APPENDIX 10

Noise Impact Assessment

umwelt

Inspired people | Dedicated team
Quality outcomes

Aus-10 Rhyolite Pty Ltd

NOISE IMPACT ASSESSMENT

Proposed Expansion of Tinda Creek Sand Quarry

June 2014

Aus-10 Rhyolite Pty Ltd

NOISE IMPACT ASSESSMENT

Proposed Expansion of Tinda Creek Sand Quarry

June 2014

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Aus-10 Rhyolite Pty Ltd

Project Director: **Peter Jamieson**
Report No. **1731/R18/FINAL**
Date: **June 2014**

Newcastle

75 York Street
Teralba NSW 2284

Ph. 02 4950 5322

www.umwelt.com.au

TABLE OF CONTENTS

1.0 Introduction 1.1
1.1 The Project 1.1
2.0 Statutory Requirements 2.1
2.1 Director-General's Requirements 2.1
2.2 Section 10 of the Industrial Noise Policy 2.1
2.3 Methodology 2.2
3.0 Existing Acoustic Environment and Assessment Criteria 3.1
3.1 Existing Noise Environment 3.1
3.2 Intrusiveness and Amenity Criteria 3.2
3.3 Project-specific Noise Levels 3.3
3.4 Sleep Disturbance Criteria 3.3
3.5 Construction Noise Criteria 3.3
3.6 Road Traffic Noise Criteria 3.4
4.0 Noise Modelling Parameters 4.1
4.1 Prediction of Projected Noise Levels 4.1
4.2 Operational Noise Sources 4.1
4.3 Construction Noise 4.2
4.4 Road Traffic Noise 4.2
4.5 Receiver Locations 4.4
4.6 Meteorological Conditions 4.4
5.0 Noise Predictions 5.1
5.1 Operational Noise Levels 5.1
5.2 Sleep Disturbance 5.2
5.3 Construction Noise Assessment 5.2
5.4 Road Traffic Noise Assessment 5.3
5.5 Cumulative Impact Assessment 5.5
6.0 Conclusion and Recommendations 6.1
6.1 Conclusion 6.1
6.2 Management and Monitoring Recommendations 6.2
7.0 References 7.1

FIGURES

1.1 Locality Map 1.1

1.2 Proposed Expansion of Tinda Creek Sand Quarry Project 1.1

3.1 Noise Monitoring and Noise Sensitive Receiver Locations 3.1

APPENDICES

A Glossary of Terms and Abbreviations

B Industrial Noise Policy Assessment Methodology

C Assessment of the Existing Noise Environment

1.0 Introduction

Aus-10 Rhyolite Pty Ltd t/a Hy-Tec Concrete and Aggregates (Hy-Tec) operate Tinda Creek Quarry, a sand quarry located approximately 67 kilometres north of Windsor along Putty Road, NSW (**Figure 1.1**). Quarrying activities have been undertaken at Tinda Creek Quarry for approximately 30 years with the quarry currently producing up to 125,000 tonnes of product per year. The existing operations have been developed in accordance with a number of development consents, licences and project approvals, including DA 134/95 (incorporating the 2009 modifications) and Environment Protection Licence (EPL) 12007.

Hy-Tec is seeking approval to increase production levels from Tinda Creek Quarry from approximately 125,000 tonnes per annum (tpa) up to 300,000 tpa by increasing the area subject to sand extraction to include additional identified resource domains (the Project). The duration of the Project is expected to be completed in approximately 30 years.

This Noise Impact Assessment (NIA) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) to support an Environmental Impact Statement (EIS) for the Project required under Section 89H of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This NIA has been undertaken in accordance with the NSW *Industrial Noise Policy* (INP) (Environment Protection Authority (EPA) 2000) with the objective of addressing the key issues relating to noise as required by the Director-General's Environmental Assessment Requirements for the Project (refer to **Section 2.1**).

1.1 The Project

The Project area is shown in **Figure 1.2** and shows the major components of the Project within parcels of land described in cadastral terms as Lot 1, Lot 2 and Lot 3 in DP 628806, on Putty Road, approximately 23 kilometres north of Colo Heights, NSW. Lot 1, Lot 2, and Lot 3 are 86 hectares, 86.67 hectares and 86 hectares respectively, with a total site area of 258.67 hectares. The Project area is bounded on the north, east and south by Yengo National Park and on the west by Putty Road, several agricultural land holdings and Wollemi National Park (**Figure 1.2**).

The proposed extension will further the existing sand extraction operations on the site as additional stages of development. The following resource domains are the subject of this assessment:

- Domain 1 – approximately 14.17 hectare area comprising an indicated product-sand resource of 1.89 million tonnes (Mt).
- Domain 2 – approximately 5.29 hectare area comprising an indicated product-sand resource of 0.35 Mt.
- Domain 3 – approximately 13.40 hectare area comprising an indicated product-sand resource of 1.95 Mt.
- Domain 4 – approximately 4.14 hectare area comprising an indicated product-sand resource of 0.39 Mt.
- Domain 6 – approximately 13.17 hectare area comprising an indicated product-sand resource of 2.26 Mt.
- Domain 7 – approximately 17.54 hectare area to the south of the current quarry site (upstream), on Lot 3 in DP 628806, consisting of a measured sand resource of 2.64 Mt.

Source: Google (2002)

0 0.5 1.0 2km
1:35 000

Legend

Project Area

FIGURE 1.1

Locality Map

Source: Google Earth (2012), LPI NSW (2007)

0 250 500 750m
1:15 000

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- Private Holding Duck Farm
- Private Holding Hobby Farm
- National Park Boundary

FIGURE 1.2

Proposed Expansion of Tinda Creek Sand Quarry Project

File Name (A4): R18_V1/1731_376.dgn

The total product-sand resource is therefore estimated at 6.84 Mt, based on a recent geological assessment on Lots 1 to 3 (Stitt, 2010; 2012) and a constraints analysis undertaken as part of this EIS, a maximum extraction depth of 15.24 metres below ground level and design internal batters of 3H:1V.

Each extraction stage will involve the removal and stockpiling of topsoil followed by the extraction of available resource via cutter suction dredge. A summary of the extraction sequence is described as follows:

- Following completion of dredging in Domain 4 (the majority of which is within the existing approved extraction area), extraction will continue in a westerly direction into Domain 6.

- While the dredge is located within Domain 6, extraction operations will also be undertaken in Domain 2 as a dry extraction operation, from which sand will be 'pushed' into the Domain 6 dredge pond (e.g. via dozer, excavator and haulage truck) and then dredged to the processing plant.

- After extraction in Domain 6 is completed, operations would move into the Domain 1 area.

- After completion of Domain 1, the dredge will be dismantled and moved back upstream to the Domain 3 area.

An alternative biodiversity offset area configuration is also being considered which, if adopted, would result in quarrying being undertaken with Domain 7 rather than Domain 3. Quarrying within Domain 7 would disturb approximately 12.12 hectares with an indicated resource of approximately 2 Mt and would be more distant from the nearest residential receivers than Domain 3 and is therefore unlikely to adversely change predicted noise impacts assessments. Apart from the possible change to where quarrying will take place, there will be no other changes associated with the alternative biodiversity offset area that have the potential to impact on noise.

The Project will not require any changes to the existing workforce of 6 to 8. Heavy vehicle loads per day on average are proposed to increase due to the Project from approximately 12 to 16 loads per day to 30 to 34 loads per day (one way).

It is proposed that hours of operation of the Project would be 5.00 am to 10.00 pm Monday to Friday and 5.00 am to 3.00 pm on Saturdays, in order to enable the quarry to service variable product demand. Extraction operations, however, would be undertaken primarily during daylight hours. Normal operations would not be undertaken on Sundays and public holidays, although it is proposed that operations such as repair and maintenance of plant/equipment and vehicles may occur during these times.

2.0 Statutory Requirements

2.1 Director-General's Requirements

The Department of Planning and Infrastructure (DP&I), now known as the Department of Planning and Environment (DP&E), has issued Director-General Requirements (DGRs) for the Project that identifies noise impacts as an issue for consideration in the EIS for the Project. The DGRs specify that the EIS must include quantitative assessment of:

- noise from construction, operational and off-site transport noise impacts;
- reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed; and
- monitoring and management measures, in particular real-time, attended noise monitoring and predictive meteorological forecasting.

The DGRs specify that this assessment should be undertaken in accordance with the following policies and guidelines:

- INP (EPA, 2000); and
- NSW Road Noise Policy (Department of Environment, Climate Change and Water – DECCW, 2011).

2.2 Section 10 of the Industrial Noise Policy

Section 10 – 'Applying the policy to existing industrial premises' of the INP (EPA, 2000) deals with application of the INP (EPA, 2000) to existing industrial noise sources such as Tinda Creek Quarry. The approach established by the EPA was designed to allow established industries to adapt to changes in the noise expectations of the community while remaining economically viable.

The INP (EPA, 2000) identifies four triggers for the application of Section 10. These are:

- the site becomes the subject of serious and persistent noise complaints;
- there is a proposal to upgrade and/or expand the site;
- the site has no formal consent or licence conditions and management wish to clarify their position; and
- management chooses to initiate a noise reduction program.

Using these triggers as a guide, the methodology for the preparation of the NIA has taken into account:

1. Tinda Creek Quarry is not the subject of noise complaints from the community or Office of Environment and Heritage (OEH).
2. As discussed in **Section 1.0**, the preparation of the EIS and supporting studies is to enable the expansion of sand extraction activities at Tinda Creek Quarry. The Project does not specifically address improvements in operating practices, equipment selection

and/or product quality/demand but this is likely to be an outcome of the continued operation of Tinda Creek Quarry.

3. The original development consent for Tinda Creek Quarry was granted in 1996. As a result, the management of the noise impacts was based around the expectation of the *Environmental Noise Control Manual* (EPA, 1985).

4. EPL 12007 and DA 134/95 (incorporating the 2009 modifications) do not contain specific noise criteria in which to monitor the noise performance of Tinda Creek Quarry.

The NIA seeks to assess the performance of the Project against a noise criterion that has been established in accordance with the expectations of the INP (EPA, 2000).

Section 10 of the INP (EPA, 2000) outlines a methodology for the assessment of a project where a company proposes to upgrade or modify its existing operations. This methodology, outlined in **Section 2.3**, is also applicable to a proposal for the continuation of an existing operation where the proponent wishes to clarify its position with respect to the expectations of the INP (EPA, 2000).

2.3 Methodology

To satisfy the requirements of the relevant policies and guidelines, the NIA has:

- identified noise sensitive locations likely to be affected by activities at the site and determined existing background and amenity noise levels at representative locations in accordance with the INP (EPA, 2000) (refer to **Section 3.0**);

- determined the Project Specific Noise Levels (PSNL) for the Project based on the assessment of underlying background and amenity noise levels of the surrounding receiver areas (refer to **Section 3.0**);

- identified all noise sources from the Project and determined the expected noise levels and noise characteristics (e.g. tonality, impulsiveness, etc.) likely to be generated from the noise sources (refer to **Section 5.0**);

- identified the times of operation of the Project and all related noise producing activities (refer to **Sections 1.0** and **4.0**);

- determined the noise levels likely to be received at the most sensitive locations under neutral meteorological conditions and relevant gradient winds (refer to **Section 5.0**);

- considered the influence of meteorological conditions such as wind and temperature inversions in the prediction model so as to provide a true representation of actual noise levels (refer to **Sections 4.0** and **5.0**);

- assessed the effect of relevant noise mitigation measures incorporated into the predictive modelling (refer to **Section 4.2**);

- compared the predicted noise levels with the appropriate PSNL determined for the activity/operation being considered (refer to **Section 5.0**). The assessment of the predicted noise levels against PSNL was undertaken in accordance with Section 10 of the INP (EPA, 2000) (refer to **Section 2.0**);

- discussed the findings from the predictive modelling and recommended control measures (refer to **Section 5.0**);

- quantified the residual level of noise impact where relevant noise criteria cannot be met after application of all feasible and cost effective mitigation measures, where relevant (refer to **Section 5.0**);

- determined the achievable project noise levels that would form the basis of project-specific noise criteria in accordance with the requirements of Section 10 of the INP (2000) (refer to **Sections 3.0**, **5.0** and **6.0**); and

- provided details of the recommended noise monitoring program to be undertaken at noise sensitive locations (subject to the agreement of the owners/occupiers) for the duration of the Project.

The computer-based modelling software package Environmental Noise Model (ENM) was used to predict the noise levels likely to be produced by the Project in the surrounding environment. The ENM noise models were based on machine and plant sound power level data collected by Umwelt, digital terrain maps of the region surrounding the Project prepared by Umwelt and the layout of the existing and proposed operations provided by Hy-Tec.

The NIA was based on the noise levels predicted by the ENM model of the proposed operations for the Project. The assessment of the predicted noise levels against PSNL was then undertaken in accordance with Section 10 the INP (EPA, 2000). The results of this investigation are presented in **Section 5.0**.

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

The noise modelling and assessment process is described in **Sections 3.0** through **5.0**. A detailed summary of the INP (EPA, 2000) assessment methodology used for this NIA is provided in **Appendix B**.

3.0 Existing Acoustic Environment and Assessment Criteria

3.1 Existing Noise Environment

The existing background noise environment in the area surrounding the Project was measured using a continuous noise logger. The location of the monitoring site is presented in **Figure 3.1** and the details of the monitoring program are given in **Table 3.1**. The monitoring results were used to assess the background (L_{A90}) and amenity (L_{Aeq}) noise levels within the residential receiving areas adjacent to the site.

Table 3.1 – Noise Monitoring Program Details

Title	Location	Logger Serial No.	Measurement Started	Measurement Stopped
N1	Lot 2, DP 628806 MGA56 E285298 N6327945	194625	10:00 17/11/10	10:45 26/11/10

Monitoring location N1 is located to the west of the existing sand quarry on Lot 2, DP 628806. The monitoring location represents an undeveloped rural area, nearby to the existing sand quarry, that is considered representative of the of the background noise environment at the potentially affected noise sensitive locations.

The results of the monitoring program are provided in **Appendix C**.

The continuous noise logger recorded:

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

The run chart of the raw data from the monitoring program and the determination of the corresponding Assessment Background Level (ABL) and Rating Background Level (RBL) are provided in **Appendix C**.

Based on the background monitoring results it can be reasonably assumed that, due to the rural nature of the area surrounding the Project, the existing background level is at or below 30 dB(A). In addition to this, there are no other industrial noise sources in areas surrounding the Project. Therefore the existing industrial $L_{Aeq,\ period}$ (where period is day, evening or night) noise levels is more than 10 dB below the Acceptable Noise Level as defined by the INP (EPA, 2000).

Source: Google Earth (2012), LPI NSW (2007)

0 250 500 750m
1:15 000

Legend

- Project Area
- Proposed Extraction Area
- Domain 3 Extraction Area
- Domain 7 Extraction Area
- Private Holding Duck Farm
- Private Holding Hobby Farm
- National Park Boundary
- Noise Monitoring Location
- Nosie Receiver Location

FIGURE 3.1

Noise Monitoring and Noise Sensitive Receiver Locations

File Name (A4): R18_V1/1731_377.dgn

3.2 Intrusiveness and Amenity Criteria

3.2.1 Application of the Industrial Noise Policy

The INP (EPA, 2000) has two components for the assessment of industrial noise sources, intrusive noise impacts and noise amenity levels. When assessing the noise impact of industrial sources both components are considered for residential receivers.

The PSNL reflects the most stringent noise levels derived from both the Intrusiveness and Amenity Criteria. Where the Intrusiveness Criteria is less than or equal to the Amenity Criteria, the Intrusiveness Criteria is applied as the limiting criterion and forms the PSNL for the industrial source as it is more stringent due to being determined over a much shorter period of time. Where the predicted amenity noise level is lower than the intrusive level, both the intrusive and amenity noise limits become the limiting criteria and form the PSNL for the industrial source.

PSNL set the benchmark against which noise impacts and the need for noise mitigation are assessed. For existing operations the PSNL are not mandatory but supply the initial target levels that are used to derive the achievable noise limits based on the implementation of feasible and reasonable control measures.

When setting the PSNL, the INP (EPA, 2000) recommends the application of the most stringent requirement so that the applicable PSNL both limits intrusive noise and protects noise amenity. The PSNL derived for the Project are provided in **Section 3.3**.

3.2.2 Intrusiveness Criteria

Where the existing background level in the region surrounding the Project is at or below 30 dB(A) the corresponding Intrusiveness Criteria would be 35 dB(A). This is the minimum possible Intrusiveness Criterion under the INP (EPA, 2000).

3.2.3 Amenity Criteria

To limit continuing increases in noise levels due to industrial development, the INP (EPA, 2000) has identified maximum ambient noise levels for typical receiver areas and land uses. The recommended acceptable and maximum ambient noise levels for a rural environment are provided in **Table 3.2**. The Amenity Criteria is then determined by comparing the existing ambient noise levels resulting from industrial noise sources with the recommended acceptable ambient noise levels (refer to Tables 2.1 and 2.2 in the INP (EPA, 2000)).

Table 3.2 – Amenity Criteria – Recommended L_{Aeq} Noise Levels from Industrial Noise Sources, dB(A)

Type of Receiver	Indicative Noise Amenity Area	Time of Day [1] (Period)	Recommended L_{Aeq} Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45

Note: 1.For Monday to Saturday, Day-time 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, Day-time 8.00 am – 6.00 pm; Evening 6.00 pm – 10.00 pm; Night-time 10.00 pm–8.00 am.

Where the existing industrial $L_{Aeq, period}$ (where period is day, evening or night) noise level is more than 10 dB below the Acceptable Noise Level referred to in **Table 3.2**, the Amenity Criteria is set at the Acceptable Noise Level nominated in **Table 3.2**.

3.3 Project-specific Noise Levels

The PSNL reflects the most stringent noise levels derived from both the Intrusiveness and Amenity Criteria and would be 35 dB(A) $L_{Aeq,15minute}$ for the day time, evening and night time periods.

3.4 Sleep Disturbance Criteria

The Sleep Disturbance Criteria are based on the criteria from the INP Application Notes which reference the review of research on sleep disturbance published in the NSW Road Noise Policy (DECCW, 2011). The INP Application Notes suggests that to prevent sleep disturbance, the $L_{A1,1minute}$ or L_{Amax} level of a noise source should not exceed the L_{A90} background noise level by more than 15 dB when measured outside the bedroom window. The Sleep Disturbance Criteria for all identified noise sensitive locations is 45 dB(A).

3.5 Construction Noise Criteria

The OEH recognises that construction activities could potentially generate higher noise levels than those of an industrial operation. Department of Environment and Climate Change (DECC)'s (now OEH's) *Interim Construction Noise Guideline* (DECC, 2009) provides criteria for construction activities as presented in **Table 3.3**, for representative residential receivers surrounding the Project. The criteria are intended to guide the need for and the selection of feasible and reasonable work practices to minimise construction noise impacts.

Table 3.3 – Construction Noise Management Levels at Residences, dB(A)

Construction Time	Management Level $L_{Aeq, 15 minute}$
Recommended standard hours Monday to Friday 7.00 am to 6.00 pm Saturday 8.00 am to 1.00 pm No work on Sundays or public holidays	Noise Affected: Rating Background Noise Level + 10 dB
	Highly Noise Affected: 75 dB(A)
Outside recommended standard hours	Noise Affected: Rating Background Noise Level + 5 dB

Source: *Interim Construction Noise Guideline* (DECC, 2009).

The construction phase of the Project is limited to the upgrade/re-alignment of the quarry access road and its connection to Putty Road. The upgrade of the quarry access road is only anticipated to occur within recommended standard construction hours. The construction noise management level for all residential receivers surrounding the Project is 40 dB(A).

3.6 Road Traffic Noise Criteria

The DECCW's (now OEH's) NSW Road Noise Policy (DECCW, 2011) sets out criteria for road traffic noise through the provision of a framework that addresses traffic noise issues associated with new developments, new or upgraded road developments or planned building developments.

Table 3.4 outlines the criteria relevant for the two-way traffic volumes due to the Project on Putty Road.

Table 3.4 – Road Noise Criteria, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria	
		Day (7.00 am – 10.00 pm)	Night (10.00 pm –7.00 am)
Freeway/ arterial/sub-arterial roads	3. Existing residences affected by additional traffic on existing freeways/ arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15\ hour)}$ 60 (external)	$L_{Aeq(9\ hour)}$ 55 (external)

Source: Table 3 NSW Road Noise Policy (DECCW, 2011)

4.0 Noise Modelling Parameters

4.1 Prediction of Projected Noise Levels

Section 6 of the INP (EPA, 2000) requires the prediction of noise levels taking into account all possible noise sources that may reasonably be expected when the plant or facility in question is fully operational. The schedule of major equipment items (or their equivalent) that Hy-Tec will typically use is described in **Section 4.2**. The ENM model has been prepared assuming that all the equipment available is operational for durations of time representative of typical operational scenarios. Sources were located in representative locations based on typical quarry operations, sand handling and processing, and product dispatch with sand extraction activities modelled within in Domain 1 (refer to **Figure 1.2**). This is likely to be representative of worst-case operational scenarios and give an indication of worst-case noise levels experienced at the receiver locations surrounding the Project.

The modelled scenario represents the proposed operations for the Project, incorporating the sand processing plant (including product loading and dispatch of road haulage trucks), sand extraction activities and the associated equipment supporting the sand extraction activities.

4.2 Operational Noise Sources

A noise source model was prepared to represent the type of equipment both currently in use at Tinda Creek Quarry and proposed for the Project. Throughout the life of the Project the equipment outlined in **Table 4.1**, or the equivalent, will typically be in use around the Project area. **Table 4.1** provides a list of typical equipment and sound power levels (SWL) associated with each item of equipment. To account for variability in the proposed quarry operation noise levels and the level of machine utilisation the combined sound power level of all noise sources modelled was 112 dB(A).

Table 4.1 – Modelled Equipment SWL, dB(A)

Equipment [1]	SWL, dB(A)
Suction Cutter Dredge	103
Dozer (equivalent to CAT D7)	108
35 t 6X6 articulated dump trucks (equivalent to Volvo A35D)	109
45 t Excavator (equivalent to Sumitomo SH 450 HD)	95
Front End Loader (equivalent to CAT 950)	110
Sand processing plant	99
Diesel Generator (500kvA)	98
Water Cart	103
Truck and Dog Tipper (transport of sand to customer)	103

Source: Umwelt SWL Library.

Note 1: Equipment make and model are listed for size comparison purposes only.

4.3 Construction Noise

A noise source model was prepared to assess the impacts of construction noise, associated with the upgrade/re-alignment of the quarry access road and its connection to Putty Road.

A range of typical construction equipment likely to be utilised on the site were included in the model. The SWL of this equipment are described in **Table 4.2**. To account for variability in the construction noise levels and level of machine utilisation the combined sound power level of all construction noise sources modelled was 109 dB(A). This represents the combination of machine related noise to construction activities during 'standard hours' as defined by the *Interim Construction Noise Guideline* (DECC, 2009).

Table 4.2 – Construction Equipment SWL, dB(A)

Equipment [1]	SWL, dB(A)
Grader	106
Dump trucks	108
Water cart (small)	106
Excavator	95

Source: Umwelt SWL Library.

4.4 Road Traffic Noise

The road noise impacts associated with traffic movements generated by the Project were modelled using the 'US Federal Highway Administration (FHWA) Traffic Noise Model (TNM) Version 2.5 Look-Up Tables' (US Department of Transportation, 2004). TNM is a highway traffic noise prediction and analysis model used to analyse highway geometries including vehicle speeds, vehicle type, setback distances and the effectiveness of barriers.

Heavy vehicle traffic volumes are expected to increase from the existing average 12 to 16 loads per day to an average of 30 to 34 loads per day associated with the increased production rate due to the Project.

Assessment of the road traffic noise impact of the Project has been conducted at three setback distances representative of the residential receivers likely to be influenced by movement of product trucks travelling to or from the Project along Putty Road. The road traffic noise impacts were modelled at setback distances of 20 metres, 50 metres and 100 metres from the centre line of Putty Road. Barrier attenuation due to terrain or structures was not included in the assessment model and presents a conservative worst case assessment approach.

Traffic volumes from NSW Roads and Maritime Service (formally the NSW RTA) AADT stations 06.122 and 06.113 have been used to determine daily existing two-way traffic volumes on Putty Road. The split of heavy vehicles to light vehicles was estimated based on AADT data and the information compiled in *Traffic Assessment – Upgrade of Existing Sand Quarry Facility – Tinda Creek Quarry, Putty Road Mellong* (TPK & Associates, 2013). The split of heavy vehicles to light vehicles was estimated to be 92% light vehicles and 8% heavy vehicles. On an axle pair basis, this has been conservatively weighted to 80% light vehicles (1 axle pair), 20% heavy vehicles (3 axles pairs). This assumption is therefore likely to overstate the influence of heavy vehicles travelling on Putty Road.

The following bases and assumptions were used for the purpose of the road traffic noise impact assessment:

- hourly AADT traffic volumes from were utilised to estimate existing day time and night time traffic noise impacts from Putty Road;
- based on AADT traffic volume data, traffic volumes along Putty Road in the vicinity of Wilberforce will likely remain unchanged during the life of the Project;
- based on AADT traffic volume data, traffic volumes along Putty Road north of Wilberforce through to Mellong will increase by 1.35% per year during the life of the Project;
- traffic volumes due to the Project will be additive to the existing traffic volumes on Putty Road;
- day time traffic numbers will increase from an average of 32 heavy vehicle passes due to existing quarry operations to an average of 54 heavy vehicle passes due to the Project;
- night time traffic numbers will increase from an average of 7 heavy vehicle passes due to existing quarry operations to an average of 14 heavy vehicle passes due to the Project;
- the predictions are based on an average speed on Putty Road of 100 kilometres per hour for the section of road north of Wilberforce for receivers with a setback distance of 50 metres or greater and an average speed of 80 kilometres per hour for receivers with a setback distance of less than 50 metres;
- the predictions are based on an average speed on Putty Road of 60 kilometres per hour for the section of Putty Road in the vicinity of Wilberforce;
- the existing estimated traffic volumes include existing light and heavy vehicle movements associated with the operation of Tinda Creek Quarry; and
- no noise barriers were included in the traffic noise prediction model.

The cumulative impact on the potentially affected residences of road traffic noise on Putty Road was estimated to give an indication of worst-case noise impacts due to traffic movements associated with the Project. The predicted road traffic noise impacts are based on the traffic volumes in **Table 4.3**.

Table 4.3 – Estimated Daily Existing Two-way Traffic Volumes for Putty Road

Location	Putty Road, north of Wilberforce through to Mellong Based on NSW RTA AADT Station 06.122				Putty Road in the Vicinity of Wilberforce Based on NSW RTA AADT Station 06.113	
Year of Project	**Year 1**		**Year 30**		**Year 1 to Year 30**	
Road Traffic Noise Assessment Period	Day Time	Night Time	Day Time	Night Time	Day Time	Night Time
Light Vehicle Classification	1071	152	1601	227	3932	328
Heavy Vehicle Classification	89	13	134	19	328	27
Total Period	1160	165	1735	246	4260	355
Total	1325		1981		4615	

Note: 1. Day (7.00 am – 10.00 pm) and Night (10.00 pm – 7.00 am).

4.5 Receiver Locations

The Single Point Calculation module of ENM was used to predict the noise impacts of the Project at three receiver locations surrounding the Project area, the location of which are shown on **Figure 3.1** and in **Table 4.4**.

Table 4.4 – Receiver Locations

Property Name	Address	Lot/ DP	Easting	Northing
1	6255 Putty Road, Mellong	Lot 24 DP753826	284032	6328955
2	6051 Putty Road, Mellong	Lot 3 DP600141	283853	6327509
3	6013 Putty Road, Mellong	Lot 4 DP600141	284183	6327192

4.6 Meteorological Conditions

The INP (EPA, 2000) notes that there are two approaches for the assessment of meteorological effects, including gradient winds and temperature inversions, on propagating noise from the source to the receiver. The simple method is to use default conditions outlined in the INP (EPA, 2000). This approach assumes that meteorological effects are present for a significant amount of time and avoids the need to quantify these effects in detail. This is a conservative approach that is likely to predict the upper range of potential noise impacts.

4.6.1 Wind

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

The INP (EPA, 2000) default wind conditions, as modelled, are a source to receiver gradient wind of 3 m/s at a height of 10 metres.

4.6.2 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions can also hinder the propagation of noise by acting as a barrier containing the noise above or below the inversion or even within a stratified layer of the inversion. Temperature inversions occur predominantly at night during the winter months but can also occur as a result of low cloud cover. Temperature inversions are generally determined based on the occurrence of atmospheric stability classes, as defined in the INP (EPA, 2000), with moderate and strong inversions corresponding to atmospheric stability categories F and G respectively.

The default inversion condition for assessing winter night time conditions in the area surrounding the Project is an F Class stability condition for all receivers, plus a 2 m/s source-to-receiver wind representative of the localised drainage flow. The INP (EPA, 2000) notes that the use of default drainage flow conditions would probably result in an over-estimate of the noise propagation from source to receiver. The INP (EPA, 2000) also notes that a gradient wind would only apply if the receiver is located at a lower elevation than the source.

As the noise sensitive receivers are located at an elevation higher than the source, drainage flow has not been included in the modelling parameters. The meteorological scenario that should be considered in the noise impact assessment is as follows:

- F class stability with no drainage flow.

5.0 Noise Predictions

5.1 Operational Noise Levels

5.1.1 Acoustically Significant Plant and Equipment

Section 6 of the INP (EPA, 2000) requires the prediction of noise levels to take into account all the acoustically significant plant and equipment that may reasonably be expected when the plant or facility in question is fully operational. Hy-Tec proposes that the operation of the Project would be 5.00 am to 10.00 pm Monday to Friday and 5.00 am to 3.00 pm on Saturdays.

5.1.2 Predicted Noise Levels

ENM's Single Point calculation feature was used to determine noise levels from the Project at the nearest residential receiver locations identified in **Section 4.5**, under the meteorological conditions described in **Section 4.6**. **Table 5.1** presents the predicted operational noise levels for the operational scenario described in **Section 4.1**. The most stringent noise criteria that the Project will need to achieve at all residential receivers is a PSNL of 35 dB(A) during the day, evening and night time periods.

Table 5.1 – Predicted Project Noise Levels, dB(A)

Receiver	Modelled Scenario			Project Specific Noise Goal LAeq,15minute
	Calm Neutral	Adverse Conditions 3m/s Source to Receiver Wind	Adverse Conditions F Class Stability	
1 – 6255 Putty Road, Mellong	<30	<30	<30	35
2 – 6051 Putty Road, Mellong	<30	<30	<30	35
3 –6013 Putty Road, Mellong	<30	35	<30	35

An analysis of the predicted noise level results for the inclusion of 'modifying factors' was conducted in accordance Section 4 of the INP (EPA, 2000) (refer to **Appendix B**). Based on this analysis, no modifying correction factors are required to be applied to the predicted noise levels.

5.1.3 Control Measures

Control measures that have been considered as a standard part of the operation of the Project and incorporated into the noise models include:

- maintenance of the existing equipment and associated sound attenuation features including mufflers and sound suppression lining of equipment; and
- selection of new equipment with sound power levels equivalent to, or less than the sound power levels nominated in **Table 4.1**.

5.1.4 Summary of Findings

No potential exceedances of the PSNL of 35 dB(A) for the Project were identified. The highest predicted noise level under worst case source to receiver winds is 35 dB(A) at Receiver 3. While no exceedances of noise goals for the Project were predicted, Hy-Tec will need to ensure that the control measures listed in **Section 5.1.3** are implemented and that operations are appropriately managed to minimise noise generating activities during extraction of sand from the areas located closest to the identified receivers (i.e. Domain 1).

5.2 Sleep Disturbance

Noise sources that could lead to sleep disturbance are typically transient noises and often have tonal characteristics. Activities occurring within the night time that could lead to sleep disturbance include:

- air horns used to control truck movement;
- reversing beepers; and
- track clatter from bulldozers.

The Single Point Calculation feature of ENM was used to determine noise levels at the nearest residential receiver locations under worst-case meteorological conditions (F Class Stability and source to receiver winds). The predicted received $L_{A1,1minute}$ noise levels associated with these activities that could result in sleep disturbance are presented in **Table 5.2**.

Table 5.2 – Predicted Sleep Disturbance Noise Levels, dB(A)

Receiver	Modelled Scenario			Sleep Disturbance Noise Goal LA1,1minute
	Calm Neutral 0 m/s Calm	Adverse Conditions 3 m/s Source to Receiver Wind	Adverse Conditions F Class Stability	
1 – 6255 Putty Road, Mellong	<30	<30	<30	45
2 – 6051 Putty Road, Mellong	<30	<30	<30	45
3 –6013 Putty Road, Mellong	<30	33	<30	45

The predicted noise levels in **Table 5.2** meet the recommended sleep disturbance noise goals outlined in **Section 3.4** at all residential receivers, for the modelled worst-case operational and meteorological scenarios. The predicted maximum $L_{A1,1minute}$ noise levels are associated with reversing beepers under F Class stability conditions.

5.3 Construction Noise Assessment

A source to receiver noise model was used to determine construction noise impacts at the nearest residential receiver to the construction activities during standard hours. The construction noise levels at the nearest residential receiver is predicted to be at or below

40 dB(A). The construction noise management level in **Table 5.3** for all residential receivers surrounding the Project is 40 dB(A).

Table 5.3 – Predicted Construction Noise Levels, dB(A)

Receiver	Modelled Scenario		Construction Noise Goal $L_{Aeq,15minute}$
	Calm Neutral 0 m/s Calm	Adverse Conditions 3 m/s Source to Receiver Wind	
1 – 6255 Putty Road, Mellong	<30	<30	40
2 – 6051 Putty Road, Mellong	<30	33	40
3 –6013 Putty Road, Mellong	<30	40	40

5.4 Road Traffic Noise Assessment

The Project includes an increase of the approved production capacity from 125,000 to 300,000 tpa and the continued road haulage of sand products via Putty Road. Heavy vehicle traffic volumes are expected to increase from the existing average 12 to 16 loads per day to an average of 30 to 34 loads per day associated with the increased production rate due to the Project. The Project is not anticipated to change the number of light vehicle movements (TPK & Associates, 2013).

Assessment of the road traffic noise impact of the Project has been conducted at three setback distances representative of the residential receivers likely to be influenced by movement of product trucks travelling to or from the Project along Putty Road. The road traffic noise impacts were modelled at setback distances of 25 metres, 50 metres and 100 metres from the centre line of Putty Road. Predictions were based on:

- a maximum of 54 heavy vehicle movements during the day time period; and
- a maximum of 14 heavy vehicle movements during the night time period.

The results of traffic noise modelling are presented in **Table 5.4**.

Table 5.4 – Predicted Day and Night Road Traffic Noise Levels on Putty Road, dB(A)

Receiver	Year of Project	Setback Distance, m	Period	Assessment Criteria, Day LAeq,15 hour Night LAeq,9 hour	Existing Predicted Traffic Noise Levels, Day LAeq,15 hour Night LAeq,1 hour	Predicted Traffic Noise Levels, Day LAeq,15 hour Night LAeq,1 hour	Increase in Predicted Traffic Noise Levels dB(A)
Putty Road, north of Wilberforce through to Mellong Based on NSW RTA AADT Station 06.122	Year 1	20	Day	60	58.9	59.9	1
			Night	55	52.6	54.4	1.8
	Year 30		Day	60	60.6	61.4	0.8
			Night	55	54.4	55.6	1.2
	Year 1	50	Day	60	53.4	54.6	1.2
			Night	55	47.2	49.2	2
	Year 30		Day	60	55.1	56.0	0.9
			Night	55	48.9	50.4	1.5
	Year 1	100	Day	60	47.5	49.0	1.5
			Night	55	41.3	43.7	2.4
	Year 30		Day	60	49.2	50.3	1.1
			Night	55	43.0	44.8	1.8
Putty Road in the vicinity of Wilberforce Based on NSW RTA AADT Station 06.113	Year 1 to Year 30	20	Day	60	61.6	62.0	0.4
			Night	55	53.0	54.1	1.1
	Year 1 to Year 30	50	Day	60	54.4	54.9	0.5
			Night	55	45.8	47.1	1.3
	Year 1 to Year 30	100	Day	60	49.4	49.9	0.5
			Night	55	40.7	42.2	1.5

Notes: 1. Criteria for existing residences affected by noise from redevelopment of existing freeways/ arterial/ sub-arterial roads.
2. Day (7.00 am – 10.00 pm) and Night (10.00 pm – 7.00 am).
3. Existing predicted traffic noise levels include existing traffic due to Tinda Creek Quarry.

The results presented in **Table 5.4** indicate the predicted road traffic noise levels from the increase in heavy vehicles travelling to or from the Project via Putty Road generally do not exceed the day and night time road traffic noise criteria outlined in the NSW Road Noise Policy (DECCW, 2011) presented in **Table 3.4**.

However, noise sensitive receivers located on Putty Road in the vicinity of Wilberforce that have a setback distance of less than 20 metres may currently experience noise levels higher than the 60 dB(A) day time noise criteria due to existing high levels of light vehicle traffic on Putty Road. The same situation may also occur if traffic numbers continue to grow on Putty road north of Wilberforce through to Mellong for noise sensitive receivers with a setback distance of less than 20 metres. The NSW Road Noise Policy (DECCW, 2011) states that 'an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.' The predicted increase in traffic noise due to the Project at these locations is less than 0.8 dB(A). As the modelling approach taken in this assessment does not consider the attenuation effects of terrain and is considered conservative and the predicted increase in noise levels are considered minor, it is unlikely that a noise sensitive receiver will perceive an increase in traffic noise due to the Project.

5.5 Cumulative Impact Assessment

To limit continuing increases in noise levels due to industrial development, the INP (EPA, 2000) has identified maximum ambient noise levels for typical receiver areas and land uses. The recommended acceptable ambient noise levels are used as the cumulative noise impact assessment criteria. There are no other industrial noise sources in the region surrounding the Project. As outlined in **Sections 3.2.3** and **3.3** the limiting criterion for the Project will be the Intrusiveness Criteria, which has been adopted as the PSNL for the Project.

6.0 Conclusion and Recommendations

6.1 Conclusion

6.1.1 Operational Noise

Umwelt has undertaken a NIA of the Project in accordance with Section 10 of the INP (EPA, 2000). The operational scenario was modelled to represent the extraction of sand from Domain 1 and the operation of the sand processing plant combined with product sand handling and dispatch operations. This scenario was modelled to provide an indication of the expected noise levels for operation over the life of the Project, including periods of potential worse case operational arrangements.

The results in **Section 5.0** indicate that the noise levels from the Project are predicted to meet or be less than the PSNL at all residential receivers.

The INP (EPA, 2000) notes that when predicted noise levels exceed the project-specific noise levels a range of strategies should be considered to reduce the noise impact on offsite receivers. Specifically the DGRs require evidence that there are no additional reasonable and feasible mitigation measures that need to be included as a part of the Project. The three main strategies used to identify reasonable and feasible noise control/mitigation strategies 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 highest predicted noise level under worst case source to receiver winds is 35 dB(A) at Receiver 3. While no exceedances of noise goals for the Project were predicted, Hy-Tec will need to ensure that the control measures listed in **Section 5.1.3** are implemented and that operations are appropriately managed to minimise noise generating activities during extraction of sand from the areas located closest to the identified receivers (i.e. Domain 1).

The management of operations during adverse weather conditions when extracting sand from the areas located closest to the identified receivers and the maintenance of equipment and associated sound attenuation features should prove adequate to control noise at the source so the Project meets the project noise goals.

If unacceptable noise impacts from a development persist after noise mitigation action has been undertaken, Section 8 and Section 10 of the INP (EPA, 2000) provide a process for negotiating an agreement between the proponent and the affected party(s).

6.1.2 Sleep Disturbance

Based on the modelling of the typically transient noises the calculated $L_{A1,1minute}$ noise levels from the operation are expected to comply with the recommended sleep disturbance noise goals at all residential receiver locations.

6.1.3 Construction Noise

The results presented in **Section 5.3** indicate that the predicted construction noise levels at the nearest residential receiver to the construction activities has the potential reach the construction noise management level of 40 dB(A). As a result Hy-Tec should apply all feasible and reasonable work practices to manage the construction noise levels. Hy-Tec should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as provide contact details as outlined in the *Interim Construction Noise Guidelines* (DECC, 2009).

6.1.4 Road Traffic Noise

The results presented in **Table 5.4** indicate the predicted road traffic noise levels from light and heavy vehicles travelling to or from the Project via Putty Road do not exceed the day and night time road traffic noise criteria outlined in the NSW Road Noise Policy (DECCW, 2011) presented in **Table 3.4**, except where existing traffic noise levels are already above the criteria.

Noise sensitive receivers during the day time assessment period on Putty Road in the vicinity of Wilberforce with a setback distance of less than 20 metres may experience noise levels above the criteria due to existing high levels of traffic on Putty Road. The predicted increase in noise levels for this region are 0.5 dB(A) or less and are considered minor. It is unlikely that a noise sensitive receiver in this region will perceive an increase in traffic noise due to the Project.

6.2 Management and Monitoring Recommendations

6.2.1 Noise Monitoring Program

It is recommended that Hy-Tec undertake an attended noise monitoring in order to assess ongoing compliance with relevant noise impact assessment as follows. The noise monitoring program should:

- be undertaken to confirm operational noise levels after extraction operations are established within extraction Domain 6 and 1 (being closer to sensitive receptors compared to existing operations) within six months of commencing in that Domain;
- make provision for a review of any noise complaint (after the complaint has been investigated and substantiated by the proponent) regarding the Project from a nearby residence or OEH and undertake additional monitoring if warranted;
- specifically assess operational performance against the Intrusiveness criteria using a $L_{Aeq,\ 15\ minute}$ descriptor; and
- if noise impacts are identified during the night time period, measure and assesses the transient noise levels due to industrial noise sources using the sleep disturbance criteria descriptor of $L_{A1,\ 1\ minute}$.

The noise monitoring program should also measure and assess the environmental noise levels due to industrial noise sources using the amenity assessment descriptor of $L_{Aeq,\ Period}$. However, as the Project is the only industrial noise source in the region this metric would only be used to measure the ambient noise levels rather than cumulative industrial noise levels.

As the Project is located in an area without any other industrial noise sources the noise monitoring program could be based on unattended monitoring with suitable justification of results analysis provided in the noise monitoring report.

As the predicted noise impacts for the Project are minor, it is recommended that the frequency of the noise monitoring program be based on the confirmation of operational noise levels after extraction operations are established within a previously undisturbed extraction domain, being not more than six months after sand is first extracted from the previously undisturbed mining domain.

Further targeted noise monitoring should be conducted to respond to any noise complaints received from nearby residents in consultation with OEH and NSW DP&E. Justification for the scope and methodology of any targeted monitoring program should be documented in the EPL Annual Return.

The detailed procedures that will be employed by Hy-Tec for assessing noise compliance by the Project will be documented in a Noise Management Plan. The Noise Management Plan will also identify and prioritise the operational constraints that could be implemented in order to maintain compliance with the requirement of the Project consent and EPL.

The use of the continuous real-time noise monitoring or predictive meteorological forecasting is not necessary for the assessment of normal operations of the Project given the low risk to the noise amenity of the nearby residences. However, temporary noise logging combined with audio recording could be used in noise compliance assessment activities.

6.2.2 Compliance Assessment

The methodology for assessing compliance with the requirement of the Project approval and EPL would be based on the noise monitoring program detailed in **Section 6.2.1** and would utilise the following components:

- undertake noise monitoring surveys to measure ambient noise levels in the region surrounding the Project and determine the Project's contribution to measured noise levels; and

- compare the noise monitoring results with predicted noise impacts for the similar meteorological conditions and operating/mining conditions and with the relevant noise impact assessment criteria to assess compliance of the Project with the relevant development consent and EPL criteria.

6.2.3 Reporting

The monitoring results should be reviewed by the Hy-Tec environmental representative to assess compliance with the NIA predictions and with the relevant noise impact assessment criteria. The results will be reported in accordance with the requirements of the Project approval and EPL.

7.0 References

Department of Environment and Climate Change (DECC) 2009. *Interim Construction Noise Guideline*.

Department of Environment, Climate Change and Water (DECCW) 2011. *NSW Road Noise Policy*.

Environment Protection Authority (EPA) 2000. *NSW Industrial Noise Policy*.

Environment Protection Authority (EPA) 1985. *Environmental Noise Control Manual.*

Stitt, Peter H & Associates Pty Ltd 2012. *Technical Note 2/2012. The Tinda Creek Sand Deposit, Updated Resource Estimates*. Unpublished report prepared for Hy_tec Industries Pty Ltd. 22p + Appendices.

Stitt, Peter H & Associates Pty Ltd 2010. The Tinda Creek Sand Deposit Near Colo Heights NSW; Drilling – Resource Estimates – Comments.

TPK & Associates 2013. *Traffic Assessment – Upgrade of Existing Sand Quarry Facility - Tinda Creek Quarry, Putty Road Mellong*.

US Department of Transportation 2004. US Federal Highway Administration Traffic Noise Model Version 2.5 Look-Up Tables, 2004.

APPENDIX A

Glossary of Terms and Abbreviations

Appendix A – Glossary of Terms 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 noise level representing each assessment period – day, evening and night (that is, three assessment background levels are determined for each 24-hr period of the monitoring period). It is determined by taking the lowest 10th percentile of the L_{90} level for each assessment period.
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(Z), dB(L)	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% 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.

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.

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. decibels.

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.

APPENDIX B

Industrial Noise Policy Assessment Methodology

Appendix B – Industrial Noise Policy Assessment Methodology

Industrial Noise Policy

Responsibility for the control of noise emissions in New South Wales (NSW) is vested in Local Government and the Office of Environment and Heritage (OEH). The NSW Environmental Protection Authority (EPA) *Industrial Noise Policy* (INP), 2000, provides a framework and methodology for deriving limit conditions for consent and licence conditions. Using this policy the OEH regulates premises that are scheduled under the *Protection of the Environment Operations Act 1997* (POEO Act).

The specific INP (EPA, 2000) objectives are:

- to establish noise criteria that would protect the community from excessive intrusive noise and preserve the noise 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 (EPA, 2000) 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 (EPA, 2000) 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. For existing industrial operations, the underlying level of noise present in the ambient noise, should be determined excluding the noise source under investigation;
- predicting or measuring the noise levels produced by the development; and
- comparing the predicted noise levels with the project-specific noise levels and assessing the impacts.

Where the project-specific noise levels are predicted to be exceeded the INP (EPA, 2000) 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.

Industrial Noise Policy 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 (EPA, 2000) and is based on the use of noise monitoring data or INP default RBLs (refer to INP (EPA, 2000)), to establish the assessable background noise levels.

- **The noise amenity criterion**, which is based on the recommended noise levels in the INP (EPA, 2000) for prescribed land use. The recommended acceptable and maximum ambient noise levels are outlined in Table 2.1 of the INP (EPA, 2000). Table 2.2 of the INP (EPA, 2000) outlines the requirements for developments where the existing noise level from industrial noise sources is close to the acceptable noise level.

The relevant tables in Section 2 of the INP relating to the amenity criteria relevant to the Project are presented in **Tables 1** and **2**.

Table 1 – Amenity Criteria – Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq 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)

Source: Table 2.1, INP (EPA, 2000).

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 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

Source: Table 2.2, INP (EPA, 2000).

Note: 1. ANL = recommended acceptable LAeq noise level for the specific receiver.

In assessing the noise impacts from industrial sources at residential receivers both the intrusive and amenity 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, a new source 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 a new source should meet the conditions set out in **Table 2** above.

Industrial Noise Policy Project-Specific Criteria

The INP (EPA, 2000) states that the criteria outlined in Tables 2.1 and 2.2 (refer to **Tables 1** and **2** above) have been selected to protect at least 90% of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP (EPA, 2000) are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

Table 3 presents the methodology for assessing noise levels which may exceed the INP (EPA, 2000) project-specific noise assessment criteria.

Table 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 to be 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.

Assessing Intrusiveness Criteria

The OEH has provided an application note for the assessment of the intrusiveness criteria such that the level for night time is no greater than the evening and evening is no greater than the daytime level (OEH, February 2013). The application note is reproduced below.

When the RBL for Evening or Night is Higher than the RBL for Daytime

http://www.environment.nsw.gov.au/noise/applicnotesindustnoise.htm

The results of long term unattended background noise monitoring can sometimes determine that the calculated Rating Background Level (RBL) for the evening or night period is higher than the RBL for the daytime period. These situations can often arise due to increased noise from for example insects or frogs during the evening and night in the warmer months or due to temperature inversion conditions during winter. The objective of carrying out long-term background noise monitoring is to determine existing background noise levels at a location that are indicative of the entire year.

In determining project-specific noise levels from the RBLs, the community's expectations also need to be considered. The community generally expects greater control of noise during the more sensitive evening and night-time periods than the less sensitive daytime period. Therefore, in determining project-specific noise levels for a particular development, it is generally recommended that the intrusive noise level for evening be set at no greater than the intrusive noise level for daytime. The intrusive noise level for night-time should be no greater than the intrusive noise level for day or evening. Alternative approaches to these recommendations may be adopted if appropriately justified.

Assessing Sleep Disturbance

The OEH have provided an application note for the assessment of sleep disturbance (OEH, February 2013). The application note is reproduced below.

Sleep Disturbance

http://www.environment.nsw.gov.au/noise/applicnotesindustnoise.htm

Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.

Research on sleep disturbance is reviewed in the NSW Road Noise Policy. 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, the EPA recognised that the current sleep disturbance criterion of an LA1, (1 minute) not exceeding the LA90, (15 minute) by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, the EPA 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 LA1, (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 NSW Road Noise Policy. 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 10.00 pm and 7.00 am); and
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

The LA1, (1 minute) descriptor is meant to represent a maximum noise level measured under 'fast' time response. The EPA will accept analysis based on either LA1, (1 minute) or LA, (Max).

Industrial Noise Policy Modifying Factor Adjustments

Section 4 of the INP (EPA, 2000) provides guidance for the assessment of noise sources that contain characteristics such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequencies. Noise sources with these characteristics can cause greater annoyance than other noise at the same level.

Where the noise source contains annoying characteristics, the INP (EPA, 2000) outlines correction factors that should be applied to the source noise level measured or predicted at the receiver before comparison with the PSNL.

The modifying factor corrections as defined by Section 4 of the INP (EPA, 2000) that are potentially relevant to the NIA for the Project include:

- Low-frequency noise in the 20 Hz to 250 Hz range according to the following criteria:
  - 'Measure/assess C- and A-weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more.'
- Tonal noises containing a prominent frequency determined where the level of the one-third octave band exceeds the level of the adjacent bands on both sides by*:*
  - '5 dB or more if the centre frequency of the band containing the tone is above 400 Hz;
  - 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive; and
  - 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.'

Where two or more modifying factors are present, the maximum correction is limited to 10 dB. However, the INP (EPA, 2000) also notes that where a source emits tonal and low frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range.

The INP (EPA, 2000) states that the modifying factors are to be applied to the noise from the source measured or predicted *at the receiver* and before comparison with the criteria. It is reasonable to conclude that if the predicted noise levels for each one-third octave band at the receiver is inaudible then it should not be included in the modifying factor assessments described above.

Audibility Test of Predicted Noise Levels

Each item of equipment used in the computer generated noise modelling for the Project is assessed for tonal noise and low frequency noise in accordance with the procedure outlined in Section 4 of the INP (EPA, 2000). While an individual noise source may be observed to possess low frequency or tonal noise characteristics close to the source, the effects of attenuation between the source noise and the modelled receiver location can diminish the effects of low frequency and tonality annoyance predicted or observed at the receiver.

The threshold of audibility is defined in AS ISO 389.7-2003 'Acoustics- Reference zero for the calibration of audiometric equipment Part 7: Reference threshold of hearing under free-field and diffuse field listening conditions'.

For each predicted noise result an analysis of audibility, as defined by AS ISO 389.7-2003, is made against each one-third octave band. Where the predicted noise result for an octave band was found to be inaudible the octave band noise result is excluded from the assessment of tonality and low frequency noise.

Management of Tonal and Low Frequency Noise Sources

The noise models for the Project are prepared on the basis that equipment generating noise in the potentially audible range of 25 to 20,000 Hz range is well maintained. Failure to replace damaged mufflers, acoustic louvres and associated attenuation equipment could result in the generation of unacceptable tonal or low frequency noises.

APPENDIX C

Assessment of the Existing Noise Environment

Appendix C – Assessment of the Existing Noise Environment

The existing background noise environment in the area surrounding the Project was measured using a continuous noise logger. The location of the monitoring site is presented in Figure 3.1 of the main text of the Noise Impact Assessment and the details of the monitoring program are given in **Table 1**. The monitoring results were used to assess the background (L_{A90}) and amenity (L_{Aeq}) noise levels within the residential receiving areas adjacent to the site.

Table 1 – Noise Monitoring Details

Title	Location	Logger Serial No.	Measurement Started	Measurement Stopped
N1	Lot 2, DP 628806 MGA56 E285298 N6327945	194625	10:00 17/11/10	10:45 26/11/10

Monitoring location N1 is located to the west of the existing sand quarry on Lot 2, DP 628806. The monitoring location represents an undeveloped rural area, nearby to the existing sand quarry, that is considered representative of the of the background noise environment at the potentially affected noise sensitive locations.

The continuous noise logger recorded: date; time; temperature; background L_{A90} noise levels; amenity $L_{Aeq,15minute}$ noise levels; maximum and minimum noise levels; and statistical noise levels representative of the noise environment.

The run chart of the raw data from the monitoring program and the determination of the corresponding are provided at the end of this Appendix.

The Assessment Background Level (ABL) and Rating Background Level (RBL) were determined for monitoring location N1 in accordance with the INP (EPA 2000). The monitoring results are summarised in **Table 2**.

For the night time period (10.00 pm to 7.00 am Monday to Saturday and 10.00 pm to 8.00 am on Saturday nights and the eve of public holidays), the monitoring data shows that background noise levels, as measured by the L_{A90} descriptor are regularly at or below 30 dB(A).

The monitoring information shows that background noise levels during the night-time period are generally less affected by wind-generated noise and have an absence of extraneous noise that typically occurs during the day-time and evening monitoring periods.

For the day time period (7:00 am to 6:00 pm Monday to Saturday and 8:00 am to 6:00 pm on Sundays and public holidays) and evening period (6:00 pm to 10:00 pm) the monitoring results show that there is a greater proportion of time when the measured background noise levels are either affected by wind generated noise or other non-industrial extraneous noise.

During deployment of the noise logger it was noted that extraneous non-industrial noise sources were present. These noise sources consist of non-industrial related activities such as:

- intermittent road traffic noise;
- residential noise;
- birds;

- farming related activities;
- traffic noise;
- aircraft;
- wildlife (such as livestock and insects); and
- vegetation noise caused by the rustling of foliage.

In the absence of wind-generated noise and other non-industrial extraneous noise sources, the background noise levels for the day time and evening period, as measured by the L_{A90} descriptor, are likely to be regularly at or below 30 dB(A).

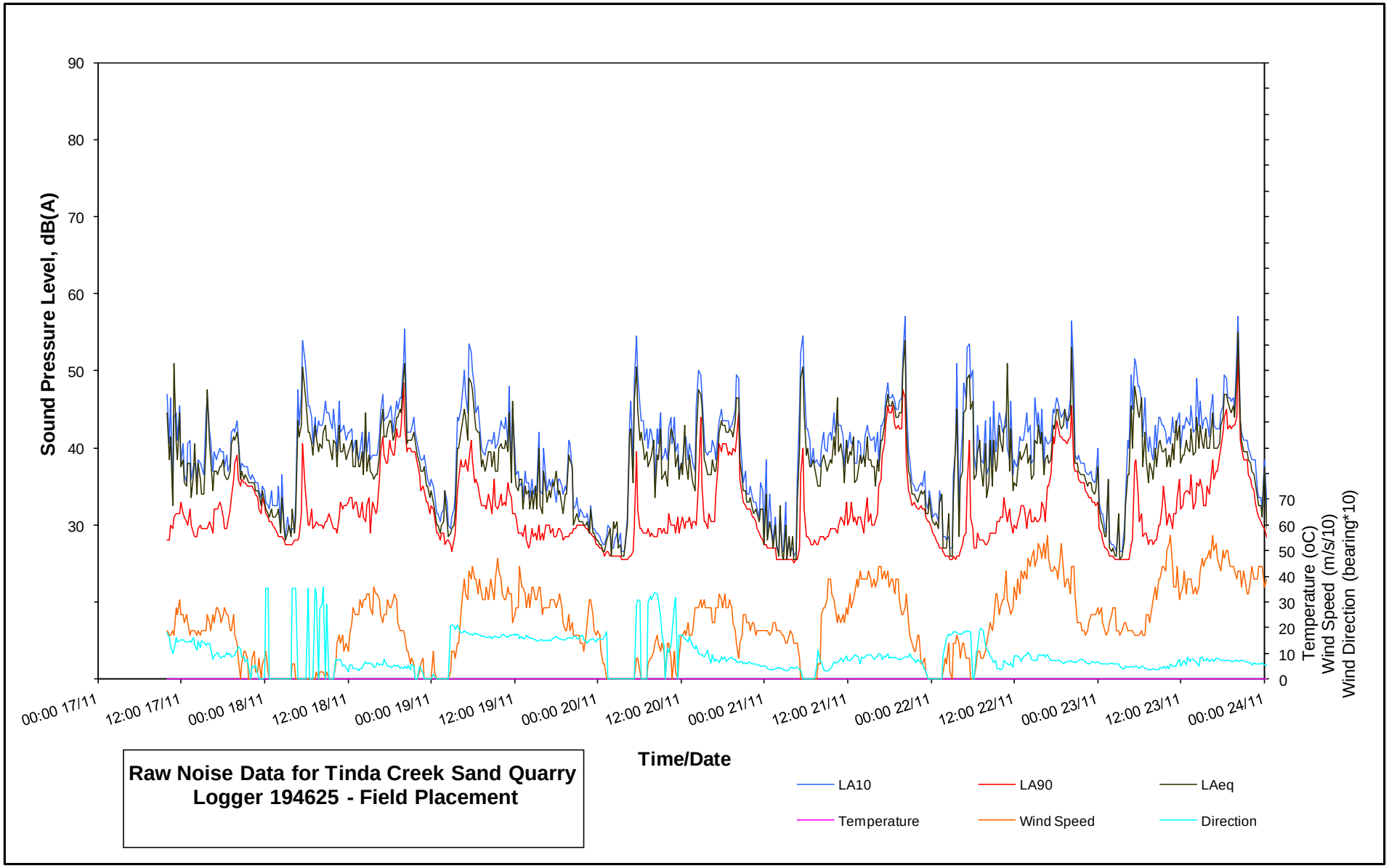
Table 2 – Monitoring Results, dB(A)

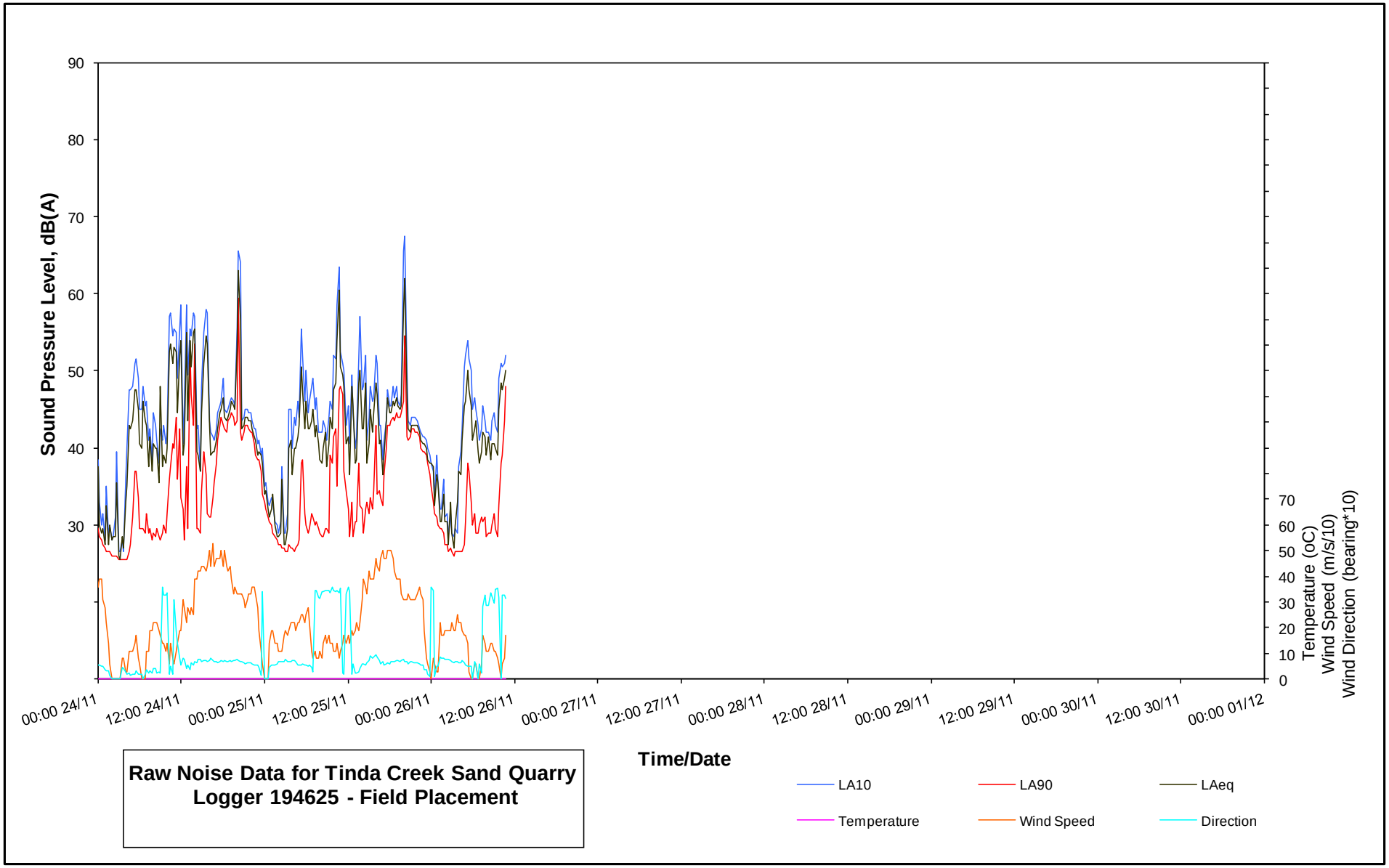
Receiver	**N1 - Lot 2, DP 628806**
Type of Receiver	Rural [1]
Day Time Assessment (0700 to 1800)	
Rating Background Noise Level	30 [2]
Intrusiveness Criteria	**35**
Acceptable Noise Level	50
Existing $L_{Aeq, Day}$	45
Amenity Criteria	**50** [3]
Evening Assessment (1800 to 2200)	
Rating Background Noise Level	30 [2]
Intrusiveness Criteria	**35**
Acceptable Noise Level	45
Existing $L_{Aeq,Evening}$	42
Amenity Criteria	**45** [3]
Night Time Assessment (2200 to 0700)	
Rating Background Noise Level	30 [2]
Intrusiveness Criteria	**35**
Acceptable Noise Level	40
Existing $L_{Aeq, Night}$	40
Amenity Criteria	**40** [3]

Note 1: Rural areas experience little or no road traffic with limited industrial activity (INP, 2000).

Note 2: The RBL for the day, evening and night time periods was found to be less than 30 dB(A), therefore the RBL was set to 30 dB(A) (INP, 2000).

Note 3: The existing level of noise from industrial sources is negligible, therefore the ABL has not been reduced (INP,2000).


Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
Temperature (oC)
Wind Speed (m/s/10)
Wind Direction (bearing*10)
70
60
50
40
30
20
10
0
00:00 17/11
12:00 17/11
00:00 18/11
12:00 18/11
00:00 19/11
12:00 19/11
00:00 20/11
12:00 20/11
00:00 21/11
12:00 21/11
00:00 22/11
12:00 22/11
00:00 23/11
12:00 23/11
00:00 24/11
Time/Date
Raw Noise Data for Tinda Creek Sand Quarry
Logger 194625 - Field Placement
LA10
LA90
LAeq
Temperature
Wind Speed
Direction


Sound Pressure Level, dB(A)
90
80
70
60
50
40
30
00:00 24/11
12:00 24/11
00:00 25/11
12:00 25/11
00:00 26/11
12:00 26/11
00:00 27/11
12:00 27/11
00:00 28/11
12:00 28/11
00:00 29/11
12:00 29/11
00:00 30/11
12:00 30/11
00:00 01/12
Time/Date
70
60
50
40
30
20
10
0
Temperature (oC)
Wind Speed (m/s/10)
Wind Direction (bearing*10)
Raw Noise Data for Tinda Creek Sand Quarry
Logger 194625 - Field Placement
LA10
LA90
LAeq
Temperature
Wind Speed
Direction