APPENDIX 8

Noise Impact Assessment

Mackas Sand

Noise Impact Assessment of Sand Extraction Operations from Lot 218 DP 1044608 and Lot 220 DP 1049608, Salt Ash

April 2009

Umwelt
Environmental Consultants

Noise Impact Assessment of Sand Extraction Operations from Lot 218 DP 1044608 and Lot 220 DP 1049608, Salt Ash

Prepared by

Umwelt (Australia) Pty Limited

on behalf of

Mackas Sand

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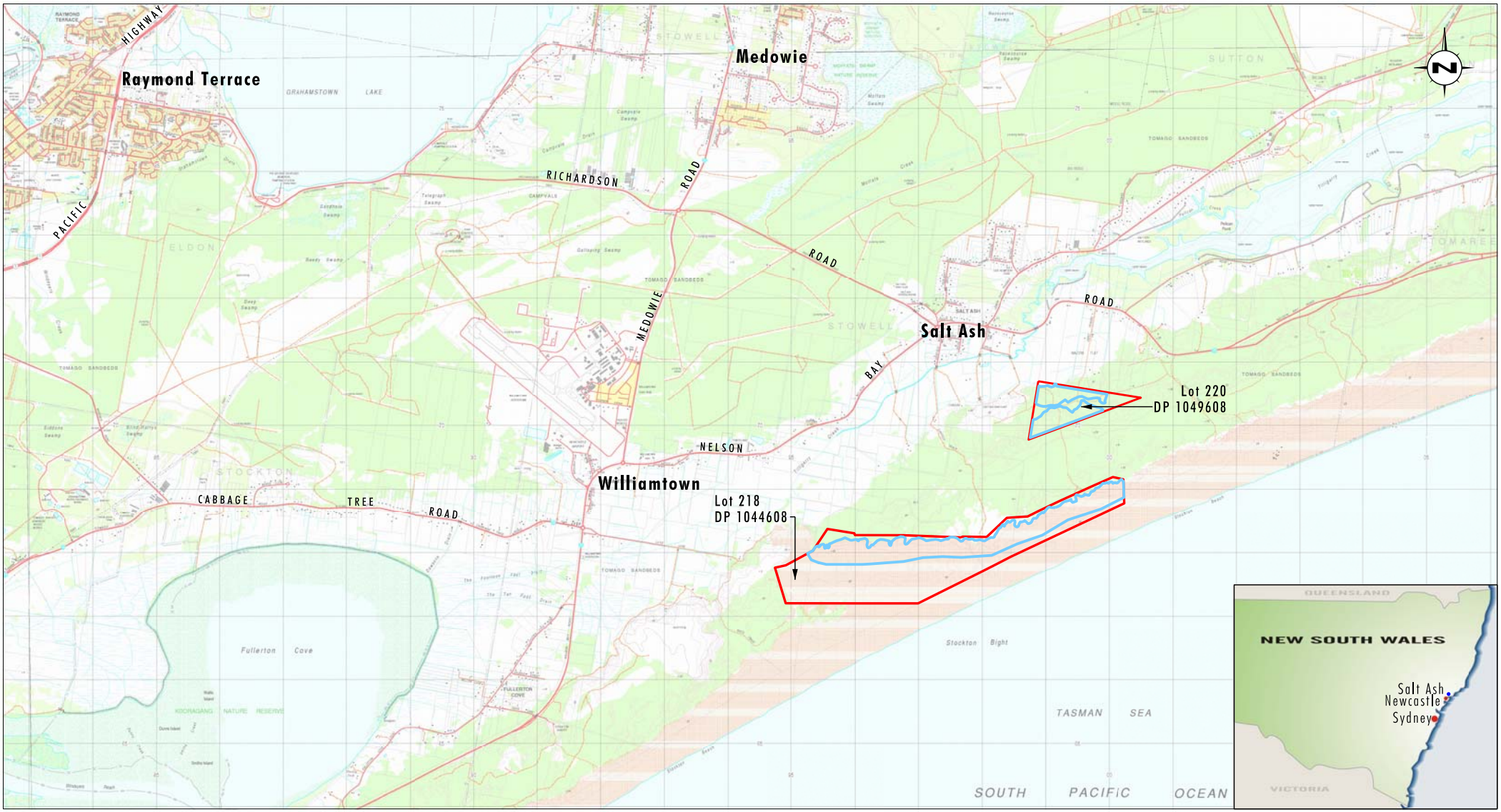
1.0 Introduction

Mackas Sand has operated a sand extraction and soil supply business based in Salt Ash since 1992. This quarry will cease operating in early 2009 due to exhaustion of sand resources.

Mackas Sand proposes to extract industrial grade and construction sand resources from two sites at Salt Ash along the edge of at Stockton Bight (refer to **Figure 1.1**) on behalf of the Worimi Local Aboriginal Land Council (Worimi LALC). The extraction will be undertaken at the locations shown on **Figure 1.1** which are known as Lot 218 in DP 1044608 and Lot 220 in DP 1049608. The sites form part of the Stockton Bight dune system and are located approximately 20 to 25 kilometres to the north-east of Newcastle (refer to **Figure 1.1**).

This Noise Impact Assessment (NIA) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) on behalf of Mackas Sand to identify key issues relating to noise to be addressed in the Environmental Assessment as required by the Director-General of the Department of Planning. This NIA has been undertaken in accordance with the NSW *Industrial Noise Policy* (INP) (Department of Climate Change – DECC, 2000).

A glossary of terms and abbreviations used in this report is provided in **Attachment 1**.



Source: Department of Lands, 2006

Legend

- Lot Boundaries (218 & 220)
- Proposed Operational Areas

FIGURE 1.1

Locality Plan

2.0 Project Description

2.1 Study Area

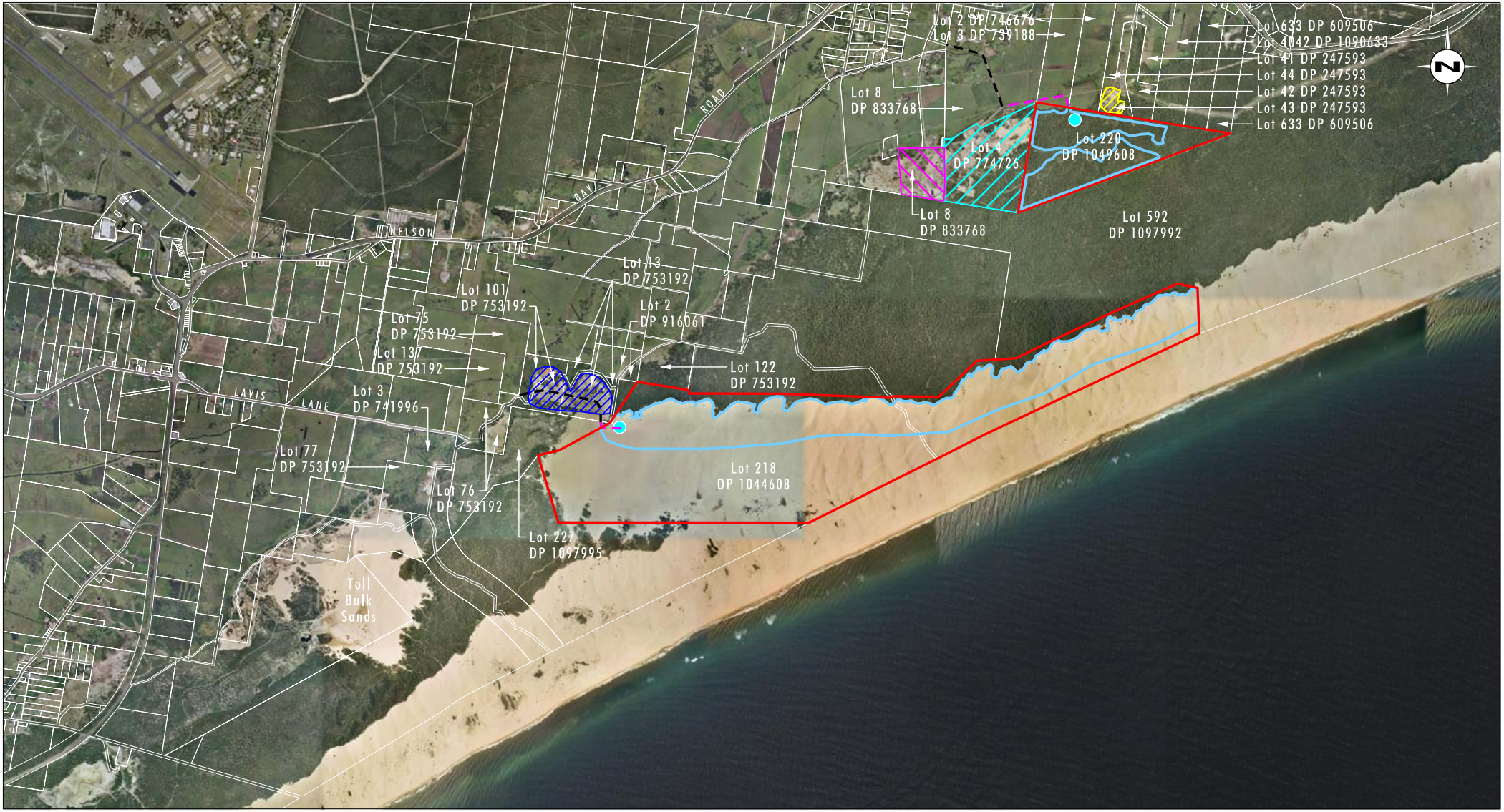
The study area for this assessment consists of the proposed Lot 218 operational area, Lot 220, two proposed access roads and the existing access roads shown on **Figure 2.1**. Lot 218 primarily consists of unvegetated outer mobile dunes and is surrounded by vegetated dunes to the north, mobile dunes to the south and a sand quarry adjoins the northernmost part of the site (refer to **Figure 2.1**). Lot 220 adjoins an existing sand extraction operation immediately to the west and is located approximately 750 metres east of the existing Mackas Sand operation. Rural land holdings and a small sand quarry operated by Hunter Quarries adjoin the site to the north, while sand dunes adjoin the eastern and southern property boundaries (refer to **Figure 1.1**).

The main transport route through the area is Nelson Bay Road, connecting Nelson Bay in the north-east to Stockton in the south-west. Access from Lot 218 to Nelson Bay Road is currently provided via Lavis Lane and an existing unsealed road. The western section of the road is located along a Crown road reserve and eastern section is located on private land (refer to **Figure 2.1**). Access from Lot 220 to Nelson Bay Road will be via Oakvale Road and an existing sealed road which will be connected to Lot 220 by the construction of a new unsealed access road of approximately 550 metres length (refer to **Figure 2.1**).

2.2 Receiver Locations

The nearest residence to Lot 218 is located approximately 1.3 kilometres from the proposed extraction area to the north along Nelson Bay Road (refer to **Figure 2.1**). The nearest identified residence to Lot 220 is located approximately 80 metres to the north of the proposed operational area (refer to **Figure 2.1**). There are 25 additional receivers located in Salt Ash and Williamtown, primarily along Nelson Bay Road and Lavis Lane (refer to **Figure 2.1**).

The nearest potentially affected residential receivers are presented in **Table 2.1** and shown on **Figure 2.2**. These locations present the receivers potentially affected by the excavation activities at both extraction areas, and the associated road traffic movements generated as a result of the operations.



Source: Department of Lands (2003)

0 0.5 1 2km
1:45 000

Legend

- Lot Boundaries (218 & 220)
- Mackas Sand (existing operations)
- Unimin
- Hunter Quarries
- Quality Sands and Ceramics
- Proposed Operational Area
- Proposed Weighbridge
- Site Access
- Proposed Site Access

FIGURE 2.1

The Study Area

File Name (A4): R10_V1/1646_137.dgn

Source: Department of Lands (2003)

0 0.5 1 2km

1:45 000

Legend

- Lot Boundaries (218 & 220)
- Proposed Operational Area
- Residential Receivers
- Noise Logger Location
- Site Access
- Proposed Site Access

FIGURE 2.2

Residential Receivers and Noise Logger Locations

File Name (A4): R10_V1/1646_138.dgn

Table 2.1 – Locations of Nearest Potentially Affected Residential Receivers

Receiver ID	Description	Easting (MGA)	Northing (MGA)	Ground Elevation (mAHD)
R1[1]	Eastern end of Lavis Lane unoccupied, unroofed derelict building	394342	6368223	6
R2[2]	End of Lavis Lane unoccupied shed	394257	6368107	6
R3	37 Lavis Lane – Towers residence	394175	6367901	1.5
R4	42 Lavis Lane Ford residence	394065	6367896	1.5
R5	16 Lavis Lane residence	392296	6368160	1.5
R6	12 Lavis Lane residence	392037	6368207	1.5
R8	Corner Lavis Lane/Nelson Bay Road	391753	6368287	1.5
R9	180 Cabbage Tree Road	391551	6368440	1.5
R10	85 Nelson Bay Road	391843	6368893	1.5
R11	16 Steel Street	393226	6369307	1.5
R12	178 Nelson Bay Road	394419	6369447	1.5
R13	204 Nelson Bay Road	395236	6369691	1.5
R14	220 Nelson Bay Road	395864	6370071	1.5
R15	20 David Drive	397628	6371107	1.5
R16	Corner David Drive and Nelson Bay Road	397726	6371508	1.5
R17	287 Nelson Bay Road	398012	6371595	1.5
R18	300 Nelson Bay Road	398345	6371421	1.5
R19	316 Nelson Bay Road	399026	6371477	1.5
R20	326 Nelson Bay Road	399358	6371864	1.5
R21	330 Nelson Bay Road	399728	6371717	8.5
R22	346 Nelson Bay Road	400179	6371642	1.5
R23	378 Nelson Bay Road	400909	6371089	1.5
R24	Janet Parade	399764	6370807	1.5
R25[1]	Mackas Sand Depot	398263	6371270	1.5
R26	Residence opposite Oakvale Farm	397813	6370959	1.5
R27	Hufnagl Property	399576	6370667	20

Note 1: Building uninhabitable, occurring on private land
2: Building uninhabitable, occurring on private land covered by agreement with Mackas Sand regarding the project

2.3 Construction Phase

The construction phase of the proposed development will occur for a maximum period of three months (less than 26 weeks). The construction phase will involve the following activities:

- vegetation clearing;
- site preparation and construction earthworks;
- construction of access roads to Lot 218 and Lot 220; and
- the construction of site facilities.

The construction of sand processing facilities at Lot 220 will not commence until a suitable water supply has been obtained and sufficient sand has been extracted to create a flat pad area for the processing plant. It is envisaged that construction of the processing plant will take several weeks to complete. Construction works will generally be undertaken between 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm on Saturdays.

2.4 Operational Phase

2.4.1 Access

Transport operations from both extraction areas will utilise Nelson Bay Road (MR108) to access regional and state wide transport routes. Access routes to both sites are shown on **Figure 2.1**.

Access routes to both sites are shown on **Figure 2.1**. Access from Lot 218 to Nelson Bay Road is provided via Lavis Lane and an unsealed access road (refer to **Figure 2.1**). This road will be extended by approximately 50 metres on Lot 227 in DP 1097995 to provide access to Lot 218.

Access from Lot 220 to Nelson Bay Road will be via Oakvale Road and an existing unsealed road. A new unsealed access road with a length of approximately 550 metres will be constructed between an existing sealed access road running off Oakvale Road and Lot 220 (refer to **Figure 2.1**).

2.4.2 Operations

The proposed sand extraction operations at each site will involve the preparation of the site, extraction of sand with front-end loaders, transport operations and site rehabilitation as required. Some extracted sand will be processed either through mobile vibrating screens or a sand processing plant located at Lot 220 prior to being transported offsite.

Development of Lot 218 will involve the establishment of an extraction area up to 150 metres wide along the landward margin of the transgressive dune. Up to four front-end loaders will work the area. Wind-blown sand will continue to replenish worked areas. It is estimated that up to 1.4 million tonnes of sand migrates into the proposed operational area at Lot 218 per year. This sand is currently encroaching on native forest at the north of the site.

Development of Lot 220 will be undertaken in stages and will involve the staged removal of vegetation and topsoil by bulldozer, followed by sand extraction and loading with up to four front-end loaders working in the area. It is anticipated that sand extraction operations will be undertaken in two areas (north and south) of Lot 220. The site will be progressively rehabilitated following extraction through replacement of topsoil and vegetative debris and the subsequent planting of local endemic plant species.

It is anticipated that up to 2,000,000 tonnes of sand will be extracted from the combined operations each year, with a maximum of 1,000,000 tonnes coming from either site.

2.4.3 Transport

Product transport routes from Lot 218 are provided via Lavis Lane to destinations north or south using Nelson Bay Road, or via Cabbage Tree Road to other destinations. Product transport routes from Lot 220 are provided via Oakvale Road to destinations north or south using Nelson Bay Road, or via Lemon Tree Passage Road to other destinations. Details of product transport routes are shown in **Figure 2.1**.

2.4.4 Timeframe and Hours of Operation

Sand extraction and processing operations at Lot 218 will occur 24 hours a day, 7 days per week. Operations at Lot 218 may continue indefinitely, due to the natural replenishment of the sand resource at this site through the movement of wind-blown sand into the operational area.

Sand extraction operations in the northern extraction area of Lot 220 will typically occur between 7.00 am and 6.00 pm Monday to Friday. Occasionally, sand extraction to within 250 metres of the nearest residence may occur outside of these hours, 7 days per week, depending on demand for sand products. Operation of the sand processing plant may occur 24 hours a day, 7 days per week in the northern section of Lot 220, depending on demand for sand products. The processing plant will generally operate the same hours as the sand extraction operation.

Sand extraction and processing through vibrating screens in the southern part of Lot 220 will typically occur between 7.00 am and 6.00 pm Monday to Friday, although operations at this site may occur 24 hours a day, 7 days a week, depending on demand for sand products.

Transport activities to and from Lot 220 will occur between 5.00 am and 10.00 pm.

2.5 Objectives

This Noise Impact Assessment has been prepared by Umwelt to assess the potential noise impacts from the proposed sand extraction operations at Lots 218 and 220 at Salt Ash in accordance with the DECC's *Industrial Noise Policy* (INP) (2000). This assessment involved the development of a model using topographical data for the region and proposed quarry plans in order to simulate the proposed sand extraction operations.

3.0 Noise Impact Assessment Procedures

3.1 Industrial Noise Policy

Responsibility for the control of noise emissions in NSW is vested in Local Government and the DECC. The INP released by DECC in December 2000 provides a framework and methodology for deriving noise criteria in accordance with consent and licence conditions. Using this policy the DECC regulates premises that are scheduled under the *Protection of the Environment Operations Act 1997* (PoEO Act).

The specific INP objectives are:

- to establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses;
- to use the criteria as the basis for deriving project-specific noise levels;
- to promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects;
- to outline a range of mitigation measures that could be used to minimise noise impacts;
- to provide a formal process to guide the determination of feasible and reasonable noise limits for consent or licence conditions that reconcile noise impacts with the economic, social and environmental considerations of industrial development; and
- to carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the PoEO Act.

The INP is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operation of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant.

The application of the INP involves the following processes:

- determining the project-specific noise levels (PSNL) from intrusiveness and amenity based measurement of the existing background and ambient noise levels;
- predicting or measuring the noise levels produced by the development; and
- comparing the predicted noise levels with the project-specific noise levels and assessing impacts.

Where the project-specific noise levels are predicted to be exceeded the INP provides guidelines on the assessment of feasible and reasonable noise mitigation strategies, including:

- ‘weighing up’ the benefit of the development against the social and environmental costs resulting from the noise impacts;
- establishment of achievable and agreed noise limits for the development in consultation with the consent authority; and
- undertaking performance monitoring of environmental noise levels to determine compliance with the consent and licence conditions.

3.2 DECC Assessment Methodology

There are two criteria to consider when establishing project-specific noise levels for the assessment of industrial noise sources. These criteria are:

- **the intrusive noise criterion**, which is based on the background noise level plus 5 dB. The background noise level, or Rating Background Level (RBL), is determined in accordance with Section 3 of the INP and is based on the use of noise monitoring data to establish the assessable background noise levels; and

- **the noise amenity criterion**, which is recommended by the INP for a prescribed land use. The recommended acceptable and maximum ambient noise levels are outlined in Table 2.1 of the INP. Table 2.2 of the INP outlines the requirements for developments where the existing noise level from industrial noise sources is close to the acceptable noise level.

The sections of the INP relating to the amenity criteria relevant to the project are presented in **Table 3.1**and **Table 3.2**.

Table 3.1 – Amenity Criteria – Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50 dB(A)	55 dB(A)
		Evening	45 dB(A)	50 dB(A)
		Night	40 dB(A)	45 dB(A)
	Suburban	Day	55 dB(A)	60 dB(A)
		Evening	45 dB(A)	50 dB(A)
		Night	40 dB(A)	45 dB(A)
	Urban	Day	60 dB(A)	65 dB(A)
		Evening	50 dB(A)	55 dB(A)
		Night	45 dB(A)	50 dB(A)
	Urban/Industrial Interface - for existing situations only	Day	65 dB(A)	70 dB(A)
		Evening	55 dB(A)	60 dB(A)
		Night	50 dB(A)	55 dB(A)
Area specifically reserved for passive recreation	All	When in use	50 dB(A)	55 dB(A)
Active recreation area (School playground, golf course)	All	When in use	55 dB(A)	60 dB(A)
Commercial premises	All	When in use	65 dB(A)	70 dB(A)
Industrial premises	All	When in use	70 dB(A)	75 dB(A)

Note 1: For Monday to Saturday, Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

Note 2: The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Table 3.2 – Modification to Acceptable Noise Level (ANL) to Account for Existing Levels of Industrial Noise

Total Existing LAeq Noise Level from Industrial Noise Sources	Maximum LAeq Noise Level for Noise from New Sources Alone, dB
≥ Acceptable noise level plus 2 dB	If existing noise level is likely to decrease in future acceptable noise level minus 10 dB If existing noise level is unlikely to decrease in future existing noise level minus 10 dB
Acceptable noise level plus 1 dB	Acceptable noise level minus 8 dB
Acceptable noise level	Acceptable noise level minus 8 dB
Acceptable noise level minus 1 dB	Acceptable noise level minus 6 dB
Acceptable noise level minus 2 dB	Acceptable noise level minus 4 dB
Acceptable noise level minus 3 dB	Acceptable noise level minus 3 dB
Acceptable noise level minus 4 dB	Acceptable noise level minus 2 dB
Acceptable noise level minus 5 dB	Acceptable noise level minus 2 dB
Acceptable noise level minus 6 dB	Acceptable noise level minus 1 dB
< Acceptable noise level minus 6 dB	Acceptable noise level

Note 1: ANL = recommended acceptable L_{Aeq} noise level for the specific receiver. Area and time of day from **Table 3.1**.

In assessing the noise impacts from industrial sources at residential receivers both criteria are considered. For each period (day, evening and night) the most stringent of either the intrusive or amenity criteria becomes the limiting criterion and forms the project-specific noise level for the industrial source.

If the existing ambient noise level is close to the acceptable noise level, any new sources must be controlled to preserve the amenity of the surrounding area. If the overall noise level from the industrial source already exceeds the acceptable noise level for the affected area, the L_{Aeq} noise level from any new source should meet the conditions set out in Table 2.2 of the INP.

3.3 INP Project-Specific Criteria

The INP states that the criteria outlined in **Table 3.1** and **Table 3.2** have been selected to protect at least 90 per cent of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90 per cent of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

Table 3.3 presents the methodology for assessing noise levels which may exceed the INP project-specific noise assessment criteria.

Table 3.3 – Noise Impact Assessment Methodology

Assessment Criterion	Project-Specific Criteria	Noise Management Zone	Noise Affectation Zone
Intrusive	Rating background level plus 5 dB	≤ 5 dB above project-specific criteria	≥ 5 dB above project-specific criteria
Amenity	INP based on existing industrial level	≤ 5 dB above project-specific criteria	≥ 5 dB above project-specific criteria

For the purposes of assessing the potential noise impacts the project-specific, management and affectation criteria are further defined in the following sections.

Project-Specific Criteria

Most people in the broader community would generally consider exposure to noise levels that achieve the project-specific criteria acceptable.

Noise Management Zone

Depending on the degree of exceedance of the project-specific criteria (1 dB to 5 dB) noise impacts in this zone could range from negligible to moderate. It is recommended that management procedures be implemented including:

- prompt response to any issues of concern raised by community;
- noise monitoring on-site and within the community;
- refinement of on-site noise mitigation measures and plant operating procedures where practical;
- consideration of acoustical mitigation at receivers; and
- consideration of negotiated agreements with property holders.

Noise Affectation Zone

Exposure to noise levels corresponding to this zone (more than 5 dB above project-specific criteria) may be considered unacceptable by some property holders and implementation of the following measures may be required:

- discussions with relevant property holders to assess concerns and provide solutions;
- implementation of acoustical mitigation at receivers; and
- negotiated agreements with property holders.

3.3.1 Assessing Sleep Disturbance

The DECC has acknowledged that the relationship between maximum noise levels and sleep disturbance is not well defined. Criteria for assessing sleep disturbance have not been defined under the INP but it is assumed that compliance with the INP will minimise the potential for sleep arousal. Notwithstanding, sleep arousal has been assessed using the guidelines set out in Section 19-3 of the DECC's Environmental Noise Control Manual (ENCM) (DECC, 1994).

To avoid the potential for sleep disturbance the ENCM recommends that the $L_{A1,\ 1\ minute}$ of the noise source should not exceed the background noise level (L_{A90}) by more than 15 dB(A). This is based on measurement outside the bedroom window of the receiver during the night-time hours (10.00 pm to 7.00 am).

4.0 Existing Acoustic and Meteorological Environment

4.1 Unattended Continuous Noise Monitoring

Unattended continuous noise monitoring was undertaken by Global Acoustics on behalf of Umwelt from 15 October 2008 to 27 October 2008 to monitor the existing ambient noise environment for the receivers identified in **Section 2**. This monitoring was undertaken using continuous noise loggers at the monitoring locations shown in **Figure 2.2**. The selected monitoring locations represent the nearest residential receiver areas identified in **Section 2**. Details of the noise monitoring schedule are presented in **Table 4.1**. The monitoring results were used to assess the background (L_{A90}) and amenity (L_{Aeq}) noise levels within the residential receiver areas adjacent to the study area.

Table 4.1 – 2008 Background Noise Monitoring Program

Monitoring ID and Location	Logger Serial No.	Measurement Started	Measurement Stopped	Representative Receiver IDs
M1 378 Nelson Bay Road, Salt Ash	194561	15/10/2008 10:54	27/10/2008 14:35	R20 to R23
M2 MacKenzies Depot, Salt Ash	194801	15/10/2008 11:00	27/10/2008 14:22	R15 to R19, R25 and R26
M3 190-192 Nelson Bay Road, Salt Ash	194677	15/10/2008 10:54	27/10/2008 14:28	R5 to R14
M4 Janet Parade, Salt Ash	194688	15/10/2008 10:54	27/10/2008 14:31	R24 and R27
M5 Lavis Lane, Salt Ash	194803	15/10/2008 11:02	27/10/2008 14:40	R1 to R4

The continuous noise loggers recorded:

- date, time and temperature;
- ambient background, L_{A90} noise levels and amenity, $L_{Aeq,\ 15\ minute}$ noise levels;
- maximum and minimum noise levels; and
- statistical noise levels representative of the noise environment.

The Rating Background Level (RBL), intrusiveness criteria and amenity criteria for monitoring locations M1 to M5 were determined in accordance with the INP.

A summary of the results of the unattended continuous noise monitoring are provided in **Table 4.2**. Noise data during periods of any periods of rainfall and/or wind speeds in excess of 5 m/s (18 km/h) were discarded in accordance with INP weather-affected data exclusion methodology.

Table 4.2 – Summary of Existing Ambient Background Noise Levels

Location	Description [1]	Rating Background Noise Level (RBL), L_{A90} dB(A) [2]	Measured L_{Aeq} Noise Level, dB(A)[3]
M1 378 Nelson Bay Road, Salt Ash	Daytime	37	59
	Evening	35	41
	Night	31	43
M2 Mackenzies Depot, Salt Ash	Daytime	40	57
	Evening	40 (41) [5]	48
	Night	40 (41) [5]	51
M3 190-192 Nelson Bay Road, Salt Ash	Daytime	41	62
	Evening	36	52
	Night	30 (29) [4]	53
M4 Janet Parade, Salt Ash	Daytime	31	49
	Evening	31 (34) [5]	42
	Night	30 (29) [4]	50
M5 Lavis Lane, Salt Ash	Daytime	33	64
	Evening	33 (36) [5]	50
	Night	32	52

Note 1: For Monday to Saturday, Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am. Morning Shoulder is from 6.00 am - 7.00 am Monday - Saturday.

Note 2: The L_{A90} represents the level exceeded for 90 per cent of the interval period and is referred to as the average minimum or background noise level.

Note 3: The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period

Note 4: Where the RBL is lower than 30 dB(A), a RBL of 30 dB(A) is applied, the measured RBL is shown in brackets.

Note 5: As per the INP Application Notes July 2006, the RBL for evening must not be greater than the daytime RBL, and the night time RBL must not be greater than the evening RBL. Where this occurs the RBL has been adjusted to the lower value and the measured value is shown in brackets.

4.2 Meteorological Conditions

Meteorological data was sourced from the Bureau of Meteorology (BoM) Station 061078 'Williamtown RAAF' collected by pDs Consultancy for 2006. This data was analysed to determine the frequency of occurrence of prevailing winds and temperature inversions.

4.2.1 Wind

Wind has the potential to increase noise impacts at a receiver when it is light and stable and blows from the direction of the noise source. As the strength of the wind increases the noise produced by the wind usually obscures noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the affected area. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30 per cent of the time during any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Section 5 of the INP requires that noise impacts be assessed under weather conditions that would be expected to occur at a particular site for a significant period of time.

The collated meteorological data for the period 2006 was analysed to determine prevailing wind conditions at the study area and is summarised in **Table 4.3**.

Table 4.3 – INP Prevailing Wind Assessment

Season	Wind Direction	Frequency of Occurrence (%)			
		Calm	0.5 m/s to 2 m/s	2 m/s to 3 m/s	0.5 m/s to 3 m/s
Daytime					
Summer	N±45	0.0%	1.4%	4.6%	6.0%
Autumn	NW±45	0.0%	1.3%	6.1%	7.4%
Winter	NW±45	0.0%	1.9%	5.8%	7.7%
Spring	NNW±45	0.0%	1.1%	4.8%	5.9%
Evening					
Summer	NE±45	0.0%	1.3%	3.9%	5.2%
Autumn	N±45	0.0%	8.2%	13.9%	22.0%
Winter	NW±45	0.0%	7.6%	15.9%	23.5%
Spring	NNE±45	0.0%	5.5%	12.0%	17.4%
Night Time					
Summer	NE±45	0.0%	7.2%	14.5%	21.6%
Autumn	NW±45	0.0%	8.0%	16.2%	24.2%
Winter	NW±45	0.0%	6.9%	16.2%	23.1%
Spring	NNW±45	0.0%	10.7%	17.6%	28.3%

The results of the wind analysis indicate that prevailing winds do not occur for greater than 30 per cent of the time and the highest occurrence of a wind condition is from the WNW, which is not a noise propagating source to receiver wind. Therefore wind impacts have not been considered in this assessment and noise predictions have been made for calm meteorological conditions.

4.2.2 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30 per cent of the total night-time (i.e. the evening and night time periods) during winter, or about two nights per week. Temperature inversions are generally determined based on the occurrence of atmospheric stability classes, with moderate and strong inversions corresponding to atmospheric stability categories F and G respectively.

Meteorological data was assessed in accordance with INP methodology to determine the likelihood of temperature inversions during the night-time period. These results are presented in **Table 4.4**.

Table 4.4 – Inversion Analysis Summary – Frequency of Stability Classes during Winter Evening and Night time Periods

Pasquill-Gifford Stability Class	Frequency of Stability Class [1]
A	1.0%
B	6.0%
C	15.0%
D	43.0%
E	17.0%
F & G	17.0%

Note 1: Total is less than 100% due to the amount of data used in analysis.
Source: Input meteorological data file for Ausplume Williamtown - 2006 (pDs Consultancy 2008).

This assessment found that the frequency of occurrence of F and G atmospheric stability categories is less than 30 per cent of the winter evening and night time periods. Therefore, the effects of temperature inversions have not been considered in this NIA.

5.0 Project-Specific Noise Emission Criteria

5.1 Operational Noise Criteria

Noise emission design criteria for the study area have been established with reference to the INP as outlined in **Section 3**. The acoustic environment in the vicinity of the study area is varied, with low traffic noise and high levels of natural sounds dominant at the receivers to the south-east of the study area (residential receivers R1 to R8). Whereas the receiver areas along Nelson Bay Road to the north and west of the study area are generally dominated by traffic noise and urban hum.

Therefore the following assessment criteria have been adopted at the receivers nearest the study area:

- 'rural' at the receivers in Lavis Lane and Janet Parade; and
- 'suburban' at the receivers along Nelson Bay Road and to the west of the study area in the vicinity of Williamtown.

The relevant intrusive and amenity noise criterion and resulting operational project-specific noise levels for the residential receivers surrounding the study area, with respect to the background noise monitoring locations, are presented in **Table 5.1**.

Table 5.1 – Project-Specific Noise Criteria at Residential Receivers, dB(A)

Location	Period [1]	RBL L_{A90}	Intrusive Criteria $L_{Aeq,\ 15\ minute}$	ANL $L_{Aeq,\ Period}$	Industrial Contribution L_{Aeq}	Amenity Criteria $L_{Aeq,\ Period}$ [2]	PSNL $L_{Aeq,\ 15\ minute}$
M1 R20 - R23 Suburban	Daytime	37	42	55	39	55	42
	Evening	35	40	45	36	45	40
	Night	31	36	40	38	36	36
M2 R15 - R19 R25, R26 Rural	Daytime	40	45	50	44	55	45
	Evening	40	45	45	38	45	45
	Night	40	45	40	33	40	40
M3 R5 - R14 Suburban	Daytime	41	46	55	40	50	46
	Evening	36	41	45	35	45	41
	Night	30	35	40	30	40	35
M4 R24- R27 Rural	Daytime	31	36	50	36	50	36
	Evening	31	36	45	34	45	36
	Night	30	35	40	39	34	35
M5 R1 - R4 Rural	Daytime	33	38	50	35	50	38
	Evening	33	38	45	38	45	38
	Night	32	37	40	39	40	37

Note 1: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night 10.00 pm to 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am.

Note 2: Amenity criteria after modification to Acceptable Noise Level (ANL) to account for existing level of industrial noise

5.2 Construction Noise Criteria

The DECC (formerly the Environmental Protection Agency (EPA)) recognises that construction activities could generate higher noise levels than normal operational noises. Section 171 of the EPA Environmental Noise Control Manual (EPA, 1994) provides criteria presented in **Table 5.2** for construction activities.

Table 5.2 – DECC Construction Noise Criteria

Length of Construction Time [1]	Construction Noise Criterion $L_{A10,\ 15\ minute}$ dB(A)
Up to 4 weeks	L_{A90} plus 20 dB
4 to 26 weeks	L_{A90} plus 10 dB
Greater than 26 weeks	L_{A90} plus 5 dB

Note 1: Time restrictions: Monday to Friday 7am to 6pm. Saturday 7am to 1pm. No construction on Sunday or Public Holidays.

Source: Environmental Noise Control Manual (DECC, 1994).

Construction activities for the project are expected to occur over a maximum period of three months, therefore construction criteria for up to 26 weeks apply. Project specific criteria are provided in **Table 5.3**.

Table 5.3 – Construction Noise Criteria at Residential Receivers

Receiver Location	RBL $L_{A90,15minute}$ dB(A) [1]	Construction Noise Criterion $L_{A10,\ 15\ minute}$ dB(A)
M1 (R20 - R23)	37	47
M2 (R15 - R19, R25, R26)	40	50
M3 (R5 - R14)	41	51
M4 (R24, R27)	31	41
M5 (R1 - R4)	33	43

Note 1: Daytime 7.00 am to 6.00 pm

5.3 Sleep Disturbance Noise Goals

The relevant sleep disturbance noise goals for the residential receivers are provided in **Table** 5.4**.**

Table 5.4 – Project-Specific Noise Criteria at Residential Receivers

Receiver Location	RBL $L_{A90,\ 15\ minute}$, dB(A) [1]	Sleep Disturbance Noise Goal $L_{A1,1minute}$,dB(A)
M1 (R20 - R23)	31	46
M2 (R15 - R19,R25, R26)	40	55
M3 (R5 - R14)	30	45
M4 (R24 and R27)	30	45
M5 (R1 - R4)	32	47

Note 1: Measured during the night-time period (10.00 pm to 7.00 am).

5.4 Road Traffic Noise Criteria

A comprehensive traffic assessment was conducted for the proposed operations by B J Bradley & Associates (October 2008) for the proposed operation. The traffic assessment concluded that product transport from Lot 218 will occur via Lavis Lane to the junction of Nelson Bay Road, Cabbage Tree Road and Lavis Lane. From this intersection, the assessment anticipated that 60 per cent of deliveries will travel via Cabbage Tree Road westwards. The remaining 40 per cent of deliveries would be split evenly to northbound and southbound destinations via Nelson Bay Road (B J Bradley & Associates October 2008).

Similarly, the traffic assessment anticipated that product transport from Lot 220 will occur via Oakvale Road to the junction of Nelson Bay Road, Lemon Tree Passage Road and Oakvale Road. From this intersection, the traffic assessment anticipated that 85 per cent of deliveries will travel to the south along Nelson Bay Road onto Richardson Road and/ or Cabbage Tree Road. Ten per cent of deliveries will travel to northbound destinations via Nelson Bay Road and the remaining 5 per cent to Lemon Tree Passage Road (B J Bradley & Associates October 2008).

Road traffic noise criteria are set out in the Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). These criteria are based on the functional categories applied by the RTA to the subject roads.

Nelson Bay Road would be classified as a sub-arterial road. Lavis Lane and Oakvale Road would be classified as collector roads. The relevant road traffic noise criteria for the roads associated with the proposed operations are provided in **Table 5.5**.

Table 5.5 – Road Traffic Noise Criteria

Type of Development	Criteria		Where Criteria are Already Exceeded
	Day [1]	Night [2]	
Land use developments with potential to create additional traffic on existing freeways/arterials	60 dB(A) $L_{Aeq, 15\ hour}$	55 dB(A) $L_{Aeq, 9\ hour}$	Where feasible, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.
Land use developments with potential to create additional traffic on collector road	60 dB(A) $L_{Aeq, 1\ hour}$	55 dB(A) $L_{Aeq, 1\ hour}$	

Note 1: Daytime 7.00 am to 10.00 pm.

Note 2: Night time 10.00 pm to 7.00 am.

6.0 Noise Modelling Methodology

6.1 Noise Modelling

Noise level predictions must take into account all significant noise sources associated with the proposed operations. One method of determining the impact of numerous noise sources at a receiver is to develop a computer model of the proposed operations using a commercially available software package. The model used for this assessment was the Environmental Noise Model (ENM), developed by RTA Technology Pty Ltd. ENM is recognised and accepted by the DECC as a computer modelling program suited to predicting noise impacts from industrial noise sources.

The computer model incorporated identifiable noise source data, meteorological data, surrounding terrain characteristics and the barrier effects of nearby buildings and structures. The model was used to predict the contributed noise levels from the proposed operations at the nearest potentially affected receivers for several operating scenarios.

ENM calculates noise levels at either specified receiver locations (single point calculation) or generates noise level contours over a defined area (contour calculation). The single point calculation feature of ENM was used to assess the noise impacts from the proposed operations for the meteorological conditions described in **Section 6.2**.

6.2 Meteorological Parameters

The noise model was used to predict noise levels under calm atmospheric conditions. The meteorological conditions under which noise predictions were made are given in **Table 6.1**.

Table 6.1 – Meteorological Conditions for Noise Modelling

Scenario	Temperature (^{o}C)	Humidity (%)	Wind Speed (m/s)	Wind Direction (deg from North)	Temperature Gradient (3^{o}C/100 m)
Calm - Daytime	20	65	-	-	-
Calm – Evening	15	80	-	-	-
Calm – Night	10	90	-	-	-

6.3 Operational Noise Sources

The Sound Power Level (SWL) of acoustically significant plant and equipment associated with the proposed operations at Lot 218 and Lot 220 have been sourced from the Umwelt reference database and from data provided by Mackas Sand. This is presented in **Table 6.2**.

Table 6.2 – Plant and Equipment Sound Power Levels

Equipment Description	Operating Condition/Location	Number		Sound Power Level dB(A) re 10^{-12}W
		Lot 218	Lot 220	
Volvo 180F front-end loader (FEL)	At sand processing plant or extraction area	4	4	108 dB(A) each
Vibrating screen	Operating in pit	1	1	113 dB(A)
Volvo A40 six-wheel articulated hauler	Hauling to plant	1	1	92 dB(A)
33-tonne road truck	Hauling	1	1	102 dB(A)
Water cart	Dust suppression	1	1	100 dB(A)
Sand processing plant/processing area	Operating	-	1	102 dB(A)

Note: Equipment models are indicative for modelling purposes only and alternative equivalent equipment may be used.

6.4 Construction Noise Sources

Construction activities will include site preparation, construction of earthworks, construction of the sand processing plant and site facilities, and the construction of access roads to Lot 218 and Lot 220 (refer to **Section 3.4**). The construction phase activities will involve the use of typical machinery and equipment as shown in **Table 6.3**. Construction operations will occur during the hours described in **Section 2.4.4**.

Noise emissions from these activities were incorporated into the ENM noise model to determine potential noise impacts at the nearest residential receivers during the daytime period.

Table 6.3 – Construction Sound Power Levels

Equipment Description	Operating Condition	Number		Sound Power Level dB(A) re 10^{-12}W
		Lot 218	Lot 220	
Bulldozer	Clearing vegetation	-	2	120 dB(A) each
Backhoe	At plant	-	1	108 dB(A)
Concrete truck (delivery)	Hauling	-	1	122 dB(A)
Crawler crane	Lifting	-	1	111 dB(A)
Compressor	Operating	-	1	110 dB(A)
Water cart	Dust suppression	1	1	100 dB(A)

6.5 Modelling Scenarios

The noise model was used to calculate noise emissions from the proposed operations at Lot 218 and Lot 220 for two operational scenarios being Normal Operations and Limited Operations as described below:

Normal Operations for Lot 218 and Lot 220:

- At Lot 218 Normal Operations involve the simultaneous use of up to four front-end loaders, a vibrating screen and a haul truck, seven days per week during daytime, evening and night time periods as detailed in **Table 6.4**. In addition a product truck and water cart will operate at Lot 218 between the hours of 5.00 am and 10.00 pm. Extraction operations will commence at the western edge of the Lot 218 extraction area and will progress in an easterly direction;

- At Lot 220 Normal Operations involve the processing of sand and extraction of sand from areas greater than 250 metres from R27. Equipment used on Lot 220 during Normal Operations will include the simultaneous use of the sand processing plant, up to four front-end loaders, a vibrating screen and a haul truck, seven days per week during daytime, evening and night time periods as detailed in **Table 6.5**. In addition a product truck and water cart will operate at Lot 220 between the hours of 5.00 am and 10.00 pm.

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Table 6.4 – Predictive Noise Modelling Scenarios – Normal Operations, Lot 218

Lot 218 Processing and Extraction	Activity	Operating Period/ Equipment Quantity		
Equipment		Daytime	Evening	Night
Vibrating screen	Screening	1	1	1
Front-end loaders	Face extraction At vibrating screen Loading product truck	4	4	4
Haul truck	Hauling between face and vibrating screen	1	1	1
Water cart	Dust suppression truck movements on unsealed section of access road[1, 2]	1	1	1[1]
Product truck	Laden product truck movements on access road	8/hour	8/hour	8/hour[1]

Notes: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night 10.00 pm to 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am.

1 - operation between 5.00 am and 10.00 pm

2 - dust suppression will be undertaken every three hours

Table 6.5 – Predictive Noise Modelling Scenarios – Normal Operations, Lot 220

Lot 220 Processing and Extraction	Activity	Operating Period/ Equipment Quantity.		
Equipment		Daytime	Evening	Night[3]
Processing plant	Washing and processing sand	1	1	1
Vibrating screen	Screening	1	1	1
Front-end loaders	Processing Plant Extraction Area	2 2	2 2	2 2
Haul truck	Hauling between face to vibrating screen	1	1	1
Water cart	Dust suppression truck movements on unsealed section of access road[1, 2]	1	1	1[1]
Product truck	Laden product truck movements on access road	8/hour	8/hour	8/hour[1]

Notes: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night 10.00 pm to 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am.

1 - operation between 5.00 am and 10.00 pm

2 - dust suppression will be undertaken every three hours

Limited Operations on Lot 220

- Normal Operations at Lot 218 with modifications to operations on Lot 220 as set out in **Table 6.6**. Daytime extraction operations on Lot 220 when within 250 metres of R27 will either have:
  - all extraction equipment (2 front-end loaders, vibrating screen and haul truck) located within 25 metres of the extraction face with the vibrating screen located within 5 metres of the face or behind a localised barrier as required; or
  - extraction being undertaken with only one front-end loader, vibrating screen and haul truck operating.
- There will be no extraction equipment operating within 250 metres of R27 during evening and night time periods under this scenario unless agreement is reached with the landholder.

Table 6.6 – Predictive Noise Modelling Scenarios – Limited Operations, Lot 220 (Daytime)

Lot 220 Processing and Extraction	Activity	Operating Period/Equipment Quantity	
Equipment		Daytime (within 25 m of Face)	Daytime (> 25 m from Face)
Processing Plant	Washing and processing sand	1	1
Vibrating screen	Screening	1[3]	1
Front-end loaders	Processing Plant Extraction Area	2 2	2 1
Haul truck	Hauling between face to vibrating screen	1	1
Water cart	Dust suppression truck movements on unsealed section of access road [1, 2]	1	1[1]
Product truck	Laden product truck movements on access road	8/hour	8/hour[1]

Notes: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night 10.00 pm to 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am.

1 - operation between 5.00 am and 10.00 pm.

2 - dust suppression will be undertaken every three hours.

3 - located within 5 metres of the face, or in conjunction with a localised barrier as required.

The ENM noise model is considered to provide conservative estimates of noise impacts as the equipment used in extraction operations has been modelled at locations to represent the maximum potential impact on the nearest residential receivers.

The assumptions used in modelling the operational phase of the proposed development include the following:

- all acoustically significant plant and equipment operates simultaneously in accordance with the extraction and operation schedule outlined in **Section 2.4.4** and **Section 6.5.**
- mobile noise sources, such as front-end loaders, trucks and haul trucks, were modelled at typical locations and assumed to operate in repetitive cycles.

6.6 Road Traffic Noise

Traffic predictions for the proposed operations were made based on the traffic assessment undertaken by B J Bradley & Associates (October 2008). Traffic noise predictions have been undertaken based on a maximum of sixteen (16) truck movements per hour (two ways) with an average of twelve (12) truck movements (two ways) per hour along Oakvale Road and Lavis Lane. These trucks will progress onto Nelson Bay Road and Cabbage Tree Road.

Road traffic noise predictions were made using the following assumptions:

- maximum sand extraction of 1,000,000 tonnes from each site;
- average truck capacity of 33 tonnes per load;

- continuous operations at each site 24 hours a day, 7 days per week;
- closure of each site for 1 week over the Christmas period; and
- product transport activities would occur between 5.00 am and 10.00 pm.

A road traffic noise assessment was undertaken using the United States Federal Highway Administration (USFHWA) L_{Aeq} calculation method (reference) (US EPA Report 550/9-74-004, (March 1974) as modified. Based on equations in Appendix A-13 & CoRTN amendments).

7.0 Noise Predictions

7.1 Predicted Operational Noise Levels

Under normal operating conditions the proposed extraction operations at Lot 218 will occur 24 hours a day, 7 days per week. Operations at Lot 220 will typically occur 5 days per week between 7.00 am and 6.00 pm, with operation of the sand processing plant and extraction operations potentially occurring 24 hours a day, 7 days a week depending on demand for sand products. Product transport on private haul roads will occur between 5.00 am and 10.00 pm.

The ENM Single Point Calculation model was used to determine noise levels at the nearest residential receiver locations under the meteorological conditions described in **Section 6.3**. The Single Point Calculation results for the proposed operational scenarios described in **Section 6.5** are presented in **Table 7.1** and **Table 7.3** and are compared to the respective PSNLs.

Table 7.1 – Predicted Operational Noise Levels
Normal Operations Lot 218 and Lot 220

Receiver ID	Daytime Calm		Evening Calm		Night Calm	
	Predicted Level	PSNL $L_{Aeq, 15\ minute}$	Predicted Level	PSNL $L_{Aeq, 15\ minute}$	Predicted Level	PSNL $L_{Aeq, 15\ minute}$
R1 [1]	39	38	39	38	39	37
R2 [1]	30	38	30	38	31	37
R3	< 30	38	< 30	38	< 30	37
R4	< 30	38	< 30	38	< 30	37
R5	< 30	46	< 30	41	< 30	35
R6	< 30	46	< 30	41	< 30	35
R7	< 30	46	< 30	41	< 30	35
R8	< 30	46	< 30	41	< 30	35
R9	< 30	46	< 30	41	< 30	35
R10	< 30	46	< 30	41	< 30	35
R11	< 30	46	< 30	41	< 30	35
R12	32	46	32	41	33	35
R13	34	46	34	41	35	35
R14	32	46	32	41	33	35
R15	34	45	34	45	35	40
R16	33	45	33	45	34	40
R17	35	45	35	45	36	40
R18	39	45	39	45	40	40
R19	36	45	36	45	37	40
R20	31	42	31	40	32	36
R21	31	42	32	40	32	36
R22	< 30	42	< 30	40	30	36

**Table 7.2 – Predicted Operational Noise Levels
Normal Operations Lot 218 and Lot 220 (cont)**

Receiver ID	Daytime Calm		Evening Calm		Night Calm	
	Predicted Level	PSNL $L_{Aeq, 15\ minute}$	Predicted Level	PSNL $L_{Aeq, 15\ minute}$	Predicted Level	PSNL $L_{Aeq, 15\ minute}$
R23	< 30	42	< 30	40	< 30	36
R24	30	36	< 30	36	31	35
R25 [1, 2]	44	36	44	36	44	35
R26	36	36	36	36	35	35
R27	32	36	32	36	32	35

Note 1: Building uninhabitable

Note 2: Building owned by the proponent

Noise levels from the proposed normal operations scenario are predicted to meet the criteria at all residential receiver locations during all operating periods.

**Table 7.3 – Predicted Operational Noise Levels
Normal Operations Lot 218 and Limited Operations Lot 220**

Receiver ID	Daytime Calm		Evening Calm		Night Calm	
	Predicted Level	PSNL $L_{Aeq, 15\ minute}$	Predicted Level	PSNL $L_{Aeq, 15\ minute}$	Predicted Level	PSNL $L_{Aeq, 15\ minute}$
R1 [1]	39	38	39	38	39	37
R2 [1]	30	38	30	38	31	37
R3	< 30	38	< 30	38	< 30	37
R4	< 30	38	< 30	38	< 30	37
R5	< 30	46	< 30	41	< 30	35
R6	< 30	46	< 30	41	< 30	35
R7	< 30	46	< 30	41	< 30	35
R8	< 30	46	< 30	41	< 30	35
R9	< 30	46	< 30	41	< 30	35
R10	< 30	46	< 30	41	< 30	35
R11	< 30	46	< 30	41	32	35
R12	33	46	32	41	33	35
R13	34	46	34	41	35	35
R14	32	46	32	41	33	35
R15	34	45	34	45	35	40
R16	33	45	33	45	34	40
R17	35	45	35	45	36	40
R18	39	45	39	45	40	40
R19	36	45	36	45	37	40
R20	31	42	31	40	32	36
R21	31	42	32	40	32	36

Table 7.4 – Predicted Operational Noise Levels
Normal Operations Lot 218 and Limited Operations Lot 220 (cont)

Receiver ID	Daytime Calm		Evening Calm		Night Calm	
	Predicted Level	PSNL $L_{Aeq, 15\ minute}$	Predicted Level	PSNL $L_{Aeq, 15\ minute}$	Predicted Level	PSNL $L_{Aeq, 15\ minute}$
R22	< 30	42	< 30	40	< 30	36
R23	< 30	42	< 30	40	< 30	36
R24	30	36	< 30	36	31	35
R25 [1, 2]	44	36	44	36	44	35
R26	36	36	36	36	35	35
R27 (equipment > 25 m from face)	35	36	N/A	N/A	N/A	N/A
R27 (equipment within 25 m of face)	36	36	N/A	N/A	N/A	N/A

Note 1: Building uninhabitable

Note 2: Building owned by the proponent

Noise levels from the proposed operation during all operating periods are predicted to meet the criteria at all residential receiver locations based on the operational scenarios described in **Section 6.5**.

The limited operation scenario for Lot 220 relates to daytime operations only within 250 metres of Receiver R27. There will be no night time extraction operations within 250 metres of R27 unless an agreement is reached with the landholder. Noise modelling within this zone has shown that the operation of two front-end loaders, the articulated haul truck and the vibrating screen, with a localised barrier, all within 25 metres of the extraction face would produce the same noise level at R27 as one front-end loader, the vibrating screen and articulated haul truck when located greater than 25 metres from the face, but within 250 metres of R27. This is due to the additional topographical shielding provided when working closer to the extraction face.

7.2 Construction Noise Levels

The Single Point Calculation model was used to determine noise levels at the nearest residential receiver locations for the representative construction phase activities under calm daytime conditions. The predicted $L_{A10, 15\ minute}$ construction noise levels are presented in **Table 7.5** and are compared to the relevant construction noise criteria.

Table 7.5 – Predicted Construction Noise Levels for Mackas Sand

Receiver ID	Predicted Construction Noise Levels, $L_{A10,\ 15\ minute}$ dB(A)	Construction Noise Criteria, $L_{A10,\ 15\ minute}$ dB(A)
R1	< 30	51
R2	< 30	51
R3	< 30	51
R4	< 30	51
R5	< 30	51
R6	< 30	51
R7	< 30	51
R8	< 30	43
R9	< 30	43
R10	< 30	43
R11	< 30	43
R12	< 30	51
R13	30	51
R14	< 30	51
R15	< 30	50
R16	< 30	50
R17	< 30	50
R18	< 30	50
R19	< 30	50
R20	< 30	50
R21	< 30	50
R22	< 30	47
R23	< 30	47
R24	< 30	41
R25	< 30	47
R26	< 30	47
R27	41	41

The results presented in **Table 7.5** indicate that construction noise levels are predicted to comply with the DECC's construction noise criteria at all residential receiver locations.

7.3 Sleep Disturbance

In assessing sleep disturbance, typical L_{Amax} noise levels experienced at the nearest residential receivers would be within 5 dB of the predicted L_{Aeq} noise levels. Therefore it is expected that the $L_{A1,\ 1\ minute}$ noise levels would be less than 41 dB(A) $L_{A1,\ 1\ minute}$ at all residential receivers. Therefore the predicted noise levels meet the recommended sleep disturbance noise goals outlined in **Table 5.3** at all residences.

7.4 Road Traffic Noise Assessment

7.4.1 Arterial and Sub–Arterial Roads

The projected additional 16 heavy vehicle movements per hour generated by the development in terms of noise emissions equates to a minor increase of heavy vehicle traffic along Nelson Bay Road and Cabbage Tree Road. This increase in heavy vehicle road traffic is predicted to increase road traffic noise by 0.2 dB at receivers along the road alignment.

Road traffic noise predictions indicate that the increase in heavy vehicle traffic will not significantly increase existing road traffic noise levels at the nearest potentially affected residential locations along arterial and sub-arterial roads.

7.4.2 Collector and Local Roads

Predictions of road traffic noise for the heavy vehicle traffic generated by the proposed operations were made at the nearest residential receivers along Lavis Lane and Oakvale Road. The results of these predictions are presented in **Table 7.6** for peak and average traffic movements.

Table 7.6 – Predicted Road Traffic Noise

Receiver Location	Distance from Road Edge (metres)	Project Related Road Traffic – Peak $L_{Aeq,\ 1\ hour}$	Project Related Road Traffic – Average $L_{Aeq,\ 1\ hour}$	Criteria
Lavis Lane	21	54.9 dB(A)	53.6 dB(A)	55 dB(A) $L_{Aeq,\ 1\ hour}$
Oakvale Road	25	54.9 dB(A)	53.7 dB(A)	55 dB(A) $L_{Aeq,\ 1\ hour}$

Heavy vehicle road traffic noise levels from the proposed operations are predicted to meet the relevant criteria at the nearest potentially affected residential receiver locations along Oakvale Road and Lavis Lane.

7.5 Noise Management Plan

Where noise levels exceed the required criteria or goals, the following strategies to reduce the noise impact on offsite receivers from should be considered.

The three main strategies for noise control are:

- **controlling noise at the source** – There are three approaches to controlling noise generated by the source: Source elimination; Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA).
- **controlling the transmission of noise** – There are two approaches: the use of barriers and land-use controls which attenuate noise by increasing the distance between source and receiver.
- **controlling noise at the receiver** – There are two approaches: negotiating an agreement with the landholder or acoustic treatment of dwellings to control noise.

The following strategies to reduce the noise impact from extraction activities within the zone 250 metres from R27 were considered.

- Alternative or quieter equipment:
    - the SWL of the Volvo 180F front-end loader and Volvo articulated haul truck are similar to that of other manufacturers and is considered to be BATEA;
- The establishment of an acoustic bund near R27 to provide additional topographical shield after year 5 of operation was modelled. The bund provided a negligible reduction in noise at R27 of less than 0.5 dB, and therefore was not considered suitable for mitigating noise impacts at this residence after year 5 of operation.

As a result of the predicted noise levels from these strategies, consideration of other noise management strategies during the daytime period for limited operations was modelled. The results of this modelling has shown that two possible operating scenarios could be utilised without exceeding the PSNL at Receiver R27 as shown in **Table 6.6**.

In consideration of the accuracy of noise modelling, typically being within ± 2 dB, and the proximity of Receiver R27 to extractive operations and that the predicted noise levels are not significantly below the PSNLs**,** an operational Noise Management Plan (NMP) to effectively manage off site noise emissions will be implemented to ensure compliance with the PSNLs.

8.0 Summary of Findings and Recommendations

Umwelt has undertaken a Noise Impact Assessment for the project in the context of operating in compliance with the relevant criteria and requirements of the INP and the DECC.

8.1 Operational Noise

The Noise Impact Assessment for operations at Lot 218 indicates that under calm meteorological conditions the proposed operations can achieve the project-specific noise levels for all operating periods at all residential receivers nearest to the study area.

In regard to operations at Lot 220, the assessment indicates that the proposed operations can achieve the project specific noise goals during all operating periods at all receivers by limiting extractive operations when within 250 metres of R27 during daytime to either having all extraction equipment operating within 25 metres of the extraction face or only use one rather than two front-end loaders for extraction. This limited mode of operation will only be undertaken during the daytime period. There will be no extraction activities within 250 metres of R27 during evening and night time periods unless an agreement is reached with the landholder.

8.1.1 Construction Noise

Construction noise levels will not result in any discernable impact on surrounding receivers as predicted noise levels comply with the DECC's construction noise criteria at all residential receiver locations.

8.1.2 Sleep Disturbance

Predicted noise levels are expected to be less than 41 dB(A) $L_{A1,\ 1\ minute}$, therefore complying with the recommended sleep disturbance noise goals at all residential receivers.

8.1.3 Road Traffic Noise

Heavy vehicle road traffic noise from the proposed operations is predicted to meet the relevant criteria at the nearest potentially affected residential receiver locations along the proposed transport routes.

8.2 Recommendations

8.2.1 Noise Monitoring Program

It is recommended that an operational noise monitoring program be developed to monitor noise emissions from the proposed operations to determine ongoing compliance with PSNLs and to identify any further feasible noise mitigation measures that can be implemented particularly when extractive operations are within 250 metres of R27.

The monitoring program should be implemented upon commencement of operations during periods of maximum production with the objective of confirming the acoustic performance of the proposed operations. Further monitoring would be undertaken as a result of any complaints received by Mackas Sand during the life of the proposed operations.

8.2.2 Noise Management Plan

It is recommended that an operational NMP be developed to specifically address the potential for noise impacts associated with the proposed operations at receiver R27 during the daytime period when extraction operations are within 250 metres of the residence.

The NMP should outline methods and procedures to manage the following:

- implementation, analysis and reporting of results from a regular noise monitoring program on-site and within the surrounding area;
- noise management measures and operating procedures to ensure compliance with noise goals;
- development of acoustic specifications for plant and equipment;
- regular noise level checks on mobile equipment; and
- response to any complaints or issues raised by the owner of the affected residence.

Noise monitoring data from the early stages of extraction activities in Lot 220 should be utilised to calibrate an operational specific noise model which could then be used to further refine the potential for noise impacts when equipment is located within 250 metres of R27.

The ability to monitor noise emissions during the early operating scenario where noise levels are predicted to comply with the criteria will enable pro-active noise management methods and suitable noise mitigation methods to be implemented prior to the commencement of the Limited Operation scenario for extraction operations within 250 metres of R27.

8.2.3 Responsibility

It is recommended that the Mackas Sand operations manager be assigned responsibility for implementing the NMP. This includes assessing the proposed operation's compliance with the noise goals listed in **Section 5.**

8.2.4 Reporting

The results of the noise monitoring program should be reviewed by the Mackas Sand operations manager to assess compliance with the goals outlined in **Section 5** and reported in accordance with any requirements of the development consent and/or Environment Protection Licence required for the project under the PoEO Act.

9.0 References

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ATTACHMENT 1

Glossary and Abbreviations

Attachment 1 – Glossary and Abbreviations

1/3 Octave	Single octave bands divided into three parts.
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment background level - A single-figure background level representing each assessment period – day, evening and night (that is, three assessment background levels are determined for each 24-h period of the monitoring period). It is determined by taking the lowest 10th percentile of the L_{90} level for each assessment period.
Airblast	Sound wave from blasting (overpressure).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dB(A), dBA	Decibels A-weighted.
dB(L), dB(Lin)	Decibels Linear or decibels Z-weighted.
Decibel (dB)	The units of sound level and noise exposure measurement where a step of 10 dB is a ten-fold increase in intensity or sound energy and actually sounds a little more than twice as loud.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second – 1 oscillation per second equals 1 hertz.
L_{A10}	The percentile sound pressure level exceeded for 10% of the measurement period with 'A' frequency weighting calculated by statistical analysis. Typically used to assess the impact of an existing operation on a receiver area and is referred to as the cumulative noise levels at the receiver attributable to the noise source.
L_{A90}	Background Noise Level. The percentile sound pressure level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis.
L_{Amax}	The maximum of the sound pressure levels recorded over an interval of 1 second.
$L_{A1,1minute}$	The measure of the short duration high-level noises that cause sleep arousal. The noise level is measured as the percentile sound pressure level that is exceeded 1 per cent of measurement period with 'A' frequency weighting calculated by statistical analysis during a measurement time interval of 1 minute.
$L_{Aeq,t}$	Equivalent continuous sound pressure level - The value of the sound pressure level of a continuous steady noise that, a measurement interval of time (t), has the same mean square sound pressure as the sound under consideration whose level varies with time. Usually measured in dB with 'A' weighting.
L_{An}	Percentile level - A measure of the fluctuation of the sound pressure level which is exceeded ‘n’ per cent of the observation time.
MIC	Maximum explosive charge mass (kg) detonated per delay (any 8ms interval).
PVS (mm/s)	Peak Vector Sum.

Attachment 1 – Glossary and Abbreviations (cont)

PVV (mm/s)	Peak Particle Velocity.
RBL	Rating background level - The overall single figure background level representing each assessment period over the whole monitoring period determined by taking the median of the ABLs found for each assessment period.
SD (m)	The scaled distance for airblast and ground vibration from the charge to the receiver.
SPL (dBL)	Blasting: peak airblast level measured in dB Linear.
SPL (dBA)	Noise: Sound pressure level - The basic measure of noise loudness. The level of the root-mean-square sound pressure in decibels given by: $SPL = 10.\log10\ (p/po)^2$ where p is the rms sound pressure in pascals and po is the sound reference pressure at 20 μPa.
SWL	Sound power level - A measure of the energy emitted from a source as sound and is given by: $SWL = 10.\log10\ (W/W_o)$ where W is the sound power in watts and W_o is the sound reference power at 10^{12} watts.