Executive summary

Operational noise impacts

Six scenarios were modelled using CadnaA 2019 to represent assumed worst-case operating conditions for noise generation during the Project. The six scenarios were assessed against the requirements of the Noise Management Framework Guideline (NMFG) (NT EPA, 2018). The results of the noise modelling indicate the following exceedances of the Project Specific Assigned Noise Level (PSANLs):

- A 7 dB exceedance at the nearest residential receiver during the excavation works at the Mt Burton WRD (Scenario 3)
- A 3 dB exceedance at the nearest residential receiver during the spoil relocation of contaminated waste rock at the Mt Fitch WRD (Scenario 6)

Noise levels during the operation of the Project are predicted to be below the PSANLs at all other sensitive receivers within the study area.

Noise mitigation measures are provided in Section 7 to reduce noise levels during Scenario 6 to within acceptable and compliant levels in accordance with the NMFG.

The Scenario 3 Mt Burton works are located within the property owned by the resident who will be affected by a predicted 7 dB exceedance of the PSANL. It is understood that the resident is in favour of the excavation works occurring and the removal of waste rock from their property. Mitigation measures have been recommended to reduce noise levels at this receiver, however, a residual noise impact 1 dB above the PSANL is expected to persist following the application the reasonable mitigation measures listed in Section 7. A residual noise level of 1 dB is considered ‘Negligible’ and in considering the context of the property owners’ support for the Project, no additional receiver-based treatments or controls have been recommended.

Vibration impacts – structural damage to standard dwellings

No standard dwellings have been identified within safe-working distances during rolling, compacting, grading or excavation works. As such, no structural damage to standard dwellings are anticipated during the operation of the Project due to vibration.

Vibration impacts – structural damage to heritage structures

Heritage structures have been identified within the main project site. The exact proximity of rolling, compacting or excavating works near heritage structures or sacred sites was not accurately available at the time of report preparation. However, it is recommended that rolling, compacting, grading or excavation works are not undertaken within the following safe working distances from Heritage structures or sacred sites:

- 40t excavator – 18 metres
- Compactor – 27 metres
- Grader – 7 metres
- Smooth drum roller – 29 metres
Road traffic noise impacts
Litchfield Park Road and Rum Jungle Road are Northern Territory Government Controlled Roads and will be used to haul materials from satellite sites to the main project site. As no future roads are proposed as part of the project, no assessment to residential receivers or other noise-sensitive receivers is necessary and the requirements of road noise regulations are considered to be met.

Mitigation measures
Management and mitigation measures are provided in Section 7 and are to be incorporated for the duration of the Project

Potential health impacts
Based on the health effects of various time averaged noise levels in the Guidelines for Community Noise (WHO, 1999), no adverse impacts to health are anticipated to any identified outdoor or indoor locations within the study area, as a result of noise associated the Project.
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adverse meteorology</td>
<td>Meteorological effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time.</td>
</tr>
<tr>
<td>Calm</td>
<td>Where noise enhancing meteorological conditions do not occur at a site for a significant period of time.</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.</td>
</tr>
<tr>
<td>dBA</td>
<td>Decibel expressed with the frequency weighting filter used to measure ‘A-weighted’ sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.</td>
</tr>
<tr>
<td>L_{A_{eq}(period)}</td>
<td>Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.</td>
</tr>
<tr>
<td>L_{A90(period)}</td>
<td>The sound pressure level that is exceeded for 90 per cent of the measurement period.</td>
</tr>
<tr>
<td>L_{A10(18hr)}</td>
<td>The $L_{A10}$ noise level for the period 6:00 am to 12:00 am.</td>
</tr>
<tr>
<td>L_{A_{max}}</td>
<td>The maximum A-weighted sound pressure level occurring in a specified time period.</td>
</tr>
<tr>
<td>Noise sensitive receiver</td>
<td>A noise modelling term used to describe a map reference point where noise is predicted. They consist of areas or places potentially affected by noise or vibration including:</td>
</tr>
<tr>
<td></td>
<td>- a residential dwelling</td>
</tr>
<tr>
<td></td>
<td>- an educational institution, library, childcare centre or kindergarten</td>
</tr>
<tr>
<td></td>
<td>- a hospital, surgery or other medical institution</td>
</tr>
<tr>
<td></td>
<td>- an active (for example sports field, golf course) or passive (for example national park) recreational area</td>
</tr>
<tr>
<td></td>
<td>- commercial or industrial premises</td>
</tr>
<tr>
<td></td>
<td>- a place of worship</td>
</tr>
<tr>
<td>Peak particle velocity (PPV)</td>
<td>Peak particle velocity is the maximum vector sum of three orthogonal time-synchronized velocity components regardless of whether these component maxima occurred simultaneously.</td>
</tr>
<tr>
<td>PSANL</td>
<td>The project specific assigned noise level (PSANL) is the lower (that is, the more stringent) value of the project intrusiveness noise level and project amenity noise level as determined in Sections 2.3 and 2.4 of the NSW EPA Noise Policy for Industry 2017.</td>
</tr>
<tr>
<td>Rating background level (RBL)</td>
<td>The overall single-figure background noise level representing each assessment period (day/evening/night) over the whole monitoring period.</td>
</tr>
<tr>
<td>Tonality</td>
<td>Noise containing a prominent frequency or frequencies characterised by definite pitch.</td>
</tr>
<tr>
<td>VDV</td>
<td>Vibration dose value - As defined in BS6472 (British Standards, 2008), VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.</td>
</tr>
<tr>
<td>Vibration</td>
<td>The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).</td>
</tr>
</tbody>
</table>
# Table of contents

Executive summary ........................................................................................................1
Glossary .......................................................................................................................... iii

1. Introduction ................................................................................................................1
   1.1 Rehabilitation project objectives .........................................................................1
   1.2 Noise and vibration assessment objectives ..........................................................2
   1.3 Project overview ...................................................................................................3
   1.4 Scope and structure of this report .........................................................................5
   1.5 Definitions .............................................................................................................6
   1.6 Limitations ............................................................................................................6

2. Project description ......................................................................................................8
   2.1 Project layout .........................................................................................................8
   2.2 Operational hours .................................................................................................8
   2.3 Workforce .............................................................................................................8
   2.4 Timing and equipment ............................................................................................8
   2.5 Traffic generation .................................................................................................10

3. Existing environment ................................................................................................11
   3.1 Project location and study area .............................................................................11
   3.2 Noise catchment areas (NCAs) ...........................................................................11
   3.3 Sensitive receivers and land uses .........................................................................11
   3.4 Nearest sensitive receivers ..................................................................................12
   3.5 Unattended noise monitoring ..............................................................................13
   3.6 Attended noise monitoring ..................................................................................17
   3.7 Meteorological effects ..........................................................................................18

4. Regulatory requirements ..........................................................................................20
   4.1 Overview of requirements ....................................................................................20
   4.2 Application of the NT EPA Noise Management Framework Guideline 2018 ........20
   4.3 Road Traffic Noise on NT Government Controlled Roads 2014 (NT DoT 2014) ....24
   4.4 Noise Guidelines for Development Sites (NT EPA 2014) ....................................25
   4.5 Vibration – human comfort ................................................................................25
   4.6 Vibration – structural damage ............................................................................27

5. Methodology ..............................................................................................................28
   5.1 Noise modelling inputs .......................................................................................28
   5.2 Vibration modelling inputs ..................................................................................31

6. Impact assessment .....................................................................................................33
   6.1 Operational noise impacts ...................................................................................33
   6.2 Potential for noise impacts on health ....................................................................35
   6.3 Noise mitigation strategies ...................................................................................35
   6.4 Residual noise impacts .........................................................................................37
6.5 Vibration impacts .......................................................... 37
7. Mitigation measures .......................................................... 39
8. Conclusion ........................................................................ 40
9. References ......................................................................... 42

Table index

Table 1-1 Potential noise and vibration impacts requiring assessment .............................................. 2
Table 2-1 Activities, equipment and duration ............................................................................... 9
Table 3-1 Sensitive receivers within the study area ........................................................................ 12
Table 3-2 Nearest residential receivers to the project ................................................................. 12
Table 3-3 Unattended noise monitoring details and results ....................................................... 15
Table 3-4 Attended noise measurement equipment details ....................................................... 17
Table 4-1 Noise and vibration criteria and assessment .............................................................. 20
Table 4-2 Minimum assumed intrusiveness noise levels (Table 3.4 of NT EPA Noise Management Framework Guideline 2018) ............................................................. 21
Table 4-3 PSANLs recommended in accordance with NT EPA Noise Management Framework Guideline 2018 ................................................................................... 22
Table 4-4 Modifying factor corrections ....................................................................................... 23
Table 4-5 Health effects of various time averaged noise levels ............................................... 24
Table 4-6 Preferred and maximum weighted rms values for continuous and impulsive acceleration (m/s²) 1-80 Hz ......................................................................................... 26
Table 4-7 Human comfort intermittent vibration limits (VDV), ms-1.75 ..................................... 26
Table 4-8 Transient vibration guide values–minimal risk of cosmetic damage ....................... 27
Table 4-9 Guidance values for short-term vibration on structures ............................................ 27
Table 5-1 Modelled equipment and sound power levels ........................................................... 28
Table 5-2 Modelled operational scenarios ................................................................................ 29
Table 5-3 Modelled equipment for each scenario ................................................................. 29
Table 5-4 Modelled equipment for each scenario ................................................................. 30
Table 5-5 Noise modelling parameters .................................................................................... 30
Table 5-6 Typical vibration levels of equipment ...................................................................... 31
Table 5-7 Safe working buffer distances for equipment .......................................................... 32
Table 6-1 Predicted noise levels at the nearest sensitive receivers .......................................... 33
Table 6-2 Noise control measures ........................................................................................ 36
Table 6-3 Residual noise levels at the nearest sensitive receivers .......................................... 37
Figure index

Figure 1-1  Site location and overall project layout.................................................................4
Figure 3-1  Sensitive receivers, NCAs and unattended noise monitoring locations ...............16
Figure 3-2  Wind roses – extracted from CALMET at Rum Jungle Project Site ......................19

Appendices

Appendix A – Detailed layouts of the Project sites
Appendix B – Detailed sensitive receiver maps
Appendix C – Predicted $L_{\text{Aeq(15min)}}$ noise levels at sensitive receivers
Appendix D – Predicted $L_{\text{Aeq(15min)}}$ noise contour maps at 1.5 m above ground level (ISO 9613-2)
1. **Introduction**

The Northern Territory Government’s Department of Primary Industry and Resources (DPIR) is the Proponent for the rehabilitation of the former Rum Jungle mine and associated satellite mines at Mt Burton and Mt Fitch (the Project). The majority of rehabilitation activities will occur at the main Rum Jungle mine (the Site), which is located approximately six kilometres north of Batchelor, in the Northern Territory. DPIR are delivering the Project in partnership with the Commonwealth Government’s Department of Industry, Innovation & Science (DIIS).

1.1 **Rehabilitation project objectives**

The high-level objectives of the Project are two-fold and incorporate environmental remediation and advancement towards resolution of the Finniss River Land Claim:

1. Improve the environmental condition of the Site and downstream catchment of the East Branch Finniss River (EBFR), with success measured against the following key outcomes:
   a. Surface water quality conditions within the EBFR progressively improve, such that they lastingly meet locally derived water quality objectives (LDWQOs).
   b. Constructed and rehabilitated landforms are chemically and physically stable.
   c. Self-sustaining vegetation systems are established within the rehabilitated landforms.
   d. Physical environmental conditions support intended final land uses.

2. Improve site conditions to support future progress of the Finniss River Land Claim over the Rum Jungle site, inclusive of the following key outcomes:
   a. Restoration of flows to the original course of the EBFR, as far as is possible.
   b. Culturally insensitive landforms are relocated to locations that are deemed to provide a culturally safe separation distance from known Sacred Sites.
   c. Return living systems including endemic species to the remaining landforms.
   d. Preserve Aboriginal cultural heritage artefacts and places.
   e. Isolate sources of pollution including radiological hazards.
   f. Maximise opportunities for Traditional Owners to work on site, to aid reconnection to country.

On 30 August 2016, the Northern Territory Environment Protection Authority (EPA) determined that the Project required assessment under the *Environment Assessment Act 1992*, at the level of an Environmental Impact Statement (EIS). Since then, several rounds of consultation and associated rehabilitation design adjustments have resulted in some updates being made to the EPA Terms of Reference (ToR) for the Project, which provide guidance on matters requiring assessment under the EIS.

To meet the requirements of the ToR (NT EPA, 2019), DPIR engaged GHD (in 2018) to prepare air-quality, noise and vibration impact assessments for the Project.
1.2 Noise and vibration assessment objectives

This Noise and Vibration Impact Assessment (NVIA) considers potential noise and vibration impacts that may be caused by the Project at surrounding sensitive land use areas.

The EPA’s updated ToR. Section 2.2.1 (Terrestrial flora and fauna) requires the Proponent to:

*Provide sufficient information to enable assessment of whether the Proposal is likely to meet the NT EPA’s objective to protect the NT’s flora and fauna so that biological diversity and ecological integrity are maintained (or improved); and the matters that must be addressed under Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000. Information requirements … below should be read in consideration of the general advice provided in section 2.6 of the NT EPA General Guidance for Proponents Preparing an EIS.*

*Quantify and/or discuss any potential for a decline in distribution, abundance or health of identified values due to:*

- dust, noise, vibration and light

Although the ToR focus on potential impacts of the Project on terrestrial ecology, risks posed by near-term (7-10 year) construction effects are of less significance when considered against the overall objectives and anticipated long-term environmental benefits of the Project.

Potential noise and vibration impacts identified from project risk workshops are considered more relevant; and more thoroughly identify drivers for assessing potential noise and vibration impacts. The relevant excerpt of the risk register is provided in Table 1-1.

**Table 1-1 Potential noise and vibration impacts requiring assessment**

<table>
<thead>
<tr>
<th>Potential event</th>
<th>Environmental Factor</th>
<th>Description of impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles/ mobile plant / excavation / material movements creating <strong>noise and vibration</strong> at elevated levels</td>
<td>Human health and safety</td>
<td>Transport of noise and vibration to nearby sensitive receptors leading to impacts on human health, including sleep disturbance, annoyance and/or disruptions to communication</td>
</tr>
<tr>
<td></td>
<td>Historic and cultural heritage</td>
<td>Altered character of sacred sites or heritage places caused by vibration impacts</td>
</tr>
<tr>
<td></td>
<td>Biodiversity - Terrestrial Ecosystem</td>
<td>Elevated noise levels in the environment leading to a reduction in habitat quality and/or quantity (within and surrounding the project area) resulting in a decrease in the diversity and/or abundance of species.</td>
</tr>
<tr>
<td></td>
<td>Socio-economic</td>
<td>Transport of noise and vibration to sensitive receptors leading to a loss of amenity</td>
</tr>
</tbody>
</table>
1.3 Project overview

1.3.1 Project location

The Project is located approximately 105 km (by road) south of Darwin and 6 km north of Batchelor. The legacy mine sites to be rehabilitated lie within the Rum Jungle Uranium field and are located within the following three land parcels:

- Rum Jungle proper – Section 2968 Hundred of Goyder (vacant Crown land recommended for grant by the Aboriginal Land Commissioner Justice Toohey on 22 May 1981)
- Mt Burton – Section 998 Hundred of Goyder (estate in fee simple held privately)
- Mt Fitch – within NT Portion 3283 (Crown Lease Perpetual 862 held by the Northern Territory Land Corporation)

Additional soil materials required by the Project will be sourced from two further sites:

- Cover materials sourced from pre-disturbed land owned by Coomalie Council
- Cover materials sourced from former sand mining areas, located on Finnis River Land Trust (FRLT)

Figure 1-1 shows the location of the site and the overall project layout showing each of the project components listed above.

1.3.2 Key project activities

The following key activities will occur as part of the Project:

- Project establishment, including:
  – Construction of new haul roads
  – Construction of new or upgraded river crossings
  – Establishment of office compound facilities
  – Establishment of laydown areas, maintenance facilities and hard stands
- Abstraction and treatment of acid-mine drainage impacted groundwater within the Rum Jungle mine site, via a purpose built water treatment plant
- In-situ treatment of water within the Main and Intermediate Pits, using reagents as required
- Excavation of the base of the 2 new Waste Storage Facilities (WSFs) to extract suitable material for construction or rehabilitation purposes elsewhere on site
- Relocation of contaminated waste rock, tailings and soil from across the site into the WSFs
- Sub-aqueous deposition of waste rock and tailings into the Main Pit
- Relocation of contaminated waste rock from Mt. Burton to the Rum Jungle WSFs
- Replacement of waste rock and (uncontaminated) spoil stockpiled at Mt Fitch into the existing open pit at Mt Fitch
- Capping of the WSFs with clay material, growth medium and rock armouring
- Rehabilitation of exposed footprints beneath existing waste rock dumps and contaminated soil areas
- Restoration of the original course of the EBFR through the Main Pit and Intermediate Pit
- Site disestablishment and clean up, including:
  – Removal of all haul roads and river crossings
  – Removal of all project related infrastructure
  – Removal of all project related equipment
Site location and overall project layout

Rum Jungle Rehabilitation Project | Air, Noise and Vibration Report

FIGURE 1-1

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52

LEGEND
- Towns
- Homesteads
- Roads
- Waterways
- Railway

Clay Borrow Area Creek Buffer
Clay Borrow Area
Granular Material Borrow Area Creek Buffer
Granular Material Borrow Area
Mt Fitch WRD
Mt Burton WRD
WRD Max Footprint
Project Site

Map ID: 4322822_003.mxd

Data Source:
- ESRI - SRTM (2008)
- NTG - Mine Features (2019)

Created by: cmacgregor

G:\43\22822\GIS\Maps\4322822_003.mxd

Issue Date: 26/09/2019

Scale 1:75,000 @ A4

Kilometres

NORTHERN TERRITORY
QUEENSLAND
WESTERN AUSTRALIA
SOUTH AUSTRALIA
GULF OF CARPENTARIA
ARAFURA SEA
TIMOR SEA
Katherine
Alice Springs
Darwin
Tennant Creek
1.4  Scope and structure of this report

1.4.1  Scope of report

GHD has assessed potential impacts of noise and vibration from machinery and equipment on the main project site and satellite sites. The assessment has involved the following tasks:

- Initial desktop review using aerial photography to identify environmental noise and vibration sensitive receivers
- Background noise monitoring at five (5) noise receiver locations selected as being representative of the local ambient noise environment
- Establishment of a project specific assigned noise level (PSANL) and vibration criteria for the Project, in consideration of the guidelines and standards listed below
- Identification of the likely principal noise and vibration sources of the Project
- Noise modelling to predict noise levels at the nearest identified sensitive noise receivers
- Identification of typical mitigation measures or controls that may be adopted during the Project to manage noise and vibration emissions

This scope of work has been completed in consideration of; or in general accordance with the following guidelines:

- NT Noise Management Framework Guideline (NMFG) (NT EPA, 2018)
- Road Traffic Noise on NT Government Controlled Roads (NT DoT, 2014)
- Noise Guidelines for Development Sites (NT EPA, 2014)
- DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of Vibration on Structures (German Standards, 1999)

1.4.2  Report structure

- Chapter 1 – Introduction: identifies the project and sites assessed
- Chapter 2 – Project description: describes details, methods and timing of the proposed construction works, relevant to noise and vibration impact assessment
- Chapter 3 – Existing environment: summarises the existing environmental noise conditions and details the noise monitoring methodology
- Chapter 4 – Regulatory requirements: outlines Commonwealth and State legislation and relevant guidelines and assessment criteria pertaining to noise or vibration.
- Chapter 5 – Methodology: outlines the modelling methodology for the noise and vibration assessment.
- Chapter 6 – Impact assessment: presents a summary of the noise and vibration modelling and identifies potential noise and vibration impacts of the proposed works
- Chapter 7 – Management and mitigation measures: provides an overview of proposed noise and vibration mitigation measures for the operational phase of the Project
- Chapter 8 – Conclusion: summarises potential noise and vibration impacts and principal conclusions of the assessment.
- Chapter 9 – References: lists documents used or referenced within this report
1.5 Definitions

The following are terms used within this report:

- ‘Project’ refers to rehabilitation of the former Rum Jungle Mine site (the Project), including the main project site and the satellite sites
- ‘Main project site’ refers to Rum Jungle proper – Section 2968 Hundred of Goyder (vacant Crown land recommended for grant by the Aboriginal Land Commissioner Justice Toohey on 22 May 1981)
- ‘Satellite sites’ refers to the 2 satellite mines, being Mt Fitch and Mt Burton, and the two borrow sites, being the clay borrow site and the granular borrow site
- ‘Mt Fitch’ refers to a parcel of land within NT Portion 3283 (Crown Lease Perpetual 862 held by the Northern Territory Land Corporation)
- ‘Mt Burton’ refers a parcel of land - Section 998 Hundred of Goyder (estate in fee simple held privately)
- ‘Clay borrow site’ refers to pre-disturbed land owned by Coomalie Council near Rum Jungle Creek South where cover materials will be sourced from
- ‘Granular borrow site’ refers to former sand mining areas which are located on Finnis River Land Trust (FRLT)
- ‘Study area’ refers to the area within 13 kilometres of the main project site and includes any identified sensitive receiver within this zone
- A ‘Noise Catchment Area’ or ‘NCA’ is an area of similar acoustic environment used to categorise sensitive receivers within a specific geographical extent
- The Northern Territory ‘NMFG’ refers to the Noise Management Framework Guideline (NMFG) (NT EPA, 2018)
- The ‘PSANL’ refers to the project-specific assigned noise level. This is the lower (more stringent) value of the project intrusiveness noise level and project amenity noise level as determined in Sections 2.3 and 2.4 of the Noise Policy for Industry (NSW EPA, 2017)

1.6 Limitations

This report has been prepared by GHD for Department of Primary Industry & Resources and may only be used and relied on by Department of Primary Industry & Resources for the purpose agreed between GHD and the Department of Primary Industry & Resources as set out in section 1.4.1 of this report.

GHD otherwise disclaims responsibility to any person other than Department of Primary Industry & Resources arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.
GHD has prepared this report on the basis of information provided by Department of Primary Industry & Resources and others who provided information to GHD (including other Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.
2. **Project description**

2.1 **Project layout**

The relative layout of the former Rum Jungle mine, satellite mines (Mt Fitch and Mt Burton) and borrow sites (clay borrow site and granular borrow site) is provided in Figure 1-1.

2.2 **Operational hours**

The proposed works are expected to be carried out during the following times:

- Seven days per week, between the hours of 6 am and 6 pm
- No work on public holidays

2.3 **Workforce**

The workforce plan is intended to maximise employment opportunities for members of Traditional Owner communities and local residents, and to maximise benefits of the Project in Batchelor and the region. The total number of workers is anticipated to range between 40 and 50 people during the first five operational years of the Project.

The proposed 12-hour work days and seven-day per week operation will necessitate rostered working patterns and will therefore utilise interchangeable work crews. Seasonal considerations and material movement limitations will further define working patterns and will require consideration in maintaining stable regional employment levels and patterns.

2.4 **Timing and equipment**

2.4.1 **Timing**

The main construction and key earthworks activities of the Project are expected to take approximately five years to complete.

Additional phases of revegetation and landform management, monitoring and maintenance are anticipated to continue for up to another four years; and will facilitate a staggered process of land relinquishment.

2.4.2 **Plant and equipment**

To provide a basis for noise and vibration impact assessment, the magnitude and duration of construction and earthworks effort has been based on the simplified activity and equipment schedule provided in Table 2-1.
Table 2-1 Activities, equipment and duration

<table>
<thead>
<tr>
<th>Operational Activity</th>
<th>Equipment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct haul roads and other establishment tasks</td>
<td>1 x excavator/shovel</td>
</tr>
<tr>
<td></td>
<td>3 x Cat 777</td>
</tr>
<tr>
<td></td>
<td>1 x grader</td>
</tr>
<tr>
<td></td>
<td>2 x 835 compactors</td>
</tr>
<tr>
<td></td>
<td>2 x smooth drum rollers</td>
</tr>
<tr>
<td>Progressive WSF foundation preparation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 x excavator/shovel</td>
</tr>
<tr>
<td></td>
<td>4 x Cat 777</td>
</tr>
<tr>
<td>Excavate contaminated waste rock or soil and haul to new WSFs (within Project boundaries)</td>
<td>1 x excavator/shovel</td>
</tr>
<tr>
<td></td>
<td>4 x Cat 777</td>
</tr>
<tr>
<td>Place, lime and nominally compact soil and waste rock in new WSFs</td>
<td>1 x D10 dozer with tyne</td>
</tr>
<tr>
<td></td>
<td>1 x spreader</td>
</tr>
<tr>
<td></td>
<td>2 x 825 compactors</td>
</tr>
<tr>
<td></td>
<td>1 x smooth drum roller</td>
</tr>
<tr>
<td>Excavate contaminated waste rock or soil and haul to Main Pit for lime amendment and sub-aqueous deposition</td>
<td>1 x excavator/shovel</td>
</tr>
<tr>
<td></td>
<td>4 x Cat 777</td>
</tr>
<tr>
<td></td>
<td>Conveyor and barge</td>
</tr>
<tr>
<td>Excavate contaminated waste rock or soil at Mt Burton and haul to new WSFs</td>
<td>1 x excavator/shovel</td>
</tr>
<tr>
<td></td>
<td>4 x 1 B-double road train</td>
</tr>
<tr>
<td>Excavate contaminated waste rock or soil at Mt Fitch and replace into Mt Fitch pit</td>
<td>1 x excavator/shovel</td>
</tr>
<tr>
<td></td>
<td>2 x B-double road trains</td>
</tr>
<tr>
<td>Haul from cover borrow area to the Project</td>
<td>1 x excavator/shovel</td>
</tr>
<tr>
<td></td>
<td>2 x B-double road trains</td>
</tr>
<tr>
<td>Haul from granular borrow area to the Project</td>
<td>1 x excavator/shovel</td>
</tr>
<tr>
<td></td>
<td>2 x B-double road trains</td>
</tr>
<tr>
<td>Ancillary earthworks support equipment</td>
<td>2 x water trucks</td>
</tr>
<tr>
<td></td>
<td>1 x grader</td>
</tr>
<tr>
<td></td>
<td>1 x fuel truck</td>
</tr>
<tr>
<td></td>
<td>1 x maintenance truck</td>
</tr>
<tr>
<td></td>
<td>1 x material movement truck (ITP)</td>
</tr>
<tr>
<td></td>
<td>6 x light vehicles</td>
</tr>
<tr>
<td>Groundwater and pit-water treatment activities</td>
<td>1 x barge</td>
</tr>
</tbody>
</table>
2.5 Traffic generation

2.5.1 Internal haul roads

The spoil excavated from waste rock dumps or contaminated soil areas is to be hauled to the new WSFs within the Project boundaries via internal haul roads, with the exception of waste rock material brought into the Rum Jungle mine site from Mt Burton.

2.5.2 Spoil movement from the borrow sites

It is estimated that approximately 1,600,000 m$^3$ of low permeability material will be brought into the site from the ‘Clay borrow site’ near Rum Jungle Creek South.

Approximately 1,700,000 m$^3$ of granular (growth material) cover will be brought into the Site from the ‘Granular borrow site’, within former sand mining areas immediately south of the Site.

Clay material will be transported to site using Poett Road, Litchfield Park Road, Rum Jungle Road and internal haul roads. Granular material will be transported into the site via internal site haul roads (no use of public roads).

It is anticipated that borrow material transport will involve between 50 and 70 truck movements per day.

2.5.3 Spoil movement from the Mt Burton site

The excavated contaminated waste rock or soil at Mt Burton will be transported to the new WSFs using White road, Lithgow Road, Bevan Road, Litchfield Park Road, Rum Jungle Road and internal haul roads at a rate of approximately 25 truck movements per day.
3. **Existing environment**

### 3.1 Project location and study area

The Project is located approximately 65 km south-southeast of Darwin, 12 km west of the Stuart Highway and approximately 6 kilometres north of the township of Batchelor. The noise and vibration impact study area includes sensitive receivers identified within 13 kilometres of the Project site. No noise and vibration impacts are anticipated outside of the study area.

### 3.2 Noise catchment areas (NCAs)

The study area has been categorised into five different noise catchment areas (NCAs).

A NCA is an area of similar acoustic environment used to categorise sensitive receivers within a specific geographical extent. The extents of the five NCAs are shown in Figure 3-1 and can be summarised as:

- **NCA1**: The area to the northwest of the Project, including Mount Fitzch
- **NCA2**: The area to the west of the Project, including Mount Burton
- **NCA3**: The area southwest of the Project, including Litchfield Park Road and Rum Jungle Lake (Rum Jungle Creek South)
- **NCA4**: Batchelor township and immediate surrounds
- **NCA5**: The area to the east of the Project, including properties adjacent to Stuart Highway and Batchelor Road

### 3.3 Sensitive receivers and land uses

Noise sensitive receivers are defined based upon the type of occupancy and the activities performed within the land parcel. The receivers are classified within the following categories:

- Residential premises
- Hotels, motel, caretakers’ quarters, holiday accommodation, permanent resident caravan parks
- School classrooms
- Hospitals wards
- Places of worship
- Passive and active recreation areas
- Commercial premises
- Industrial premises

The noise sensitive receivers identified within the study area are summarised in Table 3-2 and are shown in Figure 3-1. Detailed sensitive receiver maps are provided in Appendix B.

The sensitive receivers identified within the study area were based on aerial imagery available at the time of preparing this report and as such, some receivers within the study area may have not been identified. However, compliance at the residential receivers nearest to the main project and satellite sites ensures compliance at residential receivers further afield, as lower noise levels are expected as the distance between the source and receiver increases.
Additionally, compliance at the nearest residential receivers also ensures compliance with non-residential receivers further from the source, as the criteria for non-residential receivers is less stringent than residential receiver criteria (see Section 4.2).

**Table 3-1 Sensitive receivers within the study area**

<table>
<thead>
<tr>
<th>Noise Catchment Area (NCA)</th>
<th>Type of sensitive receivers</th>
<th>Sensitive receivers identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCA1</td>
<td>Residential premises</td>
<td>8 residential dwellings</td>
</tr>
<tr>
<td>NCA2</td>
<td>Residential premises</td>
<td>2 residential dwellings</td>
</tr>
<tr>
<td></td>
<td>Industrial premises</td>
<td>Browns Oxide project</td>
</tr>
<tr>
<td>NCA3</td>
<td>Residential premises</td>
<td>69 residential dwellings</td>
</tr>
<tr>
<td></td>
<td>Passive recreation area</td>
<td>Rum Jungle Creek South</td>
</tr>
<tr>
<td>NCA4</td>
<td>Residential premises</td>
<td>212 residential dwellings</td>
</tr>
<tr>
<td></td>
<td>Commercial premises</td>
<td>11 buildings</td>
</tr>
<tr>
<td></td>
<td>Places of worship</td>
<td>Batchelor Seventh-day Adventist Church</td>
</tr>
<tr>
<td></td>
<td>Educational institute (52 buildings)</td>
<td>• Batchelor Institute of Indigenous Tertiary Education</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Yera Children’s Service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Batchelor Outdoor Education Centre</td>
</tr>
<tr>
<td>NCA5</td>
<td>Residential premises</td>
<td>14 residential dwellings</td>
</tr>
<tr>
<td></td>
<td>Industrial premises</td>
<td>1 industrial site</td>
</tr>
</tbody>
</table>

### 3.4 Nearest sensitive receivers

#### 3.4.1 Residential receivers

The nearest residential receivers to the operational areas of the Project have been identified in Table 3-2. These receivers are also shown in the receiver maps of Appendix B.

**Table 3-2 Nearest residential receivers to the project**

<table>
<thead>
<tr>
<th>Receiver ID</th>
<th>Co-ordinates (GDA94 Zone 52)</th>
<th>Closest project area</th>
<th>Direction from project area</th>
<th>Approx. min. distance to works (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCA01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCA01_R001</td>
<td>715619 8564766</td>
<td>Main project site</td>
<td>West</td>
<td>1.70</td>
</tr>
<tr>
<td>NCA01_R002</td>
<td>712282 8565172</td>
<td>Mt. Burton</td>
<td>Northwest</td>
<td>1.15</td>
</tr>
<tr>
<td>NCA01_R004</td>
<td>714090 8564742</td>
<td>Mt. Burton</td>
<td>Northeast</td>
<td>0.85</td>
</tr>
<tr>
<td>NCA01_R005</td>
<td>713050 8568579</td>
<td>Mt. Fitch</td>
<td>Northeast</td>
<td>1.35</td>
</tr>
<tr>
<td>NCA02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCA02_R001</td>
<td>713009 8564131</td>
<td>Mt. Burton</td>
<td>Southwest</td>
<td>0.25</td>
</tr>
<tr>
<td>NCA02_R002</td>
<td>714728 8561350</td>
<td>Granular borrow site</td>
<td>West</td>
<td>2.55</td>
</tr>
<tr>
<td>NCA03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCA03_R043</td>
<td>715543 8558800</td>
<td>Clay borrow site</td>
<td>North</td>
<td>0.75</td>
</tr>
</tbody>
</table>
### 3.4.2 Non-residential receivers

Two non-residential receiver land uses have been identified as being potentially impacted by noise associated with the Project, being:

- Browns Oxide Project – located directly adjacent to the west of the main Rum Jungle site
- Rum Jungle Creek South – located directly adjacent and east of the clay borrow site

These non-residential receivers are shown in Figure 3-1.

### 3.5 Unattended noise monitoring

Unattended noise monitoring was conducted at five monitoring locations listed in Table 3-3, in general accordance with the AS 1055:2018 ‘Acoustics - Description and measurement of environmental noise’ (Australian Standards, 2018) and, the NT EPA guideline ‘Noise Management Framework Guideline’ (NT EPA, 2018). The noise monitoring period was between 4 and 16 June 2018 at M1; and 4 and 19 June 2018 for locations M2 to M5.

All noise monitoring instrumentation were in current National Association of Testing Authorities (NATA) calibration at the time of use. A calibration check was performed on site and the deviation between before/after measurement was found to less than 1 decibel (dB).

The five environmental noise loggers used in the unattended noise monitoring were capable of measuring continuous sound pressure levels and logging $L_{90}$, $L_{Aeq}$ and $L_{max}$ noise descriptors. Details of the unattended monitoring equipment and results are summarised in Table 3-3.

#### Correction for meteorological conditions

Adverse meteorological conditions such as high winds and rainfall can contaminate noise monitoring results. The NSW Noise Policy for Industry (NSW EPA, 2017) stipulates:

“noise monitoring should not be conducted (or data should be excluded) when average wind speeds (over 15-minute periods or shorter) at microphone height are greater than 5 m/s, or when rainfall occurs” (NSW EPA 2017, p.50).

Australian Standard AS 1055.1:1997: Acoustics – Description and Measurement of Environmental Noise specifies:

“Where the maximum wind speed exceeds 5 m/s at the measurement position and noise measurement are (sic) required caution should be applied and special windscreens should be utilised” (AS1055.1:1997, p. 11).
Rainfall and wind speed during the period of noise measurements were checked based on the nearest automatic weather station (AWS) situated at Rum Jungle.

The Rum Jungle weather data is recorded from an assumed standard measurement height of 10 m (mast height), and therefore requires correction for the noise microphone height of 1.5 m. The correction is undertaken using the wind shear extrapolation technique defined by the US EPA, the standard logarithmic profile of wind speed with height in a neutral atmosphere (US EPA, 2000).

Where the BoM AWS wind speed was greater than 7 m/s or whenever rainfall occurred, noise data was excluded from the baseline noise environment.
<table>
<thead>
<tr>
<th>Location (GDA94 Z52)</th>
<th>Equipment photo</th>
<th>Representative NCA</th>
<th>Equipment details</th>
<th>Equipment settings</th>
<th>Measurement period</th>
<th>L_{A90} Background noise levels, dBA</th>
<th>L_{Aeq} Ambient noise levels, dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 X: 715635 Y: 8564715 NCA01_R001</td>
<td><img src="image1" alt="Equipment photo" /></td>
<td>NCA1</td>
<td>Svan 955 SN: 69215</td>
<td>A-weighted Fast time response 15 minute intervals</td>
<td>Day</td>
<td>28</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Evening</td>
<td>34</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Night</td>
<td>27</td>
<td>37</td>
</tr>
<tr>
<td>M2 X: 714775 Y: 8561383 NCA02_R002</td>
<td><img src="image2" alt="Equipment photo" /></td>
<td>NCA2</td>
<td>Svan 955 SN: 69212</td>
<td>A-weighted Fast time response 15 minute intervals</td>
<td>Day</td>
<td>33</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Evening</td>
<td>34</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Night</td>
<td>26</td>
<td>40</td>
</tr>
<tr>
<td>M3 X: 715192 Y: 8559548 NCA03_R035</td>
<td><img src="image3" alt="Equipment photo" /></td>
<td>NCA3</td>
<td>Svan 955 SN: 59674</td>
<td>A-weighted Fast time response 15 minute intervals</td>
<td>Day</td>
<td>31</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Evening</td>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Night</td>
<td>29</td>
<td>40</td>
</tr>
<tr>
<td>M4 X: 719943 Y: 8557384 NCA04_R181</td>
<td><img src="image4" alt="Equipment photo" /></td>
<td>NCA4</td>
<td>Svan 955 SN: 59668</td>
<td>A-weighted Fast time response 15 minute intervals</td>
<td>Day</td>
<td>31</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Evening</td>
<td>28</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Night</td>
<td>26</td>
<td>45</td>
</tr>
<tr>
<td>M5 X: 729807 Y: 8560586 NCA05_R006</td>
<td><img src="image5" alt="Equipment photo" /></td>
<td>NCA5</td>
<td>Svan 955 SN: 36821</td>
<td>A-weighted Fast time response 15 minute intervals</td>
<td>Day</td>
<td>31</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Evening</td>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Night</td>
<td>25</td>
<td>41</td>
</tr>
</tbody>
</table>
Sensitive receivers, study area, NCAs and unattended noise monitoring locations

Rum Jungle Rehabilitation Project | Air, Noise and Vibration Report

FIGURE 3-1
3.6 Attended noise monitoring

Attended noise measurements were also undertaken at all five locations, with additional monitoring conducted at the nearby Mt Burton site. The monitoring at the satellite Mt Burton works area was to determine whether any notable differences exist between the main Rum Jungle site and the Mt Burton site.

A summary of short term attended noise level results is presented in Table 3-4, which shows that background (L90) and ambient (Leq) noise levels were generally consistent across all locations, except for Mount Burton.

Background noise levels of between 35 to 38 dBA and ambient noise levels of 40 to 46 dBA were measured at Rum Jungle sites M1 to M5.

Although the maximum measured level at Mt Burton was similar to the maximum measured at the five Rum Jungle sites, the L90 and Leq (i.e. background and average) noise levels were lower. This is likely due to the slightly more remote location of Mt Burton.

Table 3-4 Attended noise measurement equipment details

<table>
<thead>
<tr>
<th>Site</th>
<th>Date &amp; time</th>
<th>Measured noise level</th>
<th>Observations / comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L90, Leq, Lmax, dBA</td>
<td></td>
</tr>
</tbody>
</table>
| M1       | 4/6/2018 3:45 pm – 4:00 pm   | L90: 35, Leq: 40, Lmax: 69 | • Ambient noise dominated by noise from insects, birds whistling and wind  
|          |                              |                      | • Occasional plane noise                                       |
| M5       | 4/6/2018 11:30 am – 11:45 am | L90: 38, Leq: 46, Lmax: 61 | • Dominant background noise source from bird noise, insect noise and occasional road traffic activity involving cars  
|          |                              |                      | • Train pass by noise                                         |
| M4       | 4/6/2018 12:30 pm – 12:45 pm | L90: 38, Leq: 43, Lmax: 62 | • Dominant background noise source from mechanical noise – potentially dozers  
|          |                              |                      | • Bird noise, insect noise and wind noise consistent throughout observation period  
|          |                              |                      | • Occasional road traffic activity involving cars               |
| M3       | 4/6/2018 1:30 pm – 1:45 pm   | L90: 38, Leq: 45, Lmax: 70 | • Ambient noise dominated by noise from insects               
|          |                              |                      | • Occasional noise from birds and winds                        |
| M2       | 4/6/2018 2:30 pm – 2:45 pm   | L90: 37, Leq: 41, Lmax: 58 | • Dominant noise source was a sprinkler located approximately 20 m away  
|          |                              |                      | • Plane pass by also consistently occurred during the monitoring period  
|          |                              |                      | • Occasional road traffic activity involving cars               |
| Mt Burton| 4/6/2018 4:49 pm – 5:04 pm   | L90: 24, Leq: 33, Lmax: 61 | • Dominant background noise source from insects and wind passing through trees  
|          |                              |                      | • Frequent noise from birds                                   
|          |                              |                      | • Occasional plane pass by                                    |
3.7 Meteorological effects

To assess potential meteorological effects such as temperature inversions and wind effects, the NT NMFG recommends the use of *Noise Policy for Industry* (NSW EPA, 2017) Fact Sheet D.

3.7.1 Local meteorology

Meteorology data was obtained from the Bureau of Meteorology’s Batchelor Airport Automatic Weather Station (014272) for this assessment, situated approximately 7.5 km south of the main site.

3.7.2 Temperature inversions

The Project works are proposed from 6:00 am to 6:00 pm. The noise predictions are considered conservative as the model takes into account a moderate temperature inversion (ISO 9613-2).

3.7.3 Wind effects

Noise propagation can be enhanced by wind conditions. NPI states that when there is greater than a 30% occurrence of wind of up to 3 m/s, in any period (day, evening, night) in any season, from source to receiver, wind should be considered in noise prediction calculations.

Based on the Air Quality Impact Assessment (AQIA) report prepared by GHD in tandem with this report, wind records have been extracted from the CALMET weather station outputs for the former Rum Jungle site. The proposed operations will occur during the daytime period only. Figure 3-2 presents historical wind roses for the former Rum Jungle site. Analysis of the seasonal wind rose data indicates that winds up to 3 m/s do not occur more than 30% of the time in the direction of the sensitive receivers (Note: The NPI specifies for a 16-direction wind compass and the use of the arithmetic sum of the direction being reported and the four closest directions.)
Figure 3-2  Wind roses – extracted from CALMET at Rum Jungle Project Site
4. Regulatory requirements

4.1 Overview of requirements

Table 4-1 summarises the sections in this report that address specific categories of noise and vibration impact.

**Table 4-1 Noise and vibration criteria and assessment**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Component</th>
<th>Criteria section</th>
<th>Methodology section</th>
<th>Assessment section</th>
<th>Mitigation section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>Operational</td>
<td>Section 4.2</td>
<td>Section 5.1</td>
<td>Section 6.1</td>
<td>Section 7</td>
</tr>
<tr>
<td></td>
<td>Road traffic</td>
<td>Section 4.3</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Vibration</td>
<td>Structural damage</td>
<td>Section 4.4</td>
<td>Section 5.2</td>
<td>Section 6.5.1</td>
<td>Section 7</td>
</tr>
<tr>
<td></td>
<td>Human comfort</td>
<td>Section 4.6</td>
<td>Section 5.2</td>
<td>Section 6.5.3</td>
<td>Section 7</td>
</tr>
</tbody>
</table>

4.2 Application of the NT EPA Noise Management Framework Guideline 2018

Noise criteria for the Project have been derived in accordance with the *Noise Management Framework Guideline* (NT EPA, 2018) (NT NMFG), which addresses noise pollution and abatement requirements for the following activities and sources:

- Business activities, including industrial and commercial sectors and government
- Construction noise
- Vibration and blasting

The project specific assigned noise level (PSANL) is a recommended mandatory limit, which if exceeded will require noise management or mitigation actions to be implemented by proponents of commercial or industrial premises.

A modified table has also been added (Table 3.5 in the NT EPA guidance) for use in determining Component A of the PSANL. This modified table includes recommended maximum assigned amenity noise levels, which are mandatory limits in the NT.

Two groups of noise criteria are used to develop the PSANL:

- **Intrusiveness noise level (Component A):** Established based on background noise measurements (rating background level + 5 dB). Minimum intrusiveness noise levels are specified in Table 4-2 (below), for any case where “rating background level + 5 dB(A)” is less than the minimum values specified.

- **Amenity noise level (Component B):** The Guideline states that the ambient noise level within an area from all industrial noise sources combined should remain below the recommended maximum assigned amenity noise levels specified in Table 3.5 of the Guideline, where feasible and reasonable.
  - For residential receivers Table 3.5 defers to Table 3.6, which considers specific residential receiver categories, based on property zoning.
In the case of this assessment, residential receivers are located on unzoned land (with the exception of receivers within NCA04). For unzoned land, the Guideline requires the purpose the premises at the time the noise assessment to be considered. GHD has adopted the 'rural residential' category as being most relevant to all sites, except for residential receivers within NCA04.

Receivers located within NCA04 are zoned Single Dwelling Residential (SD) which is categorised as 'suburban residential' within the Guideline. Moreover, the recorded existing background levels are in line with those outlined in Table 3.6 of the Guideline.

Minus 5 dBA, plus 3 dBA has been applied to these values, in line with the NMFG.

The Project Specific Assigned Noise Level (PSANL) is then determined as the least of:

- The adopted intrusiveness noise level
- A-weighted equivalent amenity noise levels (measured over 15-minute intervals)

The PSANL for residential receivers located within each NCA in the study area are summarised in Table 4-2. Since the background derived criteria are low, the policy stipulates minimum acceptable PSANL should be the same for all NCAs.

The Project Specific Assigned Noise Levels (PSANLs) for all sensitive receivers within the study area are summarised in Table 4-3.

**Table 4-2 Minimum assumed intrusiveness noise levels (Table 3.4 of NT EPA Noise Management Framework Guideline 2018)**

<table>
<thead>
<tr>
<th>Monitoring site</th>
<th>Representative NCA</th>
<th>Background $L_{A90}$ dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Day</td>
</tr>
<tr>
<td>M1</td>
<td>NCA1</td>
<td>40</td>
</tr>
<tr>
<td>M2</td>
<td>NCA2</td>
<td>40</td>
</tr>
<tr>
<td>M3</td>
<td>NCA3</td>
<td>40</td>
</tr>
<tr>
<td>M4</td>
<td>NCA4</td>
<td>40</td>
</tr>
<tr>
<td>M5</td>
<td>NCA5</td>
<td>40</td>
</tr>
</tbody>
</table>
Table 4-3  PSANLs recommended in accordance with NT EPA Noise Management Framework Guideline 2018

<table>
<thead>
<tr>
<th>NCA / Non residential receiver</th>
<th>Time period</th>
<th>Measured Rating Background Level $L_{A90}$ dB(A)</th>
<th>Intrusiveness noise level $L_{A90} + 5$ dB(A)</th>
<th>Adopted intrusive noise level dB(A)</th>
<th>Project amenity noise level dB(A)</th>
<th>$L_{Aeq(15min)}$ PSANL dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1 (NCA01) – Rural residential</td>
<td>Day</td>
<td>28</td>
<td>33</td>
<td>40</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eve</td>
<td>34</td>
<td>39</td>
<td>35</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>27</td>
<td>32</td>
<td>35</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>M2 (NCA02) – Rural residential</td>
<td>Day</td>
<td>33</td>
<td>38</td>
<td>40</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eve</td>
<td>34</td>
<td>39</td>
<td>35</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>26</td>
<td>31</td>
<td>35</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>M3 (NCA03) – Rural residential</td>
<td>Day</td>
<td>31</td>
<td>36</td>
<td>40</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eve</td>
<td>30</td>
<td>35</td>
<td>35</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>29</td>
<td>34</td>
<td>35</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>M4 (NCA04) – Suburban residential</td>
<td>Day</td>
<td>31</td>
<td>36</td>
<td>40</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eve</td>
<td>28</td>
<td>33</td>
<td>35</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>26</td>
<td>31</td>
<td>35</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>M5 (NCA05) – Rural residential</td>
<td>Day</td>
<td>31</td>
<td>36</td>
<td>40</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eve</td>
<td>30</td>
<td>35</td>
<td>35</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>38</td>
<td></td>
</tr>
</tbody>
</table>

Non-residential receivers

<table>
<thead>
<tr>
<th></th>
<th>Race in use</th>
<th>Measured Rating Background Level $L_{A90}$ dB(A)</th>
<th>Intrusiveness noise level $L_{A90} + 5$ dB(A)</th>
<th>Adopted intrusive noise level dB(A)</th>
<th>Project amenity noise level dB(A)</th>
<th>$L_{Aeq(15min)}$ PSANL dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial premises</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>Educational institute</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>43$^1$</td>
<td>43</td>
</tr>
<tr>
<td>Commercial premises</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>Place of worship</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>48$^1$</td>
<td>48</td>
</tr>
<tr>
<td>Passive recreation area</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

Notes:
The recommended maximum assignment amenity noise level in the guideline is an internal noise target. A +10 dB inside to outside correction has been applied to the internal noise target to determine the external noise target accounting for noise travelling through an open window.
4.2.1 Modifying factor corrections

The NMFG recommends modifying factor corrections are applied if noise sources contain tonal, intermittent or low frequency characteristics, which have the potential to increase annoyance. The modifying factor corrections are detailed in Table 4-4 and have been sourced from Fact Sheet C of the NSW Noise Policy for Industry (NSW EPA, 2017).

Table 4-4 Modifying factor corrections

<table>
<thead>
<tr>
<th>Factor</th>
<th>Assessment/measurement</th>
<th>When to apply</th>
<th>Correction$^{1,2}$</th>
</tr>
</thead>
</table>
| Tonal noise          | One-third octave or narrow band analysis      | Level of one-third octave band exceeds the level of the adjacent bands on both sides by:  
  - 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz  
  - 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive  
  - 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz. | 5 dBA$^2$         |
| Low frequency noise  | Measurement of C-weighted and A-weighted level| Measure/assess C and A weighted $L_{eq,T}$ levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more and:  
  - Where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dBA positive adjustment to measured/predicted A-weighted levels for the evening/night period  
  - Where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dBA and cannot be mitigated, a 5 dBA positive adjustment to measured/predicted A-weighted noise levels applies for the evening/night period and a dBA positive adjustment for the daytime period. | 5 dBA$^2$         |
| Impulsive noise      | A-weighted fast response and impulse response | If the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.                                                                                           | Apply difference in measured noise levels as the correction, up to a maximum of 5 dBA |
| Intermittent noise   | Subjectively assessed                         | When the night-time noise level drops to that of the background noise level with a noticeable change in noise level of at least 5 dBA.                                                                     | 5 dBA             |

Notes:
1. Where two or more modifying factors are present the maximum correction is limited to 10 dBA.
2. Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.
4.2.2 Sleep disturbance

The NPI (NSW EPA, 2017) recommends a detailed maximum noise level event assessment be undertaken where night-time noise levels from a development exceed the following levels when assessed externally at the nearest residential location:

- \( L_{Aeq(15min)} \) 40 dBA or the prevailing RBL + 5 dBA (whichever is greater); and/or
- \( L_{AF_{\text{max}}} \) 52 dBA or the prevailing RBL + 15 dBA (whichever is greater)

It should be noted that the PSANL for the night period is \( L_{Aeq(15min)} \) 35 dBA. As such, compliance with the PSANL ensures compliance with the \( L_{Aeq(15min)} \) sleep disturbance criteria.

As such, the sleep disturbance criteria for all residential receivers in the study area is \( L_{AF_{\text{max}}} \) 52 dBA.

4.2.3 Health effects of noise

The NMFG (NT EPA, 2018) references the World Health Organisation’s (WHO) *Guidelines for Community Noise* (WHO, 1999) to identify potential loss of amenity or quality of life effects due to noise. Table 4-5 is reproduced from the WHO document and presents the health effects of various time-averaged noise levels to the applicable receiver areas.

**Table 4-5 Health effects of various time averaged noise levels**

<table>
<thead>
<tr>
<th>Specific segment of the environment</th>
<th>Critical health effect(s)</th>
<th>( L_{Aeq} ) dBA</th>
<th>Time base (hours)</th>
<th>( L_{AF_{\text{max}}} ) fast, dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor living area</td>
<td>Serious annoyance, daytime and evening</td>
<td>55</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Moderate annoyance, daytime and evening</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwelling, indoors</td>
<td>Speech intelligibility, and moderate annoyance, daytime and evening</td>
<td>35</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>Inside bedrooms</td>
<td>Sleep disturbance, night-time</td>
<td>30</td>
<td>8</td>
<td>45</td>
</tr>
<tr>
<td>Outside bedrooms</td>
<td>Sleep disturbance, window open (outdoor values)</td>
<td>45</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td>School class rooms &amp; preschools, indoors</td>
<td>Speech intelligibility, disturbance of information extraction, message communication</td>
<td>35</td>
<td>During class</td>
<td>-</td>
</tr>
<tr>
<td>School, playground outdoor</td>
<td>Annoyance (external source)</td>
<td>55</td>
<td>During play</td>
<td>-</td>
</tr>
<tr>
<td>Industrial, commercial, shopping and traffic areas, indoors and outdoors</td>
<td>Hearing impairment</td>
<td>70</td>
<td>24</td>
<td>110</td>
</tr>
</tbody>
</table>

4.3 Road Traffic Noise on NT Government Controlled Roads 2014 (NT DoT 2014)

The *Road Traffic Noise Guideline on NT Government Controlled Roads* (NT DoT, 2014) is applicable for new roads only. The document outlines a target level for ‘Future Roads – Not Currently Planned’ of 63 dBA for existing residential receivers and 58 dBA for other noise sensitive receivers. For ‘Existing Road’, ‘Existing Road – Upgrade’ or ‘Future Road – Not Currently Planned’, there are no noise targets or required actions for existing noise receivers.
Litchfield Park Road and Rum Jungle Road are NT Government Controlled Roads that will be used to haul material from satellite sites to the main project site. As no future roads are proposed as part of the project, no assessment to residential receivers or other noise-sensitive receivers is considered necessary.

4.4 Noise Guidelines for Development Sites (NT EPA 2014)

The Noise Guidelines for Development Sites (NT EPA, 2014) are intended for construction sites and are considered less relevant to the assessment of the Rum Jungle rehabilitation project. Assessment against the Noise Management Framework Guideline (NT EPA, 2018) is considered more appropriate to the assessment of potential noise impacts from the Project.

4.5 Vibration – human comfort

The Noise Management Framework Guideline (NT EPA, 2018) provides recommended assigned levels for continuous, impulsive and intermittent vibration based on Assessing Vibration: A Technical Guideline (DEC, 2006). The acceptable values for continuous and impulsive vibration (1-80 Hz) are provided in Table 4-6 for sensitive receivers.

Typically, vibration intensive activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the Vibration Dose Value (VDV). Acceptable values of vibration dose are presented in Table 4-7 for sensitive receivers.

Whilst the assessment of response to vibration in Assessing Vibration: A Technical Guideline (DEC, 2006) is based on VDV and weighted acceleration, for vibration intensive activities, it is considered more appropriate to provide guidance in terms of a peak value, since this parameter is likely to be more routinely measured to monitor potential building damage.
### Table 4-6 Preferred and maximum weighted rms values for continuous and impulsive acceleration (m/s²) 1-80 Hz

<table>
<thead>
<tr>
<th>Location</th>
<th>Assessment period</th>
<th>Preferred values</th>
<th>Maximum values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>z-axis</td>
<td>x- and y-axis</td>
</tr>
<tr>
<td><strong>Continuous vibration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical areas[2]</td>
<td>Day or night time</td>
<td>0.0050</td>
<td>0.0036</td>
</tr>
<tr>
<td>Residences</td>
<td>Day time</td>
<td>0.010</td>
<td>0.0071</td>
</tr>
<tr>
<td></td>
<td>Night time</td>
<td>0.007</td>
<td>0.005</td>
</tr>
<tr>
<td>Offices, schools, educational institutions and places of worship</td>
<td>Day or night time</td>
<td>0.020</td>
<td>0.014</td>
</tr>
<tr>
<td>Workshops</td>
<td>Day or night time</td>
<td>0.04</td>
<td>0.029</td>
</tr>
<tr>
<td><strong>Impulsive vibration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical areas[2]</td>
<td>Day or night time</td>
<td>0.0050</td>
<td>0.0036</td>
</tr>
<tr>
<td>Residences</td>
<td>Day time</td>
<td>0.30</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>Night time</td>
<td>0.10</td>
<td>0.071</td>
</tr>
<tr>
<td>Offices, schools, educational institutions and places of worship</td>
<td>Day or night time</td>
<td>0.64</td>
<td>0.46</td>
</tr>
<tr>
<td>Workshops</td>
<td>Day or night time</td>
<td>0.64</td>
<td>0.46</td>
</tr>
</tbody>
</table>


Notes:
1. Day is 7.00 am to 10.00 pm and night is 10.00 pm to 7.00 am.
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be need to assess intermittent values against the continuous or impulsive criteria for critical areas. These locations for the proposal are provided in Table 3.2 and 3.3.

### Table 4-7 Human comfort intermittent vibration limits (VDV), ms-1.75

<table>
<thead>
<tr>
<th>Location</th>
<th>Day¹</th>
<th>Night¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preferred value</td>
<td>Maximum value</td>
</tr>
<tr>
<td>Critical areas[2]</td>
<td>0.10</td>
<td>0.20</td>
</tr>
<tr>
<td>Residences</td>
<td>0.20</td>
<td>0.40</td>
</tr>
<tr>
<td>Offices, schools, educational institutions and places of worship</td>
<td>0.40</td>
<td>0.80</td>
</tr>
<tr>
<td>Workshops</td>
<td>0.80</td>
<td>1.60</td>
</tr>
</tbody>
</table>


Notes:
1. Day is 7.00 am to 10.00 pm and night is 10.00 pm to 7.00 am.
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be need to assess intermittent values against the continuous or impulsive criteria for critical areas. These locations for the proposal are provided in Table 3.2 and 3.3.
4.6 Vibration – structural damage

The Noise Management Framework Guideline (NT EPA, 2018) references the use of BS 7385-1:1990 – Evaluation and measurement of vibration in buildings (British Standards, 1993) to assess vibration induced damage to standard structures or building contents and DIN 4150-3: Structural vibration – Part 3 Effects of vibration on structures (German Standards, 1999) to assess vibration-induced damage to heritage structures.

Based on BS 7385, the transient vibration guide values for standard structures are presented in Table 4-8. The guidance values for short-term vibration on structures (including items of heritage) are presented in Table 4-9, based on DIN 4150.

Measured values exceeding those listed in Table 4-9 “… does not necessarily lead to damage; should they be significantly exceeded, however further investigations are necessary.”

**Table 4-8 Transient vibration guide values–minimal risk of cosmetic damage**

<table>
<thead>
<tr>
<th>Line</th>
<th>Type of Building</th>
<th>Peak Component Particle Velocity in Frequency Range of Predominant Pulse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reinforced or framed structures Industrial and heavy commercial buildings</td>
<td>50 mm/s at 4 Hz and above</td>
</tr>
<tr>
<td>2</td>
<td>Unreinforced or light framed structures residential or light commercial type buildings</td>
<td>15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz</td>
</tr>
</tbody>
</table>

**Table 4-9 Guidance values for short-term vibration on structures**

<table>
<thead>
<tr>
<th>Line</th>
<th>Type of structure</th>
<th>Guideline values for velocity v(t) (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 – 10 Hz</td>
</tr>
<tr>
<td>1</td>
<td>Buildings used for commercial purposes, industrial buildings, and buildings of similar design.</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Dwellings and buildings of similar design and/or occupancy</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)</td>
<td>3</td>
</tr>
</tbody>
</table>

Notes:
1. The term v refers to vibration levels in any direction (x, y or z axis)
2. Where frequencies are above 100 Hz the 50 – 100 Hz values may be used as minimum values
5. **Methodology**

5.1 **Noise modelling inputs**

5.1.1 **Noise generating equipment**

The anticipated plant and equipment used for the project is shown in Table 5-1 with the corresponding octave-band sound power levels used in the noise model. Noise level data has been obtained from the *Update of noise database for prediction of noise on construction and open sites* (DEFRA UK, 2006). Other similar equipment may be used however it is anticipated that they would produce similar noise emissions.

**Table 5-1 Modelled equipment and sound power levels**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Octave band sound power level [Hz], dBA</th>
<th>Sound Power Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>63</td>
<td>125</td>
</tr>
<tr>
<td>40T Excavator</td>
<td>79</td>
<td>98</td>
</tr>
<tr>
<td>CAT 777 truck</td>
<td>91</td>
<td>106</td>
</tr>
<tr>
<td>Grader</td>
<td>90</td>
<td>99</td>
</tr>
<tr>
<td>835 Compactor</td>
<td>78</td>
<td>90</td>
</tr>
<tr>
<td>Smooth drum roller</td>
<td>89</td>
<td>97</td>
</tr>
<tr>
<td>B-double road train</td>
<td>83</td>
<td>91</td>
</tr>
<tr>
<td>Spreader</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>D10 Dozer</td>
<td>90</td>
<td>109</td>
</tr>
<tr>
<td>Barge</td>
<td>79</td>
<td>80</td>
</tr>
<tr>
<td>Water cart</td>
<td>87</td>
<td>86</td>
</tr>
</tbody>
</table>

The magnitude of noise impacts associated with the Project will depend on a number of factors:

- The intensity and location of construction activities
- The type of equipment used
- Existing background noise levels
- Intervening terrain and structures
- The prevailing weather conditions

5.1.2 **Modelled scenarios and assumptions**

The six operational scenarios described in Table 5-2 have been modelled to represent ‘worst-case’ (noise effect) scenarios associated with the Project and to predict potential noise impacts at the identified sensitive receivers within the study area.

Table 5-3 summarises the assumptions of which equipment will typically be in use within each modelled scenarios. The following further assumptions have been applied in the modelling to represent worst-case noise conditions:

- All equipment are operating a maximum capacity for the full 15-minute modelled period
One item of each of the modelled equipment for each scenario are located at a single point at the closest point within the work area to the sensitive receiver

### Table 5-2 Modelled operational scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Operational area</th>
</tr>
</thead>
</table>
| S01      | • Site establishment  
          • Construction of haul roads | • Main project site |
| S02      | • Excavation of contaminated waste rock or soil from within Rum Jungle  
          • Ancillary earthworks  
          • Water treatment | • Main project site |
| S03      | • Excavation of contaminated waste rock and soil at Mt Fitch and Mt Burton  
          • Haulage of materials from Mt Burton to the main project site | • Mt Fitch WRD  
          • Mt Burton WRD |
| S04      | • Excavation of clay and low permeability materials from the borrow area near Rum Jungle Creek South  
          • Haulage to the main project site | • Clay borrow site |
| S05      | • Excavation of sand and gravels from the borrow area (FRLT)  
          • Haulage to the main project site | • Granular borrow site |
| S06      | • Relocation of contaminated waste rock and soil into WSFs within the main project site  
          • Relocation of contaminated waste rock and soil within the Mt Fitch WRD site | • Main project site  
          • Mt Fitch WRD |

### Table 5-3 Modelled equipment for each scenario

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Activity sound power level (SWL), dBA</th>
<th>S01</th>
<th>S02</th>
<th>S03</th>
<th>S04</th>
<th>S05</th>
<th>S06</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>120</td>
<td>116</td>
<td>108</td>
<td>108</td>
<td>108</td>
<td>121</td>
</tr>
<tr>
<td>40T Excavator</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>CAT 777 dump truck</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Grader</td>
<td></td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>835 Compactor</td>
<td></td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Smooth drum roller</td>
<td></td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>B-double road train</td>
<td></td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Spreader</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>D10 Dozer</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Barge</td>
<td></td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Water cart</td>
<td></td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
5.1.3 Sleep disturbance assessment

The six scenarios in Table 5-4 have been modelled at the closest distance between the source and receiver to assess potential for sleep disturbance impacts during the night period between 6:00 am and 7:00 am. The equipment modelled is representative of the worst-case operating conditions for the work area.

Table 5-4 Modelled equipment for each scenario

<table>
<thead>
<tr>
<th>Equipment</th>
<th>S01</th>
<th>S02</th>
<th>S03</th>
<th>S04</th>
<th>S05</th>
<th>S06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item sound power level, dBA</td>
<td>117</td>
<td>117</td>
<td>106</td>
<td>106</td>
<td>106</td>
<td>121</td>
</tr>
<tr>
<td>CAT 777 dump truck</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>40T Excavator</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>D10 Dozer</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
</tr>
</tbody>
</table>

5.1.4 Noise modelling parameters

Acoustic modelling was undertaken using CadnaA 2019 noise modelling software to predict the effects of noise generated by the proposed works at Rum Jungle and the satellite work sites.


The ISO 9613-2:1996 algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or ‘downwind’ conditions, favourable to sound propagation (and even though the proposed working hours are 6.00 am to 6.00 pm when temperature inversions are unlikely).

General parameters used in the model are listed in Table 5-5.

Table 5-5 Noise modelling parameters

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculation method</td>
<td>ISO 9613-2:1996</td>
</tr>
<tr>
<td>Meteorology</td>
<td>Well-developed moderate ground based temperature inversion, such as commonly</td>
</tr>
<tr>
<td></td>
<td>occurs on clear, calm nights or ‘downwind’ conditions which are favourable</td>
</tr>
<tr>
<td></td>
<td>to sound propagation.</td>
</tr>
<tr>
<td>Atmospheric absorption</td>
<td>Based on an average temperature of 10°C and an average humidity of 70%, to</td>
</tr>
<tr>
<td></td>
<td>be conservative</td>
</tr>
<tr>
<td>Topography</td>
<td>1 metre resolution</td>
</tr>
<tr>
<td>Receiver heights</td>
<td>1.5 metres above ground level</td>
</tr>
<tr>
<td>Buildings</td>
<td>No buildings were modelled</td>
</tr>
<tr>
<td>Ground absorption</td>
<td>0.75 for all areas</td>
</tr>
<tr>
<td></td>
<td>(0 is non-porous ground and 1 is porous ground such as that found in a rural</td>
</tr>
<tr>
<td></td>
<td>setting comprising of mainly grass and vegetation)</td>
</tr>
<tr>
<td>Source height</td>
<td>All equipment modelled at 2.0 metres above ground level</td>
</tr>
<tr>
<td>Cadna calculation method</td>
<td>L_{A_{max}} assessment</td>
</tr>
<tr>
<td>Noise contour grid spacing</td>
<td>250 metres</td>
</tr>
</tbody>
</table>
5.2 Vibration modelling inputs

5.2.1 Vibration methodology

The methodology for the construction vibration assessment includes:

- Typical vibration levels for construction plant were sourced from available data
- Minimum working distances for structural damage and human comfort were calculated
- Receivers within minimum working distances were identified and listed
- Where residences were identified within cosmetic damage buffer distances, mitigation measures were provided to minimise impacts from vibration intensive activities

5.2.2 Vibration sources

Energy from equipment is transmitted into the ground, transformed into vibration and attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- The efficiency of the energy transfer mechanism of the equipment (that is, impulsive, reciprocating, rolling or rotating equipment)
- The frequency content
- The impacted media stiffness
- The type of wave (surface or body)
- The ground type and topography

Due to the above factors, there is inherent variability in ground vibration predictions without site-specific measurement data. The Roads and Traffic Authority’s Environmental Noise Management Manual (ENMM) (NSW RTA, 2001) provides typical construction equipment ground vibration levels at 10 m. The rate of vibration attenuation can be calculated from the following regression analysis formula:

\[ V = kD^{-n} \]

where

- \( V \) = Peak Particle Velocity
- \( D \) = Distance
- \( k \) = Site constant
- \( n \) = attenuation exponent. The value of \( n \) generally lies between 0.8 and 1.6. A conservative attenuation exponent of 1.1 was used and is generally representative of hard soils or dense compacted sands.

Table 5-6 outlines typical vibration levels for vibration generating equipment associated with the proposal. These typical levels have been sourced from the RTA’s ENMM.

**Table 5-6 Typical vibration levels of equipment**

<table>
<thead>
<tr>
<th>Item</th>
<th>Peak particle velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>40t excavator</td>
<td>6 mm/s at 10 m</td>
</tr>
<tr>
<td>Compactor</td>
<td>9 mm/s at 10 m</td>
</tr>
<tr>
<td>Grader</td>
<td>3 mm/s at 8 m</td>
</tr>
<tr>
<td>Smooth drum roller</td>
<td>10 mm/s at 10 m</td>
</tr>
</tbody>
</table>
Safe working buffer distances to comply with the human comfort and structural damage screening criteria are presented Table 5-7 (calculated based on the source vibration levels presented in Table 5-6).

**Table 5-7 Safe working buffer distances for equipment**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Human comfort (m)</th>
<th>Cosmetic damage (m)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Heritage structures</td>
<td>Standard structures</td>
</tr>
<tr>
<td>40t excavator</td>
<td>50</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>Compactor</td>
<td>73</td>
<td>27</td>
<td>17</td>
</tr>
<tr>
<td>Grader</td>
<td>21</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Smooth drum roller</td>
<td>81</td>
<td>29</td>
<td>18</td>
</tr>
</tbody>
</table>
6. Impact assessment

6.1 Operational noise impacts

6.1.1 Predicted overall noise levels

Noise levels were predicted based on the operating conditions outlined in Section 5.1 and assessed during the most-stringent applicable PSNALs, being the night period. The predicted noise levels at the nearest sensitive receivers are shown in Table 6-1. Exceedances of the PSANLs are shown in red. It should be noted that these noise levels are representative of the worst-case scenario operating conditions and for the majority of the time, the expected noise levels at the receiver will be lower than the predicted noise levels presented in Table 6-1.

Predicted noise levels at all sensitive receivers within the study area are presented in Appendix C. Noise contour plots for the six operational scenarios are presented in Appendix D.

Table 6-1 Predicted noise levels at the nearest sensitive receivers

<table>
<thead>
<tr>
<th>Receiver ID</th>
<th>PSANLs (Night / when in use)</th>
<th>Predicted noise levels for each scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S01</td>
</tr>
<tr>
<td>Nearest residential receivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCA01_R001</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>NCA01_R002</td>
<td>35</td>
<td>19</td>
</tr>
<tr>
<td>NCA01_R004</td>
<td>35</td>
<td>26</td>
</tr>
<tr>
<td>NCA01_R005</td>
<td>35</td>
<td>17</td>
</tr>
<tr>
<td>NCA02_R001</td>
<td>35</td>
<td>23</td>
</tr>
<tr>
<td>NCA02_R002</td>
<td>35</td>
<td>28</td>
</tr>
<tr>
<td>NCA03_R043</td>
<td>35</td>
<td>22</td>
</tr>
<tr>
<td>NCA03_R029</td>
<td>35</td>
<td>21</td>
</tr>
<tr>
<td>NCA03_R045</td>
<td>35</td>
<td>18</td>
</tr>
<tr>
<td>NCA03_R046</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>NCA04_R001</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>NCA04_R002</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>NCA05_R002</td>
<td>35</td>
<td>13</td>
</tr>
<tr>
<td>NCA05_R015</td>
<td>35</td>
<td>12</td>
</tr>
<tr>
<td>Nearest non-residential receivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rum Jungle Lake South – NCA03_R069</td>
<td>48</td>
<td>21</td>
</tr>
<tr>
<td>Browns Oxide Project - NCA02_R003</td>
<td>68</td>
<td>53</td>
</tr>
</tbody>
</table>
6.1.1 Low frequency noise and tonal noise assessment

The predicted one-third octave band levels were reviewed for low frequency noise content. The predicted difference between the C- and A-weighted noise levels were above 15 dBA at some receivers, however one-third octave analysis of the predicted results indicates that they do not exceed the one-third octave low-frequency noise thresholds (as presented in Table C2 of the Noise Policy for Industry). Therefore, no corrections to the predicted noise levels are required as the noise levels do not contain low-frequency content.

A review of the equipment list was undertaken and no tonal characteristics are generally associated with the equipment. As such, no tonal corrections have been applied at receivers.

6.1.2 Discussion of predicted noise results

Potential noise impacts have been assessed during the most-stringent noise assessment period, being the ‘night’ period of 6:00 am to 7:00 am.

Scenario 1 – Site establishment and construction of haul roads within the main site

No exceedances of the PSANLs are predicted at any sensitive receiver within the study area. No noise significant noise impacts are anticipated during these works.

Scenario 2 – Excavation works within Rum Jungle, including ancillary earthworks and water treatment works

No exceedances of the PSANLs are predicted at any sensitive receiver within the study area. No noise significant noise impacts are anticipated during these works.

Scenario 3 – Excavation of contaminated waste rock and soil at Mt Fitch and Mt Burton

No exceedances of the PSANLs are predicted at any sensitive receiver within the study area except for receiver NCA02_R001, being the closest resident to the south-west of the Mt Burton WRD site. An exceedance of 7 dB of the PSANL is predicted at this receiver.

The Scenario 3 (Mt Burton) works are located within privately held property of the NCA02_R001 residence. It is understood that the resident at NCA02_R001 is supportive of the Project and supports the excavation and removal of waste rock from their Mt Burton property. As such, no receiver-based noise mitigation measures have been recommended at this receiver. Optional mitigation measures have been provided in Section 7, which may be applied to reduce noise levels associated with the planned Mt Burton excavation works.

Scenario 4 – Excavation of clay and low permeability materials from the borrow area near Rum Jungle Creek South (and public open space / recreation area)

No exceedances of the PSANLs are predicted at any sensitive receiver within the study area. No noise significant noise impacts are anticipated during these works. Optional mitigation measures are recommended in Section 7, which would lessen noise levels and reduce potential noise impacts at the nearest sensitive receivers.

Scenario 5 – Excavation of sand and gravels from the borrow area on Finniss River Land Trust (FRLT)

No exceedances of the PSANLs are predicted at any sensitive receiver within the study area. No noise significant noise impacts are anticipated during these works. Optional mitigation measures are recommended in Section 7 to lower noise levels and reduce potential noise impacts at the nearest sensitive receivers.
Scenario 6 – Spoil relocation of contaminated waste rock at the main project site and at Mt Fitch WRD

No exceedances of the PSANLs are predicted at any sensitive receiver within the study except for at the receiver NCA01_R005, being the closest resident to the northeast of the Mt Fitch WRD site. An exceedance of 3 dB of the PSANL is predicted at this receiver.

Noise mitigation measures have been recommended in Section 7 to reduce noise levels to within acceptable and compliant levels.

All scenarios occurring simultaneously

Although it is generally not possible for all of these scenarios to occur simultaneously, a check has been undertaken to assess whether the cumulative noise from the main project sites and satellites sites could result in exceedances of the PSANLs at any other sensitive receivers.

The results predicted in the final column of Table 6-1 indicate that cumulative noise from all areas associated with the Project would not result in any additional PSANL exceedances, other than those predicted from individual operational scenarios.

6.1.3 Sleep disturbance impacts

The $L_{Aeq(15min)}$ noise results predicted to residential receivers in Table 6-1 is representative of the $L_{A_{max}}$ noise levels at residential receivers for the sleep disturbance scenarios presented in Section 5.1.3. No residential receivers are anticipated to receive noise levels above the sleep disturbance screening criteria of $L_{A_{max}}$ 52 dBA and as such, no sleep disturbance impacts are predicted by the modelling of the Project.

6.2 Potential for noise impacts on health

Based on comparison to Guideline for Community Noise (WHO, 1999) values for health effects caused by various time-averaged noise levels, the predicted noise levels in Table 6-1 indicate that no critical health effects are anticipated to outdoor living areas, outdoor school playgrounds or at any industrial or commercial areas.

With a conservative 15 dB reduction applied to the outdoor noise levels (to account for noise transmission loss) through a closed window, the predicted noise levels in Table 6-1 indicate that no critical health effects are anticipated to the internal areas of residential dwellings (including bedrooms) during the day or night-time or to the internal areas of school class rooms.

6.3 Noise mitigation strategies

Generally, there are three mitigation strategies that can be used to reduce noise emission to sensitive receivers, being (from most preferred to least preferred):

1. Control at the source (e.g. selecting quieter equipment, enclosing the source, closing doors at sensitive times, active noise control, times of operation etc.)
2. Control in transmission (noise barriers, mound and bunds and site design to maximise distance or utilise intervening buildings as barriers etc.)
3. Receiver controls (insulation, upgraded glazing and use of mechanical ventilation etc.)

These noise mitigation strategies are discussed below and have been used to provide input for mitigation measures recommended in Section 7.
6.3.1 **Recommended noise mitigation measures (at source)**

The following mitigation measures are recommended to reduce noise at the source. The typical and maximum noise reductions due to these measures have been summarised in Table 6-2.

**Table 6-2 Noise control measures**

<table>
<thead>
<tr>
<th>Control measure</th>
<th>Type of control</th>
<th>Typical reduction dBA</th>
<th>Maximum reduction dBA</th>
<th>Feasible?</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silencers / mufflers / diffusers</td>
<td>Source</td>
<td>7 - 10</td>
<td>15</td>
<td>Yes</td>
<td>AS2436</td>
</tr>
<tr>
<td>Acoustic enclosures¹</td>
<td>Source</td>
<td>15 - 30</td>
<td>50</td>
<td>No</td>
<td>AS2436</td>
</tr>
<tr>
<td>Equipment substitution</td>
<td>Source</td>
<td>5-10</td>
<td>10</td>
<td>Where practical</td>
<td>AS2436</td>
</tr>
<tr>
<td>Distance</td>
<td>Source / transmission path</td>
<td>6 per doubling of distance</td>
<td>6 per doubling of distance</td>
<td>Yes</td>
<td>AS2436</td>
</tr>
</tbody>
</table>

Note:
1. Not recommended or feasible due to the majority of equipment in use being mobile.

**Substitution**
- Where reasonably practicable, noisy plant should be replaced by less noisy alternatives

**Modification of existing equipment**
- All engine covers should be kept closed while equipment is operating.
- Plant and vehicles should be kept properly serviced and fitted with appropriate mufflers and silencers, where applicable.
- The use of exhaust brakes should be eliminated, where practical.
- Where practical, plant operating on site are to be fitted with broadband reversing alarms.

**Use and siting of plant**
- The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practical
- Plant used intermittently is to be throttled down or shut off
- Noise-emitting plant is to be directed away from sensitive receivers, where possible

**Regular and effective maintenance**
- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made.
- Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.
6.3.2 Recommended noise mitigation measures (in transmission)

Due to the environment surrounding the project and satellite sites, it is unlikely that transmission path controls would be feasible during the operation of the Project. As such, no ‘in transmission’ noise controls have been recommended.

6.3.3 Recommended noise mitigation measures (at receiver)

Noise control measures at the receiver are not considered reasonable as noise controls at the source are expected to reduce noise levels to within acceptable and compliant noise levels at all sensitive receivers, except for the resident at NCA02_R001 during the S03 Mt Burton works.

The residual noise impact (after incorporating source mitigation measures) at this receiver is considered negligible (see Section 6.4). It is understood that the resident at NCA02_R001 is in favour of the excavation works at Mt Burton and as such, no mitigation measures at the receiver have been recommended.

6.4 Residual noise impacts

The installation of silencers / mufflers on excavators during S03 and on dozers during S06, would be expected to a typical reduction in noise levels of 7 – 10 dBA (see Table 6-2). Residual noise levels predicted at impacted sensitive after applying these mitigation measures are presented in Table 6-3 below.

**Table 6-3 Residual noise levels at the nearest sensitive receivers**

<table>
<thead>
<tr>
<th>Receiver ID</th>
<th>PSANLs (Night / when in use)</th>
<th>Predicted residual noise levels (post-mitigation)</th>
<th>Compliant?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>S03</td>
<td>S06</td>
</tr>
<tr>
<td>Residential receivers</td>
<td>35</td>
<td>19</td>
<td>33</td>
</tr>
<tr>
<td>NCA01_R005</td>
<td>35</td>
<td>19</td>
<td>33</td>
</tr>
<tr>
<td>NCA02_R001</td>
<td>35</td>
<td><strong>36</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

After noise mitigation measures are applied, only noise impacts at NCA02_R001 during S03 (Mt Burton works) remain above the applicable PSANL.

Table 4.1 of the *Noise Policy for Industry* (NPI) (NSW EPA, 2017) provides a framework to assess residual noise impacts. It states that if the predicted residual noise levels exceed the criteria by less than 2 dBA, then the significance of the residual noise level is ‘Negligible’.

Table 4.2 of the NPI provides examples of potential treatment for receivers based on the significance of the residual noise level. For ‘Negligible’ residual noise levels, it states that the exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls. As such, no further actions are required for this receiver.

6.5 Vibration impacts

6.5.1 Structural damage to standard dwellings

The most vibration intensive activity associated with the Project is the use of a smooth drum roller at the main project site and an excavator at satellite sites. Potential structural damage vibration impacts are anticipated for standard dwellings within 18 metres of rolling works and 11 metres of excavation works.
No standard dwellings have been identified within these distances and as such, no structural damage vibration impacts are anticipated for standard dwellings during the Project.

6.5.2 Structural damage to heritage structures
No heritage structures have been identified within 18 metres of excavation works at the main project site, Mt Fitch, Mt Burton, clay borrow site or granular borrow site.
As such, no project-specific vibration mitigation measures have been recommended.

6.5.3 Human comfort impacts
Potential human comfort vibration impacts are anticipated for residents within 81 metres of rolling works and 50 metres of excavation works.
No sensitive receivers have been identified within 81 metres of rolling works or 50 metres of excavation works. As such, no human comfort vibration impacts are anticipated during the Project.
7. Mitigation measures

Based on the model results described in Section 6 and subsequent to the incorporation of the mitigation and management measures below, the Project is predicted to comply with the acoustic requirements of:

- The Noise Management Framework Guideline
- Road Traffic Noise on NT Government Controlled Roads
- The human comfort guideline values set out in Section 4.5
- The structural damage vibration guideline values set out in Section 4.6

These measures should be incorporated in the Environmental Management Plan.

Work ethics

- All activities on site should be confined between the hours of 6:00 am to 6:00 pm, Monday to Sunday
- All personnel on site should be made aware of the potential for noise impacts and should aim to minimise elevated noise levels or noise impacts, where possible.

Substitution

- Where reasonably practicable, noisy plant should be replaced by less noisy alternatives

Modification of existing equipment

- All engine covers should be kept closed while equipment is operating.
- Excavators located at Mt Fitch, Mt Burton, the clay borrow site and the granular borrow site are to be fitted with silencers
- All dozers are to be fitted with silencers
- Plant and vehicles should be kept properly serviced and fitted with appropriate mufflers
- The use of exhaust brakes should be eliminated, where practical.
- Where practical, plant operating on site are to be fitted with broadband reversing alarms.

Use and siting of plant

- The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practical
- Plant used intermittently is to be throttled down or shut off
- Noise-emitting plant is to be directed away from sensitive receivers, where possible

Regular and effective maintenance

- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made.
- Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.
8. Conclusion

Operational noise impacts

Six scenarios were modelled using CadnaA 2019 to represent assumed worst-case operating conditions for noise generation during the Project. The six scenarios were assessed against the requirements of the Noise Management Framework Guideline (NMFG) (NT EPA, 2018). The results of the noise modelling indicate the following exceedances of the Project Specific Assigned Noise Level (PSANLs):

- A 7 dB exceedance at the nearest residential receiver during the excavation works at the Mt Burton WRD (Scenario 3)
- A 3 dB exceedance at the nearest residential receiver during the spoil relocation of contaminated waste rock at the Mt Fitch WRD (Scenario 6)

Noise levels during the operation of the Project are predicted to be below the PSANLs at all other sensitive receivers within the study area.

Noise mitigation measures are provided in Section 7 to reduce noise levels during Scenario 6 to within acceptable and compliant levels in accordance with the NMFG.

The Scenario 3 Mt Burton works are located within the property owned by the resident who will be affected by a predicted 7 dB exceedance of the PSANL. It is understood that the resident is in favour of the excavation works occurring and the removal of waste rock from their property. Mitigation measures have been recommended to reduce noise levels at this receiver, however, a residual noise impact 1 dB above the PSANL is expected to persist following the application of the reasonable mitigation measures listed in Section 7. A residual noise level of 1 dB is considered ‘Negligible’ and in considering the context of the property owner’s support for the Project, no additional receiver-based treatments or controls have been recommended.

Vibration impacts – structural damage to standard dwellings

No standard dwellings have been identified within safe-working distances during rolling, compacting, grading or excavation works. As such, no structural damage to standard dwellings are anticipated during the operation of the Project due to vibration.

Vibration impacts – structural damage to heritage structures

Heritage structures have been identified within the main project site. The exact proximity of rolling, compacting or excavating works near heritage structures or sacred sites was not accurately available at the time of report preparation. However, it is recommended that rolling, compacting, grading or excavation works are not undertaken within the following safe working distances from heritage structures or sacred sites:

- 40t excavator - 18 metres
- Compactor – 27 metres
- Grader – 7 metres
- Smooth drum roller – 29 metres

Road traffic noise impacts

Litchfield Park Road and Rum Jungle Road are Northern Territory Government Controlled Roads and will be used to haul materials from satellite sites to the main project site. As no future roads are proposed as part of the project, no assessment to residential receivers or other noise-sensitive receivers is necessary and the requirements of road noise regulations are considered to be met.
Mitigation measures
Management and mitigation measures are provided in Section 7 and are to be incorporated for the duration of the Project.

Potential health impacts
Based on the health effects of various time averaged noise levels in the Guidelines for Community Noise (WHO, 1999), no adverse impacts to health are anticipated to any identified outdoor or indoor locations within the study area, as a result of noise associated the Project.
9. References

DEFRA UK. (2006). Update of noise database for prediction of noise on construction and open sites
NT DoT. (2014). Road Traffic Noise on NT Government Controlled Roads
NT EPA. (2014). Noise Guidelines for Development Sites
NT EPA. (2019). Rehabilitation of the former Rum Jungle mine site - Terms of Reference for an Environmental Impact Statement
WHO. (1999). Guidelines for Community Noise
Appendices
Appendix A – Detailed layouts of the Project sites
Appendix B – Detailed sensitive receiver maps
Detailed sensitive receiver map - NCA1 and NCA2

Rum Jungle Rehabilitation Project | Air, Noise and Vibration Report

APPENDIX B
Detailed sensitive receiver map - NCA4

Rum Jungle Rehabilitation Project | Air, Noise and Vibration Report

APPENDIX B

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52

Scale 1:20,000 @ A4

LEGEND

- Towns
- Residential
- Cadastre
- Roads
- Study Area
- Noise Catchment Areas
- Commercial
- Educational institute

Data Source:
- Towns, homesteads, roads, waterways, railway, digitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

G:\43\22822\GIS\Maps\4322822_007.mxd
Appendix C – Predicted $L_{Aeq(15\text{min})}$ noise levels at sensitive receivers
### Table: Residential Noise Levels

<table>
<thead>
<tr>
<th>Resevoir</th>
<th>Location</th>
<th>Elevation (m)</th>
<th>Noise Level (dBA)</th>
<th>Noise Level (dBA)</th>
<th>Noise Level (dBA)</th>
<th>Noise Level (dBA)</th>
<th>Noise Level (dBA)</th>
<th>Noise Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCA01</td>
<td>71564</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>NCA02</td>
<td>71746</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>NCA03</td>
<td>71749</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>NCA04</td>
<td>71789</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>NCA05</td>
<td>71790</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>NCA06</td>
<td>71791</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
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Indicates an exceedance of the PSNL.
Appendix D – Predicted $L_{Aeq(15min)}$ noise contour maps at 1.5 m above ground level (ISO 9613-2)
Predicted $L_{Aeq}(15min)$ noise contours map at 1.5m above ground level - ISO 9613-2

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APPENDIX D - Scenario 1

Data Source:
NTG - Cadastre (2007).

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52

Legend:
- Project Site
- Towns
- Commercial
- Industrial
- Passive Recreation
- Residential
- Construction Scenario
- Noise contours, dB(A)
- 40 45 50 55 60 65 70 75 80 85 90
- Roads
- Waterways
- Study Area
- Noise Catchment Areas
- Cadastre

Scale 1:75,000 @ A4
Kilometres

Map ID: 4322822_009.mxd
Figure Number: 4322822_009.mxd

Issue Date: 10/10/2019
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Predicted $L_{Aeq(15min)}$ noise contours map at 1.5m above ground level - ISO 9613-2

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APPENDIX D - Scenario 2

LEGEND

- **Commercial**
- **Industrial**
- **Passive Recreation**
- **Residential**
- **Construction Scenario**

Noise Contours

- $L_{Aeq(15min)}$ noise contours, dB(A)
- **20**
- **25**
- **30**
- **35**
- **40**
- **45**
- **50**
- **55**
- **60**
- **65**
- **70**
- **75**
- **80**
- **85**
- **90**

- **Waterways**
- **Study Area**
- **Noise Catchment Areas**
- **Cadastre**
- **Project Site**
- **Roads**

Scale 1:60,000 @ A4

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52

Data Source:
Predicted $L_{Aeq(15min)}$ noise contours map at 1.5m above ground level - ISO 9613-2

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APPENDIX D - Scenario 3
Predicted L_{Aeq}(15\text{min}) noise contours map at 1.5m above ground level - ISO 9613-2

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APPENDIX D - Scenario 4

**Legend**
- **Passive Recreation**
- **Residential**
- **Roads**
- **Waterways**
- **Noise Contours**
- **Study Area**
- **Noise Catchment Areas**
- **Cadastre**
- **Construction Scenario**

**Data Source:**

**Map Projection:** Universal Transverse Mercator

**Horizontal Datum:** GDA 1994

**Grid:** GDA 1994 MGA Zone 52

**Scale:** 1:40,000 @ A4

**Map ID:** 4322822_012.mxd

**Figure Number:** 4322822_012.mxd

**Issue Date:** 10/10/2019
Predicted L_{Aeq(15min)} noise contours map at 1.5m above ground level - ISO 9613-2

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APPENDIX D - Scenario 5

LEGEND

- Towns
- Commercial
- Industrial
- Passive Recreation
- Residential
- Construction Scenario
- L_{Aeq(15min)} noise contours, dB(A)

- 40
- 45
- 50
- 55
- 60
- 65
- 70
- 75
- 80
- 85
- 90

- Study Area
- Noise Catchment Areas
- Cadastre
- Project Site
- Roads

Scale 1:40,000 @ A4

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52

Data Source:
- GHD - Noise Monitoring Locations, Sensitive Receptors, Noise Catchment Area, Noise Contours (2019)
- NTG - Cadastre (2007)

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

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Issue Date: 10/10/2019
Map ID: 4322822_013.mxd
Figure Number: 4322822_013.mxd
Predicted $L_{Aeq(15\text{min})}$ noise contours map at 1.5m above ground level - ISO 9613-2

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APPENDIX D - Scenario 6

Legend:
- Towns
- Commercial
- Industrial
- Passive Recreation
- Residential
- Construction Scenario
- Noise Contours
  - $L_{Aeq(15\text{min})}$ noise contours, dB(A)
  - 20
  - 25
  - 30
  - 35
  - 40
  - 45
  - 50
  - 55
  - 60
  - 65
- Roads
- Waterways
- Study Area
- Noise Catchment Areas
- Cadastre
- Project Site

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 52
Scale 1:110,000 @ A4

Data Source:

Issue Date: 10/10/2019
Map ID: 4322822_014.mxd
Figure Number: 4322822_014.mxd
Predicted $L_{Aeq(15min)}$ noise contours map at 1.5m above ground level - ISO 9613-2

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APPENDIX D - All Scenarios
GHD

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Document Status

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