

IMPACT ASSESSMENT

SECTION 4.6 AIR, GREENHOUSE GASES AND NOISE

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Jervois Base Metal Project

VOLUME 2 Impact Assessment

SECTION 4.6 | Air, Greenhouse Gases and Noise

4.6 Air, Greenhouse Gases and Noise

4.6.1. Introduction

The NT EPA's objective related to air quality and greenhouse gases is to:

"maintain air quality and minimise emissions and their impact so that environmental values are protected."

An air quality and noise emission assessment was undertaken by Air Noise Environment Pty Ltd in 2018 which included a desktop assessment including interrogation of spatial databases and reviews of relevant literature. In addition to this, on-ground dust monitoring has been undertaken by KGL Resources since 2016.

The database review and GIS mapping of several data sources provided the context of the air shed, greenhouse gases and climate of the lease areas. The sources include:

- Climate data online (Australian Government Bureau of Meteorology, 2017)
- Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway, 1995)
- National Pollution Inventory
- Northern Territory Ambient Air Quality Monitoring (NT EPA, 2016)
- Fire history (North Australia and Rangelands Fire Information, 2017); and
- Aerial photographs and satellite imagery.

As a detailed inventory of all construction and operating equipment was not available at the time of the desktop assessment, relevant assumptions were made based on experience with similar mining projects.

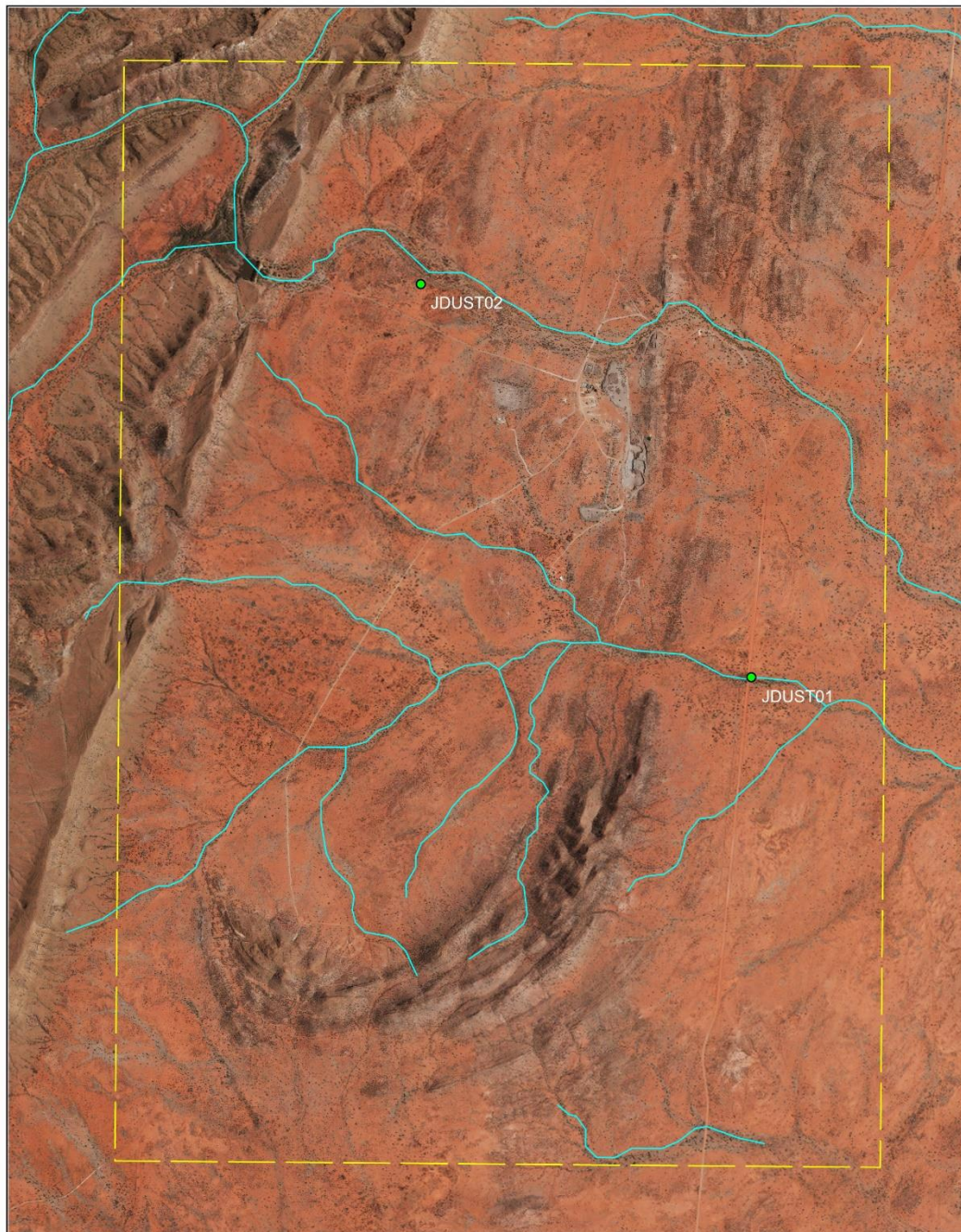
Background concentrations of key air quality indicators (carbon monoxide, nitrogen dioxide and particulate matter TSP, PM₁₀ and PM_{2.5}) were extrapolated from similar inland rural monitoring stations in the Northern Territory. The assessment and evaluation of the Project's potential air emissions was conducted using the *National Environmental Protection Policy (NEPM) for Ambient Air (1998)* document together with a comprehensive risk assessment approach. The risk assessment provided context to the various environmental aspects of the Project and their risk relevance to air quality. The air quality risk assessment identified and quantified the risks associated with the construction and operational phases of the Project.

To provide an indication of the significance of the Project in terms of dust emissions, emission estimates have been completed based on the techniques presented in the National Pollutant Inventory for Mining (DSEWPC, 2012) and for Combustion (DEWHA, 2008). For the purposes of the emissions estimation, the initial site establishment stage as well as the normal mining operational scenario has been considered. The emissions estimates take account of the proposed dust controls

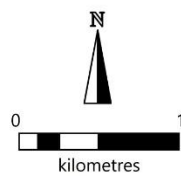
for the Project. For the purposes of the emissions calculations, the following assumptions were adopted:

- Default silt content and moisture contents from NPI manual
- Silt content of 10 % (relatively high)
- Moisture content of 2 % (relatively low); and
- Diesel fuel is used for the 12 MW power plant.

The installation of dust deposition gauges at two locations within the Project area has allowed for an ongoing monthly dust monitoring program as indicated in Figure 4.6-1. The Project dust monitoring program was undertaken between 2016 and 2018 to quantify existing ambient dust concentrations. The monitoring data is utilised to establish 'dust fall' in the area and can be further analysed to determine the amount of Total solids, Insoluble solids, Ash solids and Soluble solids present within dust suspended in the air column at the Project site for a given period of time.



Legend
● Dust Monitor
▭ Project Area



Jervois Base Metal Project
ENVIRONMENTAL IMPACT STATEMENT

KGL Dust Monitoring Locations

Created by Nitro Solutions Pty Ltd with data supplied by the Client, technical specialists and GSA. Maps may be based on or contain data provided by the respective State Government 2018

Figure 4.6-1 Locations of Depositional Dust Monitoring Gauges

Estimations of annual greenhouse gas emissions during construction and operation (the GHG emissions inventory) have been completed based on the methods outlined in the *National Greenhouse Energy Reporting Act 2007* (NGER), associated technical guidelines (Department of Climate Change, 2016) and the Greenhouse Gas Protocol (World Business Council, 2004). The models used to complete the GHG emissions inventory rely on estimations of energy consumption, particularly fuels and electricity.

Commonwealth and Northern Territory legislation that may be relevant to the air quality and greenhouse gas emissions potentially impacted by the Project, include:

- *Environmental Assessment Act 1994* (Northern Territory)
- *Environmental Protection Act 2012* (Northern Territory)
- *Waste Management and Pollution Control Act 2015* (Northern Territory)
- National Environment Protection Measure for Ambient Air Quality (NEPM Air)
- Noise Guidelines for Development Sites in the Northern Territory (May 2014); and
- *National Greenhouse Energy and Reporting Act 2007*.

Noise emissions have not been identified as a preliminary environmental factor requiring impact assessment by the ToR (Section 4.1 of the ToR), but an assessment of expected noise levels associated with the Project is required as part of the Description of the Project (Section 2.2.9 of the ToR). The noise assessment provided in this chapter of the EIS includes the potential impacts and risks arising from the Project and the proposed management and mitigation measures to be implemented to meet Noise Guidelines for Development Sites in the Northern Territory (May 2014).

The existing acoustic environment was extrapolated from the *Queensland Environmental Protection (Noise) Policy 2008* as the Northern Territory legislation is not prescriptive in relation to noise criteria for new developments including mining operations. In the absence of relevant NT noise criteria, reference has been made to the Queensland Department of Environment and Heritage Protection (DEHP) Model Mining Conditions (7 March 2017). The DEHP Model Mining Conditions specify noise emission limits that are considered to meet the intent of the *Queensland Environmental Protection (Noise) Policy 2008*, which is to protect and enhance the acoustic environment within Queensland. With reference to the Project site generally, very low background noise levels can be experienced throughout the year in this type of environment, typically at or below the 30 dB(A) reference noise level recommended in Queensland and New South Wales as the minimum noise level for defining acoustic assessment criteria.

4.6.2. Existing Environment

The Project is located in a remote rural area where the predominant land use is grazing. The Project has been subject to historic mining since 1929 and as such is littered with historical mining disturbances. Key sources of background air emissions are smoke from bushfires and dust from vehicles travelling on unsealed roads.

The Project climate can be categorised as an arid desert environment with dry, hot summers and short, dry winters. The Project area is broadly within a desert climate; however the area receives a mean annual rainfall from 281 to 303 mm and can be classified as Bsh: Subtropical steppe using the Köppen climate classification system (ISC-Audubon, 2018). The annual rainfall for the area typically falls between the months of October and March. Table 4.6-1 provides a summary of the climatic data of the Project and surrounding areas. Average annual temperatures range from 13 – 15°C (minimum) to

29 – 31°C (maximum). Wind roses located in Appendix C-3, Figure 3.1 have shown that prevailing winds are south-easterly, with easterly winds a significant feature particularly to the south of the Project site. Calm conditions are relatively low at Jervois (2.0 % - 5 %) and Ringwood (0.05 % - 11 %) and are higher for Alice Springs Airport (5 % - 22 %) (Air Noise Environment, 2018).

Table 4.6-1 Climate Data Summary

Station	Average Rainfall (mm)	Average Minimum Temperature (°C)	Average Maximum Temperatures	Prevailing Wind Directions
Jervois	290.8	14.6	31.0	South-easterly
Arltunga	298.3	13.3	28.7	Not recorded
Alice Springs Airport	281.2	13.2	28.8	South-easterly/easterly
Ringwood	302.6	12.9	29.4	South-easterly

Source: Air Assessment - Jervois Base Metal Project (Air Noise Environment, 2018)

In relation to the mining activity, the Air and Noise Assessment (Air Noise Environment, 2018) identified the nearest sensitive receptors as two homesteads and two Aboriginal communities located within 35 kilometres of the Project boundaries. These sensitive receptors and their proximity to the Project are shown in Table 4.6-2 and Figure 4.6-2.

Table 4.6-2 Sensitive Receptors Outside of the Jervois Base Metal Project

Code	Sensitive Receptor	Distance from Mining Lease	Description
SR1	Maperte Community	16 km to the north-east	Mostly unoccupied
SR2	Bonya Community (also known as Orrtipa-Thurra)	17 km to the south-west	Approximately 20 people in the community, with accommodation for up to 80 people
SR3	Jervois Homestead	35 km to the south	
SR4	Lucy Creek Homestead	24 km to the north	

Source: Air Assessment - Jervois Base Metal Project (Air Noise Environment, 2018)

The haul route associated with the Project includes the unsealed Road No. 194 and the Plenty Highway from the Project to Ongeva Creek then following the sealed portion of the Plenty Highway and the Stuart Highway. In relation to the transportation of product, the Air and Noise Assessment (Air Noise Environment, 2018) identified the nearest sensitive receptors as one homestead, two Aboriginal communities and a caravan park within 1 kilometre of the haul route. Table 4.6-3 and Figure 4.6-3 provides the nearest sensitive receptors associated with the Project truck haul route.

Table 4.6-3 Sensitive Receptors Along Plenty Highway and Road No. 194

Code	Sensitive Receptor	Distance
SR5	Bonya Community	8.3 km north-west of Road No. 194/Plenty Highway turnoff
SR6	Jervois Homestead	800 m west of Plenty Highway
SR7	Atitjere Community	1 km south of Plenty Highway
SR8	Gemtree Caravan Park	200 m north of Plenty Highway

Source: Air Assessment - Jervois Base Metal Project (Air Noise Environment, 2018)

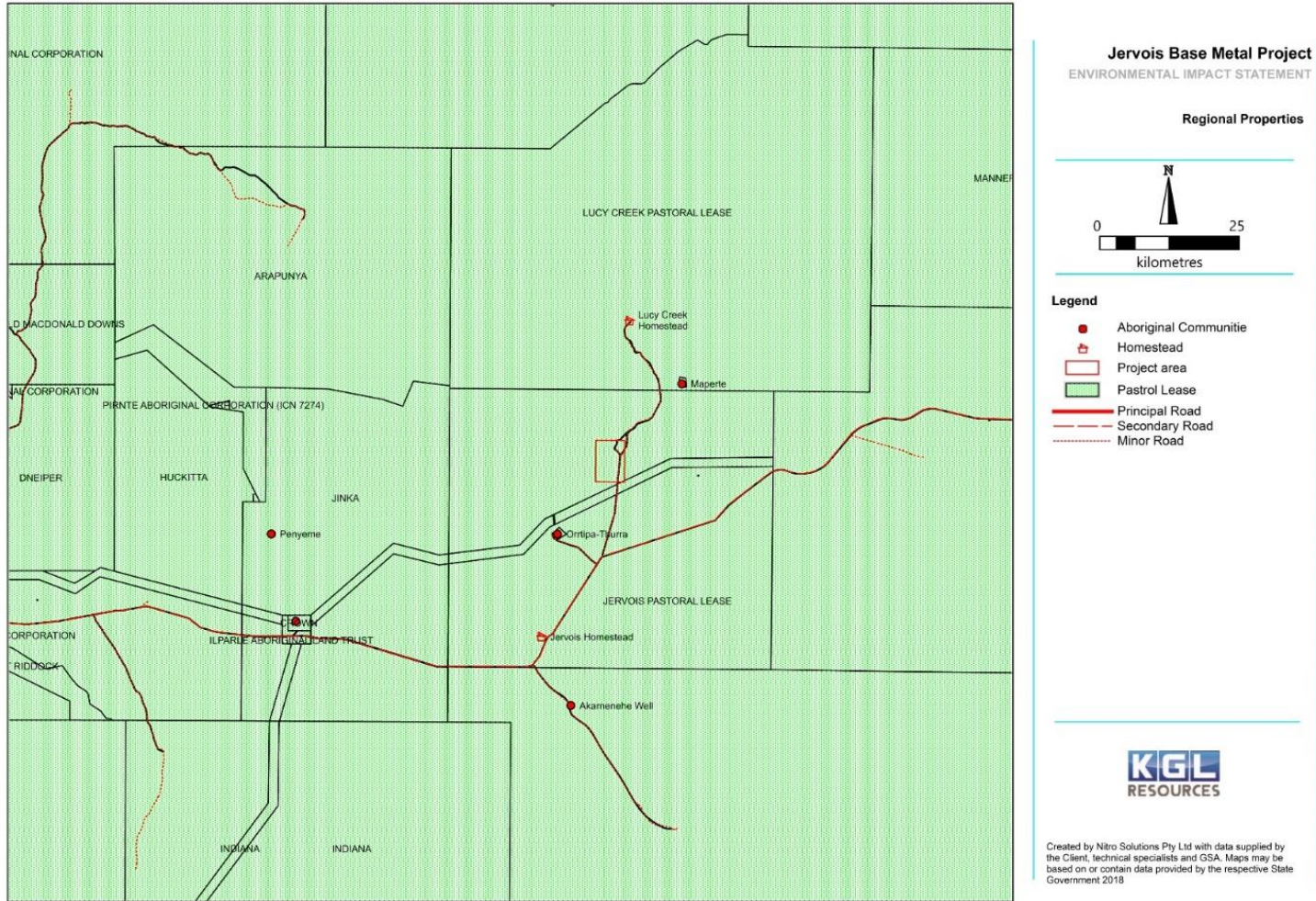


Figure 4.6-2 Sensitive Receptors Relevant to the Project Area

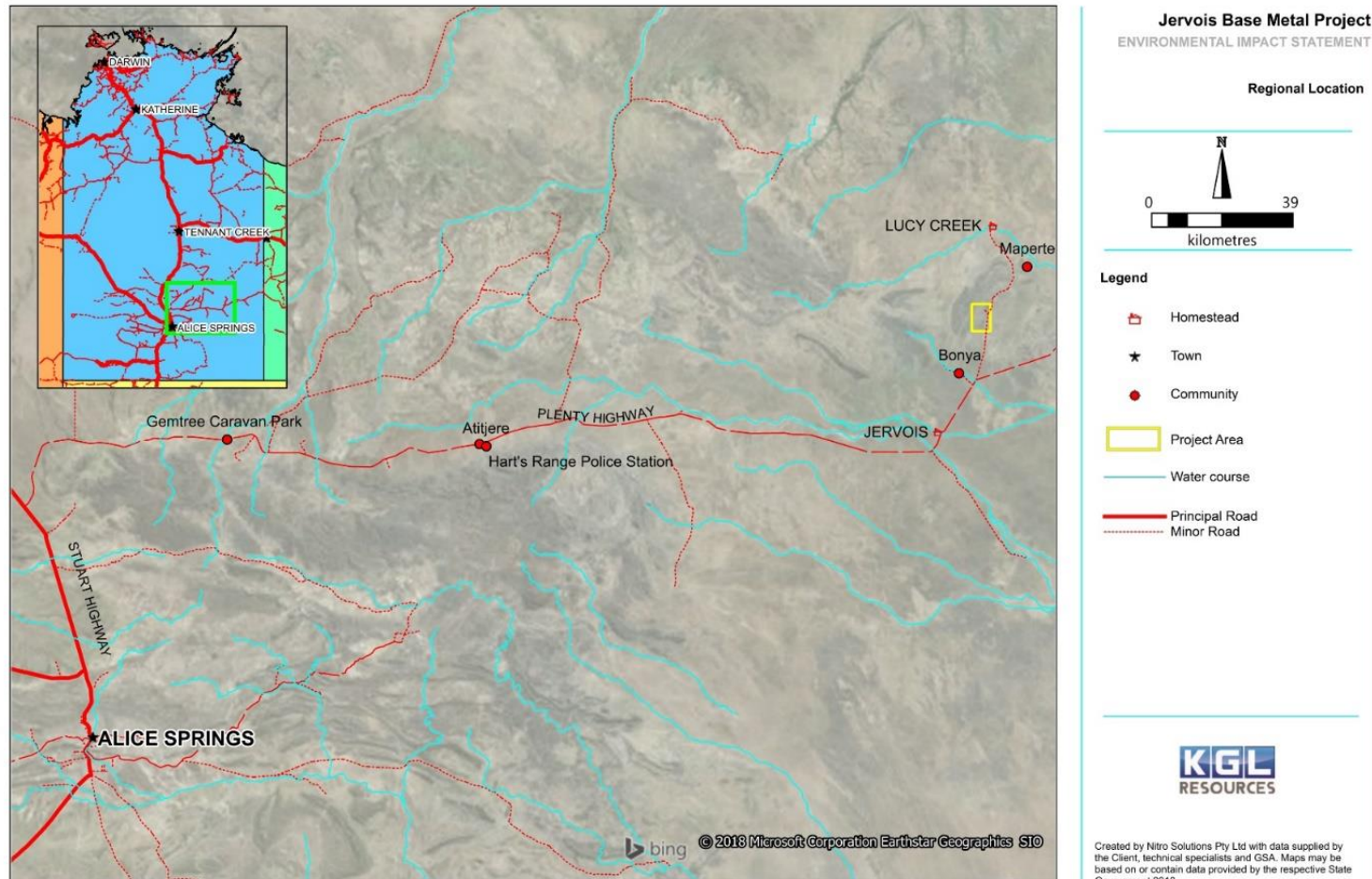


Figure 4.6-3 Ore Transport Haul Route Sensitive Receptors

The key air quality indicators identified for the Project are carbon monoxide, nitrogen dioxide and particulate matter (TSP, PM₁₀ and PM_{2.5}). There is no directly relevant air monitoring data available to provide an indication of existing air quality at the Project site. Therefore air quality monitoring completed by the Northern Territory Government and the Queensland Department of Science, Information Technology, Innovations and the Arts (DSITIA) for a range of locations in the Northern Territory and Queensland have been referenced to provide an indication of likely background air quality concentrations at the Project site. TSP, PM_{2.5}, CO and NO₂ indicators are monitored from a number of stations in Darwin and Queensland and provided monitoring data for the background concentrations potentially experienced within the Project area. Data representative of isolated rural areas, such as those located along the majority of the Project transport route, are not available.

Table 4.6-4 provides monitoring data for TSP, PM₁₀, PM_{2.5}, CO and NO₂ obtained from the reporting year of 2015 (Air Noise Environment, 2018). Where monitoring data are not available for a specific air quality parameter from the NT stations, data from monitoring stations located in QLD have been referenced for the same reporting year. Given the Project's isolation, it is expected that background ambient concentrations would potentially be lower than those presented in Table 4.6-4 within the Project area (Air Noise Environment, 2018).

Table 4.6-4 - Measured 2015 Background Concentrations

Pollutant	Measured Concentration $\mu\text{g}/\text{m}^3$	Averaging Time	Monitoring Station	Area Description
TSP	36.3	Annual	Jondaryan (Qld)	Near to highway and coal train loading area
	29.1		Townsville Coast Guard (Qld)	Industrial Port
PM ₁₀	24.8	Hour, 75th %ile Annual	Palmerston, Darwin (NT)	Boundary of General Industry
	20.1		Winnellie, Darwin (NT)	Near suburban area and refinery
	20.9			
15.7				
PM _{2.5}	10.9	24-hour, 75th %ile Annual	Palmerston, Darwin (NT)	Boundary of General Industry
	7.8		Winnellie, Darwin (NT)	Near suburban area and refinery
	4.5			
	3.4			
CO	342.8	8-hour, 75th %ile	Palmerston, Darwin (NT)	Boundary of General Industry
	381.9		Winnellie, Darwin (NT)	Near suburban area and refinery
NO ₂	11.1	1-hour, 75th %ile Annual	Palmerston, Darwin (NT)	Boundary of General Industry
	7.7		Winnellie, Darwin (NT)	Near suburban area and refinery
	7.4			
	5.6			

Source: Air Assessment - Jervois Base Metal Project (Air Noise Environment, 2018)

A dust monitoring program was conducted from February 2016 to May 2018 to quantify existing ambient dust concentrations at the Project site. The monitoring data was utilised to establish the background dust deposition rates at the Project site, broken down into a measure of Total solids, Insoluble solids, Ash solids and Soluble solids. These results are documented in Table 4.6-5. It is apparent that the results of the sampling in May 2018 represent an anomaly in the data set, which is likely related to nearby bushfires or controlled burns at the time of sampling. These results have not been incorporated into the calculation for parameter averages. Once the Project is operational, it will

be possible to compare operational dust deposition rates to the background dust deposition rates and provide a measure of increase. Dust deposition rates are frequently conditioned for mine sites at a rate of 120 mg/m²/day (insoluble solids). The background dust deposition rate for insoluble solids for the Project site has been measured as 2,000 mg/m²/month (or 71 mg/m²/day).

Table 4.6-5 Dust Monitoring Results (February 2016 – May 2018)

Parameters	2016			2017				2018		Average (excluding May 2018)
	Feb	Apr	Dec	Feb	May	Jul	Sep	Jan	May	
Total Solids (g/m²)	9.8 7.9	5.2	7.5 7.0	7.5 7.0	11.7 6.4	6.8 6.5	2.3 1.4	3.1 1.6	176	6.1
Insoluble Solids (g/m²)	4.8 4.6	1.2	1.7 1.9	1.7 1.9	3.7 1.0	1.6 1.3	0.5 0.2	2.4 0.9	156	2.0
Ash Solids (g/m²)	4.7 3.6	0.7	1.1 0.3	1.1 1.9	2.4 0.6	0.7 0.4	0.2 0.2	0.2 0.7	150	1.3
Combustible Matter (g/m²)	0.1 1.0	0.5	0.6 1.6	0.6 1.6	1.3 0.4	0.8 0.9	0.3 <0.1	2.2 0.2	6.3	0.8
Soluble Solids (g/m²)	5.0 3.3	3.9	5.8 5.1	5.8 5.1	8.0 5.4	5.3 5.2	1.8 1.2	0.7 0.7	19.3	4.2

Source: Intertek Chemical Analysis Report (Northern Environmental Laboratory, 2016, 2017, 2018)

Noise

The existing acoustic environment in the immediate surroundings of the Project area is likely to be defined by natural noise sources (birds, insects etc.) superimposed with intermittent noise from local traffic and machinery used by local graziers. Generally, very low background noise levels can be experienced throughout the year in this type of environment, typically at or below the 30 dB(A) reference noise level recommended in *Queensland Environmental Protection (Noise) Policy 2008*.

Noise levels at the nearest potential receptors to the Project site, including properties located within 500 metres of the proposed mine haul route, are likely to be at or below the 30 dB(A) reference level. Average noise levels from unsurfaced vehicle routes in the area of interest are likely to be low, as vehicle numbers will be low, however the noise from individual vehicles is expected to result in short term increases in noise levels (typically 1 – 3 minutes per event, depending on vehicle speed) and may be audible at receptors located in close proximity to the road.

4.6.3. Relevant Activities

As per the requirements of the Terms of Reference this Section describes proposed activities that have the potential to cause impacts on air quality. This includes those activities that disturb soil, rock producing dust and emissions and/or involve emissions resulting from machinery and/or ore processing activities.

The Air and Noise Assessment (Air Noise Environment, 2018) identified two potential sources of dust and/or emissions related to the Project: the mining activity (that will take place within the Project boundaries) and the transportation of product. Key air emission sources related to the mining activity include underground mining (emissions vented via an exhaust system), open cut operations such as overburden removal, blasting, excavation, truck movements within the Project area, the power generation plant and crushing at the processing plant. Air emissions for these sources are defined by particulate air quality indicators (TSP, PM₁₀, PM_{2.5} and deposited dust) and indicators associated with combustion (e.g. NO₂, CO).

The primary source of GHG emissions is associated with the operation of diesel-powered equipment (e.g. mobile plant, power generation plant) (Scope 1 emissions). Key air emission sources related to the transportation of product include truck movements outside the Project area (specifically along the unsealed Road No. 194 and the Plenty Highway from the Project to Ongeva Creek) and operation of diesel-powered equipment (i.e. haul trucks).

The Air and Noise Assessment (Air Noise Environment, 2018) identified two potential sources of noise emissions related to the Project: the above ground mining activity and transportation, and underground mining activity. The key noise emission sources are located above ground and include open cut activity (heavy machinery), drill and blast activities, haul truck movements, mobile plant and processing plant operations. Noise levels from underground mining activity is expected to be low (although some noise breakout is likely to occur through entry and ventilation points). Modelling for the purposes of the impact assessment was based on the site operating 24 hours a day for 7 days a week.

Construction of mining infrastructure is expected to occur during the year 2019. Key noise sources during construction are truck movements, mobile equipment (e.g. cranes, earthmoving equipment), concrete batching plant and general tool noise.

4.6.4. Potential Impacts and Risks

The potential impacts and risks to air quality and current ambient noise environment are described in the context of environment. Whilst this Section of the EIS refers to the potential impacts and risks to people these matters are discussed in detailed in Section 4.8 of this EIS.

The potential impacts and risks in terms of air, greenhouse gas emissions and noise have been studied to provide:

- An inventory of any emissions to air resulting from the Project (i.e. dust, machinery, vehicles, gases/vapours, odours, etc)
- Determination of the potential for Scope 1,2 and 3 greenhouse gas emissions
- Identification of sensitive receptors; and
- Establishment of estimated receptor noise levels.

For the Project, a risk is considered high or significant if there is a real chance that the Project could cause elevation of any pollutant or emission to an unacceptable level (i.e. above current guidelines and standards) detected at the nearest sensitive receptors. A risk assessment process has been undertaken to predict the level of risk associated with each impact (Appendix C-11). The process follows the procedures described in AS/NZS 4360 (1999) and ISO 31000 (2009) and has been undertaken for each impact before the application of any mitigation measures. The application of mitigation measures will ameliorate the level of risk to an acceptable level for the Project.

Air Emissions

The Northern Territory government provides guidance on the assessment of air quality through the use of Environmental Protection Objectives established in accordance with the Northern Territory *Waste Management and Pollution Control Act* (14 October 2015). As the Act does not provide specific air quality criteria reference is made to the National Environmental Protection Policy (NEPM) for Ambient Air (1998) as a possible source of criteria. The NEPM Air (1998) provides ambient air quality standards for the protection of human health and well-being. The key air quality indicators relevant to the Project are related to emissions from materials handling and combustion of diesel and gas

(carbon monoxide, nitrogen dioxide and particulate matter). The maximum concentrations in the standard are the maximum safe limit measured at sensitive receptors and do not relate to the levels of emissions measured at the source point (which would be the mine site).

Table 4.6-6 provides a summary of the pollutant standards for each potential pollutant including averaging period, maximum concentration and maximum allowable exceedances.

Table 4.6-6 Standards for Pollutants

Item	Pollutant	Averaging Period	Maximum concentration standard	Maximum allowable exceedances
1	Carbon monoxide	8 hours	9.0 ppm	1 day a year
2	Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year None
3	Photochemical oxidants (as ozone)	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
4	Sulfur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year None
5	Lead	1 year	0.50 µg/m ³	None
6	Particles as PM ₁₀	1 day 1 year	50 µg/m ³ 25 µg/m ³	None None
7	Particles as PM _{2.5}	1 day 1 year	25 µg/m ³ 8 µg/m ³	None None

Source: National Environment Protection (Ambient Air Quality) Measure (Commonwealth Government, 2016)

In terms of the air quality compounds of key significance, as the Project is in excess of 16 kilometres from the nearest potentially sensitive location, gaseous emissions are unlikely to be a risk. Given the expected mine haul vehicle numbers, estimated at 25 return trips per day, impacts from gaseous emissions are very unlikely at the nearest potentially sensitive receptor, the Gemtree Caravan Park, located 200 metres to the north of the Plenty Highway.

The potential impacts and risks associated with the Project workforce is addressed in Section 4.8 Human Health of this EIS.

RISK ASSESSMENT RATING: Medium (before mitigation)

The Project has significant historical mining disturbances and existing cleared areas which can be utilised for new mining facilities and infrastructure. Due to these disturbances, the emissions associated with the construction phase of the Project is expected to be significantly lower than for new mining activities (Air Noise Environment, 2018). The Air and Noise Assessment identified two potential sources of dust and/or emissions related to the Project: the mining activity (that will take place within the Project boundaries) and the transportation of product. For the new mining activities there is potential for dust emissions to arise as a result of the following activities:

- Waste rock removal and dumping at storage areas
- Blasting
- Loading and unloading of mined material to processing plant
- Processing of ore, including primary and secondary crushing, SAG mill and classification
- Stockpile stacking and unloading – ROM
- Waste material dumping to stockpiles

- Deposit of waste material to tailings dam (wet)
- Traffic on unsealed roads within and external to the mine
- Grading of haul roads
- Movements of light vehicles, haul trucks and other machinery
- Loading of product onto trucks, and of site haulage; and
- Wind erosion of open surfaces.

To provide an indication of the expected significance of particulate releases associated with the Project, emissions calculations have been completed. The resultant expected annual particulate emissions are considered in the context of separation distances to the nearest potentially sensitive receptors. The calculated particulate emission estimates specific for the Project are summarised in Table 4.6-7.

Table 4.6-7 - Particulate Emissions Estimates (tonnes per annum)

Source	Details	TSP	PM ₁₀	PM _{2.5}
Wind erosion of open area sources	<ul style="list-style-type: none"> • Plant and ROM: 29.2 Ha • Pit area above ground: 22.5 Ha • Waste rock dump: 75.8 Ha (based on Marshall Reward Pit) • On-site haul roads: 28 km x 25m wide 	208	104	21
Haul Vehicles on internal haul Road	<ul style="list-style-type: none"> • Internal haul of 5 Mtpa mined material, waste and product (with haul truck return trip empty) 	589	174	17
Haul route maintenance	<ul style="list-style-type: none"> • 1 x Grader operating continuously, 12 hours/day 	5	1	<1
Ore Processing	<ul style="list-style-type: none"> • 100,000 tpa processed mined material 	400	40	20
Power plant	<ul style="list-style-type: none"> • 12 MW diesel generator, operating continuously 	Negligible	45	4
Total (tpa)		1310	418	73
Total (g/s)		41.5	13.3	2.3

Source: Air Assessment - Jervis Base Metal Project (Air Noise Environment, 2018)

When compared to annual particulate emissions reported for existing metalliferous mines in the Northern Territory, estimated PM₁₀ particulate emissions for the Jervis Project (418 tpa) are also lower than all existing mines. Examples of NPI reported emissions of PM₁₀ for the 2015 – 2016 reporting year are presented in Table 4.6-8.

Table 4.6-8 NPI PM₁₀ Particulate Emissions Reported for NT Metal Mines – 2015/2016 Reporting Year

Mine	Details	PM ₁₀
Tanami Mine	Granites operation	1,400
McCarthy River	Borrooloola	1,400
Jabiru	Ranger operations	350
Alcan Gove	Gove Mine	330
Groote Eylandt	Gemco Mine	6,800

Source: Air Assessment - Jervis Base Metal Project (Air Noise Environment, 2018)

The air quality investigations associated with the Project indicate that the risk of impacts to sensitive receptors associated with particulate emissions from mining activities at the Project site is very low, given the distance to the nearest sensitive receptor is in excess of 16 kilometres (Air Noise Environment, 2018). Particulate emissions from vehicles on the off-site haul route along the Plenty Highway are a more significant risk as sections of this public road are unsealed from Road 194 to the Plenty Highway (Air Noise Environment, 2018). The nearest receptors to unsealed sections of the off-site haul route are:

- Jervois Homestead (800 metres west of Plenty Highway); and
- Atitjere Community (1 kilometre south of Plenty Highway).

There are expected to be up to 25 ore transport vehicle movements from site per day, which will translate to up to 50 truck movements per day on the Plenty Highway. Whilst the separation distance to the Jervois Homestead and the Atitjere Community are considered sufficient to provide a buffer from particulate emissions, they may experience some impacts associated with vehicle movements. Although the Gemtree Caravan Park is located 200 metres to the north of the Plenty Highway, the section that passes near to the Gemtree Caravan Park is sealed so haul route particulate emissions are unlikely to be a risk for the Park. Furthermore, ore will be transported in fully enclosed containers which will prevent the potential for emissions from haul vehicle loads during transit.

The comprehensive risk assessment for the Project identified particulate emissions (dust) produced by the mine as a potential medium risk mainly to the on-site mining community. The transportation of product along unsealed roads was highlighted as a public risk with a low risk rating. The potential impact of dust on ecosystems within the Project area is discussed in Section 4.1.

RISK ASSESSMENT RATING : low (before mitigation)

Greenhouse Gas Emissions

The National Greenhouse and Energy Reporting Act 2007 (NGER) provides a national reporting framework for GHG emissions, GHG Projects, energy consumption and production. When determining reporting requirements pursuant to the NGER Act, corporations are divided into groups and their associated emission types, Scope 1, 2, 3. Scope 1 emissions for the Project are related to fuel usage by construction and operational equipment. Primarily diesel equipment will be used during construction and operations, which includes off-road and on-road mobile equipment and stationary equipment such as generators, pumps and compressors. Scope 2 emissions are not applicable as the processing plant will be powered by an on-site power generation plant (diesel or gas-fired) with no mains power supply. Scope 3 emissions are not a mandatory requirement of reporting and have not been considered in this assessment due to estimate inaccuracies, effective controls and third-party reporting (Air Noise Environment, 2018).

For the purposes of this assessment the organisational boundary of the Project was defined as the proposed construction site and operational facilities and includes all GHG emissions controlled or produced by the Project. GHG estimates have been predicted for the following periods:

- Year 1 – construction only; and
- Year 2 onwards – annual operations.

Construction is proposed to occur in early 2019, with commencement of operations later in the year. For the purpose of the assessment, it was assumed that construction would occur over the majority of 2019 with minimal contribution to GHG emissions from commissioning. From 2020, all GHG emissions are considered to be associated with operations only.

It is expected that Scope 1 emissions would primarily relate to the use of diesel fuel to power mobile and stationary equipment. A review of activity data for construction of other mining projects provided an indicated annual diesel usage of approximately 200 kL to 4,400 kL per annum.

- Mt Todd Mine – 3,300 kL of diesel used over 2 years
- Mt Peake Mine – 1,750 kL of diesel over 2 years
- Roper Bar Iron Ore Mine – 4,350kL/year; and
- New Acland Coal Mine – 3,000 kL/year.

To estimate Scope 1 emissions during construction, the Air and Noise Assessment assumed that a similar amount of diesel would be utilised for the Project, therefore an average value of 3,000 kL/year has been adopted.

Operational activity data used to estimate Scope 1 emissions have been based on preliminary feasibility information ¹ provided by KGL Resources as shown in Table 4.6-9.

Table 4.6-9 Operational Energy Usage

Energy From	Annual Consumption
Electricity	72,391,084 kWh
Diesel Fuel	26,500 kL (10,500 kL for power generation)
Lubricants and Hydraulic Oil	21 kL

Source: GHG Assessment - Jervois Base Metal Project (Air Noise Environment, 2018)

As direct measurement of emissions is not feasible where a Project is still in the design phase, emission factors were used in accordance with the GHG Protocol methodology and are expressed in Table 4.6-10. The emission factors are determined by calculating GHG emissions per unit of activity which can establish site inventories and reduce the requirement for site specific emission testing. The relevant emission factors for the Project are associated with fuel-related emissions (Scope 1).

Table 4.6-10 Emission Factors – Consumption of Fuels (Scope 1)

Use	Fuel Combusted	Energy Content (GJ/m ³)	Emission Factor (kg CO _{2-e} /GJ)		
			CO ₂	CH ₄	NO ₂
Power Generation	Diesel	38.6	69.9	0.1	0.2
Power Generation (Alternative)	Natural Gas	46.5	64.0	0.1	0.2
Mobile Equipment	Diesel	38.6	69.9	0.1	0.2
Lube and Hydraulic Oil	-	38.8	13.9		

Source: GHG Assessment - Jervois Base Metal Project (Air Noise Environment, 2018)

The GHG Assessment has estimated the emissions summarised in Tables 4.6-11 and 4.6-12 are expected to trigger the NGER reporting threshold. This reporting threshold requires a single facility of 25 kilotonnes CO_{2-e} (25,000 tonnes CO_{2-e}) of greenhouse gases and 100,000 MJ of energy consumed (Air Noise Environment, 2018). The Project predictions of 71,854 of Total CO_{2-e} (tonnes) per annum is above the 25,000 CO_{2-e} (tonnes) limit prescribed by NGER.

In accordance with these guidelines, there is no requirement to report greenhouse gas emissions in the Project site prior to the commencement of mining activities. In the absence of any industrial or mining activities the greenhouse gases produced by the site would be limited to those associated with a low level of cattle grazing.

Table 4.6-11 Construction Scope 1 Emissions

Stage/Equipment	Total Energy Consumed GJ	Total CO ₂ -e (tonnes)
Construction	115,800	8,164

Source: Air Noise Environment, 2018

Table 4.6-12 Operations Scope 1 Emissions

Stage/Equipment	Total Energy Consumed GJ	Total CO ₂ -e (tonnes)
Operation		
Power Generation	405,300	28,574
Total Diesel	613,740	43,269
Lube and Hydraulic Oil	815	11
Total Per Annum	1,019,855	71,854
Total for Project Life (15 years)	15,297,822	1,077,805

Source: Air Noise Environment, 2018

RISK ASSESSMENT RATING: moderate (before mitigation)

Noise Emissions

Noise calculations for 'Estimated Receptor Noise Levels' have been made taking into account attenuation due to distance, atmospheric absorption and ground absorption. Attenuation from the atmosphere and ground are based on the simplified approach presented in ISO Standard 9613-2 (1996) Acoustics - Attenuation of sound during propagation outdoors. The calculations assume all sources are operating simultaneously and that no topographical shielding occurs. Noise source data has been obtained from measurements of similar equipment by Air Noise Environment, the DEFRA construction and open sites data base, and a literature review of various mining noise assessments.

As the Northern Territory legislation is not prescriptive in relation to noise criteria for new developments including mining operations, reference has been made to the Queensland Department of Environment and Heritage Protection (DEHP) Model Mining Conditions (7 March 2017). The document provides the method for deriving DEHP noise limits (as shown in Table 4.6-13) and the derived noise limits based on background noise levels (Table 4.6-14).

Table 4.6-13 Model Mining Noise Conditions for Sensitive Receptors

Noise Level dB(A) measured as:	Monday to Saturday			Sundays and Public Holidays		
	7 am to 6 pm	6 pm to 10 pm	10 pm to 7 am	9 am to 6 pm	6 pm to 10 pm	10 pm to 9 am
LAeq,adj,15mins	CV = 50 AV = 5	CV = 45 AV = 5	CV = 40 AV = 0	CV = 45 AV = 5	CV = 40 AV = 5	CV = 35 AV = 0
LA1,adj,15mins	CV = 55 AV = 10	CV = 50 AV = 10	CV = 45 AV = 5	CV = 50 AV = 10	CV = 45 AV = 10	CV = 40 AV = 5

1. CV = Critical Value
2. AV = Adjustment Value

3. To calculate noise limits:

- If $bg \leq CV - AV$, then noise limit = $bg + AV$
- If $CV - AV < bg \leq CV$, then noise limit = CV
- If $bg > CV$, then noise limit = $bg + 0$

4. In the event that measured bg (LA90, adj,15mins) is less than 30 dB(A), then 30 dB(A) can be substituted for the measured background level

5. bg = background noise level (LA90, adj, 15 mins) measured over 3-5 days at the nearest sensitive receptor

6. If the project is unable to meet the noise limits as calculated above alternative limits may be calculated using the processes outlined in the "Planning for Noise Control" guideline

Table 4.6-14 Derived Noise Limits based on Model Mining Conditions

Noise Level dB(A) measured as:	Monday to Saturday			Sundays and Public Holidays		
	7 am to 6 pm	6 pm to 10 pm	10 pm to 7 am	9 am to 6 pm	6 pm to 10 pm	10 pm to 9 am
LAeq,adj,15mins	35	35	30	35	35	30
LA1,adj,15mins	40	40	35	40	40	35

Overpressure and vibration criteria for blasting activity is provided in the Australian and New Zealand Environment Council (ANZEC) guideline 'Technical basis for guidelines to minimise annoyance due to blasting over pressure and ground vibration' (September 1990). The criteria referred to in this guideline are commonly adopted by regulatory authorities throughout Australia. Table 4.6-15 presents the ANZEC airblast overpressure and vibration criteria.

Table 4.6-15 Blasting Noise and Vibration Criteria

Blasting Criteria	Blasting Limits
Airblast overpressure	115 dB (Linear) Peak for 9 out of 10 consecutive blasts initiated and not greater than 120 dB (Linear) Peak at any time.
Ground vibration peak particle velocity	5 mm/s peak particle velocity for 9 out of 10 consecutive blasts and not greater than 10 mm/second peak particle velocity at any time.

Construction of mining infrastructure is expected to occur during the year 2019. Key noise sources during construction are truck movements, mobile equipment (e.g. cranes, earth moving equipment), concrete batching plant and general tool noise. The NT EPA specifies construction noise criteria in the Noise Guidelines for Development Sites in the Northern Territory (May 2014). The guideline specifies the following noise criteria for residential use areas: $LA_{eq} = \text{Background Noise Level} + 5 \text{ dB}$. Adopting a minimum background noise level of 30 dB(A), and a construction criteria of 35 dB(A) is applicable to the Project.

During operation the key noise emission sources are located above ground and include open cut activities including:

- Excavators
- Drill and blast activities
- Haul truck movements
- Mobile plant including dozers and graders
- Fixed plant including pumps and compressors
- Processing plant operations
- Power station; and
- Lighting plants.

Noise levels from underground mining activity (mobile plant and ventilation) is expected to be low (though some noise breakout is likely to occur through entry and ventilation points).

Modelling for the purposes of the impact assessment was based on the site operating 24 hours a day for 7 days a week. Table 4.6-6 presents predicted noise levels at the nearest sensitive receptors to the Project site. The nearest receptors are the Maperte Community 16 kilometres to the north-east and the Bonya Community 17 kilometres to the southwest. Even though the Maperte Community is mostly unoccupied, for the purpose of the predictions, a separation distance of 16 kilometres has been considered.

Table 4.6-16 Operational Noise Predictions

Noise Source	No.	SPL dB(A)	Total dB(A)
Open Cut Mining			
Drill rigs	2	127	130
Excavator (up to 810 kW, 200 t)	2	114	117
Underground Mining Activity			
Intake fans	2	90	93
Exhaust fans	4	119	125
Mobile Equipment			
50-60 t Dump Trucks (Mine to Process Plant)	5	115	122
25 t Product Trucks	2	108	111
150 t Dump Trucks (Cat 785 or similar)	5	118	125
90 t Dump Truck (Cat 777 or similar)	5	115	122
200 t Excavator	1	114	114
100 t Excavator	1	108	108
Dozer	2	108	111
Grader	1	107	107
Water Cart	1	108	108
Processing Plant			
Primary crusher	1	120	120
SAG Mill	1	120	120
Pebble crusher	1	120	120
Conveyor driver	7	94	102
Air compressor	1	110	110
Pump	32	110	120
Other			
12 MW CNG Power Station	1	114	114
Lighting plant	10	114	100
Total Operational Sound Power Level	134 dB(A)		
Predicted Noise Level at Nearest Sensitive Receiver (16 km distance)	7 dB(A)		
Noise Criteria	L_{Aeq} 30 dB(A)		

Source: Noise Assessment - Jervois Base Metal Project (Air Noise Environment, 2018)

Based on a comparison with the noise criteria derived for the assessment, the predicted noise levels associated with the Project are expected to be well within the appropriate LA_{eq} acoustic goals. Furthermore, noise levels at the nearest sensitive receptor from the mine are expected to be well below typical background noise levels for a rural area (25 dB(A)) and therefore inaudible. LA₁ and LA_{Max} noise levels are expected to be no more than 10 dB above the predicted LA_{eq} levels and are also expected to be well within the 45 dB(A) sleep disturbance noise limit.

Where operations occur during the night period (10 pm to 7 am), there is a potential for sleep disturbance impacts due to impulsive or instantaneous noise sources (e.g. reversing beepers, dropping of material onto hard surfaces). The Queensland Department of Environment and Heritage Protection (DEHP) (now Department of Environment and Science) Planning for Noise Control Guideline states that 'for good sleep over eight hours, the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dB(A) maxL pA more than 10-15 times per night. The corresponding external noise level, assuming partially closed windows, is 52 dB(A) maxL pA'.

Potential impacts associated with blasting (overpressure and vibration) are highly dependent on-site specific factors such as soil density, and the proposed methodologies and operating parameters (e.g. stemming height, mass charge rate). Nonetheless, given the large distance from the nearest sensitive receptors, the potential airblast overpressure and vibration impacts from blasting are expected to be minimal.

The comprehensive risk assessment for the Project identified noise emissions produced by the mine as a potential medium risk to the on-site mining community. The transportation of product along unsealed roads was highlighted as a public risk with a low risk rating. The potential impact of noise emissions on ecosystems within the Project area is discussed in Sections 4.1 to 4.3.

RISK ASSESSMENT RATING: low to medium (before mitigation)

4.6.5. Mitigation and Monitoring

Mitigation and management of potential risks and impacts associated with the Project is focused upon the following aspects, being the:

- Management of dust, including target thresholds with reference to regulatory industry-standard, health-related safe-limits, or aspirational parameter levels
- Management of any gas/vapours/odours
- Strategies for minimising emissions from burning fossil fuels; and
- Management of air quality post mining, including post-mining monitoring and reporting.

With specific reference to the potential risk of impacts to human health whilst these matters are raised in this section the detailed discussion of these specific matters is addressed in Section 4.8 of this EIS.

The mitigation strategy for the Project has focused on a hierarchy of:

1. Avoidance
2. Minimisation; and
3. Mitigation.

Air Quality

The objective of the air quality mitigation and monitoring strategies are to ensure there is no health risk, nuisance or loss of amenity due to particulate or airborne dust emissions from the site and to achieve compliance with the requirements of the:

- National Environment Protection Measure for Ambient Air Quality (NEPM Air); and
- *Northern Territory Waste Management and Pollution Control Act* (14 October 2015).

The recommended performance indicators, mitigation methods and monitoring strategies outlined in the Air and Noise Assessment (Air Noise Environment, 2018) are summarised in Table 4.6-17.

Table 4.6-17 Air Quality Mitigation and Monitoring Strategies

Performance Indicators	<p>The objectives of this air quality plan are being complied with if the following criteria are achieved:</p> <ul style="list-style-type: none"> • Dust generated by vehicles on the access roads external to site does not allow for visible tracking • There are no visible suspended particulate releases dispersing external to the site boundary; and • Particulate concentrations do not exceed the following limits: <ul style="list-style-type: none"> ○ Total Suspended Particulates – Annual Average: 90 µg/m³ ○ PM₁₀ – 24 hour average: 50 µg/m³ ○ PM_{2.5} – 24 hour average: 25 µg/m³ ○ PM_{2.5} – annual average: 8 µg/m³; and ○ Depositional dust – Daily average: 120 mg/m³/day.
Mitigation Methods	<p>Dust Controls</p> <ul style="list-style-type: none"> • Unsealed internal roads traversed by vehicles associated with Jervois Mine will be watered as required. The rate of watering is increased during dry periods or during periods of high winds • Vehicular access within the site is strictly limited to authorised vehicles and designated routes • Vehicle speeds will be limited onsite to minimise visible dust generation. • Dump truck routes will be kept as short as practicable • Vehicles (other than mining machinery) are not permitted on overburden dumps except for the purposes of planning, rehabilitation or monitoring • Wet dust suppression measures in the form of high pressure, low volume water sprays are to be used for crushing plant, conveyors, screening plant and stockpiles • Spoil is removed and dumped as soon as practicable after blasting • Topsoil stripping and placement is avoided on days when the wind speed is sufficient to carry dust beyond the mining lease boundary • To minimise exposed material and associated dust generation progressive rehabilitation of mined areas will occur in accordance with the mine schedule to minimise exposed material and dust generation • To assess the effectiveness of rehabilitation, conduct baseline particulate monitoring prior to construction for a period of 6 months (including dry months) to provide a basis for comparison to monitoring post-rehabilitation. As a minimum, monitoring of PM₁₀ shall be undertake • Minimise drop heights into hoppers, onto stockpiles and into haul trucks • Where practicable position crushing and screening plant and stockpiles in areas shielded by terrain, vegetation or berms to reduce wind speeds and the risk of surface erosion • The Erosion and Sediment Control Plan will be finalised and implemented prior to the commencement of development • All milling and ore processing are to be completed using wet processes • Crushing and conveying equipment for dry material shall have dust controls • Burning of cleared vegetation will be limited and shall not occur during periods of high winds; and • Application of chemical dust suppressant to a 1km section of the unsealed highway closets to Jervois Homestead and Atidjere Community on a quarterly basis to minimise the risk of dust impacts. <p>Machinery</p> <ul style="list-style-type: none"> • Scheduled vehicle and heavy equipment maintenance will occur as per the Original Equipment Manufacturer (OEM) requirements to minimise gaseous and particulate exhaust emissions • Shut down equipment when not required (to avoid diesel emissions during idling).

Monitoring	<p>Air monitoring will be undertaken where necessary to further investigate a valid complaint, where standard mitigation strategies have not resolved the issues that resulted in the complaint, and at the request of the Administering Authority (NT EPA).</p> <p>Monitoring will be completed in accordance with the relevant Australian Standards (relevant to the pollutant being measured).</p> <p>All monitoring will be completed by an appropriately qualified person, and all analysis completed by a NATA accredited laboratory.</p>
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Table adapted from the Preliminary Air Management Plan located in the Air, Noise Assessment developed by Air Noise Environment (Air Noise Environment, 2018)

RISK ASSESSMENT RATING: very low (after mitigation)

Greenhouse Gases

As GHG emissions associated with the Project are primarily associated with the combustion of fuels, in particular diesel, the GHG mitigation options are predominantly associated with the reduction of fuel combustion to reduce site emissions. Table 4.6-18 summarises these options along with additional opportunities that may be employed such the use of low emissions technology, equipment or technology changes and the use of renewable energy sources.

Table 4.6-18 GHG Mitigation Options

Controls	Details
Fuel Efficiency	<ul style="list-style-type: none"> • Minimising the use of fuel by selecting fuel efficient plant and equipment • Operation of vehicles in a fuel efficient manner • Turning off idling equipment • Selecting construction equipment based on fuel consumption • Selecting construction techniques that utilise lower amounts of fuel • Reduction of fuel usage through adopting efficient haul routes over the shortest distances; and • Implementation of a maintenance plan for all fuel-powered equipment, including mobile plant, processing plant and power generation plant
Renewable Energy sources	<ul style="list-style-type: none"> • Use of renewable energy sources such as solar technologies in conjunction with the power generation plant
Energy conservation practices	<ul style="list-style-type: none"> • Appropriate training for staff and management

RISK ASSESSMENT RATING: Very low (after mitigation)

Noise Emissions

The objective of the noise emissions mitigation and monitoring strategies are to ensure noise nuisance does not occur and to achieve compliance with the requirements of the:

- Noise Guidelines for Development Sites in the Northern Territory (May 2014)
- *Northern Territory Waste Management and Pollution Control Act* (14 October 2015); and
- QLD DEHP Model Mining Conditions.

The recommended performance indicators, mitigation methods and monitoring strategies outlined in the Air and Noise Assessment (Air Noise Environment, 2018) are summarised in Table 4.6-19.

Table 4.6-19 Noise Emissions Mitigation and Monitoring Strategies

Performance Indicators	The objectives of this air quality plan are being complied with if the following criteria are complied with: <ul style="list-style-type: none"> • There are no community complaints received • Mining operations occur within the permitted hours of operation; and • Blasting operations occurring within the permitted hours for blasting.
Mitigation Methods	<ul style="list-style-type: none"> • Complete annual noise testing of fixed and mobile plant and equipment to confirm that source noise levels are consistent with achieving a total mine noise exposure below 35 dB(A) at the nearest of-site receptors, or alternative noise limits as defined in the mine approval • Follow manufacturers maintenance schedules to minimise noise emissions from mobile plant and haul vehicle • Ensure exhaust mufflers are effective and undamaged • Ensure all of-site vehicles are compliant with the ADR (Australian Design Regulations) noise emission standards and are licensed • Minimise use of air brakes in residential areas; and • Restrict of-site haul vehicle movements to daylight hours where practicable.
Monitoring	Noise monitoring will be undertaken where necessary to further investigate a valid complaint, where standard mitigation strategies have not resolved the issues that resulted in the complaint, and at the request of the Administering Authority (NT EPA). Monitoring will be completed in a timely fashion in accordance with the relevant Australian Standards (AS 1055.1 Acoustics – Description and measurement of environmental noise – General procedures). A written response will be provided within 28 days. All monitoring will be completed by an appropriately qualified person.

Table adapted from the Noise Management Plan located in the Air, Noise Assessment developed by Air Noise Environment (Air Noise Environment, 2018)

The Northern Territory Government provides objectives for minimising noise from road transport infrastructure in the Road Traffic Noise on NT Government Controlled Roads Policy (November 2014, Version 1.0). The Policy is not specific in relation to requirements for minimising noise and noise targets (except for new roads). Nonetheless, the overall objective to prevent adverse effects of road traffic noise will be adhered to during construction and operation of the mine.

The risk assessment for the Project identified noise emissions produced by the mine will be reduced to a low risk to the on-site mining community following the implementation of mitigation strategies. The transportation of product along unsealed roads was reduced to a very low risk to the public following mitigation.

RISK ASSESSMENT RATING: low to very low (after mitigation)

The Project will be required to have a Mining Management Plan (MMP) under the *Mining Management Act 2001*. The primary purpose of a Mining Management Plan (MMP) is to formalise the actions to be taken and strategies to be implemented, that combined, will manage impacts to the environment to acceptable and sustainable limits over both the short and long-term. The MMP has several components or sub-plans relating to the management of various issues. The air and noise management strategies/plans developed as part of the Environmental Management Plan will provide a clear and concise outline of the actions and methods required to mitigate likely impacts on air quality and noise levels including those from dust and greenhouse gases.

In addition, the management of air quality is addressed indirectly in several other sub-plans including:

- Erosion and Sediment Control Plan
- Water Management Plan
- Waste Management Plan; and
- Bushfire Management Plan.

These sub-plans will consolidate information regarding the management of specific issues during the operation of the Project and provide for ongoing reference over the life of the mine. The Environmental Management Plans developed as part of this EIS will be working documents and they will be updated following formal assessment of the EIS by the NT EPA, and by Department of Primary Industries and Resources through the mine authorisation process.

4.6.6. Post Mining Management

At the end of the concept mine plan, it is expected that the mine site will be rehabilitated to be fit for the nominated future land use. Currently the Project area is part of the Jervois Pastoral Lease and has been used historically for mining and a low intensity cattle grazing. It is anticipated that the post-mining land form will remain suitable for cattle grazing, with a combination of grassland and wooded areas representing the vegetation communities currently in the Project area.

Rehabilitation will be performed in accordance with contemporary accepted industry best practice and conducted in accordance with an approved MMP. KGL has prepared a Mine Rehabilitation and Closure Plan. The MRCP will be a dynamic document that is reviewed regularly to ensure the plan remains relevant to the activities being undertaken and planned to be undertaken. The MRCP will include a post-closure monitoring and reporting program to evaluate rehabilitation success and progress toward achieving closure objectives and contingency measures to be implemented in the event that monitoring demonstrates that rehabilitation closure objectives are not being met.

The post-mining monitoring and reporting will include continued dust monitoring in the Project site in accordance with the MRCP. Any instances where particulate emissions are in exceedance of recommended guidelines will be investigated and managed in accordance with the MRCP.