7 Noise and Vibration

7.1 Introduction

This chapter presents an assessment of the impacts of the Simandou Mine on the acoustic environment. It considers the effects on people (1) and property of noise and vibration during construction and operation of the mine.

Potential sources of emissions during construction will include clearing and grubbing of the site, earthmoving, drilling, assembly and erection of plant and infrastructure, and construction traffic. Sources during operation will include noise from drilling, blasting, operation of mining equipment, crushing and screening, conveyor operation, processing plant, stockpiling and loading of ore, mine waste disposal operations, power generation and vehicle movements. With regard to blasting, explosives are used to dislodge overburden material and the ore body to enable its extraction. Blasting can affect people and property as a result of elevated noise emissions known as airblast or overpressure, and through vibration transmitted through the ground.

Movements of construction traffic on public roads approaching the mine site are not considered in this part of the assessment as they are assessed together with the impacts of construction traffic along the length of the railway in the SEIA for the Simandou Railway in Volume II. Flows of construction traffic have been estimated for the whole Project and are treated together in that volume. This chapter considers only noise from traffic on the new road from the N1 near Beyla Airport to the mine and in the mine plant and stockyard construction area.

The following impacts have been considered but it was concluded that they are unlikely to be significant for the reasons noted below and they are not therefore considered further in the assessment:

- groundborne noise: there are no significant underground noise sources or receptors within the potential area of influence and groundborne noise is not therefore expected to affect receptors; and

- vibration from mine plant operations: the closest potential sensitive receptor is located 1.3 km from the nearest potential source and vibration from operational sources other than blasting will not be perceptible at this distance.

The remainder of the chapter is structured as follows:

- Section 7.2 describes the assessment methodology;
- Section 7.3 presents the baseline conditions;
- Section 7.4 presents the assessment of impacts from the mine prior to mitigation;
- Section 7.5 describes the planned approach to mitigation and the resulting residual impacts; and
- Section 7.6 provides a summary of the assessment.

Supporting information is provided in the following annexes:

- Annex 7A - Noise and Vibration Glossary;

- Annex 7B - Noise and Vibration Impact Assessment Criteria and Methodology: this annex provides background to the development of the criteria used for evaluation of impacts, including a review of current guidance and legislation, and describes the methods used to predict noise and vibration levels; and

(1) The responses of animals (e.g., mammals and birds) to noise and vibration can differ from those of people. The assessment in this chapter focuses on impacts on people and the differential effects of noise on species are discussed in Chapter 12: Biodiversity.
Annex 7C - Noise Design Assumptions and Source Data: this annex presents Project data including design parameters and assumptions relevant to noise emissions, from which source terms have been developed for the purpose of the assessment.

As some of the terminology used in noise assessment is technical in nature a brief introduction to some key terms is provided below. More details are provided in Annex 7A: Noise and Vibration Glossary.

An Introduction to Noise Terminology

- **dB(A):** Environmental noise levels such as noise generated by industry, construction and road traffic are commonly expressed in dBA or A-weighted decibels. Decibels are units of sound measured on a logarithmic scale. This means that a step of 10 dB represents a ten-fold increase in sound energy. The A-Weighting scale is a standard weighting of the audible frequencies designed to reflect the response of the human ear to noise. To the typical human ear an increase of 10 dBA actually sounds slightly more than twice as loud.

- **L_{AeqT}:** Time varying noise sources are often described in terms of statistical noise descriptors. L_{Aeq} (the equivalent continuous A-weighted sound pressure level) is a value that, simply expressed, represents the average sound level over a period of time. The period of time (T) can be 1 hour, daytime hours (say 14 hours from 0600 to 2200), night time hours (8 hours from 2200 to 0600), all day (24 hours), or any other relevant period.

- **L_{A90T}:** This is an alternative statistical descriptor calculated from the sound level exceeded for 90% of the time. For a noise environment with a fairly steady background noise level on which occasional noisy events are superimposed (such as occasional passage of trains through a rural area) it, simply expressed, represents the background noise level. Other percentile values are used to present different aspects of the noise environment such as L_{A95T} and L_{A10T}.

- **L_{Amax}:** This is the maximum sound pressure level recorded during a measurement period.

7.2 Approach

7.2.1 Study Area

The assessment study area in this chapter is defined as the area within which people could be adversely affected by noise and vibration from construction or operation of the mine, including the mine pits, processing plant, stockpiles and ore loading area. Several settlements in the vicinity of the mine have been identified as representative of locations within the area that could be adversely affected by noise and vibration and these are identified in Table 7.1. Their locations are shown in Figure 7.1. There are a number of other, mainly smaller settlements in the same area, but the identified villages are considered to be representative of the receptors likely to be affected by the mine.

<table>
<thead>
<tr>
<th>Village</th>
<th>Population</th>
<th>Relationship to the Mine</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lamandou</td>
<td>195</td>
<td>1.3 km west of the southern extent of the Ouéléba pit</td>
</tr>
<tr>
<td>Traoréla</td>
<td>1 053</td>
<td>2.6 km west of northern extent of Ouéléba pit</td>
</tr>
<tr>
<td>Banko</td>
<td>558</td>
<td>6.8 km west of the northern extent of Pic de Fon pit</td>
</tr>
<tr>
<td>Mandou</td>
<td>222</td>
<td>7.4 km west of the northern extent of the Pit Pic de Fon pit</td>
</tr>
<tr>
<td>East</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moribadou</td>
<td>8 078</td>
<td>3.0 km southeast of the processing plant</td>
</tr>
<tr>
<td>Wataférédou II</td>
<td>279</td>
<td>3.6 km east of the Ouéléba pit and 1.5 km east of processing plant and stockyard</td>
</tr>
<tr>
<td>Wataférédou I</td>
<td>163</td>
<td>6 km east of the stockyard</td>
</tr>
<tr>
<td>Foma</td>
<td>636</td>
<td>6.2 km east of the southern extent of the Pic de Fon pit</td>
</tr>
</tbody>
</table>

Note: the settlements of Kotila and Siatouro shown on the map are now both uninhabited.
Figure 7.1
Emplacements des récepteurs du bruit /
Noise Receptor Locations

Agglomération dans la zone d'influence potentielle /
Settlement Within Potential Area of Influence

Contour de mine / Mine Outline

Terril de stériles / Waste Emplacement

Mine Plant & Infrastructure

Projet de route de la mine / Proposed Mine Road

Zone de stockage d'explosifs / Explosives storage area

Zone d'exécution autour de la zone de stockage d'explosifs / Explosives Area Clearance Zone

Dépôt de carburant / Fuel Farm

Centrale électrique / Power Station

Localisation de la base de vie / Camp Location

Tracé indicatif de la voie ferrée / Indicative Rail Alignment

Agglomération / Settlement

Route principale / Primary Road

Route secondaire / Secondary Road

Route tertiaire / Tertiary Route

Cours d'eau / Watercourse

Forêt Classée / Classified Forest

Légende

Client: RioTinto

Date: 29/06/2012

Vérifié par: RL

Approuvé par: KR

Projection: WGS 1984 UTM Zone 29N

Échelle: Comme barre d'échelle
7.2.2 Legal and Other Requirements

There are no national standards or guidelines for noise and vibration or blasting in Guinea. In the absence of national standards the assessment has therefore made reference to a range of guidelines including the International Finance Corporation (IFC) General Environmental Health and Safety (EHS) Guidelines and World Health Organization (WHO) Guidelines for Community Noise. A review of noise and vibration regulations, standards and guidance from other countries has also been conducted to inform the development of the evaluation criteria presented in Section 7.2.4. Details are provided in Annex 7B: Noise and Vibration Impact Assessment Criteria and Methodology.

The following Rio Tinto Environment Standard has also been taken into consideration:

- E6 – Noise and Vibration Control.

7.2.3 Prediction of Impacts

7.2.3.1 Construction Noise

Bruel & Kjaer's Predictor V8.01, noise modelling software was used to calculate noise emissions from construction activities utilising the methods identified within British Standard BS5228 (1). Further details are provided in Annex 7B: Noise and Vibration Impact Assessment Criteria and Methodology.

The following scenarios were modelled for construction:

- earthworks and site preparation (outside of the pit areas), including clearing and grading over the processing, infrastructure areas, conveyor alignments and access roads; and
- general construction activities such as assembly, fabrication and erection of structures, installation and commissioning of plant and equipment over all areas.

The following assumptions were made to calculate noise emissions from the construction phase of the mine:

- indicative noise source levels, expressed as sound power levels (LWA) were assumed for teams of construction plant being distributed evenly across the site; and
- screening of noise sources by on-site Project structures was not considered, so in this respect the predictions represent a worst case scenario.

7.2.3.2 Operational Noise

The same noise modelling software was used to calculate noise levels from mining operations utilising the widely used international standard ISO 9613-2 (2) combined with the meteorological effects as determined by the widely accepted CONCAWE (3) calculation method. Noise contours were predicted for four operating scenarios representing the different stages of mine operations using noise source data detailed in Annex 7C: Noise Design Assumptions and Source Data:

- year 5 – initial start-up and production in Ouéléba and Pic de Fon with operation of external waste emplacements;

(1) BS5228:2009 Noise and Vibration Control on Construction and Open Sites
• year 15 - active mining and in pit processing in Ouéléba and Pic de Fon with operation of external waste emplacements;

• year 25 - active mining and in pit processing in Ouéléba and the last stage of active mining in Pic de Fon and in-pit waste disposal; and

• year 35 - nominal 47.5 mtpa production in Ouéléba, no active mining in Pic de Fon and in-pit waste disposal.

All mobile mining equipment and fixed processing plant were assumed to achieve the design sound power levels set out in Annex 7C: Noise Design Assumptions and Source Data and to operate simultaneously. Mobile sources such as water carts, fuel trucks, graders and haul trucks, were modelled at typical locations and assumed to operate in repetitive cycles.

Four alternative meteorological scenarios were modelled as illustrated in Table 7.2.

Table 7.2 Meteorological Conditions for Noise Modelling

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Temp (°C)</th>
<th>Humidity (%)</th>
<th>Wind Speed (m/s)</th>
<th>Predominant Wind Direction</th>
<th>Pasquill –Gifford Atmospheric Stability Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>All day calm conditions</td>
<td>15 - 25</td>
<td>80</td>
<td>--</td>
<td>--</td>
<td>C</td>
</tr>
<tr>
<td>Wet Season / SW wind</td>
<td>20</td>
<td>80</td>
<td>3</td>
<td>225 SW</td>
<td>C</td>
</tr>
<tr>
<td>Dry Season / E wind</td>
<td>25</td>
<td>60</td>
<td>3</td>
<td>90 E</td>
<td>C</td>
</tr>
<tr>
<td>Night Time Temperature Inversion</td>
<td>15</td>
<td>80</td>
<td>0</td>
<td>--</td>
<td>F</td>
</tr>
</tbody>
</table>

7.2.3.3 Blasting Prediction Methodology

Airblast levels and ground vibration have been predicted using the methodology outlined in the ICI Blasting Guide. Further details are provided in Annex 7B: Noise and Vibration Impact Assessment Criteria and Methodology.

7.2.4 Evaluation of Impacts

7.2.4.1 Overview

As discussed in Section 7.2.2 there are no Guinean standards or guidance for noise and vibration and reference is therefore made to international sources. All receptors are considered to be of equal sensitivity and receptor sensitivity is not therefore considered in the analysis.

7.2.4.2 Evaluation of Construction Noise Impacts

A review of international standards and guidelines for construction noise is presented in Annex 7B: Noise and Vibration Impact Assessment Criteria and Methodology. These sources establish noise limits for construction noise at the façade of residential buildings ranging from 35-55 dBA at night to 65-75 dBA during the daytime.

IFC General EHS Guidelines also provide guidance on acceptable noise levels based on WHO standards and these are set out in Table 7.3.
Table 7.3   **IFC / World Bank Noise Level Guidelines**

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Maximum Allowable Ambient Noise Levels, LAeq,1hr, dBA Free field</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daytime</td>
</tr>
<tr>
<td></td>
<td>07:00 – 22:00</td>
</tr>
<tr>
<td>Residential, institutional, educational</td>
<td>55</td>
</tr>
<tr>
<td>Industrial, commercial</td>
<td>70</td>
</tr>
</tbody>
</table>

Source IFC General EHS Guidelines Table 1.7.1

An LAMax of 85 dBA is generally accepted as the threshold at which the potential for hearing damage starts to occur and is widely adopted as an action limit for occupational noise management.

Based on these standards and guidelines, criteria for evaluating the significance of construction noise impacts are set out in Table 7.4. Different thresholds are set for day time and night time, and according to the duration of the impacts on the basis that short term noise (<1 month) will cause less impact than medium (1-6 months) or long term (>6 months) noise.

Table 7.4   **Evaluation Criteria for Construction Noise at Dwellings (façade levels)**

<table>
<thead>
<tr>
<th>Operating Period</th>
<th>Daytime Noise Level, LAeq dBA</th>
<th>Night time Noise Level, LAeq dBA</th>
<th>All Periods LAMax</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not Significant</td>
<td>Minor</td>
<td>Moderate</td>
</tr>
<tr>
<td>Short term exposure &lt; 1 month</td>
<td>&lt;70</td>
<td>70-75</td>
<td>&gt;75-80</td>
</tr>
<tr>
<td>Medium term exposure 1 to 6 months</td>
<td>&lt;65</td>
<td>65-70</td>
<td>&gt;70-75</td>
</tr>
<tr>
<td>Long term exposure &gt; 6 months</td>
<td>&lt;55</td>
<td>55-60</td>
<td>&gt;60-65</td>
</tr>
</tbody>
</table>

**7.2.4.3 Evaluation of Operational Noise Impacts**

In accordance with IFC EHS Guidelines, two aspects of the change in noise climate during operations are considered in the assessment:

- the overall noise level caused by the mine; and
- the difference between the noise level caused by the mine and the background noise level in the environment.

The IFC/WHO guidance summarised in Table 7.3 is used to derive criteria for the first.

For the second, the difference in noise levels can be measured either by considering the change in background noise levels as represented by the LA90 parameter, where IFC guidance indicates that the background level should not increase by more than 3dBA, or by considering the difference between the baseline LA90 and the LAEq from the Project. The latter approach is adopted here as more appropriate for a noise source of a generally continuous nature such as will arise from the Simandou Mine, and reference is made in particular to guidance from the New South Wales Industrial Noise Policy and British Standard BS4142 Method for Rating Industrial Noise affecting Mixed Residential and Industrial Areas. These indicate that a difference between baseline LA90 and Project LAeq of +5 dBA is of marginal significance; at +10 dBA, complaints start to become likely (based on western European survey findings), and above this, the
likelihood of complaints increases. Further details and full references are provided in Annex 7B: Noise and Vibration Impact Assessment Criteria and Methodology.

Based on these standards and guidelines, the criteria for evaluating the significance of construction noise impacts are set out in Table 7.5. When assessing the change in background noise levels and where existing noise levels are very low, a minimum baseline noise level of 30 dBA is adopted.

Table 7.5 Evaluation Criteria for Operational Noise at Dwellings (façade levels)

<table>
<thead>
<tr>
<th>Period</th>
<th>Daytime Noise Level, dBA</th>
<th>Night time Noise Level, dBA</th>
<th>All periods LAmx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance</td>
<td>Not Significant</td>
<td>Minor</td>
<td>Moderate</td>
</tr>
<tr>
<td>LAeq,1hr</td>
<td>&lt;55</td>
<td>55-60</td>
<td>&gt;60-65</td>
</tr>
<tr>
<td>Increase above background (LAeq minus LA90)</td>
<td>10</td>
<td>&gt;10-15</td>
<td>&gt;15-20</td>
</tr>
</tbody>
</table>

7.2.4.4 Evaluation of Blasting Impacts

International standards and guidelines for airblast and vibration have also been reviewed to establish criteria for assessment of impacts from blasting. Details are presented in Annex 7B: Noise and Vibration Impact Assessment Criteria and Methodology. The resulting criteria are set out in Table 7.6. No distinction is made between minor and moderate impacts because of the nature of impacts from blasting and the response of receptors.

Table 7.6 Criteria for Evaluation of Impacts from Blasting

<table>
<thead>
<tr>
<th>Period</th>
<th>Airblast dB(Z) 95 percentile</th>
<th>Vibration PPV mm/s 95 percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significance</td>
<td>Not Significant</td>
<td>Minor / Moderate</td>
</tr>
<tr>
<td>Daytime</td>
<td>&lt;115</td>
<td>&gt;115-125</td>
</tr>
<tr>
<td>Night time</td>
<td>&lt;105</td>
<td>&gt;105-115</td>
</tr>
</tbody>
</table>

7.3 Baseline

The baseline noise environment was determined by monitoring undertaken as part of the mine baseline studies at nine locations shown on Figure 7.2 (1). Measurement locations were chosen on the outskirts of settlements to capture the baseline noise level without it being unduly affected by very localised sources such as people, vehicles or the movement of animals. Fixed monitoring stations were used to measure the ambient noise on a continuous basis over a 24 hour period at each site. The noise measurements were taken with an integrating precision sound level meter of type 1 per ICE 651 standard (1979).

The noise surveys were conducted during February 2008 (during the dry season). The meteorological conditions were typical of the dry season, with a high ambient air temperature and low humidity in day time and high at night. The wind was not significant enough to have any impact on the noise measurements.

(1) SNC Lavalin (2010); Social and Environmental Baseline Study, Simandou Project – Mine Component, Volume C Physical Baseline.
The baseline data were analysed to calculate hourly $\text{LA}_{\text{eq}}$ and $\text{LA}_{95}$ parameters. It will be noted that the baseline survey data were analysed to provide the $\text{LA}_{95}$ rather than the more usual $\text{LA}_{90}$ background noise parameter. As the monitoring and analysis was complete by the time of this assessment, it was not possible to reanalyse the data to provide $\text{LA}_{90}$ but a standard correction of 1 dB was applied to convert $\text{LA}_{95}$ to $\text{LA}_{90}$.

The ambient noise assessment results for each of the noise monitoring stations are summarised in Table 7.7 and Figure 7.2.

**Table 7.7 Summary of Measured Noise Levels**

<table>
<thead>
<tr>
<th>Monitoring Location</th>
<th>Date, Time, Duration</th>
<th>Hourly level in calm period, dBA</th>
<th>Dominant Ambient Noise Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Day (7h00-22h00)</td>
<td>Night (22h00-7h00)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\text{LA}_{\text{eq}}, 1\text{h}$</td>
<td>$\text{LA}_{90}, 1\text{h}$</td>
</tr>
<tr>
<td>Traoréla</td>
<td>15 Feb 2008-10h54 25 hrs</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>Bangalydou</td>
<td>15 Feb 2008 09h30 27 hrs</td>
<td>43</td>
<td>38</td>
</tr>
<tr>
<td>Mandou</td>
<td>16 Feb 2008-16h35 24 hrs</td>
<td>43</td>
<td>38</td>
</tr>
<tr>
<td>Banko</td>
<td>16 Feb 2008-15h27 24 hrs</td>
<td>44</td>
<td>36</td>
</tr>
<tr>
<td>Moribadou</td>
<td>13 Feb 2008-12h21 24 hrs</td>
<td>43</td>
<td>35</td>
</tr>
<tr>
<td>Wataférédou II</td>
<td>18 Feb 2008-16h26 40 hrs</td>
<td>43</td>
<td>33</td>
</tr>
<tr>
<td>Canga East</td>
<td>19 Feb 2008 18h43 12 hrs</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Kotila</td>
<td>17 Feb 2008-08h13 26 hrs</td>
<td>38</td>
<td>27</td>
</tr>
<tr>
<td>Foma</td>
<td>13 Feb 2008-09h17 25 hrs</td>
<td>39</td>
<td>31</td>
</tr>
</tbody>
</table>


Ambient noise levels at each location were found to vary throughout the day based on levels of human activity in the villages and the hourly values presented in Table 7.7 are for periods when human activities and insect noise were less evident. This provides a conservative view of the baseline. In all villages the ambient levels in the day time were higher than the night time, as expected.

Noise levels at other villages are taken to be the same as at the nearest measurement site, so Wataférédou I is assumed to have the same noise levels as Wataférédou II and Lamandou to have the same noise levels as Banko.
Figure 7.2
Mesure de référence du bruit de la mine de Simandou / Simandou Mine Noise Baseline

Légende:
- Station de mesure du bruit ambiant / Ambient Noise Measurement Location
- Contour de mine / Mine Outline
- Réservoire / Reservoir
- Zone de stockage d'explosifs /Explosives Storage Area

Figure 7.2
Mesure de référence du bruit de la mine de Simandou / Simandou Mine Noise Baseline

Laeq, Jour / Day: 43
Laeq, Jour / Day: 38
Laeq, Jour / Day: 33
Laeq, Jour / Day: 28

Laeq, Jour / Day: 44
Laeq, Jour / Day: 39
Laeq, Jour / Day: 34
Laeq, Jour / Day: 29

La eq, Nuit / Night: 40
La eq, Nuit / Night: 35
La eq, Nuit / Night: 30
La eq, Nuit / Night: 25

La90, Jour / Day: 50
La90, Jour / Day: 45
La90, Jour / Day: 40
La90, Jour / Day: 35

La90, Nuit / Night: 45
La90, Nuit / Night: 40
La90, Nuit / Night: 35
La90, Nuit / Night: 30

La eq, Jour / Day: -
La eq, Jour / Day: -
La eq, Jour / Day: -
La eq, Jour / Day: -

La90, Jour / Day: -
La90, Jour / Day: -
La90, Jour / Day: -
La90, Jour / Day: -

La eq, Nuit / Night: -
La eq, Nuit / Night: -
La eq, Nuit / Night: -
La eq, Nuit / Night: -

La90, Nuit / Night: -
La90, Nuit / Night: -
La90, Nuit / Night: -
La90, Nuit / Night: -

Projection: WGS 1984 UTM Zone 29N

Date: 29/06/2012
Verifié par: RL
Projet: 0131299
Échelle: Comme barre d'échelle

Client: Taille: Titre: Date: 29/06/2012
Dessiné par: WB
Vérifié par: RL
Approuvé par: KR
Projet: 0131299
Échelle: Comme barre d'échelle
7.4 Assessment of Impacts

7.4.1 Overview

This section presents the results of an assessment of impacts from:

- noise during construction (Section 7.4.2);
- noise during operation (Section 7.4.3); and
- blasting during operation (Section 7.4.4).

7.4.2 Noise Impacts during Construction

Noise levels during construction were predicted using the method described in Section 7.2.2. Noise contours for two construction scenarios: general construction and earthworks around the Ouéléba pit and mine plant area are illustrated in Figure 7.3. Noise levels around the Pic de Fon pit will be similar. It will be seen that LAeq noise levels from construction activities at the nearest settlements are all below 40 dBA. Noise levels in the nearest settlement to construction works on the mine plant, stockyard and rail loading area, Wataférédou II, will be between 35 and 40 dBA.

The impact from these levels of construction noise will be not significant.

During construction the main access route for construction traffic to the mine will be the new road running from the N1 near Beyla Airport, south of Bobaro and Wataférédou I, to the mine plant area (see Figure 7.1). A construction camp will be located approximately 1 km east of Wataférédou I. Neither development is close enough to any settlements to cause significant noise impacts.

There will be no significant impacts from noise during construction of the mine.

It should be noted that this assessment does not include impacts from construction traffic movements on the public road network. These are assessed as part of the assessment of overall project construction traffic impacts, within the SEIA for the Simandou Railway presented in Volume II.
Figure 7.3 Courbe générale du bruit de la construction de la mine et du terrassement / Mine Construction Noise Contours General and Earthworks

<table>
<thead>
<tr>
<th>Contour de bruit (dBA)</th>
<th>Noise Contour (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 - 40</td>
<td>60 - 70</td>
</tr>
<tr>
<td>40 - 45</td>
<td>65 - 70</td>
</tr>
<tr>
<td>45 - 50</td>
<td>70 - 75</td>
</tr>
<tr>
<td>50 - 55</td>
<td>75 - 80</td>
</tr>
<tr>
<td>55 - 60</td>
<td>&gt; 80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contour de bruit (dBA)</th>
<th>Noise Contour (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 - 40</td>
<td>60 - 70</td>
</tr>
<tr>
<td>40 - 45</td>
<td>65 - 70</td>
</tr>
<tr>
<td>45 - 50</td>
<td>70 - 75</td>
</tr>
<tr>
<td>50 - 55</td>
<td>75 - 80</td>
</tr>
<tr>
<td>55 - 60</td>
<td>&gt; 80</td>
</tr>
</tbody>
</table>
7.4.3 Noise Impacts during Operation

Noise levels from the operation of the mine have been predicted using the method described in Section 7.2.3 for each of four meteorological scenarios and four operating scenarios (Years 5, 15, 25 and 35 of mine operation). The results are presented as noise contours in Figure 7.4 to 7.11 (the series of figures is presented at the end of the chapter). The noise impacts for the worst meteorological scenario at each of eight representative settlements are presented in Table 7.8. It may be noted that the results take into account prevailing winds and occurrence of temperature inversions.

Noise levels from mining operations are predicted to be lower than the 55 dBA LAeq threshold for the day time at all locations but the difference between baseline LA90 and Project LAeq (12 dBA) will be sufficient to cause minor noise impacts at Wataférédou II through the lifetime of the mine. The main sources of noise at Wataférédou II will be the processing plant, stockyard and rail loading area.

At all other locations day time impacts will be not significant.

At night time the Project LAeq will just exceed the 45 dBA threshold at Wataférédou II but the difference between project LAeq and baseline LA90 will also be sufficient to cause:

- minor or moderate impacts at Wataférédou II throughout the lifetime of the mining operations resulting from proximity to the crushing and screening plant, conveyors, stockyard and rail loading area (difference 14-16 dBA); and

- minor impacts at Traoréla throughout the mine lifetime (difference 10-11 dBA).

At other locations night time noise impacts will be not significant.

<table>
<thead>
<tr>
<th><strong>Daytime Operational Impacts</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation, minor impacts are predicted to occur over the lifetime of the mining operations at Wataférédou II.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Night Time Operational Impacts</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Without mitigation, minor or moderate impacts will occur at Wataférédou II and minor impacts at Traoréla throughout operations. At other settlements night time impacts will be not significant.</td>
</tr>
</tbody>
</table>
Table 7.8 Summary of Assessment of Impacts (Worst Case Meteorological Scenarios)

<table>
<thead>
<tr>
<th>Settlement</th>
<th>Existing Background Noise Level LA90</th>
<th>Year 5 Impact Rating (NS=not significant)</th>
<th>Year 15 Impact Rating (NS=not significant)</th>
<th>Year 25 Impact Rating (NS=not significant)</th>
<th>Year 35 Impact Rating (NS=not significant)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Predicted Mine Noise Level LAeq, 1hr</td>
<td>Impact from mine noise</td>
<td>Impact compared to background</td>
<td>Predicted Mine Noise Level LAeq, 1hr</td>
<td>Impact from mine noise</td>
</tr>
<tr>
<td>Daytime</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traoréla</td>
<td>34</td>
<td>42</td>
<td>NS</td>
<td>NS</td>
<td>43</td>
</tr>
<tr>
<td>Wataférédou I</td>
<td>33</td>
<td>&lt;35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Wataférédou II</td>
<td>33</td>
<td>45</td>
<td>NS</td>
<td>Minor</td>
<td>46</td>
</tr>
<tr>
<td>Moribadou</td>
<td>35</td>
<td>&lt;35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Foma</td>
<td>31</td>
<td>35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Lamandou</td>
<td>37</td>
<td>35</td>
<td>NS</td>
<td>NS</td>
<td>36</td>
</tr>
<tr>
<td>Mandou</td>
<td>38</td>
<td>&lt;35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Banko</td>
<td>36</td>
<td>&lt;35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Night time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traoréla</td>
<td>32</td>
<td>42</td>
<td>NS</td>
<td>Minor</td>
<td>43</td>
</tr>
<tr>
<td>Wataférédou I</td>
<td>30</td>
<td>&lt;35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Wataférédou II</td>
<td>30</td>
<td>46</td>
<td>Minor</td>
<td>Moderate</td>
<td>46</td>
</tr>
<tr>
<td>Moribadou</td>
<td>30 (24)</td>
<td>36</td>
<td>NS</td>
<td>NS</td>
<td>35</td>
</tr>
<tr>
<td>Foma</td>
<td>30 (23)</td>
<td>35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Lamandou</td>
<td>34</td>
<td>35</td>
<td>NS</td>
<td>NS</td>
<td>36</td>
</tr>
<tr>
<td>Mandou</td>
<td>38</td>
<td>&lt;35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Banko</td>
<td>34</td>
<td>&lt;35</td>
<td>NS</td>
<td>NS</td>
<td>&lt;35</td>
</tr>
</tbody>
</table>

Notes:
[1] An adjustment of 1 dB has been added to convert the measured LA95 to LA90. Where the measured background is <30 a value of 30 is adopted for the purposes of assessment.
7.4.4 Blasting Impacts

The impacts from blasting associated with the mining operations have been predicted based on four potential charge weights or Maximum Instantaneous Charges (MIC) of 100 kg, 200 kg, 500 kg and 1 000 kg. The results of these calculations are presented in graphical format in for airblast overpressure in Figure 7.12 and for vibration (PPV) in Figure 7.13.

For the purpose of assessment an indicative blast during the daytime with the expected typical Maximum Instantaneous Charge (MIC) of 515 kg has been used. This type of blast would have the potential to create significant airblast impacts within 1 000 m and significant vibration impacts within 1 200 m of the blast location. As the nearest sensitive receptor to either mine pit is approximately 1 300 m from the pit, impacts from blasting emissions are predicted to be not significant.

As there will be no blasting at night, impacts from exceedance of the more stringent night time criterion are not predicted to occur.

Blasting during mine operations will result in no significant impacts from air blast and vibration.

Figure 7.12 Blasting - Airblast Calculation
7.5 Mitigation Measures and Residual Impacts

7.5.1 Overview

Measures to mitigate significant impacts are discussed under the three headings of:

- construction noise;
- operational noise; and
- blasting.

Additional measures for protection of wildlife are identified in Chapter 12: Biodiversity.

7.5.2 Mitigation of Construction Noise Impacts

The assessment concluded that there will be no significant impacts on people from noise and vibration during construction at the Simandou Mine. Nevertheless the Project will adopt the following good practices to minimise noise during construction:

- mobile plant (eg compressors, generators) and other noisy construction plant such as concrete batching will be located as far from the nearest potential sensitive receptors (people and wildlife) as possible, plant will be oriented to direct noise emissions away from sensitive locations as far as possible, and on-site structures and terrain will be used to screen sensitive locations wherever practicable;

- noisy construction work will be carried during daylight hours as far as is practicable;

- where construction work outside daylight hours is unavoidable the residents of nearby villages will be notified in advance;

- piling and pile driving will only be undertaken during daylight hours (except for port operations);
• equipment and vehicles will be regularly maintained in accordance with manufacturers’ specifications;

• vehicles will be required to follow designated routes and strict speed limits will be applied to all vehicles moving around the construction area and on public roads;

• the noise level of audible warning devices will be kept to the minimum necessary for the health and safety of employees; and

• noise performance will be considered in the selection of equipment and vehicles in accordance with Rio Tinto’s Buy Quiet Policy.

Noise levels will be monitored during construction and if moderate or more significant impacts are found to occur consideration will be given to identifying additional measures to mitigate these impacts. With these measures noise impacts during construction should remain not significant.

7.5.3 Mitigation of Operational Noise Impacts

The assessment has identified the potential for minor and moderate noise impacts during operation at some nearby settlements and during certain periods of mine operation.

Minor impacts will be managed by adoption of good site practices during operation including:

• noisy plant will be located as far from the nearest potential sensitive receptors as possible, orienting it to direct emissions away from receptors as far as possible, and using on-site structures and terrain to screen sensitive locations wherever practicable;

• strict speed limits will be applied for all vehicles moving on Project roads and around Project sites and on public roads through settlements;

• noisy equipment and vehicles will be regularly maintained in accordance with manufacturers’ specifications;

• the noise level of audible warning devices will be kept to minimum necessary for the health and safety of employees; and

• noise performance will be considered in the selection of equipment and vehicles in accordance with Rio Tinto’s Buy Quiet Policy.

Mitigation of moderate impacts will be planned during completion of the detailed design and prior to each new phase of operation. During detailed design and prior to each new phase of operation, the predictions presented here will be verified with updated data on scheduling of activities and the locations and specifications for equipment, in order to confirm the need for mitigation of moderate or more significant impacts. Monitoring will also be undertaken during operations to establish the impact of the Project on noise levels. If either advanced studies prior to start of operations or monitoring during operations indicate that moderate, major or critical impacts are likely to occur or are occurring, the Project will investigate the application of additional measures to control noise. These may include:

• relocating noise sources so that there is no direct line of sight between the source and receptors;

• selection of alternative lower noise equipment;

• installation of noise shielding on noisy sources such as conveyors, conveyor drives, crushers and screens;

• use of noise barriers (berms or fences) located between the noise source and the receptor; and
update of the noise model to predict the effect of any additional mitigation measures.

If avoidance of major or critical impacts is not feasible using these measures, consideration will be given to the option of relocating the affected community. This will be explored in consultation with the affected people and will be planned and implemented in accordance with the Project Framework for Land Acquisition, Resettlement and Compensation (the PARC Framework). Further details are provided in Chapter 19: Land Use and Land-Based Livelihoods.

With these measures the Project will ensure that impacts from operation of the mine are of no more than minor significance.

7.5.4 Mitigation of Blasting Impacts

The assessment predicted that there would be no significant impacts from blasting at the mine. However the Project will adopt the following good practices to minimise the potential for adverse impacts from blasting during construction of the rail tunnels and operation of the mine:

- there will be no blasting at night at the Mine;
- blasting will be undertaken following a planned schedule and the local community will be informed of this in advance;
- blast designs and procedures will be developed to keep noise and blasting to a minimum without compromising blast requirements and will consider appropriate drilling grid, charge size, charging plan, blasting ratio, charge stemming and delay interval;
- delayed / micro-delayed or electronic detonators will be used; and
- levels of airblast and vibration caused by blasting will be monitored and the results will be used to inform future blast design.

With these measures impacts from blasting at the mine should remain not significant.

7.6 Summary of Findings

Noise and vibration impacts from construction and operation of the Simandou Mine are summarised in Table 7.9.

Table 7.9 Summary of Impacts

<table>
<thead>
<tr>
<th>Impact Description</th>
<th>Impact before Mitigation</th>
<th>Key Mitigation</th>
<th>Residual Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts of noise on nearby settlements during construction</td>
<td>Not Significant</td>
<td>No specific measures but Project will adopt good construction site practices including:</td>
<td>Not Significant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• consideration of noise in site layout and placing of equipment;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• avoiding noisy activities at night where possible and advising local communities of any necessary night time activity;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• avoiding piling and pile driving at night where possible;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• speed limits and road maintenance on roads used by construction traffic;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• regular maintenance to avoid increase in noise from equipment and vehicles; and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• consideration of noise in selection of equipment and vehicles;</td>
<td></td>
</tr>
<tr>
<td>Impact Description</td>
<td>Impact before Mitigation</td>
<td>Key Mitigation</td>
<td>Residual Impact</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
</tbody>
</table>
| Impacts of day time noise in Wataférédou II and night time noise in Traoréla during operation | Minor | No specific measures but Project will adopt good operational site practices including:  
- consideration of noise in site layout and placing of equipment and traffic routes;  
- speed limits and road maintenance on roads used by construction traffic;  
- regular maintenance to avoid increase in noise from equipment and vehicles; and  
- consideration of noise in selection of equipment and vehicles | Not Significant or Minor |
| Impacts of night time noise in Wataférédou II throughout mine lifetime | Minor or Moderate | The Project will undertake further noise predictions during detailed design and monitoring during operations to confirm predicted and actual noise levels and will consider options for noise reduction if required to mitigate moderate or higher impacts by:  
- relocating noise sources to avoid direct line of sight to receptors;  
- selection of alternative equipment;  
- installation of noise shielding on facilities and equipment; and  
- installation of noise berms or fences between sources and receptors.  
If major or critical impacts cannot be avoided by these means consideration will be given to relocation of affected people in accordance with the Project PARC Framework | Not Significant or Minor |
| Airblast and vibration impacts affecting people and property from blasting | Not Significant | No specific measures but Project will adopt good blasting practices to minimise the risk of adverse effects including:  
- no blasting at night at the Mine;  
- ensuring blasting is undertaken following a planned schedule and informing the local community of this in advance; and  
- ensuring that blast designs and procedures are developed to keep noise and blasting to a minimum without compromising blast requirements and will consider appropriate drilling grid, charge size and charging plans, appropriate blasting ratios, charge stemming and use of delayed / micro-delayed or electronic detonators and results of blast monitoring are used to inform future blast design. | Not Significant |
Figure 7.4
Courbes du bruit d'exploitation de la mine (5 ans)
Conditions calmes et inversion de température / Mine Operation Noise Contours (Year 5)
Calm and Temperature Inversion

PROJECTION: WGS 1984 UTM Zone 29N

Legend:
- Mines and infrastructure mineères / Mine Plant & Infrastructure
- Proposed Mine Road
- Mine Settlement
- Mine Outline
- Waste Emplacement
- Indicative rail alignment
- Primary Road
- Secondary Road
- Tertiary Road

Conditions calmes / Calm Conditions
Inversion de température / Temperature Inversion

 contours:
- 30 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- > 80
Figure 7.6 Courbes du bruit d’exploitation de la mine (15 ans) / Conditions calmes et inversion de température / Mine Operation Noise Contours (Year 15) / Calm and Temperature Inversion

- Conditions calmes / Calm Conditions
- Inversion de température / Temperature Inversion

- Usine et infrastructures minières / Mine Plant & Infrastructure
- Projet de route de la mine / Proposed Mine Road
- Agglomération / Settlement
- Contour de mine / Mine Outline
- Terril de stériles / Waste Emplacement
- Tracé indicatif de la voie ferrée / Indicative rail alignment
- Route principale / Primary Road
- Route secondaire / Secondary Road
- Route tertiaire / Tertiary Route

- Contour de bruit (dBA) / Noise Contour (dBA)
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- > 80

PROJECTION: WGS 1984 UTM Zone 29N

Domanidou Fomala Touréla Kankoro Banko Koimoridou Canga East Camp Mandou Orono Lamandou Mafindou Moribadou Mamouroudou Korèla Wataférédou II Wataférédou I Bobaro Traoréla Siatouro Boulaydou Nionsomoridou Kouwandala Kamandou Kissiboula N.1
Usine et infrastructures minières / Mine Plant & Infrastructure
Projet de route de la mine / Proposed Mine Road
Agglomération / Settlement
Contour de mine / Mine Outline
Terrain de stériles / Waste Emplacement
Tracé indicatif de la voie ferrée / Indicative rail alignment
Route principale / Primary Road
Route secondaire / Secondary Road
Route tertiaire / Tertiary Route

Contour de bruit (dBA) / Noise Contour (dBA)
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
65 - 70
70 - 75
75 - 80
> 80

Figure 7.7
Courbes du bruit d'exploitation de la mine (15 ans)
Vents dominants / Mine Operation Noise Contours (Year 15)
Prevailing Winds

Vent d'Est 3m/s / East Winds 3m/s
Vent Sud Ouest 3m/s / South West Winds 3m/s

PROJECTION: WGS 1984 UTM Zone 29N

Figure 7.8

Courbes du bruit d’exploitation de la mine (25 ans)

Conditions calmes et Inversion de température / Mine Operation Noise Contours (Year 25)

Calm and Temperature Inversion
Contour de bruit (dBA) / Noise Contour (dBA)
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- > 80

Vent de Sud Ouest 3m/s / South West Winds 3m/s
- Vent de Sud Ouest 3m/s / South West Winds 3m/s
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- > 80

Usine et infrastructures minières / Mine Plant & Infrastructure
- Projet de route de la mine / Proposed Mine Road
- Agglomération / Settlement
- Contour de mine / Mine Outline
- Terri de vétérins / Waste Emplacement
- Tracé indicatif de la voie ferrée / Indicative rail alignment
- Route principale / Primary Road
- Route secondaire / Secondary Road
- Route tertiaire / Tertiary Road

PROJECTION: WGS 1984 UTM Zone 29N

Figure 7.9
Courbes du bruit d'exploitation de la mine (25 ans) / Mine Operation Noise Contours (Year 25)
Vents dominants / Prevailing Winds

Vent de Sud Ouest 3m/s / South West Winds 3m/s
- Vent de Sud Ouest 3m/s / South West Winds 3m/s
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- > 80

Vent d'Est 3m/s / East Winds 3m/s
- Vent d'Est 3m/s / East Winds 3m/s
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- > 80