

Statement of Environmental Effects
Cowal Gold Operations Accommodation Village

VOLUME 3 – APPENDIX K TO M

Prepared for Evolution Mining (Cowal) Pty Limited
April 2021

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Appendix K

Noise impact assessment

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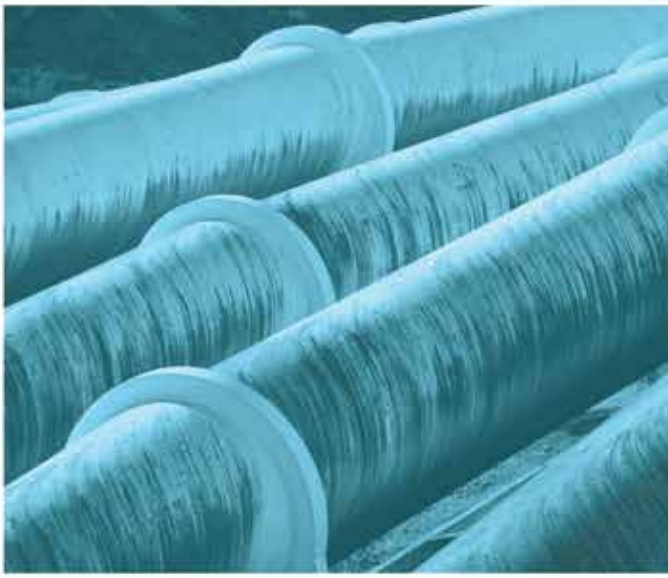
Noise and Vibration Impact Assessment

Cowal Gold Operations Accommodation Village

Prepared for Evolution Mining (Cowal) Pty Limited
April 2021

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Noise and Vibration Impact Assessment

Cowal Gold Operations Accommodation Village

Report Number

J190140A RP11

Client

Evolution Mining (Cowal) Pty Limited

Date

16 April 2021

Version

v2 Final

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16 April 2021

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16 April 2021

Executive Summary

This noise and vibration impact assessment (NVIA) has been prepared in support of the statement of environmental effects (SEE) for the construction and operation of a proposed accommodation village (the project) at Boundary Street, West Wyalong NSW. This NVIA documents the methods and results of the impact assessment undertaken, the design initiatives incorporated to avoid and minimise potential impacts, and the mitigation and management measures proposed to address any residual impacts that cannot be feasibly or reasonably avoided.

Assessment of operational noise associated with the project has confirmed compliance with *NSW Noise Policy for Industry* (NPfI) (EPA 2017) requirements for all residential assessment locations with the implementation of all feasible and reasonable mitigation measures. Compliance is predicted at all commercial and industrial assessment locations.

Intermittent night activities are predicted to satisfy the sleep disturbance screening criteria of L_{Amax} 52 dB as defined in the NSW NPfI (EPA 2017) for all residential assessment locations.

Conservative modelling of construction noise levels shows that the project is predicted to exceed noise management levels (NMLs) at the closest residential assessment locations, with exceedances greater than 10 dB above NML at some locations. Accordingly, residents will need to be notified prior to works commencing. Noise monitoring during Phases 2 and 3 of construction should be considered to determine actual construction noise levels. Subject to the measured level of exceedance, availability of feasible and reasonable noise mitigation and management measures will need to be determined. This is discussed further in Section 7.

The potential for vibration impacts on residents and vibration sensitive structures near construction has been assessed. The nearest residences are located approximately 25 m from vibration generating construction activities. The assessment locations are typically outside of the safe working distances required to maintain acceptable human response and structural vibration levels. Vibration impacts from construction at residential assessment locations are therefore highly unlikely.

The safe working distances for cosmetic damage should be monitored throughout the construction process. If construction is within 25 m of sensitive structures, then work practices should be reviewed so that the safe working distances presented in Section 5.3 (Table 5.2) are followed.

The potential for road traffic noise impacts on public roads due to project traffic has been assessed in accordance with relevant NSW Road Noise Policy (EPA 2011). In summary, road traffic noise level changes are predicted to satisfy *Road Noise Policy* (DECCW 2011) assessment requirements of <2 dB for Mid Western Highway, and RNP baseline noise levels for Boundary Street assessed to the closest residential building facades.

With the effective implementation of mitigation and management measures listed in Section 7.1, impacts from construction noise and vibration emissions from the project can be minimised.

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1 Introduction

1.1 Background

Evolution Mining (Cowal) Pty Limited (Evolution) proposes to construct and operate an accommodation village (the project) on vacant land comprising the whole of Lot 7044 DP1115128 and a portion of Lot 2 DP1239669 (the site), located immediately west of Boundary Street, West Wyalong NSW (see Figure 1.1 and Figure 1.2).

EMM Consulting Pty Limited (EMM) has been engaged by Evolution to prepare a statement of environmental effects (SEE) and accompanying development application (DA) for the project under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This noise and vibration impact assessment (NVIA) has been prepared by EMM in support of the SEE for the project.

1.2 Project description

The project will be located within the Bland Shire Local Government Area (LGA) and will be considered as a multi-dwelling residential development under the *Bland Local Environmental Plan 2011* (LEP) and *Bland Shire Development Control Plan 2012* (DCP).

The village is being developed to house the anticipated workforce associated with the construction and operation of the Cowal Gold Operations (CGO) Underground Development Project, located approximately 38 kilometres (km) north-east of West Wyalong (see Figure 1.1). The CGO Underground Development Project is currently the subject of a State significant development (SSD) application (SSD 10367), under section 4.38 of the EP&A Act.

The project conceptually comprises the following key components:

- accommodation capacity for up to 176 people total supporting the CGO Underground Development Project, including:
  - temporary construction workforce accommodation modules to house 96 people;
  - semi-permanent operational workforce accommodation modules to house 72 people;
  - semi-permanent accessible accommodation modules to house 8 people, with facilities which are Commonwealth *Disability Discrimination Act 1992* (DDA) compliant;
- use of existing access points from Boundary Street and upgrade of existing on-site roads;
- administration buildings;
- communal facilities, including:
  - laundry units;
  - communal dining and kitchen building;
  - outdoor eating areas;
  - first aid and nursing room;
  - prayer room;

  - quiet room;
  - gymnasium;
  - multipurpose outdoor court; and
  - running track;
- undercover bus shelter and bus parking spaces;
- light vehicle car parking;
- fencing and lighting;
- reticulated services; and
- landscaping.

The village components will be modular in design with different layouts dependent on the workforce (construction, operational and accessible) supporting the CGO Underground Development Project. The development will be staged, with the operations workforce and accessible modules being constructed first to ensure this area of the village is ready to house the construction workforce as soon as possible. The construction workforce modules will be completed as soon as possible thereafter.

Approval is sought for all stages of development as part of the SEE and DA. Construction of the accommodation modules is expected to take approximately eight months total. Construction of additional amenities / facilities may take up to a further three years, post removal of construction accommodation modules. Minor earthworks will be required for site establishment activities, including vegetation clearing and grubbing, ground levelling and trenching for service installation. Any excavated topsoil will be stockpiled and reused on site where possible.

Appropriate security measures such as fencing, gates, cameras and night lighting will be installed. Site landscaping will be undertaken to enhance the visual amenity of the surrounding neighbourhood and will incorporate water sensitive urban design practices. This includes maintaining existing native vegetation wherever possible.

1.3 Site description

The site is located between Boundary Street and Aleena Street in West Wyalong, in central west New South Wales (NSW), which is located approximately 360 km west of Sydney (see Figure 1.1). Under the Bland LEP (Land Zoning Map – Sheet LZN_007F), the site is zoned as Zone R1 General Residential.

The site is located on vacant freehold land comprising the whole of Lot 7044 DP1115128 and a portion of Lot 2 DP1239669 (see Figure 1.2), held by the West Wyalong Local Aboriginal Land Council (LALC) (subject to determination of native title). A native title claim (NN2020/007) was lodged on 21 August 2020 by the West Wyalong LALC over part of the site. This claim was yet to be determined at the time of writing.

The site previously hosted Barrick Gold's accommodation village, constructed in 2004 for use as a temporary residential village to support employees working at the CGO. The Barrick Gold accommodation village was demolished between 2005-2006 and the site is currently devoid of built structures. The site is located within a larger area of relatively flat vacant land with scattered native vegetation.

The site is bordered by Hyde Lane and Cedar Street to the west and Hyde Street to the north. Other land uses surrounding the site include residential, industrial and retail. The closest private residence is located immediately west of the site on Hyde Lane.

1.4 Purpose of this report

This NVIA supports the SEE for the project. It documents the existing noise environment, applicable impact assessment criteria, sources of noise and vibration, noise modelling of operational and construction activities (including traffic) and assessment of predicted impacts relative to criteria.

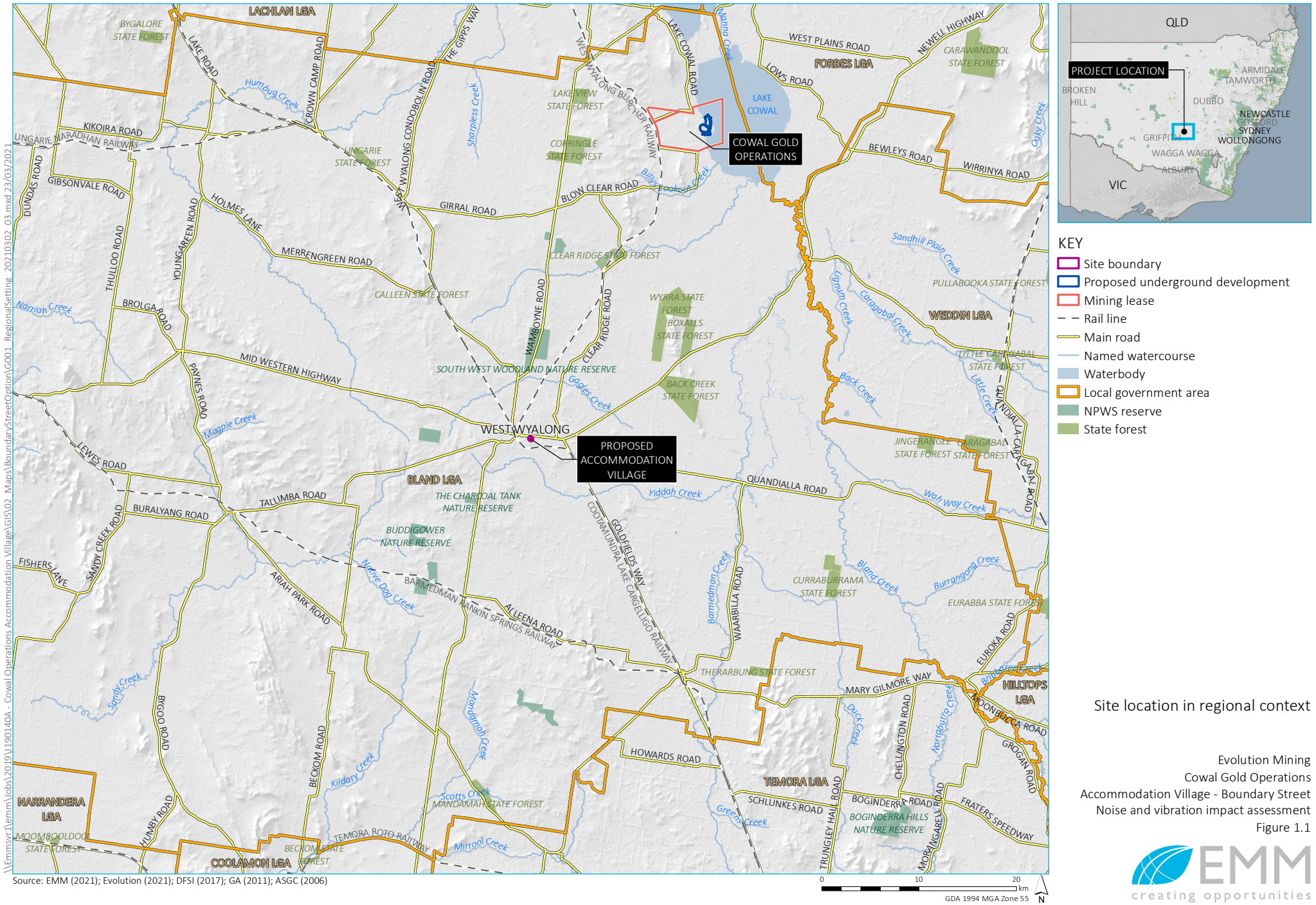
This NVIA consists of the following sections:

- a description of the local setting and surrounds of the site;
- a description of the existing environment, specifically:
  - existing noise environment; and
  - meteorology and climate;
- a list of plant and equipment adopted for noise modelling of construction and operation of the project;
- noise modelling of operational and construction noise emissions, including adverse meteorological scenarios;
- assessment of road traffic noise as a result of project related vehicles on public roads; and
- an overview of compliance and noise mitigation measures for residual impacts, where relevant.

1.5 Assessment approach

The NVIA has been prepared in general accordance with the guidelines specified in:

- NSW Department of Environment Climate Change (DECC) 2009, *Interim Construction Noise Guideline* (ICNG);
- NSW Environment Protection Authority (EPA) 2017, *NSW Noise Policy for Industry* (NPfI);
- NSW Department of Environment Climate Change and Water (DECCW) 2011, *Road Noise Policy* (RNP); and
- Department of Environment and Conservation (DEC) NSW 2006*, Assessing Vibration: a technical guideline*.



KEY

- Site boundary
- Proposed underground development
- Mining lease
- Rail line
- Main road
- Named watercourse
- Waterbody
- Local government area
- NPWS reserve
- State forest

Source: EMM (2021); Evolution (2021); DFSI (2017); GA (2011); ASGC (2006)

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Site location in regional context

Evolution Mining
Cowal Gold Operations
Accommodation Village - Boundary Street
Noise and vibration impact assessment
Figure 1.1

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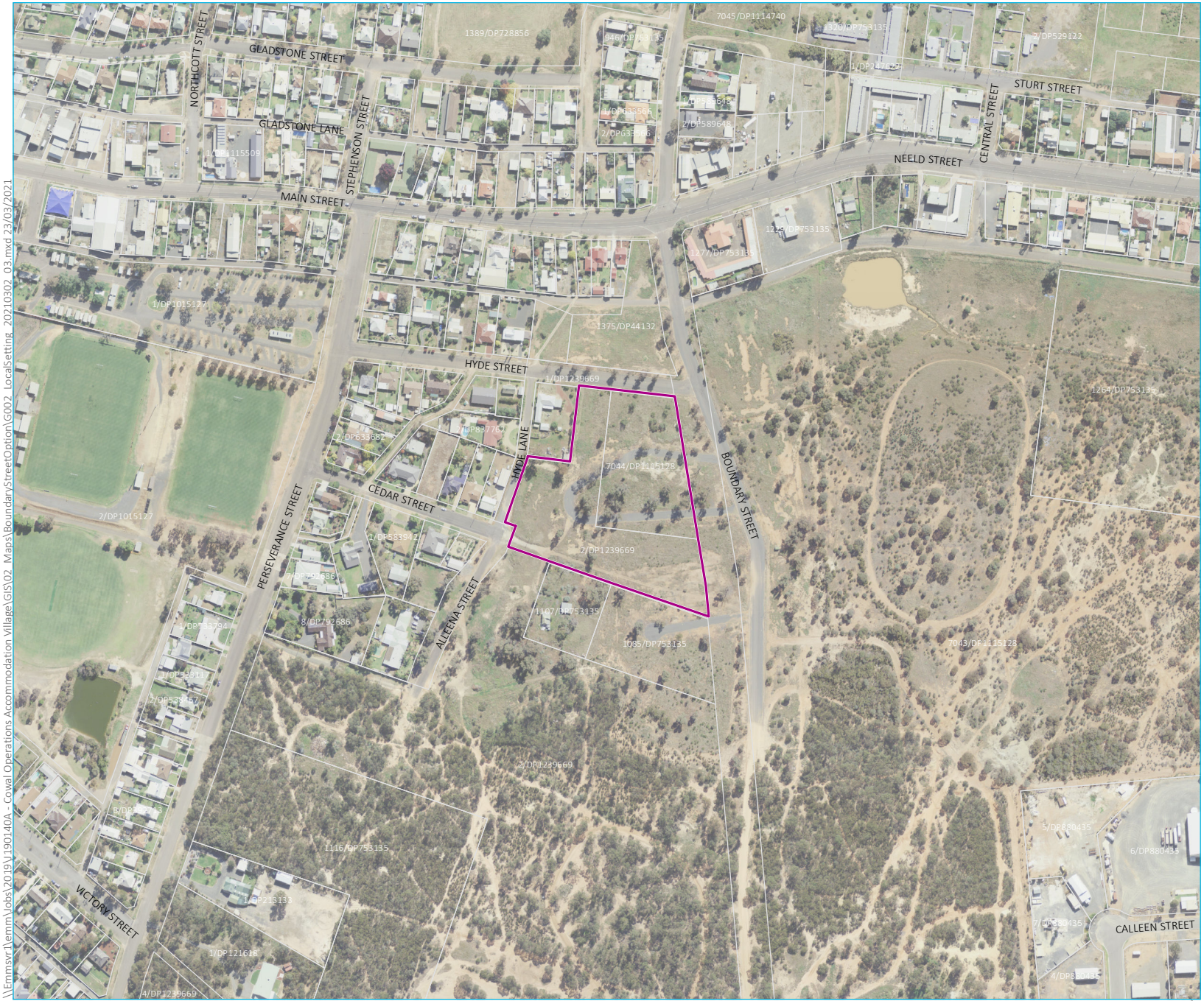

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Site location in local context

Evolution Mining
Cowal Gold Operations
Accommodation Village - Boundary Street
Noise and vibration impact assessment
Figure 1.2

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2 The proposed development

2.1 Overview

The key components of the proposed development are outlined in Section 1.2 and shown in the conceptual village layout provided in Figure 2.1.

2.1.1 Construction

i Main activities

The construction phase of the project would last about six to eight months using a workforce of about 15 people, and would involve:

- site establishment and preparatory works including clearing and grubbing;
- installation of temporary fencing and security measures;
- soil erosion and sediment control works;
- confirmation and relocation of any affected services which will need to be relocated or required to be made safe to allow construction to proceed;
- earthworks, including:
    - clearing and stripping of topsoil and vegetation (excavated topsoil will be stockpiled for reuse on site);
    - minor cut and fill where required to provide a level area for carparking and setting of buildings;
    - trenching to install services (power, water, waste);
    - laying of asphalt or concrete for car parking areas and internal roads;
- trenching and installation of bioretention/sediment basins;
- creation and demarcation of dwelling sites;
- construction of concrete pads and footings for buildings and outdoor recreation areas;
- installation of accommodation pods on concrete pads within dwelling sites;
- construction and installation of other community facilities;
- service connection to buildings; and
- finishing works including line marking, signposting, construction of footpaths and recreation/BBQ areas, landscaping works, and lighting.

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Source: EMM (2021); Evolution (2021); Nettleton Tribe (2021); DFSI (2017)

Conceptual village layout
(Source: Nettleton Tribe)

Evolution Mining - Cowal Gold Operations
Accommodation Village - Boundary Street
Noise and vibration impact assessment
Figure 2.1

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ii Construction hours and scheduling

The construction hours will be consistent with the NSW EPA's *Interim Construction Noise Guideline* (DECC 2009) recommended standard construction hours:

- Monday to Friday: 7 am to 6 pm;
- Saturday: 8 am to 1 pm (NB: following community consultation, Evolution may seek construction hours up to 6 pm on Saturday, with the intent to shorten the overall construction time frame); and
- no work on Sundays and public holidays.

Construction will be phased in the following manner:

- clearing and grubbing – approximately 1 week;
- site preparation – approximately 1-2 months; and
- construction – approximately 4-6 months.

The site is proposed to be developed in four stages across the site, nominally comprising:

- Stage 1 Northern precinct – Months 1-4
- Stage 2 South-western precinct – Months 2-5
- Stage 3 South-eastern precinct – Months 2-8
- Stage 4 Southern precinct – Year 2-3 (post removal of construction modules)

A predecessor for the commencement of Stage 4, which consists of a proposed gymnasium and multi-purpose court, is the removal of construction modules within the south-western and south-eastern precincts of the site. The assessment of construction noise has considered the total site in terms of construction activities to evaluate a potential worst case impact scenario.

iii Plant and equipment

An indicative list of plant and equipment likely to be required for the construction of the proposed accommodation village is provided below in Table 2.1. Note that not all the equipment identified below will be required for all phases of the proposed construction.

Table 2.1 Indicative construction equipment

Backhoes	Dump trucks	Mini piling rig
Bob cats	Rigid tippers	Bulldozers
Excavators	Concrete agitators	Flatbed Hiab trucks
Rollers	Concrete pumps	Semi- Trailer
Cranes	Transport trucks	Trenchers

Source: Evolution

iv Traffic

The proposed construction works will cause a temporary increase in traffic movements. Construction vehicles will comprise:

- cars to transport site personnel and equipment;
- rigid trucks to transport plant and equipment and site components;
- semi-trailers or hiab trucks for the delivery of modular accommodation and communal buildings;
- concrete agitator trucks; and
- asphalt delivery rigid trucks.

The peak hour traffic generation expected during the construction of the accommodation village is summarised in Table 2.2.

Table 2.2 Peak hour vehicle movements during construction

Trip description	Light Vehicle Trips		Heavy Vehicle Trips	
	AM Peak	PM Peak	AM Peak	PM Peak
Construction	30	30	4	4

It should be noted that the expected vehicle movements described above are inclusive of all construction stages occurring at the same time and are not expected to occur every day throughout the six to eight month construction period.

v Construction waste

All waste generated during construction will be managed in accordance with the NSW *Waste Classification Guidelines* (EPA 2014), NSW *Protection of the Environment Operations Act 1997* and the NSW Protection of the Environment Operations (Waste) Regulation 2005.

Evolution will endeavour to reuse excavated material and green waste for fill and landscaping works. Recycled off-concrete slabs and asphalt will be retained, where possible. Construction waste will be sent to an appropriately licenced facility for disposal.

2.1.2 Operation

Workers and contractors associated with the construction and operation of the Cowal Goal Operations (CGO) Underground Development Project are anticipated to stay at the accommodation village. Additionally, depending on availability, from time to time, accommodation may also be provided to Evolution personnel and contractors for broader mine-related activities. Generally, personnel employed from outside of the region will reside at the village.

Upon arrival, personnel will report to the administration office to 'check-in' and obtain keys for their room. Depending upon their length of stay and workforce type, they will either occupy a construction, operations or accessible accommodation type module. During their stay, occupants will have access to the accommodation village's communal facilities. However, it is anticipated that occupants will also access services in West Wyalong.

Up to four company supplied buses will operate between the village and CGO mine site to transport personnel throughout the day.

The accommodation village will be operated by a sub-contracted workforce of about 10 people. The canteen will be used to store food products and provide appliances to allow for the preparation and consumption of meals. A food delivery truck (single axle truck or equivalent) will operate weekly or as required to replenish food at the canteen.

i Access and parking

a Car parking

The accommodation village design has provision for 95 light vehicle parking spaces total. This includes standard parking spaces, accessible parking spaces, visitor parking spaces and spaces for spill-over parking.

b Bus/minivan parking

The accommodation village has provision for 2 bus layover areas designed for 12.5 m length buses. A maximum of 4 buses is expected to service the accommodation village during the peak demand period. The provision of 2 bus layover areas is expected to satisfy bus parking demand for the accommodation village. Traffic

c Access and egress

Cars, buses, and delivery trucks will enter and exit the site via the existing driveway at Boundary Street. It is envisaged that minor upgrade and tie-in works will be required within the site where the existing driveway meets the internal road.

d Traffic movement

Estimated vehicle movements during the operational phase of the accommodation village are provided in Table 2.3.

Table 2.3 Peak vehicle movements during operation

Vehicles	Peak movements per day
Light passenger vehicles	246
Bus/coach	16
Delivery truck/waste/other	32

Note: A vehicle movement is defined as a vehicle entering the site (1 movement) and a vehicle exiting a site (1 movement).
Source: Evolution

ii Operation waste

Operational waste will be managed in accordance with the waste management plan. A designated waste collection point will operate near to the administration office and will be used for the staging of bins for the temporary storage of waste. Waste will be removed from site by contractors as required. Waste will be transported and disposed of at an appropriate licenced facility.

2.2 Key aspects relevant to noise and vibration

Potential noise and vibration impacts have been identified for the accommodation village and associated activities. This identification process has considered the proposed project activities and the types of potential impacts at noise and vibration sensitive assessment locations. The following aspects are considered relevant to this assessment:

- construction noise to nearest noise sensitive assessment locations;
- construction vibration from plant and equipment;
- operational noise from the accommodation village including mechanical plant, noise from occupants and on-site vehicles; and
- road traffic noise on public roads due to project related traffic.

3 Existing environment

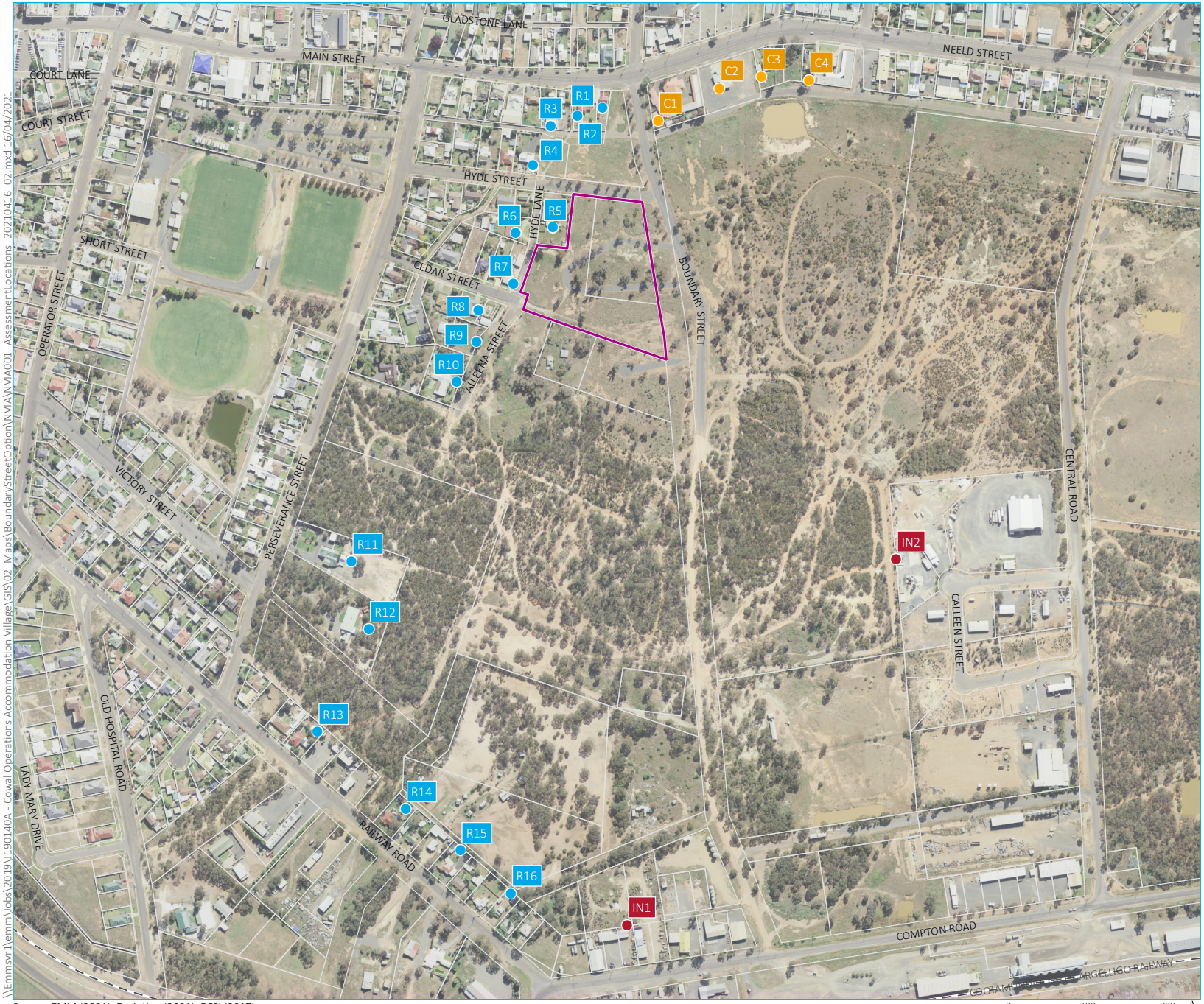
3.1 Noise and vibration assessment locations

The nearest representative noise sensitive locations to the accommodation village have been identified for the purpose of assessing potential noise and vibration impacts. These locations were selected to represent receivers potentially exposed to a range of noise impacts from the site. Details are provided in Table 3.1 and their locations are shown in Figure 3.1. They are referred to in this report as assessment locations.

Table 3.1 Noise assessment locations

ID	Address	Classification	Easting	Northing
R1	2 Main Street	Residential	519893	6246227
R2	4 Main Street	Residential	519862	6246217
R3	10 Main Street	Residential	519828	6246205
R4	15 Hyde Street	Residential	519806	6246155
R5	14 Hyde Street	Residential	519831	6246077
R6	1 Hyde Lane	Residential	519784	6246070
R7	25 Cedar Street	Residential	519781	6246006
R8	26 Cedar Street	Residential	519737	6245973
R9	28 Cedar Street	Residential	519735	6245933
R10	1 Alleena Street	Residential	519710	6245883
R11	77 Perserverance Street	Residential	519578	6245657
R12	83 Perserverance Street	Residential	519600	6245572
R13	143 Railway Road	Residential	519535	6245443
R14	131 Railway Road	Residential	519646	6245346
R15	119 Railway Road	Residential	519715	6245294
R16	109 Railway Road	Residential	519778	6245240
C1	True Blue Motor Inn	Commercial	519963	6246211
C2	Metro Petroleum	Commercial	520040	6246252
C3	Renrow Wash & Go	Commercial	520093	6246267
C4	Mayfair Hotel	Commercial	520153	6246262
IN1	97-103 Compton Road	Industrial	519924	6245200
IN2	8-12 Calleen Street	Industrial	520262	6245660

Background noise monitoring was not undertaken as part of this noise assessment considering limited traffic, industry and noise producing activities in the vicinity of site and assessment locations. Accordingly, this assessment has conservatively adopted the minimum rating background noise level (RBL) thresholds as defined in the *Noise Policy for Industry* (NPfI) (EPA 2017), where the RBL is set to 35 dB(A) day and 30 dB(A) for the evening and night periods typical of country areas (Figure G.1).



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Source: EMM (2021); Evolution (2021); DFSI (2017)

Noise assessment locations

Evolution Mining - Cowal Gold Operations
Accommodation Village - Boundary Street
Noise and vibration impact assessment
Figure 3.1

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3.2 Meteorology

The NPfI (EPA 2017) requires assessment of noise under standard and noise enhancing weather conditions. The NPfI defines these as follows:

- **Standard meteorological conditions:** defined by stability categories A through to D with wind speeds up to 0.5 metres per second (m/s) at 10 m above ground level (AGL) for day, evening and night periods.

- **Noise-enhancing meteorological condition:** defined by stability categories A through to D with light winds (up to 3 m/s at 10 m AGL) for the day and evening periods; and stability categories A through to D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL.

The NPfI specifies the following two options to consider meteorological effects:

1. Adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receiver wind vectors for all assessment locations and F class temperature inversions with wind speeds up to 2 m/s at night; or

2. Determine the significance of noise-enhancing conditions. This involves assessing the significance of temperature inversions (F and G class stability categories) for the night-time period and the significance of light winds up to and including 3 m/s for all assessment periods during stability categories other than E, F or G. Significance is based on a threshold of occurrence of 30% determined in accordance with the provisions in the NPfI. Where noise-enhancing meteorological conditions occur for less than 30% of the time, standard meteorological conditions may be adopted for the assessment.

The assessment has adopted option 1 with the utilisation of noise-enhancing meteorological conditions for all assessment periods utilising the "*Acoustics – Attenuation of Sound during Propagation Outdoors – general method*" algorithm.

4 Assessment criteria

4.1 Construction noise

The ICNG (DECC 2009) has been jointly developed by NSW Government agencies, including the NSW Environment Protection Authority (EPA) and Department of Planning (DoP). The objectives of the guideline relevant to the planning process are to promote a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' work practices. The guideline recommends standard construction hours where noise from construction activities is audible at residential premises (ie assessment locations), as follows:

- Monday to Friday 7 am to 6 pm;
- Saturday 8 am to 1 pm; and
- no construction work is to take place on Sundays or public holidays.

The ICNG acknowledges that works outside standard hours may be necessary, however, justification should be provided to the relevant authorities.

The ICNG provides two methods to assess construction noise emissions. The first is a quantitative approach, which is suited to major construction projects with typical durations of more than three weeks. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.

The second is a qualitative approach, which is a simplified assessment process that relies more on noise management strategies. This method is suited to short-term infrastructure and maintenance projects of less than three weeks.

This assessment has adopted a quantitative approach. The qualitative aspects of the assessment include identification of assessment locations, description of works involved including predicted noise levels and proposed management measures that include a complaint's handling procedure.

4.1.1 Construction noise management levels - residents

Table 4.1 provides ICNG noise management levels (NML) which apply to residential assessment locations.

Table 4.1 ICNG construction noise management levels for residences

Time of day	NML $L_{Aeq,15min}$	Application
Recommended standard hours: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, No work on Sundays or public holidays	Noise-affected RBL + 10 dB	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{eq(15\text{-}min)}$ is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise-affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by

Table 4.1 ICNG construction noise management levels for residences

Time of day	NML $L_{Aeq,15min}$	Application
		restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise-affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise-affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Source: ICNG (EPA, 2009).

4.1.2 Construction noise management levels – other noise sensitive land uses

Table 4.2 summarises the ICNG recommendations and provides NML for other land uses.

Table 4.2 ICNG noise levels at other land use

Land use	Management level, $L_{Aeq,15\ minute}$
Industrial premises	External noise level 75 dB (when in use)
Offices, retail outlets	External noise level 70 dB (when in use)
Hotels[1]	External noise level 65 dB (7am to 10pm) 60 dB (10pm to 7am)
Classrooms at schools and other educational institutions	Internal noise level 45 dB (when in use)
Hospital wards and operating theatres	Internal noise level 45 dB (when in use)
Places of worship	Internal noise level 45 dB (when in use)
Active recreation areas	External noise level 65 dB (when in use)
Passive recreation areas	External noise level 60 dB (when in use)

Source: ICNG (DECC, 2009).

1. NML based on AS2017 recommend maximum internal noise level and the premise that windows and doors for such development would typically remain closed, providing 20 dB of outdoor to indoor construction noise level reduction.

4.1.3 Project specific construction noise management levels

The project construction NMLs for recommended standard and out of hour periods are presented in Table 4.3 for all assessment locations. However, it is acknowledged that construction of the accommodation village would be during daytime hours only.

Table 4.3 Construction noise management levels – all assessment locations

Assessment location	Period	Adopted RBL[1]	NML $L_{Aeq,15min}$, dB
R1-R16	Day (standard ICNG hours)	35	45
	Evening (out of hours)	30	35
	Night (out of hours)	30	35
C1- C4	Day (standard ICNG hours)	n/a	65
	Evening (out of hours)		
	Night (out of hours)		60
IN1	When in use	n/a	75

1. The RBLs adopted from NPfI baseline levels Section 3.1.
2. NML based on AS2017 recommend maximum internal noise level and the premise that windows and doors for such development would typically remain closed, providing 20 dB of outdoor to indoor construction noise level reduction.

4.2 Construction vibration

4.2.1 Human perception of vibration

Humans can detect vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not in itself be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2 1999. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 4.4.

Table 4.4 suggests that people will just be able to feel floor vibration at levels of approximately 0.15 millimetres per second (mm/s) and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

Table 4.4 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hertz (Hz) to 80 Hz.

4.2.2 Assessing vibration - a technical guideline

Environmental Noise Management – Assessing Vibration: a technical guideline (DEC 2006) (the guideline) is based on BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz).

The guideline presents preferred and maximum vibration values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended that the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in Table 4.5.

Table 4.5 Examples of types of vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, eg occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZEC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Continuous vibration associated with compaction of fill on the site is most relevant to the construction of the accommodation village. Albeit fill is likely to be limited to formalisation of roads and carparking areas with the prefabricated homes and other structures on site would be installed on piers and footings from bored piles or similar.

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of heavy vehicle pass-bys and construction activities such as impact hammering, rolling or general excavation work.

Section 2.4 of the guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz.

To calculate VDV the following formula is used (refer to Section 2.4.1 of the guideline):

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted rms of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV for intermittent vibration are reproduced in Table 4.6.

Table 4.6 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night-time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: 1. Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.

2. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline recommends that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

4.2.3 Structural vibration

i Australian Standard AS 2187.2 – 2006

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 *Explosives* - Storage *and Use* - *Use of Explosives* recommends that the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2* be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to manage minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4.7 and graphically in Figure 4.1.

Table 4.7 Transient vibration guide values - minimal risk of cosmetic damage

Line[1]	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: Refers to the "Line" in Figure 4.1

The standard notes that the guide values in Table 4.7 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is sufficient to cause dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 4.7 may need to be reduced by up to 50%.

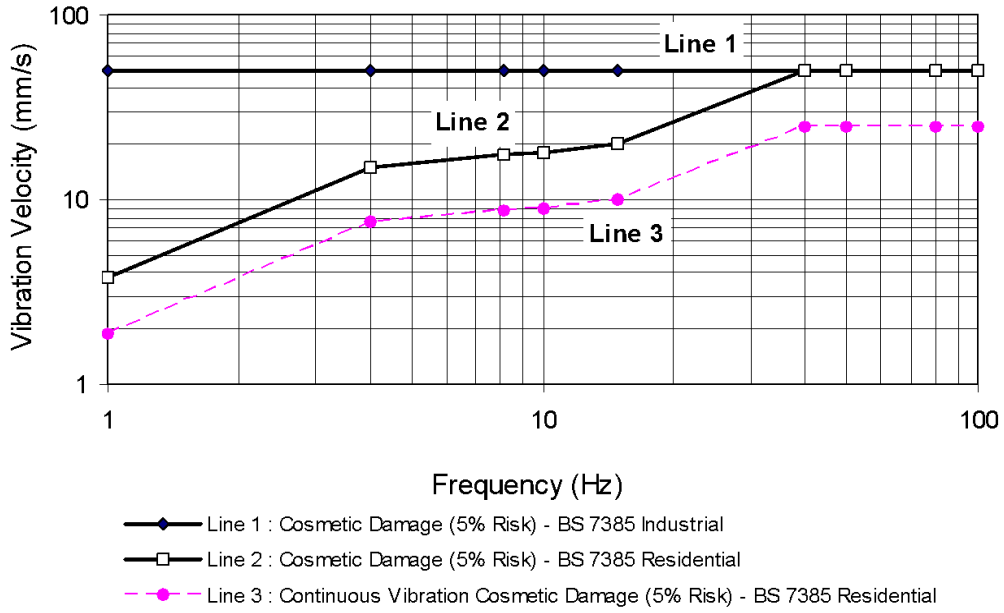


Figure 4.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz (as shown in Figure 4.1).

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 4.7 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 4.7.

It is noteworthy that in addition to the guide values nominated in Table 4.7 the standard states that:

> Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

4.3 Operational noise

Following the construction and commissioning of the accommodation village there will be periodic noise emissions from maintenance equipment (such as vacuum cleaners and lawn mowers), plant and equipment, vehicles and workers associated with the use of the facility.

Noise from development in NSW is regulated by the local council, DPIE and/or the EPA, and generally have a licence and/or development consent conditions stipulating noise limits. These limits are typically derived from project specific trigger or operational noise levels predicted at assessment locations. They are based on EPA guidelines or noise levels that can be achieved by a specific site following the application of all feasible and reasonable noise mitigation.

The objectives of noise trigger levels established in accordance with the NPfI are to protect the community from excessive intrusive noise and preserve amenity for specific land uses. It should be noted that the audibility of a noise source does not necessarily equate to disturbance at an assessment location.

To ensure these objectives are met, the EPA provides project specific noise trigger levels, namely intrusiveness and amenity.

4.3.1 Intrusiveness noise levels

The intrusiveness noise levels require that $L_{Aeq,15min}$ noise levels from the site during the relevant operational periods do not exceed the RBL by more than 5 dB. It is noted that intrusiveness noise levels are only applicable at residential assessment locations.

Table 4.8 presents the intrusiveness noise levels determined for the site based on the adopted conservative RBLs. Where assessment locations have been grouped together in the following tables, it has been assumed that the ambient noise environment at these assessment locations is similar.

Table 4.8 Project intrusiveness noise levels

Residential assessment location[1]	Assessment period[2]	Adopted RBL, dBA	Project intrusiveness noise level (RBL + 5 dB), $L_{Aeq,15min}$, dB
R1-R16	Day	35	40
	Evening	30	35
	Night	30	35

1. Residential assessment locations only.
2. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; 6 am to 7 am Monday to Saturday, 6 am to 8 am Sundays and public holidays; Night: remaining periods.

4.3.2 Amenity noise levels

The assessment of amenity is based on noise levels specific to the land use. The noise levels relate only to industrial noise and exclude road or rail traffic noise. Where the measured existing industrial noise approaches recommended amenity noise levels, it needs to be demonstrated that noise levels from new developments will not contribute to existing industrial noise such that amenity noise levels are exceeded.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level for a new industrial development is the recommended amenity noise level (outlined in Table 2.2 of the NPfI) minus 5 dB. It is noted that this approach is based on a receiver being impacted by multiple industrial sites (or noise sources), which is unlikely in this case but has been conservatively adopted.

Residential areas potentially affected from operational noise are located to the north, west and south of the site. The project amenity noise level for the identified assessment locations are presented in Table 4.9.

Table 4.9 Project amenity noise levels

Residential assessment location	Time period[1]	Indicative area	Project amenity noise level[2] dB, $L_{Aeq,period}$
R1-R16	Day	Suburban	50
	Evening		40
	Night		35
C1-C4	When in use	Commercial	60
IN1 & IN2	When in use	Industrial	65

Source: NPfI (EPA 2017)

1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: 10 pm to 7 am Monday to Saturday; 10 pm to 8 am Sundays and public holidays.
2. Project amenity noise level is Amenity noise level (Table 2.2 of NPfI) -5dB in accordance with NPfI Section 2.4.2.

4.3.3 Project noise trigger level

The project noise trigger level (PNTL) is the lower of the calculated intrusiveness or amenity noise levels. Taking account of the measured background noise levels, project intrusive noise levels and project amenity levels for residential assessment locations. A summary of the project noise trigger levels (PNTL) for the assessment of noise from the use of the accommodation village is presented in Table 4.10.

Table 4.10 Project noise trigger levels

Assessment location	Assessment period[1]	Intrusiveness noise level, $L_{Aeq,15min}$, dB	Amenity noise level[2], $L_{Aeq,15min}$, dB	PNTL[3], $L_{Aeq,15min}$, dB
R1-R16	Day	40	53	40
	Evening	35	43	35
	Night	35	38	35
C1-C4	When in use	n/a	63	63
IN1 & IN2	When in use	n/a	73	73

1. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; 6 am to 7 am Monday to Saturday, 6 am to 8 am Sundays and public holidays; Night: remaining periods.
2. Project amenity LAeq,15min noise level is the recommended amenity noise level $L_{Aeq,period}$ +3 dB as per the NPfI.
3. PNTL is the lower of the calculated intrusiveness or amenity noise levels.

4.4 Mitigating noise

Where noise levels above the PNTLs are predicted, all feasible and reasonable mitigation are to be considered for the project to reduce noise levels towards the PNTLs, before any residual impacts are determined and addressed.

The significance of the residual noise impacts is generally based around the human perception to changes in noise levels as explained in the glossary of the acoustic terms. For example, a change in noise level of 1 to 2 dB is typically indiscernible to the human ear. The characterisation of a residual noise impact of 0 to 2 dB above the PNTL is therefore considered negligible. This characterisation of residual noise impacts is outlined further in Table 4.11.

Table 4.11 Significance of residual noise impacts

If the predicted noise level minus the project noise trigger level is:	And the total cumulative industrial noise level is:	Then the significance of the residual noise level is:
≤ 2 dB	Not applicable	Negligible
≥ 3 but ≤5 dB	< recommended amenity noise level or > recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from development is ≤1 dB	Marginal
≥ 3 but ≤5 dB	> recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is >1dB	Moderate
> 5 dB	≤ recommended amenity noise level	Moderate
> 5 dB	> recommended amenity noise level	Significant

Source: NPfI (NSW Government, 2017)

4.5 Sleep disturbance

The NPfI suggests that a detailed maximum noise level event assessment should be undertaken where operation or construction night-time noise levels at a residential location exceed:

- $L_{Aeq,15\ minute}$ 40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or
- L_{Amax} 52 dB or the prevailing RBL plus 15 dB (whichever is the greater).

Guidance regarding potential for sleep disturbance is also provided in the RNP. The RNP calls upon numerous studies that have been conducted into the effect of maximum noise levels on sleep. The RNP acknowledges that, at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. However, the RNP provides the following conclusions from the research on sleep disturbance:

- maximum internal noise levels (L_{Amax}) below 50 to 55 dB are unlikely to awaken people from sleep; and
- one or two noise events per night, with maximum internal noise levels (L_{Amax}) of 65 to 70 dB, are not likely to affect health and wellbeing significantly.

It is commonly accepted by acoustic practitioners and regulatory bodies (ie EPA) that a facade including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60 to 65 dB calculated at the facade of a residence is unlikely to awaken people according to the RNP.

If noise levels over the screening criteria are identified, then additional analysis would consider factors such as:

- how often the events would occur;
- the time the events would occur;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current scientific literature available regarding the impact of maximum noise level events at night.

Table 4.12 provides the noise level event screening criteria for the residential assessment locations.

Table 4.12 Sleep disturbance screening criteria at residences

Assessment location	Adopted night RBL, dB	Night-time maximum noise level event screening criteria, dB	
		$L_{Aeq,15\ minute}$	L_{Amax}
Residences	30	40	52

4.6 Road traffic noise

Construction and operational traffic require assessment for potential noise impacts. The principal guidance to assess the impact of the road traffic noise on assessment locations is in the RNP. Table 4.13 presents the road noise assessment criteria for residential land uses (ie assessment locations), reproduced from Table 3 of the RNP for road categories relevant to construction and use of the accommodation village.

Table 4.13 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/development	Assessment criteria – dBA	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{eq,15hr}$ 60 (external)	$L_{eq,9hr}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{eq,1hr}$ 55 (external)	$L_{eq,1hr}$ 50 (external)

Additionally, the RNP states that where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to an increase of up to 2 dB.

In addition to meeting the assessment criteria in Table 4.13 any significant increase in total traffic noise at the relevant residential assessment locations must be considered. Residential assessment locations experiencing increases in total traffic noise levels above those presented in Table 4.14 should be considered for mitigation.

Table 4.14 Road traffic relative increase criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase – dBA	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads and transit ways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{eq(15\text{-}hr)}$+12 dB (external)	Existing traffic $L_{eq(9\text{-}hr)}$+ 12 dB (external)

Appendix B of the RNP, states that noise levels shall be rounded to the nearest integer, whilst difference between two noise levels are to be rounded to a single decimal place.

5 Assessment method

5.1 Noise modelling

This section presents the methods and base parameters used to model operational and construction noise and vibration emissions from the proposed accommodation village.

Operational and construction noise levels were predicted using DGMR Software proprietary modelling software, iNoise. The model allows prediction under the ISO9613-2 *"Acoustics – Attenuation of Sound during Propagation Outdoors – general method"* algorithm. This algorithm is accepted by the EPA. Features which affect the predicted noise level that are considered in the noise modelling include:

- equipment sound power levels and locations;
- screening from structures;
- receiver locations;
- ground topography;
- noise attenuation due to geometric spreading;
- ground absorption; and
- atmospheric absorption.

The model was populated with 3-D topography of the project and surrounding area, extending out past nearest assessment locations. Plant and equipment representing the range of proposed construction and operation scenarios was placed at locations which would represent worst case noise levels throughout the construction and operational scenarios.

5.2 Construction noise

5.2.1 Times

Construction of the accommodation village would be during daytime hours only, with an envisaged duration of up to six to eight months. Key phases in construction of the site will include:

- Phase 1: clearing / grubbing and site preparation;
- Phase 2: bulk earthworks, minor filling, compaction, footings and drainage; and
- Phase 3: carpark areas, paths, building erection and commissioning.

The development of the total site will be staged as outlined in Section 2.1.1ii.

5.2.2 Equipment sound power levels

i Continuous

Equipment sound power levels have been taken from the Department of Environment, Food and Rural Affairs (DEFRA) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*, where available. Otherwise, data was sourced from an EMM database of similar equipment which is based on measurements at other construction sites.

Acoustically significant fixed and mobile equipment items were considered in the model for the site with 100% utilisation based on information confirmed by Evolution to represent a range of activities likely to represent the construction works. A summary of the construction phases, duration, number of plant and cumulative sound power levels (Lw) are presented in Table 5.1. The model considered the cumulative plant and equipment sound power level as an area source across the site providing a potential worst-case scenario for each phase of construction. It is noted that clearing / grubbing activities provides the greatest potential for noise impacts, however it is understood that these works may have been completed as part of previous works involved in the demolition of existing structures on site as part of a separate development application.

Table 5.1 Construction stages and equipment sound power levels

Equipment/Activity	Number of items (per 15 minutes)	SWL per item, LAeq	Total SWL, LAeq	Cumulative SWL per phase, LAeq
Phase 1: Clearing/grubbing site prep (duration = 1 week)				
Dump truck	2	107	110	113
Dozer	2	104	107	
Excavator	1	107	107	
Phase 2: Earthmoving/earthworks (duration = 4 weeks)				
Grader	1	109	109	115
Bobcat	2	95	98	
Roller	1	109	109	
Excavator	2	107	110	
Mini piling rig	1	104	104	
Semi-trailer	1	103	103	
Phase 3: Building (install facilities/containers) (duration = 18 weeks)				
Concrete agitator	1	108	108	113
Concrete pump	1	109	109	
Crane	2	95	98	
Semi-trailer	1	103	103	
Flatbed Hiab truck	1	103	103	

ii Night-time maximum noise level events and sleep disturbance

Construction activities are not proposed during the ICNG night-time hours of 10 pm to 7 am. Therefore, intermittent noise and assessment of the sleep disturbance at residential assessment locations has not been considered further for construction activities.

5.2.3 Noise predictions

i Single point predictions

To assess a potential worst-case construction scenario, the assessment has considered the identified plant and equipment in Table 5.1 and operating continuously over a 15 minute period. Construction noise levels were predicted to the assessment locations listed in Table 3.1 and identified in Figure 3.1.

ii Noise contours

Further to the above approach and acknowledging adjacent industrial land uses and other residential areas to the north, south and west of the site, noise contours have been generated for the day to evaluate noise exposure surrounding the site.

5.2.4 Noise enhancing meteorology

Construction is proposed to occur during day hours only. Modelling of construction noise considered standard ISO9613 noise enhancing weather conditions.

5.3 Construction vibration

Safe working distances for typical items of vibration intensive plant are listed in Table 5.2. The safe working distances are quoted for both "Cosmetic Damage" (refer British Standard BS 7385) and "Human Comfort" (refer British Standard BS 6472-1).

Table 5.2 Recommended safe working distances for vibration intensive plant

Plant Item	Rating/Description	Safe working distance	
		Cosmetic damage (BS 7385)	Human response (BS 6472)
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	n/a
Vibratory Rollers	<50kN (Typically 1-2 tonnes)	5 m	15 to 20 m
	<100kN (Typically 2-4 tonnes)	6 m	20 m
	<200kN (Typically 4-6 tonnes)	12 m	40 m

Source: From Transport Infrastructure Development Corporation Construction's Construction Noise Strategy (Rail Projects), November 2007 – based on residential building.

Safe work distances relate to continuous vibration. For most construction activity, vibration emissions are intermittent in nature. The safe working distances are therefore conservative.

The safe working distances presented in Table 5.2 are indicative and will vary depending on the item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

The safe working distances have been used to assess the potential for construction vibration impacts based on proposed activities.

5.4 Operational noise

5.4.1 Design drawings

The acoustic assessment has been based on site layout Figure 2.1 and design details listed in Section 1.2

The structures on site are proposed to be premanufactured modular buildings that would be placed on site with cranes to pre-prepared building footings.

5.4.2 Plant and equipment

Plant and equipment and associated sound power levels considered for accommodation village operations are presented in Table 5.3. The list is based on information of similar facilities and was confirmed by Evolution.

Activities associated with the use of the site comprise fixed plant and equipment, on-site vehicles and noise from occupants. The assessment has considered:

- each occupancy would have their own air-conditioning and exhaust fan;
- communal facilities mechanical plant and equipment are as referenced in Table 5.3;
- occupant noise from people, including:
  - internal noise and potential for noise breakout (Kitchen/Dining and Multi Purpose Function Space); and
  - externally for people within the four recreation areas.

For on-site vehicles, the assessment considered the three visitor parking areas and bus/minivan parking and manoeuvring area.

The sound power levels assigned to each item have been sourced from an EMM measurement database of similar equipment, Department of Environment, Food and Rural Affairs (DEFRA) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*, manufacturer data and other equivalent facilities.

Table 5.3 Operational noise sources

Building	Noise source	No. of items	Sound power level per item (L_{Aeq}) dBA	Total sound power level ($L_{Aeq,15min}$) dBA
Operations accommodations (total of 78)	ACU	78	55	79
	TEF	78	58	
Operations accessible accommodations (total of 8)	ACU	8	55	69
	TEF	8	58	
Construction accommodation (total of 96)	ACU	96	55	80
	TEF	96	58	
Kitchen/Dining/Admin	ACU	8	58	75
	Refrigeration	*Internal cabinets*	-	

Table 5.3 Operational noise sources

Building	Noise source	No. of items	Sound power level per item (L_{Aeq}) dBA	Total sound power level ($L_{Aeq,15min}$) dBA
	KEF	4	68	
	TEF	4	58	
	breakout[1]	internal	83	94[1]
Multi Purpose Function Space	ACU	6	58	
	TEF	4	58	68
	Breakout[1]	internal	83	93[1]
Laundries	LEF	12	58	69
Recreation area – northeast[2]	People	10	74	81
Recreation area – north[2]	People	10	74	81
Recreation area – west[2]	People	10	74	81
Recreation area – south[2]	People	10	74	81
Car parking – southeast[3]	Light vehicles	3	73	79
Car parking – south[3]	Light vehicles	3	73	79
Car parking – west[3]	Light vehicles	3	73	79
Bus parking[4]	Medium bus – L_{Aeq}	1	90	90
	Medium Bus – L_{Amax}	1	97	97

ACU based on Daikin or equivalent.

TEF based on Fantech RP306 or eq.

LEF based on Fantech RP306 or eq.

KEF based on Fantech CHD 456 or eq.

1. Internal space averaged level of 83dBA with total glazed surface areas of 133m2 for kitchen/dining and 107m2 for multi purpose function space. Facades closed for modelling
2. Considered SPL of 66dBA @1m per person and 50% of people talking at any one time.
3. Based on SEL 97dBA for typical vehicle movement and three vehicles in 15 minutes
4. Based on one bus per 2min activity per 15 minutes

The following additional assumptions were incorporated into the noise modelling:

- Items assumed to operate 24/7 are the:
  - air-conditioning units servicing the short and long-term accommodation;
  - laundry exhaust fans (LEF);
  - multi-purpose function space including AC and exhaust fans;
  - car parking; and
  - bus parking and manoeuvring.
- Items assumed to operate day and evening are the:
  - kitchen and dining;
  - administration;

- recreation and BBQ area; and
- toilet exhaust fans (TEF) for short and long-term accommodation (occasional intermittent use linked to light switch).

Preliminary noise modelling predicted noise levels potentially above PNTLs at the closest residential assessment location as a result of people within the western and southern outdoor recreation spaces. Where exceedance of PNTLs have been identified for a project, Section 3.1 of the NPfI requires the proponent to consider all feasible and reasonable mitigation measures to reduce noise levels.

Accordingly, the model was amended to include localised screens to the north of the western recreation areas and west of the southern recreation area. Closed windows and doors are assumed for the kitchen/dining area and multi-purpose function space.

5.4.3 Night-time maximum noise level events and sleep disturbance

Use and occupation of the site will be 24/7, hence assessment of intermittent noise and potential for sleep disturbance at neighbouring residential assessment locations during the night-time hours (10pm to 7am) is required by the NPfI. Medium sized buses/coaches will be used for transporting personnel to and from site and do not typically incorporate airbrake release mechanisms. For the purpose of assessing sleep disturbance, a sound power level of 97 dBA L_{Amax} was considered during bus manoeuvring. It is noted that this is anticipated to occur during a discrete night period of 6am to 7am.

The location on site where this will occur is the bus/coach parking area on the east portion of the site as shown on Figure 2.1.

5.4.4 Noise predictions

i Single point predictions

Noise levels were predicted to assessment locations identified in Table 3.1 using the noise sources outlined in Table 5.3 and the scenario assumptions for day, evening and night. The overall $L_{Aeq,15min}$ noise contribution was modelled for direct assessment against NPfI PNTLs.

ii Noise contours

Further to the above approach and acknowledging other residential areas to the north, east and south of the site, noise contours have been generated for the day, evening and night operational activities to determine the potential extent of noise exposure.

5.4.5 Noise enhancing meteorology

Noise modelling was conducted using DGMR Software proprietary modelling software, iNoise. The model utilised international standard ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors'. As per Section 1 of the standard:

> The method predicts the equivalent continuous A-weighted sound pressure level (as described in parts 1 to 3 of ISO 1996) under meteorological conditions favourable to propagation from sources of known sound emission.
>
> These conditions are for downwind propagation, as specified in 5.4.3.3 of ISO 1996-2:1987 or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

A summary of modelling conditions for which noise predictions have been provided are shown in Table 5.4.

Table 5.4 Conditions adopted in the model

Assessment condition	Period	Temperature	Wind speed (m/s)[1]	Relative humidity	Stability class
ISO9613	Day	20°C	2	60%	n/a
	Evening	10°C	2	70%	n/a
	Night	0°C	2	90%	F[2]

1. Downwind conditions in accordance with ISO9613 algorithm – Section 5 and 8.
2. Moderate inversion as defined in NPfI.

5.5 Road traffic noise

5.5.1 Overview

Access for vehicles associated with the operation of the accommodation village will be from Mid Western Highway and Boundary Street. Project related traffic has the potential to impact on residential properties on these road segments. The assessment has considered existing traffic volumes and projected vehicle movements associated with the construction and operation activities.

5.5.2 Existing traffic volumes

Existing average hourly traffic movements for Mid Western Highway (2019) are summarised in Table 5.5 and extracted from data published on the Road and Maritime Services traffic volume viewer website.

Table 5.5 Average hourly traffic volumes – Mid Western Highway (2019)

Day 7am to 10pm				Night 10pm to 7am			
LV[1]	HV[2]	Total	HV%	LV	HV	Total	HV%
63	49	112	44%	9	20	29	69%

1. LV light vehicles
2. HV heavy vehicles

Boundary Street provides access to the site, however there is limited traffic that currently uses this road. The project will use Boundary Street for construction and operation of the village, therefore road traffic noise from this road has been considered against the requirements of the NSW Road Noise Policy (RNP) 2011.

5.5.3 Projected traffic volumes

Evolution provided a summary of the predicted peak daily traffic generation for construction and operation of the facility, as summarised in Table 2.2 and Table 2.3, respectively. Considering the stages of construction and operation of the facility, Table 5.6 provides a summary of projected AM and PM peak 1hr movements.

Table 5.6 Projected peak 1hr movements

Day 7am to 10pm		Night 10pm to 7am	
LV[1]	HV[2]	LV	HV
Construction			
30	4	30	4
Operation			
63	8[3]	63	8[3]

1. LV light vehicles
2. HV heavy vehicles
3. HV for operation relate to buses and assessed as medium heavy vehicle

5.5.4 Methodology

The US EPA Federal Highways (FHWA) method was considered in the assessment of road traffic noise due to the relatively low traffic flows (<200 vehicles per hour) as the calculation procedure is more sensitive to low traffic volumes.

Road traffic noise levels from the project have been assessed by calculating existing and existing plus project traffic at representative residential assessment locations using FHWA methods. The following assumptions have been adopted:

- a vehicle speed for Mid Western Highway of 50 km/h as sign posted;
- a vehicle speed limit on Boundary Street of 50 km/h as sign posted;
- no buildings or other intervening objects that will act like a noise barrier between the road and the noise assessment point are proposed; and
- a facade reflection has been added to predicted noise levels in accordance with the RNP.

6 Impact assessment

6.1 Construction noise

6.1.1 Single point predictions

In accordance with procedures outlined in Section 5.2.3, prediction of construction noise levels is provided in Table 6.2 for standard and out of hours (OOH) day periods under ISO9613 conditions. The level presented for each assessment location represents the energy-average noise level over a 15-minute period and assumes all plant operating concurrently. The predicted exceedance of the ICNG noise affected NML at each assessment location is also provided.

The proponent will manage construction noise levels where exceedances of NMLs have been identified. The construction noise management methods will be detailed in a construction noise management plan as discussed further in Section 7.1.

The ICNG recommends the following where NMLs are predicted to be exceeded:

- application of feasible and reasonable work practices to minimise noise;
- inform potentially impacted residents of the nature of the works to be carried out, expected noise levels and duration and relevant contact details; and
- negotiation with the community where noise from work outside standard hours is predicted to exceed the relevant NML by more than 5 dB.

Table 6.1 Predicted construction noise levels

Assessment location	Classification	Period	Noise affected NML, dB	Highly noise affected NML, dB	Predicted construction noise level, dB $L_{Aeq,15min}$			Level above Standard NML		
					Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
R1	Residential	Standard	45	75	55	57	56	10	12	11
		OOH	40	n/a						
R2	Residential	Standard	45	75	55	58	56	10	13	11
		OOH	40	n/a						
R3	Residential	Standard	45	75	56	58	56	11	13	11
		OOH	40	n/a						
R4	Residential	Standard	45	75	58	60	59	13	15	14
		OOH	40	n/a						
R5	Residential	Standard	45	75	64	67	65	19	22	20
		OOH	40	n/a						
R6	Residential	Standard	45	75	61	63	62	16	18	17
		OOH	40	n/a						
R7	Residential	Standard	45	75	64	66	65	19	21	20
		OOH	40	n/a						

Table 6.1 Predicted construction noise levels

Assessment location	Classification	Period	Noise affected NML, dB	Highly noise affected NML, dB	Predicted construction noise level, dB $L_{Aeq,15min}$			Level above Standard NML		
					Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
R8	Residential	Standard	45	75	59	61	59	14	16	14
		OOH	40	n/a						
R9	Residential	Standard	45	75	57	60	58	12	15	13
		OOH	40	n/a						
R10	Residential	Standard	45	75	55	57	55	10	12	10
		OOH	40	n/a						
R11	Residential	Standard	45	75	47	49	47	2	4	2
		OOH	40	n/a						
R12	Residential	Standard	45	75	45	48	46	0	3	1
		OOH	40	n/a						
R13	Residential	Standard	45	75	43	45	43	0	0	0
		OOH	40	n/a						
R14	Residential	Standard	45	75	38	40	38	0	0	0
		OOH	40	n/a						
R15	Residential	Standard	45	75	37	40	38	0	0	0
		OOH	40	n/a						
R16	Residential	Standard	45	75	37	39	37	0	0	0
		OOH	40	n/a						
C1	Commercial	Any period	65	n/a	55	58	56	0	0	0
C2	Commercial	Any period	65	n/a	52	54	53	0	0	0
C3	Commercial	Any period	65	n/a	51	53	51	0	0	0
C4	Commercial	Any period	65	n/a	49	52	50	0	0	0
IN1	Industrial	Any period	75	n/a	36	39	37	0	0	0
IN2	Industrial	Any period	75	n/a	46	48	46	0	0	0

1. Standard hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday and no work on Sunday or public holidays.
2. OOH – out of hours (Day – 1pm to 6pm Saturday, Sunday and public holidays).

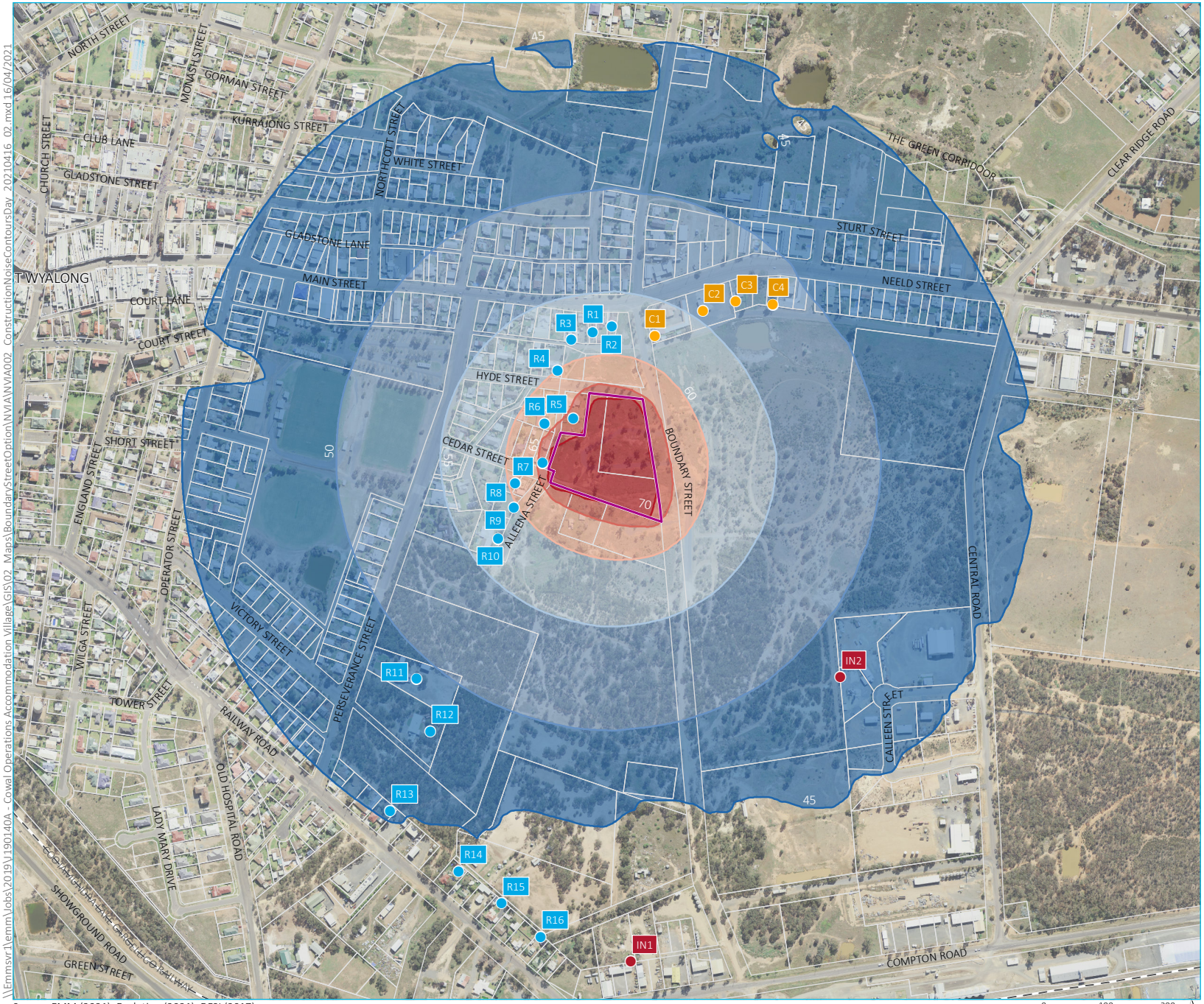
The results of modelling confirm that the NML is likely to be exceeded at the closest residential assessment locations and surrounding residential areas. Residents would be notified prior to works commencing. Noise monitoring during the initial stages of construction would be undertaken to determine actual construction noise levels. If NMLs are exceeded, the proponent will:

- identify and apply feasible and reasonable mitigation measures that reduce construction noise levels to at or below NMLs where practical; and
- consider construction during ICNG standard hours only.

The above will be determined depending on the measured level of exceedance and the availability of feasible and reasonable noise mitigation and management measures. This is discussed further in Section 7.1.

6.1.2 Contours

Predicted $L_{Aeq,15minute}$ noise contours representing the worst-case noise level footprint from the project construction are provided in Figure 6.1 for Phase 2 construction activities which represent potential worst case noise impacts. The figure represents the predicted construction noise levels under ISO9613 noise enhancing conditions and identifies the exposure from daytime construction activities.



\\Emmsvr1\emm\Jobs\2019\J190140A - Cowal Operations Accommodation Village\GIS\02 Maps\BoundaryStreetOption\MXD\A002 ConstructionNoiseContoursDay 20210416 02.mxd 16/04/2021

Construction noise contours, day, ISO9613 - phase 2 bulk earthworks

Evolution Mining - Cowal Gold Operations
Accommodation Village - Boundary Street
Noise and vibration impact assessment
Figure 6.1

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6.2 Construction vibration

In relation to human comfort response, the safe working distances in Table 5.2 relate to continuous vibration and apply to residential assessment locations. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed, as discussed in BS 6472-1.

The nearest residence (R5) is located approximately 25 metres to the closest proposed construction activities. This assessment location is typically beyond the safe working distances for human response (Table 5.2). Vibration impacts from construction at residential assessment locations are therefore highly unlikely.

The safe working distances for cosmetic damage should be monitored throughout the construction process. Based on the safe working distances guide in Table 5.2, if construction is within 25 m of sensitive structures, then work practices should be reviewed so that the safe working distance in Table 5.2 are followed.

If safe working distances need to be encroached, real time vibration monitoring with audible and visual alarms should be installed at vibration sensitive structures so actual vibration levels can be monitored and managed appropriately in real-time.

6.3 Operational noise

6.3.1 Single point predictions

In accordance with procedures outlined in Section 5.4.4 prediction of single point operational noise levels is provided in Table 6.2 for day, evening and night periods. The levels presented for each assessment location represents the energy-average noise level over a 15 minute period and assumes all plant and activities operating concurrently in accordance with scenarios outlined in Section 5.4 under ISO9613 noise enhancing conditions.

Table 6.2 Predicted operational noise levels – ISO9613

Assessment location	Classification	Period	PNTL, dB	Predicted noise level, dB $L_{Aeq,15min}$
R1	Residential	Day	40	35
		Evening	35	35
		Night	35	33
R2	Residential	Day	40	33
		Evening	35	33
		Night	35	<30
R3	Residential	Day	40	31
		Evening	35	31
		Night	35	<30
R4	Residential	Day	40	30
		Evening	35	30
		Night	35	<30

Table 6.3 Predicted operational noise levels – ISO9613

Assessment location	Classification	Period	PNTL, dB	Predicted noise level, dB $L_{Aeq,15min}$
R5	Residential	Day	40	35
		Evening	35	35
		Night	35	31
R6	Residential	Day	40	34
		Evening	35	34
		Night	35	<30
R7	Residential	Day	40	34
		Evening	35	34
		Night	35	<30
R8	Residential	Day	40	<30
		Evening	35	<30
		Night	35	<30
R9	Residential	Day	40	30
		Evening	35	30
		Night	35	<30
R10	Residential	Day	40	<30
		Evening	35	<30
		Night	35	<30
R11	Residential	Day	40	<30
		Evening	35	<30
		Night	35	<30
R12	Residential	Day	40	<30
		Evening	35	<30
		Night	35	<30
R13	Residential	Day	40	<30
		Evening	35	<30
		Night	35	<30
R14	Residential	Day	40	<30
		Evening	35	<30
		Night	35	<30
R15	Residential	Day	40	<30
		Evening	35	<30
		Night	35	<30

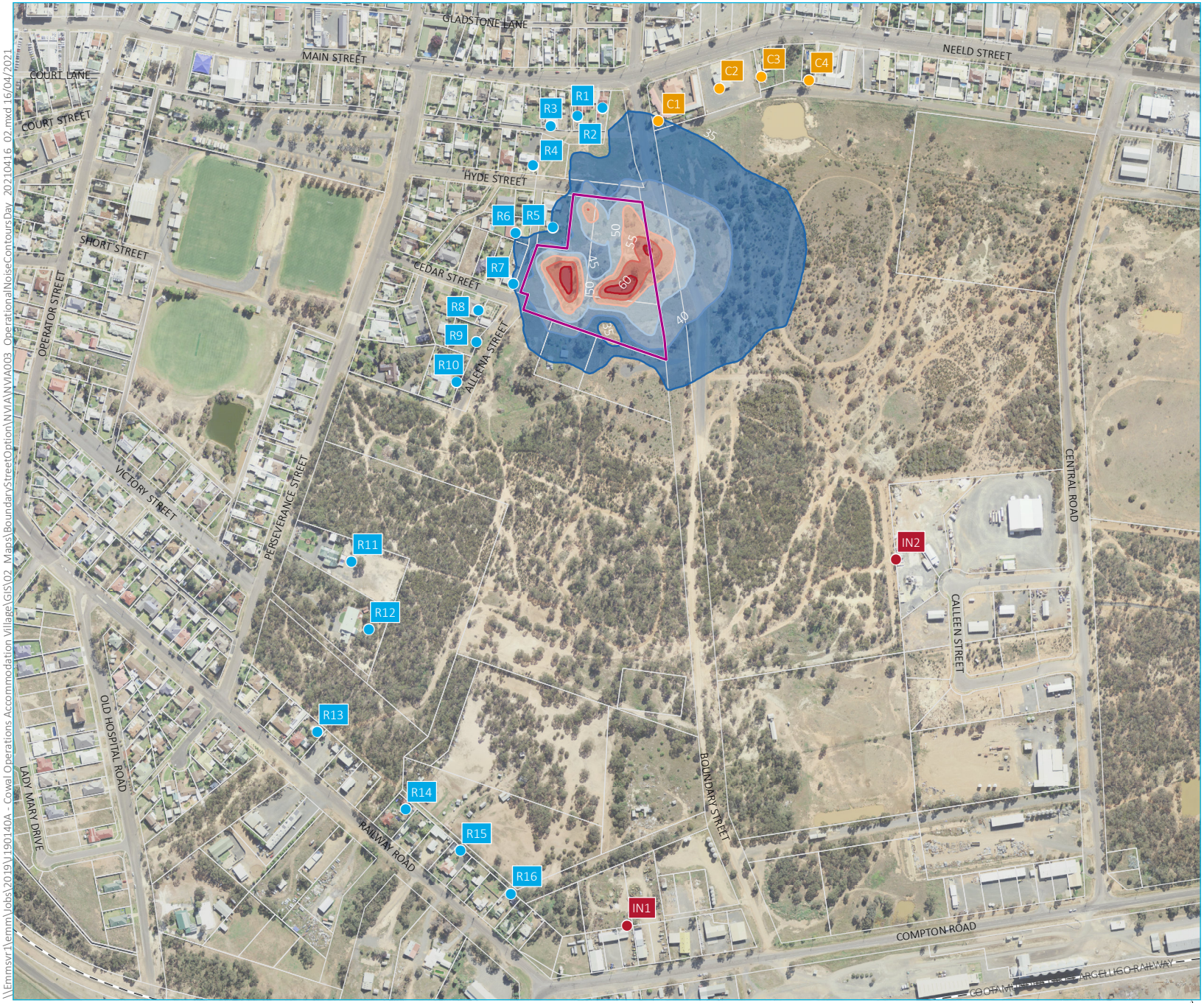
Table 6.4 Predicted operational noise levels – ISO9613

Assessment location	Classification	Period	PNTL, dB	Predicted noise level, dB $L_{Aeq,15min}$
R16	Residential	Day	40	<30
		Evening	35	<30
		Night	35	<30
C1	Commercial	When is use	63	35
C2	Commercial	When is use	63	32
C3	Commercial	When is use	63	31
C4	Commercial	When is use	63	30
IN1	Industrial	When is use	73	<30
IN2	Industrial		73	<30

Noise modelling has demonstrated the PNTLs are satisfied at all assessment locations during day, evening and night operation of the site.

6.3.2 Contours

Predicted $L_{Aeq,15min}$ operational noise contours representing day, evening and night operations under ISO9613 noise enhancing conditions are provided in Figure 6.2, Figure 6.3 and Figure 6.4, respectively.



KEY

- Site boundary
- Cadastral boundary

Noise assessment locations

- Residential
- Commercial
- Industrial

Operational day noise level contour

- 35 dB(A)
- 40 dB(A)
- 45 dB(A)
- 50 dB(A)
- 55 dB(A)
- 60 dB(A)

Operational day noise level contour range

- 35 - 39 dB(A)
- 40 - 44 dB(A)
- 45 - 49 dB(A)
- 50 - 54 dB(A)
- 55 - 59 dB(A)
- 60 - 64 dB(A)

Source: EMM (2021); Evolution (2021); DFSI (2017)

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Operational noise contours, day, ISO9613

Evolution Mining - Cowal Gold Operations
Accommodation Village - Boundary Street
Noise and vibration impact assessment
Figure 6.2

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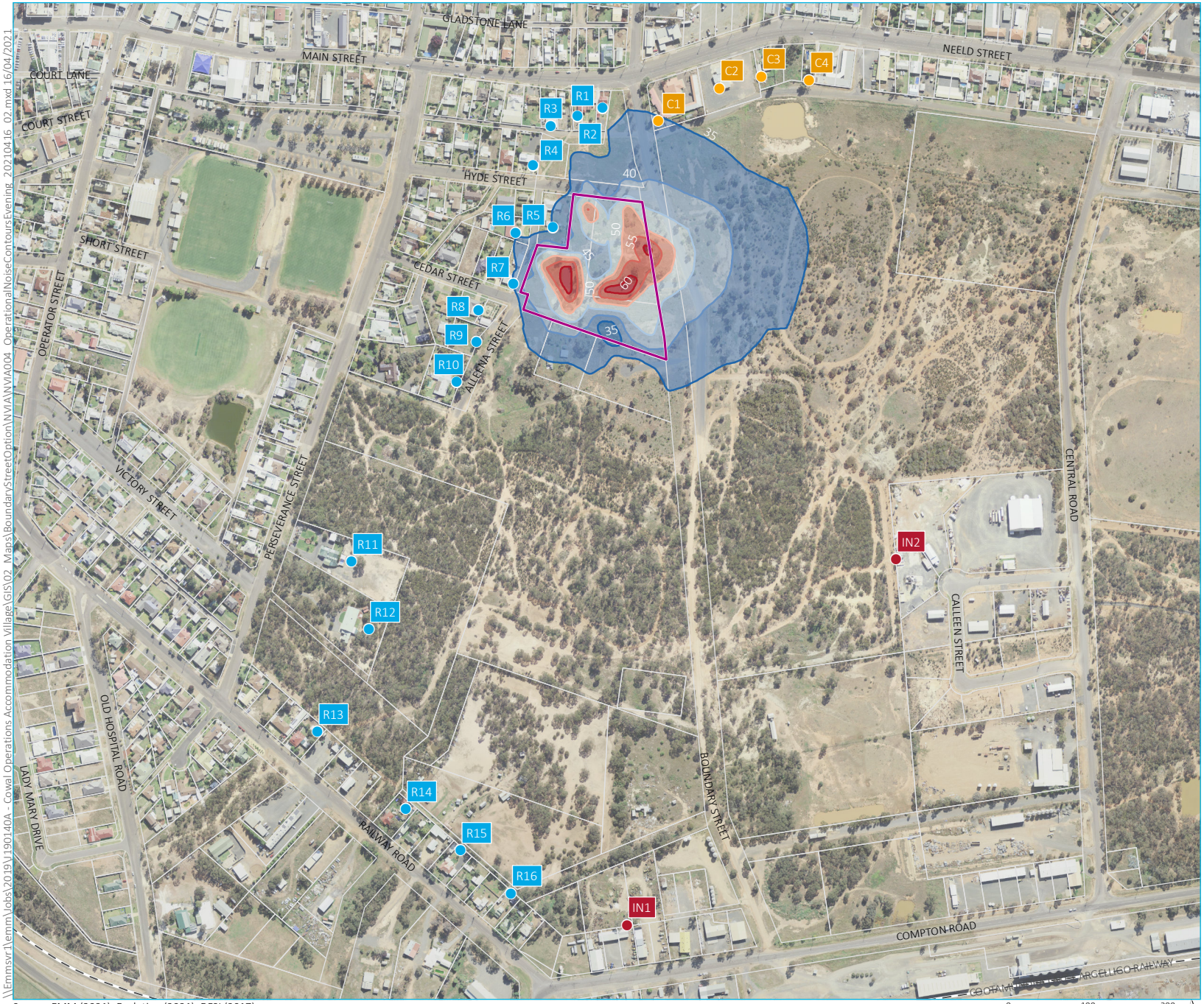

KEY

- Site boundary
- Cadastral boundary

Noise assessment locations

- Residential
- Commercial
- Industrial

Operational evening noise level contour

- 35 dB(A)
- 40 dB(A)
- 45 dB(A)
- 50 dB(A)
- 55 dB(A)
- 60 dB(A)

Operational evening noise level contour range

- 30 - 34 dB(A)
- 35 - 39 dB(A)
- 40 - 44 dB(A)
- 45 - 49 dB(A)
- 50 - 54 dB(A)
- 55 - 59 dB(A)
- 60 - 64 dB(A)

Source: EMM (2021); Evolution (2021); DFSI (2017)

0 100 200 m

GDA 1994 MGA Zone 55

N

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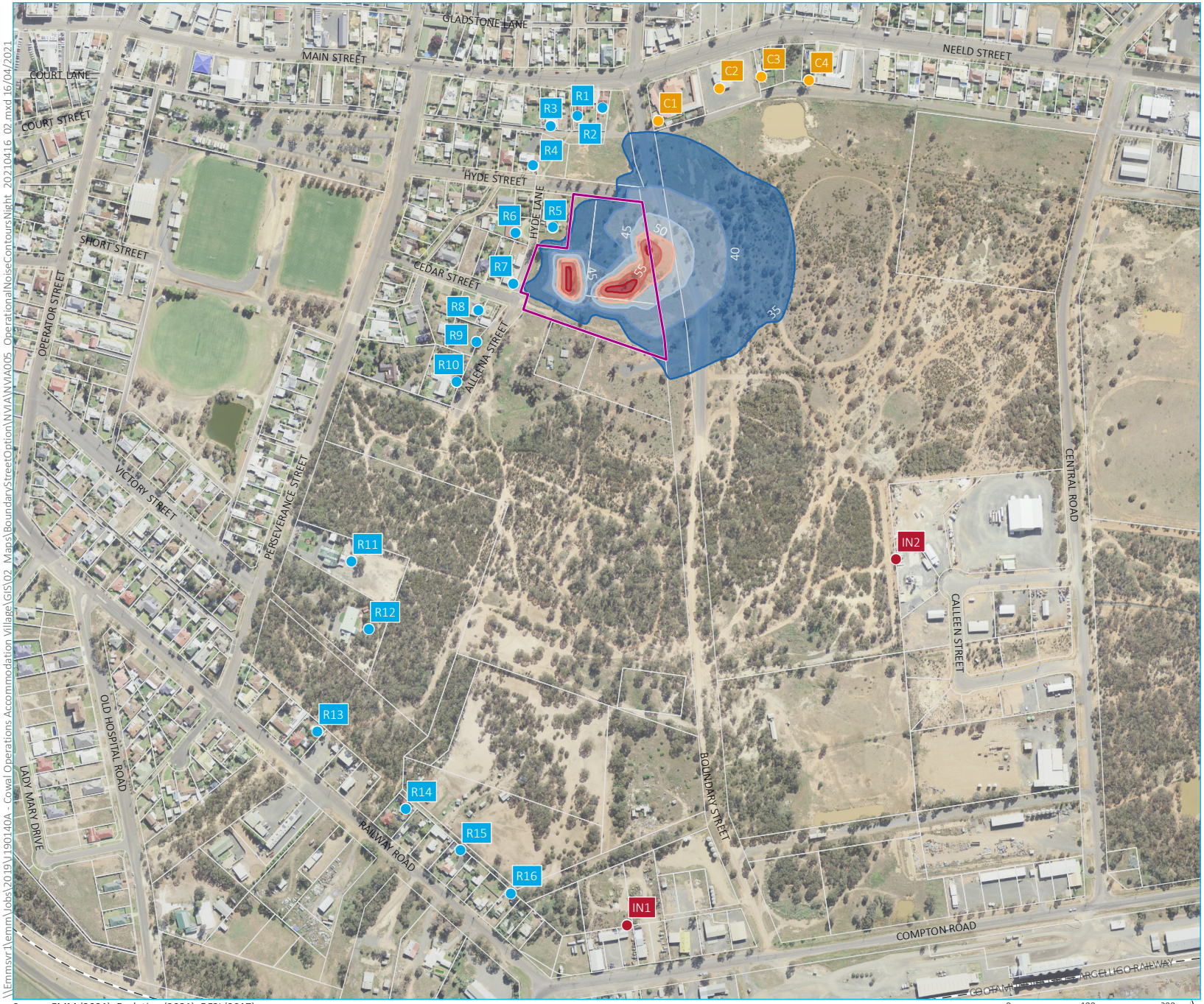
Operational noise contours, evening, ISO9613

Evolution Mining - Cowal Gold Operations
Accommodation Village - Boundary Street
Noise and vibration impact assessment
Figure 6.3

EMM
creating opportunities



KEY

- Site boundary
- Cadastral boundary

Noise assessment locations

- Residential
- Commercial
- Industrial

Operational night noise level contour

- 35 dB(A)
- 40 dB(A)
- 45 dB(A)
- 50 dB(A)
- 55 dB(A)
- 60 dB(A)

Operational night noise level contour range

- 35 - 39 dB(A)
- 40 - 44 dB(A)
- 45 - 49 dB(A)
- 50 - 54 dB(A)
- 55 - 59 dB(A)
- 60 - 64 dB(A)

Source: EMM (2021); Evolution (2021); DFSI (2017)

0 100 200 m

GDA 1994 MGA Zone 55

N

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Operational noise contours, night, ISO9613

Evolution Mining - Cowal Gold Operations
Accommodation Village - Boundary Street
Noise and vibration impact assessment
Figure 6.4

EMM
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6.3.3 Intermittent noise events

Modelling of intermittent L_{Amax} noise events at night considered a typical worst case event for proposed buses and a source sound power level of 97 dB. Potential for these events was considered at the bus/coach parking area located near the western boundary of the site and predicted to the identified assessment locations. The results of the predictions under ISO9613 conditions are presented in Table 6.5.

Table 6.5 Predicted intermittent noise levels – ISO9613

Assessment location	Classification	Period	Screening Level, dB	Predicted intermittent noise level, dB L_{Amax}
R1	Residential	Night	52	40
R2	Residential	Night	52	37
R3	Residential	Night	52	36
R4	Residential	Night	52	35
R5	Residential	Night	52	<30
R6	Residential	Night	52	31
R7	Residential	Night	52	39
R8	Residential	Night	52	35
R9	Residential	Night	52	34
R10	Residential	Night	52	33
R11	Residential	Night	52	32
R12	Residential	Night	52	<30
R13	Residential	Night	52	<30
R14	Residential	Night	52	<30
R15	Residential	Night	52	<30
R16	Residential	Night	52	<30

Results of modelling confirm compliance with the sleep disturbance screening level of L_{Amax} 52 dB for all residential assessment locations.

6.4 Road traffic noise

Traffic volumes were provided by Evolution to represent the vehicle generation associated with the operation and construction of the accommodation village (Section 2.1.1ii and Section 2.1.1). Road traffic noise level predictions considered peak 1 hr day and night traffic generation from the site outlined in Table 5.6 considering construction and operation of the site.

In the calculation of the $L_{Aeq,1hr}$ road traffic noise levels utilising the FHWA procedures, buses were represented as a medium truck based on the dimensions shown in site plans.

Table 6.6 Road traffic noise calculations, Day (7 am to 10 pm)

Road segment	Approximate distance from nearest carriageway	Existing movements[1]	Existing plus project movements	RNP Criteria[1,2] L_{Aeq}	Noise level increase due to the Project, $L_{Aeq,1hr}$
		Calculated level, $L_{Aeq,1hr}$	Predicted level, $L_{Aeq,1hr}$		
Construction					
Mid Western Highway	18	64.6	65.0	60	0.4
Boundary Street	36	-	49.9	55	n/a
Operation					
Mid Western Highway	18	64.6	64.8	60	0.2
Boundary Street	36	-	49.1	55	n/a

1. Mid Western Highway is an arterial road and is normally assessed as LAeq,15hr 60dBA
2. Boundary Street and Solomon Lane are local roads and assessed as LAeq,1hr 55dBA

Existing daytime traffic noise levels on Mid Western Highway exceed the baseline RNP criteria of $L_{Aeq,15hr}$ 60 dBA. Assessment of day ($L_{Aeq,1hour}$) traffic predictions confirm compliance with the <2 dB allowance criterion for Mid Western Highway and the baseline RNP day goal of $L_{Aeq,1hr}$ 55 dBA for Boundary Street. Noise levels for Mid Western Highway have considered a peak 1 hr assessment, however under the RNP the assessment over the full day period (15 hr) would reduce the relative increase to less than 0.1 dB.

Table 6.7 Road traffic noise calculations, Night (10 pm to 7 am)

Road segment	Approximate distance from nearest carriageway	Existing movements[1]	Existing plus project movements	RNP Criteria[1] L_{Aeq}	Noise level increase due to the Project, $L_{Aeq,1hr}$
		Calculated level, $L_{Aeq,1hr}$	Predicted level, $L_{Aeq,1hr}$		
Construction					
Mid Western Highway	18	60.8	61.6	55	0.8
Boundary Street	36	-	49.9	50	n/a
Operation					
Mid Western Highway	18	60.8	61.2	55	0.4
Boundary Street	36	-	49.1	50	n/a

1. Mid Western Highway is an arterial road and is normally assessed as LAeq,9hr 55dBA
2. Boundary Street and Solomon Lane are local roads and assessed as LAeq,1hr 50dBA

Assessment of night ($L_{Aeq,1hour}$) traffic predictions confirm compliance with the <2 dB allowance criterion for Mid Western Highway and the baseline RNP night goal of $L_{Aeq,1hr}$ 50 dBA for Boundary Street. Noise levels for Mid Western Highway have considered a peak 1 hr assessment, however under the RNP the assessment over the full night period (9 hr) and would reduce the relative increase to less than 0.1 dB.

7 Noise mitigation and management

7.1 Construction

7.1.1 General

The EPA's NSW ICNG requires that construction noise levels be assessed against NMLs.

Noise levels above NMLs have been predicted for residential assessment locations. It is not uncommon for construction projects to exceed NMLs. For this reason, they are not considered as noise criteria, but as a trigger for all feasible and reasonable noise mitigation and management to be considered.

There is limited opportunity due to proximity of residential assessment locations, site location and local topography to provide significant noise mitigation. Management measures that could be implemented on site as part of the construction environmental management plan (CEMP) are provided in the following sub-sections.

7.1.2 Work practices

Work practice methods include:

- regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration;
- review and implementation of feasible and reasonable mitigation measures that reduce construction noise levels;
- consideration of construction of modules closest to the residential assessment locations (west and north-west) to assist in providing a level of acoustic shielding for the remainder of the construction;
- avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- develop routes for the delivery of materials and parking of vehicles to minimise noise;
- where possible, avoid the use of equipment that generates impulsive noise; and
- notify residents prior to the commencement of intensive works.

7.1.3 Plant and equipment

Additional measures for plant and equipment include:

- where possible, choose quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks;
- operate plant and equipment in the quietest and most efficient manner; and
- regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.

7.1.4 Quantifying noise reductions

Approximate noise reductions provided by some of these measures are provided in Table 7.1.

Table 7.1 Relative effectiveness of various forms of noise control

Noise control	Nominal noise reduction possible, in total A-weighted sound pressure level, dB
Increase source to receiver distance[1]	approximately 6 dB for each doubling of distance
Reduce equipment operating times or turn off idling machinery[2]	approximately 3 dB per halving of operating time
Operating training on quiet operation[2]	Up to 3 to 5 dB
Screening (eg noise barrier)[1]	normally 5 dB to 10 dB, maximum 15 dB
Enclosure (eg shed/building)[1]	normally 15 dB to 25 dB, maximum 50 dB
Silencing (eg exhaust mufflers) [1]	normally 5 dB to 10 dB, maximum 20 dB

1. Sourced from AS2436-2010
2. Based on EMM's measurement experience at construction and mining sites

7.2 Operation

The site would be operated in accordance with proposed plans, configuration and assumptions presented in Section 5.4 including:

- specification of mechanical plant and equipment;
- times and use of facilities;
- operational restrictions for kitchen/dining and multi-purpose function space (windows and doors closed);
- noise barriers allocated to the recreational areas a noted; and
- vehicle movements.

During the design development phase and prior to construction and final specification it is recommended that all aspects of the design including selection and location of mechanical plant be reviewed to ensure that project noise goals and any pending conditions of consent can be satisfied.

8 Conclusion

This NVIA has been prepared to support the SEE for the construction and operation of an accommodation village at the site, located immediately west of Boundary Street, West Wyalong NSW. The use of the village is to support the anticipated construction and operational workforce associated with the CGO Underground Development Project. From time to time, accommodation may also be provided to Evolution personnel and contractors for broader mine-related activities. This NVIA has documented the methods and results of the impact assessment undertaken, the design initiatives incorporated to avoid and minimise associated impacts, and the mitigation and management measures proposed to address any residual impacts not able to be feasibly and reasonably avoided.

Construction noise levels from the project are predicted to exceed NMLs at the closest assessment locations, with exceedances greater than 10 dB above NML at some locations. Accordingly, residents will need to be notified prior to construction works commencing. Noise monitoring during Phases 2 and 3 of construction should be considered to determine actual construction noise levels. Subject to the measured level of exceedance, availability of feasible and reasonable noise mitigation and management measures should be determined. This is discussed further in Section 7.

The potential for vibration impacts on residents and vibration sensitive structures near construction has been assessed. The nearest residence to construction activity is assessment location R5 which is approximately 25 m away from closest construction activities. The assessment location is typically outside of the safe working distances required to maintain acceptable human response and structural vibration levels. Vibration impacts from construction at residential assessment locations are therefore highly unlikely.

The safe working distances for cosmetic damage should be monitored throughout the construction process. If construction is within 25 m of sensitive structures, then work practices should be reviewed so that the safe working distances presented in Table 5.2 are followed.

Assessment of operational noise associated with the use of the site has confirmed compliance with NSW NPfI (EPA 2017) requirements for all residential assessment locations after the implementation of all feasible and reasonable mitigation measures. Compliance is predicted at all commercial (motel) and industrial assessment locations.

Intermittent night activities are predicted to satisfy the sleep disturbance screening criteria of L_{Amax} 52 dBA as defined in the NSW NPfI (EPA 2017) for all residential assessment locations.

The potential for road traffic noise impacts on public roads due to project traffic has been assessed in accordance with relevant *NSW Road Noise Policy* (EPA 2011). In summary, road traffic noise levels are predicted to satisfy RNP assessment requirements of <2 dB for Mid Western Highway and RNP baseline noise levels for Boundary Street assessed to the closest residential building facades.

With the effective management and incorporation of mitigation and management measures listed in Section 7.1, construction noise and vibration emissions from the project can be managed to minimise impacts.

References

NSW Environment Protection Authority (EPA) 2017, *NSW Noise Policy for Industry* (NPfI)

NSW Department of Environment Climate Change and Water (DECCW) 2011, *Road Noise Policy* (RNP)

NSW Environmental Protection Authority (EPA) 2009, *The Interim Construction Noise Guideline* (ICNG)

Department of Environment and Conservation NSW 2006, *Assessing Vibration: a technical guideline*

BS 6472 – 2008 *"Evaluation of human exposure to vibration in buildings (1-80Hz)"*

BS 7385 Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2"*

Department of Environment, Food and Rural Affairs (DEFRA – United Kingdom) 2005, *Update of Noise Database for Prediction of Noise on Construction and Open Sites*

Abbreviations

Abbreviation	Term
AGL	above ground level
ANZEC	Australian and New Zealand Environment Council
ABL	Assessment background level
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
DECC	Department of Environment and Climate Change
DEC	Department of Environment and Conservation
DEFRA	Department of Environment, Food and Rural Affairs (United Kingdom)
DP&E	Department of Planning and Environment
EPA	Environmental Protection Authority
EMM	EMM Consulting Pty Limited
FHWA	US EPA Federal Highways
HV	heavy vehicle
ICNG	Interim Construction Noise Guideline
LGAs	local government areas
LV	light vehicle
NATA	National Association of Testing Authorities
NPfI	Noise Policy for Industry
NML	noise management level
NVIA	Noise and vibration impact assessment
OOH	out of hours
PPV	peak particle velocity
POEO Act	Protection of the Environment Operations Act 1997 (NSW)
PNTL	project noise trigger level
RBL	rating background level
RNP	Road Noise Policy
RMS	root mean square
VDV	vibration dose value

Glossary

Table G.8.1 Project and technical terms

Term	Meaning
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Amenity noise criteria	The amenity noise criteria relate to existing industrial noise. Where industrial noise approaches base amenity noise criteria, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise. See Section 3.1.2 for more detail.
Day period	Monday-Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dBC	Noise is measured in units called decibels (dB). There are several scales for describing noise, with the 'C-weighted' scale typically used to assess low frequency noise.
Evening period	Monday-Sunday: 6 pm to 10
Intrusive noise criteria	The intrusive noise criteria refers to noise that intrudes above the background level by more than 5 dB. The intrusiveness criterion is described in detail in Section 3.1.1.
L1	The noise level exceeded for 1% of the time.
L10	The noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L90	The noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
Leq	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The Leq(15min) descriptor refers to a Leq noise level measured over a 15-minute period.
Lmax	The maximum sound pressure level received during a measuring interval.
Night period	Monday-Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 am to 8 am.
NPfI	Noise Policy for Industry
PNTL	The project-noise trigger level (PNTL) is criteria for a particular industrial noise source or industry. The PSNL is the lower of either the intrusive noise criteria or amenity noise criteria.
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the 90th percentile assessment background levels for each day, evening and night.
Sound power level (Lw)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.

Common noise levels

The table below gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels encountered on a daily basis are provided in the figure below.

Table G.8.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times as loud (or quarter) as loud.

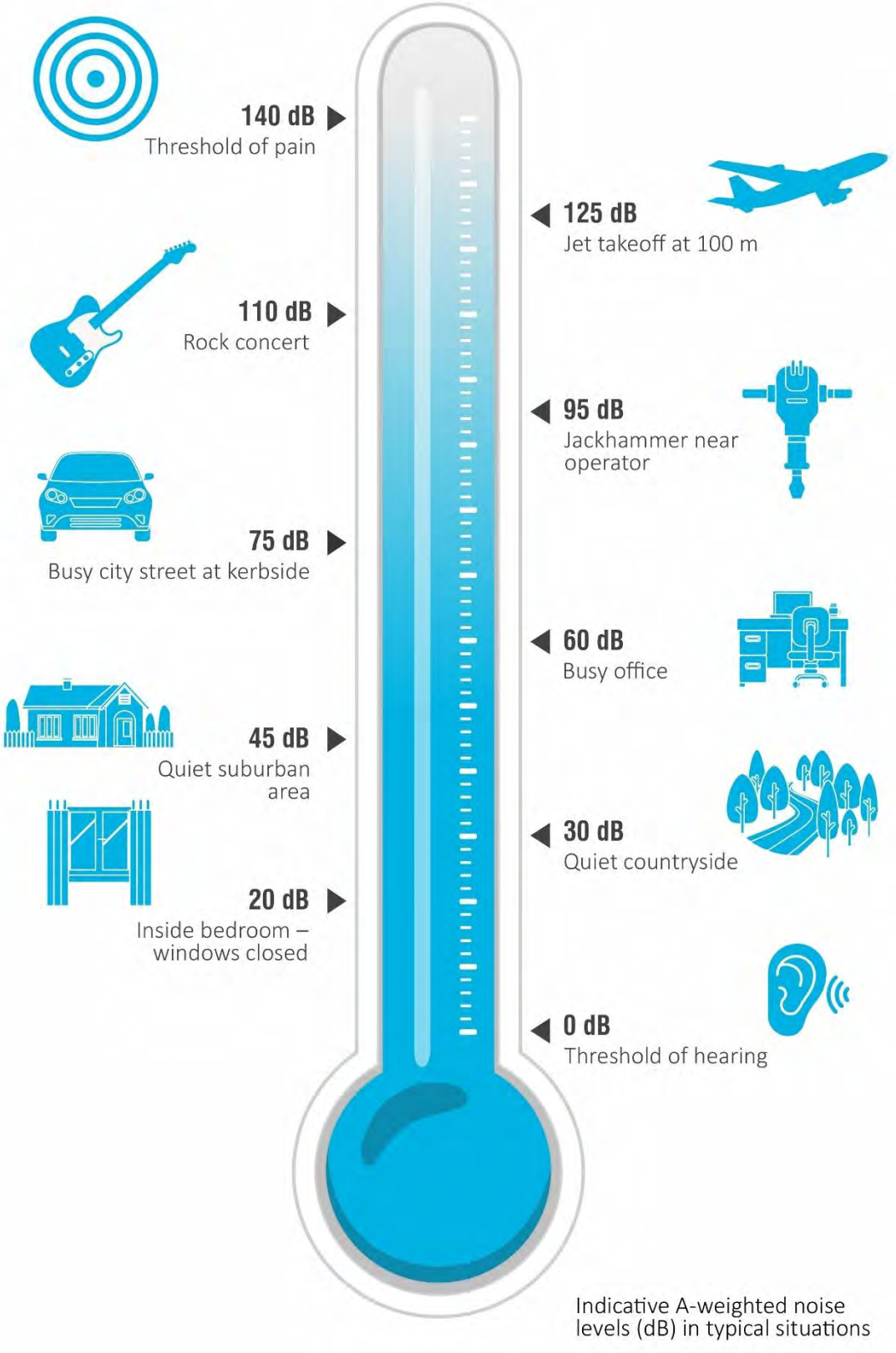
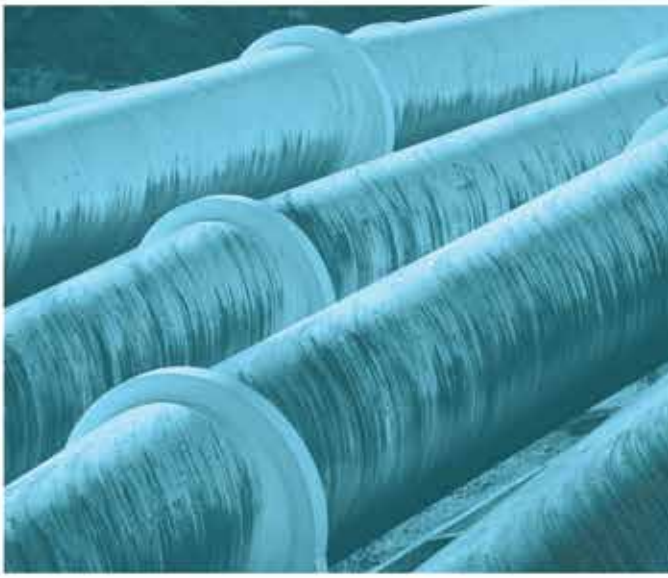


Figure G.1 **Common sources of noise with levels**





Appendix L

Air quality impact assessment

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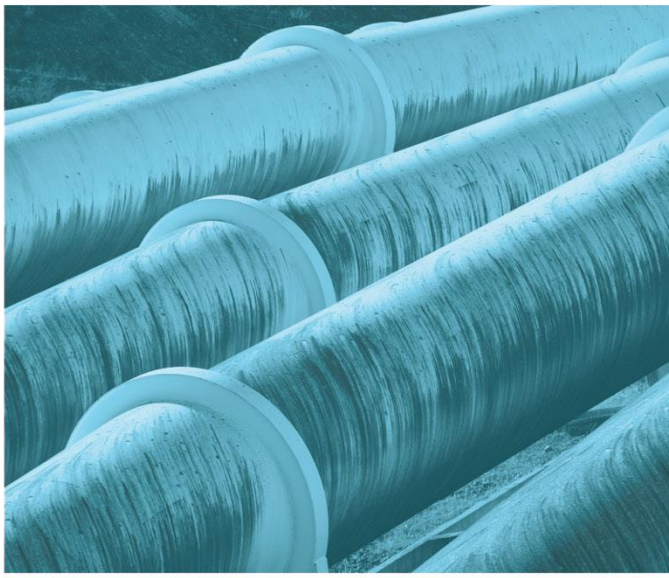
Construction Air Quality Impact Assessment

Cowal Gold Operations Accommodation Village

Prepared for Evolution Mining (Cowal) Pty Limited
March 2021

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Construction Air Quality Impact Assessment

Cowal Gold Operations Accommodation Village

Prepared for Evolution Mining (Cowal) Pty Limited
March 2021

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Construction Air Quality Impact Assessment

Cowal Gold Operations Accommodation Village

Report Number

J19014A RP10

Client

Evolution Mining (Cowal) Pty Limited

Date

25 March 2021

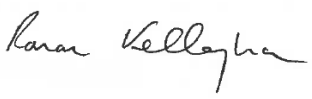
Version

v1 Final

Prepared by

Francine Manansala
Associate – Air Quality
25 March 2021

Approved by



Ronan Kellaghan
Associate - Air Quality
25 March 2021

Executive Summary

Evolution Mining (Cowal) Pty Limited (Evolution) proposes to construct and operate an accommodation village (the project) on vacant land comprising the whole of Lot 7044 DP1115128 and a portion of Lot 2 DP1239669 (the site), located immediately west of Boundary Street, West Wyalong. EMM Consulting Pty Ltd (EMM) was commissioned by Evolution Mining (Cowal) Pty Limited) to prepare an air quality impact assessment (AQIA) for the project.

The village is being developed to house the anticipated workforce associated with the construction and operation of the Cowal Gold Operations (CGO) Underground Development Project. Key components of the project include:

- accommodation capacity for up to 176 people total supporting the CGO Underground Development Project, including:
    - temporary construction workforce accommodation modules to house 96 people;
    - semi-permanent operational workforce accommodation modules to house 72 people; and
    - semi-permanent accessible accommodation modules to house 8 people.

This AQIA provides an assessment of construction phase air quality impacts arising from the project. Air quality impacts during the operations phase are expected to be limited to emissions from infrequent vehicle movements associated with staff and contractors entering and exiting the site and regarded as negligible. As a result, these been excluded from this assessment. This AQIA follows the *Guidance on the Assessment of Dust from Demolition and Construction* published by the Institute of Air Quality Management in the United Kingdom (IAQM 2014)..

In the IAQM assessment procedure, activities at construction sites are divided into four types: demolition, earthworks, construction and track-out. A risk-based study method was used to consider amenity impacts due to soiling by dust deposition, health effects due to an increase in exposure to dust, and harm to ecological receptors. The IAQM approach aims to identify risks and to recommend appropriate mitigation measures.

In relation to dust soiling impacts, the risk was determined to be low for track-out and medium for earthworks and construction. For human health impacts the risk was determined to be medium for earthworks, construction and track-out (transport of dust and dirt by vehicles onto the public road network). For ecological impacts, the risk was determined to be low for track-out and medium for earthworks and construction.

A Construction Environmental Management Plan (CEMP) should be produced and should include measures to manage dust. Recommended mitigation measures include logging dust complaints, carrying out regular inspections and recording results, providing adequate water supply for dust suppression and ensuring that vehicles entering and leaving sites are covered to prevent escape of materials during transport. The complete list of recommended mitigation measures is provided in Section 3 of this report.

The proposed mitigation measures are considered sufficient to ensure off-site impacts from the construction phase of the project are effectively managed.

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Appendices

Tables

Figures

1 Introduction

1.1 Background

Evolution Mining (Cowal) Pty Limited (Evolution) proposes to construct and operate an accommodation village (the project) on vacant land comprising the whole of Lot 7044 DP1115128 and a portion of Lot 2 DP1239669 (the site), located on Boundary Street, West Wyalong (see Figure 1.1 and Figure 1.2).

EMM Consulting Pty Limited (EMM) has been engaged by Evolution to prepare a statement of environmental effects (SEE) and accompanying development application (DA) for the project under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This construction air quality impact assessment (AQIA) has been prepared by EMM to inform the SEE and DA for the project. Air quality impacts during operations are expected to be negligible, limited to emissions from infrequent vehicle movements associated with staff and contractors entering and exiting the site, and have therefore been excluded from this assessment.

1.2 Project description

The project will be located within the Bland Shire Local Government Area (LGA) and will be considered as a multi-dwelling residential development under the *Bland Local Environmental Plan 2011* (LEP) and *Bland Shire Development Control Plan 2012* (DCP).

The village is being developed to house the anticipated workforce associated with the construction and operation of the Cowal Gold Operations (CGO) Underground Development Project, located approximately 38 kilometres (km) north-east of West Wyalong (see Figure 1.1). The CGO Underground Development Project is currently the subject of a State significant development (SSD) application (SSD 10367), under section 4.38 of the EP&A Act.

The project conceptually comprises the following key components:

- accommodation capacity for up to 176 people total supporting the CGO Underground Development Project, including:
    - temporary construction workforce accommodation modules to house 96 people;
    - semi-permanent operational workforce accommodation modules to house 72 people;
    - semi-permanent accessible accommodation modules to house 8 people, with facilities which are Commonwealth *Disability Discrimination Act 1992* (DDA) compliant;
- use of existing access points from Boundary Street and use of upgraded on-site roads;
- administration buildings;
- communal facilities, including:
    - laundry units;
    - communal dining and kitchen building;
    - outdoor eating areas;
    - first aid and nursing room;

  - prayer room;
  - quiet room;
  - gymnasium;
  - multipurpose outdoor court; and
  - running track;
- undercover bus shelter and bus parking spaces;
- light vehicle car parking;
- fencing and lighting;
- reticulated services; and
- landscaping.

The village components will be modular in design with different layouts dependent on the workforce (construction, operational and accessible) supporting the CGO Underground Development Project. The development will be staged, with the operations workforce and accessible modules being constructed first. This area of the village will initially house the construction workforce. The construction workforce modules, including accessible modules, will be completed as soon as possible thereafter.

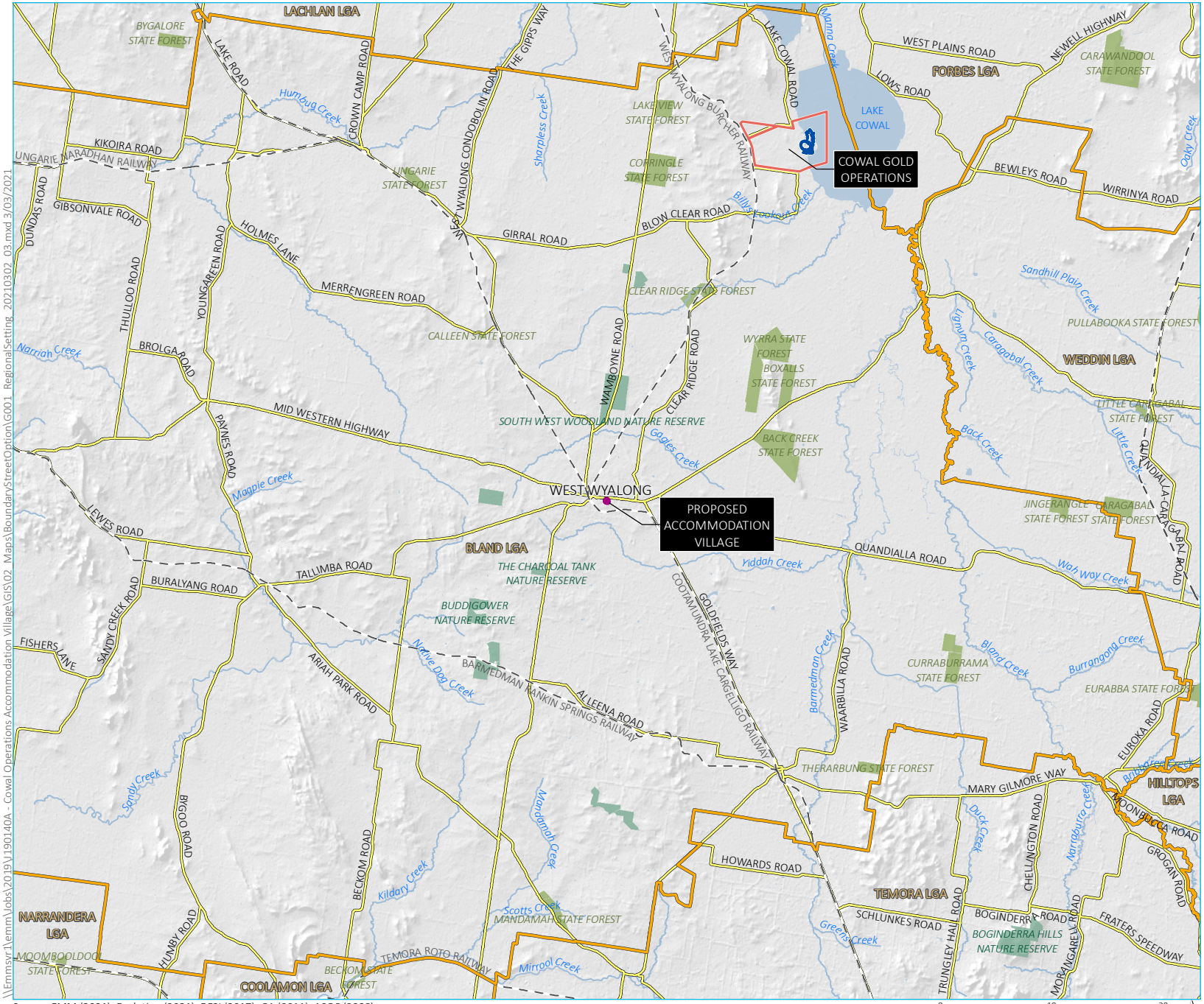
Approval is sought for all stages of development of the village as part of the SEE and DA. Construction of the accommodation modules is expected to take approximately eight months in total. Construction of additional amenities / facilities may take up to a further three years, once construction accommodation modules have been removed. Minor earthworks will be required for site establishment activities, including vegetation clearing and grubbing, ground levelling and trenching for service installation. Any excavated topsoil will be stockpiled and reused on site where possible.

Appropriate security measures such as fencing, gates, cameras and night lighting will be installed. Site landscaping will be undertaken to increase visual amenity consistent with the surrounding neighbourhood and will incorporate water sensitive urban design practices. This includes maintaining existing native vegetation wherever possible.

1.3 Site description

The site is located between Boundary Street and Aleena Street in West Wyalong, in central west New South Wales (NSW), which is located approximately 360 km west of Sydney (see Figure 1.1). Under the Bland LEP (Land Zoning Map – Sheet LZN_007F), the site is zoned as Zone R1 General Residential. The site is located on vacant freehold land comprising the whole of Lot 7044 DP1115128 and a portion of Lot 2 DP1239669 (see Figure 1.2), held by the West Wyalong Local Aboriginal Land Council (LALC) (subject to determination of native title). A native title claim (NN2020/007) was lodged on 21 August 2020 by the West Wyalong LALC over part of the site. This claim was yet to be determined at the time of writing.

The site was formerly the location of Barrick Gold's accommodation village, constructed in 2004 for use as a temporary residential village to support employees working at the CGO. The Barrick Gold accommodation village was demolished between 2005-2006 and the site is currently devoid of built structures. The site is located within a larger area of relatively flat vacant land which contains fragmented native vegetation. The site is bordered by Hyde Lane and Cedar Street to the west and Hyde Street to the north. Other land uses surrounding the site include residential, industrial and retail. The closest private residence is located immediately west of the site on Hyde Lane.



KEY

- Site boundary
- Proposed underground development
- Mining lease
- Rail line
- Main road
- Named watercourse
- Waterbody
- Local government area
- NPWS reserve
- State forest

Source: EMM (2021); Evolution (2021); DFSI (2017); GA (2011); ASGC (2006)

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Regional setting

Evolution Mining
Cowal Gold Operations
Accommodation Village - Boundary Street
Construction air quality impact assessment
Figure 1.1

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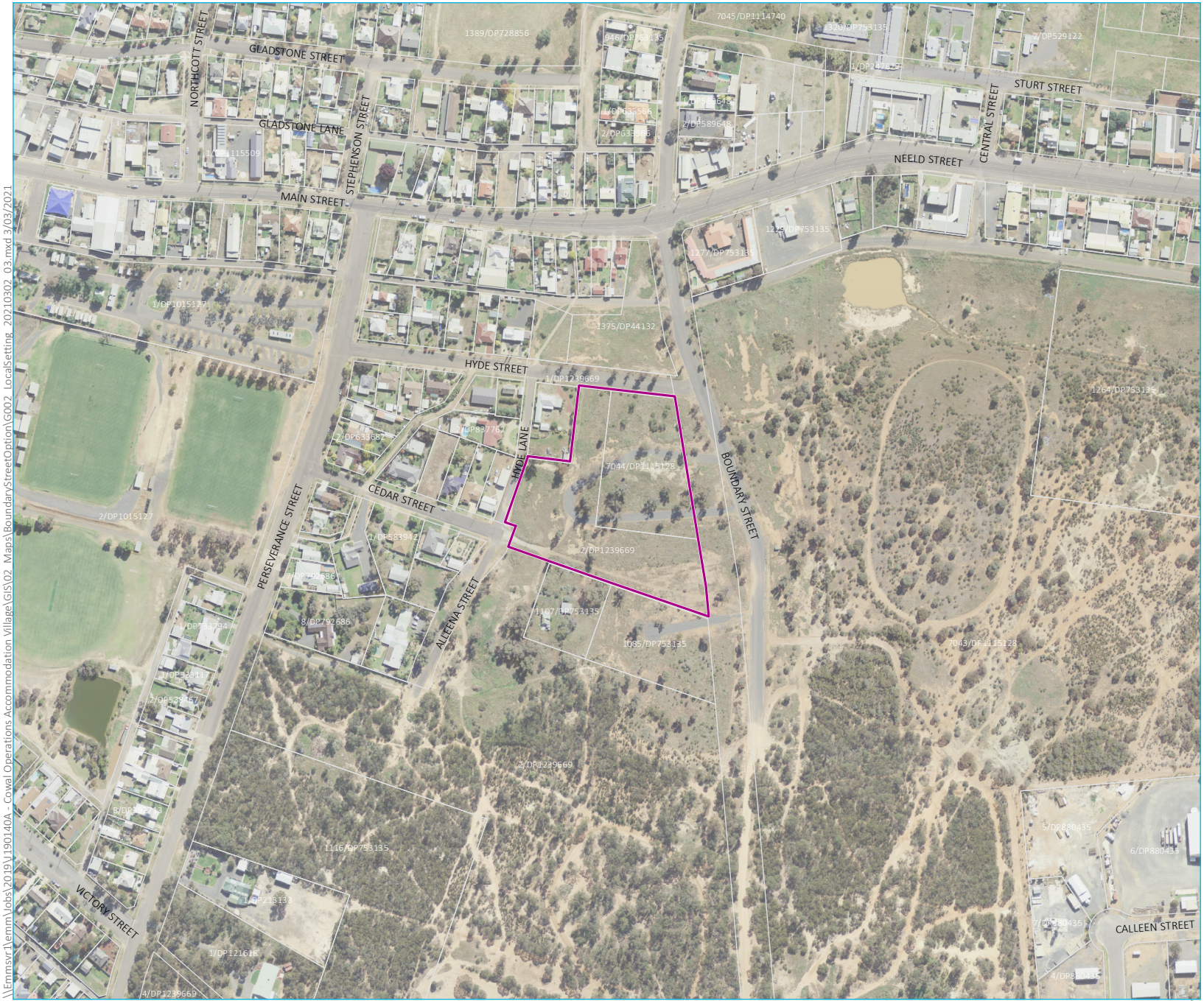

Source: EMM (2021); Evolution (2021); DFSI (2017)

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Local setting

Evolution Mining
Cowal Gold Operations
Accommodation Village - Boundary Street
Construction air quality impact assessment
Figure 1.2

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2 Construction dust risk assessment

2.1 Overview

This section of the report provides an assessment of the dust impacts associated with the construction of the project. The assessment follows the *Guidance on the Assessment of Dust from Demolition and Construction* published by the Institute of Air Quality Management in the United Kingdom (IAQM 2014).

The main air pollution and amenity issues[1] at construction sites are:

- annoyance due to dust deposition (soiling of surfaces) and visible dust plumes;
- elevated particulate matter less than 10 micrometres (µm) in aerodynamic diameter (PM_{10}) concentrations due to dust-generating activities; and
- particulate matter exhaust emissions from diesel-powered construction equipment[2].

Very high levels of soiling can also damage plants and affect the diversity of ecosystems.

Dust emissions can occur during the preparation of the land (eg demolition and earthmoving) and during construction itself. They can vary substantially from day to day depending on the level of activity, the specific operations being undertaken, and the weather conditions.

The risk of dust impacts from a construction site is related to the following:

- the nature of the activities being undertaken;
- the duration of the activities;
- the size of the site;
- the meteorological conditions (wind speed, direction and rainfall), as adverse impacts are more likely to occur downwind of the site and during drier periods;
- the proximity of receptors to the activities;
- the sensitivity of the receptors to dust;
- the adequacy of the mitigation measures applied to reduce or eliminate dust.

Any effects of construction on air pollution and amenity would generally be temporary and relatively short-lived. Moreover, mitigation should be straightforward, as most of the necessary measures are routinely employed as 'good practice' on construction sites. The IAQM approach aims to identify risks and to recommend appropriate mitigation measures.

1 There are other potential impacts, such as the release of heavy metals, asbestos fibres or other pollutants during the demolition of certain buildings. These issues need to be considered on a site by site basis (IAQM 2014).

2 Exhaust emissions from on-site plant and site traffic are unlikely to have a significant impact on local air quality, and in the majority of cases they will not need to be quantitatively assessed (IAQM 2014).

In the IAQM assessment procedure, activities at construction sites are divided into four types:

1. Demolition, which is any activity that involves the removal of existing structures.

2. Earthworks, which covers the processes of soil stripping, ground levelling, excavation and landscaping. Earthworks will primarily involve excavating material, haulage, tipping and stockpiling.

3. Construction, which is any activity that involves the provision of new structures, modification or refurbishment.

4. Track-out, which involves the transport of dust and dirt by vehicles from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

The assessment method considers three separate dust impacts:

- annoyance due to dust soiling;
- the risk of health effects due to an increase in exposure to PM_{10}; and
- harm to ecological receptors.

The procedure for assessing risk is shown in Figure 2.1. Professional judgement is required in some cases, and where justification cannot be given, a precautionary approach is adopted. The assessment is used to define appropriate mitigation measures to ensure that there will be no significant residual effects.

The key steps in the procedure are as follows:

- Step 1 – a screening requirement for a detailed assessment based on the proximity of surrounding receptors;
- Step 2 – an assessment of the risk of dust impacts and the sensitivity of surrounding receptors;
- Step 3 – a determination of site-specific mitigation;
- Step 4 – consideration of residual effects and significance; and
- Step 5 – an assessment report (this document).

The following sections document the construction dust assessment for the project, and recommended mitigation measures are addressed in Section 3.

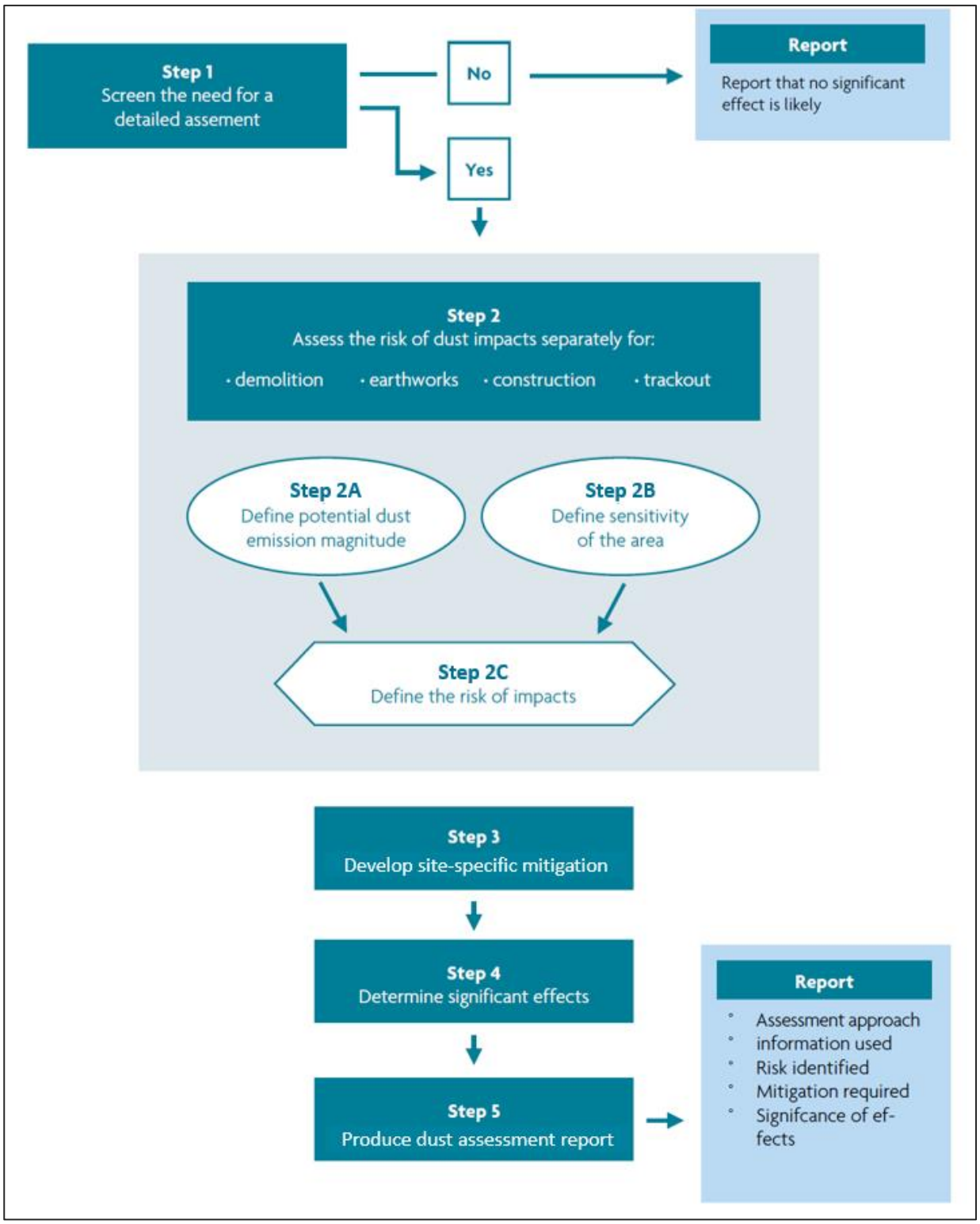


Figure 2.1 Procedure for the assessment of construction dust

2.2 Step 1 – Screening

The IAQM guidance specifies that a detailed construction dust assessment should be undertaken if:

- a human receptor[3] is located within 350 m of the site boundary;
- an ecological receptor[4] is located within 50 m of the site boundary; or
- a human/ecological receptor is within 50 m of a route used by construction vehicles up to 500 m from a site entrance.

The footprint for the project is shown in Figure 1.2.

The results of Step 1 are summarised in Table 2.1. As there were human receptors within 350 m of the boundary of the construction footprint, and ecological receptors within 50 m of the boundary, the proposed construction activities triggered the requirement for a detailed assessment of construction impacts.

Table 2.1 Results of Step 1

Human receptors		Ecological receptors		Detailed assessment required
Within 350 m of site boundary	**Within 50 m of route used by construction vehicles**	**Within 50 m of site boundary**	**Within 50 m of route used by construction vehicles**	
Yes	Yes	Yes	Yes	Yes

2.3 Step 2 – Assessment of risk of dust impacts

The IAQM guidance dictates that the risk category for dust impacts from construction activities should be allocated based on the following:

- the scale and nature of works (Step 2A); and
- the sensitivity of the area to dust impacts (Step 2B).

These factors are then combined to determine the risk of impacts from the construction activities (Step 2C). The risk rating process is addressed in the following sections.

2.3.1 Step 2A – Scale and nature of works

The scale and nature of demolition, earthworks, construction and track-out were determined. The IAQM guidance prescribes a range of criteria that classify the magnitude of each activity as either large, medium or small (see Table A.1 of Appendix A). The proposed activities were reviewed in order to allocate a potential dust emission magnitude in accordance with the guidance, and the findings are summarised in Table 2.2.

[3] A 'human receptor' refers to any location where a person or property may experience the adverse effects of airborne dust or dust soiling, or exposure to PM_{10} over a time period relevant to air quality standards and goals. In terms of annoyance effects, this will most commonly relate to dwellings, but may also refer to other premises such as museums, galleries, vehicle showrooms, food manufacturers, electronics manufacturers, amenity areas and horticultural operations.

[4] An 'ecological receptor' refers to any sensitive habitat affected by dust soiling. This includes the direct impacts on vegetation or aquatic ecosystems of dust deposition, and the indirect impacts on fauna (eg on foraging habitats).

Table 2.2 Dust emission potential

Activity	Project details	Potential dust emission magnitude
Demolition	No demolition required.	Nil
Earthworks	Minor earthworks required including vegetation clearing and grubbing, ground levelling and trenching for service installation.	Medium
Construction	Construction activities include accommodation capacity for up to 176 people, administration buildings, communal facilities, bus shelter, parking, fencing and lighting, reticulated services, and landscaping.	Medium
Track-out	During Stage 1, there will be approximately 40 people per day with 30 light vehicles travelling to/from site. There will be approximately 20 heavy vehicles per week evenly distributed.	Small

2.3.2 Step 2B – Sensitivity of area

In determining the sensitivity of the area to dust impacts, soiling, human health and ecological receptors are treated separately.

i Dust soiling effects on people and property

For dust soiling impacts, the sensitivity of the local area is defined based on the sensitivity of receptors and their number (see Table A.2 of Appendix A). For earthworks, construction and track-out, the receptors within 350 m of the construction footprint were allocated a 'medium' sensitivity rating for dust soiling on the basis of the following:

- any residential receptors (which would normally be given a high rating), where mainly located in the maximum distance band for the assessment (200-350 m); and
- other receptors within 350 m of the project construction boundary were places of work, and mainly storage facilities.

The numbers of buildings in each distance band were estimated using Google Earth. The exact counting of the number of human receptors is not required by the guidance. Instead, it is recommended that judgement is used to determine the approximate number of buildings within each distance band. For buildings which are not dwellings professional judgement should be used to determine the number of human receptors. For this assessment, the following numbers of human receptors per building were assumed:

- residential property = 1 (by convention in the IAQM guidance); and
- commercial = 20.

The numbers of human receptors for commercial premises is based on the assumption that most of the premises in the affected area are motels.

The resulting numbers of human receptors and IAQM distance bands are shown in Table 2.3.

Table 2.3 Numbers of human receptors for dust soiling impacts

	Number of human receptors by distance from construction footprint boundary or routes for construction traffic			
Activity	**<20 m**	**20-50 m**	**50-100 m**	**100-350 m**
Earthworks, construction, track-out	3	2	11	284

Based on the receptor sensitivity and the numbers of receptors within certain distances from construction activities, the sensitivity to dust soiling effects for earthworks and construction was determined to be 'medium' and high for track-out (Table 2.4).

Table 2.4 Summary of sensitivity of area to dust soiling impacts

Activity	**Sensitivity of local area to dust soiling impacts**
Demolition	Nil
Earthworks	Medium
Construction	Medium
Track-out	High

ii Human health impacts

The IAQM guidance defines the approach to categorise the sensitivity of the local area to human health impacts, taking into account the sensitivity of receptors in the area, the proximity and number of receptors, and annual mean concentrations of PM_{10} (see Table A.3 of Appendix A).

For earthworks, construction and track-out activities, the receptors in the area of the project were allocated a 'high' sensitivity rating given that the majority are residential.

Table 2.5 shows the IAQM distance bands for construction and the receptors for human health impacts. For human health impacts the 200 m distance is included. The resulting numbers of human receptors and IAQM distance bands are shown in Table 2.5.

Table 2.5 Numbers of human receptors for human health impacts

	Number of human receptors by distance from construction footprint boundary or routes for construction traffic				
Activity	**<20 m**	**20-50 m**	**50-100 m**	**100-200 m**	**200-350 m**
Earthworks, construction, track-out	3	2	11	47	87

In the Air Quality Impact Assessment (AQIA) for the Cowal Gold Operations Underground Development (EMM 2020), existing pollutant concentrations for air quality impact assessment were quantified using monitoring data obtained from the CGO mine. The annual average PM_{10} concentration for CGO, based on a five-year period from 2014 to 2018 was 17 µg/m^3. Adopting this as background for the site, PM_{10} concentration would be in the 15 – 17.5 µg/m^3 IAQM category. In the absence of PM_{10} monitoring data available in the West Wyalong township, the CGO data provides a conservatively high background for this assessment.

Based on these assumptions, the sensitivity of the local area to human health impacts for earthworks and construction was determined to be 'medium' and high for track-out (Table 2.6).

Table 2.6 Summary of sensitivity of area to human health impacts

Activity	Sensitivity of local area to human health impacts
Demolition	Nil
Earthworks	Medium
Construction	Medium
Track-out	High

iii Ecological impacts

For ecological impacts, the sensitivity of the local area is defined based on the sensitivity of locations and their distance from the construction activity (see Table A.4 of Appendix A).

EMM's ecology team has provided advice regarding potential ecological impacts in the vicinity of the site. The ecological assessment, which included field survey, has determined that plant community type (PCT) 217 Mugga Ironbark (Western Grey Box, cypress pine tall woodland) is present within and immediately south of the site. Whilst this is not a threatened ecological community, there may be potential impacts on vegetation from dust. PCT 177 Blue Mallee (Bull Mallee, Green Mallee, very tall mallee shrubland) which is associated with the Critical Endangered Ecological Community *Mallee and Mallee-Broombush dominated woodland and shrubland lacking Triodia* is also found within the site and to the east and south.

It was therefore assumed that, for all construction activities, there would be ecological receptors within 20 m of the site boundary, and that their sensitivity was 'medium' (ie locations with an important species or national designation, and where sensitivity to dust is uncertain or unknown). As a result, for all construction activities, the sensitivity of the local area to ecological impacts was determined to be 'medium'.

Table 2.7 Summary of sensitivity of area to ecological impacts

Activity	Sensitivity of local area to ecological impacts
Demolition	Nil
Earthworks	Medium
Construction	Medium
Track-out	Medium

2.3.3 Step 2C – Definition of risk of impacts

To determine the risk of impacts with no mitigation applied, the IAQM guidance requires that the dust magnitude rating is combined with the sensitivity of the local area for each of the four activity categories (ie demolition, earthworks, construction and track-out). Using the lookup tables in the guidance (see Table A.5 of Appendix A), risk ratings for each type of activity were allocated and are presented in Table 2.8.

For earthworks and construction, the unmitigated risk was determined to be medium for dust soiling, human health and ecological impacts. For track out, the unmitigated risk was determined to be low for dust soiling and human

health and negligible for ecological impacts. The unmitigated risk ratings in Table 2.8 are useful to help focus and target mitigation measures (Step 3 below), such that these unmitigated risks are reduced to 'not significant'.

Table 2.8 Summary of risk assessment

Activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area			Step 2C: Risk of dust impacts		
		Dust soiling	Human health	Ecological	Dust soiling	Human health	Ecological
Demolition	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Earthworks	Medium	Medium	Medium	Medium	Medium Risk	Medium Risk	Medium Risk
Construction	Medium	Medium	Medium	Medium	Medium Risk	Medium Risk	Medium Risk
Track-out	Small	High	High	Medium	Low Risk	Low Risk	Negligible

2.3.4 Step 3: Recommended mitigation measures

The dust impact risk allocations in Step 2C relate to unmitigated construction dust emissions. Based on the risk of dust impacts identified in Table 2.8, Step 3 involved identifying mitigation measures for each of the four potential activities in Step 2 to further reduce the residual risk for impacts on the surrounding area. The project would be constructed according to conventional methods and would be guided by a Construction Environmental Management Plan (CEMP) to effectively manage site environmental impacts. The measures recommended for inclusion in the CEMP are summarised in Section 3.

2.3.5 Step 4: Significance of risks

Once the appropriate dust mitigation measures have been identified in Step 3, the next step in the IAQM procedure is to determine whether there are residual significant effects arising from the construction phase of a proposed development. For almost all construction activities the aim should be to prevent significant effects on receptors through effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant' (IAQM 2014).

Given the distance between the construction boundary and most residential receptors, construction dust is unlikely to represent a serious ongoing problem at the site, assuming the recommended mitigation measures outlined in Section 3 are implemented. Therefore, the residual risk for impacts on the surrounding area following mitigation will be 'not significant'.

3 Mitigation measures

The project would be constructed according to conventional methods and would be guided by a CEMP to effectively manage off-site environmental impacts. The CEMP may include (but will not be limited to) the recommended mitigation measures listed below. These measures are routinely employed as 'good practice' on construction sites.

The following mitigation measures are recommended:

- prior to commencement of construction activities, develop appropriate communications to notify the nearby residences of the project (duration, types of works, etc), relevant contact details for environmental complaints reporting;
- a complaints logbook will be maintained throughout the construction phase which should include any complaints related to dust. Where a dust complaint is received, the details of the response actions to the complaint should be detailed in the logbook. The logbook should be made available to local authorities when asked;
- record any exceptional incidents that cause dust and/or air emissions, either on or off site, and the action taken to resolve the situation in the logbook;
- hold regular meetings with the operators of other high-risk construction sites within 500 m of the site boundary (if applicable) to ensure that cumulative particulate matter emissions are minimised;
- carry out regular site inspections, record inspection results, and make the logbook available for review as requested;
- plan site layout ensuring that machinery and dust causing activities are located away from receptors as far as possible;
- erect shade cloth barriers to site fences around potentially dusty activities such as trench excavations and material stockpiles where practicable;
- keep site fencing and barriers clean using wet methods (such as through application of sprays), as required;
- remove materials that have a potential to product dust from the site as soon as possible, unless being re-used on the site;
- cover, seed or fence long term stockpiles (if applicable) to prevent wind whipping;
- ensure vehicles switch off engines when stationary where practicable;
- impose a maximum-speed-limit of 20 km/h on all internal roads and work areas during construction;
- deploy water carts to ensure that exposed areas and topsoils/subsoil are kept moist;
- provide an adequate water supply on the construction site for effective dust/particulate matter suppression/mitigation;
- modify working practices by limiting clearing, stripping and spoil handling during periods of adverse weather (hot, dry and windy conditions) and when dust is seen leaving the site;

- limit the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing;
- minimise drop heights from loading or handling equipment;
- re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- avoid scabbling (roughening of concrete surfaces) where possible;
- ensure that sand and other aggregates are stored in bunded areas and are not allowed to dry out unless this is required for a particular process, in which case, ensure that appropriate additional control measures are in place;
- ensure that bulk cement and other find powder materials are delivered in enclosed tankers and stored in silos with emission control systems to prevent escape of materials and overfilling during delivery. For smaller supplies of fine powder materials, ensure that bags are sealed after use and stored appropriately to prevent dust;
- use water-assisted dust sweeper(s), to remove, as necessary, any material tracked out of the site;
- avoid dry sweeping of large areas;
- ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport;
- trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips;
- inspect on-site haul routes for integrity and repair the surface where needed as soon as possible. Haul route inspections should be recorded in a site log book;
- install hard surfaced haul routes where practicable and apply fixed or mobile sprinklers and ensure that they are regularly cleaned; and
- establish a laydown area for the delivery and storage of plant and equipment.

Visual monitoring by construction personnel will represent an effective means of dust monitoring during the construction phase. Visual monitoring should comprise of the following:

- undertaking daily on-site and off-site inspections, where receptors are nearby, to monitor dust. The inspection results should be recorded in a specific log. Inspection should include regular dust soiling checks of surfaces such as street furniture and cars;
- at the commencement of each day's activities, the local meteorological forecast should be reviewed, including the timing of notable increases in wind speed and/or temperature. Appropriate increased intensity or additional mitigation measures should be planned for the day based on this forecast review. The likely meteorological conditions and implications for dust emissions and impacts should be discussed at the morning toolbox meeting; and
- increasing the frequency of site inspections when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions. Should notable visual dust emissions be observed leaving the site boundary, increased intensity or additional mitigation measures should be deployed.

4 Summary and conclusions

The construction dust assessment followed the *Guidance on the Assessment of Dust from Demolition and Construction* published by the Institute of Air Quality Management in the United Kingdom. A risk-based methodology was used to consider amenity impacts due to dust soiling, health effects due to an increase in exposure to PM_{10}, and harm to ecological receptors.

For earthworks and construction, the unmitigated risk was determined to be medium for dust soiling, human health and ecological impacts. For track out, the unmitigated risk was determined to be low for dust soiling and human health and negligible for ecological impacts.

However, assuming recommended mitigation measures are implemented for the project, the residual risk for impacts on the surrounding area following mitigation will be 'not significant'.

Recommended mitigation measures include logging dust complaints, carrying out regular inspections and recording results, providing adequate water supply for dust suppression and ensuring that vehicles entering and leaving sites are covered to prevent escape of materials during transport. These measures are routinely employed as 'good practice' on construction sites and should be included in the CEMP prepared for the project.

5 References

EMM 2020, Cowal Gold Operations Underground Development – air quality and greenhouse gas assessment o support SSD application and Modification 16, prepared by EMM Consulting for Evolution Mining (Cowal) Pty Limited), August 2020.

IAQM 2014, Guidance on the assessment of dust from demolition and construction, Version 1.1, Institute of Air Quality Management, London, www.iaqm.co.uk/ text/guidance/construction-dust-2014.pdf.

Appendix A

IAQM criteria

The assessment criteria in the IAQM guidance are summarised in the following tables.

Table A.1 Site categories (scale of works)

Type of activity	Site category definitions		
	Large	**Medium**	**Small**
Demolition	Building volume >50,000 m^3, potentially dusty construction material (eg concrete), on-site crushing and screening, demolition activities >20 m above ground level.	Building volume 20,000–50,000m^3, potentially dusty construction material, demolition activities 10-20 m above ground level.	Building volume <20,000 m^3, construction material with low potential for dust release (eg metal cladding, timber), demolition activities <10 m above ground and during wetter months.
Earthworks	Site area >10,000 m^2, potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth-moving vehicles active at any one time, formation of bunds>8 m in height, total material moved >100,000 tonnes.	Site area 2,500-10,000 m^2, moderately dusty soil type (eg silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4-8 m in height, total material moved 20,000-100,000 tonnes.	Site area <2,500 m^2, soil type with large grain size (eg sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <20,000 tonnes, earthworks during wetter months.
Construction	Total building volume >100,000 m^3, piling, on site concrete batching; sandblasting	Building volume 25,000-100,000 m^3, potentially dusty construction material (eg concrete), piling, on site concrete batching.	Total building volume <25,000 m^3, construction material with low potential for dust release (eg metal cladding or timber).
Track-out	>50 HDV (>3.5t) OUTWARD movements in any one day, potentially dusty surface material (eg high clay content), unpaved road length >100 m.	10-50 HDV (>3.5t) OUTWARD movements in any one day, moderately dusty surface material (eg high clay content), unpaved road length 50–100 m.	<10 HDV (>3.5t) OUTWARD movements in any one day, surface material with low potential for dust release, unpaved road length <50 m.

Table A.2 Sensitivity of area to dust soiling impacts

Receptor sensitivity	Number of receptors	Distance from source (m)			
		<20	**<50**	**<100**	**<350**
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A.3 Sensitivity of area to human health impacts

Receptor sensitivity	Annual mean PM_{10} concentration	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>20 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	17.5 - 20 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	15 – 17.5 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<15 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>20 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	17.5 - 20 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	15 – 17.5 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<15 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

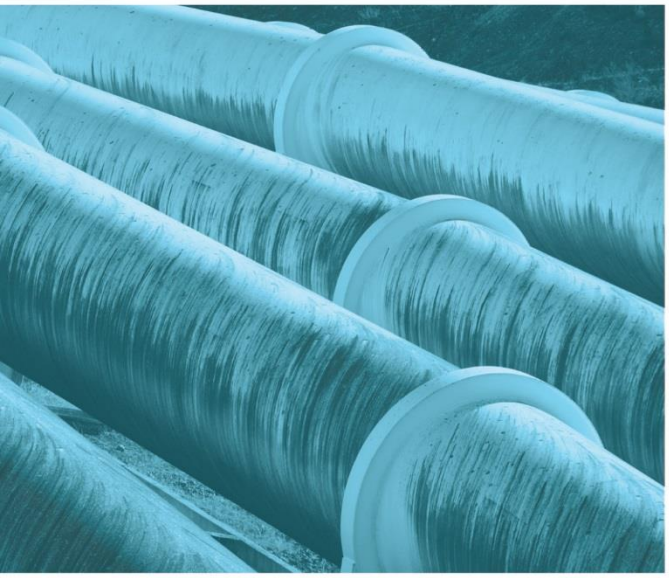
Table A.4 Sensitivity of area to ecological impacts

Receptor sensitivity	Distance from source (m)	
	<20	20-50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Table A.5 Risk of dust impacts

Type of activity	Sensitivity of area	Dust emission potential		
		Large	**Medium**	**Small**
Demolition	High	High Risk	Medium Risk	Medium Risk
	Medium	High Risk	Medium Risk	Low Risk
	Low	Medium Risk	Low Risk	Negligible
Earthworks	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Medium Risk	Low Risk
	Low	Low Risk	Low Risk	Negligible
Construction	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Medium Risk	Low Risk
	Low	Low Risk	Low Risk	Negligible
Track-out	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Low Risk	Negligible
	Low	Low Risk	Low Risk	Negligible








Appendix M

Traffic impact assessment

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Traffic Impact Assessment

Cowal Gold Operations Accommodation Village

Prepared for Evolution Mining (Cowal) Pty Limited
March 2021

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Traffic Impact Assessment

Cowal Gold Operations Accommodation Village

Report Number

J190140A RP5

Client

Evolution Mining (Cowal) Pty Limited

Date

24 March 2021

Version

v1 Final

Prepared by

Baqir Husain
Traffic Engineer
24 March 2021

Approved by

Tim Brooker
Associate Transport Planner
24 March 2021

Executive Summary

Evolution Mining (Cowal) Pty Limited (Evolution) proposes to construct and operate an accommodation village (the project) on vacant land comprising the whole of Lot 7044 DP1115128 and a portion of Lot 2 DP1239669 (the site), located immediately west of Boundary Street, West Wyalong, NSW. The project will be located within the Bland Shire Local Government Area (LGA).

The village is being developed to house the anticipated workforce associated with the construction and operation of the Cowal Gold Operations (CGO) Underground Development Project, located approximately 38 kilometres (km) north-east of West Wyalong.

This traffic impact assessment (TIA) has been prepared to assess the impacts on the local road network of both the construction phase workforce traffic during construction of the accommodation village and the habitation phase workforce traffic, during construction and operation of the CGO Underground Development Project.

Potential traffic impacts were assessed through intersection performance (SIDRA) modelling, mid-block capacity analysis and assessment of any potential impacts on public transport services, pedestrian and cyclist access.

The key findings of the TIA are as follows:

- Boundary Street/Main Street intersection operates within capacity for all project-related scenarios modelled for both AM and PM peak hours;
- the mid-block capacities of Boundary Street and Main Street operate with level of service (LOS) B or better;
- the number of car spaces provided meets the proposed development requirements; and
- public transport services, pedestrian and cycling infrastructure will not be significantly impacted.

Based on the results of this TIA report, it is concluded that the construction and habitation phase workforce traffic for the accommodation village will not have significant traffic impacts on the nearby road network. Therefore, no mitigating measures or road works are deemed necessary for the project.

Table of Contents

Appendices

Tables

Figures

Plates

1 Introduction

1.1 Background

Evolution Mining (Cowal) Pty Limited (Evolution) proposes to construct and operate an accommodation village (the project) on vacant land comprising the whole of Lot 7044 DP1115128 and a portion of Lot 2 DP1239669 (the site), located immediately west of Boundary Street, West Wyalong (see Figure 1.1 and Figure 1.2).

EMM Consulting Pty Limited (EMM) has been engaged by Evolution to prepare a statement of environmental effects (SEE) and accompanying development application (DA) for the project under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This traffic assessment has been prepared by EMM in support of the SEE for the project.

1.2 Project description

The project will be located within the Bland Shire Local Government Area (LGA) and will be considered as a multi-dwelling residential development under the *Bland Local Environmental Plan 2011* (LEP) and *Bland Shire Development Control Plan 2012* (DCP).

The village is being developed to house the anticipated workforce associated with the construction and operation of the Cowal Gold Operations (CGO) Underground Development Project, located approximately 38 kilometres (km) north-east of West Wyalong (see Figure 1.1). The CGO Underground Development Project is currently the subject of a State significant development (SSD) application (SSD 10367), under section 4.38 of the EP&A Act.

The project conceptually comprises the following key components:

- accommodation capacity for up to 176 people in total supporting the CGO Underground Development Project, including:
  - temporary construction workforce accommodation modules to house 96 people;
  - semi-permanent operational workforce accommodation modules to house 72 people;
  - semi-permanent accessible accommodation modules to house 8 people, with facilities which are Commonwealth *Disability Discrimination Act 1992* (DDA) compliant;
- use of existing access points off Boundary Street and upgrade of existing on-site roads;
- administration buildings;
- communal facilities, including:
  - laundry units;
  - communal dining and kitchen building;
  - outdoor eating areas;
  - first aid and nursing room;
  - prayer room;

  - quiet room;
  - gymnasium;
  - multipurpose outdoor court; and
  - running track;
- undercover bus shelter and bus parking spaces;
- light vehicle car parking;
- fencing and lighting;
- reticulated services; and
- landscaping.

The village components will be modular in design with different layouts dependent on the workforce (construction, operational and accessible) supporting the CGO Underground Development Project. The development will be staged, with the operational and accessible workforce modules being constructed first to ensure this area of the village is ready to house the construction workforce as soon as possible. The construction workforce modules will be completed as soon as possible thereafter.

Approval is sought for all stages of development as part of the SEE and DA. Construction of the accommodation modules is expected to take approximately eight months. Additional amenities / facilities will be added within three years, after removal of construction accommodation modules. Minor earthworks will be required for site establishment activities, including vegetation clearing and grubbing, ground levelling and trenching for service installation. Any excavated topsoil will be stockpiled and reused on site where possible.

Appropriate security measures such as fencing, gates, cameras and night lighting will be installed. Site landscaping will be undertaken to increase visual amenity consistent with the surrounding neighbourhood and will incorporate water sensitive urban design practices. This includes maintaining existing native vegetation wherever possible.

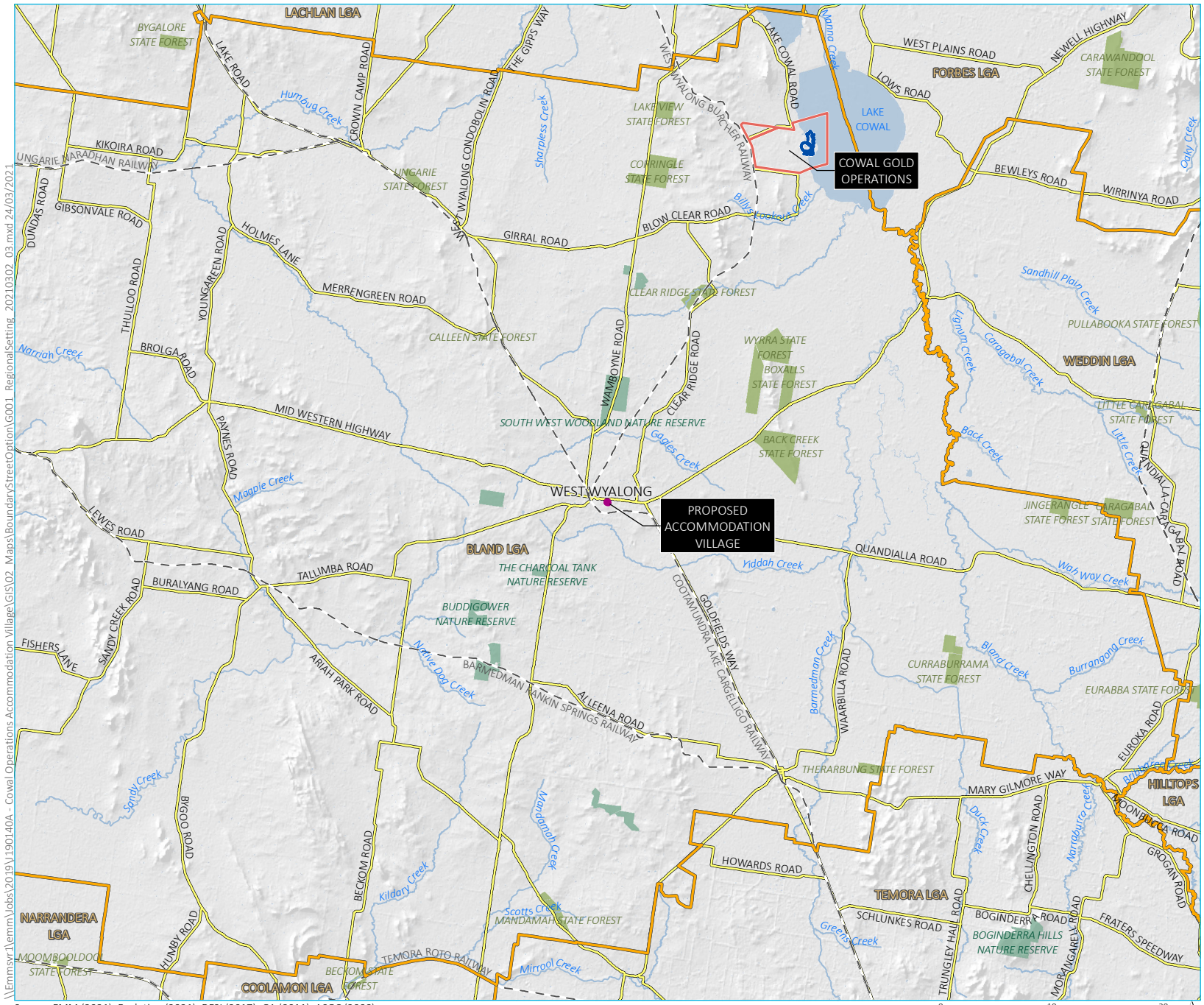
1.3 Site description

The site is located between Boundary Street and Aleena Street in West Wyalong, in central west New South Wales (NSW), which is located approximately 360 km west of Sydney (see Figure 1.1). Under the Bland LEP (Land Zoning Map – Sheet LZN_007F), the site is zoned as Zone R1 General Residential.

The site is located on vacant freehold land comprising the whole of Lot 7044 DP1115128 and a portion of Lot 2 DP1239669 (see Figure 1.2), held by the West Wyalong Local Aboriginal Land Council (LALC) (subject to determination of native title). A native title claim (NN2020/007) was lodged on 21 August 2020 by the West Wyalong LALC over part of the site. This claim was yet to be determined at the time of writing.

The site was formerly the location of Barrick Gold's accommodation village, constructed in 2004 for use as a temporary residential village to support employees working at the CGO. The Barrick Gold accommodation village was demolished between 2005-2006 and the site is currently devoid of built structures. The site is located within a larger area of relatively flat vacant land which contains fragmented native vegetation.

The site is bordered by Hyde Lane and Cedar Street to the west and Hyde Street to the north. Other land uses surrounding the site include residential, industrial and retail. The closest private residence is located immediately west of the site on Hyde Lane.



KEY

- Site boundary
- Proposed underground development
- Mining lease
- Rail line
- Main road
- Named watercourse
- Waterbody
- Local government area
- NPWS reserve
- State forest

Source: EMM (2021); Evolution (2021); DFSI (2017); GA (2011); ASGC (2006)

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Regional context

Evolution Mining
Cowal Gold Operations
Accommodation Village - Boundary Street
Traffic impact assessment
Figure 1.1

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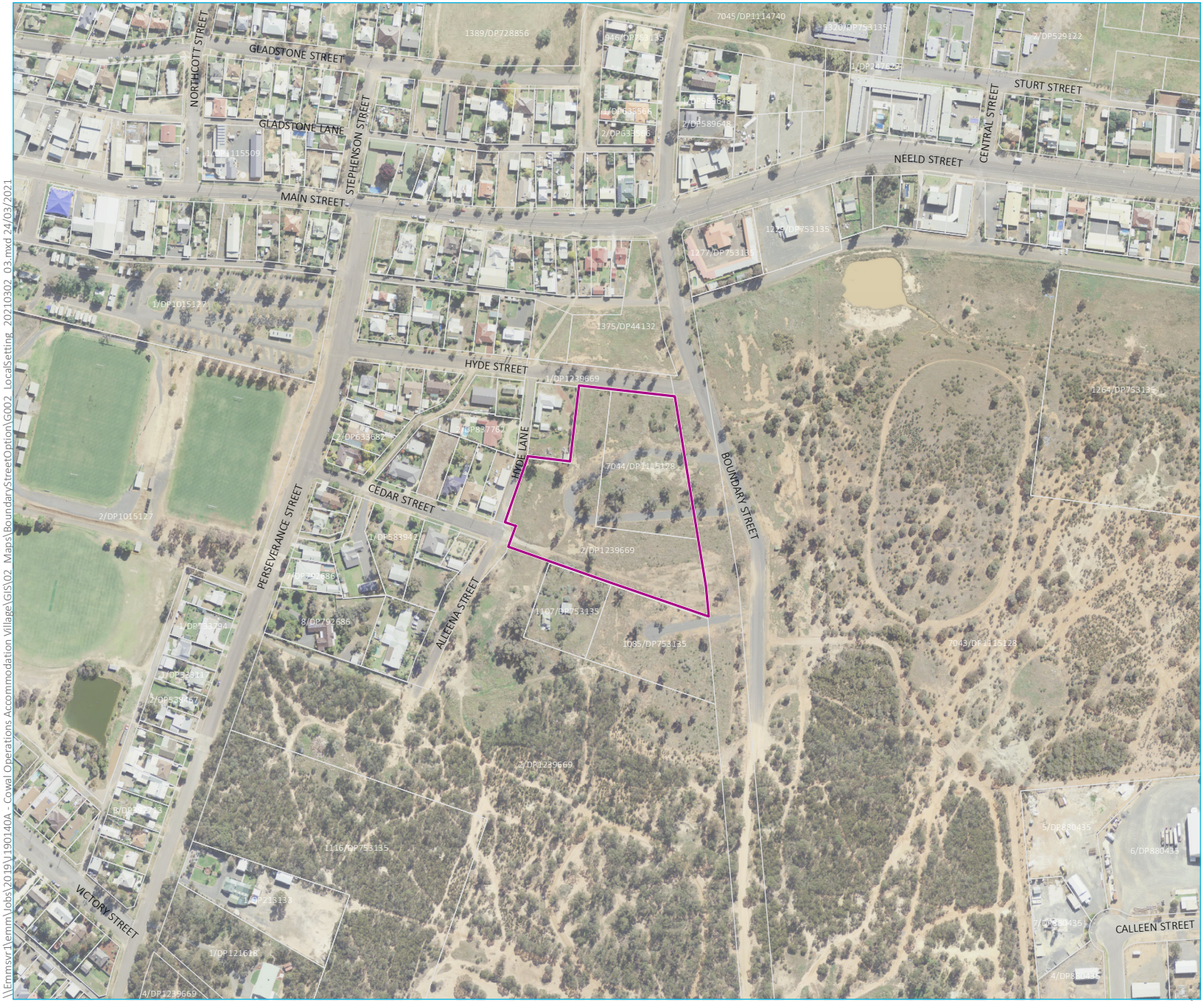

Source: EMM (2021); Evolution (2021); DFSI (2017)

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Local context

Evolution Mining
Cowal Gold Operations
Accommodation Village - Boundary Street
Traffic impact assessment
Figure 1.2

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1.4 Purpose of this report

This TIA has been prepared in accordance with the relevant Council and NSW government assessment requirements, guidelines and policies, and in consultation with the relevant government agencies.

The assessment is based on the following general scope for matters to consider in a TIA, which is defined by the Transport for NSW (TfNSW) Guide to Traffic Generating Developments (RTA, 2002):

- the site access and traffic arrangements;
- the existing traffic flows on major roads and at intersections in the locality;
- the proposed construction and operational traffic circulation and car parking;
- effects of the proposal on the external road network and intersections;
- SIDRA intersection analysis; and
- effects of the proposal on traffic safety, public transport, pedestrian and cycling facilities.

A visual inspection of the primary affected road, which is Boundary Street, has been undertaken to confirm the current general road widths and traffic condition for this route and photographs have been taken at the key project access intersections.

2 Existing conditions

2.1 Site access

The site has existing access from Boundary Street as shown in Plate 2.1.

Source: EMM

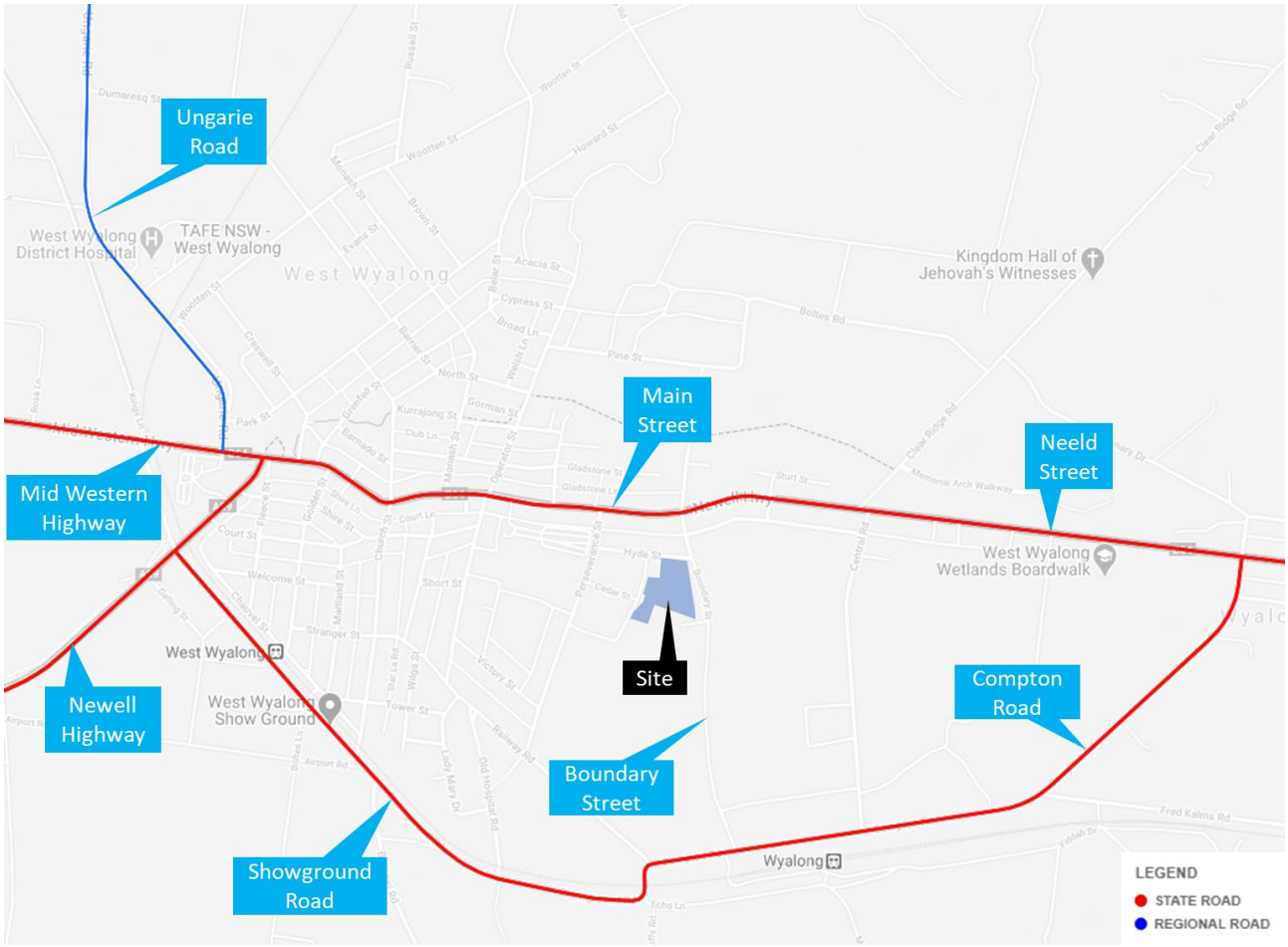
Plate 2.1 Existing site access

2.2 Road network

The NSW administrative road hierarchy comprises the following road classifications, which align with the generic road hierarchy, as follows:

- state roads – freeways and primary arterials (TfNSW managed);
- regional roads – secondary or sub arterials (council managed and part funded by the State); and
- local roads – collector and local access roads (council managed).

The road hierarchy near the site is shown in Figure 2.1. An overview of each of the key roads near the site is provided in Table 2.1 and Table 2.2. Images of the key roads of Boundary Street and Main Street are shown in Plate 2.2 and Plate 2.3, respectively.



Source: Carto

Figure 2.1 Road hierarchy near site

Table 2.1 Boundary Street roadway attributes- overview

Aspect	Description
Road classification and connectivity	Local road between Pine Street (north) and Compton Road (south)
Alignment	North-south
Number of lanes	One lane each way
Carriageway type	Sealed road for approx. 450m from Main Street/Newell Highway. The remaining section is unsealed.
Carriageway width	Approximately 13 m
Posted speed limit	50 km/h
Heavy vehicle access	No heavy vehicle access
Traffic function	Carries local traffic
Additional comments	The road section between Newell Highway and the site is sealed

Source: EMM

Plate 2.2 Boundary Street (looking northbound)

Table 2.2 Main Street roadway attributes- overview

Aspect	Description
Road classification and connectivity	State road between Mid Western Highway (west) and Neeld Street (east)
Alignment	East-west
Number of lanes	One lane each way
Carriageway type	Sealed road
Carriageway width	Approximately 12 m with 3.5 m travel lanes, a parking lane is provided on both sides of the road
Posted speed limit	50 km/h
Heavy vehicle access	26 m B-double approved
Traffic function	Provides arterial connection between townships

Source: EMM

Plate 2.3 Main Street (looking eastbound)

2.3 Key intersection

The key intersection which has been assessed for the project related traffic impacts is Boundary Street / Main Street (Neeld Street), as shown in Figure 2.2 and Figure 2.3 and described in Table 2.3.

Source: Google Maps

Figure 2.2 Key intersection

Table 2.3 Boundary Street / Main Street intersection attributes

Aspect	Description
Location from the site	210m south-east of the site
Intersection control	Signalised intersection
Major Road	Boundary Street
North Approach	Two shared lanes on approach and departure. Kerbside lane on approach and departure is short due to parking
South Approach	Two shared lanes on approach and departure. Kerbside lane on departure is short due to parking
Each Approach	Two shared lanes on approach and departure. Kerbside lane on approach and departure is short due to parking
West Approach	Two shared lanes on approach and departure.
Pedestrian Connectivity	Pedestrian connectivity is provided in all approaches
Traffic function	Predominantly carries regional and local traffic
Speed limit	50 km/hour in all approaches

Source: SIX Maps

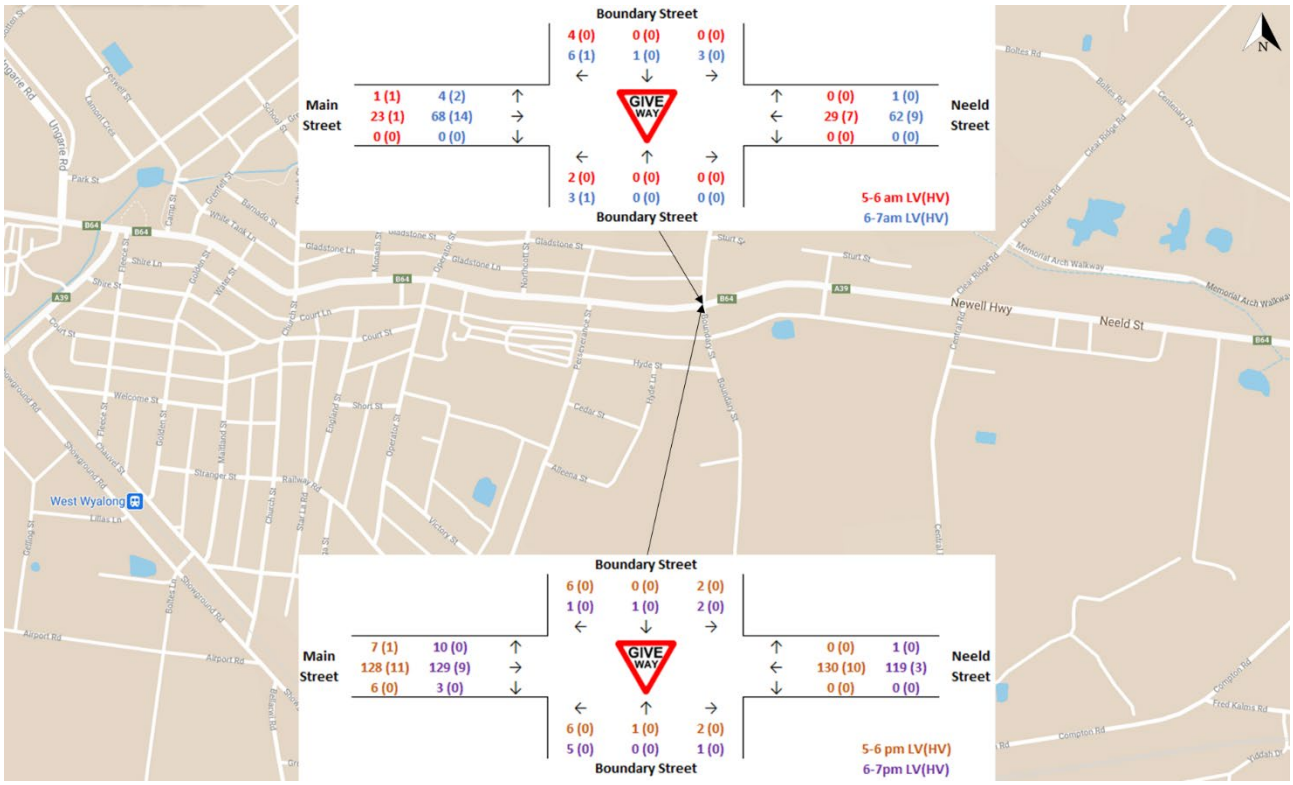
Figure 2.3 Boundary Street/Main Street intersection

2.4 Existing traffic volumes

2.4.1 Intersection counts

The Boundary Street/Main Street intersection was manually surveyed between 5 am and 7 am and between 5 pm and 7 pm, on 6 August 2020. The survey count data is provided in Appendix A.

The surveyed traffic volumes during the AM and PM peak hours are summarised in Figure 2.4. The LV and HV in the figures correspond to light vehicles and heavy vehicles, respectively.



Source: Google Maps

Figure 2.4 Existing AM & PM peak surveyed traffic volume

2.4.2 Average annual daily traffic volume

The annual average daily traffic (AADT) data for weekdays was obtained from TfNSW traffic volume viewer website for the year 2019. The AADT data was retrieved for Newell Highway from the permanent classifier station approximately 420m east of Nicholson Lane on Newell Highway. The AADT data is presented in Figure 2.5.

The AADT data shows a high proportion of heavy vehicles as the traffic count location is on a section of the Newell Highway, east of the heavy vehicle bypass route via Showground Road, Compton Road and Copeland Street, which diverts most of the Newell Highway and Mid-Western Highway heavy vehicle traffic around the township area of West Wyalong.

Source: Google Maps

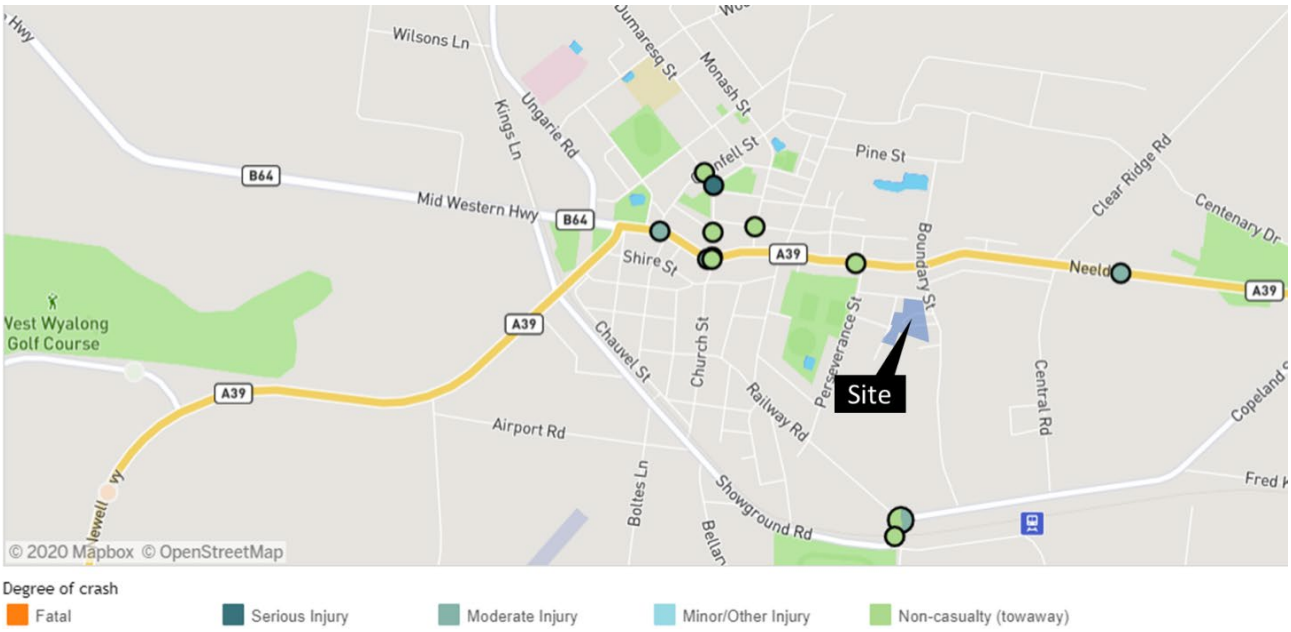
Figure 2.5 Summary of 2019 AADT volume

2.5 Crash analysis

Crash data from TfNSW Centre for Road Safety interactive history database for the West Wyalong urban area for the last five years between 2015 and 2019 has been studied in the vicinity of the site and is presented in Figure 2.6.

The crashes are categorised based on the severity of the crashes as follows:

- fatal;
- serious injury;
- moderate injury;
- minor/other injury; or
- non-casualty (eg towaway).



Source: TfNSW Centre for Road Safety

Figure 2.6 Crash data between 2015 and 2019

There were no fatal incidents in the vicinity of the site between 2015 and 2019 and there were no reported crashes on Boundary Street. Newell Highway (including Main Street and Neeld Street) had six reported crashes with the highest degree of crash being moderate injury. Several crashes were recorded on other local streets of West Wyalong north-west of the site.

Only one crash was recorded as serious injury (on School Street). This overall crash rate is considered low over the 5-year period, which indicates that the road can be considered safe currently. The detailed crash analysis is presented in Table 2.4.

Table 2.4 Crash history (2015-2019)

Intersection / road / street	Report year	Degree of crash	Crash	Speeding	Fatigue	Truck involvement
Newell Highway (including Main Street and Neeld Street)	2018	Minor/other injury	1	0	0	0
		Moderate injury	2	1	1	0
	2019	Non-casualty (towaway)	2	0	0	2
		Moderate injury	1	0	0	1
Showground Road	2015	Non-casualty (towaway)	1	1	0	0
	2016	Non-casualty (towaway)	1	1	0	0
	2017	Moderate injury	1	0	0	0

Table 2.4 Crash history (2015-2019)

Intersection / road / street	Report year	Degree of crash	Crash	Speeding	Fatigue	Truck involvement
School Street	2015	Non-casualty (towaway)	1	0	0	0
		Serious injury	1	0	0	0
Church Street	2016	Non-casualty (towaway)	1	0	0	0
Monash Street	2018	Non-casualty (towaway)	1	0	0	0
Overall			**13**	**3**	**1**	**3**

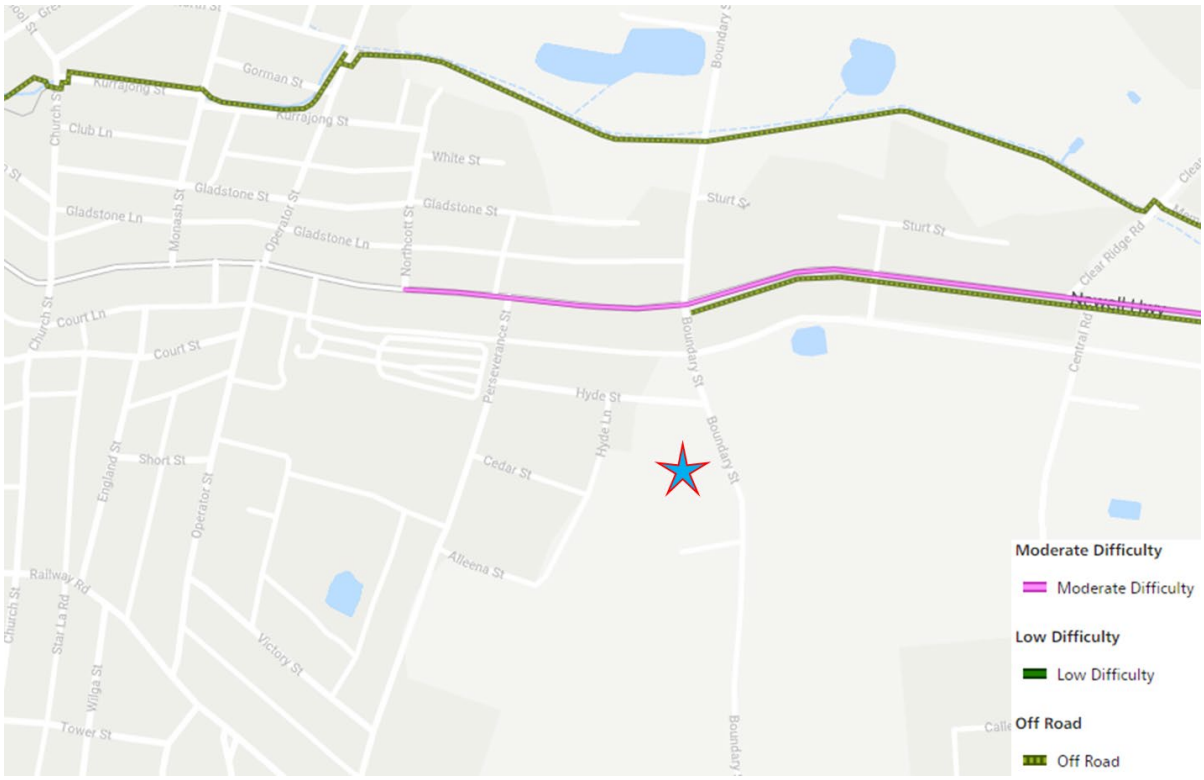
2.6 Public transport

West Wyalong does not have public transport bus services operating within the town. Regional coach services operate from the coach stop on Church Street. The regional coach services provide connections between Wagga Wagga and Condobolin Town.

2.7 Walking and cycling

There are currently no pedestrian footpaths on any side of the road along Boundary Street. This is due to the surrounding land being mostly unoccupied or vacant lots.

There is no specific on or off-road cycling infrastructure along Boundary Street (Figure 2.7). There are cycling paths along Newell Highway however they are not continuous.



Source: TfNSW Cycleway Finder

Figure 2.7 Bicycle network in the vicinity of the site

3 The proposal

3.1 Hours of operation

The proposed construction work hours for the CGO Underground Development Project will be from 6 am to 6 pm seven days per week, resulting in two significant hourly peaks of construction related traffic movements, travelling inbound to the mine site between 5-6 am and travelling outbound from the mine site between 6-7 pm.

The operational work hours for the CGO Underground Development Project will be from 6 am to 6 pm and from 6 pm to 6 am, seven days per week. This results in four significant hourly peaks of operational workforce traffic movements, travelling inbound to the mine site between 5-6 am and 5-6 pm seven days per week and travelling outbound from the mine site between 6-7 am and 6-7 pm seven days per week.

3.2 Workforce

The workforce for the project will be divided into two workforce streams:

1. The **construction workforce** for the accommodation village, ie the workforce who will construct the village, consisting of a peak workforce of 40 workers per day, with the assumption being that this workforce will reside off-site.

2. The **habitation workforce**, ie the workforce who will service the construction and operation of the CGO Underground Development Project, consisting of a peak workforce of 176 workers at maximum village inhabitation, with the assumption being that this workforce will reside on-site once the village is constructed.

For the purposes of the TIA, it has been assumed that the accommodation village will be constructed in four stages, with approximate staging and inhabitation as follows:

- **Stage 1:** accommodation modules to house 52 people associated with the construction of the CGO Underground Development Project, plus construction of enabling infrastructure and amenities sufficient for the operation of Stage 1.

- **Stage 2:** accommodation modules to house 48 people associated with the construction of the CGO Underground Development Project.

- **Stage 3:** accommodation modules to house 76 people associated with the operation of the CGO Underground Development Project.

- **Stage 4:** Provisional spatial design for additional amenities.

Construction of the accommodation modules (Stages 1 to 3) is expected to take approximately eight months in total. Additional amenities / facilities in stage 4 will be added within three years, post removal of construction accommodation modules. Minor changes to the total number of people within each stage are not likely to materially change the findings of this TIA.

3.3 Traffic generation

As for the workforce, the traffic generation for the accommodation village has been divided into two traffic streams:

1. The traffic associated with the **construction workforce** for the accommodation village, where workers will reside off-site.

2. The traffic associated with the **habitation workforce** (construction and operation of the CGO Underground Development Project), where workers will reside on-site, with staged occupation as described in sub-Section 3.2 (Stages 1 to 3).

Traffic associated with village construction will involve movement of heavy vehicles and light vehicles to and from the site.

Traffic associated with the construction and operational phases of the CGO Underground Development Project will involve movements of light vehicles and buses transporting the workforces between the accommodation village and the CGO sites. It will also include accommodation village service vehicle trips and trips made by staff or residents to or from the accommodation village for non-mine related purposes, eg trips to or from the West Wyalong business district.

3.4 Construction phase traffic

It has been assumed that the traffic for construction of the accommodation village will consist of a peak workforce of 40 workers per day residing off-site, generating approximately 30 light vehicle trips (assumed 1.5 workers per light vehicle). It has been assumed that there will be approximately 20 heavy vehicles per week evenly distributed, which translates to approximately 4 heavy vehicles per day. A 'vehicle trip' is defined as a vehicle entering the site once (1 movement) and a vehicle exiting the site once (1 movement).

3.4.1 Daily traffic generation

The daily traffic generation for the construction phase of the accommodation village is presented in Table 3.1.

Table 3.1 Daily traffic generation – accommodation village construction

Trips description	Daily Light Vehicle Trips	Daily Heavy Vehicle Trips
Construction traffic	60	8

3.4.2 Peak hour traffic generation

The peak hour traffic generation for the construction phase of the accommodation village is presented in Table 3.2.

Table 3.2 Peak hour traffic generation – accommodation village construction

Trips description	Light Vehicle Trips		Heavy Vehicle Trips	
	AM Peak	PM Peak	AM Peak	PM Peak
Construction traffic	30	30	4	4

3.5 Habitation phase traffic

Due to the overlap of the habitation workforce stages (construction and operational workforces), and to observe a conservative approach, the traffic associated with construction and operation of the CGO Underground Development Project considers trips from the three stages of habitation (Stages 1, 2 and 3) for a total workforce of 176 people. The following assumptions have been made to estimate trip generation:

- 'Bus trips' are calculated for the 75% split of workers who it has been assumed will be using a company supplied bus to travel to and from the CGO mine site, with a capacity of 30 pax per bus assumed.
- 'Additional trips village operations' refers to the trips made by staff or residents to or from the accommodation village for non-mine related purposes (eg travelling to or from the West Wyalong business district).
- 'Mine related LV trips' refers to the remaining 25% split of workers who it has been assumed will be using light vehicles to travel to and from the mine. It is assumed each worker will contribute 1 vehicle trip.

3.5.1 Daily traffic generation

The daily traffic generation for all three stages of village habitation is presented in Table 3.3.

Table 3.3 Daily traffic generation – accommodation village habitation

Stage and trips description	Daily Light Vehicle Trips	Daily Heavy Vehicle Trips
Stage 1 CGO Underground Development Project construction traffic (52 workers)		
Bus trips	-	4
Mine related LV trips	26	-
Additional trips village operations	40	10
Daily MRV[1] waste vehicle	-	2
Total	**66**	**16**
Stage 2 CGO Underground Development Project construction traffic (48 workers)		
Bus trips	-	4
Mine related LV trips	24	-
Additional trips village operations	40	10
Daily MRV waste vehicle	-	2
Total	**64**	**16**
Stage 3 CGO Underground Development Project operations traffic (76 workers)		
Bus trips	-	8
Mine related LV trips	76	-
Additional trips village operations	40	10
Daily MRV waste vehicle	-	2
Total	**116**	**20**

[1] MRV = Medium Rigid Vehicle

Table 3.3 Daily traffic generation – accommodation village habitation

Stage and trips description	Daily Light Vehicle Trips	Daily Heavy Vehicle Trips
Combined all stages traffic (176 workers)		
Bus trips	-	16
Mine related LV trips	126	-
Additional trips village operations	120	30
Daily MRV waste vehicle	-	2
Total	**246**	**48**

3.5.2 Peak hour traffic generation

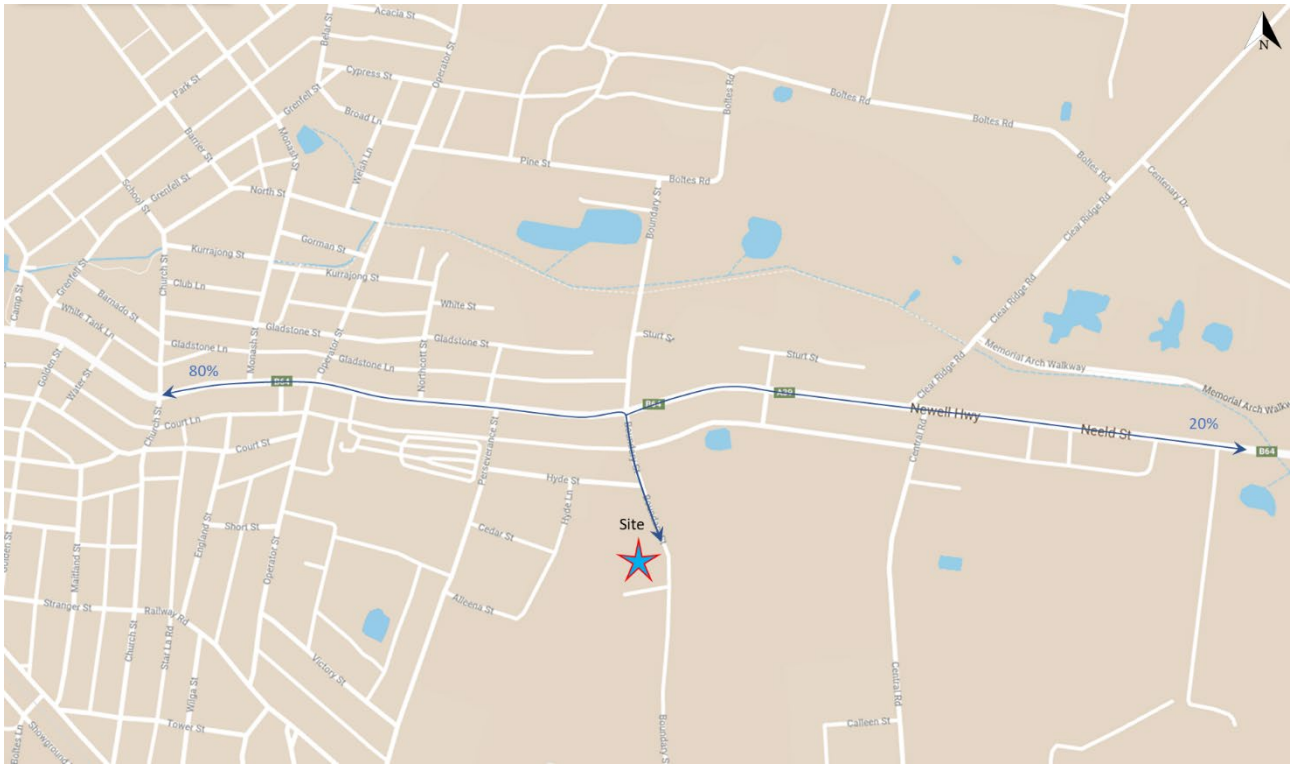
The peak hour traffic generation for all three stages of village habitation is presented in Table 3.4. The midday peak represents trips made by staff or residents to or from the accommodation village for non-mine related purposes.

Table 3.4 Peak hour traffic generation – accommodation village habitation

Stage and trips description	Light Vehicle Trips			Heavy Vehicle Trips		
	AM Peak	PM Peak	Midday Peak	AM Peak	PM Peak	Midday Peak
Stage 1 CGO Underground Development Project construction traffic (52 workers)						
Bus trips				2	2	
Mine related LV trips	13	13				
Additional trips village operations			6			2
Total	**13**	**13**	**6**	**2**	**2**	**2**
Stage 2 CGO Underground Development Project construction traffic (48 workers)						
Bus trips				2	2	
Mine related LV trips	12	12				
Additional trips village operations			6			2
Total	**12**	**12**	**6**	**2**	**2**	**2**
Stage 3 CGO Underground Development Project operations traffic (76 workers)						
Bus trips				4	4	
Mine related LV trips	38	38				
Additional trips village operations			6			2
Total	**38**	**38**	**6**	**2**	**2**	**2**
Combined all stages traffic (176 workers)						
Bus trips				8	8	
Mine related LV trips	63	63				
Additional trips village operations			18			6
Total	**63**	**63**	**18**	**8**	**8**	**6**

3.6 Traffic distribution

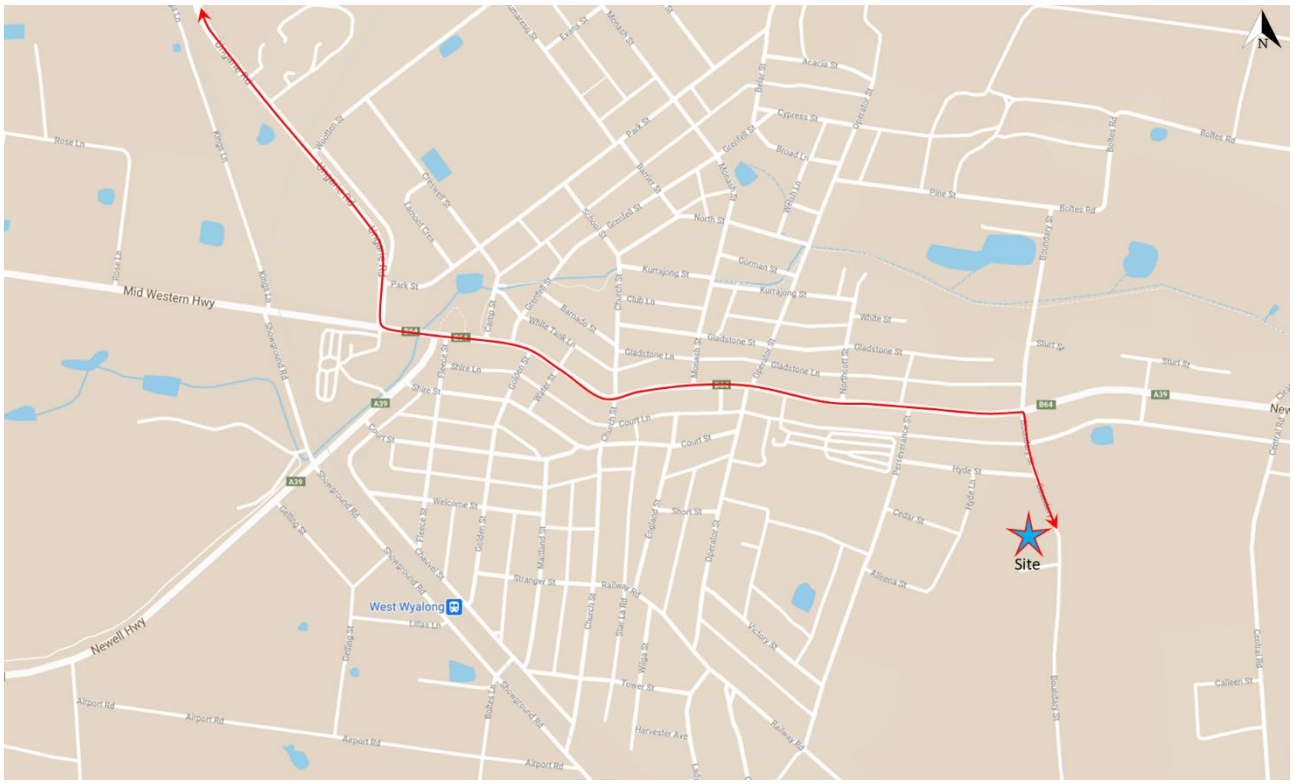
The main routes to approach/depart from the site are Boundary Street and Main Street. Trips associated with the accommodation village construction are expected to be split approximately 80% coming from the west and 20% coming from the east along Main Street. The trip distribution for the accommodation village construction is presented in Figure 3.1.



Source: Google Maps

Figure 3.1 Accommodation village construction trip distribution

Construction and operational trips to/from the CGO Underground Development Project will travel west from Boundary Street/Main Street intersection and turn right onto Ungarie Road. The trip distribution for the CGO Underground Development Project is presented in Figure 3.2.



Source: Google Maps

Figure 3.2 CGO Underground Development Project trip distribution

3.7 Development traffic

For the purposes of modelling the traffic movements associated with the different stages of accommodation village development and habitation, the development traffic has been split into three scenarios, as follows:

- Scenario 1 – traffic for the **construction workforce** for the accommodation village (40 workers).
- Scenario 2 – traffic for the **habitation workforce** (construction workforce only) for the CGO Underground Development Project (100 workers).
- Scenario 3 – traffic for the combined **habitation workforce** (construction + operational workforces) for the CGO Underground Development Project (176 workers).

The development traffic distribution volumes are presented in Figure 3.3, Figure 3.4 and Figure 3.5. The combined existing + development traffic volumes are presented in Figure 3.6, Figure 3.7 and Figure 3.8.

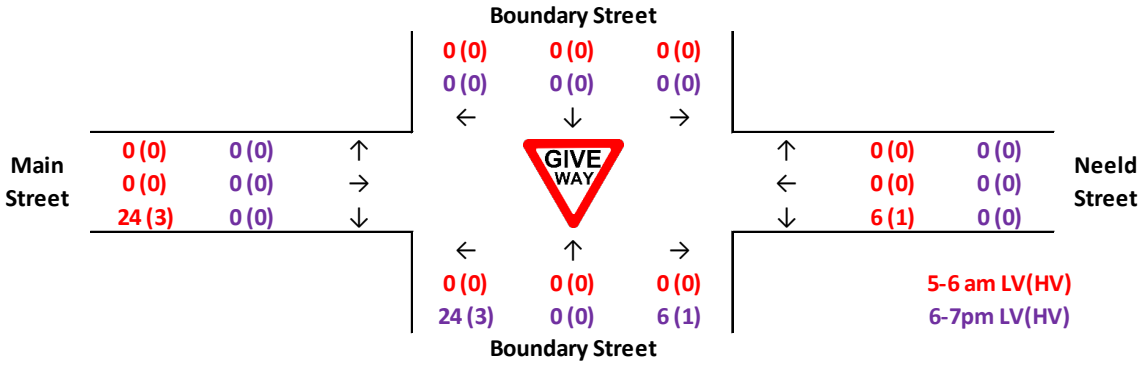


Figure 3.3 Traffic for construction workforce for the accommodation village (Scenario 1)

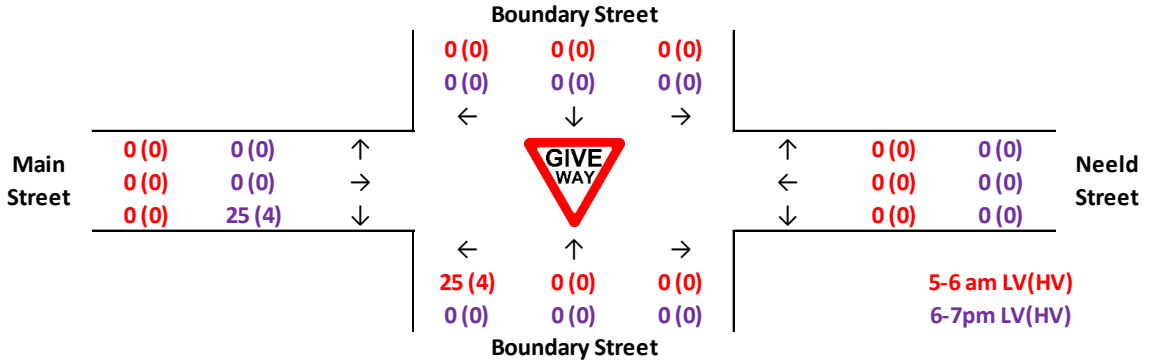


Figure 3.4 Traffic for construction workforce of the CGO Underground Development Project (Scenario 2)

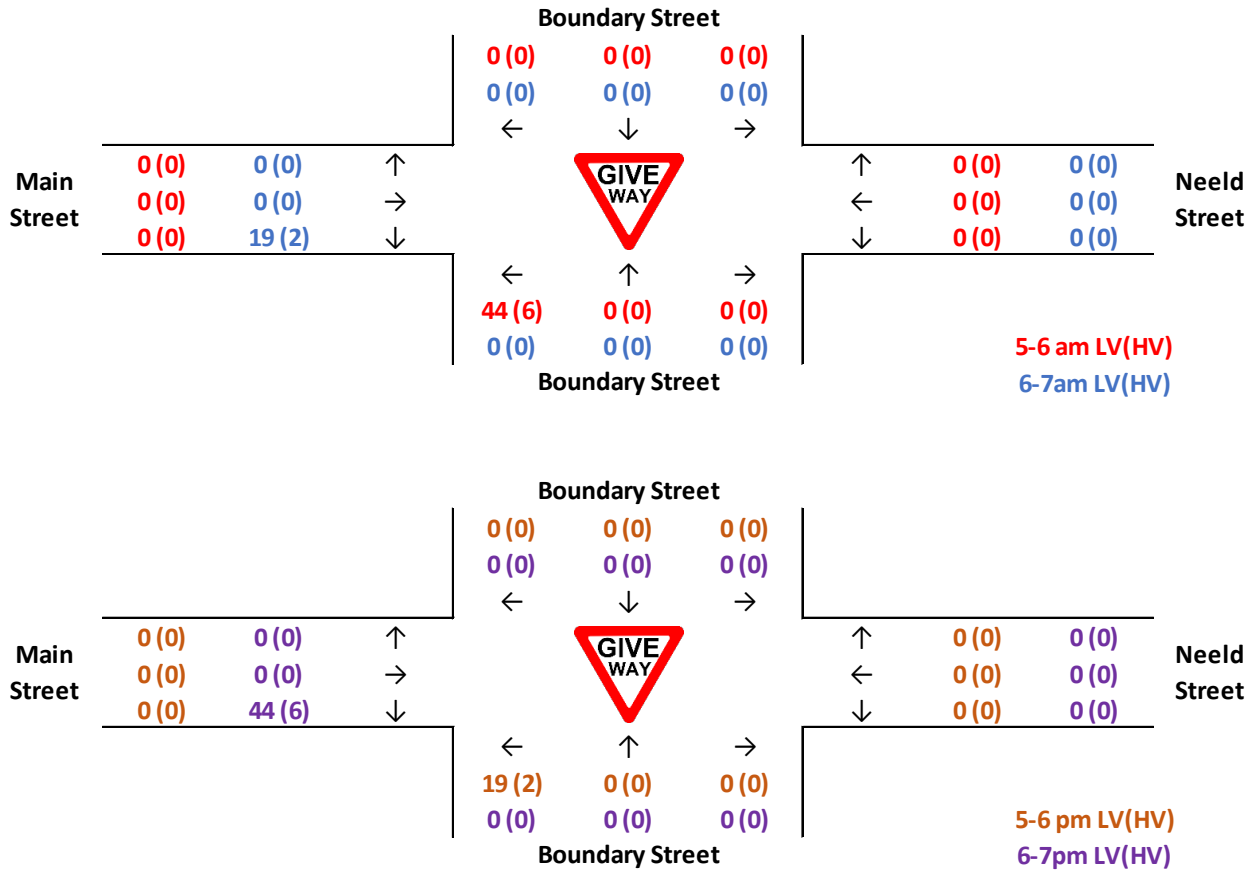


Figure 3.5 Combined construction + operational workforce traffic for the CGO Underground Development Project (Scenario 3)

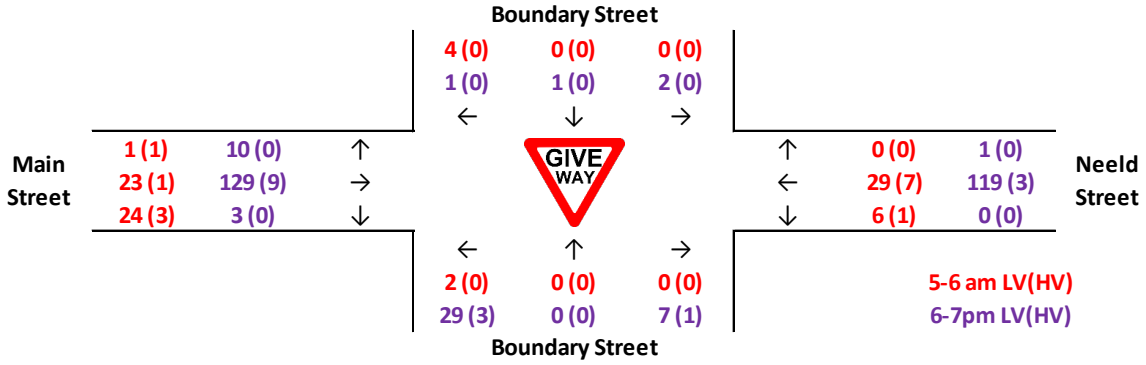


Figure 3.6 Existing + construction workforce traffic for the accommodation village (Existing + Scenario 1)

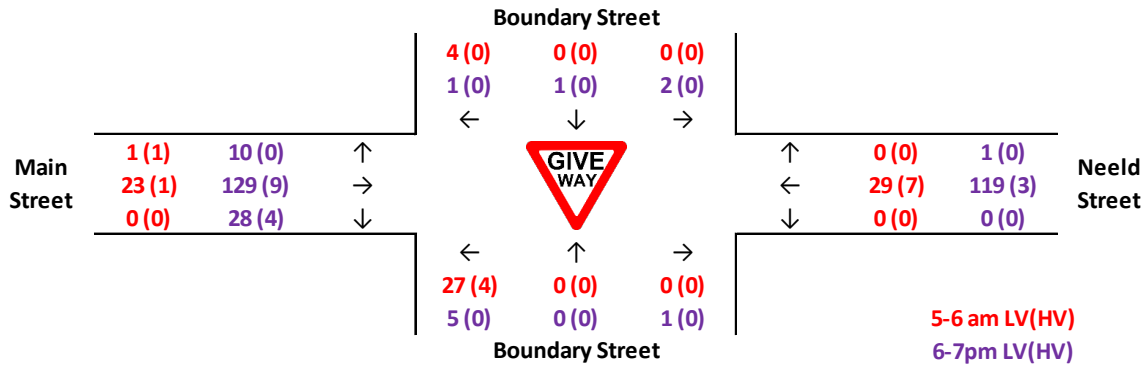
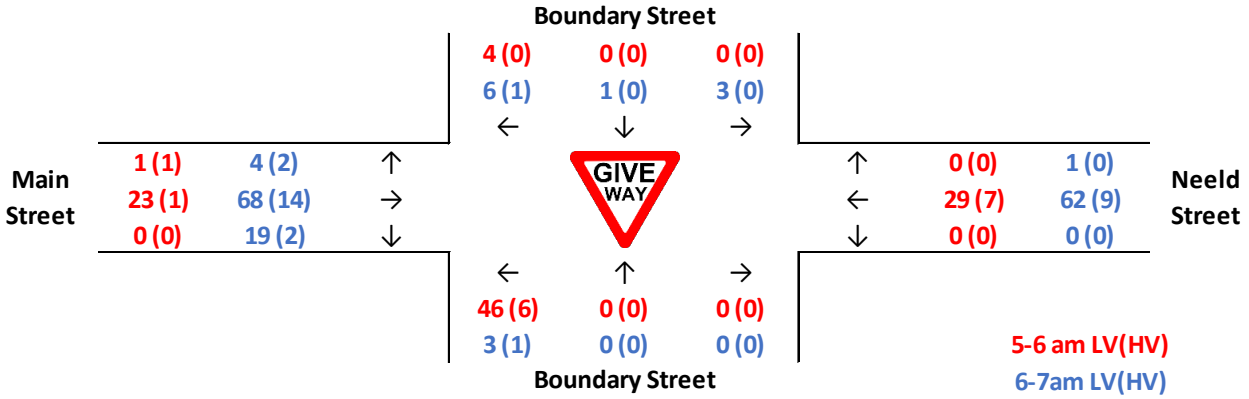


Figure 3.7 Existing + construction workforce traffic for CGO Underground Development Project (Existing + Scenario 2)



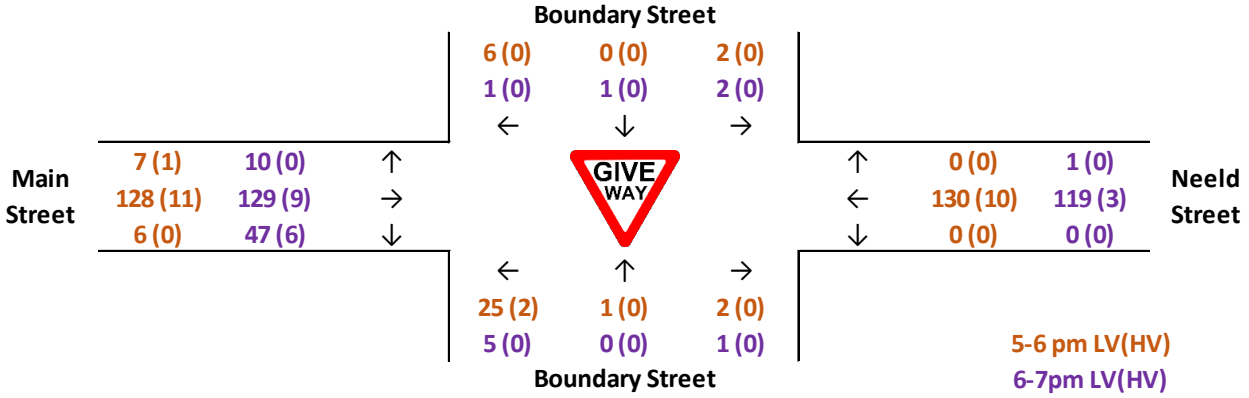


Figure 3.8 Existing + construction and operational workforce traffic for CGO Underground Development Project (Existing + Scenario 3)

3.8 Car and bus parking

The accommodation village design has provision for 93 parking spaces total (see Figure 3.9). This includes 39 standard parking spaces, 8 accessible parking spaces, 8 visitor parking spaces and the remaining 38 spaces for spill-over parking.

Due to the overlap of construction and operational stages of the CGO Underground Development Project, the accommodation village may have a peak habitation phase workforce of 176 workers at any one time. It is assumed that 25% of these workers will use light vehicles to travel to and from the mine. This equates to a parking demand for 44 car parking spaces. This demand is not expected to occur for extended periods. Some additional parking demand may be generated by staff working at the accommodation village. The provision of 85 parking spaces (excluding 8 visitor parking spaces) is expected to satisfy car parking demand for the accommodation village.

The accommodation village has provision for 2 bus layover areas designed for 12.5 m length buses. A maximum of 4 buses is expected to service the accommodation village during the peak demand period. The provision of 2 bus layover areas is expected to satisfy bus parking demand for the accommodation village.

3.9 Road upgrade work

There are no road upgrade works proposed for this development.

Source: Nettleton Tribe

Figure 3.9 Conceptual village layout

4 Impact assessment

4.1 Intersection performance

The key intersections have been modelled with the SIDRA Intersection 9.0 software; a micro-analytical tool for individual intersections and linked intersection-network modelling. The modelling is based on the traffic survey data detailed in Section 2.4. SIDRA provides the following performance indicators:

- Degree of saturation (DOS) – the total usage of the intersection expressed as a factor of 1 with 1 representing 100% use/saturation (eg 0.8 = 80% saturation);
- Average delay (DEL) – the average delay in seconds encountered by all vehicles passing through the intersection. It is often important to review the average delay of each approach as a side road could have a long delay time, while the large free flowing major traffic will provide an overall low average delay;
- Level of service (LOS) – this is a categorisation of average delay, intended for simple reference; and
- 95% queue lengths (Q95) – is defined to be the queue length in metres that has only a 5% probability of being exceeded during the analysed time period. It transforms the average delay into measurable distance units.

The LOS is a good indicator of overall performance for individual intersections, with each level summarised in Table 4.1.

Table 4.1 Intersection LOS standards

Level of service	Average delay (seconds per vehicle)	Traffic signals, roundabout	Priority intersection ('Stop' and 'Give Way')
A	<14	Good operation	Good operations
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At traffic signals, incidents will cause extensive delays. Roundabouts require other control mode.	At capacity; required other control mode
F	>71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; required other control mode

Source: *RTA Guide to Traffic Generating Development* (RTA 2002)

The SIDRA results for the Boundary Street/Main Street intersection are presented in the following tables (Table 4.2 to Table 4.6).

Table 4.2 SIDRA modelling result for Main Street/ Boundary Street existing AM peaks

Control/ Scenarios	5-6 AM Peak					6-7 AM Peak				
Priority controlled (Giveway)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
Existing traffic AM Peak (survey)	79	5	A	0.023	0.1 (west)	188	5.6	A	0.054	0.2 (north)

Key Findings:

- in AM and PM, the intersection performs satisfactorily within capacity with LOS A and DoS < 0.06; and
- overall, the intersection has significant additional capacity currently to accommodate future traffic volumes generated by the accommodation village.

Table 4.3 SIDRA modelling result for Main Street/ Boundary Street existing PM peaks

Control/ Scenarios	5-6 PM Peak					6-7 PM Peak				
Priority controlled (Giveway)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
Existing traffic PM Peak(survey)	329	6.1	A	0.088	0.36 (north)	301	5.9	A	0.085	0.2 (west)

Key Findings:

- in AM and PM, the intersection performs satisfactorily within capacity with LOS A and DoS < 0.09; and
- overall, the intersection has significant additional capacity currently to accommodate future traffic volumes generated by the accommodation village.

Table 4.4 SIDRA modelling result for Main Street/ Boundary Street for construction traffic Scenarios 1 and 2

Control/ Scenarios	5-6 AM Peak					6-7 PM Peak				
Priority controlled (Giveway)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
Existing + Scenario 1	113	5.2	A	0.033	1.1 (west)	337	6.2	A	0.085	0.7 (south)
Existing + Scenario 2	109	5.0	A	0.023	0.1 (west)	332	6.1	A	0.107	2.0 (west)

Table 4.5 SIDRA modelling result for Main Street/ Boundary Street for peak stage CGO traffic Scenario 3

Control/ Scenarios	5-6 AM Peak					6-7 AM Peak				
Priority controlled (Giveway)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
Existing + Scenario 3 AM Peak	132	5.1	A	0.037	1.1 (south)	209	5.8	A	0.067	0.2 (north)

Key Findings:

- in AM and PM, the intersection performs satisfactorily within capacity with LOS A and DoS < 0.07; and
- overall, the intersection has significant additional capacity currently to accommodate future traffic volumes generated by the accommodation village.

Table 4.6 SIDRA modelling result for Main Street/ Boundary Street for peak stage CGO traffic Scenario 3

Control/ Scenarios	5-6 PM Peak					6-7 PM Peak				
Priority controlled (Giveway)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)	Intersection volume	DEL(s)	LOS	DOS	Max Q in m (approach)
Existing + Scenario 3 PM Peak	352	6.3	A	0.088	0.6 (south)	354	6.3	A	0.122	3.0 (west)

Key Findings:

- in AM and PM, the intersection performs satisfactorily within capacity with LOS A and DoS < 0.2; and
- overall, the intersection has significant spare capacity to accommodate future traffic volumes generated by habitation workforce (construction and operations) traffic scenarios for the accommodation village.

The full output details of the intersection results are attached in Appendix C.

4.2 Mid-block capacity analysis

Level of Service (LOS) is a qualitative stratification of the performance measure or measures representing quality of service. These service measures include speed and travel time, delay, density, freedom to manoeuvre, traffic interruptions, comfort and convenience, and safety. In general, there are six levels of service, designated A to F, with LOS A representing the best operating condition and service quality from the users' perspective (ie free-flow) and LOS F the worst (ie forced or breakdown flow or having reached a point that most users would consider unsatisfactory, as described by a specific service measure value or a combination of service measure values).

The mid-block LOS on rural and urban roads is assessed based on a vehicle's average travel speed. At low traffic volumes and under ideal conditions, drivers are able to travel at their desired speed without interference. As traffic volumes increase, and as roadway, terrain and traffic conditions become less than ideal, drivers are affected by the presence of other vehicles on the road and bunches form in the traffic stream.

The Austroads *Guide to Traffic Management Part 3: Traffic Studies and Analysis* (Austroads, 2016) provides typical mid-block capacities for various types of urban roads. These are provided in Table 4.7.

Table 4.7 Typical mid-block capacities for urban roads with interrupted flow

Type of lane		One-way mid-block capacity per lane (passenger cars per hour)
Median or inner lane	Divided road	1,000
	Undivided road	900
Middle lane (of a 3-lane carriageway)	Divided road	900
	Undivided road	1,000
Kerb lane	Adjacent to parking lane	900
	Occasional parked vehicles	600
	Clearway conditions	900

Source: Austroads (2016).

Based on their existing configuration as undivided roads, Boundary Street and Main Street have capacities of 900 vehicles per hour per lane.

The maximum peak hour flow for each LOS, for one lane of unidirectional travel, based on volume/capacity ratios applicable for rural roads in level terrain with no sight distance restriction on overtaking are provided in Table 4.8. These are indicative figures based on the rural volume/capacity ratios for a maximum lane capacity of 900 vehicles per hour in each direction.

Table 4.8 Urban road peak hour lane flows per direction

Level of service	Flow (passenger cars per hour)
A	120
B	240
C	380
D	570
E	900

Table 4.9 Mid-block LOS

Road	Scenarios	Eastbound/northbound		Westbound/southbound	
		Traffic volumes	LOS	Traffic volumes	LOS
Boundary Street	Existing (5-6 AM, 5-6 PM)	2 (AM)/ 9 (PM)	A	0 (AM)/ 6 (PM)	A
	Existing (6-7 AM, 6-7 PM)	4 (AM)/ 6 (PM)	A	1 (AM)/ 4 (PM)	A
	Existing + Scenario 1	2 (AM)/ 40 (PM)	A	34 (AM)/ 4 (PM)	A
	Existing + Scenario 2	31 (AM)/ 6 (PM)	A	0 (AM)/ 33 (PM)	A
	Existing + Scenario 3 (5-6AM,5-6PM)	52 (AM)/ 30 (PM)	A	0 (AM)/ 6 (PM)	A
	Existing + Scenario 3 (6-7AM, 6-7PM)	4 (AM)/ 6 (PM)	A	22 (AM)/ 54 (PM)	A
Main Street/Newell Highway	Existing (5-6AM,5-6PM)	26 (AM)/ 153 (PM)	B	36 (AM)/ 140 (PM)	B
	Existing (6-7AM, 6-7PM)	88 (AM)/ 151 (PM)	B	72 (AM)/ 123 (PM)	B
	Existing + Scenario 1	53 (AM)/ 151 (PM)	B	43 (AM)/ 123 (PM)	B
	Existing + Scenario 2	26 (AM)/ 180 (PM)	B	36 (AM)/ 123 (PM)	B
	Existing + Scenario 3 (5-6AM,5-6PM)	26 (AM)/ 153 (PM)	B	36 (AM)/ 140 (PM)	B
	Existing + Scenario 3 (6-7AM, 6-7PM)	109 (AM)/ 201 (PM)	B	72 (AM)/ 123 (PM)	B

For all existing and future scenarios, the capacity of Boundary Street and Main Street will comply with the maximum urban threshold of 900 vehicles per lane per hour. The maximum assessed LOS achieved is A for Boundary Street and B for Main Street. The assessed LOS achieved does not change with the proposed development traffic for either of these roads. These levels of service are considered generally good for the peak hourly traffic flows in urbanised areas in NSW.

4.3 Car park compliance

A review of the site plan was conducted to assess the compliance of the car parking spaces. The findings of this assessment are detailed in Table 4.10.

Table 4.10 Compliance Summary

Component	Requirement	Provided (min)	Compliance	Notes
		Class 1A Parking		
90 Degree parking				
Space Length	5.4m	5.4m	✓	
Space Width	2.4m	2.4m	✓	
Aisle Width	5.8m	6.2m	✓	

Table 4.10 Compliance Summary

Component	Requirement	Provided (min)	Compliance	Notes
Parallel parking				
Space Length	5.9m	5.9m	✓	
Space Width	2.1m	2.1m	✓	
Aisle Width	3.6m	4.0m	✓	
		Accessible Parking		
Space Length	5.4m	5.5m	✓	
Space Width	2.4m	2.4m	✓	
Shared Area Dimensions	2.4m x 5.4m (with bollard)	2.4m x 5.4m (without bollard)	✓	Plans to show bollard in accessible spaces
Aisle Width	5.8m	6.2m	✓	
Height Clearance	2.5m	Open to sky	✓	

The car parking spaces are generally compliant in accordance with Australian Standards for Off-Street Parking (AS2890.1-2004) and Off-Street Parking for people with disabilities (AS2890.6-2009).

4.4 Road safety assessment at the project site entrance

The access to the site is via Boundary Street which is a local road having a speed limit of 50 km/h. Due to the low speed and traffic volumes there are no sight distance or safety issues for entering or exiting vehicles to/from the site. The alignment of Boundary Street is straight and has clear visibility on either side of the site access as shown in Plate 4.1.

Sight visibility to the left

Sight visibility to the right

Plate 4.1 Sight visibility from site egress to Boundary Street

4.5 Impact on public transport, pedestrians and cyclists

The proposed accommodation village workforce (all stages) is not anticipated to create a high demand for either pedestrian or cyclist access or public transport services within the West Wyalong area.

The existing public and active transport facilities, as outlined in Section 2.6 and 2.7 are not expected to be impacted by the project.

5 Summary and conclusion

Evolution proposes to construct and operate an accommodation village on vacant land comprising of two lots located immediately west of Boundary Street, West Wyalong, NSW. The village is being developed to house the anticipated workforce associated with the construction and operation of the CGO Underground Development Project.

The proposed development will be constructed in four stages over a period of up to three years. The peak construction workforce for the accommodation village is expected to be 40 workers per day. The peak construction workforce for the CGO Underground Development Project is expected to be 100 workers. The peak combined construction and operational workforce for the CGO Underground Development Project is expected to be 176 workers.

The proposed construction work hours for the CGO Underground Development Project will be from 6 am to 6 pm seven days per week, resulting in two significant hourly peaks of construction related traffic movements. The proposed operational work hours for the CGO Underground Development Project will be from 6 am to 6 pm and from 6 pm to 6 am, seven days per week resulting in four significant hourly peaks of workforce traffic movements.

The traffic impacts during the construction phase of the accommodation village will impact less on the road network than will the habitation phase, ie during construction and operation of the CGO Underground Development Project.

The key findings of the project TIA for the predicted daily and peak hour traffic movements are as follows:

- all intersections operate within capacity for all project-related scenarios modelled for both AM and PM peak hours;
- the mid-block capacities of Boundary Street and Main Street operate with LOS B or better;
- the number of car spaces provided meets the proposed development control plan requirements; and
- public transport services, pedestrian and cycling infrastructure will not be significantly impacted by the project.

Based on the results of this TIA report, it is concluded that the construction and habitation workforce traffic for the accommodation village will not have significant traffic impacts on the nearby road network. Therefore, no mitigating measures or road works are deemed necessary for the project.

References

Austroads 2016. *Guide to Traffic Management Part 3: Traffic Studies and Analysis.*

RTA. 2002. *Guide to Traffic Generating Developments*.

Australian Standards for Off-Street Parking (AS2890.1-2004).

Australian Standards for Off-Street Parking for people with disabilities (AS2890.6-2009).


Appendix A

Traffic survey data




year		2019	2019	2019	2019	2019	2019
cardinal_direction_seq	Northbound		Northbound	Northbound	Southbound	Southbound	Southbound
classification_seq	Light Vehicles		Heavy Vehicles	All Vehicles	Heavy Vehicles	Light Vehicles	All Vehicles
hour_00		3	12	14	6	4	9
hour_01		3	12	13	5	3	7
hour_02		3	11	13	4	3	5
hour_03		3	10	12	4	2	5
hour_04		4	10	14	5	4	8
hour_05		8	11	19	7	6	12
hour_06		18	16	34	11	14	24
hour_07		32	22	54	17	23	40
hour_08		45	25	69	26	45	70
hour_09		56	28	83	31	53	83
hour_10		61	28	88	33	60	92
hour_11		65	30	94	36	62	97
hour_12		62	28	89	35	59	94
hour_13		65	28	92	36	55	91
hour_14		65	26	91	36	54	89
hour_15		58	25	83	34	55	88
hour_16		51	23	73	31	50	81
hour_17		40	22	62	28	42	70
hour_18		26	21	47	25	32	56
hour_19		17	21	38	20	19	39
hour_20		12	22	34	16	12	28
hour_21		9	21	30	14	8	22
hour_22		6	18	24	12	6	17
hour_23		4	14	17	10	5	13
daily_total		716	484	1187	482	676	1140

Appendix B

Site plan

1 Site Plan Ground
1 : 500

ACCOMMODATION LEGEND

- OPERATIONS ACCOMODATION
- OPERATIONS ACCESSIBLE ACCOMODATION
- CONSTRUCTION ACCOMODATION
- OUTDOOR EATING AREA
- LAUNDRY & BIN STORE MODULES
- COMMUNAL AMENITIES MODULES

ACCOMODATION SUMMARY.

CONSTRUCTION UNITS	(96)
CONSTRUCTION MODULES	(24)
OPERATIONS UNITS	(72)
OPERATIONS MODULES	(24)
OPERATIONS ACCESSIBLE UNITS	(8)
OPERATIONS ACCESSIBLE MODULES	(4)
TOTAL UNITS	**(176)**
TOTAL MODULES	**(52)**
LAUNDRY UNITS 1 OFF 9 MACHINE BLOCK PER 44 ROOMS	(4)
STORAGE	TBC
OUTDOOR EATNG 1 PER 44 ROOMS COVERED AREA FOR 4 TABLES WITH 6 CHAIRS	(4)

CARPAKING (TBC)

STANDARD	(39)
ACCESSIBLE	(8)
VISITOR	(8)
SPILLOVER	(38)
TOTAL	**(93)**

Client: Evolution MINING

Issue	Description	Date
5	ISSUED FOR INFORMATION	12.03.21
4	ISSUED FOR INFORMATION	12.03.21
3	ISSUED FOR INFORMATION	11.03.21
2	ISSUED FOR INFORMATION	10.03.21
1	ISSUED FOR INFORMATION	01.03.21

PROJECT MANAGER: CURRAJONG

Project Name
ACCOMMODATION VILLAGE, WEST WYALONG

Project Address
West Wyalong

Key Plan

Drawing Title:
SITE PLAN - GROUND LEVEL

Author:	Checker:	Sheet Size:	Scale:
JB	GL	A1	1 : 500

Drawing Number: **11985-AR-0111** Issue: **5**

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Appendix C

SIDRA results




MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 5-6 AM (Site Folder: Existing Traffic)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	2	0	2	0.0	0.001	4.7	LOS A	0.0	0.0	0.11	0.49	0.11	46.4
2	T1	1	0	1	0.0	0.002	3.4	LOS A	0.0	0.0	0.15	0.48	0.15	46.8
3	R2	1	0	1	0.0	0.002	4.8	LOS A	0.0	0.0	0.15	0.48	0.15	46.3
Approach		4	0	4	0.0	0.002	4.4	LOS A	0.0	0.0	0.13	0.48	0.13	46.4
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.023	4.6	LOS A	0.0	0.1	0.01	0.03	0.01	49.3
5	T1	36	7	38	19.4	0.023	0.0	LOS A	0.0	0.1	0.01	0.03	0.01	49.8
6	R2	1	0	1	0.0	0.023	4.6	LOS A	0.0	0.1	0.01	0.03	0.01	49.1
Approach		38	7	40	18.4	0.023	0.2	NA	0.0	0.1	0.01	0.03	0.01	49.7
North: Boundary Street (N)														
7	L2	1	0	1	0.0	0.001	4.6	LOS A	0.0	0.0	0.08	0.50	0.08	46.4
8	T1	1	0	1	0.0	0.005	3.4	LOS A	0.0	0.1	0.15	0.51	0.15	46.5
9	R2	4	0	4	0.0	0.005	4.9	LOS A	0.0	0.1	0.15	0.51	0.15	46.0
Approach		6	0	6	0.0	0.005	4.6	LOS A	0.0	0.1	0.14	0.51	0.14	46.2
West: Main Street (W)														
10	L2	2	1	2	50.0	0.015	5.0	LOS A	0.0	0.1	0.01	0.06	0.01	48.4
11	T1	24	1	25	4.2	0.015	0.0	LOS A	0.0	0.1	0.01	0.06	0.01	49.7
12	R2	1	0	1	0.0	0.015	4.7	LOS A	0.0	0.1	0.01	0.06	0.01	49.0
Approach		27	2	28	7.4	0.015	0.6	NA	0.0	0.1	0.01	0.06	0.01	49.6
All Vehicles		75	9	79	12.0	0.023	0.9	NA	0.0	0.1	0.03	0.10	0.03	49.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 6-7 AM (Site Folder: Existing Traffic)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	4	1	4	25.0	0.003	5.0	LOS A	0.0	0.1	0.17	0.48	0.17	45.9
2	T1	1	0	1	0.0	0.002	3.8	LOS A	0.0	0.0	0.26	0.49	0.26	46.5
3	R2	1	0	1	0.0	0.002	5.3	LOS A	0.0	0.0	0.26	0.49	0.26	46.0
Approach		6	1	6	16.7	0.003	4.9	LOS A	0.0	0.1	0.20	0.48	0.20	46.0
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.043	4.7	LOS A	0.0	0.1	0.01	0.02	0.01	49.4
5	T1	71	9	75	12.7	0.043	0.0	LOS A	0.0	0.1	0.01	0.02	0.01	49.9
6	R2	1	0	1	0.0	0.043	4.9	LOS A	0.0	0.1	0.01	0.02	0.01	49.2
Approach		73	9	77	12.3	0.043	0.1	NA	0.0	0.1	0.01	0.02	0.01	49.9
North: Boundary Street (N)														
7	L2	3	0	3	0.0	0.002	4.8	LOS A	0.0	0.1	0.18	0.48	0.18	46.2
8	T1	1	0	1	0.0	0.009	3.8	LOS A	0.0	0.2	0.27	0.53	0.27	46.2
9	R2	7	1	7	14.3	0.009	5.6	LOS A	0.0	0.2	0.27	0.53	0.27	45.5
Approach		11	1	12	9.1	0.009	5.2	LOS A	0.0	0.2	0.25	0.52	0.25	45.8
West: Main Street (W)														
10	L2	6	2	6	33.3	0.054	4.9	LOS A	0.0	0.1	0.01	0.04	0.01	48.7
11	T1	82	14	86	17.1	0.054	0.0	LOS A	0.0	0.1	0.01	0.04	0.01	49.8
12	R2	1	0	1	0.0	0.054	4.8	LOS A	0.0	0.1	0.01	0.04	0.01	49.1
Approach		89	16	94	18.0	0.054	0.4	NA	0.0	0.1	0.01	0.04	0.01	49.7
All Vehicles		179	27	188	15.1	0.054	0.7	NA	0.0	0.2	0.03	0.08	0.03	49.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 5-6 PM (Site Folder: Existing Traffic)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	6	0	6	0.0	0.004	5.0	LOS A	0.0	0.1	0.24	0.49	0.24	46.1
2	T1	1	0	1	0.0	0.004	4.4	LOS A	0.0	0.1	0.36	0.53	0.36	46.1
3	R2	2	0	2	0.0	0.004	6.0	LOS A	0.0	0.1	0.36	0.53	0.36	45.6
Approach		9	0	9	0.0	0.004	5.1	LOS A	0.0	0.1	0.28	0.51	0.28	46.0
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.080	4.8	LOS A	0.0	0.1	0.01	0.01	0.01	49.4
5	T1	140	10	147	7.1	0.080	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	49.9
6	R2	1	0	1	0.0	0.080	5.1	LOS A	0.0	0.1	0.01	0.01	0.01	49.2
Approach		142	10	149	7.0	0.080	0.1	NA	0.0	0.1	0.01	0.01	0.01	49.9
North: Boundary Street (N)														
7	L2	2	0	2	0.0	0.001	5.0	LOS A	0.0	0.0	0.23	0.48	0.23	46.1
8	T1	1	0	1	0.0	0.009	4.4	LOS A	0.0	0.2	0.36	0.57	0.36	45.9
9	R2	6	0	6	0.0	0.009	6.1	LOS A	0.0	0.2	0.36	0.57	0.36	45.4
Approach		9	0	9	0.0	0.009	5.7	LOS A	0.0	0.2	0.33	0.55	0.33	45.6
West: Main Street (W)														
10	L2	8	1	8	12.5	0.088	4.9	LOS A	0.1	0.4	0.03	0.05	0.03	48.9
11	T1	139	11	146	7.9	0.088	0.0	LOS A	0.1	0.4	0.03	0.05	0.03	49.6
12	R2	6	0	6	0.0	0.088	5.1	LOS A	0.1	0.4	0.03	0.05	0.03	48.9
Approach		153	12	161	7.8	0.088	0.5	NA	0.1	0.4	0.03	0.05	0.03	49.6
All Vehicles		313	22	329	7.0	0.088	0.6	NA	0.1	0.4	0.04	0.06	0.04	49.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 6-7 PM (Site Folder: Existing Traffic)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	5	0	5	0.0	0.004	4.9	LOS A	0.0	0.1	0.21	0.49	0.21	46.1
2	T1	1	0	1	0.0	0.002	4.3	LOS A	0.0	0.1	0.34	0.51	0.34	46.4
3	R2	1	0	1	0.0	0.002	5.9	LOS A	0.0	0.1	0.34	0.51	0.34	45.9
Approach		7	0	7	0.0	0.004	5.0	LOS A	0.0	0.1	0.25	0.49	0.25	46.1
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.068	4.8	LOS A	0.0	0.1	0.01	0.01	0.01	49.4
5	T1	122	3	128	2.5	0.068	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	49.9
6	R2	1	0	1	0.0	0.068	5.1	LOS A	0.0	0.1	0.01	0.01	0.01	49.2
Approach		124	3	131	2.4	0.068	0.1	NA	0.0	0.1	0.01	0.01	0.01	49.9
North: Boundary Street (N)														
7	L2	2	0	2	0.0	0.001	5.0	LOS A	0.0	0.0	0.23	0.48	0.23	46.1
8	T1	1	0	1	0.0	0.002	4.2	LOS A	0.0	0.1	0.34	0.51	0.34	46.4
9	R2	1	0	1	0.0	0.002	5.9	LOS A	0.0	0.1	0.34	0.51	0.34	45.9
Approach		4	0	4	0.0	0.002	5.0	LOS A	0.0	0.1	0.29	0.49	0.29	46.1
West: Main Street (W)														
10	L2	10	0	11	0.0	0.085	4.7	LOS A	0.0	0.2	0.02	0.05	0.02	49.2
11	T1	138	9	145	6.5	0.085	0.0	LOS A	0.0	0.2	0.02	0.05	0.02	49.7
12	R2	3	0	3	0.0	0.085	5.0	LOS A	0.0	0.2	0.02	0.05	0.02	49.0
Approach		151	9	159	6.0	0.085	0.4	NA	0.0	0.2	0.02	0.05	0.02	49.6
All Vehicles		286	12	301	4.2	0.085	0.4	NA	0.0	0.2	0.02	0.05	0.02	49.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 5-6 AM (Site Folder: Ex + Construction Traffic Accommodation Village)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	2	0	2	0.0	0.001	4.7	LOS A	0.0	0.0	0.11	0.49	0.11	46.4
2	T1	1	0	1	0.0	0.002	3.5	LOS A	0.0	0.0	0.19	0.48	0.19	46.7
3	R2	1	0	1	0.0	0.002	5.0	LOS A	0.0	0.0	0.19	0.48	0.19	46.2
Approach		4	0	4	0.0	0.002	4.5	LOS A	0.0	0.0	0.15	0.48	0.15	46.4
East: Neeld Street (E)														
4	L2	7	1	7	14.3	0.027	4.7	LOS A	0.0	0.1	0.01	0.10	0.01	48.7
5	T1	36	7	38	19.4	0.027	0.0	LOS A	0.0	0.1	0.01	0.10	0.01	49.4
6	R2	1	0	1	0.0	0.027	4.6	LOS A	0.0	0.1	0.01	0.10	0.01	48.7
Approach		44	8	46	18.2	0.027	0.9	NA	0.0	0.1	0.01	0.10	0.01	49.3
North: Boundary Street (N)														
7	L2	1	0	1	0.0	0.001	4.6	LOS A	0.0	0.0	0.08	0.50	0.08	46.4
8	T1	1	0	1	0.0	0.005	3.5	LOS A	0.0	0.1	0.19	0.51	0.19	46.4
9	R2	4	0	4	0.0	0.005	5.0	LOS A	0.0	0.1	0.19	0.51	0.19	45.9
Approach		6	0	6	0.0	0.005	4.7	LOS A	0.0	0.1	0.17	0.51	0.17	46.1
West: Main Street (W)														
10	L2	2	1	2	50.0	0.033	5.2	LOS A	0.1	1.1	0.12	0.28	0.12	46.9
11	T1	24	1	25	4.2	0.033	0.1	LOS A	0.1	1.1	0.12	0.28	0.12	48.1
12	R2	27	3	28	11.1	0.033	4.8	LOS A	0.1	1.1	0.12	0.28	0.12	47.3
Approach		53	5	56	9.4	0.033	2.7	NA	0.1	1.1	0.12	0.28	0.12	47.6
All Vehicles		107	13	113	12.1	0.033	2.1	NA	0.1	1.1	0.08	0.23	0.08	48.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 6-7 PM (Site Folder: Ex + Construction Traffic Accommodation Village)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	32	3	34	9.4	0.024	5.0	LOS A	0.1	0.7	0.22	0.50	0.22	46.0
2	T1	1	0	1	0.0	0.012	4.3	LOS A	0.0	0.3	0.35	0.57	0.35	45.9
3	R2	8	1	8	12.5	0.012	6.2	LOS A	0.0	0.3	0.35	0.57	0.35	45.2
Approach		41	4	43	9.8	0.024	5.3	LOS A	0.1	0.7	0.25	0.52	0.25	45.8
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.068	4.8	LOS A	0.0	0.1	0.01	0.01	0.01	49.4
5	T1	122	3	128	2.5	0.068	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	49.9
6	R2	1	0	1	0.0	0.068	5.1	LOS A	0.0	0.1	0.01	0.01	0.01	49.2
Approach		124	3	131	2.4	0.068	0.1	NA	0.0	0.1	0.01	0.01	0.01	49.9
North: Boundary Street (N)														
7	L2	2	0	2	0.0	0.001	5.0	LOS A	0.0	0.0	0.23	0.48	0.23	46.1
8	T1	1	0	1	0.0	0.002	4.2	LOS A	0.0	0.1	0.35	0.51	0.35	46.3
9	R2	1	0	1	0.0	0.002	6.1	LOS A	0.0	0.1	0.35	0.51	0.35	45.8
Approach		4	0	4	0.0	0.002	5.1	LOS A	0.0	0.1	0.29	0.50	0.29	46.1
West: Main Street (W)														
10	L2	10	0	11	0.0	0.085	4.7	LOS A	0.0	0.2	0.02	0.05	0.02	49.2
11	T1	138	9	145	6.5	0.085	0.0	LOS A	0.0	0.2	0.02	0.05	0.02	49.7
12	R2	3	0	3	0.0	0.085	5.0	LOS A	0.0	0.2	0.02	0.05	0.02	49.0
Approach		151	9	159	6.0	0.085	0.4	NA	0.0	0.2	0.02	0.05	0.02	49.6
All Vehicles		320	16	337	5.0	0.085	1.0	NA	0.1	0.7	0.05	0.10	0.05	49.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 5-6 AM (Site Folder: Ex + Construction Traffic CGO)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	31	4	33	12.9	0.022	4.8	LOS A	0.1	0.7	0.11	0.50	0.11	46.2
2	T1	1	0	1	0.0	0.002	3.4	LOS A	0.0	0.0	0.15	0.48	0.15	46.8
3	R2	1	0	1	0.0	0.002	4.8	LOS A	0.0	0.0	0.15	0.48	0.15	46.3
Approach		33	4	35	12.1	0.022	4.8	LOS A	0.1	0.7	0.12	0.49	0.12	46.2
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.023	4.6	LOS A	0.0	0.1	0.01	0.03	0.01	49.3
5	T1	36	7	38	19.4	0.023	0.0	LOS A	0.0	0.1	0.01	0.03	0.01	49.8
6	R2	1	0	1	0.0	0.023	4.6	LOS A	0.0	0.1	0.01	0.03	0.01	49.1
Approach		38	7	40	18.4	0.023	0.2	NA	0.0	0.1	0.01	0.03	0.01	49.7
North: Boundary Street (N)														
7	L2	1	0	1	0.0	0.001	4.6	LOS A	0.0	0.0	0.08	0.50	0.08	46.4
8	T1	1	0	1	0.0	0.005	3.4	LOS A	0.0	0.1	0.18	0.51	0.18	46.5
9	R2	4	0	4	0.0	0.005	5.0	LOS A	0.0	0.1	0.18	0.51	0.18	46.0
Approach		6	0	6	0.0	0.005	4.7	LOS A	0.0	0.1	0.16	0.51	0.16	46.1
West: Main Street (W)														
10	L2	2	1	2	50.0	0.015	5.0	LOS A	0.0	0.1	0.01	0.06	0.01	48.4
11	T1	24	1	25	4.2	0.015	0.0	LOS A	0.0	0.1	0.01	0.06	0.01	49.7
12	R2	1	0	1	0.0	0.015	4.7	LOS A	0.0	0.1	0.01	0.06	0.01	49.0
Approach		27	2	28	7.4	0.015	0.6	NA	0.0	0.1	0.01	0.06	0.01	49.6
All Vehicles		104	13	109	12.5	0.023	2.0	NA	0.1	0.7	0.05	0.21	0.05	48.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 6-7 PM (Site Folder: Ex + Construction Traffic CGO)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	5	0	5	0.0	0.004	4.9	LOS A	0.0	0.1	0.21	0.49	0.21	46.1
2	T1	1	0	1	0.0	0.002	4.4	LOS A	0.0	0.1	0.36	0.51	0.36	46.3
3	R2	1	0	1	0.0	0.002	6.1	LOS A	0.0	0.1	0.36	0.51	0.36	45.8
Approach		7	0	7	0.0	0.004	5.0	LOS A	0.0	0.1	0.26	0.50	0.26	46.1
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.068	4.8	LOS A	0.0	0.1	0.01	0.01	0.01	49.4
5	T1	122	3	128	2.5	0.068	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	49.9
6	R2	1	0	1	0.0	0.068	5.1	LOS A	0.0	0.1	0.01	0.01	0.01	49.2
Approach		124	3	131	2.4	0.068	0.1	NA	0.0	0.1	0.01	0.01	0.01	49.9
North: Boundary Street (N)														
7	L2	2	0	2	0.0	0.001	5.0	LOS A	0.0	0.0	0.23	0.48	0.23	46.1
8	T1	1	0	1	0.0	0.002	4.4	LOS A	0.0	0.1	0.36	0.51	0.36	46.3
9	R2	1	0	1	0.0	0.002	6.1	LOS A	0.0	0.1	0.36	0.51	0.36	45.8
Approach		4	0	4	0.0	0.002	5.1	LOS A	0.0	0.1	0.30	0.50	0.30	46.0
West: Main Street (W)														
10	L2	10	0	11	0.0	0.107	5.0	LOS A	0.3	2.0	0.11	0.12	0.11	48.5
11	T1	138	9	145	6.5	0.107	0.1	LOS A	0.3	2.0	0.11	0.12	0.11	49.0
12	R2	32	4	34	12.5	0.107	5.2	LOS A	0.3	2.0	0.11	0.12	0.11	48.1
Approach		180	13	189	7.2	0.107	1.3	NA	0.3	2.0	0.11	0.12	0.11	48.8
All Vehicles		315	16	332	5.1	0.107	0.9	NA	0.3	2.0	0.08	0.09	0.08	49.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 5-6 AM (Site Folder: Ex + Construction and Operational Traffic CGO)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	52	6	55	11.5	0.037	4.8	LOS A	0.1	1.1	0.12	0.50	0.12	46.2
2	T1	1	0	1	0.0	0.002	3.4	LOS A	0.0	0.0	0.15	0.48	0.15	46.8
3	R2	1	0	1	0.0	0.002	4.8	LOS A	0.0	0.0	0.15	0.48	0.15	46.3
Approach		54	6	57	11.1	0.037	4.8	LOS A	0.1	1.1	0.12	0.50	0.12	46.2
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.023	4.6	LOS A	0.0	0.1	0.01	0.03	0.01	49.3
5	T1	36	7	38	19.4	0.023	0.0	LOS A	0.0	0.1	0.01	0.03	0.01	49.8
6	R2	1	0	1	0.0	0.023	4.6	LOS A	0.0	0.1	0.01	0.03	0.01	49.1
Approach		38	7	40	18.4	0.023	0.2	NA	0.0	0.1	0.01	0.03	0.01	49.7
North: Boundary Street (N)														
7	L2	1	0	1	0.0	0.001	4.6	LOS A	0.0	0.0	0.08	0.50	0.08	46.4
8	T1	1	0	1	0.0	0.005	3.4	LOS A	0.0	0.1	0.19	0.51	0.19	46.4
9	R2	4	0	4	0.0	0.005	5.1	LOS A	0.0	0.1	0.19	0.51	0.19	45.9
Approach		6	0	6	0.0	0.005	4.7	LOS A	0.0	0.1	0.18	0.51	0.18	46.1
West: Main Street (W)														
10	L2	2	1	2	50.0	0.015	5.0	LOS A	0.0	0.1	0.01	0.06	0.01	48.4
11	T1	24	1	25	4.2	0.015	0.0	LOS A	0.0	0.1	0.01	0.06	0.01	49.7
12	R2	1	0	1	0.0	0.015	4.7	LOS A	0.0	0.1	0.01	0.06	0.01	49.0
Approach		27	2	28	7.4	0.015	0.6	NA	0.0	0.1	0.01	0.06	0.01	49.6
All Vehicles		125	15	132	12.0	0.037	2.5	NA	0.1	1.1	0.06	0.26	0.06	47.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 6-7 AM (Site Folder: Ex + Construction and Operational Traffic CGO)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	4	1	4	25.0	0.003	5.0	LOS A	0.0	0.1	0.17	0.48	0.17	45.9
2	T1	1	0	1	0.0	0.002	3.9	LOS A	0.0	0.0	0.28	0.49	0.28	46.5
3	R2	1	0	1	0.0	0.002	5.4	LOS A	0.0	0.0	0.28	0.49	0.28	46.0
Approach		6	1	6	16.7	0.003	4.9	LOS A	0.0	0.1	0.21	0.49	0.21	46.0
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.043	4.7	LOS A	0.0	0.1	0.01	0.02	0.01	49.4
5	T1	71	9	75	12.7	0.043	0.0	LOS A	0.0	0.1	0.01	0.02	0.01	49.9
6	R2	1	0	1	0.0	0.043	4.9	LOS A	0.0	0.1	0.01	0.02	0.01	49.2
Approach		73	9	77	12.3	0.043	0.1	NA	0.0	0.1	0.01	0.02	0.01	49.9
North: Boundary Street (N)														
7	L2	3	0	3	0.0	0.002	4.8	LOS A	0.0	0.1	0.18	0.48	0.18	46.2
8	T1	1	0	1	0.0	0.010	3.9	LOS A	0.0	0.2	0.29	0.54	0.29	46.2
9	R2	7	1	7	14.3	0.010	5.8	LOS A	0.0	0.2	0.29	0.54	0.29	45.5
Approach		11	1	12	9.1	0.010	5.3	LOS A	0.0	0.2	0.26	0.53	0.26	45.7
West: Main Street (W)														
10	L2	6	2	6	33.3	0.067	5.1	LOS A	0.2	1.2	0.08	0.13	0.08	48.0
11	T1	82	14	86	17.1	0.067	0.1	LOS A	0.2	1.2	0.08	0.13	0.08	49.0
12	R2	21	2	22	9.5	0.067	4.9	LOS A	0.2	1.2	0.08	0.13	0.08	48.1
Approach		109	18	115	16.5	0.067	1.3	NA	0.2	1.2	0.08	0.13	0.08	48.8
All Vehicles		199	29	209	14.6	0.067	1.2	NA	0.2	1.2	0.07	0.12	0.07	48.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 5-6 PM (Site Folder: Ex + Construction and Operational Traffic CGO)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	27	2	28	7.4	0.021	5.1	LOS A	0.1	0.6	0.24	0.51	0.24	45.9
2	T1	1	0	1	0.0	0.004	4.4	LOS A	0.0	0.1	0.36	0.53	0.36	46.1
3	R2	2	0	2	0.0	0.004	6.0	LOS A	0.0	0.1	0.36	0.53	0.36	45.6
Approach		30	2	32	6.7	0.021	5.1	LOS A	0.1	0.6	0.26	0.51	0.26	45.9
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.080	4.8	LOS A	0.0	0.1	0.01	0.01	0.01	49.4
5	T1	140	10	147	7.1	0.080	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	49.9
6	R2	1	0	1	0.0	0.080	5.1	LOS A	0.0	0.1	0.01	0.01	0.01	49.2
Approach		142	10	149	7.0	0.080	0.1	NA	0.0	0.1	0.01	0.01	0.01	49.9
North: Boundary Street (N)														
7	L2	2	0	2	0.0	0.001	5.0	LOS A	0.0	0.0	0.23	0.48	0.23	46.1
8	T1	1	0	1	0.0	0.009	4.4	LOS A	0.0	0.2	0.37	0.57	0.37	45.8
9	R2	6	0	6	0.0	0.009	6.3	LOS A	0.0	0.2	0.37	0.57	0.37	45.4
Approach		9	0	9	0.0	0.009	5.8	LOS A	0.0	0.2	0.34	0.55	0.34	45.6
West: Main Street (W)														
10	L2	8	1	8	12.5	0.088	4.9	LOS A	0.1	0.4	0.03	0.05	0.03	48.9
11	T1	139	11	146	7.9	0.088	0.0	LOS A	0.1	0.4	0.03	0.05	0.03	49.6
12	R2	6	0	6	0.0	0.088	5.1	LOS A	0.1	0.4	0.03	0.05	0.03	48.9
Approach		153	12	161	7.8	0.088	0.5	NA	0.1	0.4	0.03	0.05	0.03	49.6
All Vehicles		334	24	352	7.2	0.088	0.9	NA	0.1	0.6	0.05	0.09	0.05	49.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Boundary St/Main St/Neeld St Ex 6-7 PM (Site Folder: Ex + Construction and Operational Traffic CGO)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Boundary Street (S)														
1	L2	5	0	5	0.0	0.004	4.9	LOS A	0.0	0.1	0.21	0.49	0.21	46.1
2	T1	1	0	1	0.0	0.002	4.5	LOS A	0.0	0.1	0.38	0.52	0.38	46.2
3	R2	1	0	1	0.0	0.002	6.2	LOS A	0.0	0.1	0.38	0.52	0.38	45.7
Approach		7	0	7	0.0	0.004	5.0	LOS A	0.0	0.1	0.26	0.50	0.26	46.1
East: Neeld Street (E)														
4	L2	1	0	1	0.0	0.068	4.8	LOS A	0.0	0.1	0.01	0.01	0.01	49.4
5	T1	122	3	128	2.5	0.068	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	49.9
6	R2	1	0	1	0.0	0.068	5.1	LOS A	0.0	0.1	0.01	0.01	0.01	49.2
Approach		124	3	131	2.4	0.068	0.1	NA	0.0	0.1	0.01	0.01	0.01	49.9
North: Boundary Street (N)														
7	L2	2	0	2	0.0	0.001	5.0	LOS A	0.0	0.0	0.23	0.48	0.23	46.1
8	T1	1	0	1	0.0	0.002	4.5	LOS A	0.0	0.1	0.38	0.52	0.38	46.2
9	R2	1	0	1	0.0	0.002	6.3	LOS A	0.0	0.1	0.38	0.52	0.38	45.7
Approach		4	0	4	0.0	0.002	5.2	LOS A	0.0	0.1	0.31	0.50	0.31	46.0
West: Main Street (W)														
10	L2	10	0	11	0.0	0.122	5.0	LOS A	0.4	3.0	0.16	0.16	0.16	48.2
11	T1	138	9	145	6.5	0.122	0.2	LOS A	0.4	3.0	0.16	0.16	0.16	48.6
12	R2	53	6	56	11.3	0.122	5.2	LOS A	0.4	3.0	0.16	0.16	0.16	47.8
Approach		201	15	212	7.5	0.122	1.7	NA	0.4	3.0	0.16	0.16	0.16	48.4
All Vehicles		336	18	354	5.4	0.122	1.2	NA	0.4	3.0	0.10	0.12	0.10	48.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.


Turbot St
EXIT