicting noise levels from the Proposed Modification's construction and operation phases at the potentially affected receivers (refer to **Figure 3.1**). The construction phase activities are temporary and will occur in support of the proposed additional undergound mining to establish the surface infrastructure required for the Proposed Modification. The noise levels predicted from the construction phases for the Proposed Modification are compared against the construction noise criteria in **Table 2.2**.

The noise levels predicted from the Proposed Modification's operation phase are compared against the operational noise criteria provided in **Table 2.3** and **Table 2.4**.

3.2 Modelling Approach

The noise levels at receivers were predicted using the proprietary noise modelling software ENM.

In accordance with NPfI Fact Sheet D, the detailed approach to the analysis of the meteorological data was used to determine if specific wind effects and/or inversion conditions warranted further analysis. The vectored wind analysis and review of the wind roses, undertaken in accordance with the requirements of the NPfI, identified the presence of a range of conditions that could enhance the propagation of noise from the Proposed Modification towards sensitive noise receivers. 15-minute meteorological data for 2017 was sourced from UCMPL's SentineX monitoring unit SX71, shown on **Figure 3.1**.

Standard meteorological conditions are defined as: atmospheric stability class D, wind speed 0 metres/second (m/s), temperature 10°C, 70 % relative humidity.

The potential noise-enhancing conditions identified from the analysis of the 2017 meteorological dataset presented in **Appendix A** are as follows:

- summer nights: ENE to E winds at 3m/s
- autumn and spring evenings: SW to W winds at 3m/s
- autumn and spring nights: SSW to W winds at 3m/s
- winter evening/nights: SSW to W winds at 3m/s plus F-class atmospheric stability weather conditions.

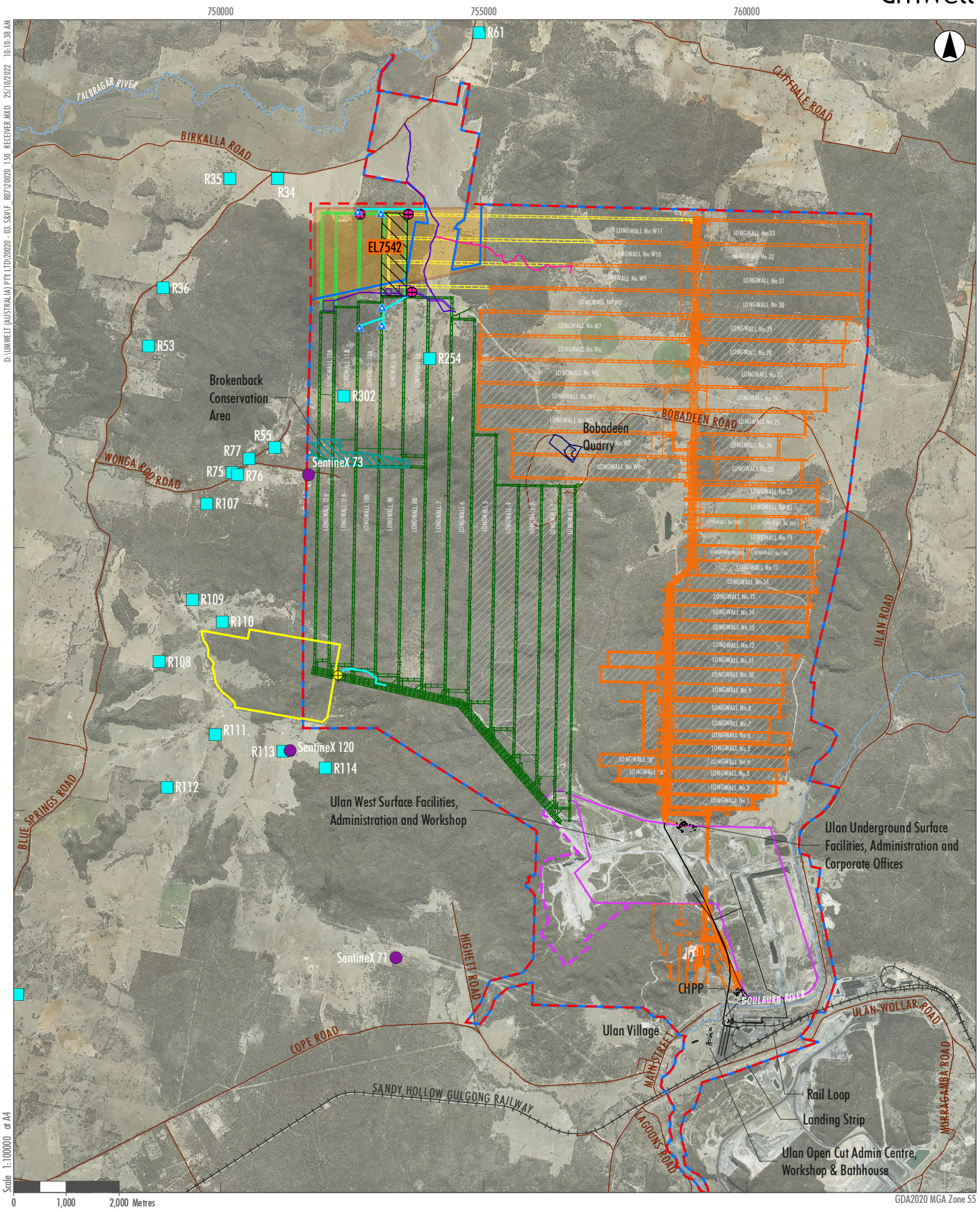
3.3 Modelled Receivers

The locations of receivers potentially affected by the Proposed Modification were provided by UCMPL and are shown in **Table 3.1** and **Figure 3.1**.

There is one private property potentially affected by the Proposed Modification that does not contain a residential dwelling (Lot 72 DP 750742, as shown on **Figure 3.1**). Noise contours were estimated for this property to determine if the noise acquisition criteria could be exceeded during the operational phase of the Proposed Modification.

Table 3.1 Receiver Location Details

Property ID	Receiver Coordinates (Easting, Northing)	
34	751077	6442018
35	750170	6442019
36	748907	6439936
53	748627	6438834
55	751027	6436896
61	754910	6444802
75	750214	6436437
76	750320	6436385
77	750534	6436693
107	749736	6435834
108	748831	6432826
109	749463	6434006
110	750028	6433585
111	749897	6431453
112	748975	6430445
113	751178	6431126
114	751988	6430811
254	753971	6438598
302	752336	6437882
Private Vacant Property	Lot 72 DP750742	



Legend

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- Approved Ulan West Mine Plan
- Previously Mined
- Previous Ulan Open Cut Area
- Approved Ulan Open Cut Extension
- Lot 72 DP750742
- Unattended Noise Monitoring Location
- Modelled Receiver Locations
- Proposed Borehole
- Proposed Vent Shaft
- Proposed Dewatering Bores
- Proposed Infrastructure
- Proposed Access Track Corridor
- Proposed Ulan Underground Mine Plan Modification
- Proposed Ulan West Underground Mine Plan Modification
- Longwall Option Area

FIGURE 3.1

Modelled Receiver Locations

Image Source: Glencore (2018) Data source: Glencore (2020); NSW DFSI (2020)

4.0 Predicted Impacts

4.1 Construction Noise Impacts

4.1.1 Noise Sources

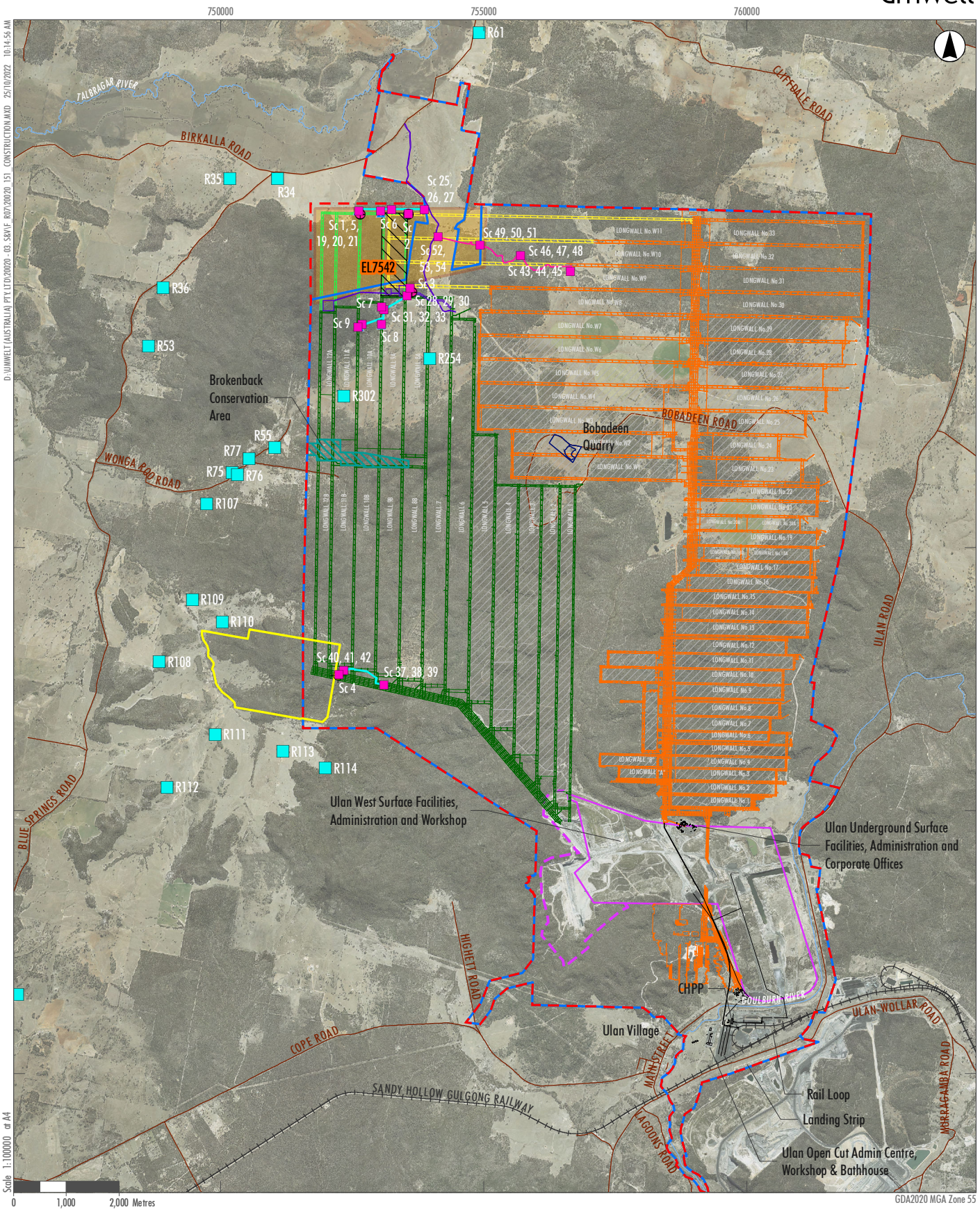
As described in **Section 3.1**, the construction phase activities would establish the surface infrastructure for the Proposed Modification. The majority of construction phase activities would only occur for a short duration of time with longer periods (up to 6 months) for borehole drilling activities. The NIA has modelled 45 construction phase noise scenarios. The indicative noise sources for each construction phase noise scenario are presented in **Table 4.1.** The corresponding noise source sound power levels (SWL) are expressed in dB(A) and dB(Z). The locations of all modelled construction phases are shown in **Figure 4.1**.

Table 4.1 Modelled Construction Phase Noise Scenarios and SWL

Phase of Work	Modelled Scenarios [1]	Sources	SWL dB(Z)	SWL dB(A)
Vent Shafts	1–3	30 t Excavator	117	105
		31 t Front end loader	120	110
		Drilling rig	108	94
		150 t Crane	112	106
		Air compressor	117	104
		Diesel generator	109	93
		Forklift	125	121
		Semi-trailer truck	124	109
		Concrete truck and pump	110	105
Borehole	4	30 t Excavator	117	105
		31 t Front end loader	120	110
		Drilling rig	108	94
		150 t Crane	112	106
		Air compressor	117	104
		Diesel generator	109	93
		Forklift (with beeper)	125	121
		Semi-trailer truck	124	109
		Concrete truck and pump	110	105
Dewatering Borehole	5-9	30 t Excavator	117	110
		31 t Front end loader	120	110
		Drilling rig	108	94
		150 t Crane	112	106
		Air compressor	117	104

Phase of Work	Modelled Scenarios [1]	Sources	SWL dB(Z)	SWL dB(A)
		Diesel generator	109	93
		Forklift	125	121
		Semi-trailer truck	124	109
		Concrete truck and pump	110	105
Corridor Clearing	19, 22, 25, 28, 31, 34, 37, 42, 45, 48, 51, 54	30 t excavator with shear attachment	117	110
		Tree mulching tractor	126	121
		Truck mounted water cart	124	108
Road Construction	20, 23, 26, 29, 32, 35, 38, 40, 43, 46, 49, 52	30 t excavator	117	110
		Truck mounted water cart	124	108
		13 t roller	115	109
		Grader	115	108
		30 t articulated dump truck	111	108
		D8 dozer	122	112
		20 t excavator	117	105
		Semi trailers	124	109
		Light vehicles	92	92
		30 KVa generator	109	93
		20 t franna crane	101	98
		Concrete truck	110	105
Construction / Powerline Installation	21, 24, 27, 30, 33, 36, 39, 41, 44, 47, 50, 53	20 t franna crane	101	98
		80 t hydraulic crane	117	105
		30 KVa generator	109	93
		Light vehicles	92	92
		Bucket truck	112	109
		Truck mounted auger	109	106
		20 t excavator	117	105
		Concrete truck	110	105

Note: 1 Scenario numbers are consecutive by location and not by activity.



Legend

- Project Approval Boundary
- Proposed Project Approval Boundary
- Brokenback Conservation Area
- Bobadeen Quarry
- Exploration Lease - EL7542
- Roads
- Railway
- Major Watercourses
- Approved Infrastructure related to Mod 6
- Approved Ulan Underground Mine Plan
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- Modelled Receiver Locations
- Noise Model Scenario Location
- Proposed Borehole
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- Proposed Dewatering Bores
- Proposed Infrastructure
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- Proposed Ulan West Underground Mine Plan Modification
- Longwall Option Area

FIGURE 4.1

Construction Phase Modelled Noise Source Locations

Image Source: Glencore (2018) Data source: Glencore (2020); NSW DFSI (2020)

4.1.2 Predicted Noise Levels

The predicted noise levels at nearby receivers for the construction phase scenarios during recommended standard hours are presented in **Table 4.2**. The noise impacts should be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time (i.e. wind is considered a feature of the area where source-to-receiver winds of 3 m/s occur for 30 per cent of the time in any assessment period). The analysis of the local meteorological data presented in **Appendix A** indicates wind effects are not considered a feature of the area during the daytime. Therefore the results presented in **Table 4.2** are for the standard meteorological conditions.

The predicted noise levels at the nearby receivers for the construction phase scenarios that could occur outside the recommended standard hours are presented in **Table 4.3**. The analysis of the local meteorological data presented in **Appendix A** indicates wind effects and inversions that enhance noise propagation are considered a feature of the area during the evening and night time. Therefore the results presented in **Table 4.3** are for both standard meteorological conditions and the noise-enhancing meteorological conditions identified in **Section 3.2**.

The noise levels highlighted in grey indicate where the construction phase activities may exceed the construction noise management levels (NML) for the Proposed Modification.

Table 4.2 Predicted Construction Noise Levels during Recommended Standard Hours, dB(A)

Receiver	NML	Scenario					
		Vent Shafts	Borehole	Dewatering Borehole	Corridor Clearing	Road Construction	Powerline Installation
34	45	14 – 34	< 10	11 – 35	< 10 – 41	< 10 – 43	< 10 – 37
35	45	13 – 30	< 10	< 10 – 31	< 10 – 35	< 10 – 36	< 10 – 27
36	45	< 10 – 12	< 10	< 10 – 11	< 10 – 15	< 10 – 17	< 10 – 12
53	45	< 10	< 10	< 10	< 10 – 13	< 10 – 11	< 10
55	45	< 10	< 10 – 11	< 10 – 13	< 10 – 16	< 10 – 17	< 10 – 13
61	45	15 – 25	< 10	10 – 22	< 10 – 30	< 10 – 31	< 10 – 27
75	45	< 10	< 10	< 10 – 10	< 10 – 14	< 10 – 15	< 10 – 12
76	45	< 10	< 10 – 11	< 10 – 11	< 10 – 15	< 10 – 15	< 10 – 14
77	45	< 10	< 10	< 10 – 11	< 10 – 15	< 10 – 15	< 10 – 13
107	45	< 10	< 10 – 11	< 10	< 10 – 14	< 10 – 16	< 10 – 15
108	45	< 10	13 – 19	< 10	< 10 – 20	< 10 – 20	< 10 – 19
109	45	< 10	16 – 21	< 10	< 10 – 21	< 10 – 24	< 10 – 23
110	45	< 10	14 – 18	< 10	< 10 – 18	< 10 – 21	< 10 – 22
111	45	< 10	12 – 16	< 10	< 10 – 16	< 10 – 17	< 10 – 18
112	45	< 10	< 10 – 14	< 10	< 10 – 17	< 10 – 17	< 10 – 14
113	45	< 10	17 – 20	< 10	< 10 – 24	< 10 – 24	< 10 – 21
114	45	< 10	24 – 24	< 10	< 10 – 24	< 10 – 24	< 10 – 20
254	45	17 – 37	< 10	14 – 24	< 10 – 41	< 10 – 41	< 10 – 36
302	45	12 – 17	12 – 15	10 – 19	< 10 – 22	15 – 24	< 10 – 18

Table 4.3 Predicted Construction Noise Levels outside of Recommended Standard Hours, dB(A)

Receiver	NML	Scenario			
		Standard Meteorological Conditions		Noise-Enhancing Meteorological Conditions	
		Vent Shafts	Borehole	Vent Shafts	Borehole
34	35	14 – 34	< 10	31 – 40	10
35	35	13 – 30	< 10	28 – 35	16
36	35	< 10 – 12	< 10	22 – 28	17
53	35	< 10	< 10	< 10 – 23	18
55	35	< 10	11	19 – 27	26
61	35	15 – 25	< 10	24 – 28	13
75	35	< 10	< 10	< 10 – 25	25
76	35	< 10	11	14 – 25	27
77	35	< 10	< 10	< 10 – 26	25
107	35	< 10	11	15 – 22	26
108	35	< 10	19	14 – 14	30
109	35	< 10	21	< 10	31
110	35	< 10	18	< 10 – 13	33
111	35	< 10	16	< 10 – 12	21
112	35	< 10	14	11 – 14	29
113	35	< 10	20	< 10 – 11	29
114	35	< 10	24	< 10 – 13	29
254	35	17 – 37	< 10	29 – 44	14
302	35	12 – 17	15	14 – 27	25

4.1.3 Results Discussion

The results in **Table 4.2** indicate the construction activities that occur during the recommended standard construction hours will comply with the adopted NML of 45 dB(A) under the standard meteorological conditions.

It is noted that noise-enhancing conditions could occur at times during recommended standard hours. However, the analysis of the UCMPL meteorological data in accordance with Fact Sheet D of the NPfI (refer to **Appendix A**) indicated an assessment of the noise impacts during noise-enhancing conditions was not required. Notwithstanding this, the management of the construction activities should aim to mitigate the noise impact during noise-enhancing conditions, when they occur.

The results in **Table 4.3** indicate the activities associated with the construction of the fan shafts outside recommended standard construction hours could exceed the adopted NML of 35 dB(A) at one (1) receiver location under standard meteorological conditions and two (2) receiver locations under the noise-enhancing meteorological conditions identified in **Section 3.2**. The potential exceedance at Receiver 34 during noise enhancing meteorological conditions outside recommended standard construction hours is associated with easterly wind conditions during summer nights. The potential exceedance at Receiver 254 outside recommended standard construction hours could occur during calm conditions, during inversion conditions and when the wind is from the east-north-east (refer to **Section 3.2** and **Appendix A**).

The management of construction activities should aim to avoid any work outside recommended standard hours. Where this cannot be avoided the noise impact of the construction activities will need to be carefully managed during noise-enhancing meteorological conditions to avoid the potential noise impacts predicted in **Table 4.3**.

Mitigation and management measures are further discussed in **Section 5.0**.

4.2 Operational Noise Impacts

4.2.1 Noise Sources

Eight (8) operational phase noise scenarios have been modelled for this NIA. The corresponding noise sources for the operation phase noise scenarios are presented in **Table 4.4**. The corresponding noise source sound power levels (SWL) are expressed in dB(A) and dB(Z). The locations of all the modelled noise sources are shown in **Figure 4.1**.

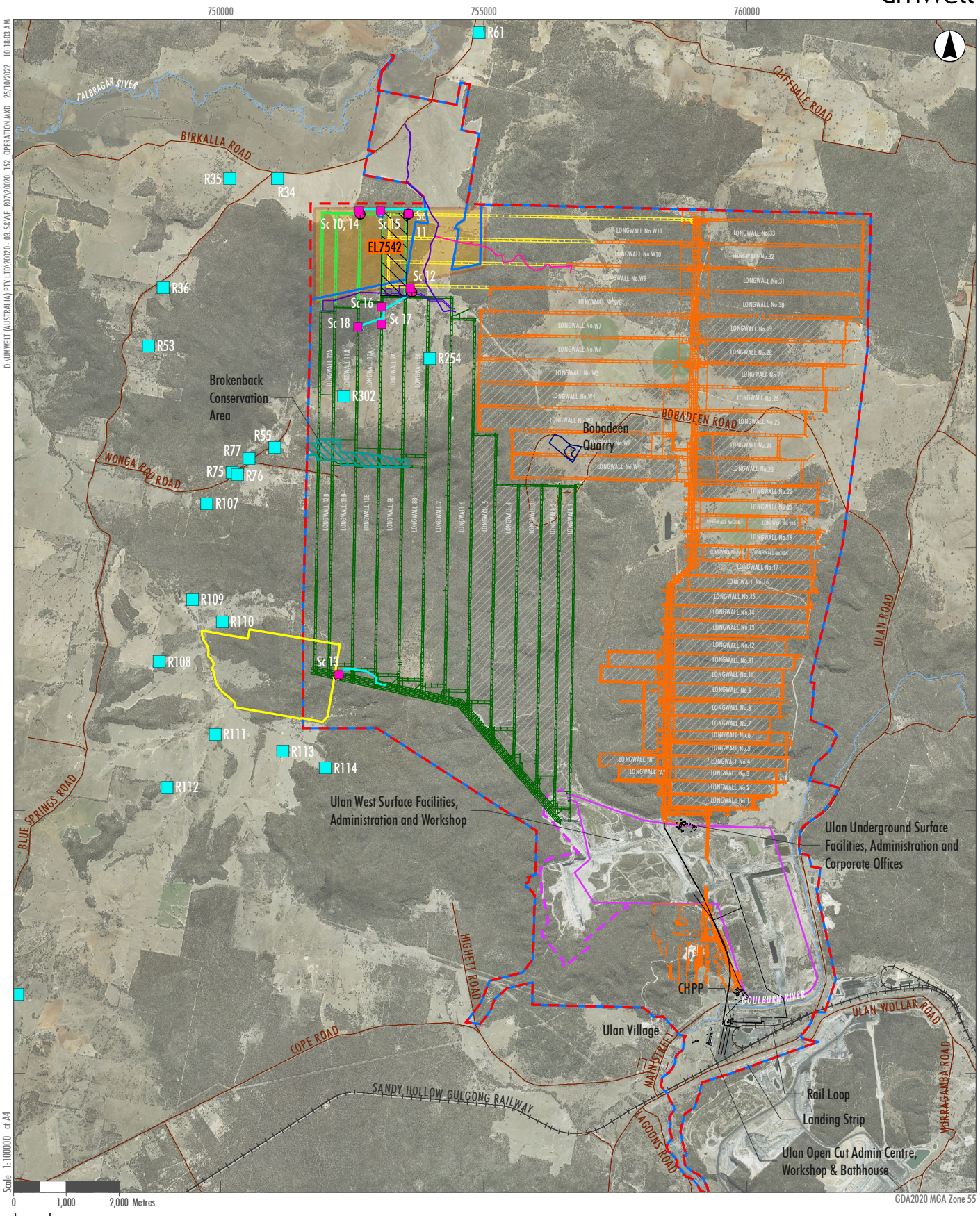
Table 4.4 Modelled Operational Phase Noise Scenarios and SWL

Description	Modelled Scenarios	Sources	SWL dB(Z)	SWL dB(A)
Ventilation Fan	10–12	Vent Fan	117	107
Large Substation	13	Large Substation	131	103
Small Substation	14–18	Small Substation	122	94

4.2.2 Predicted Noise Levels

The worst-case predicted noise levels at nearby receivers for the operation phase noise scenarios for the meteorological conditions described in **Section 3.2** are presented in **Table 4.5**.

The worst-case predicted noise contours for the private vacant property at Lot 72 DP750742 are presented in **Figure 4.3**. The contours show whether noise acquisition criteria would be exceeded during the closest operational phase (Scenario 13) of the Proposed Modification.



Legend

- Project Approval Boundary
- Proposed Project Approval Boundary
- Brokenback Conservation Area
- Bobadeen Quarry
- Exploration Lease - EL7542
- Roads
- Railway
- Major Watercourses
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- Approved Ulan Underground Mine Plan
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- Proposed Dewatering Bores
- Proposed Infrastructure
- Proposed Access Track Corridor
- Proposed Ulan Underground Mine Plan Modification
- Proposed Ulan West Underground Mine Plan Modification
- Longwall Option Area

FIGURE 4.2

Operation Phase Modelled Noise Source Locations

Image Source: Glencore (2018) Data source: Glencore (2020); NSW DFSI (2020)

Table 4.5 Predicted Operational Noise Levels, dB(A)

Receiver	Existing Noise Limits d/e/n	PNTL d/e/n	Scenario			
			Standard Meteorological Conditions		Noise Enhancing Conditions	
			Vent Fans	Substations	Vent Fans	Substations
34	35/35/35	40/35/35	< 10 – 28	< 10 – 17	24 – 34 [1]	< 10 – 21
35	35/35/35	40/35/35	< 10 – 23	< 10 – 12	22 – 27	< 10 – 16
36	35/35/35	40/35/35	< 10	< 10	15 – 22	< 10 – 13
53	35/35/35	40/35/35	< 10	< 10	< 10 – 17	< 10 – 14
55	35/35/35	40/35/35	< 10	< 10	11 – 22	< 10 – 19
61	35/35/35	40/35/35	< 10 – 18	< 10	17 – 22	< 10 – 11
75	35/35/35	40/35/35	< 10	< 10	< 10 – 19	< 10 – 19
76	35/35/35	40/35/35	< 10	< 10	< 10 – 19	< 10 – 20
77	35/35/35	40/35/35	< 10	< 10	< 10 – 20	< 10 – 19
107	35/35/35	40/35/35	< 10	< 10	< 10 – 14	< 10 – 20
108	35/35/35	40/35/35	< 10	< 10 – 13	< 10	< 10 – 23
109	35/35/35	40/35/35	< 10	< 10 – 14	< 10	< 10 – 23
110	35/35/35	40/35/35	< 10	< 10 – 13	< 10	< 10 – 20
111	35/35/35	40/35/35	< 10	< 10 – 12	< 10	< 10 – 16
112	35/35/35	40/35/35	< 10	< 10	< 10	< 10 – 22
113	35/35/35	40/35/35	< 10 - 12	< 10 – 15	< 10	< 10 – 22
114	35/35/35	40/35/35	< 10	< 10 – 17	< 10	< 10 – 23
254	38/38/37	40/35/35	< 10 – 30	< 10	26 – 36 [1]	< 10 - 20
302	35/35/35	40/35/35	< 10	< 10	< 10 – 20	< 10 - 12

*Notes: 1 – There is potential for both of these results to be subjected to modifying factors for low frequency, as identified by previous monitoring results (see **Section 4.2.3**).*

4.2.3 Low-frequency and Tonal Noise Assessment

Low-frequency noise is defined in the NPfI as noise that contains major components in the low-frequency range from 10 Hz to 160 Hz. A low-frequency penalty may be applicable if there is a difference of 15 dB or more between the predicted C- and A-weighted noise levels. Where this difference is 15 dB or more, the one-third octave spectrum is compared to a threshold spectrum and adjustments are made if the source levels exceed the threshold.

Tonal noise is defined in the NPfI as noise that contains a prominent frequency and is characterised by a definite pitch. A tonal noise modifying factor applies when noise levels of a one-third octave band exceed the level of the adjacent band on both sides by 5, 8 or 15 dB depending on the frequency of the one-third band.

The predicted noise levels at Receivers 34 and 254 for the operational phase noise scenario under noise-enhancing meteorological conditions have been assessed for low-frequency and tonal noise components.

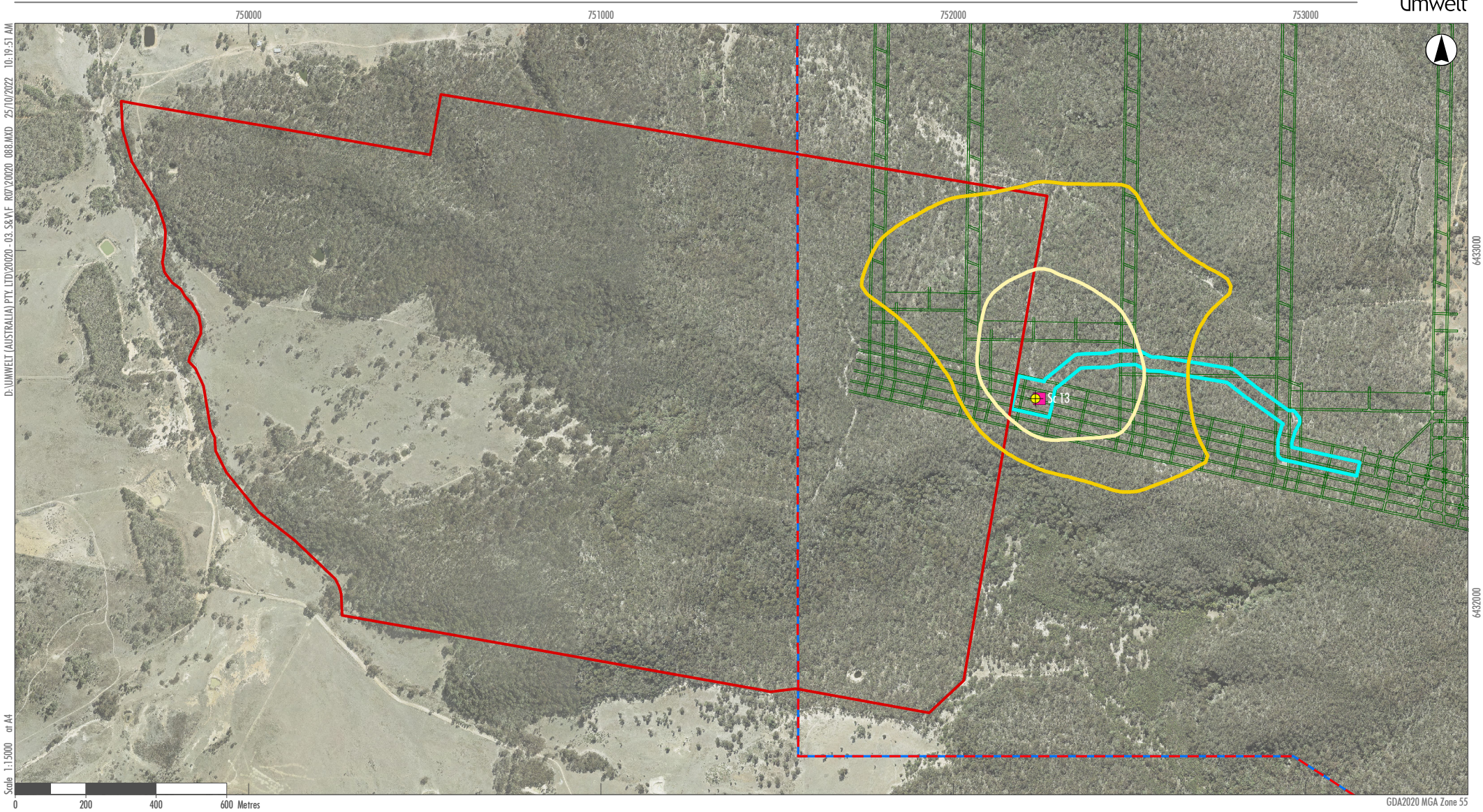
The difference between the predicted C- and A-weighted noise levels for both receivers under noise enhancing conditions is less than 15 dB(A). Additionally, the modelling does not identify tonal components that would exceed the NPfI low-frequency reference spectrum or the one-third octave band analysis for tonal characteristics. Therefore, no further assessment of low frequency or tonal noise is required.

4.2.4 Results Discussion

The results in Table 4.5 indicate the operational phase scenarios which consider the sequential operation of the ventilation fans will comply with the operational phase noise limits/criteria (refer to **Section 2.2**) at all receiver locations during both standard and noise enhancing meteorological conditions (as identified in **Section 3.2**).

As shown on **Figure 4.3**, the predicted noise contours from the worst-case operational phase noise scenario (Scenario 13) to the private vacant property at Lot 72 DP750742 do not exceed the existing noise acquisition criteria (refer to **Section 2.2**) over more than 25 % of the property.

The Proposed Modification is not predicted to exceed the equivalent 15-minute project amenity noise level of 38 dB(A) (refer to **Table 2.9**) at any receiver. As stated by the NPfI, where a project can achieve the project amenity noise level no additional consideration of cumulative industrial noise is required.



Legend

- Project Approval Boundary
- Proposed Project Approval Boundary
- Approved Ulan West Mine Plan
- Proposed Borehole
- Proposed Infrastructure
- Lot 72 DP750742
- Noise Model Scenario Location
- 45dB(A) Noise Contour Envelope
- 40dB(A) Noise Contour Envelope

FIGURE 4.3

Lot 72, DP750742 Noise Contours

Image Source: Glencore (2018) Data source: Glencore (2020), NSW DFSI (2020)

5.0 Conclusion and Recommendations

5.1 Construction Phase Noise

As described in **Section 3.1**, the construction phase activities are temporary and will be undertaken to establish the surface infrastructure for the Proposed Modification. The predicted noise levels in **Table 4.2** indicate that NMLs will not be exceeded during recommended standard construction hours under standard meteorological conditions.

As noted in the discussion in **Section 4.1.3**, even though an assessment of the noise impacts during noise-enhancing conditions is not required for the daytime period as per the requirements of Fact Sheet D of the NPfI, noise-enhancing conditions could still occur during recommended standard construction hours. As a result, the management of the construction activities should aim to mitigate the noise impact during noise-enhancing meteorological conditions. While this relates specifically to corridor clearing and road construction activities, UCMPL is committed to managing noise from the construction of the surface infrastructure in line with the NPfI at the neighbouring properties. UCMPL's commitments to noise management are described below.

Construction work for the Proposed Modification should be scheduled to be conducted within the ICNG recommended standard work hours where practicable. Due to the nature of the construction activities for the ventilation fan shafts and dewatering boreholes, construction work may be required outside of the ICNG recommended standard work hours. The predicted noise levels in **Table 4.3** indicate that NMLs could be exceeded by the construction of the ventilation shafts outside recommended standard hours under standard meteorological conditions at one (1) receiver location and at two (2) receiver locations under noise-enhancing meteorological conditions. The options to manage the noise impacts are described below.

Noise Management Commitments

UCMPL prepared a Construction Noise Management Plan (CNMP) for the construction of the surface infrastructure for Modification 4 (Longwall Optimisation Project) of Approval 08_0184 (MOD 4). The commitments in the MOD 4 CNMP will be retained for the construction of the Proposed Modification. These include:

- consultation with landowners and regulators
- consideration of the timing of additional construction activities and impacts upon cumulative noise generated at neighbouring properties
- notification to stakeholders of the timing of the commencement and finish of the construction noise period
- mitigation measures to be implemented and learnings from the previous construction campaign such as equipment location and orientation, and the use of temporary noise screens, where required
- modelling results of the effectiveness of the proposed measures
- measures to manage any potential residual exceedances, including:
    - noise monitoring – targeted attended monitoring, or if required, real-time monitoring with triggers for response

- a Trigger, Action, Response Plan (TARP) related to monitoring results that triggers further noise management controls

- management of noise levels in accordance with any private noise agreements for alternative criteria that have been reached with a landholder following consultation.

Further noise management controls that could be implemented at construction sites may include:

- operational constraints such as:
  - modification or pausing of construction activities during specific adverse meteorological conditions, particularly in the evening/night time, which may include operating only one or two items of plant
  - programming the noisiest construction activities to occur during the day
  - modification of equipment layout and the use of portable noise barriers around noise generating equipment.
- community consultation with affected residents, including but not limited to:
  - individual briefings to affected receivers detailing construction plans and noise mitigation measures to be implemented
  - project specific respite offers
  - specific notifications, either letterbox drops or hand delivered notifications, no later than seven days ahead of specific construction activities that are likely to exceed the noise criteria.

The type(s) of community consultation implemented for the receivers would be based on the level of noise at individual receivers.

For construction work to occur outside recommended standard hours the INCG requires:

- clear justification for reasons other than convenience such as to sustain operational integrity of construction activity

- the application of all feasible and reasonable work practices to meet the NML.

Where all feasible and reasonable practices have been applied and noise remains more than 5 dB(A) above the NML, negotiation with the community in accordance with Section 7.2.2 of the ICNG would be required.

5.2 Operational Phase Noise

The operational noise levels are discussed in **Section 4.2** and are predicted to comply with the day, evening and night period operational noise criteria at all receiver locations under standard and noise-enhancing meteorological conditions identified in **Section 3.2**.

The noise contours across the private vacant property at Lot 72 DP750742 do not exceed the noise acquisition criteria over more than 25 % of the property. Notwithstanding this, it is recommended the enclosure around the borehole substation (modelled as a 15 MVA transformer) is oriented to reduce the transmission of noise to the west of the installation.

5.3 Cumulative Noise

As the Proposed Modification is not predicted to exceed the equivalent 15-minute project amenity noise (refer to **Table 2.9**) at any receiver, an assessment of cumulative industrial noise is not required.

6.0 References

Department of Environment and Climate Change NSW, 2009. *Interim Construction Noise Guideline*.

Department of Environment, Climate Change and Water, 2011. *NSW Road Noise Policy*.

Environment Protection Authority, 2020. *Draft Construction Noise Guideline*.

Environment Protection Authority, 2017. *Noise Policy for Industry*.

Environment Protection Authority, 2000. *Industrial Noise Policy*.

NSW Government, 2018. *Voluntary Land Acquisition and Mitigation Policy – For State Significant Mining, Petroleum and Extractive Industry Developments*.

APPENDIX A

Meteorological Conditions

Appendix A – Detailed Analysis of Meteorological Conditions

Certain meteorological conditions may increase noise levels by focusing soundwave propagation paths to a specific location. Such refraction of sound waves will occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level) and where there is a wind gradient (i.e. wind velocities increasing with height above ground level) with wind direction from the source to the receiver.

Fact Sheet D of the *Noise Policy for Industry* (NPfI) (EPA, 2017) requires that noise impacts be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time.

The NPfI notes that there are two approaches for the assessment of meteorological effects, such as gradient winds and temperature inversions, on propagating the noise from the source to the receiver. The simple method is to adopt the noise-enhancing meteorological conditions for all assessment periods outlined in the policies. Alternatively, local meteorological data can be used to determine weather conditions that would be expected to occur at a particular site for a significant period of time.

15-minute meteorological data for 2015 (inclusive) to 2020 (inclusive) was sourced from UCMPL's SentineX monitoring unit SX71 located at -32.2634354, 149.6893311. In the Air Quality Impact Assessment for this Project, Jacobs identified the 2017 calendar year as a representative meteorological year. The 2017 dataset has been analysed to determine the prevailing meteorological conditions (frequency of occurrence of prevailing winds and temperature inversions) for the area surrounding the Project Area. Wind roses generated from the collated meteorological dataset are shown in **Figures A1** to **A5**.

The NPfI requires that wind effects be assessed when wind is considered a feature of the area. Wind is considered a feature of the area where source-to-receiver winds of 3 m/s occur for 30 per cent of the time in any assessment period. The policies require that noise impacts be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time.

The collated meteorological data was analysed to determine prevailing wind conditions likely to influence the propagation of noise at the Project site. The following conditions are applicable based on the detailed, rather than the default NPfI condition, to assess noise-enhancing meteorological conditions in this noise impact assessment:

- Summer Nights: ENE to E winds at 3 m/s.
- Autumn and Spring Evenings: SW to W winds at 3 m/s.
- Autumn and Spring Nights: SSW to W winds at 3 m/s.
- Winter Evening/Nights: SSW to W winds at 2 m/s plus F-class atmospheric stability weather conditions.

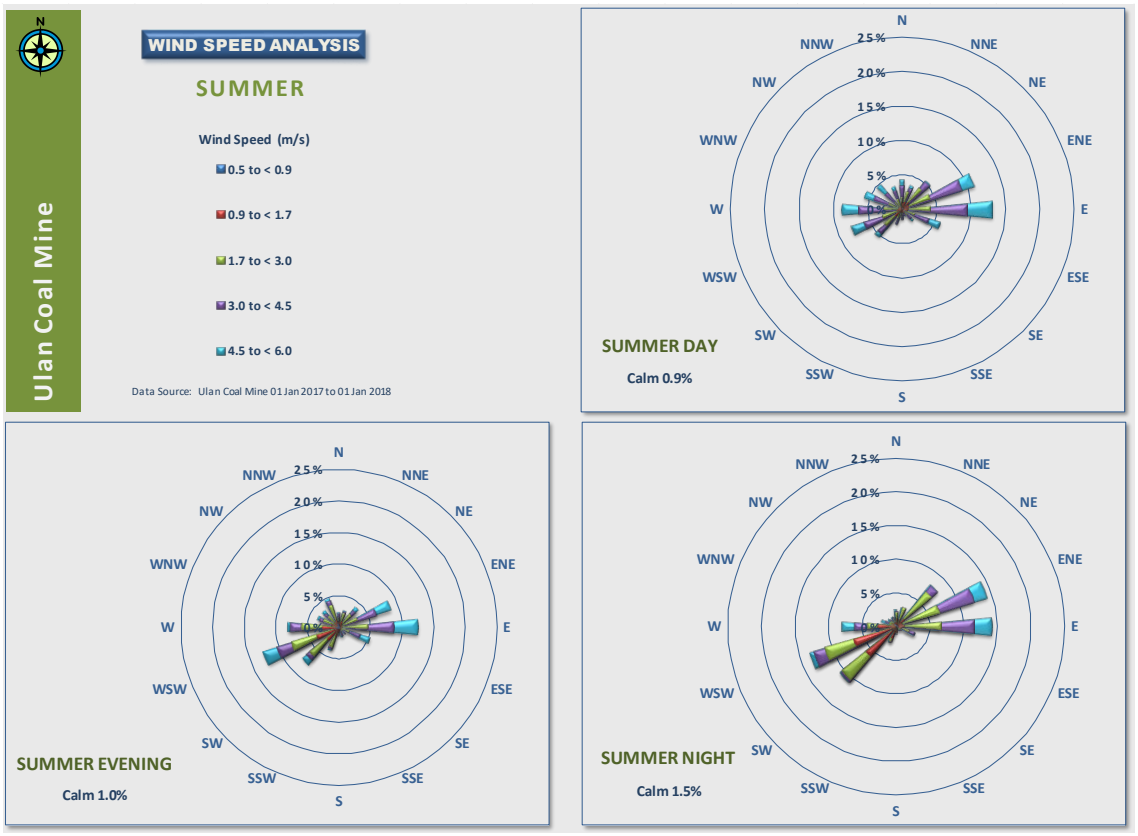


Figure A1 UCMPL Summer Wind Roses

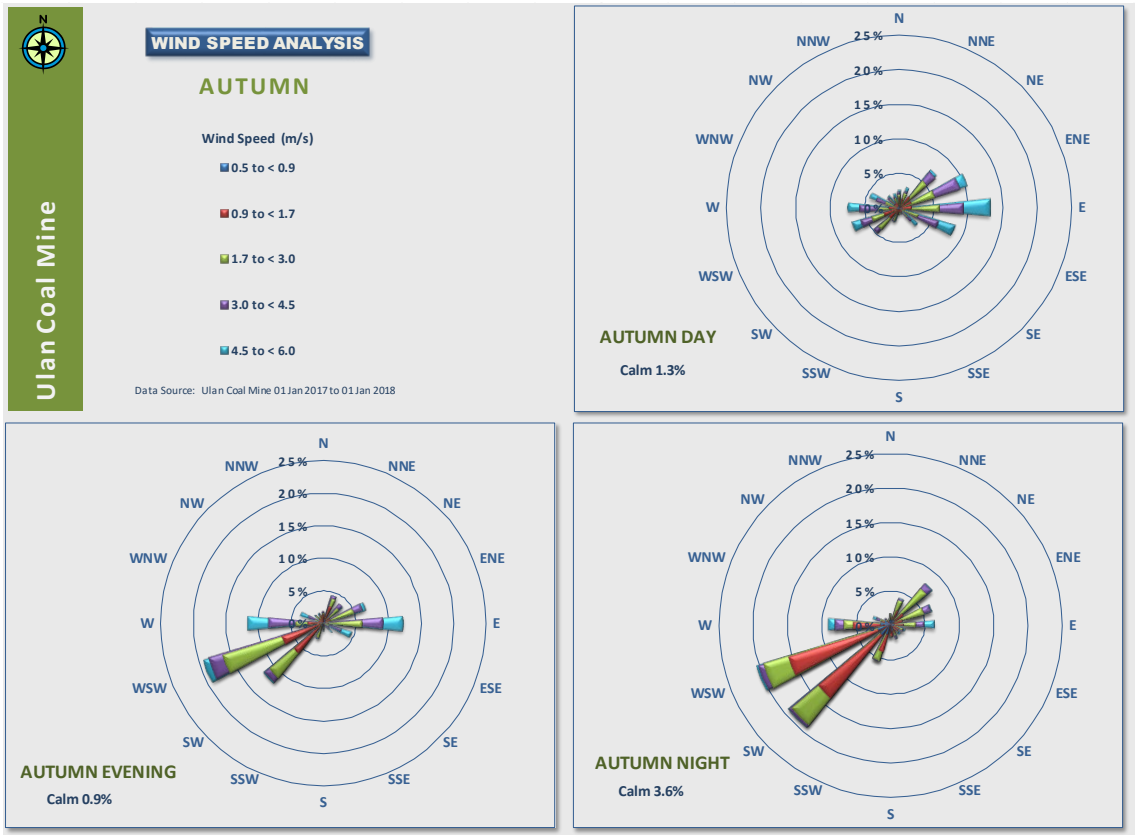


Figure A2 UCMPL Autumn Wind Roses

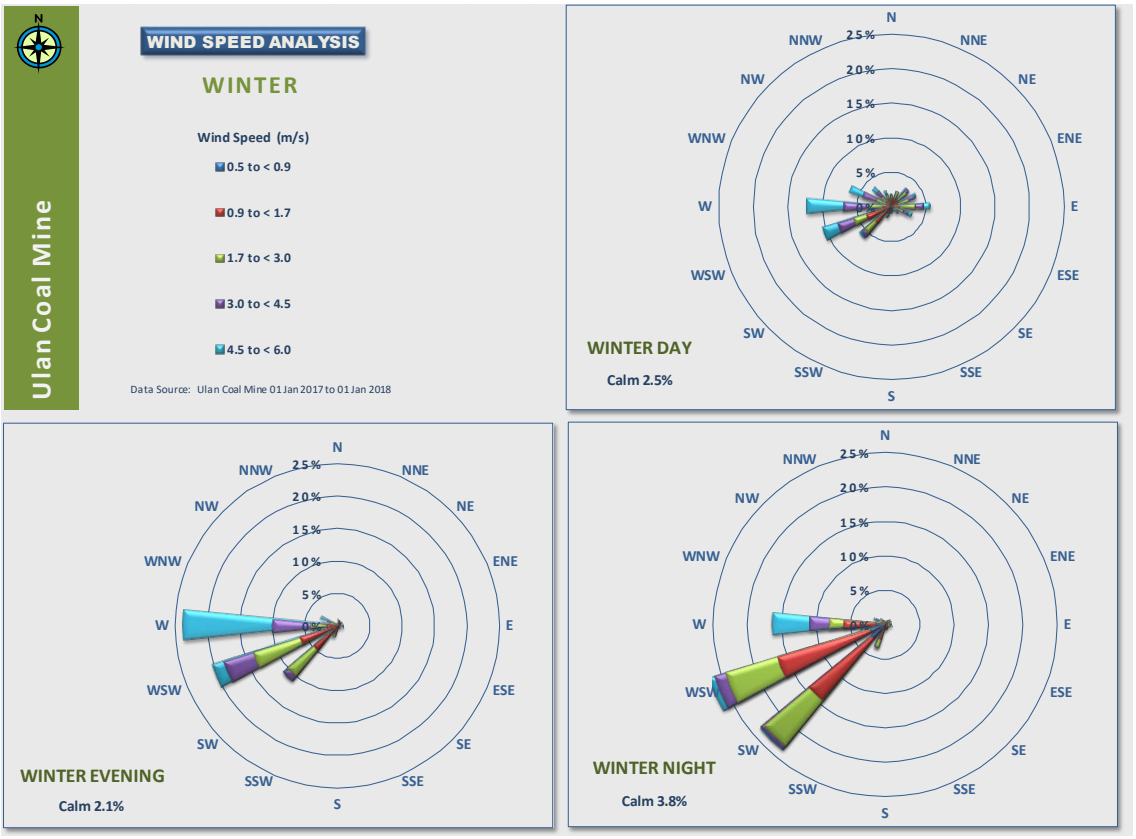


Figure A3 UCMPL Winter Wind Roses

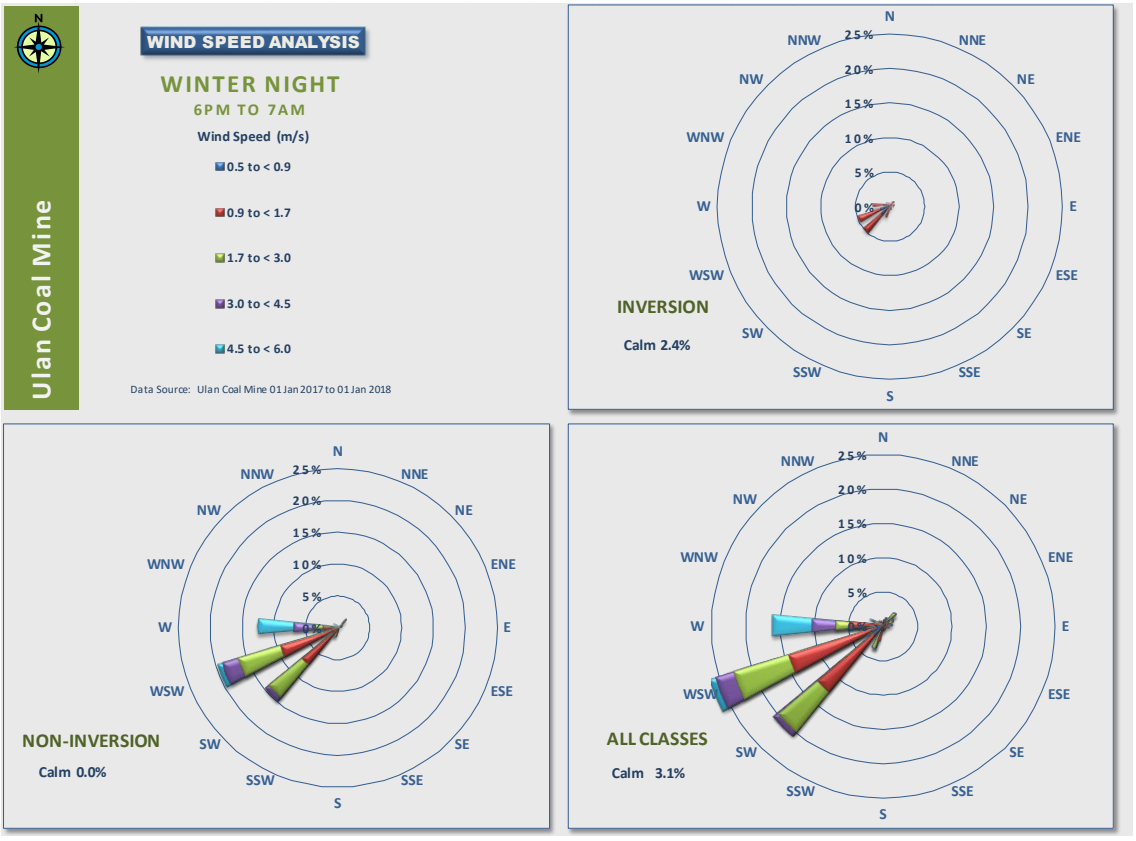


Figure A4 UCMPL Winter Night Wind Roses

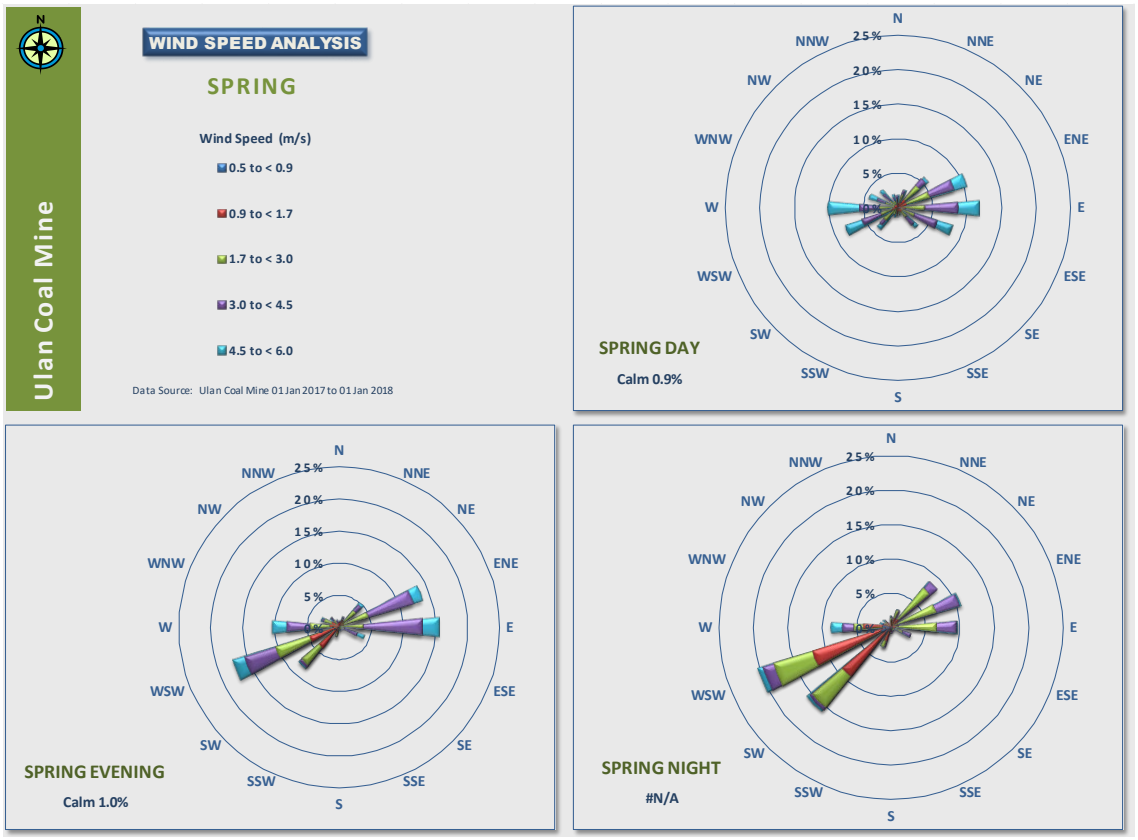


Figure A5 UCMPL Spring Wind Roses

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