Annex J – Noise Impact Assessment

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Tattersall Lander PTY LTD

Bobs Farm Sand Mine

Noise Impact Assessment

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Report Title: Noise Impact Assessment **Job Title: Bobs Farm Sand Mine**	
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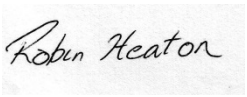
AUTHORISED BY:	 Robin Heaton **Project Engineer**	Date: 09 Jun 2015

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EXECUTIVE SUMMARY

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Tattersall Lander Pty Ltd to conduct a noise impact assessment of the proposed Sand Mine located on Deposited Plans DP753204 (40.9ha) and DP1015671 (6.63ha) with associated land at DP1071458 (2.53ha), Bob's Farm NSW. The location of the proposed development site is illustrated in ***Figure 1***.

The site is located in Bob's Farm approximately 27 km north-east of Newcastle and approximately 14 km south-west of Nelsons Bay. The site is bounded to the south by Nelson Bay Road and to the north by Marsh Road.

The Bobs Farm Sand Project comprises:

- The establishment of a quarry to extract and process sand at a rate of approximately 750,000 tonnes per annum, from a total sand resource of approximately 8-10 million tonnes. The estimated life of the extraction process is 13 years;
- The construction of extractive materials processing and transport infrastructure;
- The transportation of extractive materials off-site via roads; and
- The rehabilitation of the site.

Sand will be extracted from the site by two main mining methods:

- Dry mining utilising excavator and haul trucks to remove dry sand products from the pit areas above the water table for processing prior to export, and
- Wet mining utilising a dredge and pump line system to pump wet raw sand materials for processing prior to export.

SAND MINE OPERATIONS (OPERATIONAL NOISE ASSESSMENT) - DAYTIME OPERATIONS

Vipac has assessed the potential operational phase noise impacts on the 25 identified receivers surrounding the proposed Sand Mine for each of the first four years of operation down to the maximum pit depth. From operational Year 1 receivers R1-R3, R5, R7 are predicted to exceed the noise criteria for worst-case conditions. These exceedances are attributed to the operation of the export lorries along the private haul road. To mitigate these exceedances Vipac proposes a 4m high acoustic barrier along both sides of the haul road at the Marsh Road exit, with the eastern barrier to be an absorbent barrier. Additionally a 6m high noise bund is proposed to run the length of the western boundary of the sand mine, along the northern boundary and down to join the 4m noise barrier at Marsh Road to mitigate the noise levels for receivers R1, R13 – R17. With the implementation of these barriers the predicted noise levels at R1-R3, R5, and R7 are compliant with the daytime noise criteria.

Additionally the results of the noise modelling also show that there are exceedances predicted at R13- R16 for Year 1, 2 & 3 operations under worst case conditions in the west end of the mine operation. To mitigate these noise levels Vipac proposes a 4m high bund around the processing area in conjunction with the 6m high bund around the pit of the Sand Mine as outlined above. These noise mitigation measures will reduce the noise levels to below the criteria for Year 1 and 2. During Year 3 Operational scenario a 1dB exceedance of the noise criteria is still predicted for receivers R14-R16 for this scenario, although this is not considered to be a significant impact, and this impact will only be for a short period before the pit progresses to a lower level beneath sea level.

Vipac has also conducted noise modelling to assess the impact to the receivers for the proposed peak of 200 export lorries utilising the private haul road during peak production. The results show that with the above proposed mitigation measures in place, the peak 200 trucks are predicted to comply with the criteria at all receiver locations for both neutral and worst-case conditions with the exception R2 & R3 during worst-case conditions. Vipac has conducted additional noise modelling to assess the maximum number of export lorries permissible to utilise the private haul road under worst-case weather conditions and comply with the noise criteria at R2 & R3 and found the maximum number of lorries to be 150 lorries.

SAND MINE OPERATIONS (OPERATIONAL NOISE ASSESSMENT) - NIGHT TIME OPERATIONS

Noise modelling was conducted to assess the night-time operations (6am-7am) for the proposed Sand Mine and there are exceedances predicted at receivers at R1 on the eastern end of the Sand Mine and R2-R7 & R20-R24 at the Marsh Road exit of the haul road. These exceedances are attributed to the operation of the haul road accessing the Sand Mine from Marsh road and export lorries on the road. Vipac again has conducted modelling to ascertain the maximum number of trucks permissible in this night-time period (6am-7am) without exceeding the noise criteria at this point and the predicted maximum number of trucks on the haul road is a single truck.

Noise prediction modelling has been carried out to assess the potential sleep disturbance impact associated with the proposed Sand Mine on the existing noise environment at the nearest noise sensitive receptors located in proximity to the site during the night period.

The predicted noise impact associated with the proposed development of the Sand Mine on the noise sensitive receivers range between 34 to 63dB(A) at the façade of the noise sensitive receptors. The predicted noise levels are raised above the sleep disturbance criteria during the Sand Mine operations at receivers R1, R5, R7,R14, R15, R20 and R21. The exceedances range from 1dB exceedance to 7dB. The Marsh Road receivers at the exit of the Haul Road are the most effected experiencing exceedances of 4-7dBA during the operation of the Sand Mine.

Due to the predicted exceedances of the sleep disturbance criteria at receivers R1, R5, R7, R14, R15, R20 & R21 and the exceedance of the operational L_{Aeq} criteria for any more than a single truck at the Marsh Road exit of the Sand Mine site during the night-time period of 6am-7am it is not recommended for the mine to operate during this period.

TRAFFIC NOISE ASSESSMENT

Noise modelling has also been undertaken to assess the potential noise impacts associated with the additional vehicle movements Nelson Bay Road and the eastern end of Marsh Road. The noise model has taken into account all the sources (Nelson Bay Road and Marsh Road) associated with traffic that will be generated by the proposed Sand Mine as outlined in ***Section 6.3*** to determine the cumulative noise levels in the area. As Receivers 9-15 are situated along Marsh Road where no additional traffic flow is proposed to be generated by the Sand Mine they have not been assessed as part of the traffic noise impact assessment.

Additionally as night-time operations are not recommended due to the exceedances of the noise criteria as outlined in ***Section 7.1*** and ***Section 7.2***, no traffic noise modelling has been conducted for the night-time period (6am-7am).

As seen from ***Tables 23 to 27*** there is an acceptable increase in the predicted traffic noise at all locations for Years 1 to 4 with the maximum increase being 0.9 dB.

Modelling was also conducted for the peak lorries outlined in the Seca Traffic Impact Assessment of 200 lorries and the maximum increase is predicted to be an increase of 1.6dB at receiver R22, located at 781 Marsh Road. As these increases in traffic noise levels are within +2dB of the existing road traffic noise levels at the sensitive receivers, the increase in traffic volumes on Marsh Road and Nelson Bay Road are deemed to be acceptable.

Although the peak number of 200 export lorries is acceptable along Nelson Bay Road and Marsh Road, the maximum number of lorries permitted to utilise the private haul road remains 150 for the worst-case weather conditions, as outlined in ***Section 7.1***.

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1 INTRODUCTION

Vipac Engineers and Scientists Ltd (Vipac) was commissioned by Tattersall Lander Pty Ltd to conduct a noise impact assessment of the proposed Sand Farm located on Deposited Plans DP753204 (40.9ha) and DP1015671 (6.63ha) with associated land at DP1071458 (2.53ha), Bob's Farm NSW. The location of the proposed development site is illustrated in ***Figure 1***.

2 GLOSSARY OF TERMS

A list of commonly used acoustical terms (and their definition) used in this report is provided below in ***Table 1***, as an aid to readers of the report.

Table 1: Definition of Acoustical Terms

Term	Definition
$L_{eq,1hr}$	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event, has the same amount of acoustic energy as the given event for the period of one hour.
$L_{A10,1\ hr}$	The noise level, which is equalled or exceeded for 10% of the measurement period of one hour.
$L_{A90,T}$	The noise level, which is equalled or exceeded for 90% of a given measurement period, T. $L_{A90,T}$ is used in Australia as the descriptor for background noise.
$L_{Aeq,T}$	The equivalent continuous A-weighted sound pressure level that has the same mean square pressure level as a sound that varies over time, for a given time period. It can be considered as the average sound pressure level over the measurement period and is commonly used as a descriptor for ambient noise.
L_n	The Sound Pressure levels that is equalled or exceeded for n% of the interval time period. Commonly used noise intervals are L_1, L_{10}, L_{90} and L_{99}%
$L_{A10,18hrs}$	The L_{10} noise level for the time period extending from 6am to midnight.

3 PROJECT DESCRIPTION

3.1 SITE LOCATION

The Bobs Farm site deposit is situated on the northern end of the Stockton Bight Dunal system, approximately 200 km north of Sydney, near Bobs Farm, NSW. The surrounding area is predominately zoned as rural with minimal primary production.

The site is located in Bob's Farm approximately 27 km north-east of Newcastle and approximately 14 km south-west of Nelsons Bay. The site is bounded to the south by Nelson Bay Road and to the north by Marsh Road.

3.2 PROPOSED OPERATIONS

The Bobs Farm Sand Project comprises:

- The establishment of a quarry to extract and process sand at a rate of approximately 750,000 tonnes per annum, from a total sand resource of approximately 8-10 million tonnes. The estimated life of the extraction process is 13 years;
- The construction of extractive materials processing and transport infrastructure;
- The transportation of extractive materials off-site via roads; and
- The rehabilitation of the site.

Sand will be extracted from the site by two main mining methods:

- Dry mining utilising excavator and haul trucks to remove dry sand products from the pit areas above the water table for processing prior to export, and
- Wet mining utilising a dredge and pump line system to pump wet raw sand materials for processing prior to export.

A graphical display of the Deposited Plan is presented below in ***Figure 1*** also showing the outline of the mine boundary.

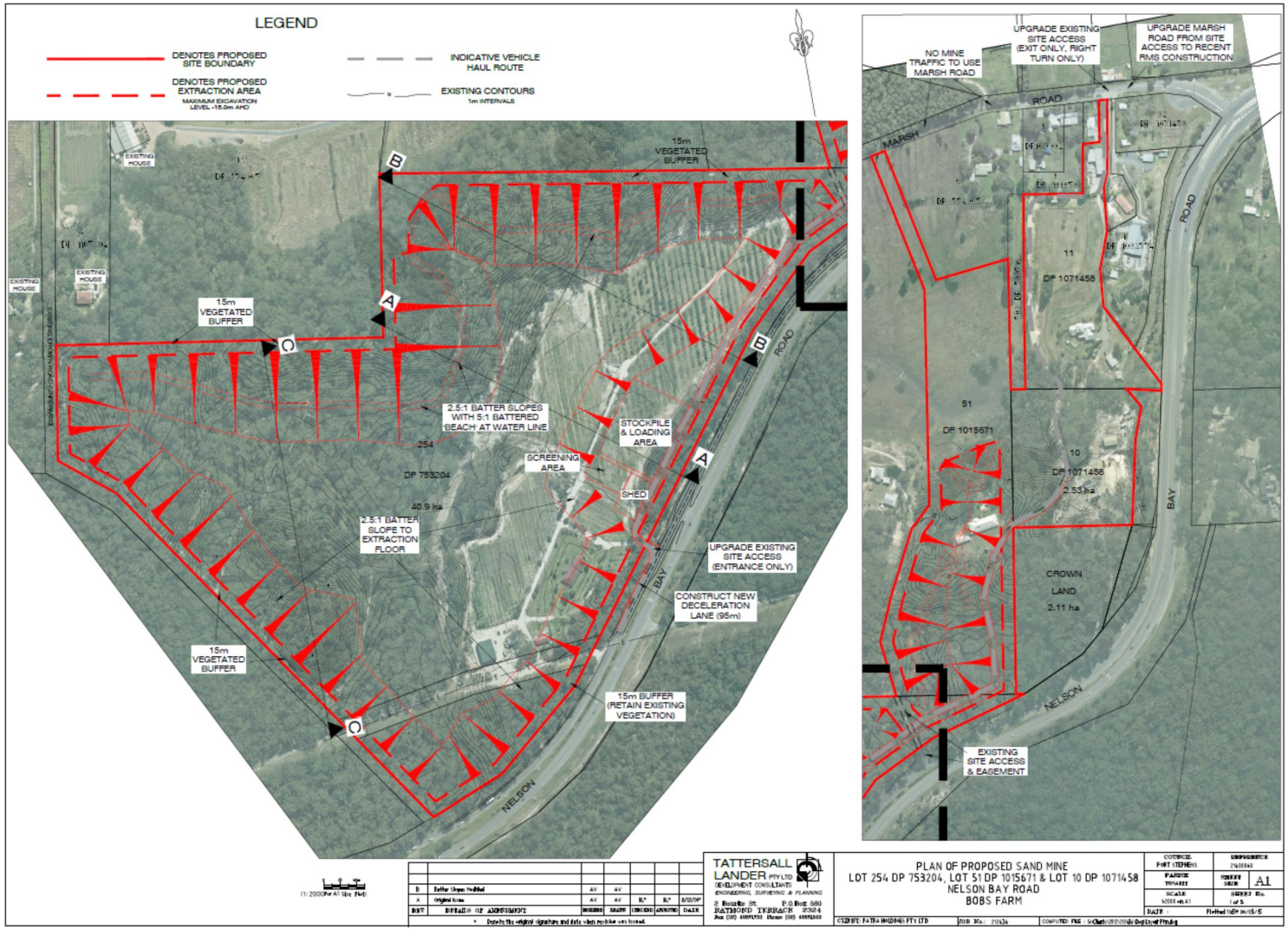

Figure 1: Site Location – Deposited Plans

An overview of the developmental stages during the Project life is provided in ***Table 2***. A cross-section of the proposed Sand Mine presents the extent of each production stage in relation to the water table (between the blue and green lines), as shown in ***Figure 2***.

Table 2: Overview of Proposed Operations

Stage	Operational Year	Annual Throughput (tonnes)	Method	Location in Relation to Water Table
Initial Stage	Year 1	150,000	Stripping of topsoil & dry mining (Stripping Phase)	Above (***Figure 2***)
Production Stage 1	Year 2	250,000	Dry mining Construction Stage and Year 1 Extraction/Production)	Above (***Figure 2***)
Production Stage 2	Year 3	450,000	Dry mining (Initial Extraction Stage down to Water Table)	Above and below (***Figure 2***)
Production Stage 3	Years 4 - 13	700,000	Wet production (Final Extraction – production below the water table down to a depth of -15m below the water table)	Below (***Figure 2***)

The main activities of the Project will be the bulk handling of sand material, utilising mobile plant, general truck movements for the transport of the material to the plant where the sand is screened and washed before being de-watered and stockpiled. The final product will be transported, when necessary from site using trucks.

Entrance to the proposed sand mine will be via a left hand turn off Nelson Bay road to the south of the site entering into a sales area where road lorries will fill be filled by two sales loaders.

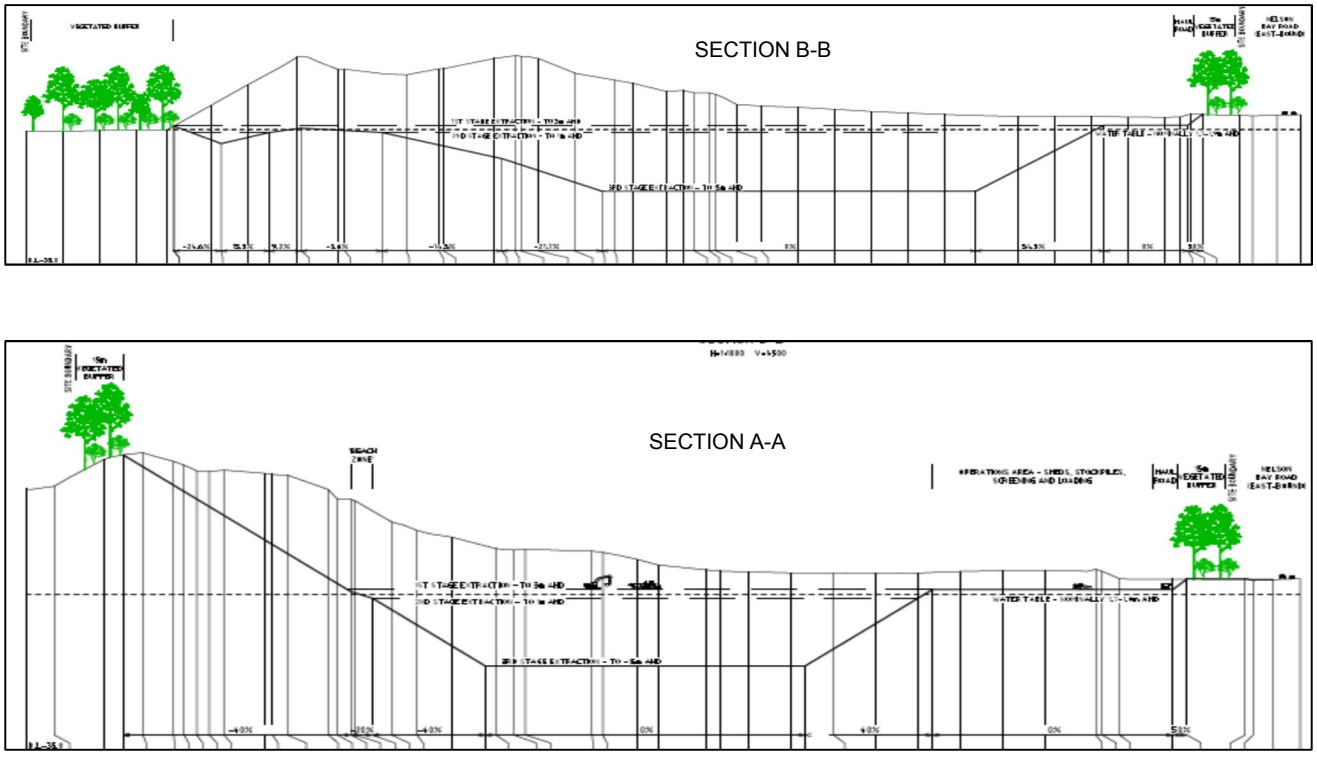

Figure 2: Production Stages (Section B-B and Section A-A) [Tattersall Lander]

3.3 OPERATIONAL HOURS

During construction of the proposed Sand Mine the proposed operating hours will be for 10 hours per day from 07:00 to 17:00.

During initial operation of the proposed Sand Mine the operating hours will commence as a single shift of 10 hours, from 06:00 – 16:00, with provision for an additional 10 hour shift if production and or sales demands require it. Production is based upon 11 months per year, 19 days per month and 8 hours per day.

Operational hours for both extraction, loading of vehicles and transportation of material are proposed to be Monday to Saturday – 06:00 to 18:00 only.

3.4 EQUIPMENT

The proposed equipment for the Project will comprise of core mobile plant which will change in quantity to reflect the product throughput and ancillary equipment. The proposed equipment includes:

- Excavators;
- Articulated dump truck (44 tonne capacity);
- Front end loaders;
- Conveyor;
- Screens and hoppers;
- Wash / recovery plant;
- Dredge (stage 3 only); and
- Road trucks.

The proposed concept design is provided below in ***Figure 3.***

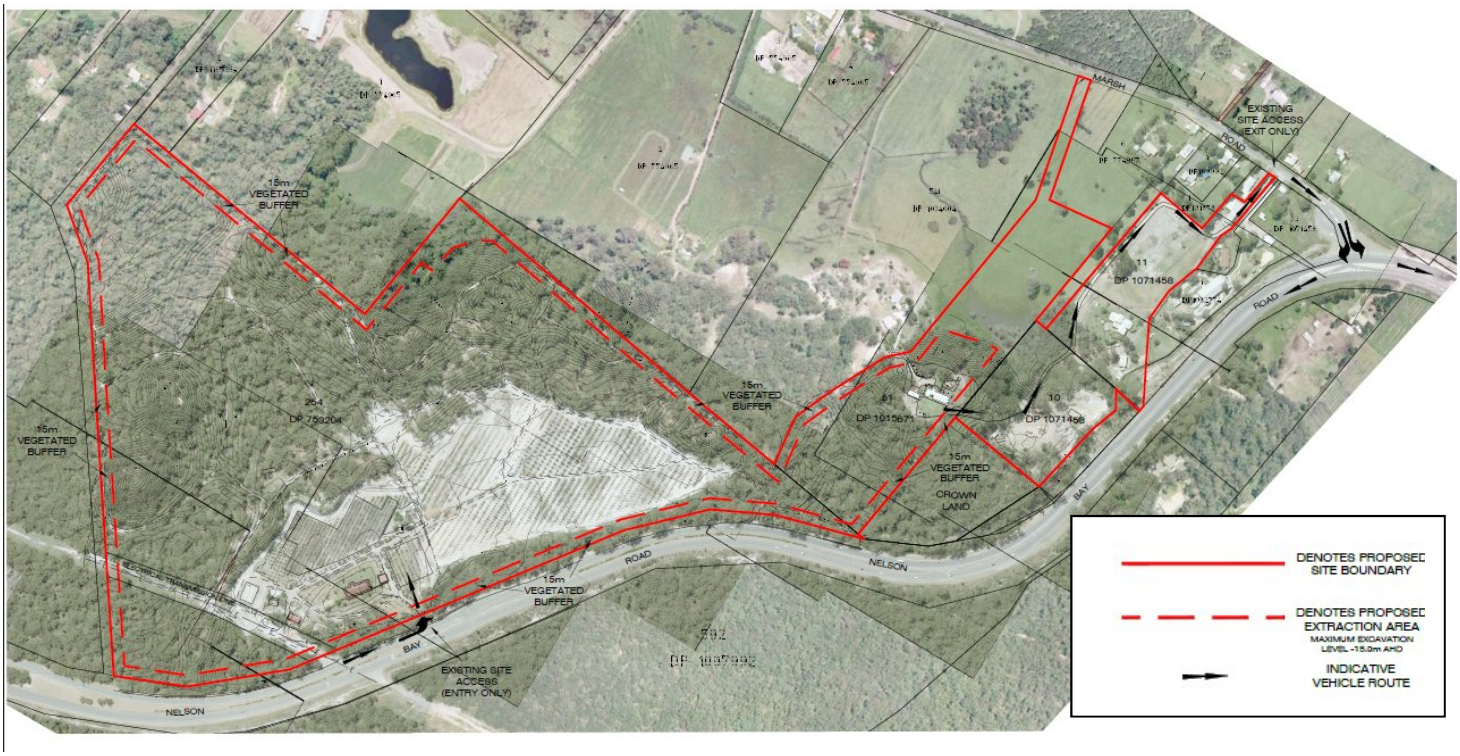

Figure 3: Proposed Mine Design and Configuration

3.5 NOISE SENSITIVE RECEIVERS

The closest dwellings to the site are located approximately 10m to west of the Haul Road at the exit end of the haul road at Marsh Road, approximately 45m to the north-west of the site boundary at the eastern end of the proposed extraction area and approximately 53m to the west of the site boundary at the western end of the extraction area of the proposed mine. The sensitive receptors considered in this assessment are presented in ***Table 3*** below and illustrated in ***Figure 4 and Figure 5.***

Table 3: Noise Sensitive Receptors

Reference	Description	Distance from Site Boundary (approx.)	UTM Coordinates	
			Easting	Northing
R1	724 Marsh Road - Residential	45m	407080	6373782
R2	776 Marsh Road - Residential	10m	407432	6374056
R3	772 Marsh Road - Residential	10m	407410	6374157
R4	764 Marsh Road (Marsh Road Public School)	8m	407377	6374169
R5	762 Marsh Road - Residential	30m	407313	6374153
R6	760 Marsh Road (Marsh Road Public Hall)	95m	407306	6374183
R7	756 Marsh Road - Residential	65m	407270	6374128
R8	710 & 712 Marsh Road - Residential	500m	406822	6374040
R9	698 Marsh Road - Residential	160m	406807	6373689
R10	666 Marsh Road - Residential	330m	406409	6373926
R11	650 Marsh Road - Residential	365m	406345	6373915
R12	686 Marsh Road (Shark and Ray Centre)	240m	406209	6373694
R13	644 Marsh Road - Residential	53m	406123	6373508
R14	640 Marsh Road - Residential	103m	406016	6373514
R15	630 Marsh Road - Residential	154m	405912	6373456
R16	3551 Nelson Bay Road - Residential	485m	405906	6373182
R17	3515 Nelson Bay Road - Residential	235m	405758	6372941
R18	723 Marsh Road - Residential	650m	406868	6374185
R19	731 Marsh Road - Residential	500m	407003	6374232
R20	761 Marsh Road - Residential	150m	407322	6374277
R21	767 Marsh Road - Residential	100m	407385	6374280
R22	781 Marsh Road - Residential	80m	407503	6374223
R23	3780 Nelson Bay Road - Residential	215m	407631	6374081
R24	3724 Nelson Bay Road - Residential	180m	407629	6373758
R25	3790 Nelson Bay Road - Residential	300m	407547	6373678

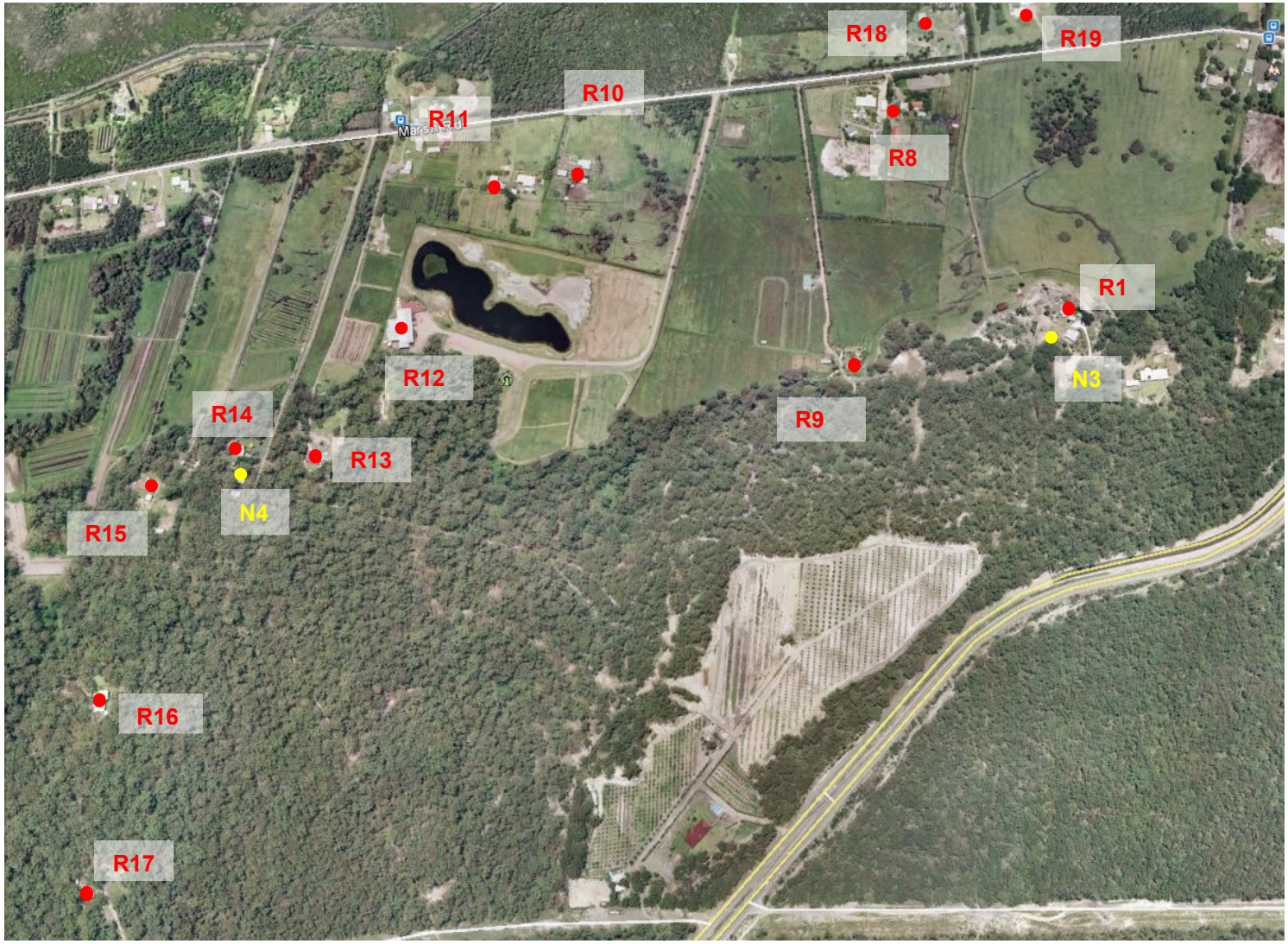

Figure 4: Noise Sensitive Receivers (R1 & R8 - R19) and Noise Monitoring Locations (N3 – N4)

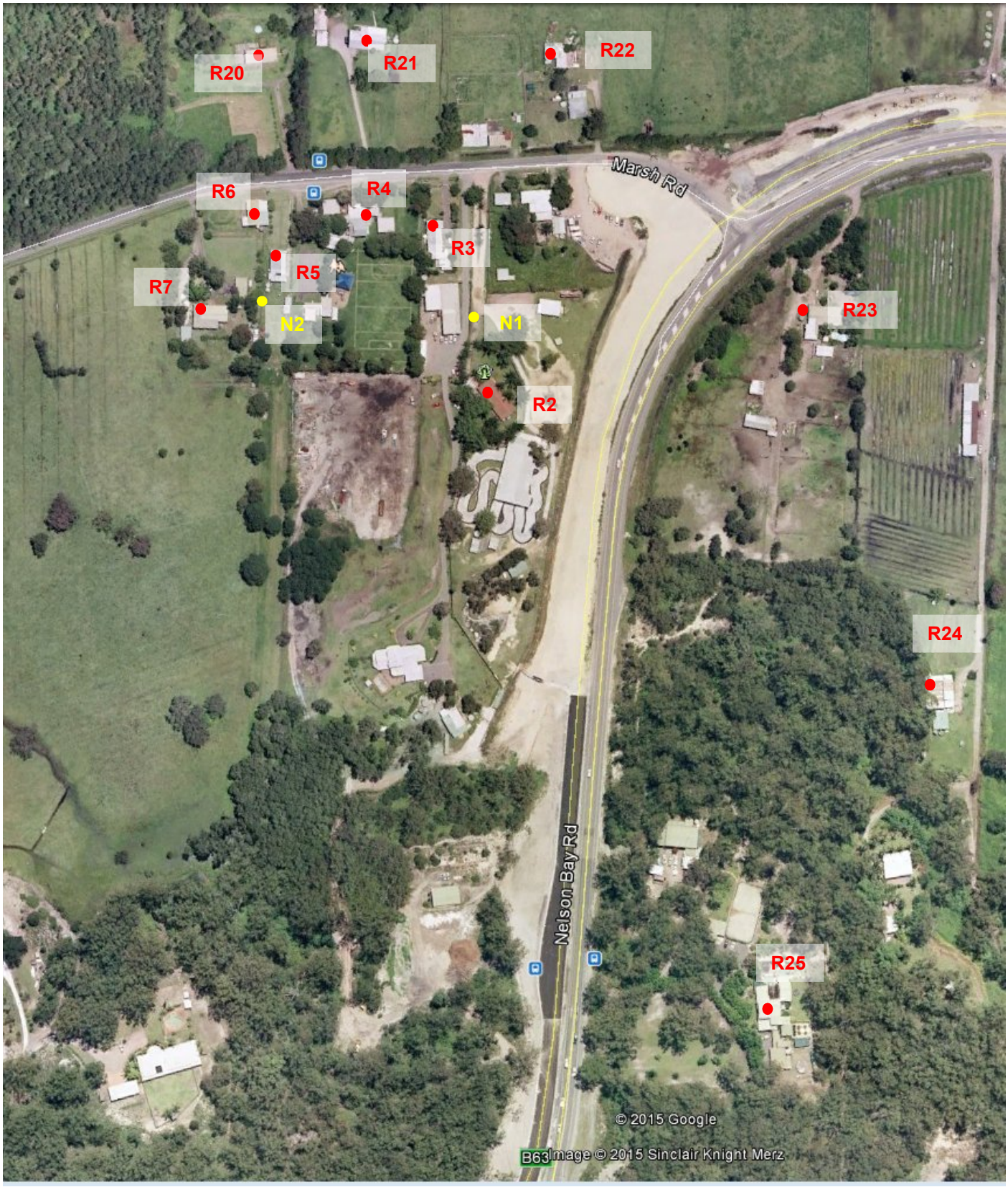

Figure 5: Noise Sensitive Receivers R2-R7 & R20-R25 & Noise Monitoring Locations N1 & N2

4 EXISTING NOISE ENVIRONMENT

4.1 UNATTENDED NOISE MEASUREMENTS

Vipac installed noise logging equipment at four locations to measure baseline environmental noise levels at representative noise sensitive receptor locations in the vicinity of the proposed sand mine site. The location of the monitoring points are listed in ***Table 4*** and shown in ***Figure 4*** and ***Figure 5***.

The primary aim of the noise logging survey was to determine the existing environmental noise levels of the potentially affected area and to enable an assessment of the potential noise impacts on the receiving environment. Logger Location 1 (N1) represented receivers along Nelson Bay Road, Logger Location 2 (N2) represents receivers in the vicinity of Marsh Road Public School and Public Hall, Logger Location 3 (N3) represents receivers R1 & R11 and Logger Location 4 (N4) represents the receivers R14- R19 to the west of the proposed sand mine site.

Table 4: Monitoring Locations

Loc.	Noise Survey Dates	Location / Address	Instrument	Serial No.
N1	02nd- 06th Sept 2014	776 Marsh Road	Larson Davis 824	A2597
N2	12th-25th Aug 2014	762 Marsh Road	Larson Davis 870	1466
N3	12th-25th Aug 2014	724 Marsh Road	Larson Davis 870	1461
N4	12th-18th Aug 2014	640 Marsh Road	Larson Davis 870	1459

The instruments were programmed to accumulate noise data continuously over sampling periods of 15-minutes for the entire monitoring period. Internal software then calculates and stores the Ln percentile noise levels for each sampling period, which can later be retrieved for detailed analysis.

The instruments were calibrated using a Rion NC-73 calibrator immediately before and after monitoring and showed a maximum error of 0.5 dB.

Table presents a summary of the current ambient noise levels at the monitoring locations.

Table 5: Summary of current ambient noise levels (dB (A))

Loc.	Period	L_{Aeq}	L_{A90}	RBL[1]
N1	Day	70	52	52
	Evening	60	49	48
	Night	68	51	49
N2	Day	61	43	43
	Evening	69	43	41
	Night	48	41	47
N3	Day	47	40	40
	Evening	46	40	39
	Night	45	38	36
N4	Day	47	40	40
	Evening	40	37	36
	Night	41	39	38

[1] RBL is the median of the overall assessment background noise level calculated using OEH Industrial Noise Policy methodology as defined in the glossary of acoustic term

5 CRITERIA

5.1 NSW EPA INDUSTRIAL NOISE POLICY (INP)

THE EPA (OEH) INP sets limits on the noise that may be generated by a wide array of facilities and includes guidance applicable for the assessment potential noise impacts from developments such as the proposed sand mine, during the operational stage. These limits are dependent upon the existing noise levels at the site and are designed to ensure changes to the existing noise environment are minimised and deal with the intrusiveness of the noise and the amenity of the environment. The most stringent of the limits is taken as the limiting criterion for the noise source.

The intrusiveness noise criterion requires that the $L_{Aeq,15minutes}$ for the noise source, measured at the most sensitive receiver under worst-case conditions, should not exceed the Rated Background Level (RBL) by more than 5dB, represented as follows:

- $L_{Aeq,15minutes}$ < RBL+ 5dB

Noise levels at nearby noise sensitive receptors (located in the surrounding area), associated with the proposed sand mine should not exceed the Project Specific Noise Levels detailed in ***Table 6***, which have been determined on the basis of the results of the baseline noise surveys. It should be noted that there are no existing noise sensitive receptors located near the rear of the proposed development site, represented by the baseline noise monitoring location N4.

Table 6: Project Specific Noise Levels at Noise Sensitive Receptors dB(A) - Residential

Location	Period	L_{Aeq}	RBL	Recommended Acceptable L_{Aeq} [1]	Intrusiveness Criteria Level	Project Specific Noise Level
N1 R2, R3, R22-R25	Day	70	52	50	57	50
	Evening	60	48	45	53	45
	Night	68	49	40	54	40
N2 R5, R7, R8, R10, R11, R18-R21	Day	61	43	50	48	48
	Evening	69	41	45	46	45
	Night	48	37	40	52	40
N3 R1 & R9	Day	47	40	50	45	45
	Evening	46	39	45	44	44
	Night	45	36	40	41	40
N4 R13-R17	Day	47	40	50	45	45
	Evening	40	36	45	41	41
	Night	41	38	40	43	40

Table 7: Project Specific Noise Levels for Non - Residential - dB(A)

Loc.	Period	Recommended L_{Aeq} - Acceptable Levels (Noisiest 1-hour period)
R4 - Marsh Road Public School	When in Use	40
R6 - Marsh Road Public Hall	When in Use	55
R12 - Shark and Ray Centre	When in Use	55

[1] Recommended Acceptable L_{Aeq} noise level for residence in Rural and Suburban area from Table 2.1 in OEH Industrial Noise Policy. 09 Jun 2015

5.2 SLEEP DISTURBANCE APPROACH

Guidance indicating the potential for sleep disturbance is set out in the NSW Environmental Criteria for Road and Traffic Noise (EPA 1999), and is summarised as follows:

"OEH reviewed research on sleep disturbance in the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, OEH recognised that current sleep disturbance criterion of an $L_{A1,\ (1\ minute)}$ not exceeding the L_{A90}, (15 minute) by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, OEH will continue to use it as a guide to identify the likelihood of sleep disturbance.

This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or $L_{A1,\ (1\ minute)}$, that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:

- *How often high noise events will occur*
- *Time of day (normally between 10pm and 7am)*
- *Whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*

The $L_{A1,\ (1\ minute)}$ descriptor is meant to represent a maximum noise level measured under 'fast' time response. DECCW will accept analysis based on either $L_{A1,\ (1\ minute)}$ or $L_{A(Max)}$.

It should be noted that the OEH refers to the Office of Environment and Heritage, and DECCW refers to the Department of Environment, Climate Change and Water.

Table 8 details the criteria for sleep disturbance for each individual noise receivers

Table 8: Sleep Disturbance Noise Criteria at Noise Sensitive Receptors dB(A) - Residential

Location	Period	L_{A90}	Criteria (L_{A90} +15)
N1 R2, R3, R22-R25	Day	52	67
	Evening	49	64
	Night	51	66
N2 R5, R7, R8, R10, R11, R18-R21	Day	43	58
	Evening	43	58
	Night	41	56
N3 R1 & R9	Day	40	55
	Evening	40	55
	Night	38	53
N4 R13-R17	Day	40	55
	Evening	37	52
	Night	39	54

5.3 NSW ROAD NOISE POLICY (RNP)

The requirements of the NSW Road Noise Policy (RNP) published by the Department of Environment, Climate Change and Water (DECCW) are also applicable to this assessment. ***Table 9*** summarises the road category to establish the noise assessment criteria based on the type of road and the land use developments. The proposed development has the potential to generate additional traffic on the arterial/local roads that can potentially impact on the nearby noise sensitive receivers.

Table 9: Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of project / land use	Assessment Criteria/ Target Noise Level, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Freeway/arterial/sub-arterial Road (Nelson Bay Road)	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	$L_{Aeq,\ (15hour)}$ 60 (external)	$L_{Aeq,\ (9\ hour)}$ 55 (external)
Local Roads (Marsh Road)	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq,\ (1\ hour)}$ 55 (external)	$L_{Aeq,\ (1\ hour)}$ 50 (external)

Note: These criteria are for assessment against façade- corrected noise levels when measured in front of a building façade. Hence, a correction factor of 2.5 dB is added to the predicted noise levels

As stated in Section 3.4 of the Road Noise Policy, with regard to existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use development, any increase in total traffic noise level should be limited to 2dB above that of the corresponding 'no build option'.

The noise assessment criterion for non-residential land use is listed in ***Table 10***. This criterion is applied when assessing the impact and determining mitigation measures in the following situations:

- When there is a new road or road development;
- When there is a land use development with the potential to generate additional traffic on local, sub-arterial or arterial roads.

Table 10: Road traffic noise assessment criteria for non-residential land uses affected by proposed road projects and traffic generating developments (Sheet 1 of 2)

Existing sensitive land use	Assessment criteria- dB(A)		Additional Consideration
	Day (7am – 10pm)	Night (10pm – 7am)	
School classrooms	$L_{Aeq,1hr}$ 40 (Internal) When in use	-	In the case of a building used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2000 (Standards Australia 2000).
Places of worship	$L_{Aeq,1hr}$ 40 (Internal)	$L_{Aeq,1hr}$ 40 (Internal)	The criteria are internal, i.e. the inside of a Church. Areas outside the place of worship, such as Churchyard or Cemetery, may also be a place of worship. Therefore, in determining appropriate criteria for such external areas, it should be established what in these areas may be affected by road traffic noise.

Table 10: Road traffic noise assessment criteria for non-residential land uses affected by proposed road projects and traffic generating developments (Sheet 2 of 2)

Existing sensitive land use	Assessment criteria- dB(A)		Additional Consideration
	Day (7am – 10pm)	**Night (10pm – 7am)**	
Childcare facilities	Sleeping rooms $L_{Aeq,1hr}$ 35 (Internal) Indoor Play areas $L_{Aeq,1hr}$ 40 (Internal) Outdoor Play areas $L_{Aeq,1hr}$ 55 (External)	-	Multi-purpose spaces, e.g. shared indoor play/sleeping rooms should meet the lower of the respective criteria. Measurements for sleeping rooms should be taken during designated sleeping times for the facility or if these are not known, during the highest hourly traffic noise level during the opening hours of the facility.
Commercial and Industrial Premises	Shopping Mall $L_{Aeq,}$45-55 (Internal) Small Retail Stores (general) L_{Aeq} 45-50 (Internal) Hotels and motels (sleeping areas) L_{Aeq} 35-40 (Internal)	Shopping Mall $L_{Aeq,}$45-55 (Internal) Small Retail Stores (general) L_{Aeq} 45-50 (Internal) Hotels and motels (sleeping areas) L_{Aeq} 35-40 (Internal)	Information on desirable internal noise levels is contained in Australian Standard 2107:2000.

Where internal noise levels were specified for the applicable criteria outlined in ***Table 11*** above, +10dB was added to approximate to an external noise level, for the purposes of the traffic noise assessment which is undertaken to assess noise levels externally to noise sensitive properties.

5.3.1 PRACTICE NOTE 3 (SLEEP DISTURBANCE IMPACT)

A substantial portion of the DECC NSW Road Noise Policy (RNP) discusses a review of international research on the subject of sleep disturbance associated with noise. The guidance outlined with regard to road traffic noise and potential impacts on sleep disturbance expands on previous guidance set out in the RTA Environmental Noise Management Manual (ENMM) and earlier guidance set out in the Environmental Protection Authority Environmental Criteria for Road Traffic Noise (ECRTN).

The most recent guidance set out in the RNP states that "*there appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise*". The RNP refers to the RTA Practice Note 3 protocol as the method for assessing and reporting on maximum noise levels that may cause sleep disturbance. The guidelines indicate that:

- Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions, and
- One or two noise events per night with maximum internal noise levels of 65-70 dB(A) are not likely to significantly affect health and well-being.

6 NOISE MODELLING

Noise modelling has been undertaken using the SoundPLAN® computational noise modelling software package. The use of the SoundPLAN® software and referenced modelling methodology is accepted for use in the state of NSW by the EPA (OEH) for environmental noise modelling purposes. Vipac have undertaken numerous noise modelling and impact assessments previously for a range of projects, including infrastructure development and industrial projects using SoundPLAN®.

6.1 GEOGRAPHICAL DATA

Tattersall Lander supplied topographical details of the area to Vipac and ***Table 11*** below lists the drawings received and used in the noise prediction model.

Table 11: Drawings used

Drawing Title	Description	Date
Existing Surface Survey dxf	Current Terrain Layout	11/08/2014
3m Design Surface dxf	3m pit proposed design	11/08/2014
1m Design Surface dxf	1m pit proposed design	11/08/2014
-15m Design Surface dxf	-15m proposed pit design	11/08/2014
Sand Mine Plan (Rev B)	Proposed Mine Layout	06/05/2015

6.2 OPERATIONAL PHASES

6.2.1 NOISE SOURCES

Vipac has been advised by Tattersall Lander that the main noise contributor associated with the proposed sand mine will be the operation of the mobile plant and export lorries utilised in the mining process. A list of mobile plant for use in the noise modelling has been compiled in conjunction with Tattersall Lander and with details of the mining process and plant as outlined in the QMS mining plan.

Details of the plant and equipment that will be used during the operational phase of the proposed Sand Mine and associated sound power levels (i.e. noise emission levels associated with the equipment) are listed in ***Table 12***.

Table 12: Sound Power Levels (L_w).

Description	Sound Power levels, L_w (dB(A))	Sound Power Reference Source
22 Tonne Excavator	106	BS5228-1-2009
35 Tonne Excavator	109	BS5228-1-2009
44 tonne Haul Truck	118	BS5228-1-2009
Sales Loader	112	BS5228-1-2009
Conveyor System Head Drive	97	BS5228-1-2009
Screens	109	BS5228-1-2009
Pump	100	BS5228-1-2009
Export lorry 32 tonne	110	BS5228-1-2009
Pump on Dredge	108	BS5228-1-2009

6.2.2 NOISE MODELLING SCENARIO

Vipac understands that the proposed sand mine will operate from 6am to 4pm once the mine is operational. A site layout plan of the proposed facility is provided as ***Figure 3*** above.

The mine will progress in phases with Dry mining from current terrain down to the water table and then wet mining commencing by way of dredge down to a final depth of -15m AHD. Vipac has, as worst-case, conservatively modelled at the beginning of each Phase. Dry mining at the current terrain levels, at the 3m terrain level provided and wet mining commencing at the 1m terrain level and -15m terrain level provided.

6.2.3 WEATHER CONDITIONS

Four acoustic modelling scenarios were assessed for the operational phase of the proposed sand mine within the SoundPLAN program using CONCAWE algorithms under both neutral and worst case weather conditions for the day and night periods. It should be noted that sound will propagate further through the atmosphere under certain weather conditions dependent on air pressure variations, wind speed and direction variations, temperature inversions etc. The 'worst-case' weather conditions chosen were those highly conducive to the propagation of sound.

Table 13 presents the weather parameters used in the CONCAWE calculations based on annual data from the Bureau of Meteorology (BoM) Weather Station at Nelson Bay.

Table 13: Sound Plan Weather Parameters

Parameter	Day		Evening/Night	
	Neutral	Worst-case	Neutral	Worst-case
Pasquill Stability Category	B	D	D	F
Wind Speed (m/s)	0	3	0	3
Humidity (%)	57	57	75	75
Temperature (deg Celsius)	16	16	10	10
Met Category	3	5	4	6

6.3 NOISE IMPACT FROM GENERATED TRAFFIC

The Calculation of Road Traffic Noise (CoRTN) method of traffic noise prediction was used, which is a method approved by the EPA (OEH). The traffic data presented in the "Bobs Farm Sand Quarry Traffic Impact Assessment" (by Seca Solution, dated 24th October 2014) and augmented with automatic traffic counts which were obtained on Nelson Bay Road between Marsh Road and Port Stephens Road in September 2014.

Traffic will enter the site via the entrance off Nelson Bay Road at the south of the site. Vehicles will travel along the private road on the south and east of the site and exit turning right onto to Marsh road near the junction of Marsh Road and Nelson Bay Road.

The Seca Solutions report assumes the site will generate 200 trucks per day during peak periods, increasing the AADT west of the site by 360 vehicles per day, raising it from 15,311 to 15,671 vehicles per day representing an increase of 2.3%.

Vipac has also conducted noise modelling for the initial four years of operation, as outlined in the Quarry Mining System reports, based on projected export tonnage specified in the report and an average export load of 30 tonnes per shipment to assess the traffic outside peak times. The increased number of trucks utilising the road is outlined below in ***Table 14.***

Table 14: Estimated Truck Movements

Year	Truck movements
1	24
2	40
3	72
4	112
Peak	200

Table 15 and ***Table 16*** provide the following increase of traffic travelling eastbound to the west of the site on Nelson Bay Road and exiting along Marsh Road and turning right westbound onto Nelson Bay Road.

Table15: Traffic Volumes – Nelson Bay Road

Traffic Details	Nelson Bay Road					
	Base Traffic	**Base Traffic + Year 1**	**Base Traffic + Year 2**	**Base Traffic + Year 3**	**Base Traffic + Year 4**	**Base Traffic + Proposed Peak**
Average Daily Traffic	15311	15335	15351	15383	15433	15511
15 hour traffic flows (Day Period)	14323	14343	14358	14390	14430	14518
% Percentage Heavy Vehicles (15 hours)	4	4.4	4.5	4.7	5.0	5.5
9 hour traffic flows (Night Period)	988	992	993	993	933	933
% Percentage Heavy Vehicles (9 hours)	4.6	5.0	5.0	5.0	5.0	5.0
Speed Limit (km/h)	80					

Table 16: Traffic Volumes – Marsh Road

Traffic Details	Marsh Road					
	Base Traffic	**Base Traffic + Year 1**	**Base Traffic + Year 2**	**Base Traffic + Year 3**	**Base Traffic + Year 4**	**Base Traffic + Proposed Peak**
Average Daily Traffic	708	732	748	780	820	908
15 hour traffic flows (Day Period)	680	700	715	747	787	875
% Percentage Heavy Vehicles (15 hours)	4.55	7.28	9.2	13.1	13.6	15.8
9 hour traffic flows (Night Period)	28	32	33	33	33	33
% Percentage Heavy Vehicles (9 hours)	0	12.5	15.1	15.1	15.1	15.1
Speed Limit (km/h)	60					

7 RESULTS

7.1 MODELLED NOISE- OPERATIONAL PHASES (L_{AEQ})

Noise prediction modelling has been carried out to assess the potential impact associated with the proposed sand mine on the existing noise environment at the nearest noise sensitive receptors located in proximity to the site. Due to the layout of the proposed mine Vipac has approached the modelling by breaking the mine up into two sides, the western end of the mine close to Receivers R13-17 and the eastern end of the mine close to receivers R1 & R9 with an operational scenario being conducted for each of the phases of operation. The haul road accessing the site from Nelson Bay Road and exiting onto Marsh Road has also been modelled to assess the impact on the receivers in Marsh Road Village from the private haul road.

The predicted noise levels representative of each of the operational phases for Year 1, Year 4 and Peak operation for both neutral conditions and worst-case conditions during day and evening/night-time are presented in ***Tables 17 - 21***. The results for Year 2 & Year 3 are presented in ***Appendix A*** of this report.

Table 17: Year 1 Operation - West End of Mine Working Scenario – Predicted Noise Impact (L_{Aeq})

Rec #	Predicted Noise Levels dB(A)																	
	Criteria	Day Period No Mitigation			Day Period Mitigation applied			Criteria	Night Period No Mitigation			Night Period Mitigation applied		
		Neutral	Worst-case	Compliant	Neutral	Worst-case	Compliant		Neutral	Worst-case	Compliant	Neutral	Worst-case	Compliant
R1	45	40	46	✓ ✗	34	42	✓ ✓	40	42	46	✗ ✗	38	43	✓ ✗
R2	50	49	52	✓ ✗	40	43	✓ ✓	40	50	52	✗ ✗	42	42	✗ ✗
R3	50	65	65	✗ ✗	36	38	✓ ✓	40	50	51	✗ ✗	37	38	✓ ✓
R4	40 (when in use)	35	38	✓ ✓	26	30	✓ ✓	40 (when in use)	36	38	✓ ✓	38	40	✓ ✓
R5	48	48	50	✓ ✗	37	40	✓ ✓	40	49	50	✗ ✗	38	40	✓ ✓
R6	55 (when in use)	39	44	✓ ✓	30	36	✓ ✓	55 (when in use)	41	44	✓ ✓	33	36	✓ ✓
R7	48	45	48	✓ ✓	34	39	✓ ✓	40	46	48	✗ ✗	36	39	✓ ✓
R8	48	25	34	✓ ✓	23	31	✓ ✓	40	29	34	✓ ✓	27	31	✓ ✓
R9	45	25	33	✓ ✓	22	30	✓ ✓	40	28	33	✓ ✓	26	30	✓ ✓
R10	48	22	30	✓ ✓	18	26	✓ ✓	40	25	30	✓ ✓	22	26	✓ ✓
R11	48	22	30	✓ ✓	18	26	✓ ✓	40	25	30	✓ ✓	22	26	✓ ✓
R12	55 (when in use)	38	44	✓ ✓	27	35	✓ ✓	55 (when in use)	39	44	✓ ✗	30	35	✓ ✓
R13	45	45	50	✓ ✗	32	38	✓ ✓	40	44	48	✓ ✗	35	38	✓ ✓
R14	45	41	47	✓ ✗	37	45	✓ ✓	40	42	46	✗ ✗	41	45	✗ ✗
R15	45	38	45	✓ ✓	34	43	✓ ✓	40	40	44	✓ ✗	39	43	✓ ✗
R16	45	38	46	✓ ✗	36	44	✓ ✓	40	40	45	✓ ✗	33	38	✓ ✓
R17	45	30	40	✓ ✓	28	37	✓ ✓	40	35	40	✓ ✓	31	34	✓ ✓
R18	48	26	35	✓ ✓	21	30	✓ ✓	40	30	35	✓ ✓	25	30	✓ ✓
R19	48	30	39	✓ ✓	24	34	✓ ✓	40	34	39	✓ ✓	29	34	✓ ✓
R20	48	35	42	✓ ✓	29	37	✓ ✓	40	38	42	✓ ✗	33	37	✓ ✓
R21	48	39	43	✓ ✓	32	39	✓ ✓	40	41	44	✗ ✗	35	39	✓ ✓
R22	50	41	44	✓ ✓	29	34	✓ ✓	40	42	44	✗ ✗	37	40	✓ ✓
R23	50	34	41	✓ ✓	29	37	✓ ✓	40	38	42	✓ ✗	36	40	✓ ✓
R24	50	32	40	✓ ✓	32	40	✓ ✓	40	36	40	✓ ✓	40	44	✓ ✗
R25	50	31	40	✓ ✓	30	39	✓ ✓	40	35	40	✓ ✓	33	38	✓ ✓

Table 18: Year 1 Operation - East End of Mine Working Scenario – Predicted Noise Impact (L_{Aeq})

Rec #	Predicted Noise Levels dB(A)																	
	Criteria	Day Period No Mitigation			Day Period Mitigation applied			Criteria	Night Period No Mitigation			Night Period Mitigation applied					
		Neutral	Worst-case	Compliant	Neutral	Worst-case	Compliant		Neutral	Worst-case	Compliant	Neutral	Worst-case	Compliant			
R1	45	51	54	✗	✗	40	45	✓	✓	40	53	54	✗	✗	42	45	✗	✗
R2	50	49	52	✓	✗	40	43	✓	✓	40	50	52	✗	✗	42	42	✗	✗
R3	50	65	65	✗	✗	36	38	✓	✓	40	50	51	✗	✗	37	38	✓	✓
R4	40 (when in use)	35	38	✓	✓	26	31	✓	✓	40 (when in use)	36	38	✓	✓	38	41	✓	✗
R5	48	48	50	✓	✗	37	41	✓	✓	40	49	50	✗	✗	39	42	✓	✗
R6	55 (when in use)	39	44	✓	✓	31	37	✓	✓	55 (when in use)	41	44	✓	✓	34	38	✓	✓
R7	48	45	49	✓	✗	35	41	✓	✓	40	47	49	✗	✗	37	41	✓	✗
R8	48	29	38	✓	✓	28	37	✓	✓	40	33	38	✓	✓	32	37	✓	✓
R9	45	29	35	✓	✓	25	32	✓	✓	40	31	35	✓	✓	28	32	✓	✓
R10	48	23	32	✓	✓	21	29	✓	✓	40	27	32	✓	✓	25	30	✓	✓
R11	48	23	32	✓	✓	21	29	✓	✓	40	27	32	✓	✓	25	30	✓	✓
R12	55 (when in use)	29	38	✓	✓	28	37	✓	✓	55 (when in use)	33	38	✓	✓	33	38	✓	✓
R13	45	31	40	✓	✓	23	32	✓	✓	40	35	40	✓	✓	27	32	✓	✓
R14	45	31	40	✓	✓	26	35	✓	✓	40	35	41	✓	✓	30	35	✓	✓
R15	45	30	39	✓	✓	26	35	✓	✓	40	35	40	✓	✓	30	35	✓	✓
R16	45	29	39	✓	✓	27	37	✓	✓	40	34	39	✓	✓	29	35	✓	✓
R17	45	28	37	✓	✓	25	34	✓	✓	40	32	38	✓	✓	32	36	✓	✓
R18	48	28	37	✓	✓	26	35	✓	✓	40	33	38	✓	✓	30	35	✓	✓
R19	48	31	40	✓	✓	28	37	✓	✓	40	36	40	✓	✓	32	37	✓	✓
R20	48	35	42	✓	✓	30	37	✓	✓	40	38	42	✓	✗	33	37	✓	✓
R21	48	40	44	✓	✓	32	40	✓	✓	40	41	44	✗	✗	36	40	✓	✓
R22	50	41	44	✓	✓	29	36	✓	✓	40	42	44	✗	✗	38	41	✓	✗
R23	50	34	42	✓	✓	30	38	✓	✓	40	38	42	✓	✗	36	41	✓	✗
R24	50	33	41	✓	✓	32	40	✓	✓	40	37	41	✓	✗	32	37	✓	✓
R25	50	32	41	✓	✓	31	40	✓	✓	40	36	41	✓	✗	34	39	✓	✓

Table 19: Year 4 Operation- West End of Mine Working Scenario – Predicted Noise Impact (L_{Aeq})

Rec #	Predicted Noise Levels dB(A)																	
	Criteria	Day Period No Mitigation				Day Period Mitigation applied				Criteria	Night Period No Mitigation				Night Period Mitigation applied			
		Neutral	Worst-case	Compliant		Neutral	Worst-case	Compliant			Neutral	Worst-case	Compliant		Neutral	Worst-case	Compliant	
R1	45	47	51	✗	✗	38	44	✓	✓	40	49	51	✗	✗	40	44	✓	✗
R2	50	54	57	✗	✗	45	49	✓	✓	40	55	57	✗	✗	48	48	✗	✗
R3	50	69	69	✗	✗	41	44	✓	✓	40	55	57	✗	✗	42	44	✗	✗
R4	40 (when in use)	40	42	✓	✗	31	35	✓	✓	40 (when in use)	41	42	✗	✗	43	46	✗	✗
R5	48	52	55	✗	✗	42	45	✓	✓	40	53	55	✗	✗	43	45	✗	✗
R6	55 (when in use)	44	49	✓	✓	39	43	✓	✓	55 (when in use)	46	49	✓	✓	41	43	✓	✓
R7	48	50	53	✗	✗	39	43	✓	✓	40	51	53	✗	✗	41	43	✗	✗
R8	48	29	38	✓	✓	26	34	✓	✓	40	34	38	✓	✓	30	34	✓	✓
R9	45	29	37	✓	✓	25	33	✓	✓	40	33	37	✓	✓	29	33	✓	✓
R10	48	31	41	✓	✓	21	29	✓	✓	40	36	41	✓	✗	25	29	✓	✓
R11	48	31	41	✓	✓	21	29	✓	✓	40	36	41	✓	✗	25	29	✓	✓
R12	55 (when in use)	32	41	✓	✓	31	40	✓	✓	55 (when in use)	36	41	✓	✗	36	40	✓	✓
R13	45	33	42	✓	✓	19	27	✓	✓	40	37	42	✓	✗	23	28	✓	✓
R14	45	32	41	✓	✓	23	31	✓	✓	40	36	41	✓	✓	27	31	✓	✓
R15	45	31	40	✓	✓	23	32	✓	✓	40	35	40	✓	✓	27	32	✓	✓
R16	45	31	41	✓	✓	26	35	✓	✓	40	36	41	✓	✗	26	31	✓	✓
R17	45	29	38	✓	✓	21	30	✓	✓	40	33	38	✓	✓	27	32	✓	✓
R18	48	30	39	✓	✓	26	34	✓	✓	40	34	39	✓	✓	30	34	✓	✓
R19	48	33	42	✓	✓	27	36	✓	✓	40	37	42	✓	✗	31	36	✓	✓
R20	48	41	47	✓	✓	36	42	✓	✓	40	44	47	✗	✗	39	42	✓	✗
R21	48	46	49	✓	✗	41	45	✓	✓	40	47	49	✗	✗	43	45	✗	✗
R22	50	48	51	✓	✗	42	45	✓	✓	40	49	51	✗	✗	42	45	✗	✗
R23	50	39	47	✓	✓	33	41	✓	✓	40	43	47	✗	✗	40	43	✗	✗
R24	50	38	44	✓	✓	37	43	✓	✓	40	41	44	✗	✗	30	35	✗	✗
R25	50	35	44	✓	✓	34	42	✓	✓	40	39	44	✓	✗	37	41	✗	✗

Table 20: Year 4 Operation - East end of Mine Working Scenario – Predicted Noise Impact (L_{Aeq})

Rec#	Predicted Noise Levels dB(A)																	
	Criteria	Day Period No Mitigation				Day Period Mitigation applied				Criteria	Night Period No Mitigation				Night Period Mitigation applied			
		Neutral	Worst-case	Compliant		Neutral	Worst-case	Compliant			Neutral	Worst-case	Compliant		Neutral	Worst-case	Compliant	
R1	45	47	51	✓	✓	38	44	✓	✓	40	49	51	✗	✗	40	44	✗	✗
R2	50	54	57	✓	✗	45	49	✓	✓	40	55	57	✗	✗	48	48	✗	✗
R3	50	69	69	✗	✗	41	44	✓	✓	40	55	57	✗	✗	42	44	✗	✗
R4	40 (when in use)	40	42	✓	✗	31	35	✓	✓	40 (when in use)	41	42	✗	✗	43	46	✗	✗
R5	48	52	55	✗	✗	42	45	✓	✓	40	53	55	✗	✗	43	45	✗	✗
R6	55 (when in use)	44	49	✓	✓	39	43	✓	✓	55 (when in use)	46	49	✓	✓	41	43	✓	✓
R7	48	50	53	✗	✗	39	43	✓	✓	40	51	53	✗	✗	41	43	✗	✗
R8	48	29	38	✓	✓	26	34	✓	✓	40	33	38	✓	✓	30	34	✓	✓
R9	45	29	36	✓	✓	25	32	✓	✓	40	32	36	✓	✓	28	32	✓	✓
R10	48	31	41	✓	✓	21	29	✓	✓	40	36	43	✓	✗	25	29	✓	✓
R11	48	31	41	✓	✓	21	29	✓	✓	40	36	43	✓	✗	25	29	✓	✓
R12	55 (when in use)	30	38	✓	✓	28	36	✓	✓	55 (when in use)	34	46	✓	✗	32	37	✓	✓
R13	45	40	49	✓	✗	27	33	✓	✓	40	45	49	✗	✗	29	33	✓	✓
R14	45	38	47	✓	✓	27	35	✓	✓	40	42	47	✓	✓	31	35	✓	✓
R15	45	31	40	✓	✓	26	34	✓	✓	40	36	45	✓	✗	30	34	✓	✓
R16	45	31	41	✓	✓	24	33	✓	✓	40	36	46	✓	✗	25	30	✓	✓
R17	45	28	38	✓	✓	20	30	✓	✓	40	33	38	✓	✓	27	32	✓	✓
R18	48	30	39	✓	✓	26	34	✓	✓	40	34	39	✓	✓	29	34	✓	✓
R19	48	33	42	✓	✓	27	36	✓	✓	40	37	42	✓	✗	31	36	✓	✓
R20	48	41	47	✓	✓	36	42	✓	✓	40	44	47	✗	✗	39	42	✓	✗
R21	48	46	49	✓	✗	41	45	✓	✓	40	47	49	✗	✗	43	45	✗	✗
R22	50	48	51	✓	✗	42	45	✓	✓	40	49	51	✗	✗	42	45	✗	✗
R23	50	39	47	✓	✓	33	41	✓	✓	40	43	47	✗	✗	40	43	✓	✓
R24	50	38	44	✓	✓	37	43	✓	✓	40	41	44	✗	✗	28	33	✓	✓
R25	50	35	44	✓	✓	34	42	✓	✓	40	39	44	✓	✗	37	41	✓	✗

Table 21: Proposed Peak Truck Requirement (200 trucks per day) Scenario – Predicted Noise Impact (L_{Aeq})

Rec#	Predicted Noise Levels dB(A)																	
	Criteria	Day Period No Mitigation				Day Period Mitigation applied				Criteria	Night Period No Mitigation				Night Period Mitigation applied			
		Neutral	Worst-case	Compliant		Neutral	Worst-case	Compliant			Neutral	Worst-case	Compliant		Neutral	Worst-case	Compliant	
R1	45	50	54	✗	✗	41	46	✓	✗	40	52	54	✗	✗	43	47	✗	✗
R2	50	57	60	✗	✗	49	52	✓	✗	40	59	60	✗	✗	51	51	✗	✗
R3	50	73	73	✗	✗	45	46	✓	✓	40	58	60	✗	✗	46	47	✗	✗
R4	40 (when in use)	43	46	✓	✗	35	38	✓	✓	40 (when in use)	44	46	✗	✗	47	49	✗	✗
R5	48	55	58	✗	✗	46	48	✓	✓	40	57	58	✗	✗	47	48	✗	✗
R6	55 (when in use)	47	52	✓	✓	42	46	✓	✓	55 (when in use)	50	52	✓	✓	44	47	✓	✓
R7	48	53	56	✗	✗	43	45	✓	✓	40	55	56	✗	✗	44	46	✗	✗
R8	48	33	41	✓	✓	29	37	✓	✓	40	37	41	✓	✗	33	38	✓	✓
R9	45	31	38	✓	✓	27	34	✓	✓	40	34	38	✓	✓	30	35	✓	✓
R10	48	32	41	✓	✓	24	31	✓	✓	40	37	42	✓	✗	28	32	✓	✓
R11	48	32	41	✓	✓	24	31	✓	✓	40	37	42	✓	✗	28	32	✓	✓
R12	55 (when in use)	32	40	✓	✓	31	39	✓	✓	55 (when in use)	36	41	✓	✗	35	40	✓	✓
R13	45	40	49	✓	✗	27	34	✓	✓	40	45	49	✗	✗	30	34	✓	✓
R14	45	38	47	✓	✓	28	36	✓	✓	40	42	47	✗	✗	32	36	✓	✓
R15	45	32	41	✓	✓	27	35	✓	✓	40	37	41	✓	✗	32	36	✓	✓
R16	45	32	41	✓	✓	27	35	✓	✓	40	37	42	✓	✗	31	36	✓	✓
R17	45	29	39	✓	✓	23	32	✓	✓	40	34	39	✓	✓	27	32	✓	✓
R18	48	33	42	✓	✓	29	36	✓	✓	40	38	42	✓	✗	33	37	✓	✓
R19	48	36	45	✓	✓	31	38	✓	✓	40	40	45	✓	✗	35	39	✓	✓
R20	48	44	50	✓	✗	39	45	✓	✓	40	47	50	✗	✗	42	45	✗	✗
R21	48	50	53	✗	✗	45	48	✓	✓	40	51	53	✗	✗	46	49	✗	✗
R22	50	51	54	✗	✗	45	47	✓	✓	40	53	54	✗	✗	46	49	✗	✗
R23	50	43	50	✓	✓	36	44	✓	✓	40	46	50	✗	✗	43	46	✗	✗
R24	50	41	47	✓	✓	40	46	✓	✓	40	44	47	✗	✗	31	36	✓	✓
R25	50	38	47	✓	✓	37	45	✓	✓	40	42	47	✗	✗	40	44	✓	✗

The results of the noise modelling show that there are exceedances at Receivers R1 &R3 for both neutral and worst case conditions from Year 1 operation onwards for the operation of the sand mine. There are also exceedances predicted for Receivers R2, R5 & R7 predicted for the worst-case weather conditions during the mines operation. To mitigate these exceedances Vipac proposes that a 4m high acoustic barrier be installed along the private haul road at the exit onto Marsh Road, with the last 50m of the barrier at the Marsh Road end to be transparent on both sides to provide visibility to export lorries in both directions. Modelling conducted with the mitigation in place shows compliance with the noise criteria for year's 1 - 4 operation based on the required truck movements.
The results of the noise modelling also show that there are exceedances predicted at R13 - R16 for Year 1, 2 & 3 operations under worst-case conditions in the western end of the mine operation. To mitigate these noise levels Vipac proposes a 4m high bund or noise barrier around the processing area and a 6m high bund around the pit as shown in ***Figure 6***. These noise mitigation measures will reduce the noise levels to below the criteria for year 1 & 2. During Year 3 operation a 1dB exceedance of the noise criteria is still predicted for R14-R16 for this scenario, although this is not considered to be a significant impact, and is only for a short period before the pit progresses to a lower level beneath sea level.

An additional model has also been run to assess the proposed peak 200 export lorry movements during demand as outlined in the Seca Traffic Impact Assessment. The results of this model, presented in ***Table 22***, show that even with the mitigation measures of the acoustic barriers in place, exceedances for worst case conditions were predicted for receivers R1 & R2 due to the higher number of export lorries utilising the private haul road and exiting from the mine. Vipac has conducted modelling to determine the maximum number of export lorries that can access the site and exit along Marsh Road during the daytime period under worst-case conditions and ensure compliance with the noise criteria, as presented in ***Table 22***. This noise modelling has shown that the maximum number of trucks that can exit the private haul road is 150 truck movements exiting at the Marsh Road exit.

Table 22: Maximum Trucks allowable (150 trucks per day) Scenario – Predicted Noise Impact (L_{Aeq})

Location	Predicted Noise Levels dB(A)				
	Criteria	Day Period No Mitigation			
		Neutral	Worst-case	Compliant	
R1	45	39	45	✓	✓
R2	50	47	50	✓	✓
R3	50	43	45	✓	✓
R4	40 (when in use)	33	37	✓	✓
R5	48	44	46	✓	✓
R6	55 (when in use)	40	45	✓	✓
R7	48	41	44	✓	✓
R8	48	28	36	✓	✓
R9	45	26	33	✓	✓
R10	48	22	30	✓	✓
R11	48	22	30	✓	✓
R12	55 (when in use)	29	38	✓	✓
R13	45	27	33	✓	✓
R14	45	27	35	✓	✓
R15	45	26	35	✓	✓
R16	45	25	34	✓	✓
R17	45	22	31	✓	✓
R18	48	27	35	✓	✓
R19	48	29	37	✓	✓
R20	48	37	43	✓	✓
R21	48	43	47	✓	✓
R22	50	44	46	✓	✓
R23	50	34	42	✓	✓
R24	50	39	44	✓	✓
R25	50	35	44	✓	✓

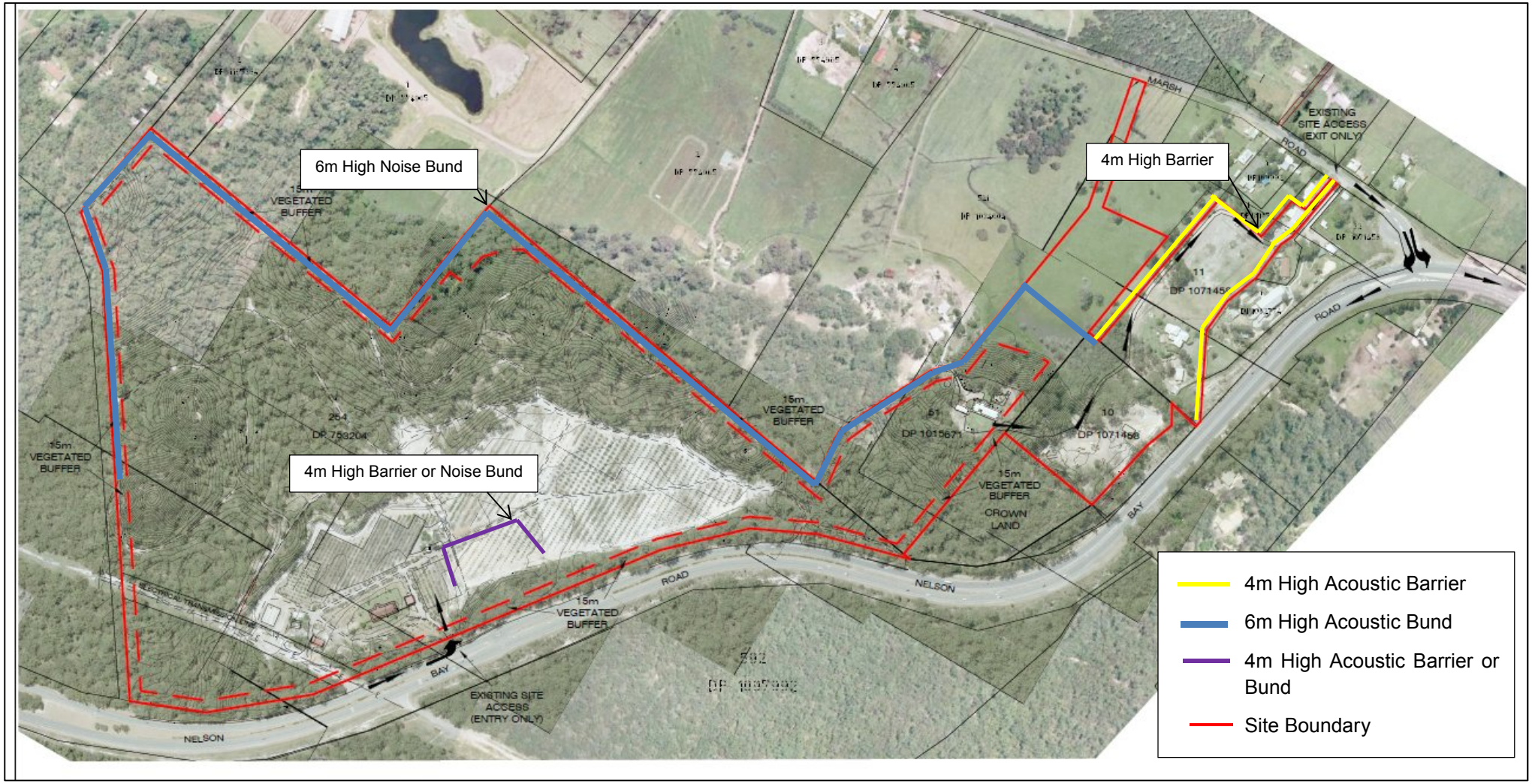

Figure 6: Proposed Noise Bund and Barrier Location

For night-time operations (6am-7am), there are exceedances predicted at receivers at R1 on the eastern end of the pit and R2-R7 & R20-R24 at the Marsh Road exit of the Haul road. These exceedances are attributed to the operation of the private haul road and export lorries. Vipac again has conducted modelling to ascertain the maximum number of trucks permissible in this night-time period (6am-7am) without exceeding the noise criteria at this point and the predicted maximum number of trucks on the Haul road is a single truck.

7.2 MODELLED NOISE - OPERATIONAL PHASE (SLEEP DISTURBANCE)

Noise prediction modelling has been carried out to assess the potential sleep disturbance impact associated with the proposed Sand Mine on the existing noise environment at the nearest noise sensitive receptors located in proximity to the site during the night period. The predicted noise levels representative of the operational phase for both neutral conditions and worst-case conditions during the night-time are presented in ***Appendix B*** of this report.

The predicted noise impact associated with the proposed development of the Sand Mine on the noise sensitive receivers range between 34 to 63dB(A) at the façade of the noise sensitive receptors. The predicted noise levels are predicted to exceed the sleep disturbance criteria during the operational phase of the sand mine at receivers R1, R5, R7, R14, R15, R20 & R21. The exceedances range from 1dB exceedance to 7dB. The Marsh Road receivers at the exit of the haul road are the most effected experiencing exceedances of 4-7dB during the operation of the mine.

Due to the exceedances of the sleep disturbance criteria at receivers R1, R5, R7, R14, R15, R20 & R21 and the exceedance of the operational L_{Aeq} criteria for any more than a single truck at the Marsh Road exit of the Sand Mine site during the night-time period of 6am-7am it would not be permissible for the mine to operate for this period.

7.3 TRAFFIC NOISE IMPACT

Noise modelling has also been undertaken to assess the potential noise impacts associated with vehicle movements on Nelson Bay Road and the eastern end of Marsh Road. The noise model has taken into account all the sources (Nelson Bay Road and Marsh Road) associated with traffic that will be generated by the proposed Sand Mine as outlined in ***Section 6.3*** to determine the cumulative noise levels in the area. As Receivers 9-15 are situated along Marsh Road where no additional traffic flow is proposed to be generated by the Sand Mine they have not been assessed as part of the traffic noise impact assessment. Additionally as night-time operations are not recommended due to the exceedances of the noise criteria as outlined in ***Section 7.1*** and ***Section 7.2*** no traffic noise modelling has been conducted for the night-time period (6am-7am).

The results of the noise predictions associated with the proposed Sand Mine development are presented in ***Tables 23 - 27***.

Table 23: Cumulative Traffic Noise Impact (dBA) – Year 1 Operation

Rec #	Location	Day Period ($L_{Aeq,15hr}$)			
		Base Traffic Flow	Base Traffic Flow + year 1 development Flow	Criteria	Difference
1	724 Marsh Road	45.8	45.9	55	0.1
2	776 Marsh Road	57.9	57.9	60	0.0
3	772 Marsh Road	55.5	55.6	55	0.1
4	764 Marsh Road - Public School	53.6	53.7	55	0.1
5	762 Marsh Road	49.2	49.2	55	0.0
6	760 Marsh Road - Public Hall	58.3	58.3	55	0.0
7	756 Marsh Road	48.2	48.2	55	0.0
8	712 Marsh Road	46.9	47.0	55	0.1
16	3551 Nelson Bay Road	48.3	48.4	60	0.1
17	3515 Nelson Bay Road	52.2	52.3	60	0.1
18	723 Marsh Road	48.1	48.1	55	0.0
19	731 Marsh Road	48.9	49.0	55	0.1
20	761 Marsh Road	52.4	52.5	55	0.1
21	767 Marsh Road	54.2	54.2	55	0.0
22	781 Marsh Road	59.4	59.7	60	0.3
23	3780 Nelson Bay Road	58.8	58.8	60	0.0
24	3724 Nelson Bay Road	54.7	54.8	60	0.1
25	3790 Nelson Bay Road	59.9	60.0	60	0.1

Table 24: Cumulative Traffic Noise Impact (dBA) – Year 2 Operation

Rec #	Location	Day Period ($L_{Aeq,15hr}$)			
		Base Traffic Flow	Base Traffic Flow + year 2 development Flow	Criteria	Difference
1	724 Marsh Road	45.8	45.9	55	0.1
2	776 Marsh Road	57.9	57.9	60	0.0
3	772 Marsh Road	55.5	55.7	55	0.2
4	764 Marsh Road - Public School	53.6	53.8	55	0.2
5	762 Marsh Road	49.2	49.2	55	0.0
6	760 Marsh Road - Public Hall	58.3	58.4	55	0.1
7	756 Marsh Road	48.2	48.2	55	0.0
8	712 Marsh Road	46.9	47.0	55	0.1
16	3551 Nelson Bay Road	48.3	48.4	60	0.1
17	3515 Nelson Bay Road	52.2	52.4	60	0.2
18	723 Marsh Road	48.1	48.1	55	0.0
19	731 Marsh Road	48.9	49.0	55	0.1
20	761 Marsh Road	52.4	52.5	55	0.1
21	767 Marsh Road	54.2	54.2	55	0.0
22	781 Marsh Road	59.4	59.8	60	0.4
23	3780 Nelson Bay Road	58.8	58.9	60	0.1
24	3724 Nelson Bay Road	54.7	54.8	60	0.1
25	3790 Nelson Bay Road	59.9	60.0	60	0.1

Table25: Cumulative Traffic Noise Impact (dBA) – Year 3 Operation

Rec #	Location	Day Period ($L_{Aeq,15hr}$)			
		Base Traffic Flow	Base Traffic Flow + year 3 development Flow	Criteria	Difference
1	724 Marsh Road	45.8	46.0	55	0.2
2	776 Marsh Road	57.9	58.0	60	0.1
3	772 Marsh Road	55.5	55.8	55	0.3
4	764 Marsh Road - Public School	53.6	53.9	55	0.3
5	762 Marsh Road	49.2	49.2	55	0.0
6	760 Marsh Road - Public Hall	58.3	58.4	55	0.1
7	756 Marsh Road	48.2	48.2	55	0.0
8	712 Marsh Road	46.9	47.0	55	0.1
16	3551 Nelson Bay Road	48.3	48.5	60	0.2
17	3515 Nelson Bay Road	52.2	52.5	60	0.3
18	723 Marsh Road	48.1	48.1	55	0.0
19	731 Marsh Road	48.9	49.0	55	0.1
20	761 Marsh Road	52.4	52.5	55	0.1
21	767 Marsh Road	54.2	54.3	55	0.1
22	781 Marsh Road	59.4	60.1	60	0.7
23	3780 Nelson Bay Road	58.8	58.9	60	0.1
24	3724 Nelson Bay Road	54.7	54.9	60	0.2
25	3790 Nelson Bay Road	59.9	60.1	60	0.2

Table 26: Cumulative Traffic Noise Impact (dBA) – Year 4 Operation

Rec #	Location	Day Period ($L_{Aeq,15hr}$)			
		Base Traffic Flow	Base Traffic Flow + year 4 development Flow	Criteria	Difference
1	724 Marsh Road	45.8	46.3	55	0.5
2	776 Marsh Road	57.9	58.1	60	0.0
3	772 Marsh Road	55.5	55.9	55	0.4
4	764 Marsh Road - Public School	53.6	54.1	55	0.5
5	762 Marsh Road	49.2	49.3	55	0.1
6	760 Marsh Road - Public Hall	58.3	58.4	55	0.1
7	756 Marsh Road	48.2	48.3	55	0.1
8	712 Marsh Road	46.9	47.0	55	0.1
16	3551 Nelson Bay Road	48.3	48.5	60	0.2
17	3515 Nelson Bay Road	52.2	52.6	60	0.4
18	723 Marsh Road	48.1	48.1	55	0.0
19	731 Marsh Road	48.9	49.0	55	0.1
20	761 Marsh Road	52.4	52.5	55	0.1
21	767 Marsh Road	54.2	54.3	55	0.1
22	781 Marsh Road	59.4	60.3	60	0.9
23	3780 Nelson Bay Road	58.8	58.9	60	0.1
24	3724 Nelson Bay Road	54.7	55.0	60	0.3
25	3790 Nelson Bay Road	59.9	60.2	60	0.3

Table 27: Cumulative Traffic Noise Impact (dBA) – Peak truck Operation (200 Trucks)

Rec #	Location	Day Period ($L_{Aeq,15hr}$)			
		Base Traffic Flow	Base Traffic Flow + peak development Flow	Criteria	Difference
1	724 Marsh Road	45.8	46.4	55	0.6
2	776 Marsh Road	57.9	58.3	60	0.4
3	772 Marsh Road	55.5	56.2	55	0.7
4	764 Marsh Road - Public School	53.6	54.4	55	0.8
5	762 Marsh Road	49.2	49.3	55	0.1
6	760 Marsh Road - Public Hall	58.3	58.4	55	0.1
7	756 Marsh Road	48.2	48.3	55	0.1
8	712 Marsh Road	46.9	47.1	55	0.2
16	3551 Nelson Bay Road	48.3	48.8	60	0.5
17	3515 Nelson Bay Road	52.2	52.9	60	0.7
18	723 Marsh Road	48.1	48.2	55	0.1
19	731 Marsh Road	48.9	49.0	55	0.1
20	761 Marsh Road	52.4	52.6	55	0.2
21	767 Marsh Road	54.2	54.4	55	0.2
22	781 Marsh Road	59.4	61.0	60	1.6
23	3780 Nelson Bay Road	58.8	59.1	60	0.3
24	3724 Nelson Bay Road	54.7	55.2	60	0.5
25	3790 Nelson Bay Road	59.9	60.4	60	0.5

The predicted existing traffic levels at receivers R3 & R6 are slightly raised above the daytime noise criteria for the current traffic flows on the road. As stated in Section 3.4 of the Road Noise Policy, with regard to existing residences and other sensitive land uses affected by additional traffic on existing roads, generated by land use development, any increase in total traffic noise level should be limited to 2dB above that of the corresponding existing noise level at any residential property.

As seen from ***Table 23*** to ***Table 27*** there is an acceptable increase in the predicted traffic noise at all locations for years 1 to 4 with the maximum increase being 0.9 dB. Modelling was also conducted for the peak lorries outlined in the Seca Traffic Impact Assessment of 200 lorries and the maximum increase is predicted to be an increase of 1.6dB at receiver R22, located at 781 Marsh Road. As these increases in traffic noise levels are within +2dB of the existing road traffic noise levels at the sensitive receivers, the increase in traffic volumes on Marsh Road and Nelson Bay Road are deemed to be acceptable.

Although the peak number of 200 export lorries is acceptable along Nelson Bay Road and Marsh Road, the maximum number of lorries permitted to utilise the private haul road remains 150 for the worst-case weather conditions, as outlined in ***Section 7.1***.

8 CONCLUSION

A noise impact assessment has been undertaken to determine the potential noise impact of the proposed Sand Mine at Bobs Farm on noise sensitive receptors in the surrounding area of the proposed development site.

8.1 SAND MINE OPERATIONS (OPERATIONAL NOISE ASSESSMENT) - DAYTIME OPERATIONS

Vipac has assessed the potential operational phase noise impacts on the 25 identified receivers surrounding the proposed Sand Mine for each of the first four years of operation down to the maximum pit depth. From operational Year 1 receivers R1-R3, R5, R7 are predicted to exceed the noise criteria for worst-case conditions. These exceedances are attributed to the operation of the export lorries along the private haul road. To mitigate these exceedances Vipac proposes a 4m high acoustic barrier along both sides of the haul road at the Marsh Road exit, with the eastern barrier to be an absorbent barrier. Additionally a 6m high noise bund is proposed to run the length of the western boundary of the sand mine, along the northern boundary and down to join the 4m noise barrier at Marsh Road to mitigate the noise levels for receivers R1, R13 – R17. With the implementation of these barriers the predicted noise levels at R1-R3, R5, and R7 are compliant with the daytime noise criteria.

Additionally the results of the noise modelling also show that there are exceedances predicted at R13- R16 for Year 1, 2 & 3 operations under worst case conditions in the west end of the mine operation. To mitigate these noise levels Vipac proposes a 4m high bund around the processing area in conjunction with the 6m high bund around the pit of the Sand Mine as outlined above. These noise mitigation measures will reduce the noise levels to below the criteria for Year 1 and 2. During Year 3 Operational scenario a 1dB exceedance of the noise criteria is still predicted for receivers R14-R16 for this scenario, although this is not considered to be a significant impact, and this impact will only be for a short period before the pit progresses to a lower level beneath sea level.

Vipac has also conducted noise modelling to assess the impact to the receivers for the proposed peak of 200 export lorries utilising the private haul road during peak production. The results show that with the above proposed mitigation measures in place, the peak 200 trucks are predicted to comply with the criteria at all receiver locations for both neutral and worst-case conditions with the exception R2 & R3 during worst-case conditions. Vipac has conducted additional noise modelling to assess the maximum number of export lorries permissible to utilise the private haul road under worst-case weather conditions and comply with the noise criteria at R2 & R3 and found the maximum number of lorries to be 150 lorries.

8.2 SAND MINE OPERATIONS (OPERATIONAL NOISE ASSESSMENT) - NIGHT TIME OPERATIONS

Noise modelling was conducted to assess the night-time operations (6am-7am) for the proposed Sand Mine and there are exceedances predicted at receivers at R1 on the eastern end of the Sand Mine and R2-R7 & R20-R24 at the Marsh Road exit of the haul road. These exceedances are attributed to the operation of the haul road accessing the Sand Mine from Marsh road and export lorries on the road. Vipac again has conducted modelling to ascertain the maximum number of trucks permissible in this night-time period (6am-7am) without exceeding the noise criteria at this point and the predicted maximum number of trucks on the haul road is a single truck.

Noise prediction modelling has been carried out to assess the potential sleep disturbance impact associated with the proposed Sand Mine on the existing noise environment at the nearest noise sensitive receptors located in proximity to the site during the night period.

The predicted noise impact associated with the proposed development of the Sand Mine on the noise sensitive receivers range between 34 to 63dB(A) at the façade of the noise sensitive receptors. The predicted noise levels are raised above the sleep disturbance criteria during the Sand Mine operations at receivers R1, R5, R7,R14, R15, R20 & R21. The exceedances range from 1dB exceedance to 7dB. The Marsh Road receivers at the exit of the Haul Road are the most effected experiencing exceedances of 4-7dBA during the operation of the Sand Mine.

Due to the predicted exceedances of the sleep disturbance criteria at receivers R1, R5, R7, R14, R15, R20 & R21 and the exceedance of the operational L_{Aeq} criteria for any more than a single truck at the Marsh Road exit of the Sand Mine site during the night-time period of 6am-7am it is not recommended for the mine to operate during this period.

8.3 TRAFFIC NOISE ASSESSMENT

Noise modelling has also been undertaken to assess the potential noise impacts associated with the additional vehicle movements Nelson Bay Road and the eastern end of Marsh Road. The noise model has taken into account all the sources (Nelson Bay Road and Marsh Road) associated with traffic that will be generated by the proposed Sand Mine as outlined in ***Section 6.3*** to determine the cumulative noise levels in the area. As Receivers 9-15 are situated along Marsh Road where no additional traffic flow is proposed to be generated by the Sand Mine they have not been assessed as part of the traffic noise impact assessment.

Additionally as night-time operations are not recommended due to the exceedances of the noise criteria as outlined in ***Section 7.1*** and ***Section 7.2***, no traffic noise modelling has been conducted for the night-time period (6am-7am).

As seen from ***Tables 23 to 27*** there is an acceptable increase in the predicted traffic noise at all locations for Years 1 to 4 with the maximum increase being 0.9 dB.

Modelling was also conducted for the peak lorries outlined in the Seca Traffic Impact Assessment of 200 lorries and the maximum increase is predicted to be an increase of 1.6dB at receiver R22, located at 781 Marsh Road. As these increases in traffic noise levels are within +2dB of the existing road traffic noise levels at the sensitive receivers, the increase in traffic volumes on Marsh Road and Nelson Bay Road are deemed to be acceptable.

Although the peak number of 200 export lorries is acceptable along Nelson Bay Road and Marsh Road, the maximum number of lorries permitted to utilise the private haul road remains 150 for the worst-case weather conditions, as outlined in ***Section 7.1***.

APPENDIX A: YEAR 2 & 3 OPERATION RESULTS

Year 2 Operation - West End of Mine Working Scenario – Predicted Noise Impact (L_{Aeq})

Rec #	Predicted Noise Levels dB(A)									
	Criteria	Day Period No Mitigation		Day Period Mitigation applied		Criteria	Night Period No Mitigation		Night Period Mitigation applied	
		Neutral	Worst-case	Neutral	Worst-case		Neutral	Worst-case	Neutral	Worst-case
R1	45	41	44	33	37	40	44	47	37	42
R2	50	50	51	41	42	40	51	52	43	44
R3	50	65	65	37	38	40	51	52	38	39
R4	40 (when in use)	35	36	27	29	40 (when in use)	36	38	39	41
R5	48	48	49	38	39	40	49	50	39	41
R6	55 (when in use)	40	42	34	36	55 (when in use)	42	45	37	39
R7	48	46	47	35	37	40	47	49	37	40
R8	48	26	30	23	27	40	30	35	27	32
R9	45	26	29	22	25	40	29	34	25	30
R10	48	31	36	21	25	40	36	41	25	30
R11	48	31	36	21	25	40	36	41	25	30
R12	55 (when in use)	32	36	27	30	55 (when in use)	36	41	30	35
R13	45	44	47	33	36	40	48	52	36	39
R14	45	41	45	39	43	40	45	50	43	48
R15	45	39	44	38	42	40	44	48	42	47
R16	45	37	42	34	39	40	42	47	33	38
R17	45	30	35	28	33	40	35	40	39	40
R18	48	26	31	22	26	40	31	36	26	30
R19	48	30	34	24	28	40	34	39	28	32
R20	48	37	40	32	35	40	40	43	35	38
R21	48	42	43	37	39	40	43	45	39	41
R22	50	44	45	38	39	40	45	46	38	41
R23	50	35	39	29	33	40	39	43	36	40
R24	50	33	36	33	36	40	37	41	39	44
R25	50	32	36	31	35	40	36	41	33	37

Year 2 Operation - East End of Mine Working Scenario – Predicted Noise Impact (L_{Aeq})

Rec #	Predicted Noise Levels dB(A)									
	Criteria	Day Period No Mitigation		Day Period Mitigation applied		Criteria	Night Period No Mitigation		Night Period Mitigation applied	
		Neutral	Worst-case	Neutral	Worst-case		Neutral	Worst-case	Neutral	Worst-case
R1	45	48	52	41	44	40	48	52	41	45
R2	50	51	52	42	44	40	51	52	43	44
R3	50	65	65	38	39	40	51	52	38	39
R4	40 (when in use)	36	38	29	31	40 (when in use)	36	38	39	42
R5	48	49	50	40	42	40	49	50	40	42
R6	55 (when in use)	42	45	37	39	55 (when in use)	42	45	37	40
R7	48	47	49	37	41	40	47	49	38	41
R8	48	31	35	28	32	40	31	35	28	32
R9	45	31	35	27	31	40	32	36	27	32
R10	48	37	42	29	34	40	37	42	30	34
R11	48	37	42	29	34	40	37	42	30	34
R12	55 (when in use)	35	40	34	39	55 (when in use)	35	40	34	39
R13	45	38	42	25	29	40	38	43	25	30
R14	45	37	41	31	36	40	37	41	31	36
R15	45	36	41	32	37	40	36	41	32	37
R16	45	37	41	33	38	40	37	42	30	35
R17	45	34	39	29	34	40	34	39	39	40
R18	48	31	36	27	31	40	31	36	27	31
R19	48	35	40	29	33	40	35	40	29	33
R20	48	40	43	35	39	40	40	43	35	39
R21	48	43	46	39	42	40	43	46	39	42
R22	50	45	46	39	40	40	45	46	38	41
R23	50	39	43	33	38	40	39	43	37	41
R24	50	37	41	37	40	40	37	42	33	38
R25	50	37	42	36	41	40	38	43	33	38

Year 3 Operation- West End of Mine Working Scenario – Predicted Noise Impact (L_{Aeq})

Rec #	Predicted Noise Levels dB(A)									
	Criteria	Day Period No Mitigation		Day Period Mitigation applied		Criteria	Night Period No Mitigation		Night Period Mitigation applied	
		Neutral	Worst-case	Neutral	Worst-case		Neutral	Worst-case	Neutral	Worst-case
R1	45	43	49	34	42	40	46	49	38	42
R2	50	52	55	43	47	40	53	55	46	46
R3	50	67	67	39	42	40	53	55	40	42
R4	40 (when in use)	38	40	29	33	40 (when in use)	39	40	41	43
R5	48	50	53	40	43	40	51	53	41	43
R6	55 (when in use)	42	47	37	41	55 (when in use)	44	47	39	42
R7	48	48	51	37	41	40	49	51	39	41
R8	48	27	36	24	32	40	31	36	28	32
R9	45	27	34	23	30	40	30	34	26	30
R10	48	31	40	19	27	40	35	40	23	28
R11	48	31	40	19	27	40	35	40	23	28
R12	55 (when in use)	30	37	28	35	55 (when in use)	34	38	31	36
R13	45	43	50	36	40	40	52	55	38	40
R14	45	40	48	37	41	40	49	52	40	44
R15	45	37	46	35	41	40	40	44	38	42
R16	45	38	47	34	41	40	40	44	24	29
R17	45	28	37	20	29	40	32	37	41	43
R18	48	28	37	24	32	40	32	37	28	32
R19	48	31	40	25	34	40	36	40	29	34
R20	48	39	45	34	40	40	42	45	37	40
R21	48	44	47	39	43	40	46	48	41	43
R22	50	46	49	40	43	40	47	49	40	43
R23	50	37	45	31	39	40	41	45	38	41
R24	50	36	42	35	41	40	39	42	38	41
R25	50	33	42	32	41	40	38	42	34	39

Year 3 Operation - East end of Mine Working Scenario – Predicted Noise Impact (L_{Aeq})

Rec #	Predicted Noise Levels dB(A)									
	Criteria	Day Period No Mitigation		Day Period Mitigation applied		Criteria	Night Period No Mitigation		Night Period Mitigation applied	
		Neutral	Worst-case	Neutral	Worst-case		Neutral	Worst-case	Neutral	Worst-case
R1	45	43	49	34	42	40	46	49	38	42
R2	50	52	55	43	47	40	53	55	46	46
R3	50	67	67	39	42	40	53	55	40	42
R4	40 (when in use)	38	40	29	33	40 (when in use)	39	40	41	43
R5	48	50	53	40	43	40	51	53	41	43
R6	55 (when in use)	42	47	37	41	55 (when in use)	44	47	39	42
R7	48	48	51	37	41	40	49	51	39	41
R8	48	27	36	24	32	40	32	36	28	33
R9	45	29	36	24	32	40	32	36	28	32
R10	48	31	40	19	27	40	35	40	23	28
R11	48	31	40	19	27	40	35	40	23	28
R12	55 (when in use)	33	43	33	43	55 (when in use)	38	43	38	43
R13	45	32	41	18	26	40	37	41	22	26
R14	45	31	40	21	30	40	35	40	25	30
R15	45	30	39	21	30	40	34	39	26	31
R16	45	31	40	24	34	40	35	41	26	31
R17	45	28	37	21	31	40	33	38	41	43
R18	48	28	37	24	32	40	32	37	28	32
R19	48	31	40	25	34	40	36	40	29	34
R20	48	39	45	34	40	40	42	45	37	40
R21	48	44	47	39	43	40	46	48	41	43
R22	50	46	49	40	43	40	47	49	40	43
R23	50	37	45	31	39	40	41	45	38	42
R24	50	36	42	35	41	40	39	42	29	34
R25	50	34	43	33	42	40	38	43	34	39

APPENDIX B: SLEEP DISTURBANCE RESULTS

Year 1, 4 & Peak Operation Sleep Disturbance Assessment

Rec #	Predicted Noise Levels dB(A)										
	Criteria	Year 1 West- Night Mitigation Applied		Year 1 East- Night Mitigation Applied		Year 4 West- Night Mitigation Applied		Year 4 East- Night Mitigation Applied		Peak- Night Mitigation Applied	
		Neutral	Worst-case	Neutral	Worst-case	Neutral	Worst-case	Neutral	Worst-case	Neutral	Worst-case
R1	53	50	55	54	57	52	56	52	56	55	59
R2	66	54	54	54	54	60	60	60	60	63	63
R3	66	49	50	49	50	54	56	54	56	58	59
R4	N/a	50	52	50	53	55	58	55	58	59	61
R5	56	50	52	51	54	55	57	55	57	59	60
R6	N/a	45	48	46	50	53	55	53	55	56	59
R7	56	48	51	49	53	53	55	53	55	56	58
R8	54	39	43	44	49	42	46	42	46	45	50
R9	53	38	42	40	44	41	45	40	44	42	47
R10	56	34	38	37	42	37	41	37	41	40	44
R11	56	34	38	37	42	37	41	37	41	40	44
R12	N/a	42	47	45	50	48	52	44	49	47	52
R13	54	47	50	39	44	35	40	41	45	42	46
R14	54	53	57	42	47	39	43	43	47	44	48
R15	54	51	55	42	47	39	44	42	46	44	48
R16	54	45	50	41	47	38	43	37	42	43	48
R17	54	43	46	44	48	39	44	39	44	39	44
R18	56	37	42	42	47	42	46	41	46	45	49
R19	56	41	46	44	49	43	48	43	48	47	51
R20	56	45	49	45	49	51	54	51	54	54	57
R21	54	47	51	48	52	55	57	55	57	58	61
R22	66	49	52	50	53	54	57	54	57	58	61
R23	66	48	52	48	53	52	55	52	55	55	58
R24	66	52	56	44	49	42	47	40	45	43	48
R25	66	45	50	46	51	49	53	49	53	52	56

*Receivers R4, R6, R12 do not have applicable sleep disturbance criteria as they are not residential buildings

Year 2 & 3 Operation Sleep Disturbance Assessment

Rec #	Predicted Noise Levels dB(A)								
	Criteria	Year 2 West- Night Mitigation Applied		Year 2 East- Night Mitigation Applied		Year 3 West- Night Mitigation Applied		Year 3 East- Night Mitigation Applied	
		Neutral	Worst-case	Neutral	Worst-case	Neutral	Worst-case	Neutral	Worst-case
R1	53	49	54	53	57	50	54	50	54
R2	66	55	56	55	56	58	58	58	58
R3	66	50	51	50	51	52	54	52	54
R4*	N/a	51	53	51	54	53	55	53	55
R5	54	51	53	52	54	53	55	53	55
R6*	N/a	49	51	49	52	51	54	51	54
R7	54	49	52	50	53	51	53	51	53
R8	54	39	44	40	44	40	44	40	45
R9	53	37	42	39	44	38	42	40	44
R10	54	37	42	42	46	35	40	35	40
R11	54	37	42	42	46	35	40	35	40
R12*	N/a	42	47	46	51	43	48	50	55
R13	54	48	51	37	42	50	52	34	38
R14	54	55	60	43	48	52	56	37	42
R15	54	54	59	44	49	50	54	38	43
R16	54	45	50	42	47	36	41	38	43
R17	54	51	52	51	52	53	55	53	55
R18	54	38	42	39	43	40	44	40	44
R19	54	40	44	41	45	41	46	41	46
R20	54	47	50	47	51	49	52	49	52
R21	54	51	53	51	54	53	55	53	55
R22	66	50	53	50	53	52	55	52	55
R23	66	48	52	49	53	50	53	50	54
R24	66	51	56	45	50	50	53	41	46
R25	66	45	49	45	50	46	51	46	51

*Receivers R4, R6, R12 do not have applicable sleep disturbance criteria as they are not residential buildings