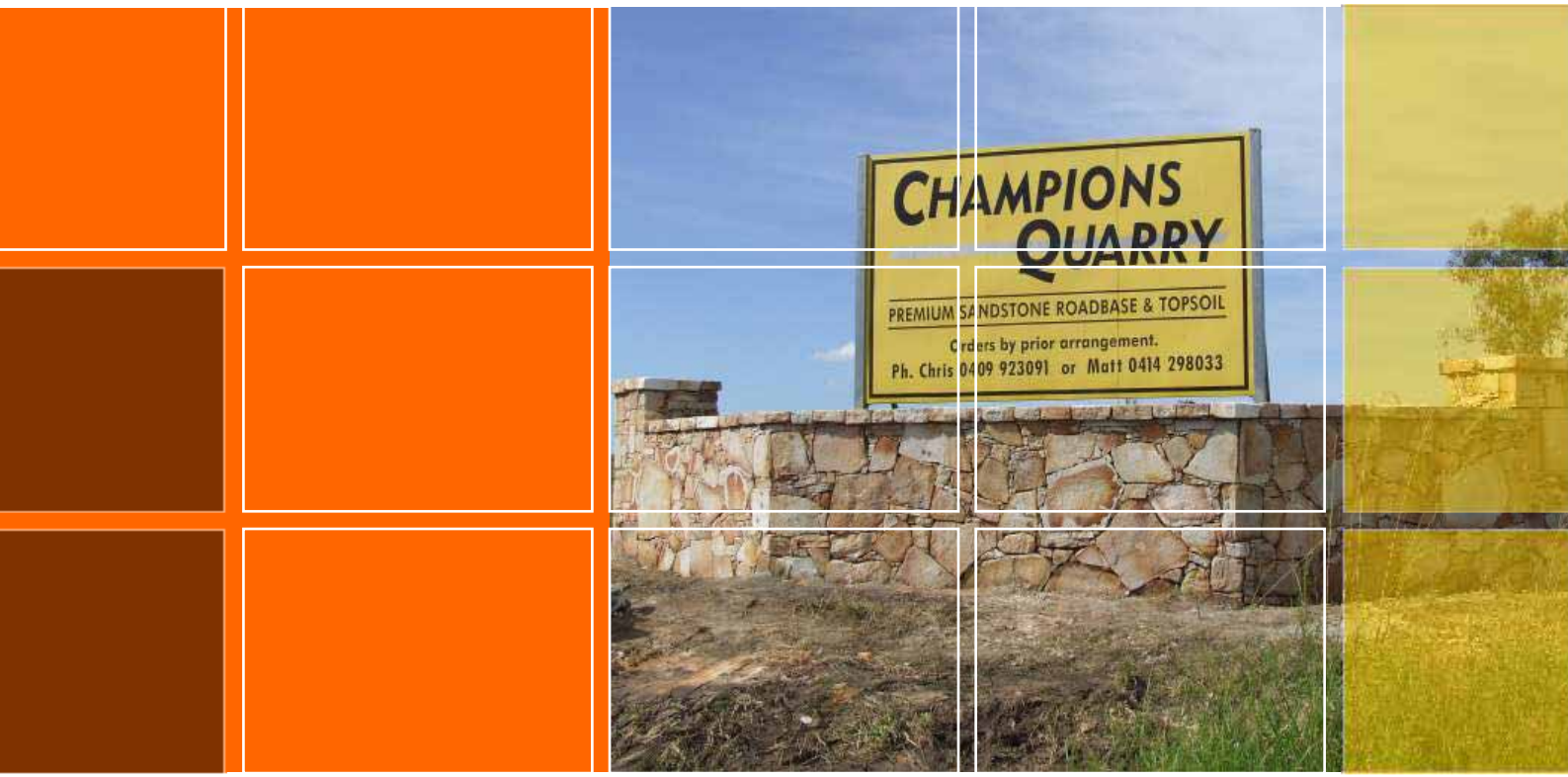

Appendix D
Noise Assessment

FINAL REPORT

Reavill Farm Pty Ltd and Tucki Hills Pty Ltd

Champions Quarry, 1586 Wyrallah Road, Tuckurimba NSW

Noise Impact Assessment

December 2009

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FINAL REPORT

Reavill Farm Pty Ltd and Tucki Hills Pty Ltd

Champions Quarry, 1586 Wyrallah Road, Tuckurimba NSW

Noise Impact Assessment

December 2009

Reference: 0098287_Noise_Final

For and on behalf of:
Environmental Resources Management Australia

Approved by: Murray Curtis

Signed: 

Position: Managing Partner

Date: 23 December 2009

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1 INTRODUCTION

This report has been prepared for Reavill Farm Pty Ltd and Tucki Hills Pty Ltd to assess environmental noise emissions associated with the proposed expansion of the existing sandstone quarry (Champions Quarry) located at Wyrallah Road, Tuckurimba, NSW, approximately 16 km south of Lismore, NSW.

Champions Quarry has an existing 2006 development consent to extract sandstone at the site, limiting its production to 29,000 cubic metres per annum (approximately 64,000 tonnes per annum) over a period of 15 years. Champions Quarry is seeking approval for the expansion of the quarry under Part 3A of *Environmental Planning and Assessment Act, 1979.* The proposed expansion will involve the extraction up to 6.25 million tonnes of sandstone resource at an extraction rate of 250,000 tonnes per annum over a period of 25 years, and importantly, the implementation of a sand washing plant.

The Noise Assessment report addresses the Director-General's requirements for the *Environmental Assessment* (EA) of the proposed quarry expansion and issues raised by the relevant regulatory authorities.

The proposed development involves lateral expansion of the existing sandstone quarry located on the site, whilst also creating additional extractive cells of up to 3 ha to the south. The proposed operating areas are as follows:

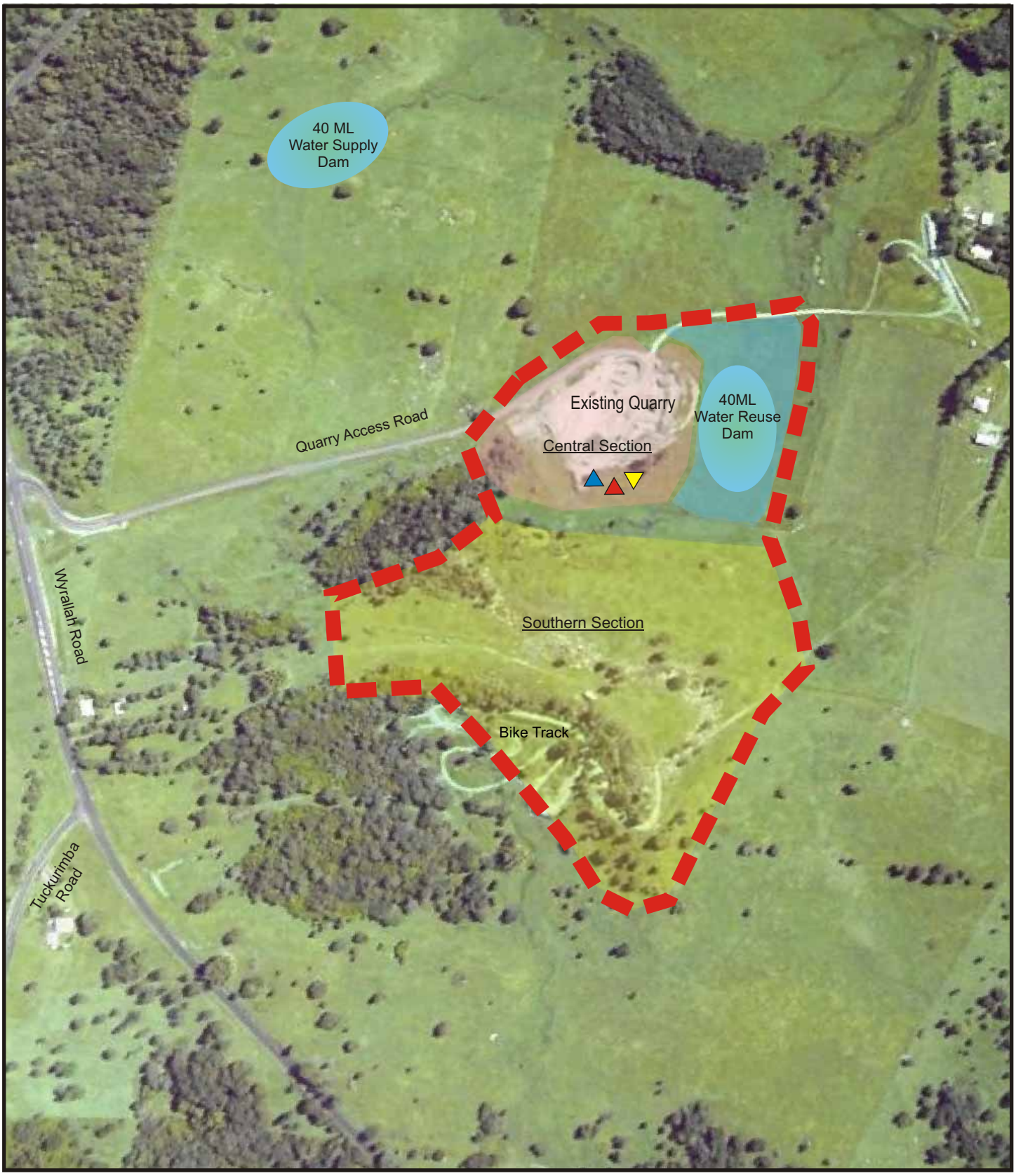
- ***Central Section***, extraction to between RL 8m (AHD) to RL 10m (AHD) (AHD) in the central section containing approximately 300,000 tonnes; and
- ***Southern Section,*** extraction to between RL 8m (AHD) to RL 10m (AHD) in the southern section containing approximately 6,000,000 tonnes.

These sections are shown in *Figure 1.1*.

The proposed operating hours for the quarry are from 7.00am to 5.30pm during the weekdays and from 7.30am – 3.00pm on Saturdays.

This report examines future operations for the Central and Southern sections and evaluates the associated noise emissions at nearest residential assessment locations.

The noise emissions from the quarry sections will be quantified using the Environmental Noise Model (ENM) which is widely accepted as a reliable method of predicting noise levels from industrial sources. Noise modelling conservatively assumes the concurrent operation of modelled equipment used in each scenario as described in *Section 6.4* of this report. This assessment has been prepared in accordance with the Department of Environment, Climate Change and Water's (DECCW) *Industrial Noise Policy* (*INP*), (EPA 2000).



Legend

- Extent of Quarry Extraction and Operations
- Washing Plant
- Processing Plant
- Service Area and Temporary Stockpile Holding Area
- Water Management Dam
- Central Section
- Southern Section
- Water Management (Non-quarrying area)

Figure 1.1

Proposed Site Layout

Client:	Champions Quarry		
Project:	Champions Quarry Expansion		
Drawing No:	0098287pm_03	Suffix No:	V4
Date:	12/08/09	Drawing size:	A4
Drawn by:	AM	Reviewed by:	WW
Source:	-		
Scale:	Refer to Scale Bar		

N 0 50 100 150 200 m

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1.1 GLOSSARY

A number of technical terms used in this report describe various noise levels from the quarry. These are explained in *Table 1.1*.

Table 1.1 Glossary of Terms

Term	Description
ABL	Assessment Background Level (ABL) is defined in the *INP* as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L_{90} statistical noise levels.
dB(A)	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(LinPeak)	The peak sound pressure level (not RMS) expressed as decibels with no frequency weighting.
L1	The noise level exceeded for 1 % of a measurement period.
L10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
L90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
Leq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
Lmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
MIC_{8MS}	Maximum Instantaneous Charge (with a minimum 8 milli-sec delay).
Peak Particle Velocity	The maximum velocity of a particle of the transmission medium, used in assessment of vibration.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
RMS	Root Mean Square which is a measure of the mean displacement (velocity or acceleration) of a vibrating particle.
SI	Still isothermal (SI) refers to calm weather conditions (defined as no wind and standard temperature gradients).
sigma-theta (σ_θ)	The standard deviation of horizontal wind fluctuation.
Sound power level	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment.
Temperature inversion	A positive temperature gradient. A meteorological condition where atmospheric temperature increases with altitude to some height.

The following concepts offer qualitative guidance in respect of the average response to changes in noise levels:

- differences in noise level of less than approximately 2dB are generally imperceptible in practice.

- differences in noise level of above 5 dB are perceived to be significant.

- a difference in noise level of around 10 dB is generally perceived to be a doubling (or halving) of the loudness of the noise.

The INP includes a method for prescribing noise criteria for the purpose of assessing potential noise impacts from a source. This methodology is prescribed in terms of the measured "assessment background levels" and "rating background levels" of noise.

- ABL - The Assessment Background Level is the lowest tenth percentile value of the L_{90} levels measured for each day/evening/night assessment period respectively.

- RBL - The Rating Background Level is defined as the overall single value representative background level for each of the day, evening and night periods respectively. The RBL is calculated as the median value of the corresponding ABL's (e.g. for each night period of the monitoring cycle). RBL's account for temporal variation of background noise and are used in determining the intrusiveness criterion for industrial noise.

For industrial noise there are three assessment periods – Day/Evening/Night. **Day** is the time period from 7:00 am to 6:00 pm (Monday to Saturday) or 8:00 am to 6:00 pm on Sundays and public holidays. **Evening** is the time period from 6:00 pm to 10:00 pm. **Night** is the time period from 10:00 pm to 7:00 am (Monday to Saturday) or 10:00 pm to 8:00 am on Sundays and public holidays.

2 NOISE IMPACT ASSESSMENT CRITERIA

2.1 GENERAL CRITERIA

DECCW's INP (EPA 2000), gives guidelines for assessing industrial facilities including extractive industries. Assessment criteria depend on the existing amenity of areas potentially affected by a proposed development as outlined below.

Assessment criteria for sensitive receivers near industry are based on the following objectives:

- protection of the community from excessive intrusive noise; and
- preservation of amenity for specific land uses.

To meet these objectives, two separate criteria are prescribed by the DECCW, namely the intrusiveness criteria and the amenity criteria. A fundamental difference between the intrusiveness and the amenity criteria is that the former is applicable over 15 minutes in any period, while the latter covers the entire assessment period (day, evening and night).

2.1.1 *Assessing for Intrusiveness*

The intrusiveness criterion requires that $L_{Aeq,15min}$ noise levels from a newly introduced source during the day, evening and night do not exceed the existing Rating Background Levels (RBL) by more than 5dB. This is expressed as:

$$L_{Aeq,15min} \leq RBL + 5 - K$$

where $L_{Aeq,15min}$ is the L_{eq} noise level from the source, measured over a 15 minute period and K is a series of adjustments for various noise characteristics. Where the RBL is less than 30 dB(A), a value of 30 dB(A) is used. For typical noise from the quarry, no adjustment factors are considered applicable.

2.1.2 *Assessing for Amenity*

The DECCW's amenity criterion requires industrial noise (including extractive industries) to be within an acceptable level for the particular locality and land use. Where ambient noise is already high, the acoustic environment should not be deteriorated significantly. The strategy behind the amenity criterion is a holistic approach to noise, where all industrial noise (existing and future) received at a given receptor does not exceed the recommended goals.

Private residences and other potentially sensitive receivers potentially affected by the quarry are covered by the DECCW's varying amenity categories as presented in *Table 2.1* of the INP and are reproduced below

Table 2.1 ***Amenity Criteria - Recommended L_{Aeq} Noise Levels from Industrial Noise Sources***

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq(Period) Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban/Industrial Interface (for existing situations only)	Day	65	70
		Evening	55	60
		Night	50	55
School classrooms - internal	All	Noisiest 1 hour period when in use	35	40
Hospital wards - internal - external	All	Noisiest 1 hour period	35 50	40 55
Place of worship - internal	All	When in use	40	45
Area specifically reserved for passive recreation (e.g. National Park)	All	When in use	50	55
Active recreation area (e.g. school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note: Monday – Saturday Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 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.

2.2 *CUMULATIVE NOISE*

The cumulative impact of more than one development can be compared against the base amenity criteria listed above (refer *Table 2.1*). This is consistent with the INP's holistic approach to industrial noise. However, no other industries are sufficiently near Champions Quarry for cumulative noise to be of concern, therefore, cumulative noise has not been considered further in this assessment.

2.3 *ROAD TRAFFIC NOISE CRITERIA*

The Environment Protection Authority released the *Environmental Criteria for Road Traffic Noise* (ECRTN) in May 1999. The policy sets out noise criteria applicable to different road classifications for the purpose of defining traffic noise impacts.

2.4 *SLEEP DISTURBANCE*

While the INP does not specify a criterion for assessing sleep disturbance, the ENCM (1994) recommends that $L_{1,1minute}$ noise from a source should not exceed the existing background noise by more than 15dB(A) . Depending on the measured background noise, the sleep disturbance criteria for the quietest location could be as low as 45 dB(A)L_1.

Only the daytime criterion is applicable for this assessment as the quarry does not operate at night, therefore, sleep disturbance has been not considered further in this report.

3 EXISTING ACOUSTICAL ENVIRONMENT

3.1 SENSITIVE RECEIVERS AND NOISE ASSESSMENT LOCATIONS

Four rural dwellings have been selected as representative of those potentially the most affected by the quarry expansion and are designated as Noise Assessment Locations (NAL). These are shown in *Table 3.1* and are illustrated in *Figure 3.1*.

Table 3.1 Noise Assessment Locations Used for Modelling Purposes

Noise Assessment Location	GPS Coordinates		Location from existing quarry pit at Champions Quarry	
	Easting	Northing	Compass Point	Distance, m
NAL 1	531089	6799150	N	875
NAL 2	531738	6798473	NE	380
NAL 3	532043	6798156	E	670
NAL 4	530867	6797990	WSW	530

3.2 BACKGROUND NOISE ASSESSMENT

Acoustic instrumentation utilised during the monitoring and assessment process for this assessment complies with the requirements of AS IEC 6167, 2004 *'Electroacoustics - Sound level meters – Specifications'*. Additionally, all equipment used has current NATA or manufacturer calibration certificates. All instrumentation was calibrated before and after each measurement survey and the tolerance of each unit did not vary by more than ±0.5 dBA.

Furthermore, all monitoring has been conducted in accordance with 'AS 1055.1-1997 : Acoustics - *Description and measurement of environmental noise - General procedures*'.

3.3 MEASUREMENT EQUIPMENT

Measurements were performed with the following NATA calibrated instrumentation:

- 2 x Acoustic Research Laboratories (ARL) EL215 noise logger;
- Rion NA-27 Precision Sound Analyser;
- Rion NL-15 Sound Level Meter; and
- Brüel & Kjaer 4230 Calibrator.

The Brüel & Kjær 4230 sound level calibrator was used to calibrate the equipment prior to measurement and again at the conclusion of monitoring, with the variation in calibrated levels not exceeding ±0.5dB(A). All monitoring was guided by Australian Standard AS 1055 *'Acoustics, Description and Measurement of Environmental Noise'*.

3.3.1 Unattended Noise Monitoring

A key element in assessing environmental noise impacts from industry is to quantify the ambient noise environment, including quantifying existing industrial noise where relevant. Unattended long-term and short-term attended monitoring was undertaken to evaluate the ambient noise at the assessment locations.

Unattended continuous noise monitoring by means of two ARL EL215 environmental noise loggers was conducted from 7 November 2007 to 23 November 2007 at assessment locations 2 and 4. Data was collected with the logger microphones at approximately 1.5m above ground level.

Figure 3.1 shows the noise logging locations. Total summaries of the recorded data are presented in *Table 3.2*, which includes the Rating Background Level (RBL), ambient noise level and a range of daytime maximum noise levels. Daily summaries and logging charts of the data are presented in *Annex A*.

Table 3.2 Summary of Background and Ambient Noise Levels

Location	Rating Background Level (RBL), dB(A)			Ambient Noise Level, dB(A)$L_{eq,period}$			Range of Maximum Noise Levels dB(A)$L_{max,period}$
	Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]	Day[1]
Logger 1 (NAL 4)	35	40	35	54	53	50	65-107
Logger 2 (NAL 2)	32	35	28	48	42	42	35-98

Notes:
1. Day is from 7am to 6pm; Evening is from 6pm to 10pm; and Night is from 10pm to 7am (INP).
2. Noise data during periods of any rainfall and/or wind speeds above 5m/s at the logger microphone were discarded.

The measurement data was analysed in accordance with the INP. Wind speed, direction and rainfall data were obtained from the NSW Bureau of Meteorology's nearest relevant weather station No. 058214 at Lismore Airport. This was used to identify times when rain occurred or when wind speeds exceeded 5m/s. During such adverse weather conditions the corresponding data from the noise logger was disregarded.

An assessment of noise for high traffic areas (in accordance with *Section 2.2.3* of the INP) has been undertaken and no corrections are applied, as levels are not more than 10 dB above the recommended acceptable amenity levels.

Typical ambient noise sources audible near the logger locations include:

- traffic noise from Wyrallah Road, a designated heavy vehicle route;
- general noise from backyard activities;
- noise from agriculture such as cattle and tractors with slashers;
- noise from motorbikes; and
- noise from trees, insects, birds and dogs.

Note: No tractor or slashing work was undertaken on-site during the logging period.

From site observations, the dominant noise source is from traffic on Wyrallah Road. Noise levels from *Table 3.2* are in good correlation with this statement, showing higher background noise levels at *Logger 1*, (located 20m from Wyrallah Road) versus *Logger 2* (situated off Hazlemount Lane).

Legend

- 4 — Noise Assessment Location
- 1 — Noise Logger Location
- — — Extent of Quarry Extraction and Operations (Project Area)

Figure 3.1

Sensitive Receptor Locations

Client:	Champions Quarry	
Project:	Champions Quarry Expansion	
Drawing No:	0098287pm_GIS_Noise_2.1	
Date:	25/08/2009	Drawing size: A4
Drawn by:	AM	Reviewed by: WW
Source:	-	
Scale:	Refer to Scale Bar	

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0 100 200 300m

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4 NOISE CRITERIA

4.1 OPERATIONAL NOISE CRITERIA

The noise emission criteria for the quarry have been set in accordance with *Section 4.0* of the INP. The intrusiveness and amenity design criteria have been set, based on logging measurements conducted at the nearest representative receivers to the site.

The background noise levels for setting the intrusiveness criterion have been determined and any potential contribution from the quarry has been excluded from background data to provide background noise levels representative of the area in the absence of the site.

The existing LAeq in the area surrounding the site is dominated by local traffic, residential noise sources and some rural sources.

An assessment of transport noise in accordance with *Section 2.2.3* of the INP identified that corrections to the amenity criteria to account for high traffic noise is not applicable, as levels are not more than 10 dB above the recommended acceptable amenity levels. Additionally, as there is no existing industrial noise contribution at representative receivers, no adjustment to the amenity criteria is necessary and the recommended acceptable amenity levels from *Table 2.1* of the INP has been adopted as the amenity criteria.

Project specific noise criteria (PSNC) are presented in *Table 4.1.* The more stringent intrusiveness goals are the criteria that are adopted.

Table 4.1 Project Specific Noise Criteria (PSNC)

Location	Period	Intrusiveness Criteria LAeq(15minute)	Amenity Criteria LAeq(Period)
NAL 1	Day	**40**	50
NAL 2		**37**	50
NAL 3		**37**	50
NAL 4		**40**	50

1. Weekdays and Saturdays - Daytime 7:00 am – 6:00 pm; Sundays -Daytime 8am - 6pm.
2. The INP states that these criteria 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 are achieved, it is unlikely that most people would consider the resultant noise levels excessive.
3. Applicable project specific design criteria are in bold and are the lower of the intrusiveness and amenity criteria in each instance.

4.2 *ROAD TRAFFIC NOISE CRITERIA*

The NSW DECCW's ECRTN (EPA 1999) recommends external and internal traffic noise goals. Traffic noise impacts have been assessed for receivers located off Wyrallah Road (which is anticipated to be used by all vehicles accessing the site). Therefore the traffic noise impact assessment has adopted noise goals for 'land use developments with the potential to create additional traffic on arterial roads or freeways', in accordance with the ECRTN and reproduced in *Table 4.2*.

Table 4.2 Traffic Noise Design Goals

Location	Road Classification	Traffic Noise Goal
		Daytime LAeq(15hour)
All Receivers	Freeway/Arterial	60dBA

1. Daytime: 07:00 am – 10:00 pm.

Further, the ECRTN identifies that where these levels are already exceeded that traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dBA.

4.3 *MODIFYING FACTORS*

As discussed in the INP (EPA, 2000) *where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration.*

The INP provides correction factors to be applied to the source noise level at the receiver before comparison with the criteria to account for the additional annoyance caused by these modifying factors. These factors are applied for the following circumstances:

- **Tonal noise**—containing a prominent frequency and characterised by a definite pitch.
- **Low-frequency noise**—containing major components within the low frequency range (20 Hz–250 Hz) of the frequency spectrum.
- **Impulsive noise**—having a high peak of short duration or a sequence of such peaks.

- **Intermittent noise**—the level suddenly drops to that of the background noise several times during the assessment period, with a noticeable change in noise level of at least 5 dB.

- **Adjustment for duration**—applied where a single event noise is continuous for a period of less than two and a half hours in any 24-hour period. The acceptable noise level may be increased by the adjustment shown in *Table 4.2*. This adjustment is designed to account for unusual and one-off events, and does not apply to regular high-noise levels that occur more frequently than once per day.

- **Maximum adjustment**—the maximum correction to be applied to the criteria or the measured level where two or more modifying factors are present. The maximum adjustment is 10 dB(A) where the noise contains two or more modifying factors (excluding the duration correction).

ERM has analysed all plant items to be used as part of the proposed Champions Quarry operations and assessed these against the modifying factors presented in *Table 4.1* of the INP.

Based on the analysis of all noise sources, and in particular the impact hammer and rock saw, the modifying factors were not deemed applicable. The checks are reproduced as follows:

- Tonal noise - Analysis of one-third analysis completed and found not to exceed the prescribed levels for specific frequencies and therefore not applicable.

- Low frequency noise – dB(C) –dB(A) = 11.7 dB (i.e. < 15dB), therefore not applicable.

- Impulsive Noise - LAIMax-LAFMax = 1.3 dBA (i.e. <2 dB), therefore not applicable

- Intermittent - Is applicable although only during night periods. As the proposed quarry operations are to occur in the day time this correction factor is not relevant.

- Duration - Not applicable, as all may operations may occur more than once in one 24hr period.

- Maximum – Not applicable as no modifying factors applied.

ERM have recently completed measurements of a medium sized impact hammer. The analysis for Low Frequency and Impulsiveness over a fifteen minute attended survey while the impact hammer was in operation is

provided in *Annex E* (refer attached) which demonstrate that the modifying factors in question are not applicable (i.e. LAIMax-LAFMax > 2.0 dBA).

5 METEOROLOGICAL ANALYSIS

5.1 PREVAILING WEATHER CONDITIONS

The efficiency of noise propagation over long distances can be significantly affected by the weather conditions. Of most interest are source to receiver winds and the presence of temperature inversions as both these conditions can enhance received noise levels. To account for these phenomena the DECCW in their INP specify weather analysis procedures to determine the prevalent weather conditions that enhance noise propagation with a view to determining whether they can be described as a feature of the project area.

In this study, temperature inversions are not considered as the quarry operates only during the day and temperature inversions typically occur at night.

The prevailing wind directions have been determined in accordance with the INP which requires that winds at or below 3m/s with an occurrence greater than 30% be assessed. As the quarry operates only during the day, only daytime wind occurrences are relevant to this study. Daytime wind roses have been created from data obtained from the NSW Bureau of Meteorology's nearest relevant weather station No. 058214 at Lismore Airport from the 23/11/2005 to 23/11/2007. This data indicates that winds below 3m/s do not occur in a particular direction for more than 30% of the time as shown in *Annex B*. Hence, noise levels under wind are not assessed in this study, although noise will be enhanced during adverse winds.

6 NOISE IMPACT ASSESSMENT

6.1 CALCULATION PROCEDURES

ENM noise modelling software was used to assess potential noise impacts associated with the proposal. ENM is a NSW DECCW accepted software package and takes into account distance, ground effect, atmospheric absorption and topographic detail.

The model incorporated three-dimensional digitised ground contours for the site, as derived from proposed site plans, and the surrounding land base topography, superimposed on each other. Plant and equipment was modelled at various locations and heights, representative of realistic operating conditions chosen for the worst-case operating scenario.

The noise model predicts L_{eq} noise levels, although it should be noted that each scenario in this assessment has adopted all plant and equipment operating simultaneously; in practice, such an operating scenario would be unlikely to occur and the results should be considered conservative. Where relevant, modifying factors in accordance with *Section 4* if the INP have been applied to calculations.

6.2 EQUIPMENT SOUND POWER LEVELS

The sound power data for the noise modelling of plant for the quarry were calculated from measurements obtained at an existing site or where particular items were unavailable to be measured, data was obtained from manufacturer's data.

Plant items used in modelling scenarios and their associated sound power levels (SWL) are summarised in *Table 6.1.*

Table 6.1 Plant Sound Power Levels

Plant Item	Model	Source	Representative $L_{eq,15minute}$ Sound Power Level (SWL), dB(A)
Mobile Crushing and Screening Plant	Terex Pegson: XA400 primary crusher, 428 Trackpactor tertiary crusher, 2 x Chieftain 2100 Powerscreen.	Measured by ERM at Alstonville Quarry	114
Washing Plant	Terex Finlay Hydrasander 150E or similar	ERM File Data	105
Site Truck (Central Section)	Ford L8000	Measured by ERM on-site	91
Dump Truck (Southern Section)	Caterpillar 35T or similar	ERM File Data	119
Road Truck	Scania 124L Truck and Dog or similar	Measured by ERM on-site	103
Water Truck (Pass-by)	Isuzu	ERM File Data	90
Excavator	Komatsu PC200	Measured by ERM on-site	100
Excavator	Komatsu PC400	ERM File Data	106
Bull Dozer	Caterpillar D8/D9 or similar	ERM File Data	109
Front-End Loader	Komatsu WA320	Measured by ERM on-site	101
Grader	Unknown	ERM File Data	105
Rock Hammer	Typical medium sized Rock Hammer	ERM File Data	121
Rock Saw	Typical medium sized Rock Saw	ERM File Data	113

Notes: 1. Refer to *Annex D* for spectral data used for noise modelling

2. The sound power of the rock hammer was modified to reflect its limited utilisation as the hammer would be used for periods of approximately 5 minute intervals over any 15 minute period.

6.3 NOISE MODELLING METEOROLOGICAL PARAMETERS

The modelled meteorological conditions adopted in this report are presented in *Table 6.2*.

Table 6.2 Relevant Site Specific Meteorological Parameters

Assessment Condition	Temperature	Wind Speed / Direction	Relative Humidity	Temperature Gradient
Daytime - Calm	20^0C	N/A	65%	N/A

6.4 NOISE MODELLING SCENARIOS

In order to assess the impact of the proposed expansion, various representative modelled scenarios for each section were created and used in ENM.

The modelled scenarios are described as follows:

A. *Model Validation/Existing Operations Scenario* is representative of the operations measured during model validation and is also representative of the typical existing operations. Plant equipment has been modelled in the *Central Section* pit at the existing pit depth.

B. *Central Section Scenario* is as per *Existing Operation* scenario but includes a dozer and excavator operating in the *Central Section* pit area and road trucks collecting product.

C. *Central Section Processing Operations Scenario* is representative of crushing, screening and washing of the extracted material in the *Central Section*. This will be undertaken separately to extractive works and has therefore been modelled separately. Processing plant has been located at the western end of *the Central Section* pit.

D. *Southern Section Processing Scenario* is representative of crushing and/or screening of the extracted material in the southern section. This will be undertaken separately to extractive works and has therefore been modelled separately. Processing plant has been located at the north-western cell of the southern pit.

E. *Southern Section: Overburden Stripping Scenario* is indicative of the first three to six months (approximately) of operation that will be undertaken in the initial 3 ha cells, at the surface whilst overburden stripping occurs. Shielding will be provided by earth bunds directly adjacent to items of plant during this period. Noise levels will be progressively reduced as topsoil bunding and quarry benches are increased in height. The extractive equipment is located in the north western edge of the *Southern Section,* which is where the overburden stripping will be most exposed to residences (*NAL 4* in particular).

F. *Southern Section Scenario* is indicative of the operations in 5 to 10 years once the benching has been established. Extractive plant is generally located in the pit, which will provide shielding from noise at the assessment locations. A dump truck is moving material between the pits on the haul road between the *Central* and *Southern* section pits. There are road trucks in both *Central* and *Southern* section pits being loaded with material.

G. *Processing and Extraction Scenario* represents a combination of *Scenarios C* and *F*, combining extractive plant located in the southern pit and crushing and processing being undertaken simultaneously within the *Central Section* processing area.

H. *Rock Hammer operation* represents a combination of *Scenario F* with a rock hammer being utilised in the central pit;

I. *Rock Saw operation* represents a combination of *Scenario F* with a rock saw being used in the central pit.

Table 6.3 shows the equipment that is used in each modelled scenario.

Table 6.3 Modelled Scenarios: Equipment Used

Plant Item	Equipment Used								
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Mobile Crushing and Screening Plant			X	X			X		
Washing Plant			X				X		
Site Truck (Ford L8000)	X	X							
Dump Truck (CAT 35T)					X	X		X	X
Road Truck 1		X	X	X		X	X	X	X
Road Truck 2		X	X	X		X	X	X	X
Excavator (20T)	X	X							
Excavator (40T)					X	X	X	X	X
Bull Dozer		X			X	X	X	X	X
Front-End Loader 1	X	X	X	X		X	X	X	X
Front-End Loader 2						X	X	X	X
Rock Hammer								X	
Rock Saw									X

The six operational modelling scenarios (*Scenario B* to *Scenario G*) are graphically presented in *Annex C,* showing equipment included and their locations, note *Scenario G* is a combination of *Scenario C* and *Scenario F*. *Scenario's H* and *I* have both been added to *Scenario F* with a single additional item of plant being utilised in the base of the central pit for each. Whilst Rock Hammer and Rock Saw will both be utilized within the Southern Pit, the operation of these within the Central Pit is considered conservative as it is in closer proximity to receivers. Additionally, the modelled *Scenario's H* and *I* include operational elements as outlined within *Scenario F*. It is not intended to operate any other plant within the quarry during operation of either the rock saw or the rock hammer.

6.5 NOISE MODEL VALIDATION

Noise model validation monitoring was undertaken at an interim location between the central section and *NAL 4* on the 1st October 2008. An ambient measurement without the quarry operating was conducted followed by a reading with the quarry operational. The items of plant that were operational during the validation were the Komatsu PC200 Excavator, the Komatsu WA320 Front End Loader, and the Ford L8000 Haul Truck.

These items of plant have been subsequently modelled using ENM as per the locations during attended monitoring (modelled *Scenario A* from *Section 6.4.)* Accurate topographic data (to 2m) has been incorporated into the model in order to be consistent with the site topography. *Table 6.4* presents the on-site measured quarry contribution against the noise modelling predictions.

Table 6.4 Noise Model Validation Results

Noise Assessment Location	Measured Quarry Contribution, $L_{eq,15minute}$ dB(A)	Predicted Noise Model Quarry Contribution, $L_{eq,15minute}$ dB(A)	Difference, dB(A)
NAL 4 (Interim)	28	30	2

Table 6.4 shows that the measured quarry contribution to be 2dBA lower than predicted from the noise model. The noise model validation indicates that the noise model developed for the quarry is slightly conservative and generally within typical noise modelling tolerance.

6.6 NOISE MODELLING RESULTS

6.6.1 Results - No Noise Control (i.e. Bunds)

Multiple operational scenarios described in *Section 6.5* were modelled to quantify the potential acoustic impact on the surrounding community of the expansion of the quarry at various operational stages and activities. In accordance with Section 4 'Modifying Factor Adjustments' of the INP, sources that contain certain characteristics, such as tonality or intermittency may result in a greater annoyance to the community. To account for this, the INP provides modifying factor corrections to be applied to such noise sources. Noise sources in this assessment were found to not contain modifying factor components.

A summary of predicted noise levels at assessed representative residences adjacent to the quarry are provided in *Table 6.5* for calm meteorological conditions.

It should be noted that once 'on-site', vehicles are considered 'on-site' noise sources and are to be assessed in accordance with the INP, while traffic generation on public roads associated with the proposal is assessed in accordance with the ECRTN.

Note the validation scenario (*Scenario A*) was used to demonstrate the accuracy of the model and as it has no bearing on potential noise impacts, has not been included in the results section of this assessment.

Table 6.5 Noise Modelling Summary - No Noise Control Bunds

Assessment Location	Predicted Daytime $L_{eq,15minute}$ Noise Levels, dB(A)								
	B	**C**	**D**	**E**	**F**	**G**	**H**	**I**	***PSNC***
NAL 1	33	31	30	32	33	35	35	34	*40*
NAL 2	**42**	**41**	35	**38**	**40**	**44**	**43**	**41**	*37*
NAL 3	34	36	34	34	**38**	**40**	**40**	**39**	*37*
NAL 4	**42**	40	38	**43**	**44**	**46**	**44**	**44**	*40*

Note : Exceedences of the PSNC are in BOLD

Modelled noise levels are identified to exceed the PSNC at all receptors excluding *NAL 1*, in some cases by up to 8dBA, note noise level exceedences of more than 5dBA are considered significant and therefore in accordance with the INP, reasonable and feasible noise control measures should be considered by the proponent.

6.6.2 *Results - Including Noise Control*

ERM and the proponent had several meetings and correspondence to determine reasonable and feasible noise control options that could be practically implemented to site and include 4 metre earth mound construction in several key areas. The key areas include adjacent to operations within the *Central* and *Southern* operations, a bund along the cutting of the haul road between the *Central* and *Southern* section pits, and a bund adjacent to *Receptor 2* (north east residence). Additionally, the noise model adopting noise control also included some localised barriers adjacent to dominant plant inside the *Central* and *Southern* section pits, namely the processing and screening plants. See *Figure 6.1* for bund positioning and layouts.

A summary of predicted noise levels at assessed representative residences adjacent to the quarry once the above bunds are in place are provided in *Table 6.6* for calm meteorological conditions.

Table 6.6 Noise Modelling Summary – Including Noise Control

Assessment Location	Predicted Daytime $L_{eq,15minute}$ Noise Levels, dB(A)								
	B	**C**	**D**	**E**	**F**	**G**	*H*	*I*	***PSNC***
NAL 1	28	26	30	29	30	31	35	31	*40*
NAL 2	32	35	34	33	34	**38**	**39**	36	*37*
NAL 3	32	34	34	33	33	37	**39**	35	*37*
NAL 4	37	33	38	36	36	38	39	37	*40*

Note : Exceedences of the PSNC are in BOLD

It is noted that once construction of 4 metre bunds in the identified positions are completed, there would be significant noise reductions achieved to adjoining receptors and compliance is generally expected to be achieved at all receptors except with regard to *Scenario G* and *Scenario H*.

Modelling identifies a 1 dBA exceedance at *NAL 2* for *Scenario G,* which is acoustically insignificant, especially considering the 2 dBA tolerance shown in the model validation.

These results also indicate that the noise levels associated with the use of the rock hammer will result in exceedances of the PSNL for receivers NAL2 and NAL3 by 2 dBA. Using the rock hammer (with noise control) in isolation from other plant would remove the cumulative noise impacts on neighbouring receivers. *Table 6.7* presents the results of modelling showing the rock hammer working in isolation (i.e. no other plant working in tandem with rock breaking).

Table 6.7 Revised Noise Modelling Summary– Rock hammer Only (with mitigation)

Assessment Location	Predicted Daytime $L_{eq,15minute}$ Noise Levels, dB(A)	
	H	*PSNC*
NAL 1	33	*40*
NAL 2	37	*37*
NAL 3	**38**	*37*
NAL 4	35	*40*

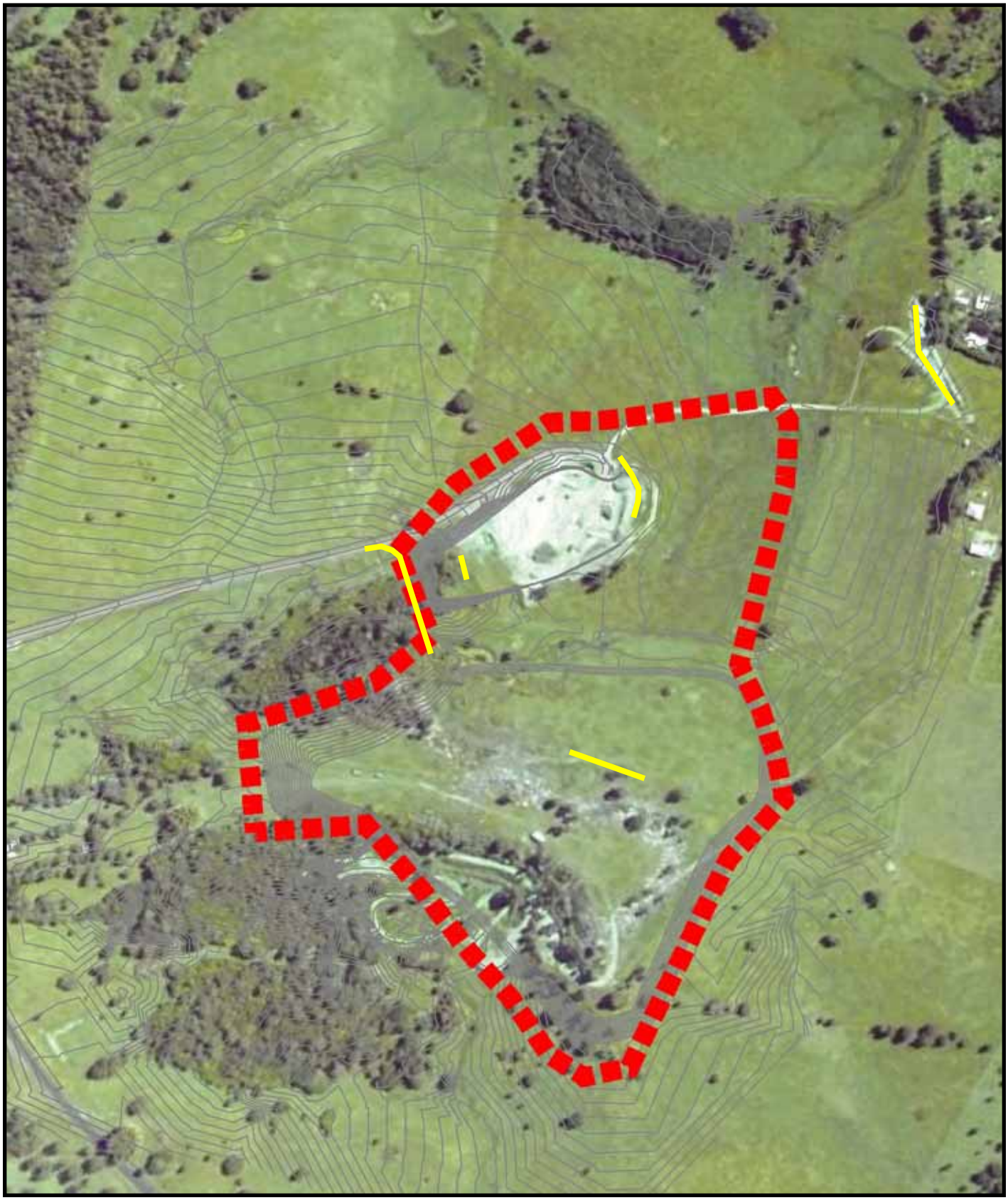
Note : Exceedances of the PSNC are in BOLD

The above results indicate that it would be preferable to use a rock saw for sandstone quarrying as the resulting noise impacts are below the PSNC for all criteria. Notwithstanding this, if the rock hammer (with mitigation) is used in isolation the project specific noise criteria would be met at all receptors, with the exception of NAL3 where a 1dBA exceedance is identified, which is within the noise modelling resolution.

To further ameliorate any impacts associated with the rock hammer and rock saw, it is proposed to implement the following mitigation measures:

- no other on-site plant is to be operational when the rock saw or rock hammer is in use;
- use of the rock hammer to be limited to between 9:00am to 12.00pm and 2.00pm to 4.00pm; and
- in-situ noise monitoring of the operational rock hammer to take place to verify results of the model and to determine success of mitigation measures to be implemented.

In consideration of the application of modifying factors as outlined in *Section 4* of the INP (2000), it is noted that in the event that the rock hammer and/or saw were to be used, any adjustment for intermittent noise would be applied for night-time periods only. The proposed quarrying would be undertaken during the hours of 7:00am-5:30pm weekdays and 7:30am -3pm Saturdays, and therefore the modifying factor would not be applied.



Legend

Noise Control Bund Locations

Extent of Quarry Extraction and Operations (Project Area)

Figure 6.1

Noise Control and Bund Locations

Client:	Champions Quarry	
Project:	Champions Quarry Expansion	
Drawing No:	0098287pm_GIS_Noise_6.1	
Date:	25/08/2009	Drawing size: A4
Drawn by:	AM	Reviewed by: WW
Source:	-	
Scale:	Refer to Scale Bar	

N

0 100 200 300m

Environmental Resources Management Australia Pty Ltd
Building C, 33 Saunders St, Pyrmont, NSW 2009
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ERM

7 *ROAD TRAFFIC NOISE*

The haul trucks enter and leave Champions Quarry via Wyrallah Road. The existing operations (as per *DA 2005/999)* had an average of 11 truck loads leaving the quarry per day. The proposed expansion is expected to increase to an average of 30 truck loads leaving the quarry each day with approximately 50% travelling north and 50% travelling south. The truck movements are between 7.00am and 5.30pm Weekdays and 7.30am and 3.00pm Saturdays during the operational hours of the quarry.

Noise assessment locations *1* and *4* are representative of the most exposed residences to Wyrallah Road and are both located approximately 20 metres from the road.

Traffic noise has been modelled using the Calculation of Road Traffic Noise (CoRTN). All noise predictions have been made to 1 metre in front of the most exposed façade of a dwelling, at a height of 1.5 metres above floor level.

The contribution from non-site related traffic on Wyrallah Road has been calculated at 64dB(A) L_{eq15hr} for location *1* and *4*, based on a daily traffic volume of 2798 vehicles per day (*Traffic Impact Assessment, Roadnet 2009*). The contribution from site vehicles has been calculated at 56dB(A) L_{eq15hr} for location *1* and *4*, based on 30 trucks leaving the quarry per day. The total combined road traffic noise level is 64dB(A) L_{eq15hr}. This complies with ECRTN criteria as site related traffic noise on Wyrallah Road will not increase existing road traffic noise on average over a 15-hour period.

8 MITIGATION MEASURES

Additional noise control would be employed where feasible and practicable throughout the proposed expansion of Champions Quarry. These measures are summarised as follows:

- the operating hours of the quarry are restricted from 7am to 5.30pm. This time restriction prevents noise emissions during the evening and night periods, at which time background noise levels are lower. It also avoids potential sleep disturbance to the residents;
- road traffic noise created by the haul trucks accessing the site is ameliorated by imposing a speed limit of 30km/h and prohibiting haul trucks from using compression braking on-site;
- effective placement and stockpiling of product so that where possible, plant equipment can be working behind stockpiles;
- a 4m earth bund adjacent to plant that is not shielded by permanent bunding;
- modern, well maintained industrial equipment will be used;
- regular operational noise attended noise monitoring will be undertaken at established permanent monitoring locations to provide additional noise data during quarry operations;
- plant operations personnel will undergo induction training into best practice quarry operations, the benefits of which help to minimise unnecessary noise emissions from plant equipment;
- for compliance purposes, attended noise monitoring (at established permanent noise assessment locations) and plant equipment audits will be undertaken on an annual basis; and
- sealing of the main access road from the site entrance intersection to the central pit.

Noise experienced at sensitive receivers is expected to be progressively reduced as the quarry expansion proceeds, through implementation of the following measures:

- plant is to be progressively moved in-pit where the pit walls will act to shield receiver locations from noise generated;
- plant will be relocated to greater pit depths throughout the life of the quarry to further reduce noise at receiver locations;
- the earth bund adjacent to the existing pit will be progressively increased in height and consequently increase shielding to the residences nearest to the quarry; and

- no additional noise producing activities, plant or equipment will be introduced at the site.

To further ameliorate any impacts associated with the rock hammer and rock saw, it is proposed to implement the following mitigation measures:

- no other plant is to be operational when the rock saw or rock hammer is in use;

- use of the rock hammer to be limited to between 9:00am to 12.00pm and 2.00pm to 4.00pm; and

- in-situ noise monitoring of the operational rock hammer to take place to verify results of the modelling and to determine success of mitigation measures.

By adopting the above management measures, noise emissions from the quarry are expected to be controlled.

9 CONCLUSION

ERM has completed a noise impact assessment for the proposed expansion of Champions Quarry located at 1586 Wyrallah Road, Tuckurimba, NSW.

Operational noise emissions are predicted to generally comply with the relevant PSNC at all assessed residences, following the implementation of noise controls presented in this report. Specific operational management requirements for use of a rock hammer will need to be instituted.

Conservative calculations of road traffic noise associated with Champions Quarry found that levels complied with stipulated criteria at potentially affected residences.

In conclusion, implementation of the noise mitigation measures outlined in this report would see noise levels at the receiver locations comply with relevant noise criteria at all receptors, and furthermore, would be progressively reduced throughout the proposed Champions Quarry expansion due to increased shielding of pit walls.

REFERENCES

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

Environment Protection Authority (EPA, 1994), **Environmental Noise Control Manual** (ENCM).

Environment Protection Authority (EPA, 1999), **Environmental Criteria for Road Traffic Noise** (ECRTN).

RTA Technology, **Environmental Noise Model** (ENM) Windows Version 3.06.

Annex A

A ***UNATTENDED NOISE MONITORING DATA***

Unattended Noise Monitoring Data

Table A.1 Noise logger 1: Results table, L_{eq}, dB(A)

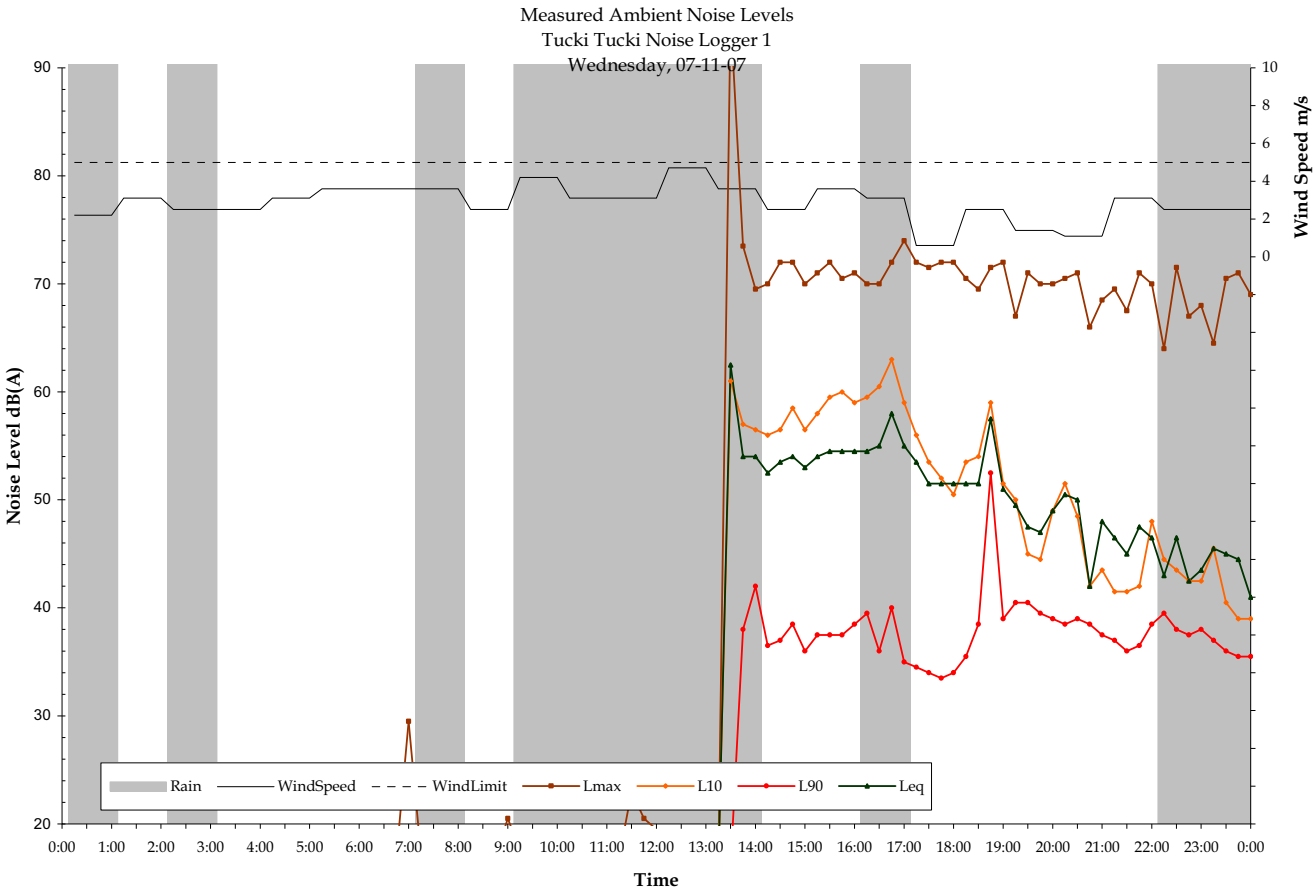
Date	ABL Day	ABL Evening	ABL Night
Wednesday, 07-11-07	0	36	0
Thursday, 08-11-07	0	0	0
Friday, 09-11-07	0	41	0
Saturday, 10-11-07	0	0	0
Sunday, 11-11-07	0	44.5	0
Monday, 12-11-07	0	44.5	35.5
Tuesday, 13-11-07	0	43	35.5
Wednesday, 14-11-07	35.5	0	35
Thursday, 15-11-07	35.5	0	34
Friday, 16-11-07	34.5	40	35
Saturday, 17-11-07	35	38.5	31
Sunday, 18-11-07	36	0	31.5
Monday, 19-11-07	36	39	34.5
Tuesday, 20-11-07	34.5	35.5	33.5
Wednesday, 21-11-07	33	0	35.5
Thursday, 22-11-07	0	0	35
Friday, 23-11-07	0	0	0
Summary Values	35.3	40	35

1. 0 indicates periods with too few valid samples due to weather or logger

Table A.2 Noise logger 2: Results table, L_{eq}, dB(A)

Date	ABL Day	ABL Evening	ABL Night
Wednesday, 07-11-07	0	30	0
Thursday, 08-11-07	0	0	0
Friday, 09-11-07	0	36.5	0
Saturday, 10-11-07	0	0	0
Sunday, 11-11-07	0	38.5	0
Monday, 12-11-07	0	38	32.5
Tuesday, 13-11-07	0	35	28
Wednesday, 14-11-07	31.5	0	28
Thursday, 15-11-07	31.5	0	29.5
Friday, 16-11-07	31.5	34.5	28.5
Saturday, 17-11-07	31.5	33.5	28
Sunday, 18-11-07	31	0	27.5
Monday, 19-11-07	30.5	32	28
Tuesday, 20-11-07	32	31	27
Wednesday, 21-11-07	31	0	28.5
Thursday, 22-11-07	0	0	28
Friday, 23-11-07	0	0	0
Summary Values	31.5	34.5	28

1. 0 indicates periods with too few valid samples due to weather or logger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Time
Rain
WindSpeed
WindLimit
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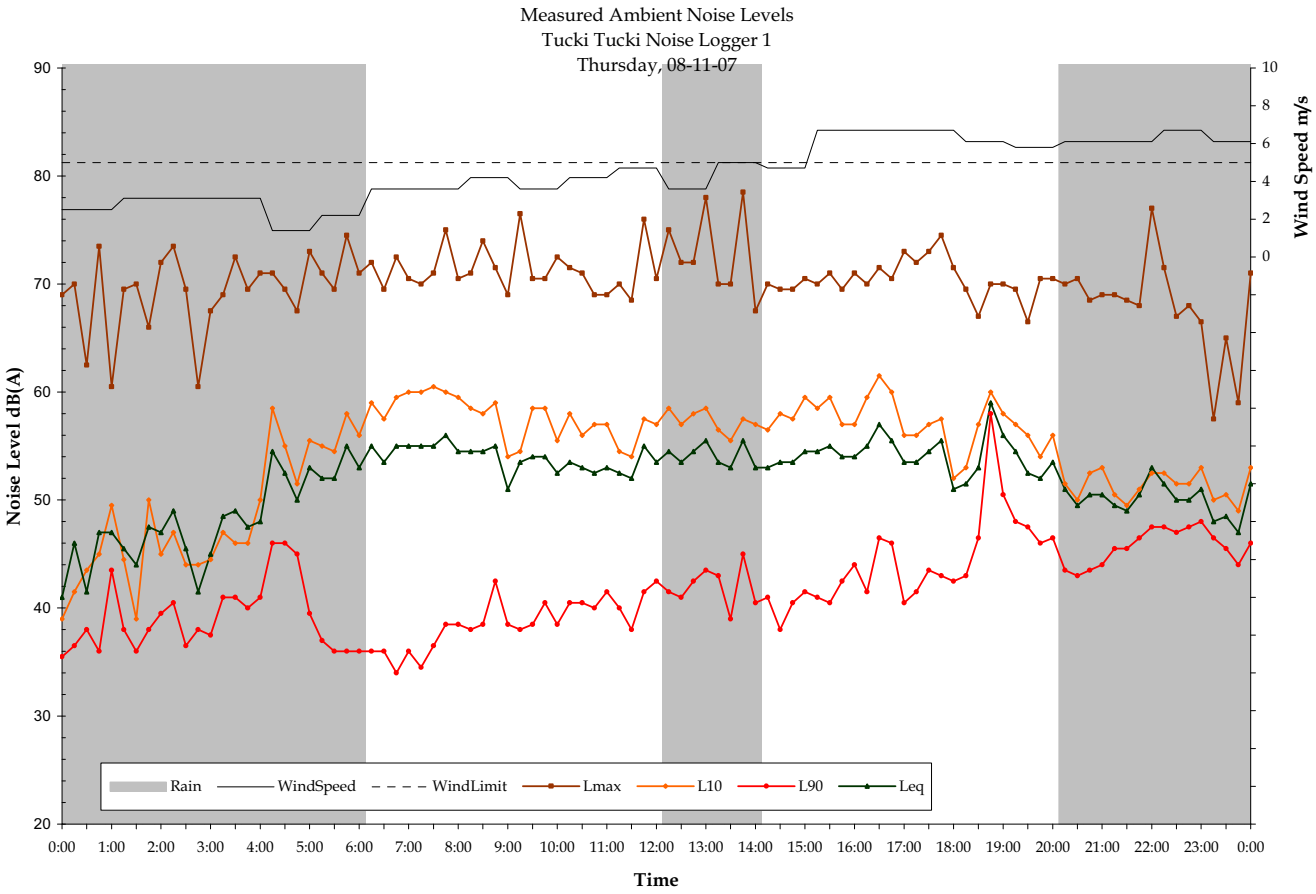
Leq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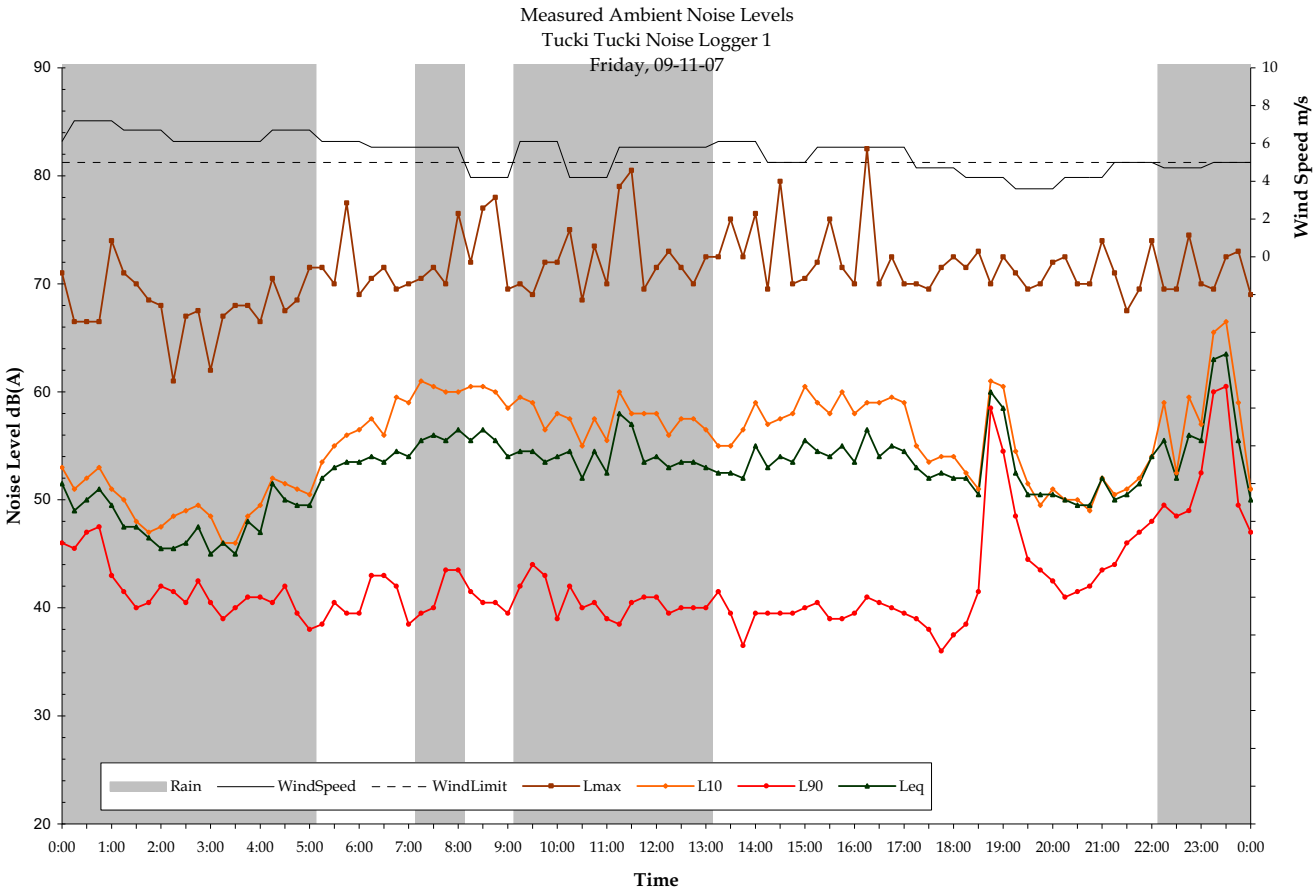
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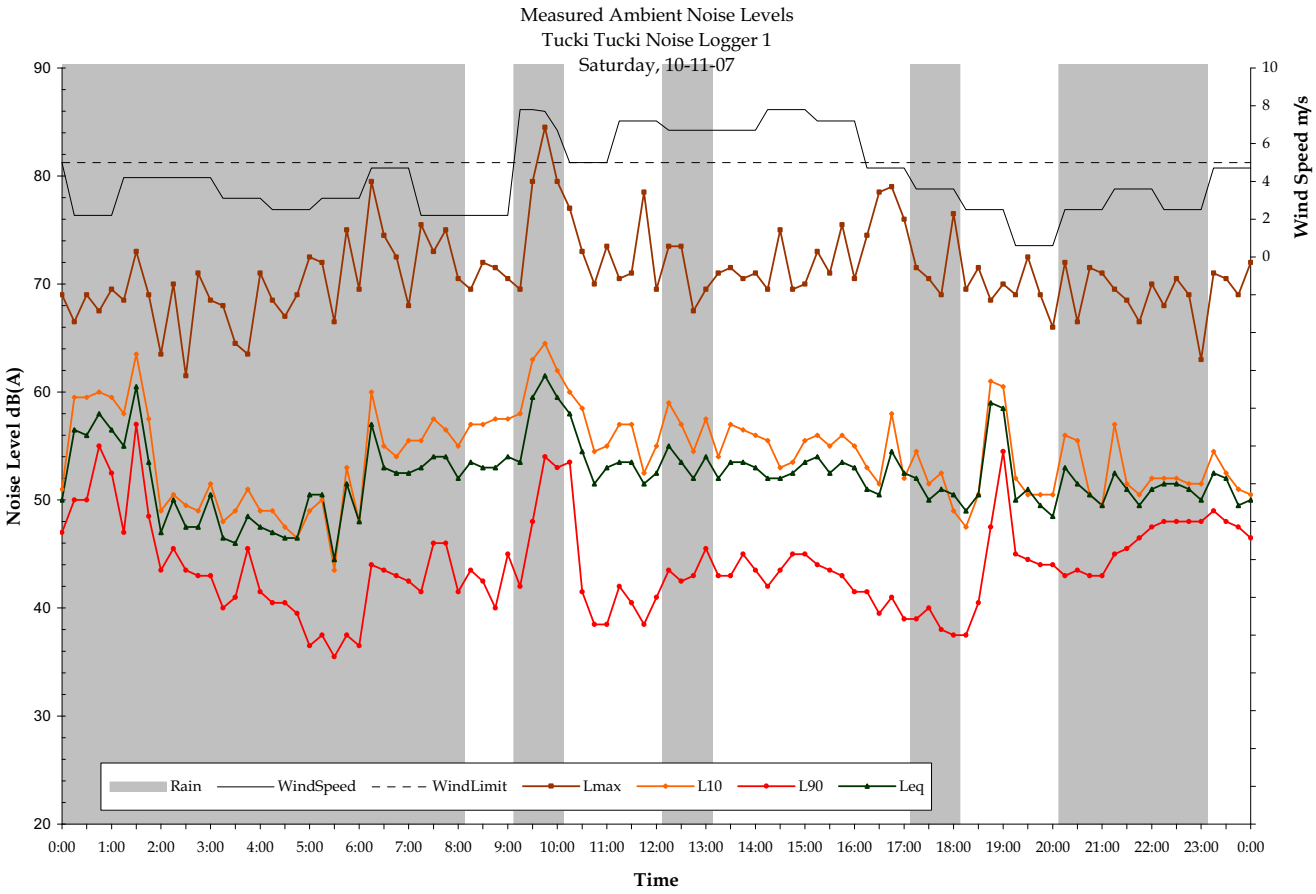
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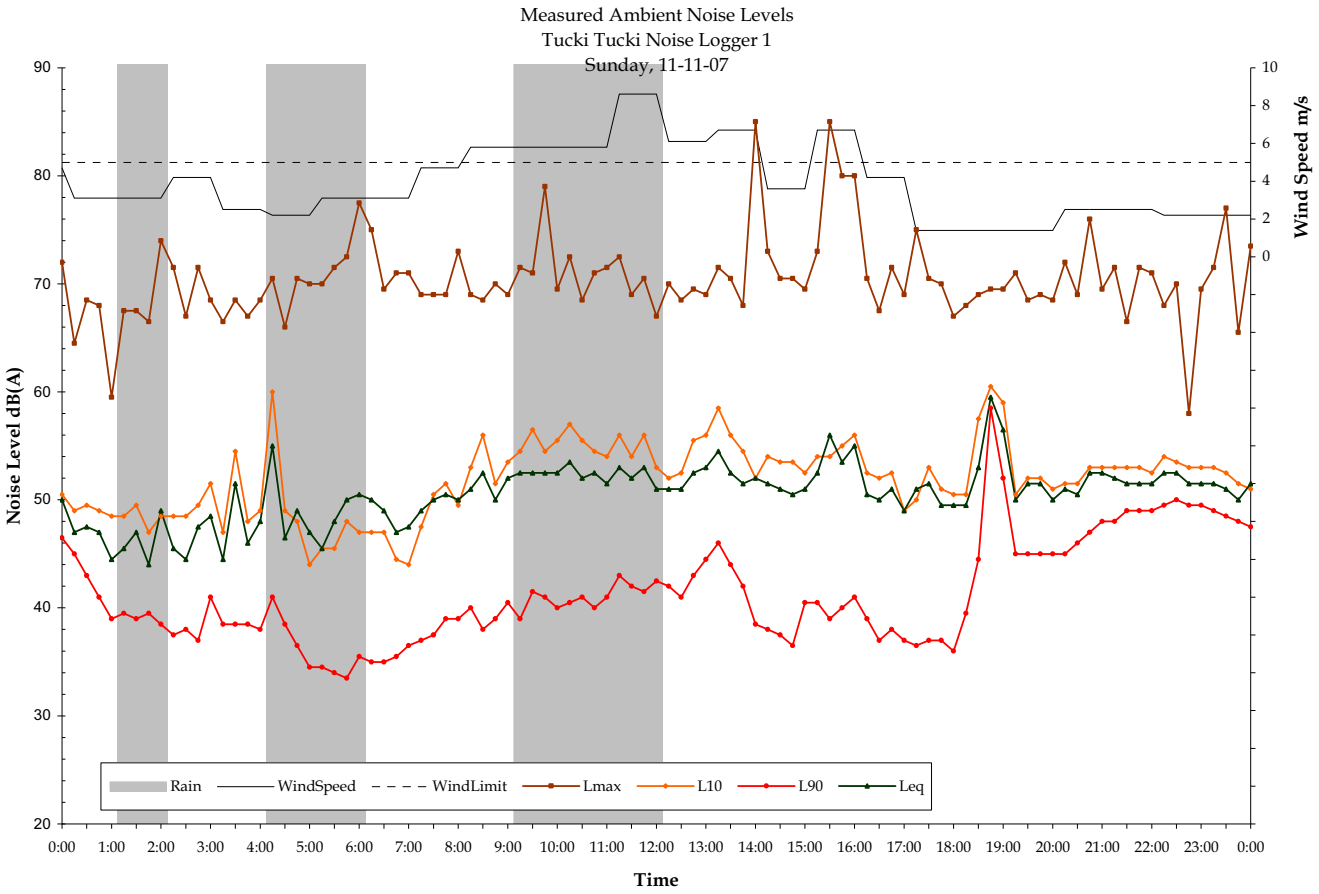
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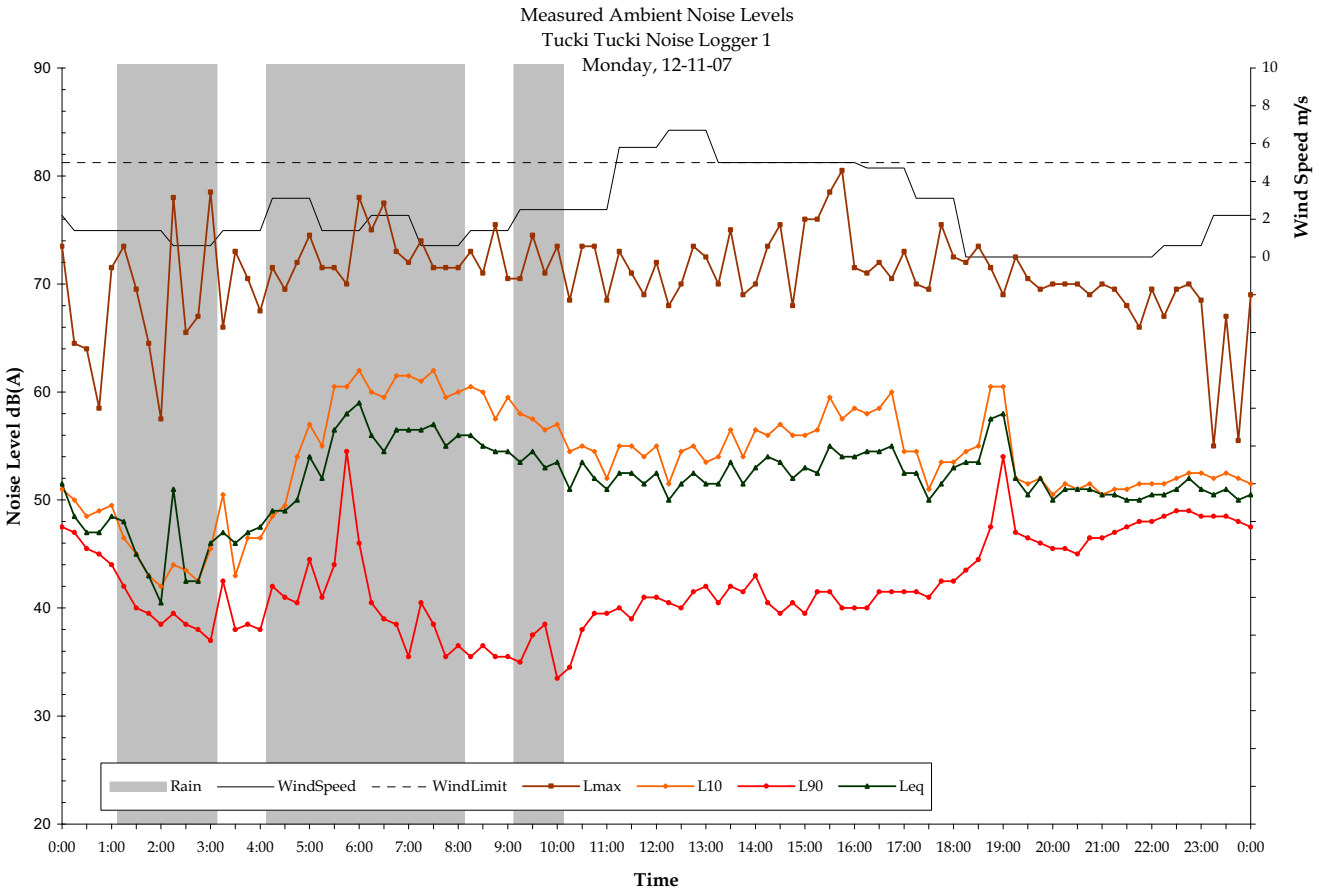
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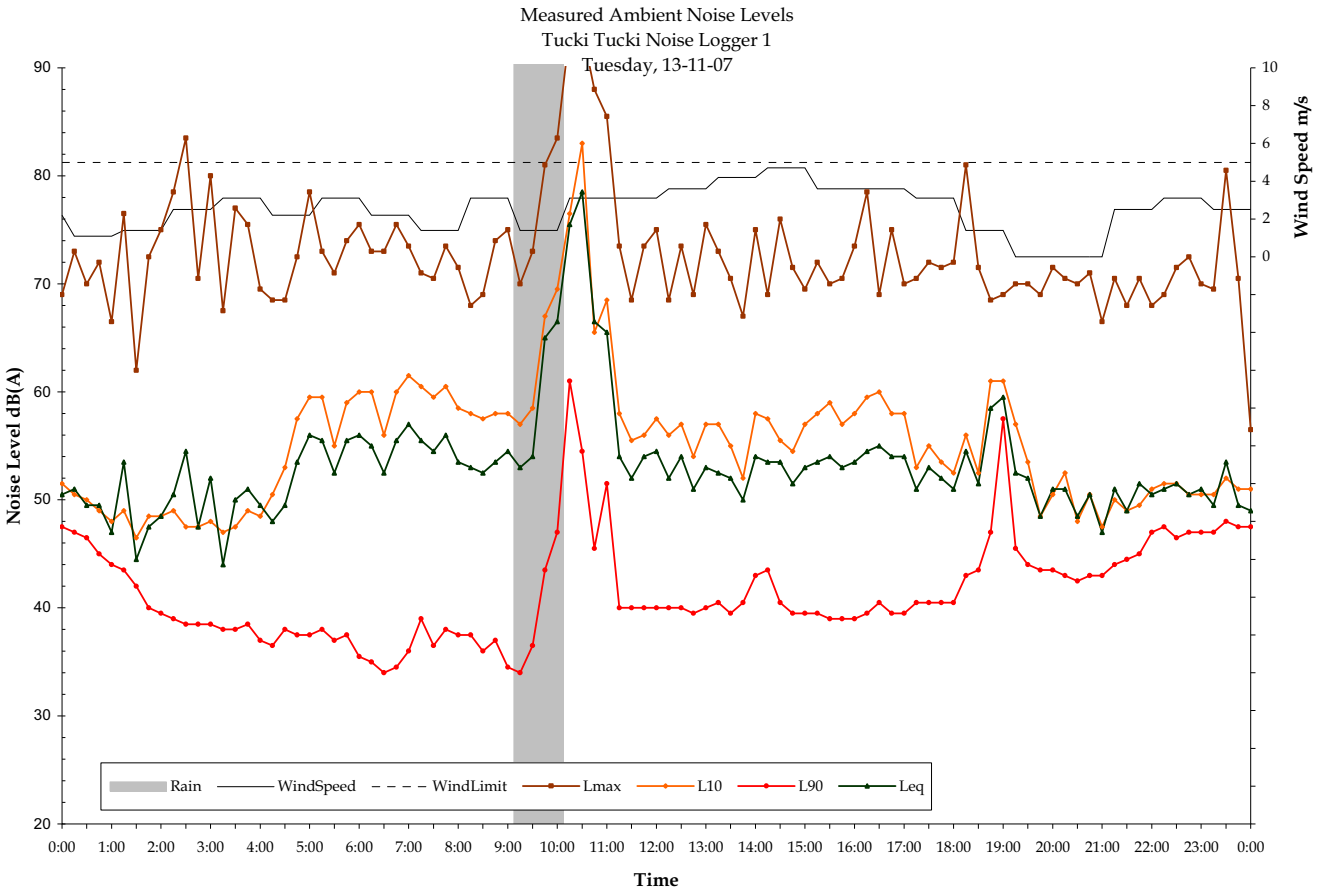
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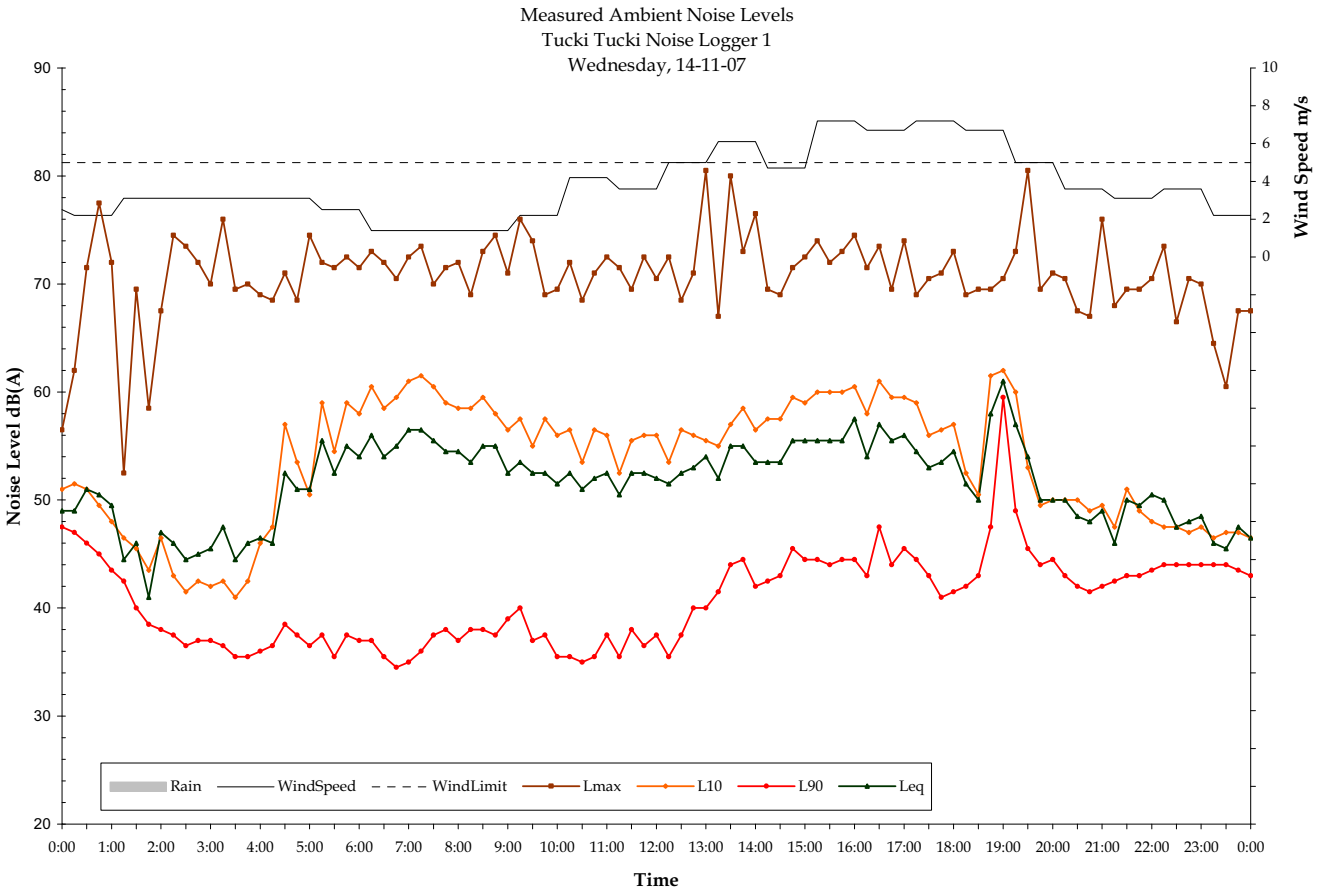
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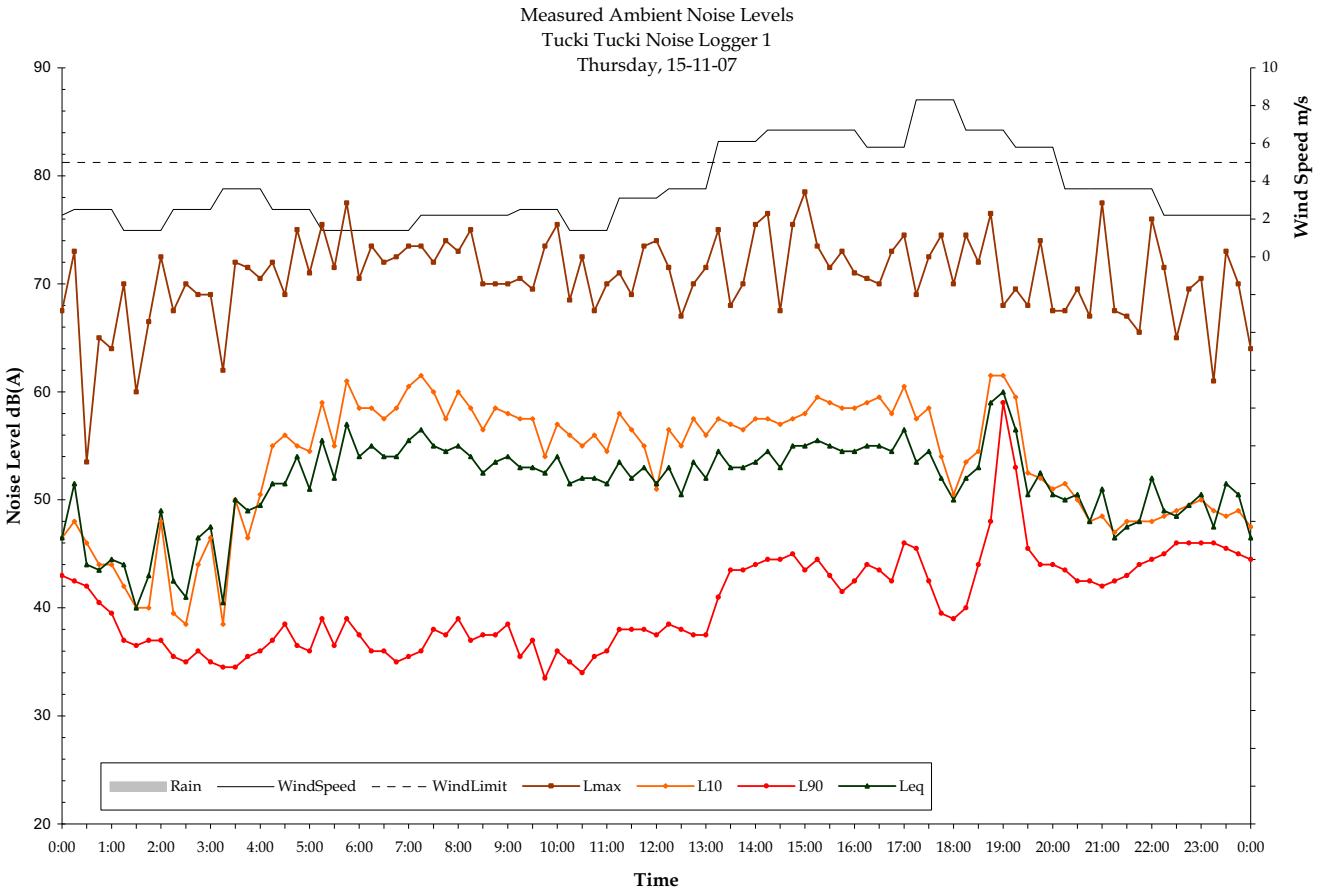
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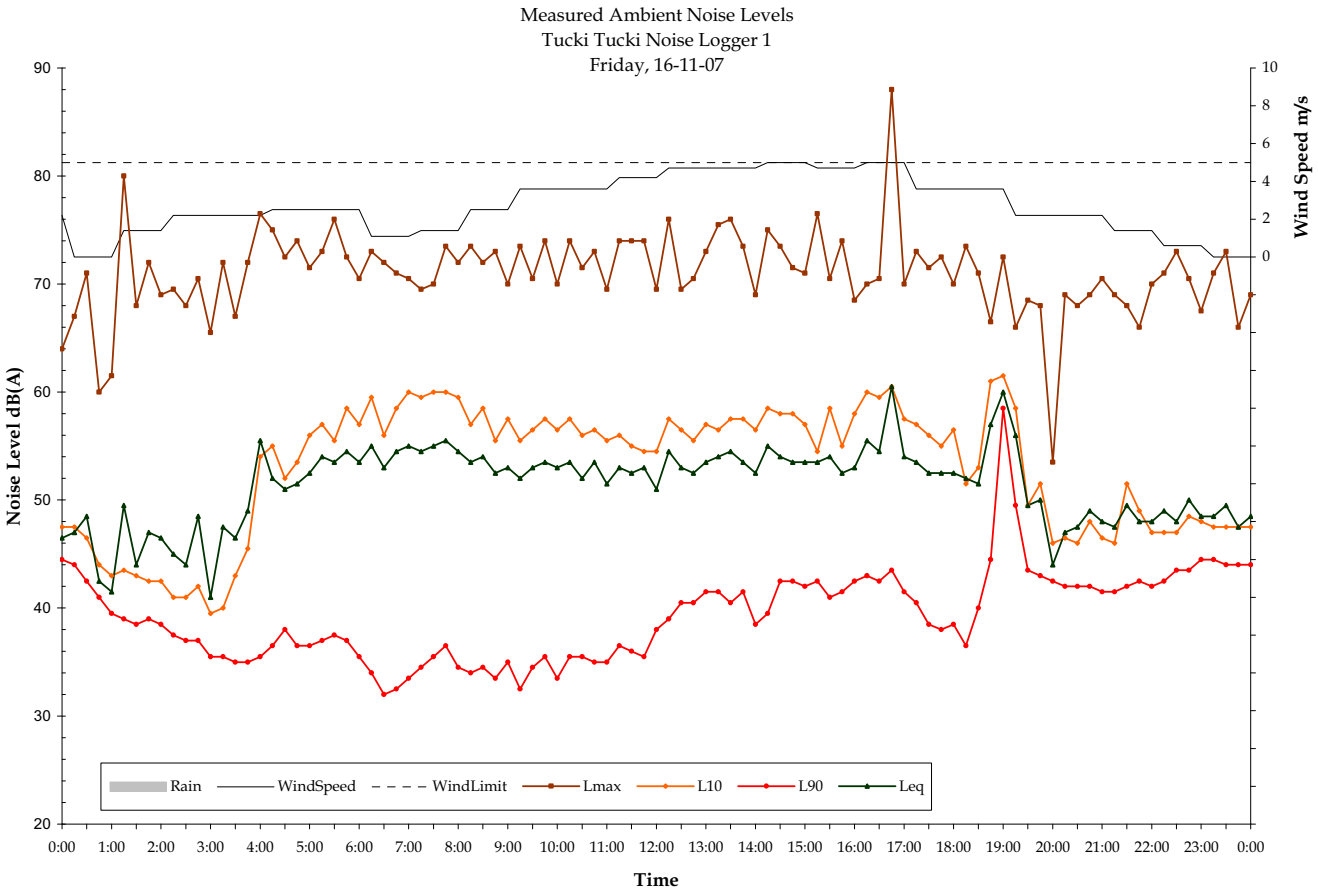
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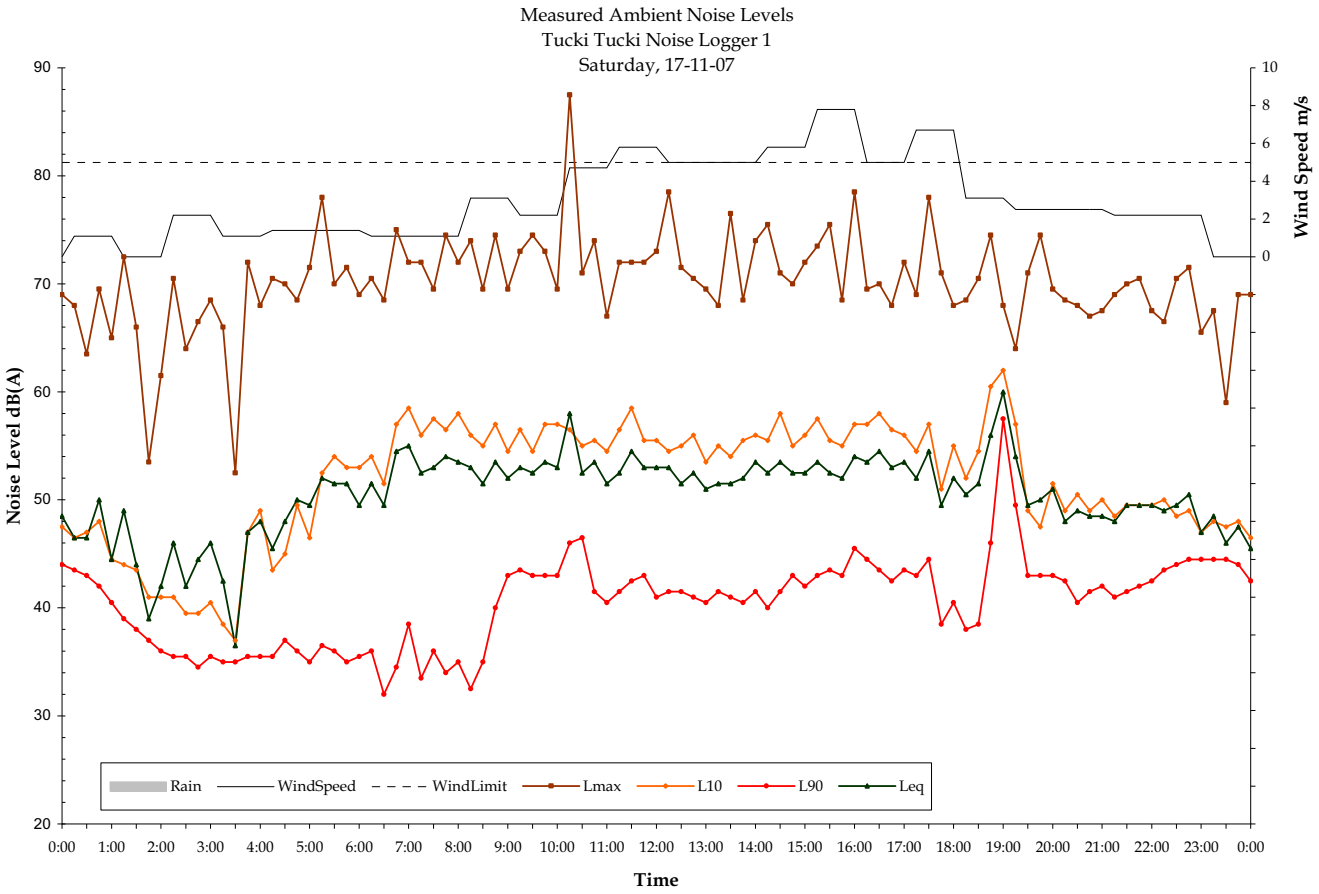
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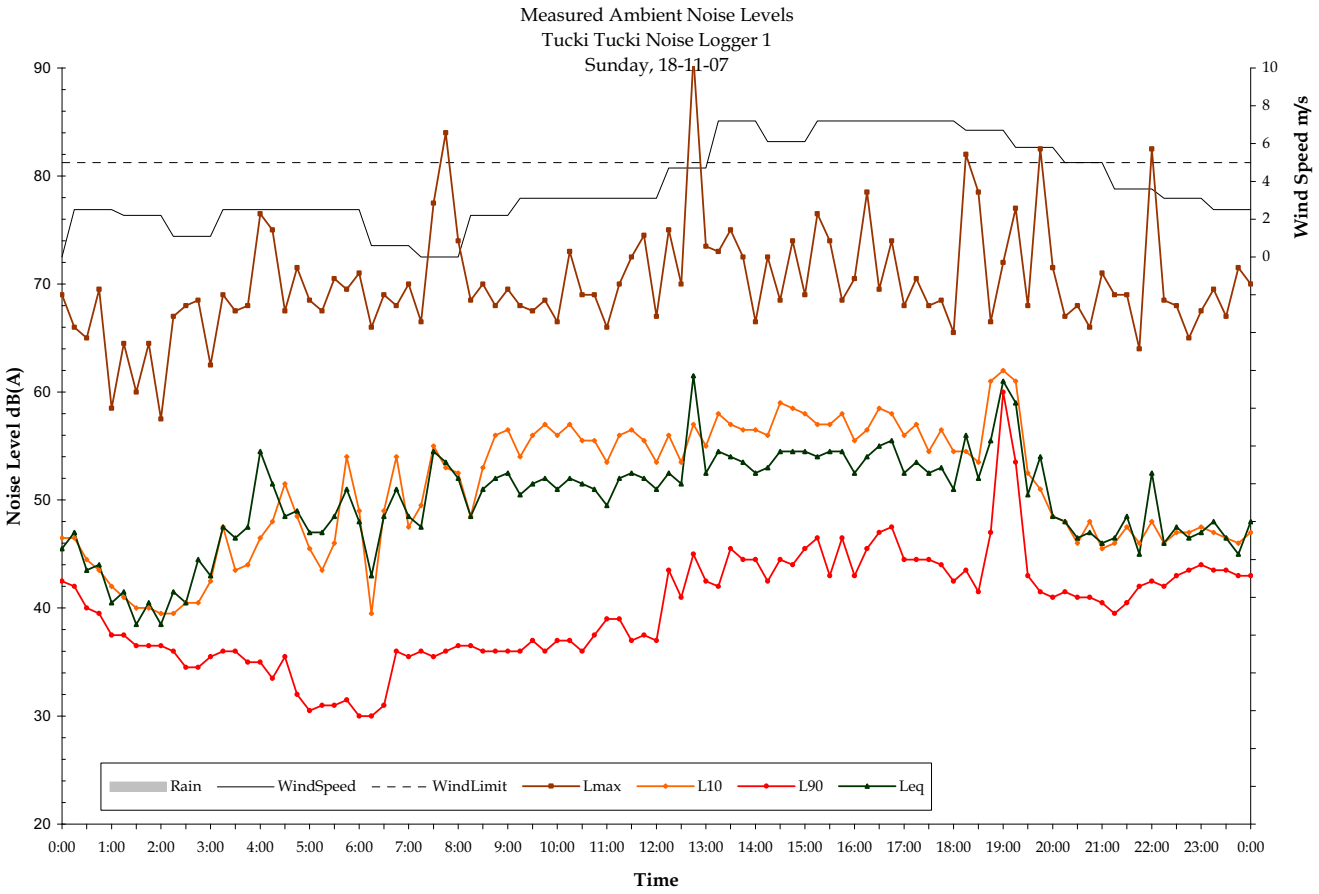
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Time
Rain
WindSpeed
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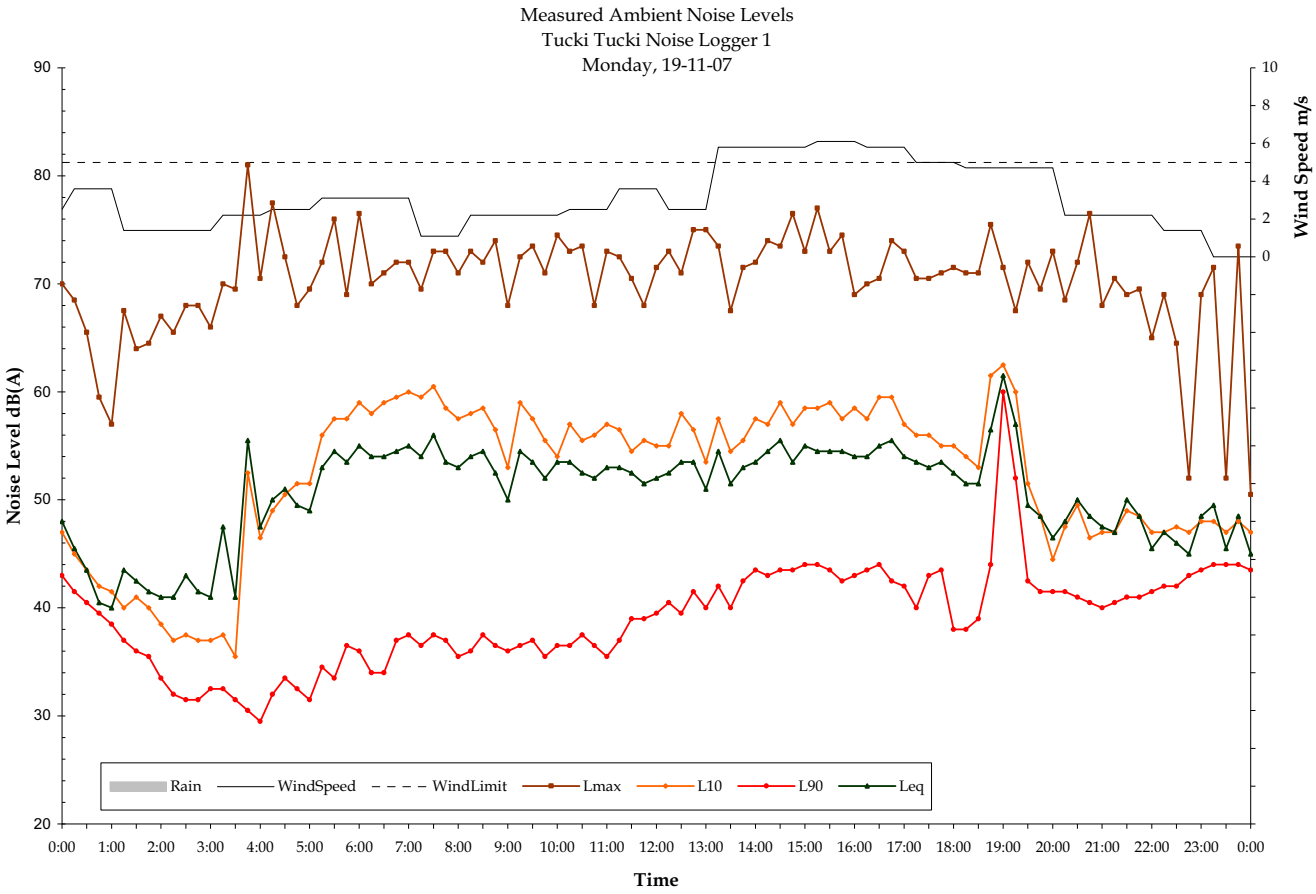
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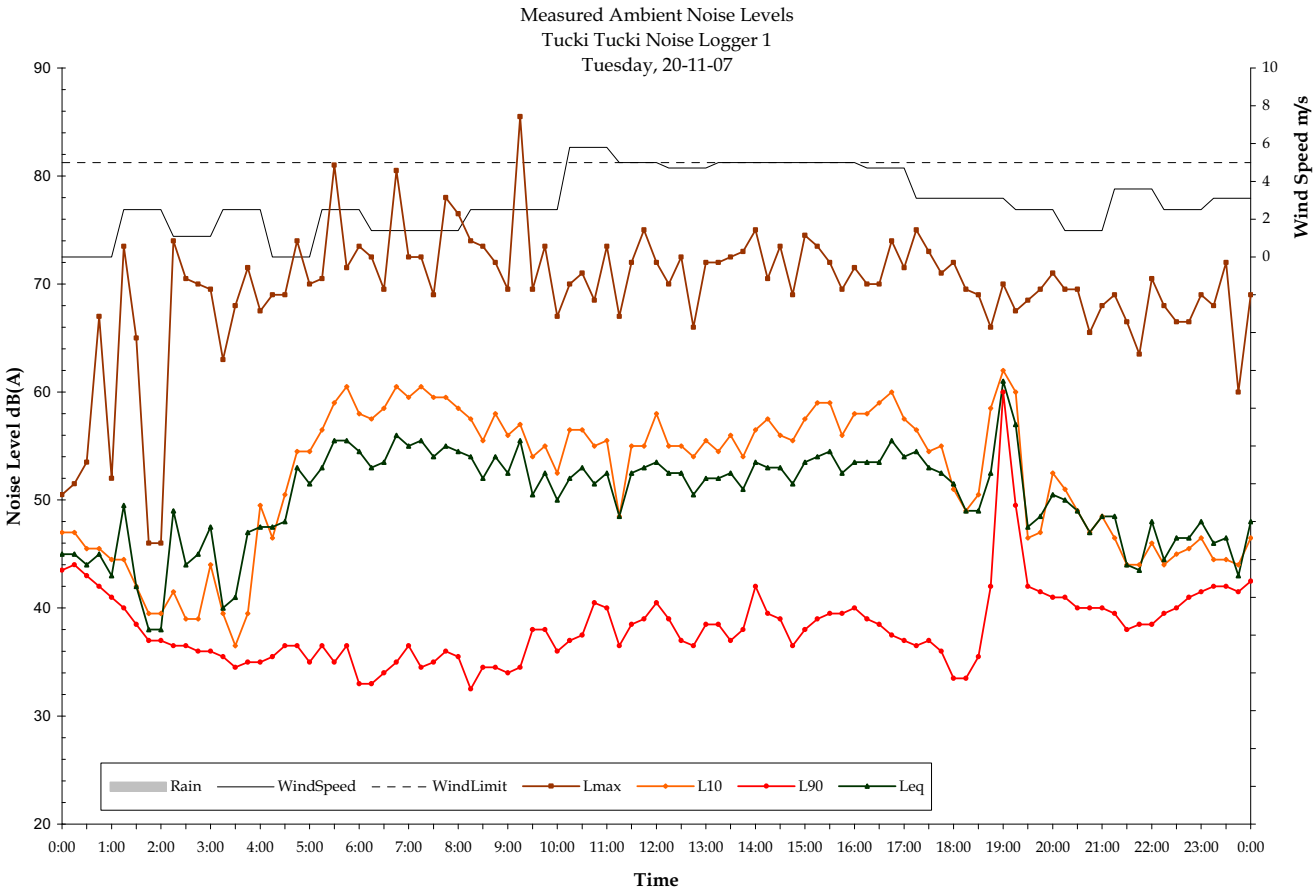
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WindSpeed
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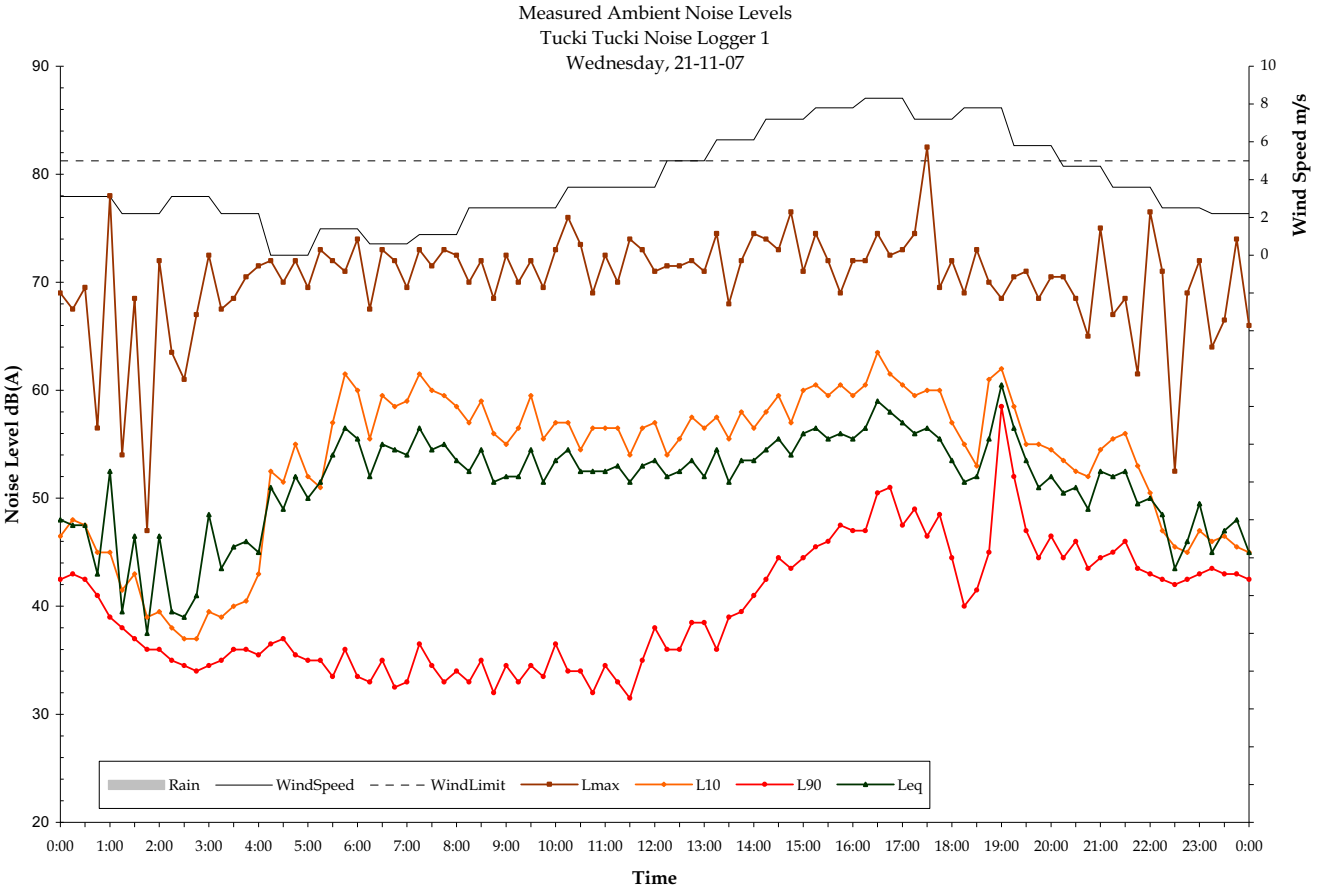
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WindSpeed
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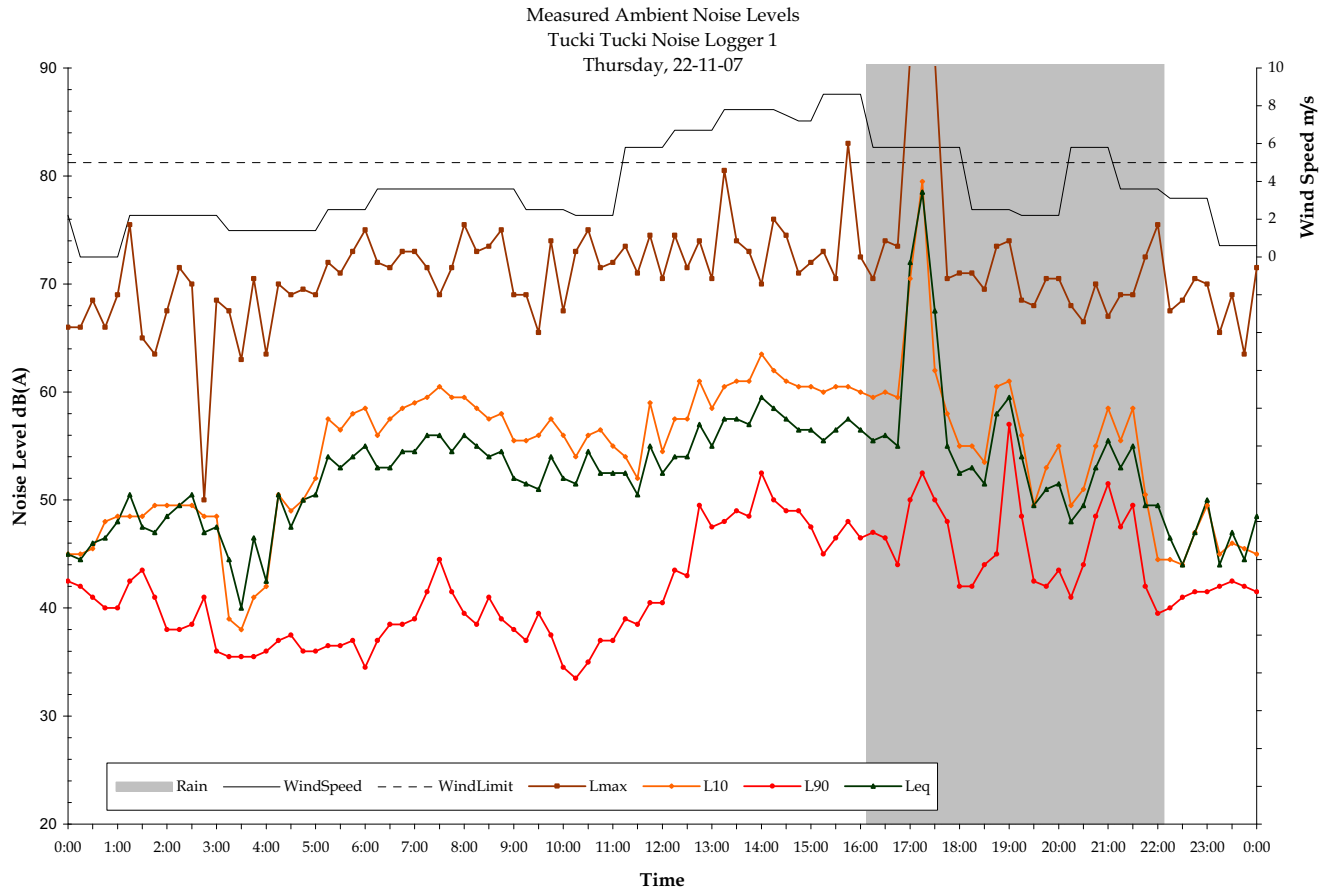
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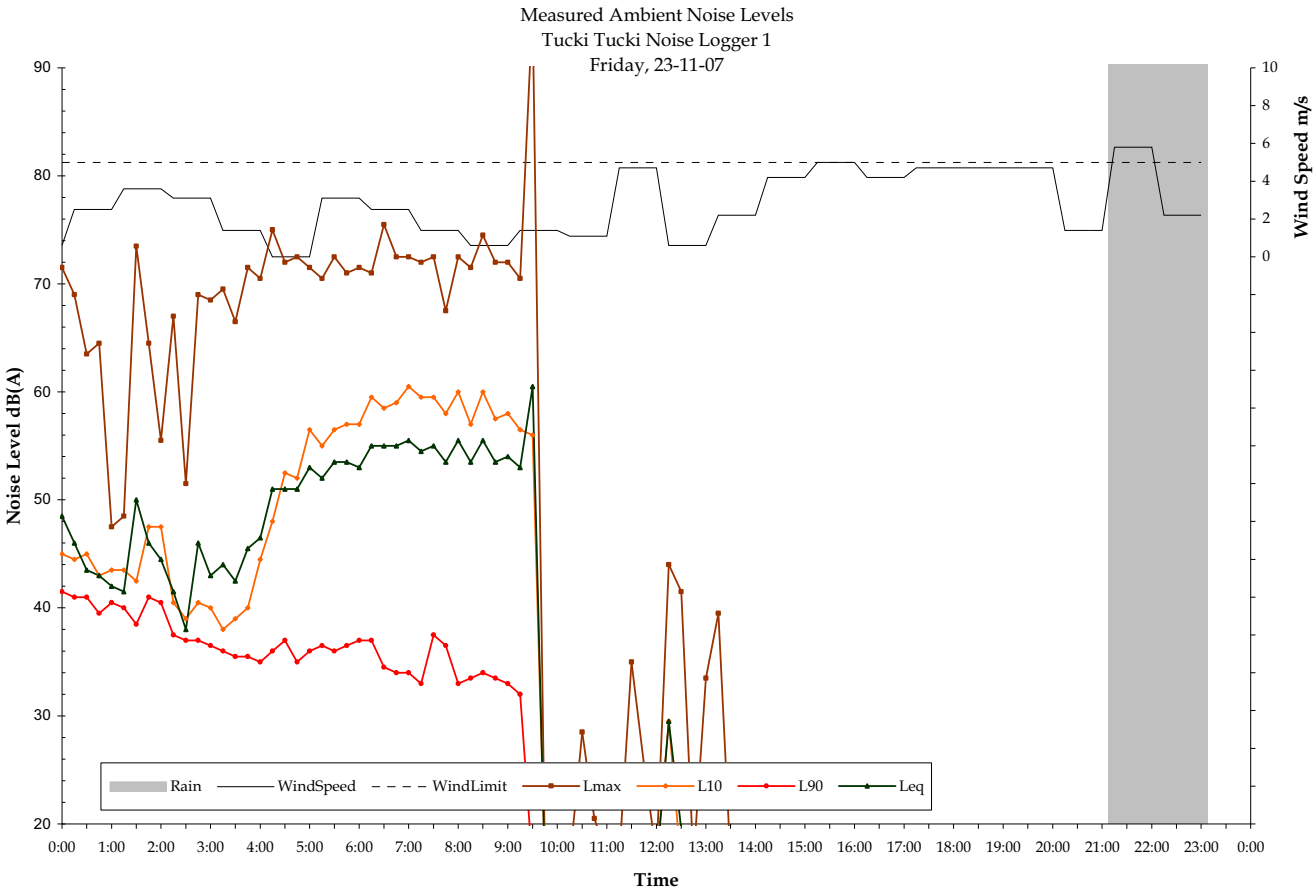
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Rain
WindSpeed
WindLimit
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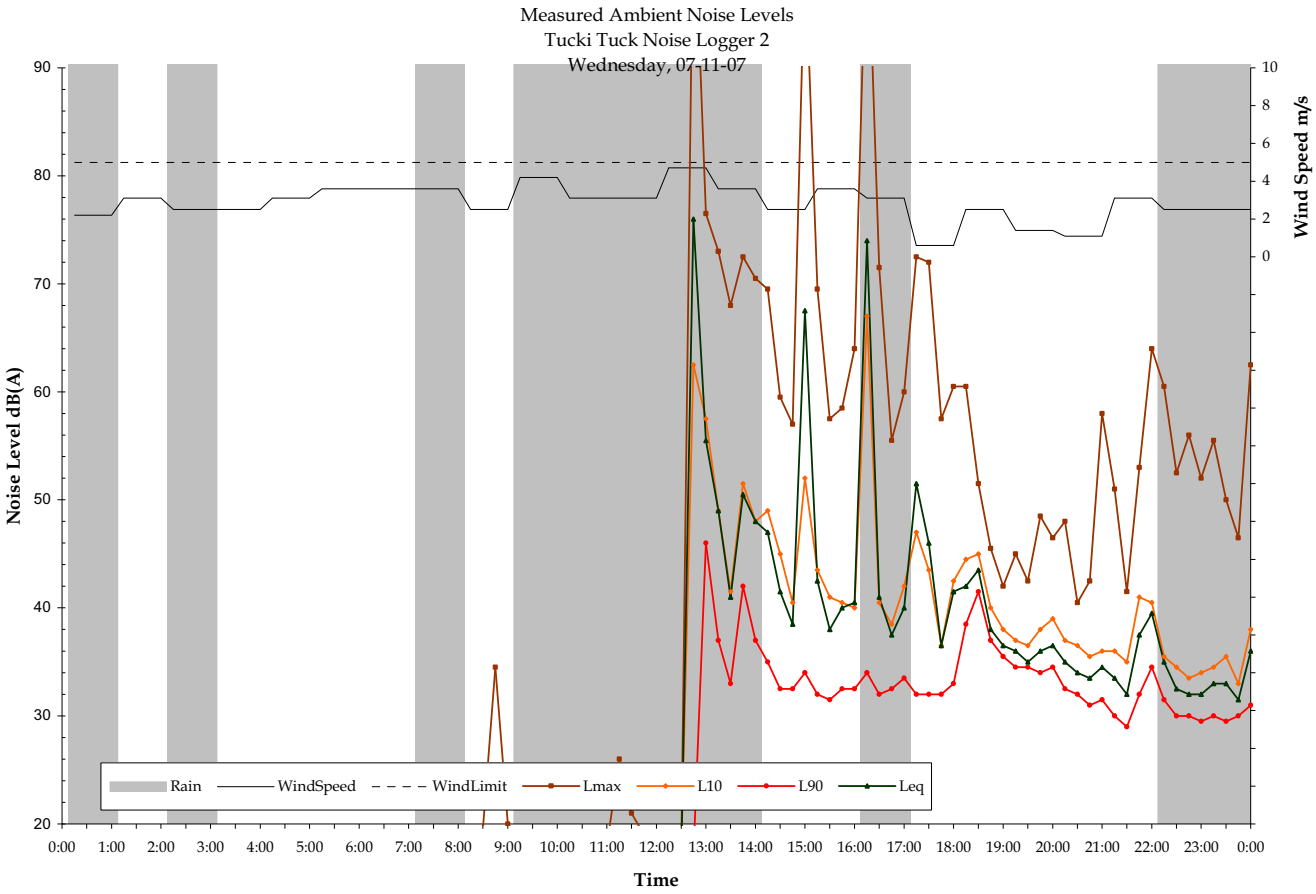
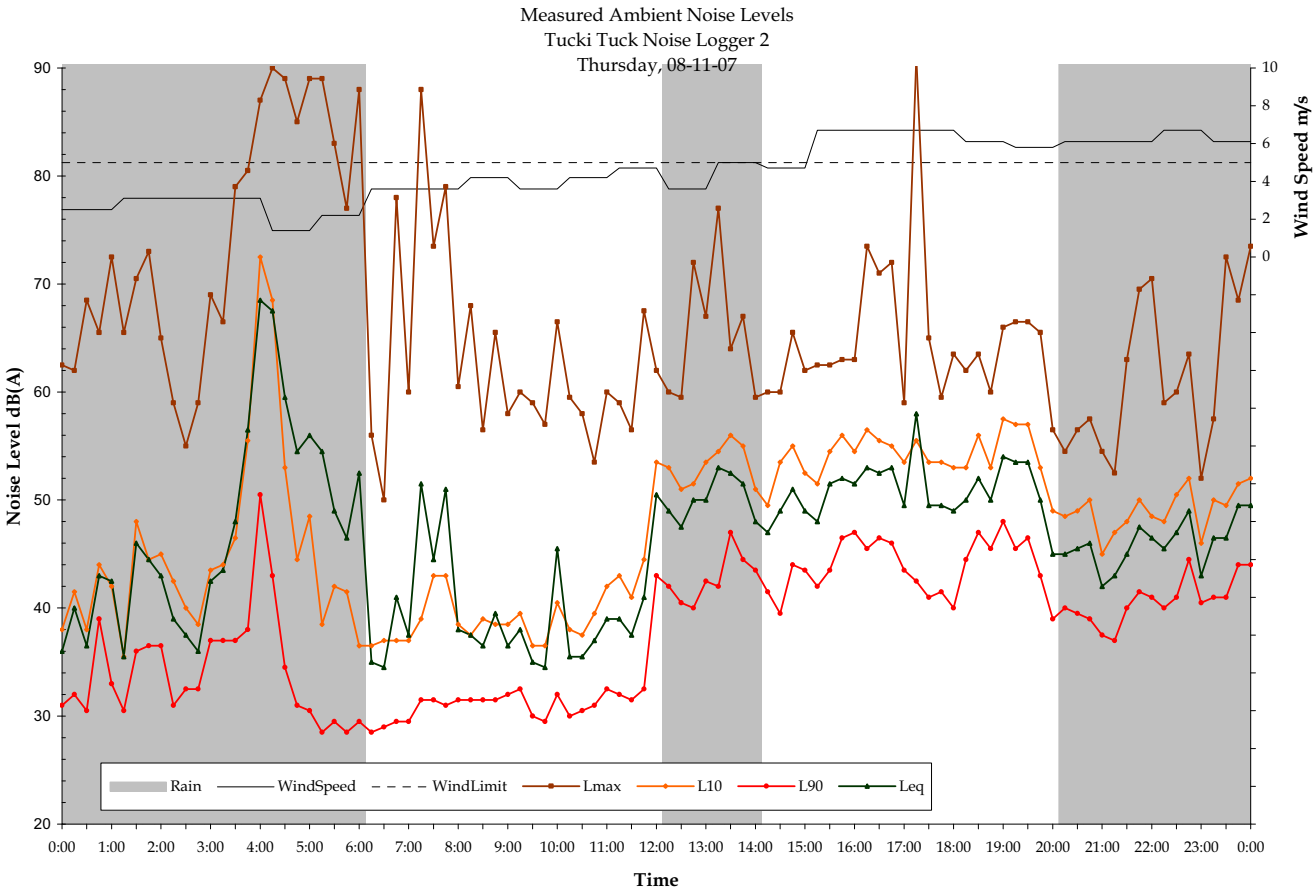
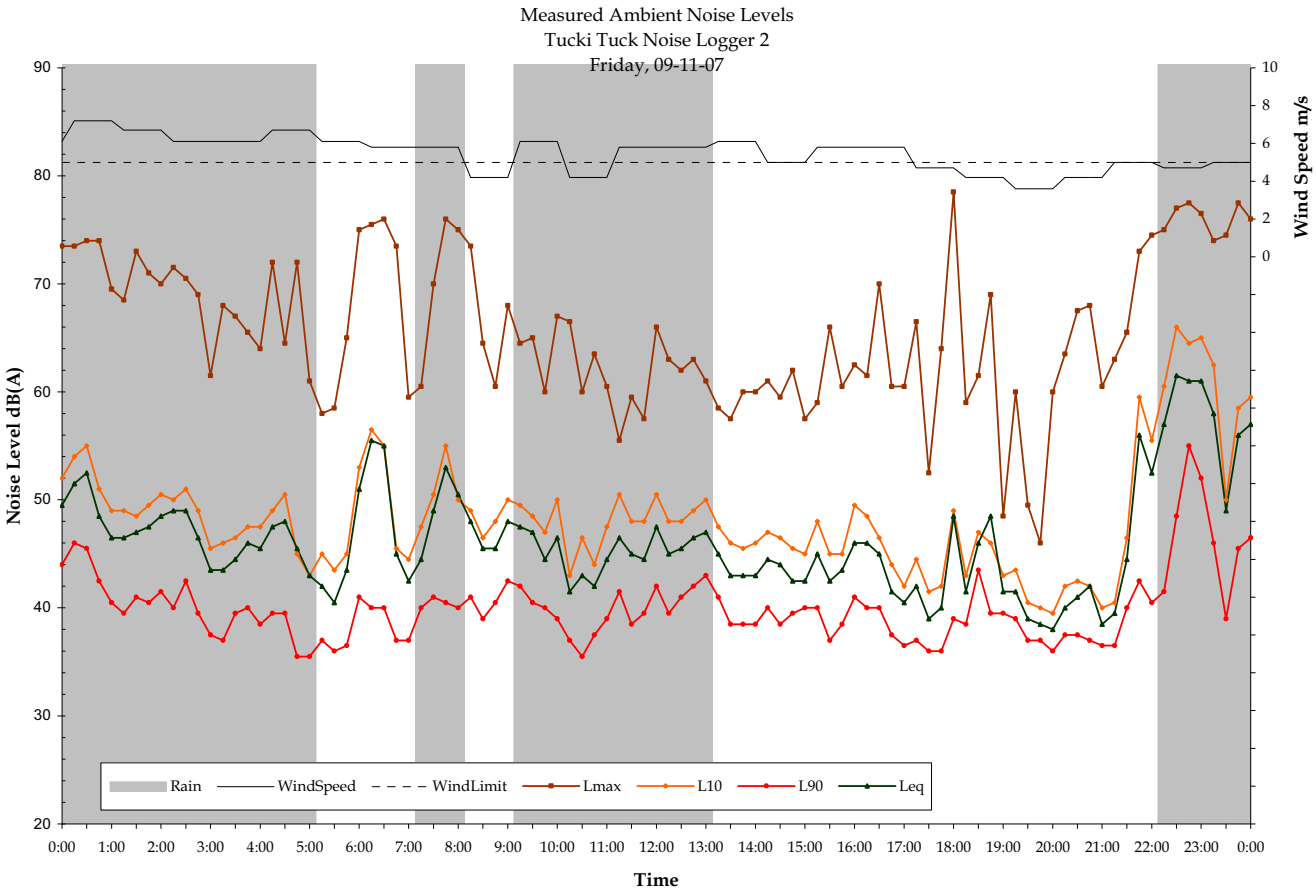
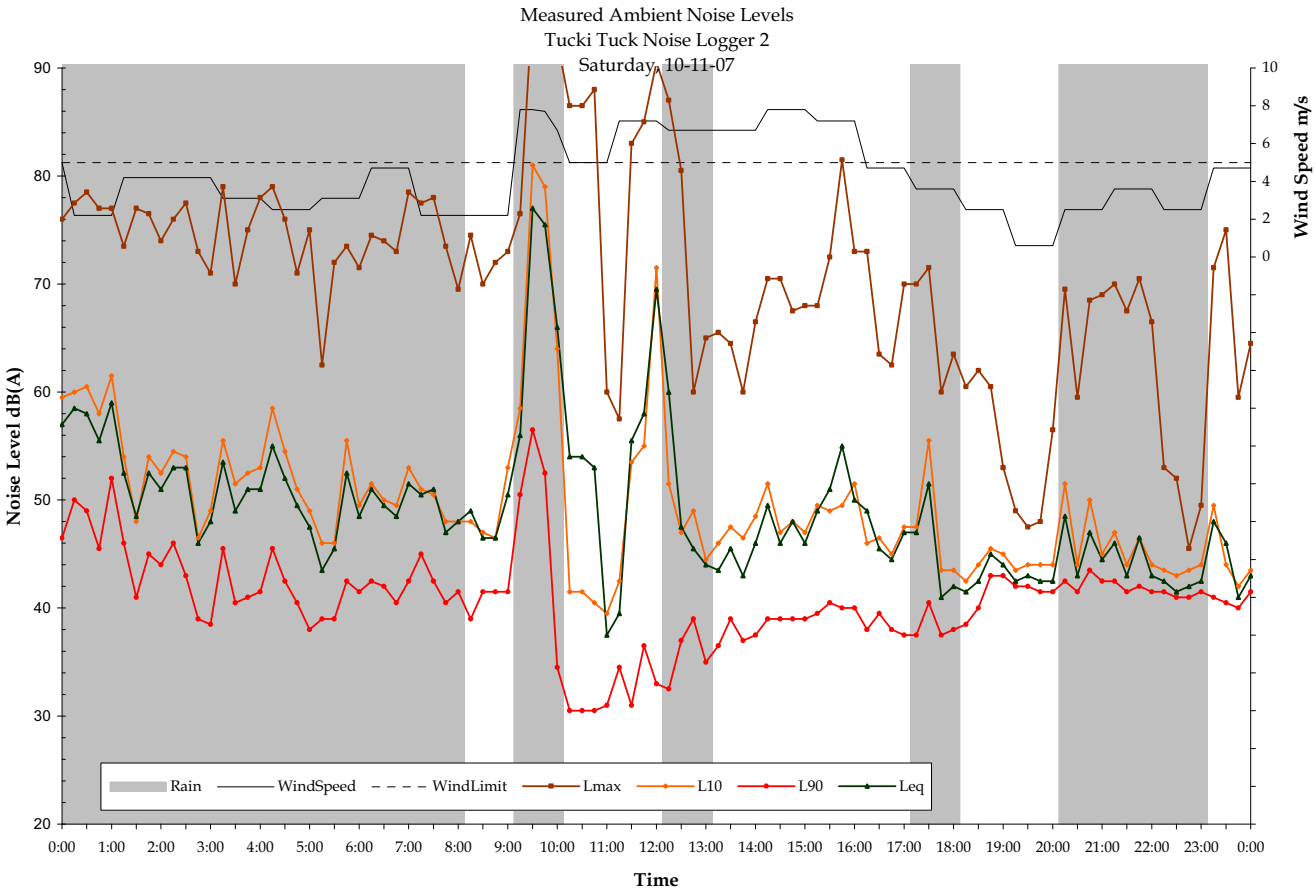
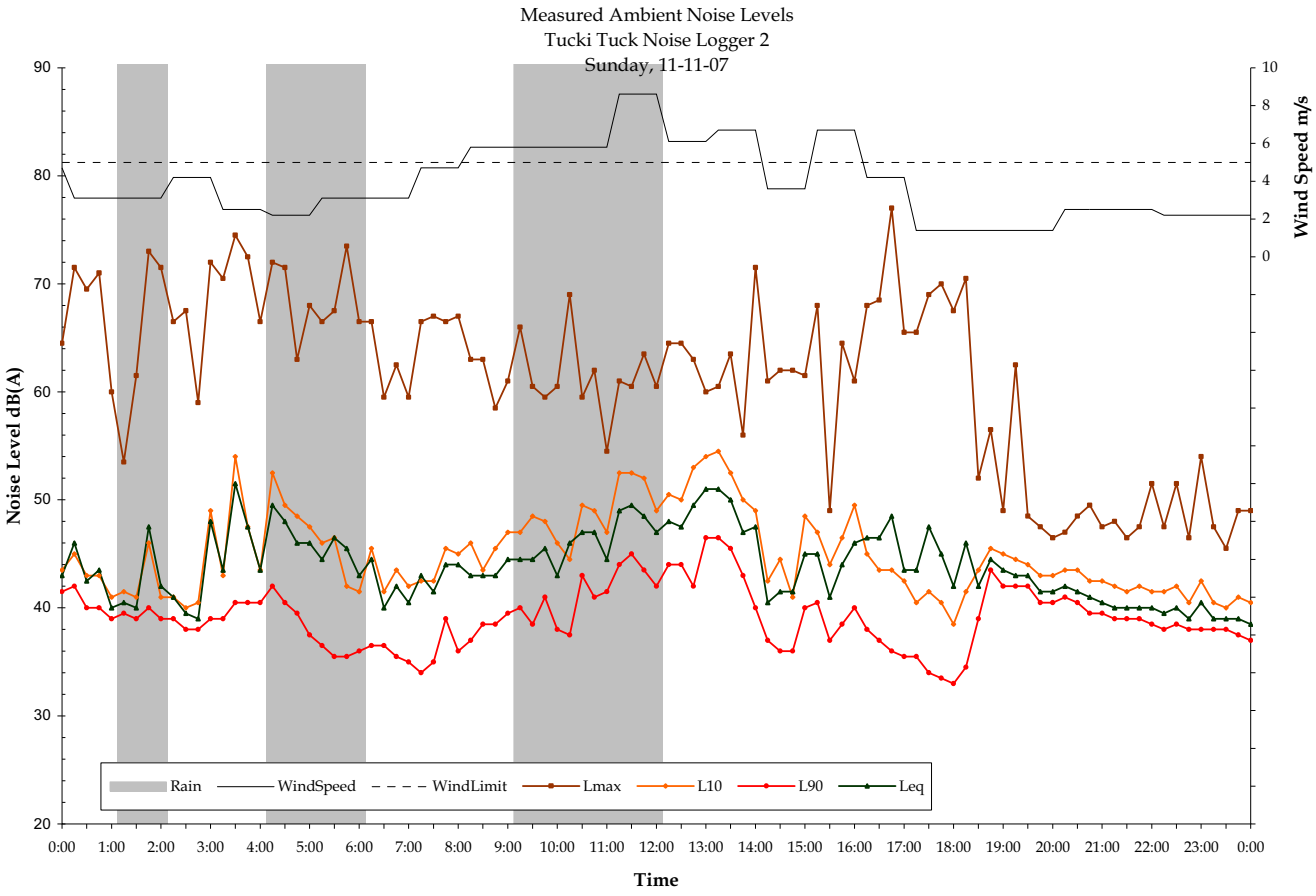
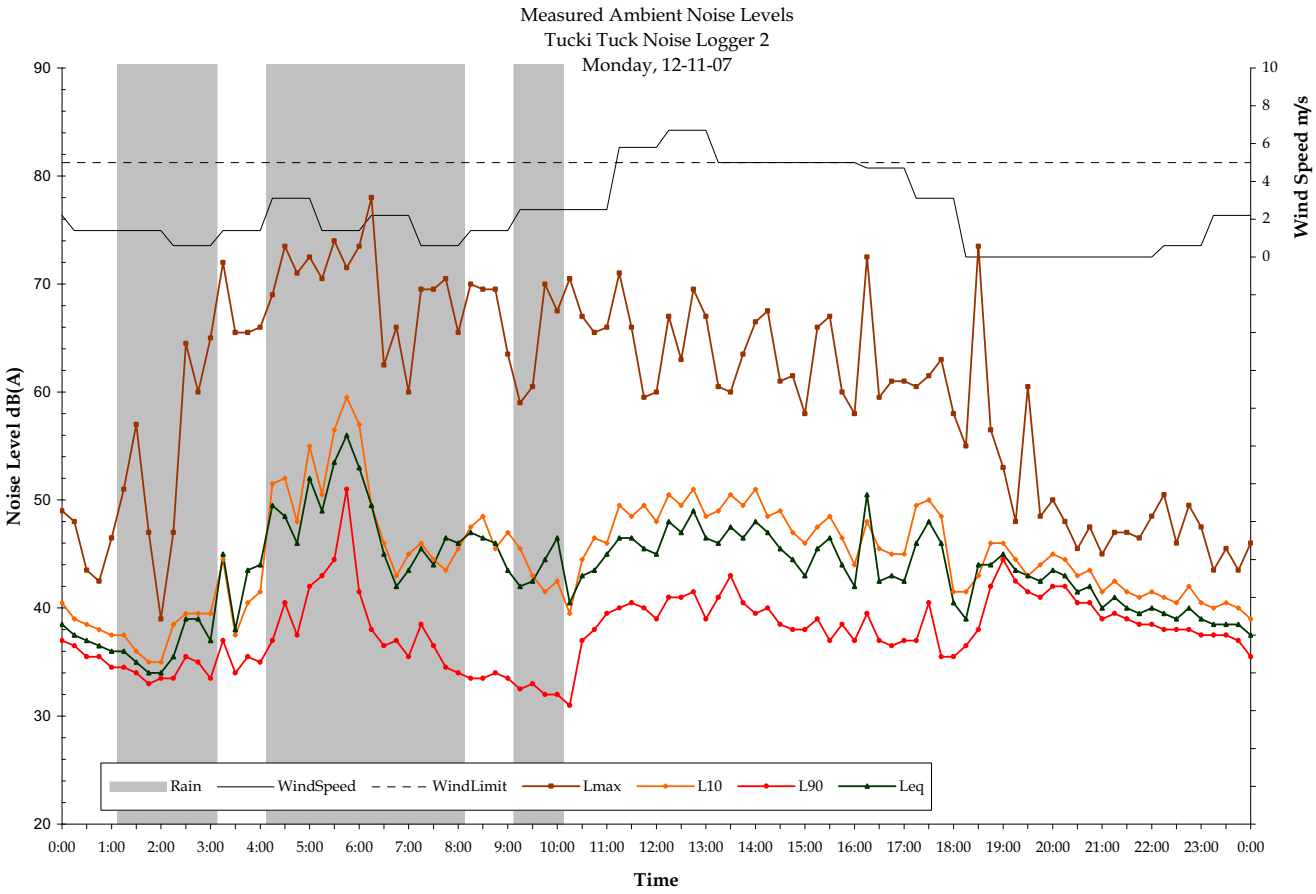

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Wednesday, 07-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

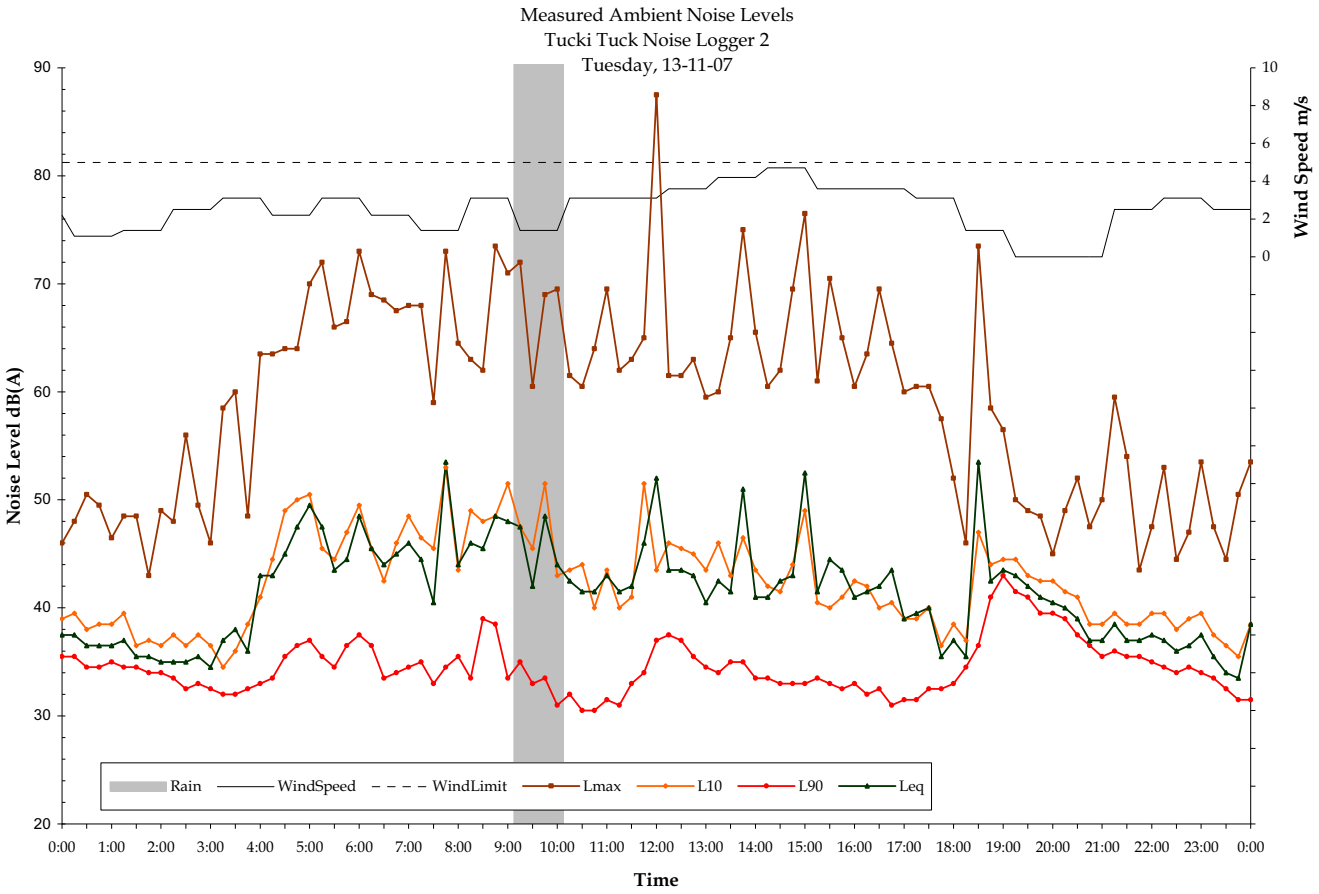

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Thursday, 08-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

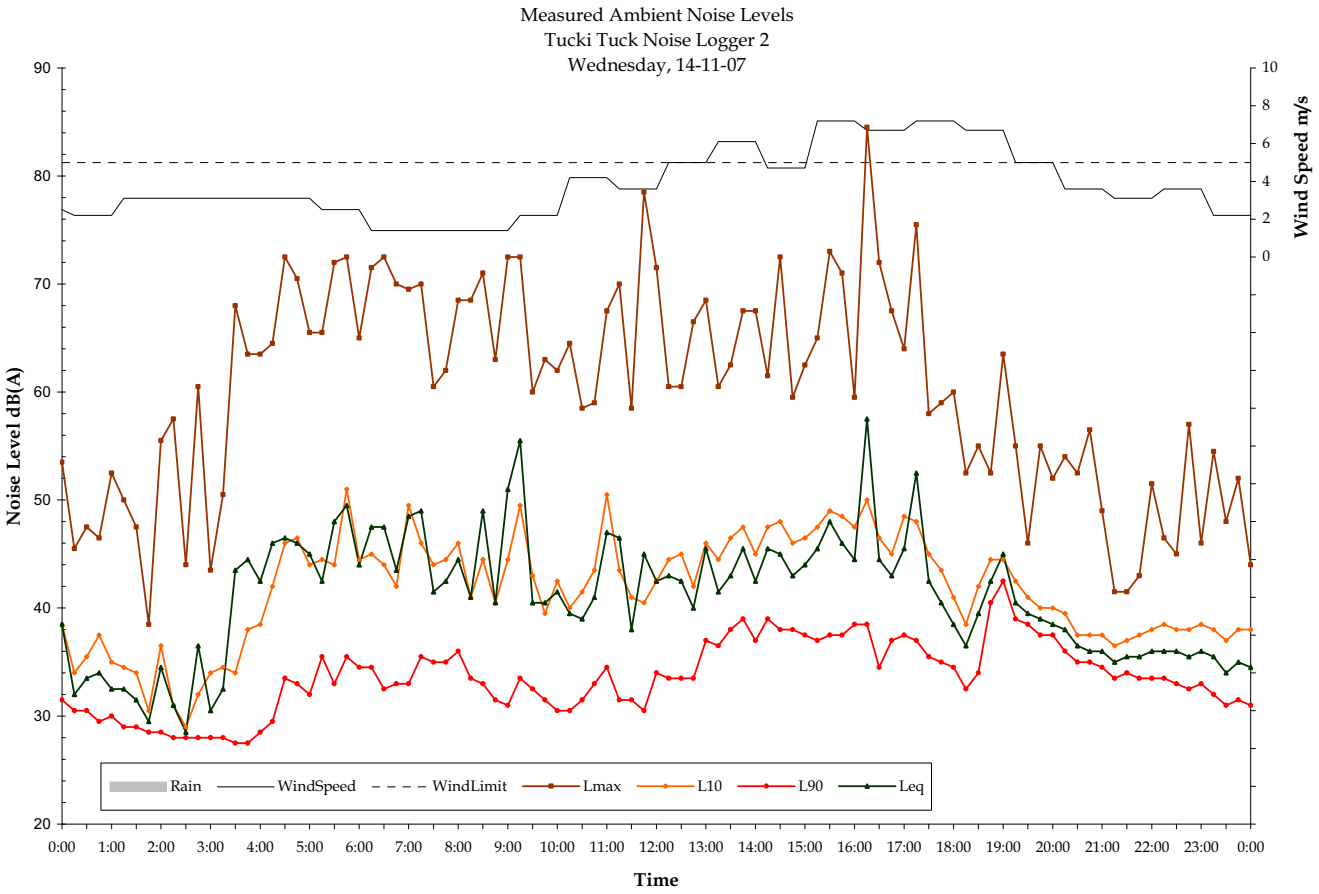

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Friday, 09-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

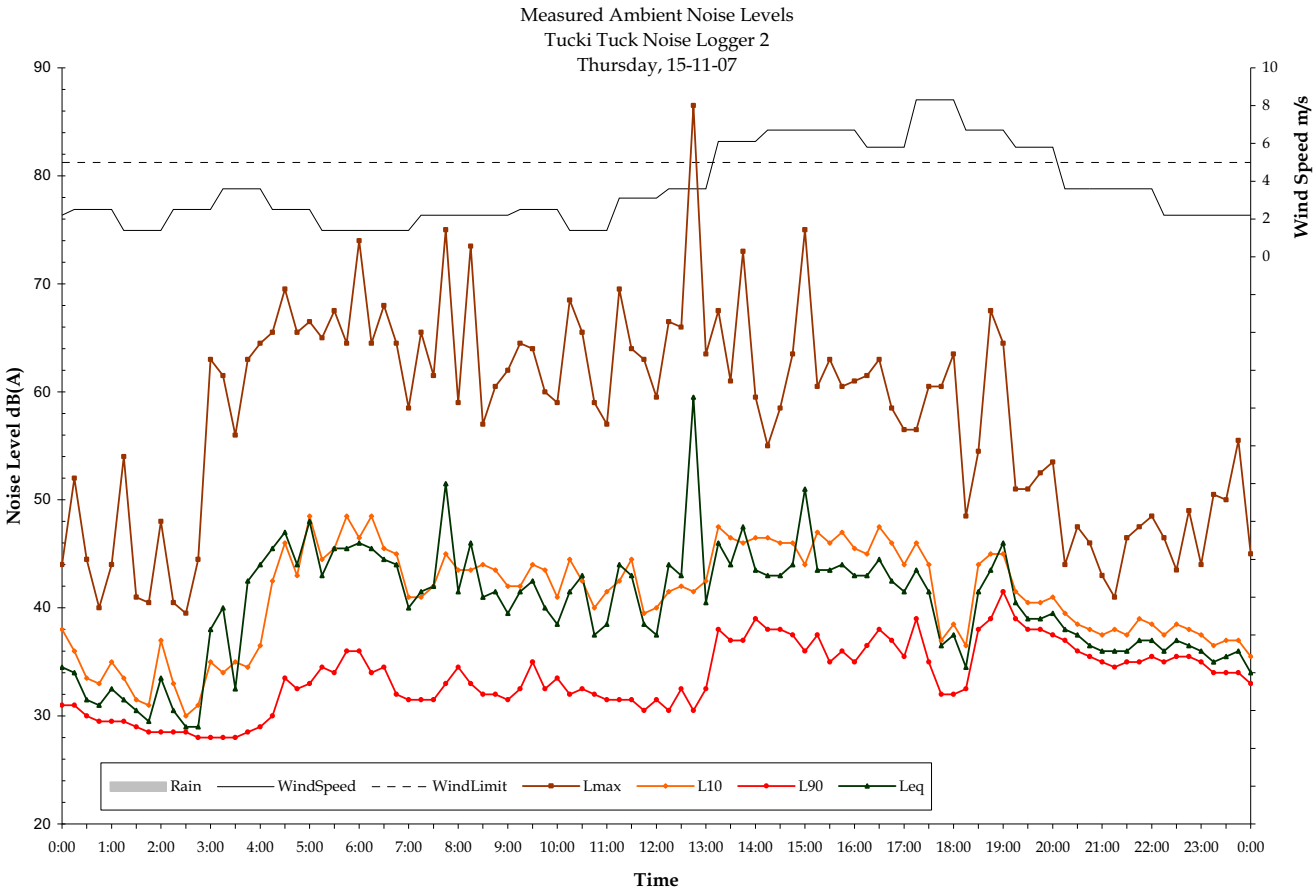

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Saturday, 10-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

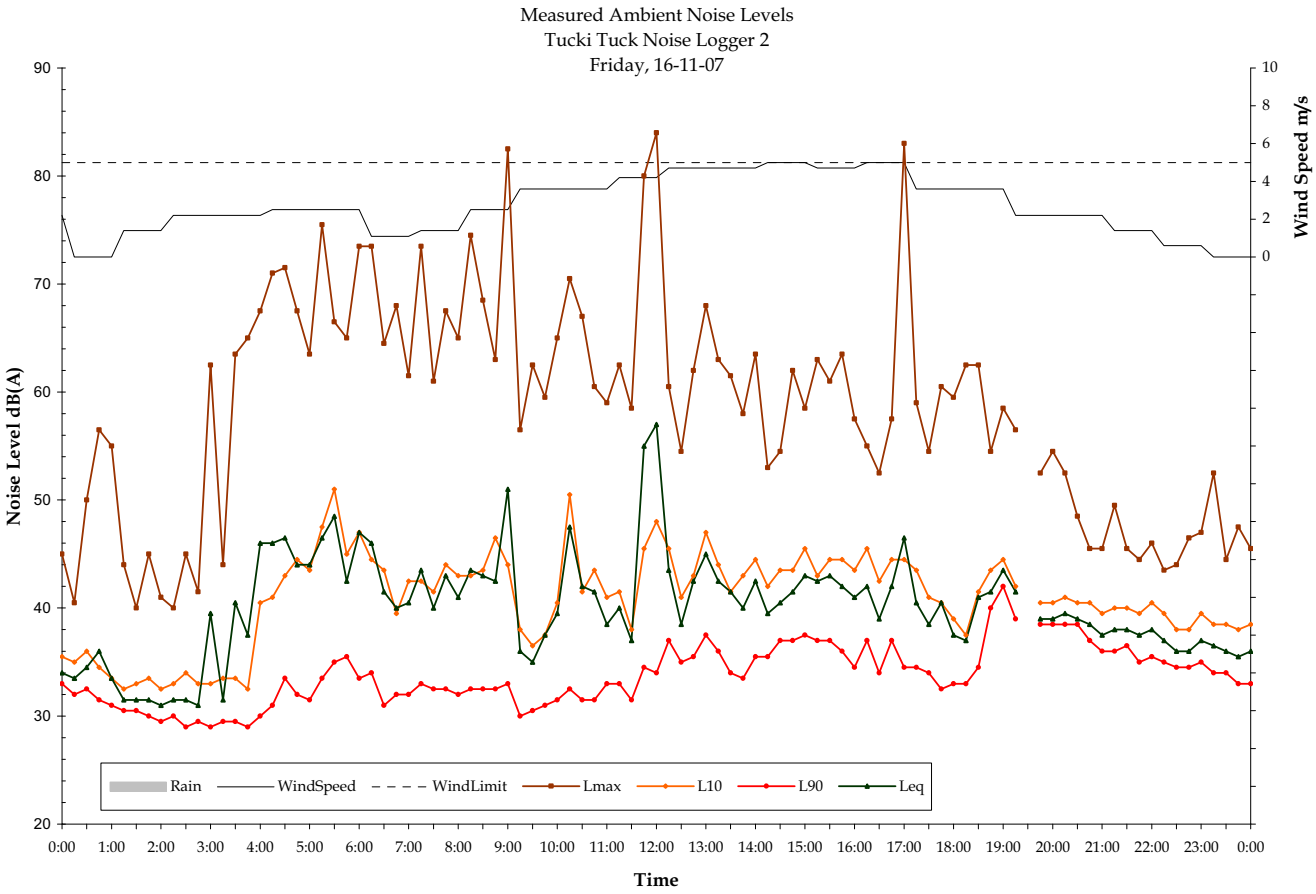

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Sunday, 11-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

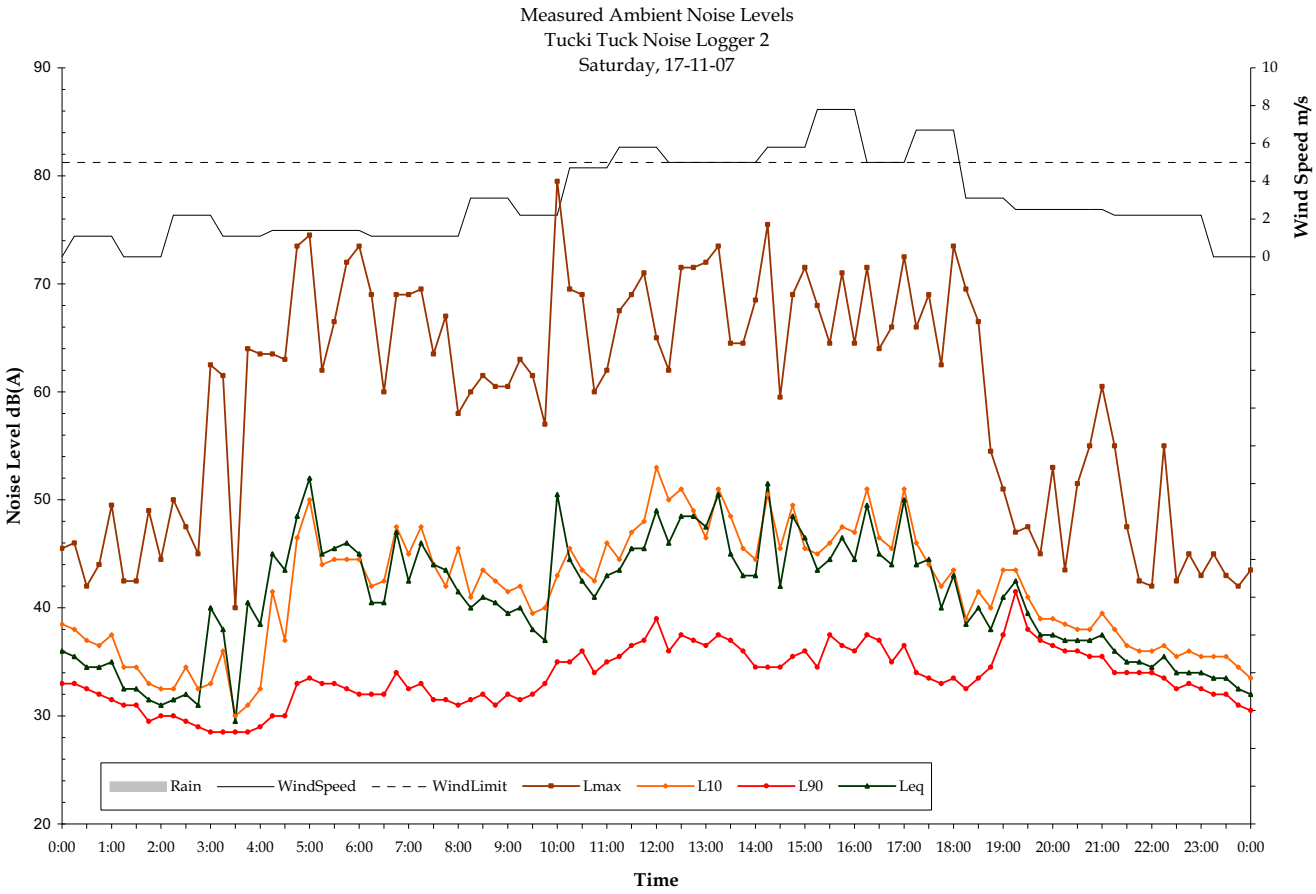

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Monday, 12-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

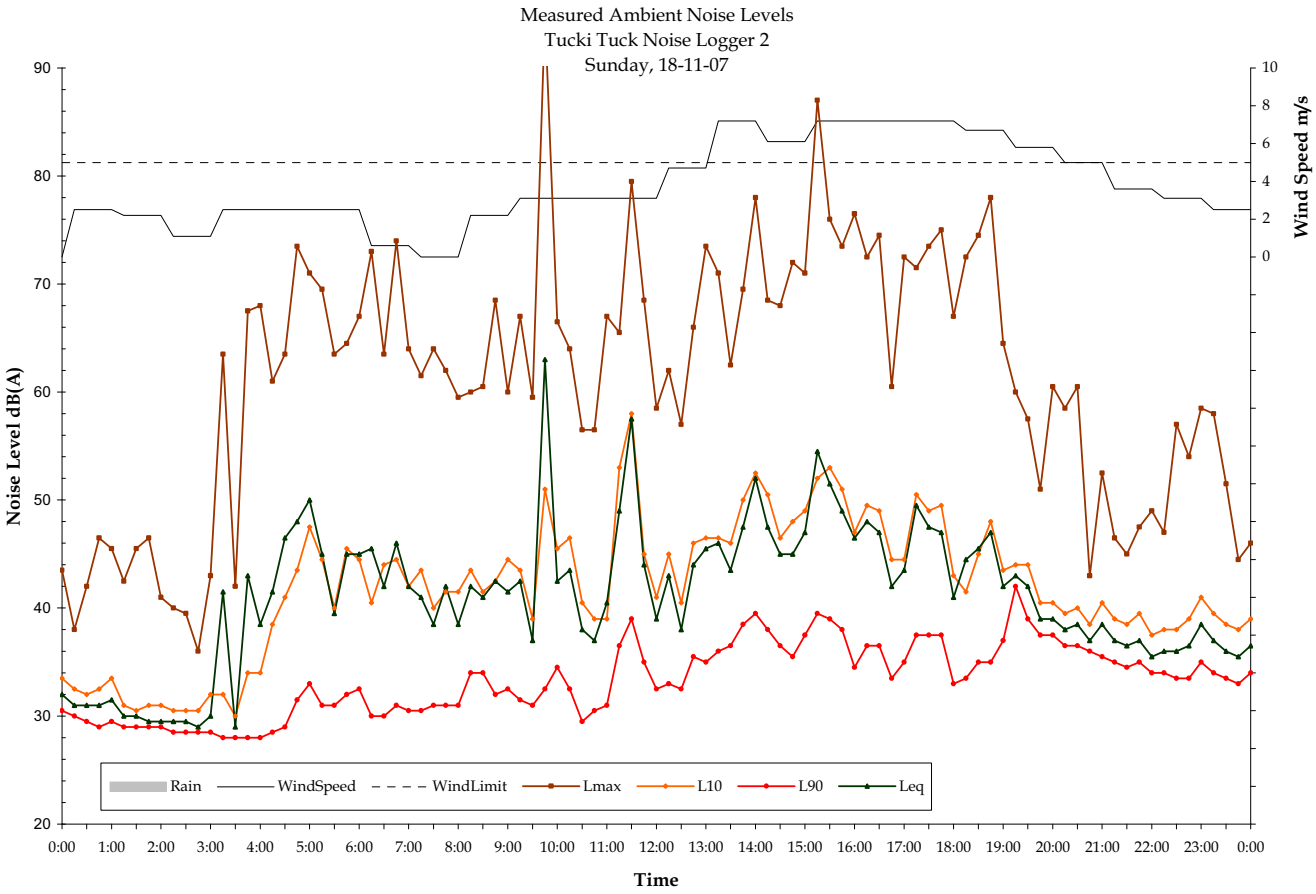

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Tuesday, 13-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

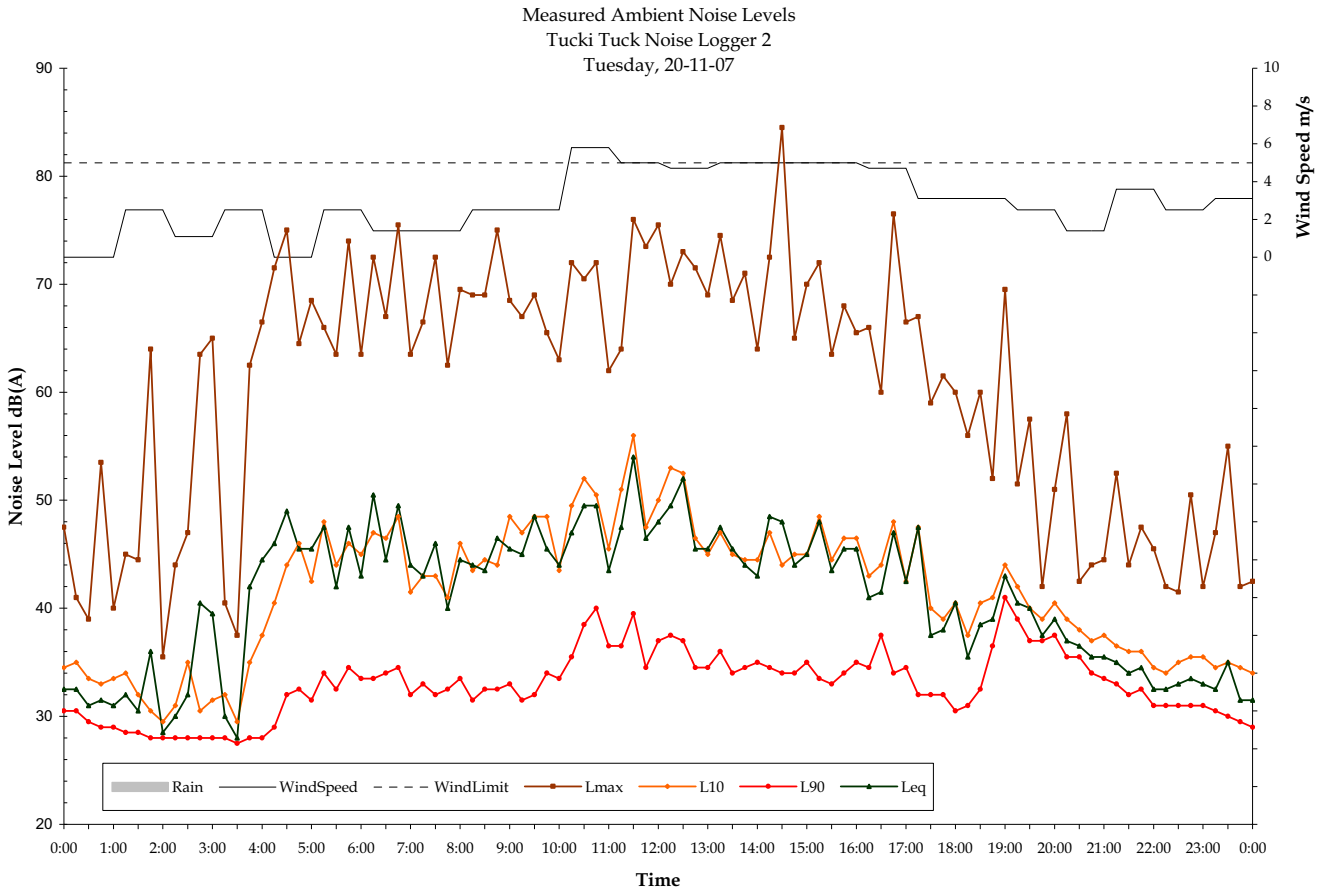

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Wednesday, 14-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

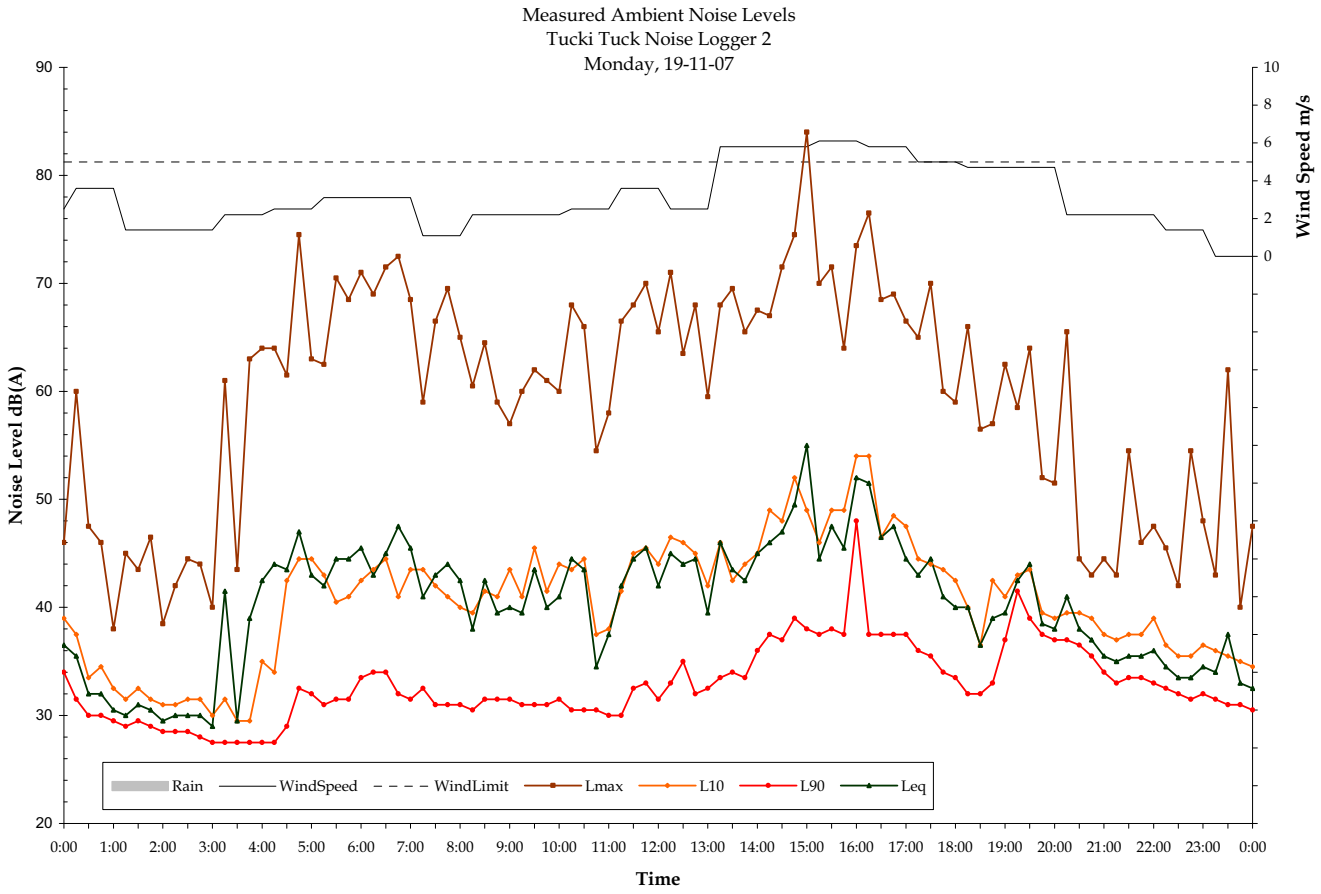

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Thursday, 15-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

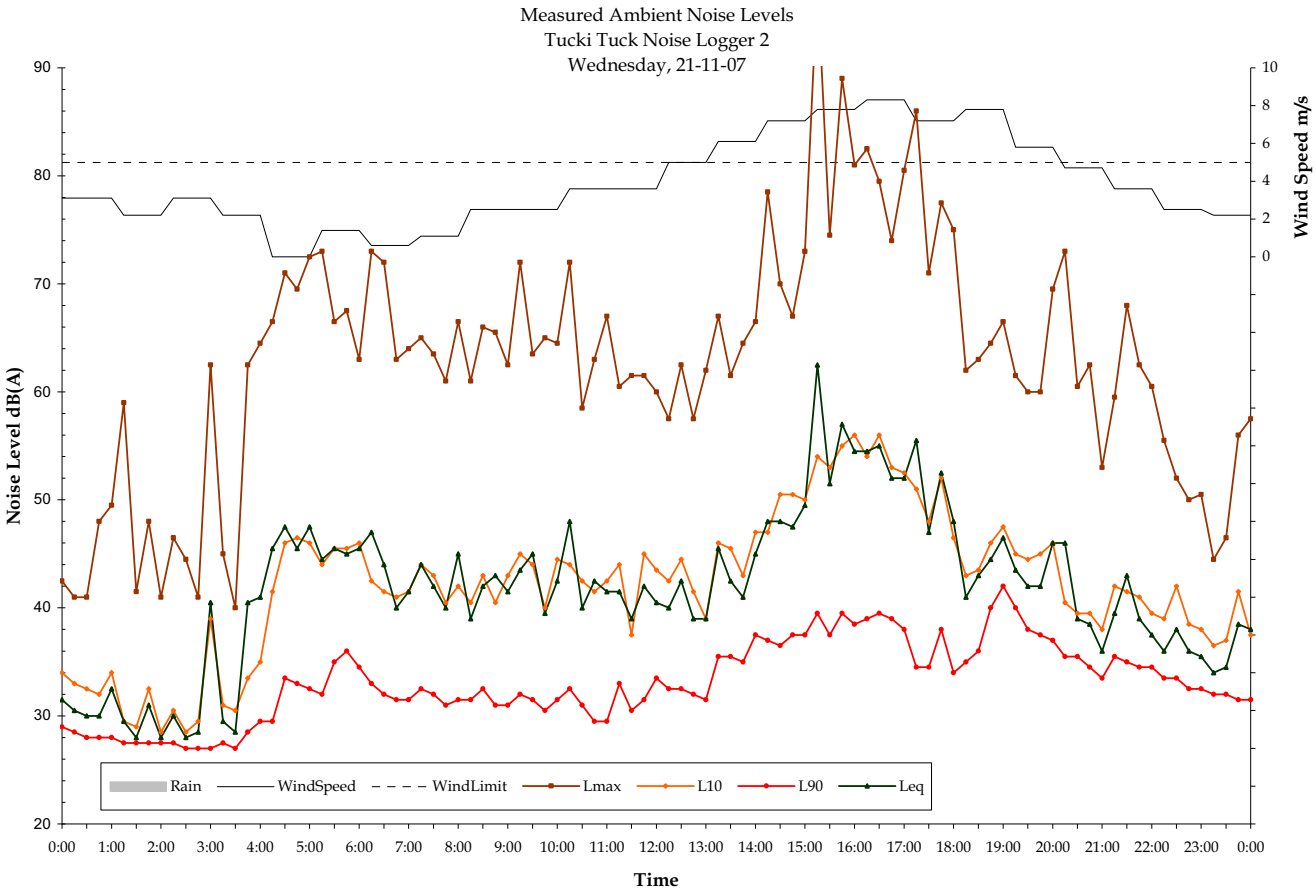

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Friday, 16-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

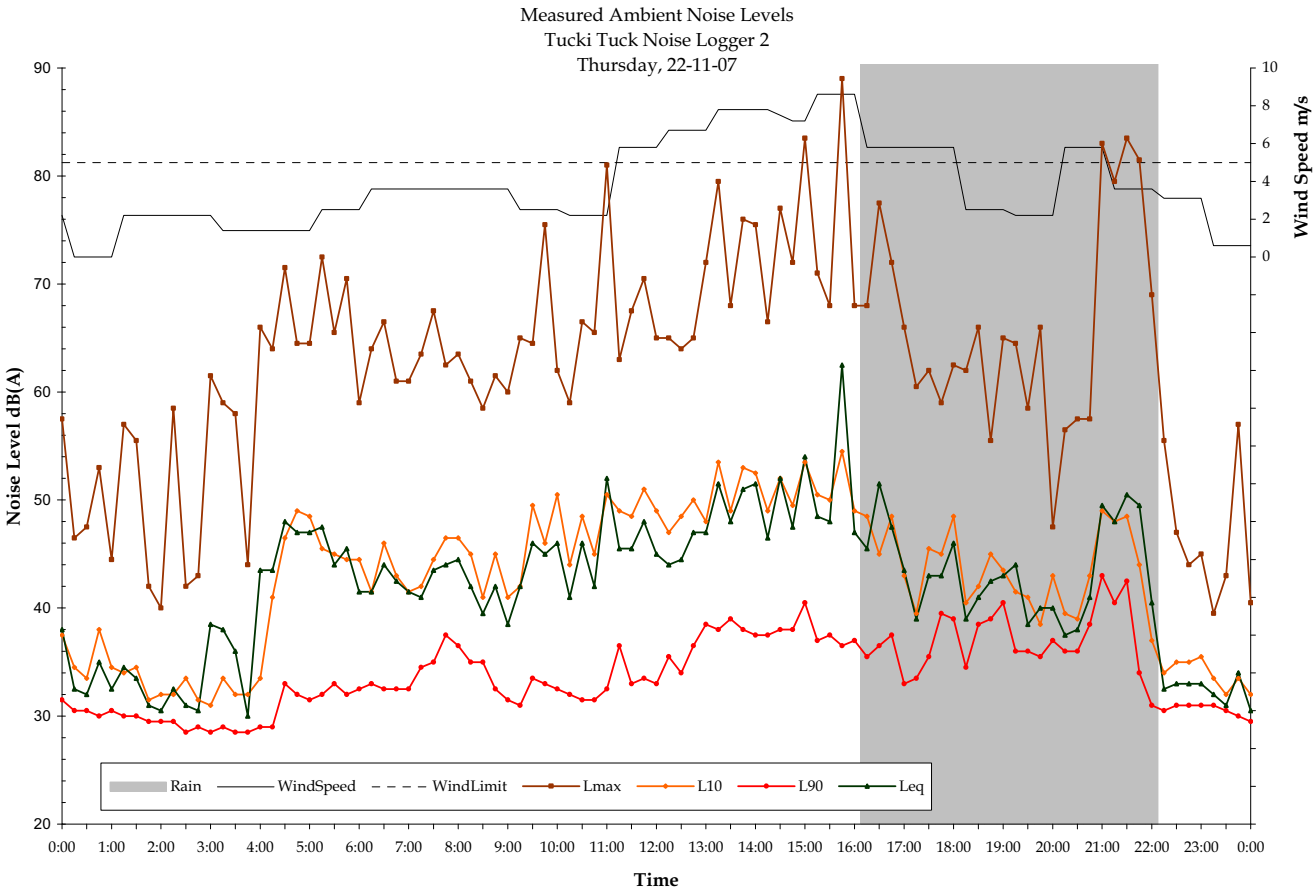

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Saturday, 17-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

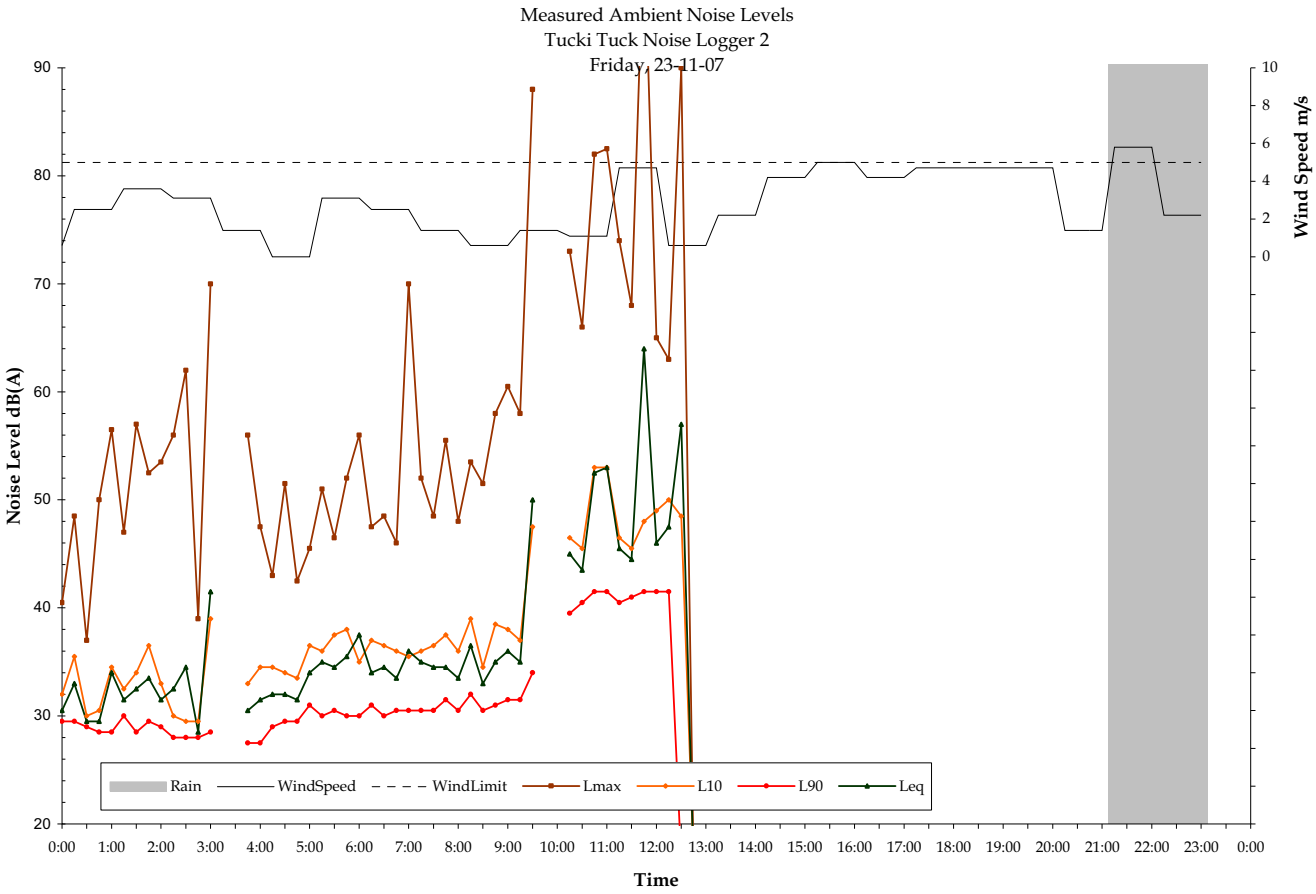

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Sunday, 18-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq


Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Tuesday, 20-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq


Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Monday, 19-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq


Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Wednesday, 21-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq


Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Thursday, 22-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq

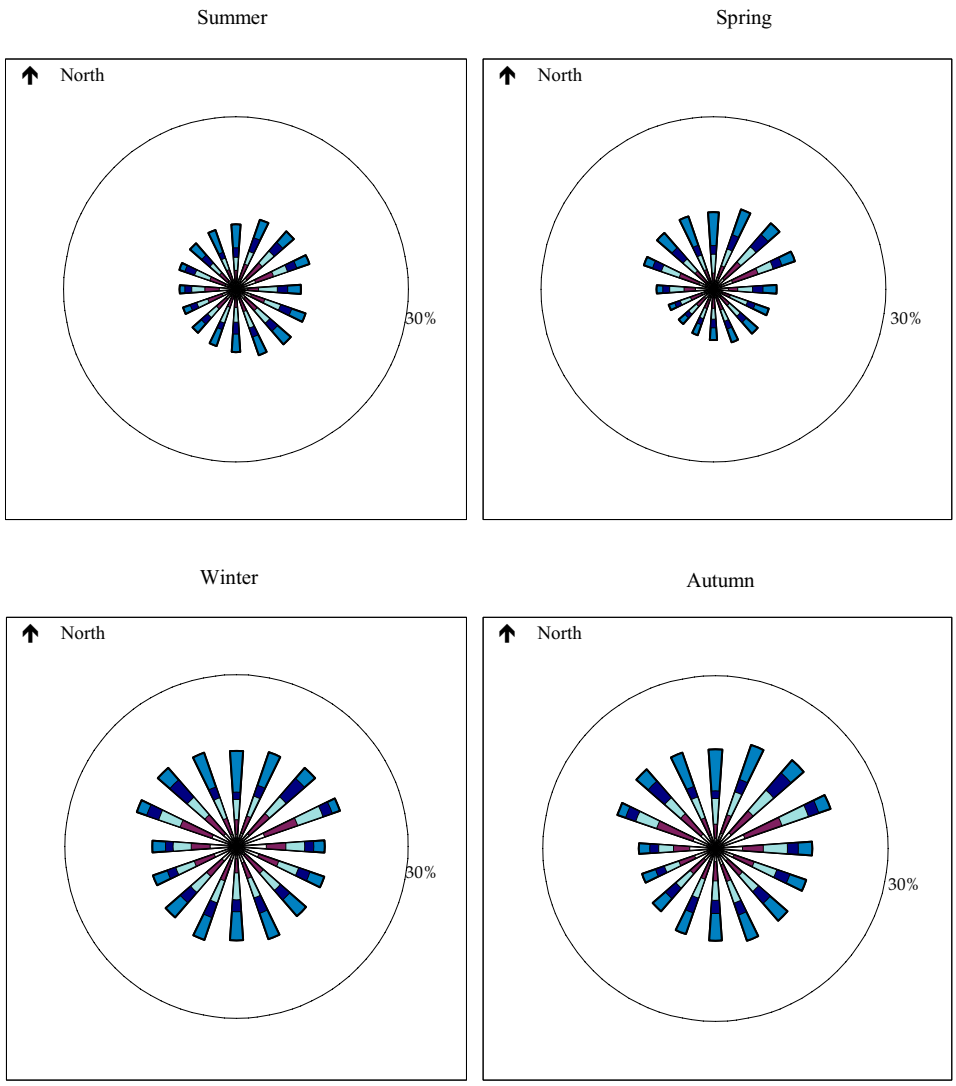

Measured Ambient Noise Levels
Tucki Tuck Noise Logger 2
Friday, 23-11-07
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
Lmax
L10
L90
Leq
90
80
70
60
50
40
30
20
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00

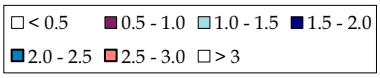
Annex B

B *VECTOR WIND ROSES ANNUAL HOURLY WIND ANALYSIS*

Vector Wind Roses Annual Hourly Wind Analysis

Day

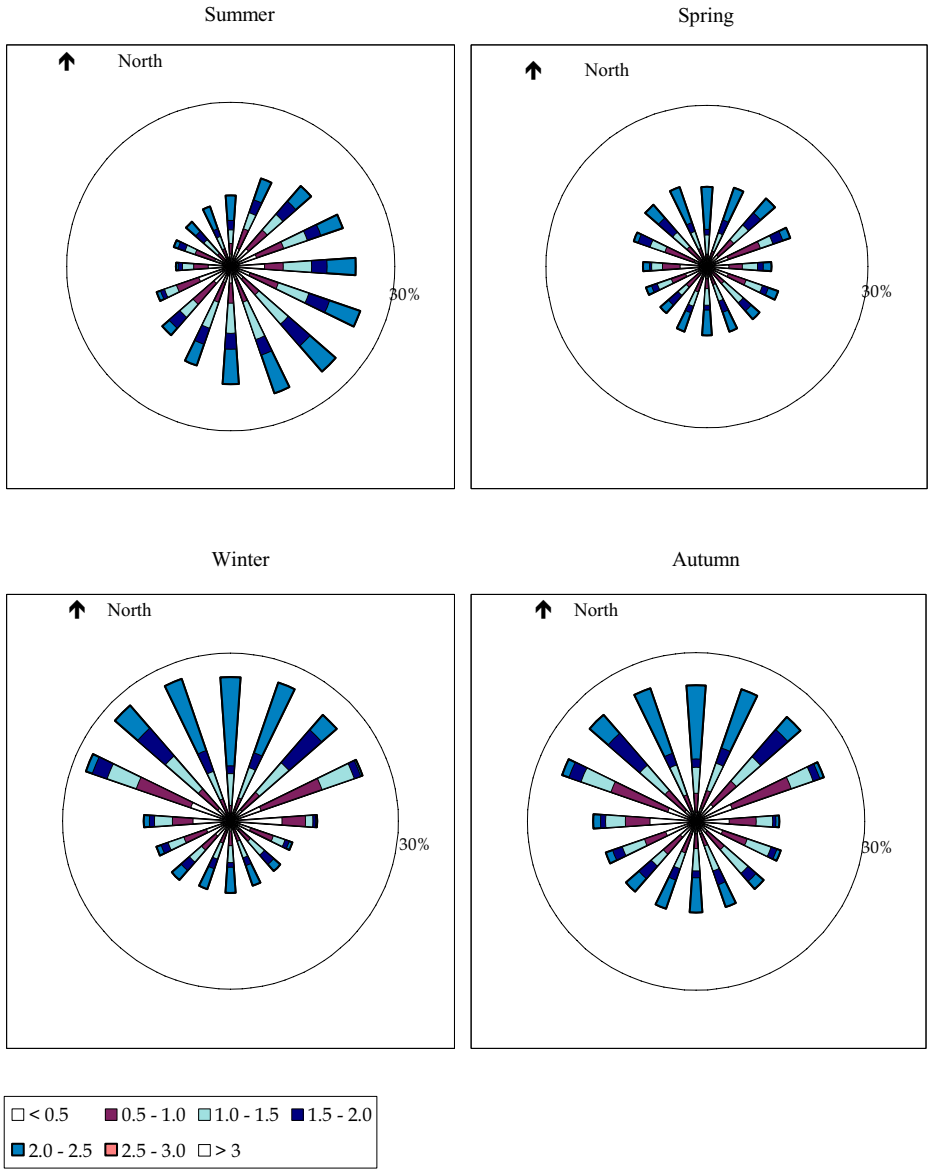




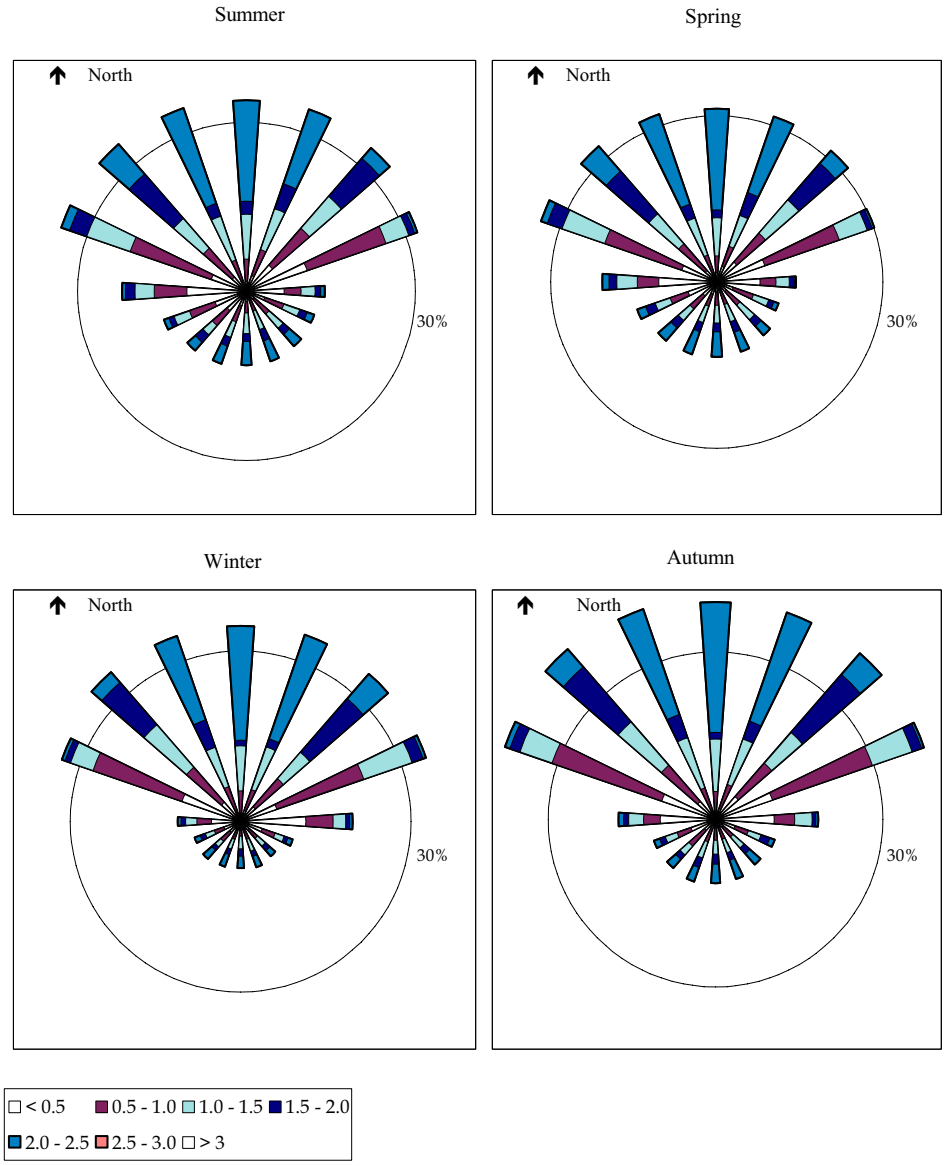
Data Source: Anvil Site at Wybong Rd
Data Range: 10 min, 01-04-02 to 30-11-03

The segments of each arm represent the six valid wind speed classes, with increasing windspeed from the centre outwards. The length of each arm represents the vector components (for each direction) of wind speeds 3m/s or below as a proportion of the total time for the period .
The circle represents the 30% occurrence threshold.

Evening

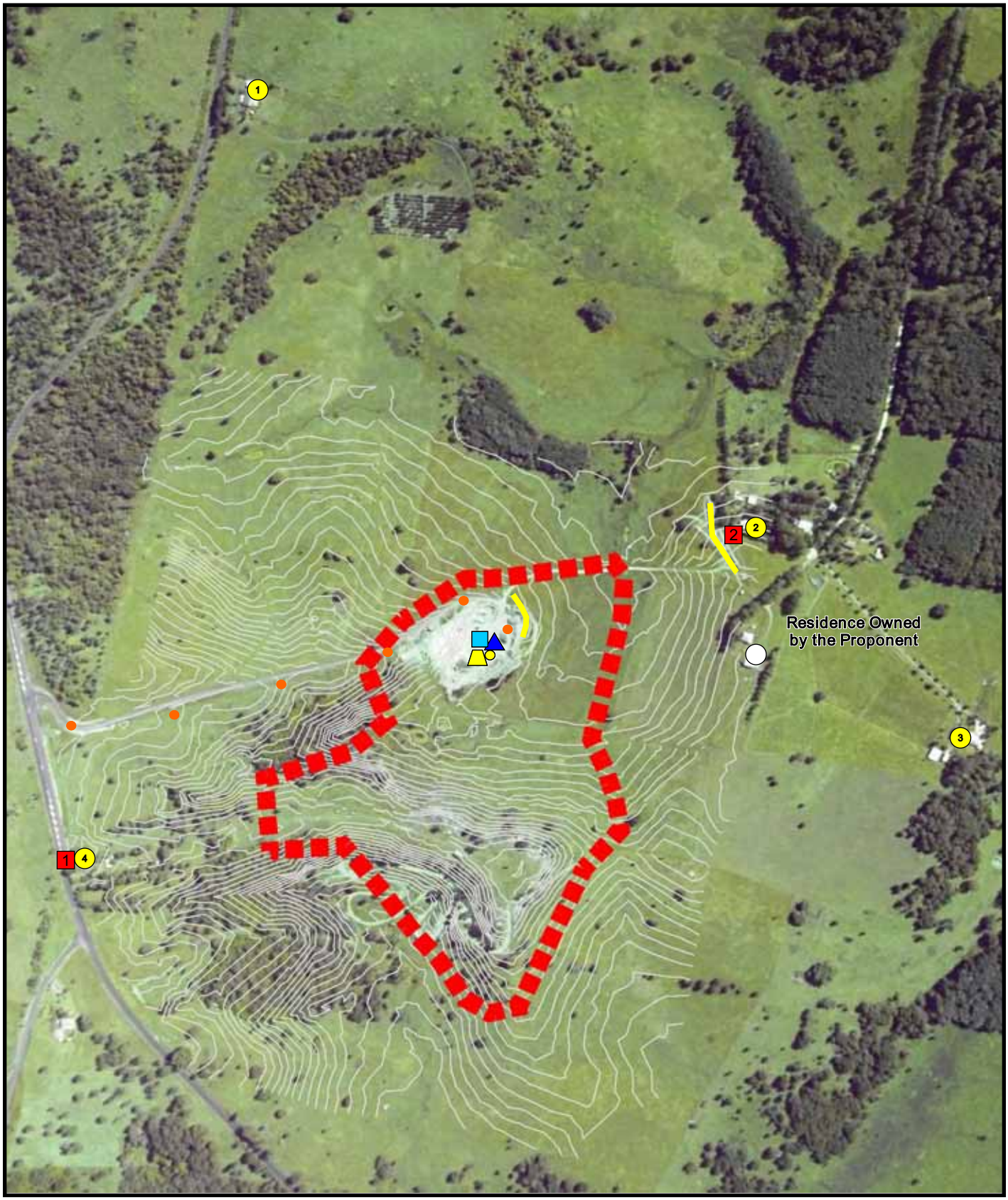

Summer
North
30%
Spring
North
30%
Winter
North
30%
Autumn
North
30%
< 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
> 3

Night


Summer
North
30%
Spring
North
30%
Winter
North
30%
Autumn
North
30%
< 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
> 3

Annex C

Noise Modelling Scenarios



Legend

- Noise Control Bund Locations
- Extent of Quarry Extraction and Operations (Project Area)
- Front End Loader
- Excavator (20 tonne)
- Bulldozer
- Road Truck
- Site Truck
- Noise Assessment Location
- Noise Logger Location

Figure C1

Noise Modelling Scenario B

Client:	Champions Quarry	
Project:	Champions Quarry Expansion	
Drawing No:	0098287pm_GIS_Noise_C1	
Date:	25/08/2009	Drawing size: A4
Drawn by:	AM	Reviewed by: WW
Source:	-	
Scale:	Refer to Scale Bar	

N

0 100 200 300m

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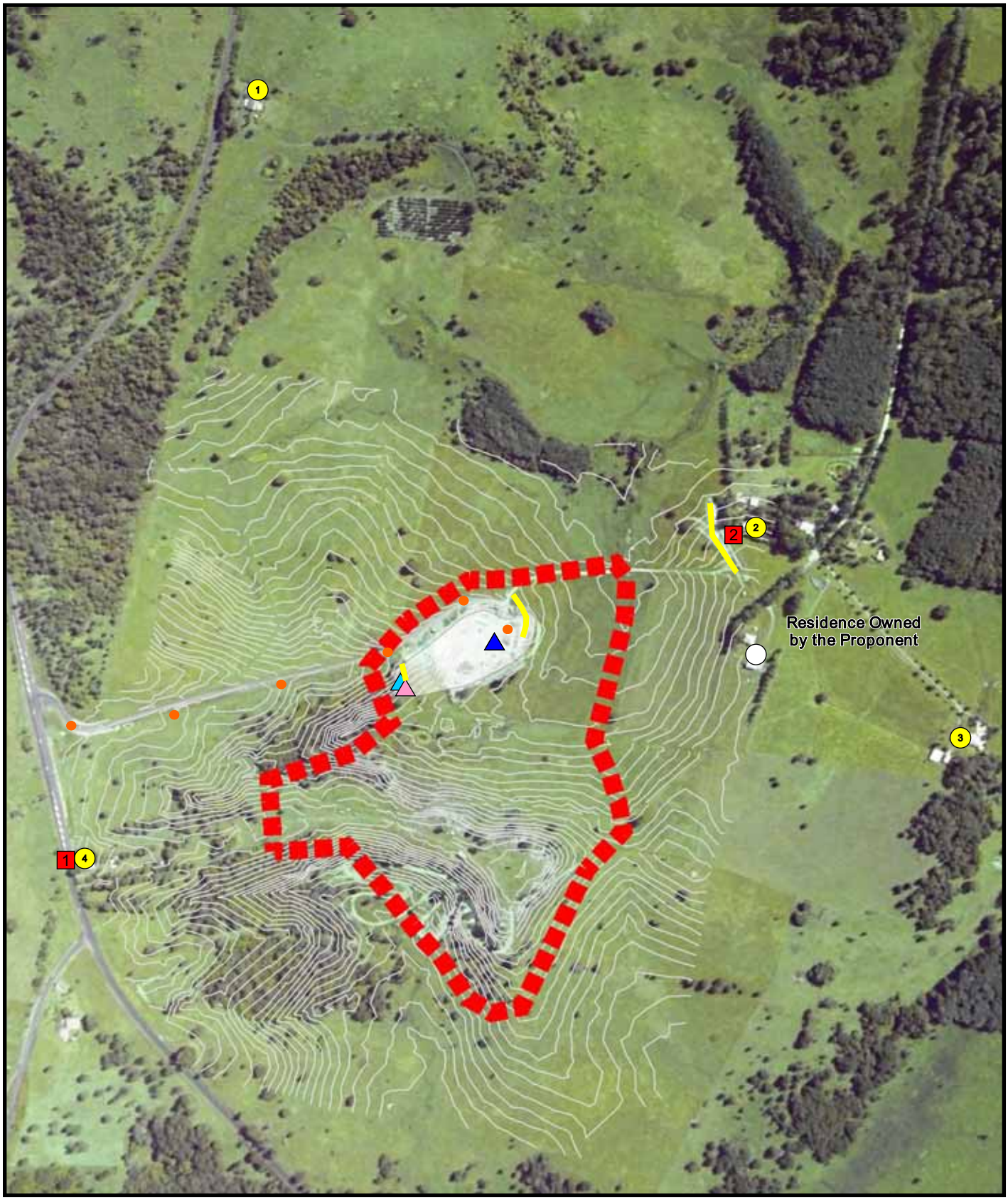
ERM



Legend

- Noise Control Bund Locations
- Extent of Quarry Extraction and Operations (Project Area)
- Crusher/Screen
- Front End Loader
- Washing Plant
- Road Truck
- Noise Assessment Location
- Noise Logger Location

Figure C2

Noise Modelling Scenario C

Client:	Champions Quarry	
Project:	Champions Quarry Expansion	
Drawing No:	0098287pm_GIS_Noise_C2	
Date:	25/08/2009	Drawing size: A4
Drawn by:	AM	Reviewed by: WW
Source:	-	
Scale:	Refer to Scale Bar	

N

0 100 200 300m

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ERM

Legend

- Noise Control Bund Locations
- Extent of Quarry Extraction and Operations (Project Area)
- Crusher
- Front End Loader
- Road Truck
- 4 Noise Assessment Location
- 1 Noise Logger Location

N

0 100 200 300m

Figure C3

Noise Modelling Scenario D

Client:	Champions Quarry	
Project:	Champions Quarry Expansion	
Drawing No:	0098287pm_GIS_Noise_C3	
Date:	25/08/2009	Drawing size: A4
Drawn by:	AM	Reviewed by: WW
Source:	-	
Scale:	Refer to Scale Bar	

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Legend

- Noise Control Bund Locations
- Extent of Quarry Extraction and Operations (Project Area)
- Excavator (40 tonne)
- Bulldozer
- Dump Truck
- Noise Assessment Location
- Noise Logger Location

Figure C4

Noise Modelling Scenario E

Client:	Champions Quarry	
Project:	Champions Quarry Expansion	
Drawing No:	0098287pm_GIS_Noise_C4	
Date:	25/08/2009	Drawing size: A4
Drawn by:	AM	Reviewed by: WW
Source:	-	
Scale:	Refer to Scale Bar	

N

0 100 200 300m

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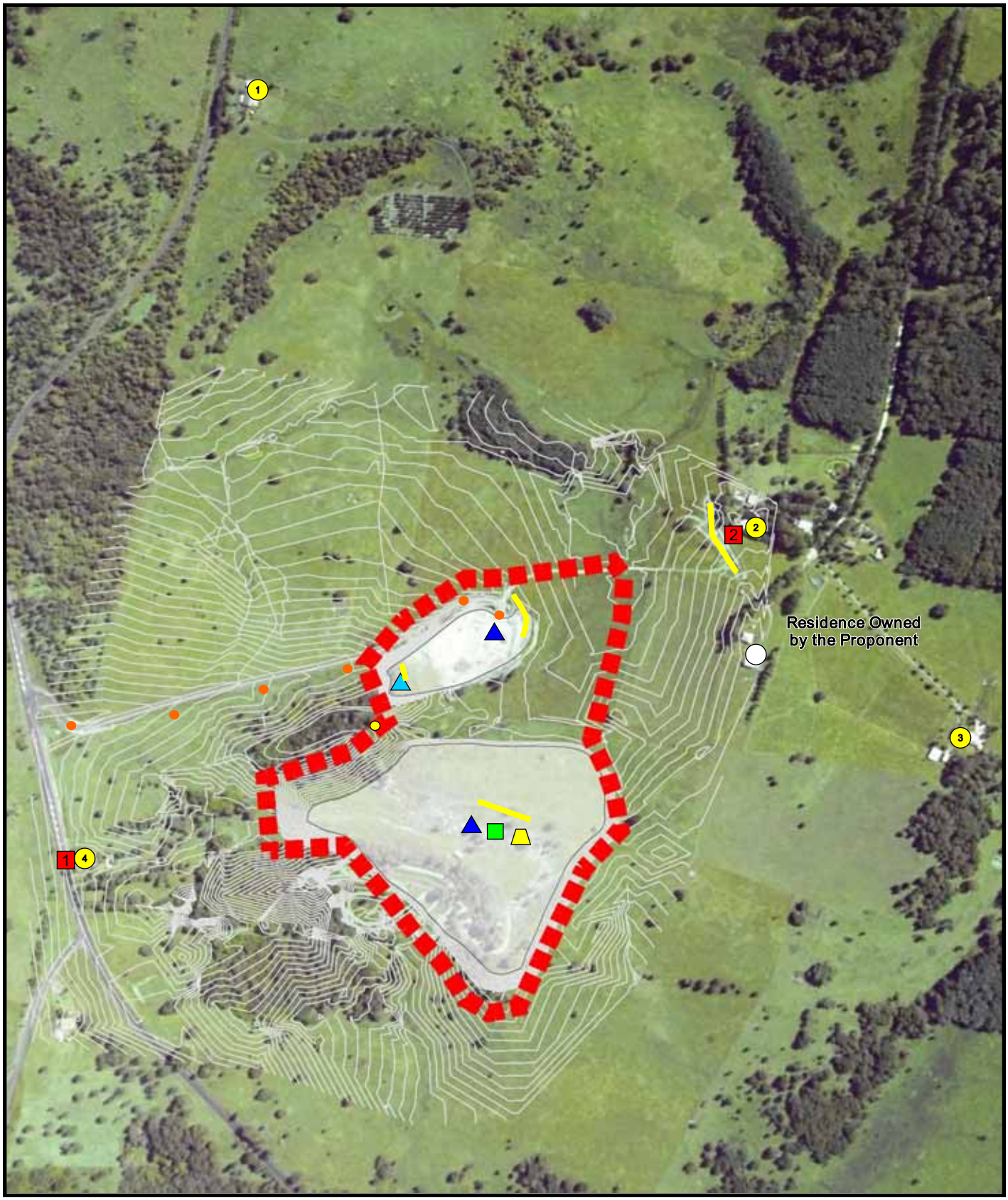
ERM



Legend

- Noise Control Bund Locations
- Extent of Quarry Extraction and Operations (Project Area)
- Washing Plant
- Front End Loader
- Excavator (40 tonne)
- Bulldozer
- Road Truck
- Dump Truck
- Noise Assessment Location
- Noise Logger Location

Figure C5

Noise Modelling Scenario F

Client:	Champions Quarry	
Project:	Champions Quarry Expansion	
Drawing No:	0098287pm_GIS_Noise_C5	
Date:	25/08/2009	Drawing size: A4
Drawn by:	AM	Reviewed by: WW
Source:	-	
Scale:	Refer to Scale Bar	

N

0 100 200 300m

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ERM

Annex D

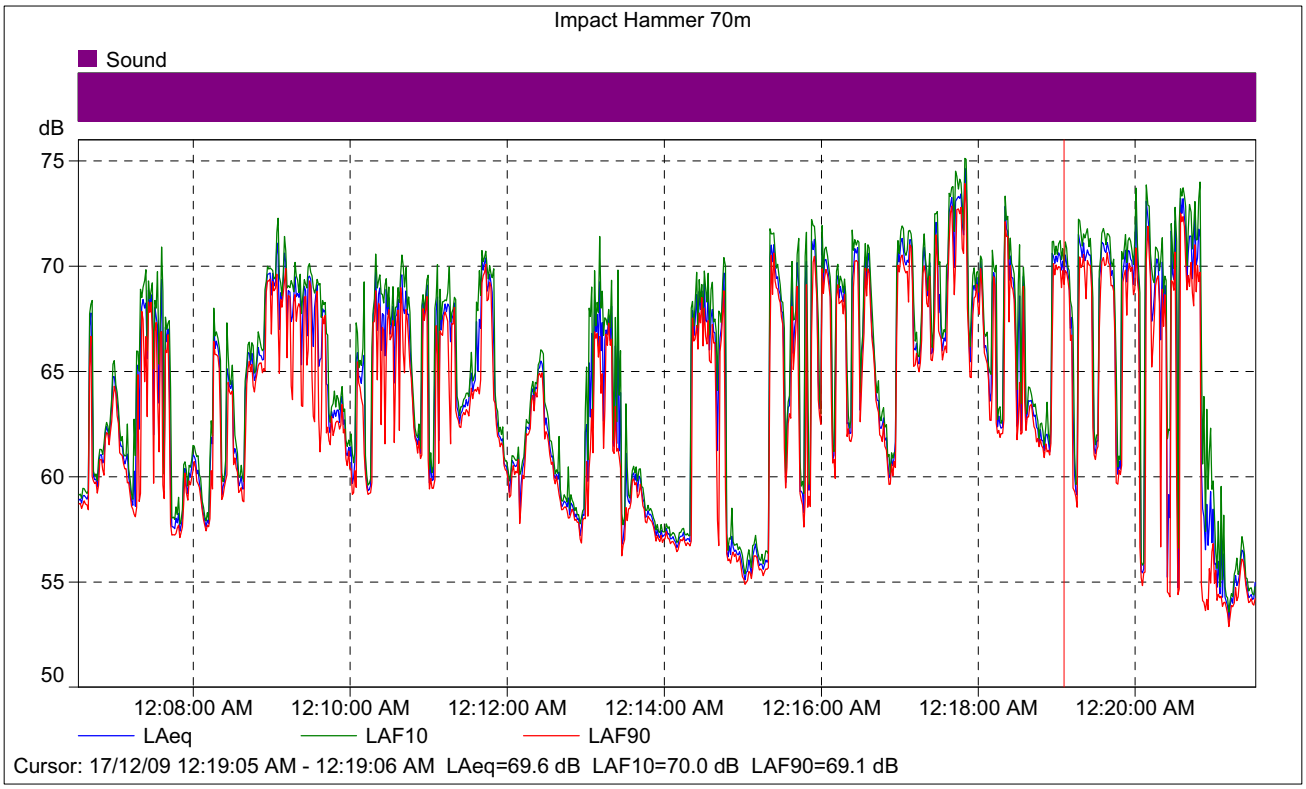
Sound Power Spectral Data

Table D.1 Sound Power Spectral Data, dB

No.		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	A-Weighted
1	Bull Dozer	68	80	89	94	99	100	101	99	96	106
2	Excavator	65	77	89	97	98	108	100	94	89	109
3	Front-end Loader	62	74	92	102	103	107	103	97	91	110
4	Road Truck 1	55	70	86	94	96	97	99	92	85	103
5	Road Truck 2	42	57	73	81	83	84	86	79	72	90
6	Processing Plant	58	70	88	98	99	103	99	93	87	106
7	Grader	63	81	89	94	100	102	99	91	82	105
8	Water Truck	42	57	73	81	83	84	86	79	72	90
9	Washing Plant	57	69	87	97	98	102	98	92	86	105
10	Impact Hammer	107	105	109	111	117	116	114	110	102	121
11	Rock Saw	64	76	91	104	105	109	109	101	93	114

Annex E

Rock Hammer Monitoring Results


Impact Hammer 70m
Sound
dB
75
70
65
60
55
50
12:08:00 AM
12:10:00 AM
12:12:00 AM
12:14:00 AM
12:16:00 AM
12:18:00 AM
12:20:00 AM
LAeq
LAF10
LAF90
Cursor: 17/12/09 12:19:05 AM - 12:19:06 AM LAeq=69.6 dB LAF10=70.0 dB LAF90=69.1 dB

Impact Hammer 70m

	Start time	Elapsed time	LAF90 [dB]	LAeq [dB]	LAImax [dB]	LAFmax [dB]	LAF1 [dB]	LAF10 [dB]	LCeq-LAeq [dB]
Value			57.1	66.7	77.0	75.7	73.1	70.4	11.7
Time	12:06:32 AM	0:15:00							
Date	17/12/09								

	LAIeq-LAeq [dB]
Value	1.3
Time	
Date