Mannering Colliery

Environmental Assessment

Appendix J
NOISE IMPACT ASSESSMENT

ABN: 73 254 053 305

78 Woodglen Close
P.O. Box 61
PATERSON NSW 2421

Phone : (02) 4938 5866
Fax: (02) 4938 5831
Mobile: (0407) 38 5866
E-mail: bridgesacoustics@bigpond.com

CENTENNIAL COAL COMPANY LIMITED

MANNERING COLLIERY
ENVIRONMENTAL ASSESSMENT

NOISE IMPACT ASSESSMENT

REPORT J0130-10-R1
21st MARCH 2007

Prepared for:
Hansen Bailey Pty Ltd
P.O. Box 473
SINGLETON NSW 2330

Prepared by:
Mark Bridges BE Mech (Hons) MAAS
Principal Consultant

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1 INTRODUCTION

Centennial Coal Company Limited (Centennial) propose to continue coal mining operations using the bord and pillar method at Mannering Colliery (Mannering) to extract up to 1.1 million tonnes per annum (mtpa) (The Project). Recent changes to the *Environmental Planning and Assessment Act 1979* (EP&A Act) have resulted in Mannering requiring Project Approval for its existing surface facilities by August 2007 and for continuation of mining operations beyond August 2010.

Mannering is an underground mining operation extracting coal from the Fassifern Seam. The coal is processed at the Mannering Coal Crushing Facility (MCCF) which consists of a rotary breaker to decrease the average lump size and remove any rocks or other material, then through screens and crushers to produce a maximum lump size of 50mm. All coal produced by Mannering is transferred to the nearby Vales Point Power Station by overland conveyor, under a contract with Delta Electricity. Further details regarding The Project are provided in the Environmental Assessment (EA) prepared by Hansen Bailey Pty Ltd (Hansen).

This assessment includes a survey of existing environmental noise levels at three representative rural residential receiver areas and analysis of weather conditions in the area to determine the occurrence of noise enhancing winds and temperature inversions. Noise modelling using widely accepted and best practice procedures and software has been used to predict environmental noise levels from Mannering to all potentially affected residents (or receivers). Results are presented as noise contours over the receiver area and at each of the closest receivers. Sleep disturbance and road traffic noise levels have also been considered in the assessment.

As underground mining activities have no noticeable acoustic effect on any sensitive receiver, this assessment is limited to noise produced by the Mannering surface facilities including the MCCF, workshop, ventilation equipment, conveyors and associated activities including vehicle movements. The overland conveyor from Mannering to Vales Point Power Station is operated under separate approvals held by Vales Point Power Station. This assessment includes all equipment up to the airspace through which coal falls onto the overland conveyor.

This report has been commissioned by Hansen on behalf of Centennial to form part of an EA for the Project. The assessment and report are based on current NSW Department of Environment and Conservation (DEC) guidelines and policies as described below and in accordance with the Environmental Assessment Requirements (EARs) provided by the Department of Planning (DoP).

1.1 Environmental Noise Policies

The Department of Environment and Conservation (DEC) has developed or adopted policies and recommended procedures to assess environmental noise levels from various noise source categories. The following policy documents are relevant to this assessment:

- The NSW Industrial Noise Policy (INP) (EPA, 2000) provides guidance for noise investigations from existing or proposed industrial developments including coal mines. The INP recommends procedures to consistently determine:
  - background noise levels at receiver properties,
  - existing noise levels from an industrial site,
  - recommended, not mandatory, noise criteria for existing and proposed operations,
  - predicted noise levels from proposed developments, and
  - negotiation options if recommended noise criteria may not be met.
- The Environmental Noise Control Manual (ENCM) has been superseded by more recent policy documents although some sections remain relevant, including Chapter 19 related to sleep disturbance from industrial sources operating at night.

- The Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999) provides recommended noise criteria and assessment procedures for road traffic noise from public roads.

1.2 Receivers

The Mannering surface facilities are located off Rutleys Road and are situated on land owned by Delta Electricity. Vales Point Power Station is located approximately 1700m to the north while coal stockpiles and handling equipment associated with the Power Station are located approximately 800m to the north west.

Nearest residential receivers to Mannering are located within the Macquarie Shores Home Village approximately 800m east of Mannering's surface facilities, with additional residences located south of the site near the Pacific Highway and to the north east off Tall Timbers Road (see Figure A1 in Appendix A). Rural and residential receivers have been divided into three areas with similar geographical and acoustical features:

1. Three rural residences south of the site and fronting the Pacific Highway;
2. Over 150 relocatable residences within the Macquarie Shores Home Village, east of the site and fronting Tall Timbers Road; and
3. Various scattered rural residences off Tall Timbers Road north of the Macquarie Shores Home Village plus the adjacent Chain Valley Bay suburban area.

Additional residences are located further from the site in each direction including on the southern side of the Pacific Highway and eastern side of Tall Timbers Road. These residences are, in all cases, more distant from the site and would receive lower environmental noise levels from the Project. Noise contour figures in Appendix A show the location of closest residences.

Privately owned properties identified in the EA but not shown in Appendix A are either industrial/commercial properties, are unaffected by the Project or are currently unoccupied.

2 EXISTING ENVIRONMENT

2.1 Noise Monitoring Program

An investigation into existing environmental noise levels at closest receivers has been carried out to determine appropriate noise criteria for this assessment according to procedures recommended in the INP. Noise surveys have been carried out to measure existing background and ambient noise levels using a combination of long term unattended noise monitoring and short term operator-attended noise measurements at three assessment locations as shown in Appendix A.

Noise monitors providing results to Type 1 accuracy according to AS1259, which are suitable for laboratory or field use, were installed at three assessment locations for a minimum 12 day period from Tuesday 31st October to Sunday 12th November 2006. Attended noise surveys over 15 minute periods were also undertaken at each location during the day, evening and night to assist in identifying and quantifying the noise contribution from dominant noise sources at each location. Noise monitoring locations are described in Table 1.

Table 1: Noise Monitoring Locations.

Receiver	Noise Monitoring Locations
1. Residences near the Pacific Highway	Noise monitoring was undertaken in a wooded area approximately 110m north of the Pacific Highway, 500m east of the three residences.
2. Macquarie Shores Home Village	Noise monitoring was undertaken in a wooded area approximately 20m from the western boundary of the property.
3. Tall Timbers Road	Noise monitoring was undertaken in a wooded area approximately 50m

residences	west of Tall Timbers Road, just south of the Karoola Road intersection.

The long term noise monitor at Location 1 (Pacific Highway) was a Svan 949 sound level meter, while the other two monitors were 01dB SIP95S sound level meters. All instruments were housed inside weatherproof boxes and fitted with a 12.7mm condenser microphone on an extension cable and a windshield over the microphone. Each monitor was installed within a wire security cage and attached to a tree with the microphones mounted approximately 1.2m above the ground. The sound level meters were programmed to measure and store one-second average (LAeq) values for the entire monitoring period, allowing software provided by the manufacturer to calculate 15 minute percentile statistics for analysis and presentation in this report. The noise monitor installed at location 2 (Macquarie Shores) returned only intermittent results due to a loose microphone extension cable, although partial results obtained from this monitor were consistent with corresponding results obtained at the other two monitoring locations.

Short term attended noise surveys were completed using a Svan 912AE sound level analyser fitted with a 12.7mm polarised condenser microphone and a windshield. This instrument was mounted on a tripod close to each long term monitor, with the microphone approximately 1.2m above the ground. Calibration levels for all instruments were checked at the beginning and end of the survey using an 01dB Cal-01 Type 1 calibrator producing 94 dB at 1kHz, with each reading within 0.2 dB of the expected value and a maximum difference of 0.2 dB noted from the start to the end of the survey. Calibration certificates for these instruments, from a NATA-accredited laboratory, are available upon request. Appendix B includes detailed noise monitoring results.

2.2 Background Noise Levels

The background noise level at each monitoring location has been determined to recommended procedures in the INP. The background level in any 15 minute period is defined in the INP as 'the level exceeded for 90% of the time' which is more easily understood as the quietest 10% of the time. The background level is therefore controlled by constant or long-term noise sources such as insects and heavy traffic rather than louder short-term sources such as intermittent road traffic or barking dogs. Results from all noise monitors include the background noise level in each 15 minute period.

The INP further recommends that 'assessment background noise levels' (ABLs) are determined for each day, evening or night period by taking the 'L90 of the individual 15 minute L90s' after excluding data affected by wind above 5m/s or rain. Weather conditions during the noise survey were reported by the Bureau of Meteorology's Norah Head weather station in standard 10 minute intervals. These data were converted to 15 minute intervals by deleting results stored 20 minutes and 50 minutes after each hour. As Norah Head is some distance from the site and located on the coast rather than inland, a detailed comparison of long term wind speeds at Norah Head and Munmorah was made to determine any correction factors that would apply. This analysis revealed a 5m/s wind at Norah Head occurs for approximately the same proportion of time as a 2m/s breeze at Munmorah closer to the site, implying wind speeds measured by the Norah Head weather station should be divided by a factor of 2.5 to approximate the wind speed near the site. While this factor is not accurate under all weather conditions, it has been adopted for the purposes of the INP's data exclusion rule and means noise monitoring data have been excluded when the 10m wind speed at Norah Head exceeded 12.5m/s.

Calculated ABLs for each time period and receiver location are included in Appendix C. A single 'rating background level' (RBL) was then determined for each receiver location by taking the median value of all ABLs for each day, evening or night period. Results from this calculation are shown in Table 2.

Table 2: Measured Background Noise Levels, LA90,15min.

Receiver Area	Measured Background Level, LA90,15min		
	Day	Evening	Night
1. Pacific Highway, Doyalson Nth	46.7	42.8	34.4
2. Macquarie Shores Home Village *	37.8	39.0	35.3
3. Tall Timbers Road	37.4	37.9	36.8

* Background noise levels at this location are based on intermittent results due to a loose microphone connection.

2.3 Receiver Properties

2.3.1 Receivers near the Pacific Highway

Observations made during the attended noise surveys indicate the Pacific Highway is the dominant source of noise during all time periods, with insects and birds contributing significant noise particularly during the day and evening. Background noise levels are influenced by traffic and birds during the day, by traffic and insects during the evening and by a combination of Mannering industrial noise and insects during the night when Pacific Highway traffic flows are intermittent.

The dominant nature of Highway traffic noise indicates ambient noise levels are unlikely to vary from one season to the next, while day and evening background noise levels are similarly unlikely to vary due to constant traffic noise. Night background noise levels may vary due to changes in weather conditions affecting insect noise and noise transmission from Mannering Colliery, although seasonal variations are expected to be insignificant compared to the nightly variations noted during the survey. After excluding noise measurement data affected by wind and rain according to recommended procedures in the INP, night background levels varied from 29.4 to 37.8 LA90,15min with a median value of 34.4 LA90,15min. With existing Mannering noise only intermittently audible depending on road traffic and weather conditions, background noise levels in the absence of Mannering's noise contribution are not expected to vary from the measured levels.

Vales Point Power Station is likely to be audible at times as a distant background source although noise from this source could not be distinguished during the survey. The power station's background noise level contribution is estimated at 30 LA90,15min, based on the measured background level at the Tall Timbers Road monitoring location and relative distances from the power station.

2.3.2 Macquarie Shores Home Village

The Macquarie Shores Home Village consists mainly of relocatable cabin accommodation for permanent residents and tourists and appears to contain approximately 150 dwellings. The rear, or western, boundary of the Village is the closest residential boundary to Mannering's surface facilities. Observations made during the noise survey indicate birds and insects are the dominant sources of noise during the day while background levels during the evening and night are influenced by insects combined with Mannering's surface facilities and Vales Point Power Station. While the relative contribution of these sources changes from time to time, observations indicate the Power Station, Mannering's surface facilities and insects can all contribute similar background noise levels at times.

Other sources of intermittently audible noise would most likely include Delta Electricity's overland conveyor from Mannering to the Power Station and traffic noise from the Pacific Highway, although these sources were not audible or could not be separately identified during the attended noise surveys. Traffic noise from Tall Timbers Road was intermittently audible during all time periods but occurred rarely during the night.

It should be noted that the measured background noise levels are consistent with background levels of 35 LA90,1hr measured during the day and night in August 1996.

2.3.3 Tall Timbers Road Residences

Residences near Tall Timbers Road, particularly those north of the Macquarie Shores Home Village, receive noise from birds and insects and intermittent traffic movements on Tall Timbers Road during the day. Evening and night noise levels are dominated by insects and Vales Point Power Station, with a very intermittent contribution from Tall Timbers Road traffic. Noise from Delta Electricity's overland conveyor from Mannering, and from Mannering's Surface Facilities, would be audible at times but could not be separately identified during the attended noise surveys. Pacific Highway traffic noise may be intermittently audible during the night with a light southerly breeze but was not noted during the attended surveys.

Measured background noise levels during the night varied from 33.2 to 39.8 LA90,15min, with this variation mainly due to changing weather conditions affecting power station noise levels in this area.

3 CRITERIA

3.1 Mining Noise

Noise criteria for this assessment have been developed using procedures in the DEC's INP which recommends methods to determine background noise levels and to derive appropriate operational noise criteria for an industrial site near noise-sensitive receivers such as residences. Both the intrusive and amenity noise criteria are normally referred to in each of the day, evening and night time periods and are described below.

3.2 Intrusive Criteria

Intrusive criteria are set 5 decibels above the Rating Background Level (RBL) in each time period and are designed to limit the relative audibility of the Project. These criteria can be adjusted by one or more 'modifying factors' described in Section 4 of the INP, or alternatively the source noise levels can be adjusted to consider any modifying factors applicable to those sources.

Modifying factors apply to specific sources, such as conveyor start alarms, but do not apply to other sources such as ventilation fans. As modifying factors do not apply to all sources on the site they have been added to source noise levels as required, rather than subtracted from the intrusive criteria.

3.3 Amenity Criteria

Amenity limits recommended in the INP depend on existing industrial noise levels and the nature of the receiver area. The amenity limits are designed to control the total or cumulative level of industrial noise at a sensitive receiver such as a residence. Amenity criteria are set to the amenity limits in cases where limited industrial noise is currently received, or to lower levels to ensure the cumulative impact of existing and proposed noise sources does not exceed the limit for each time period.

Rural receivers located within audible range of existing industrial sites such as Mannering Colliery and the Vales Point Power Station, or close to the Pacific Highway, are considered to be 'urban' receivers for the purposes of setting appropriate amenity criteria according to the INP.

The following amenity limits therefore apply:

- Day 60 LAeq,11hr,
- Evening 50 LAeq,4hr, and
- Night 45 LAeq,9hr.

Table 2.2 in the INP recommends corrections to the amenity limits to consider existing sources of industrial noise. No corrections are recommended when existing industrial noise levels (excluding

Mannering's noise contribution) are at least 6 dBA below the relevant amenity limits, which is the case for all receivers according to the noise survey results described in Section 2 above. As the amenity criteria implicitly consider potential cumulative noise impacts from multiple industrial noise sources in the area, no further cumulative noise assessment is required.

3.4 Summary of Mining Noise Criteria

The lowest of the intrusive or amenity criteria are normally adopted as the limiting criterion for each receiver and time period, as shown in Table 3.

Table 3: Adopted Mining Noise Criteria at Residences, LAeq.

Receiver Area	Intrusive Criteria, LAeq,15min			Amenity Criteria, LAeq,period		
	Day	Evening	Night	Day	Evening	Night
1. Pacific Highway residences	52	48	39	60	50	45
2. Macquarie Shores Home Village	43	44	40	60	50	45
3. Tall Timbers Road residences	42	43	42	60	50	45

Table 3 shows the intrusive criteria are, in all cases, lower than the corresponding amenity criteria. The assessment point for each residential property is defined in the INP as the closest or potentially most affected point within 30m of the residence, or at the property boundary if the boundary is closer than 30m from the residence.

3.5 Where Criteria May be Exceeded

Noise criteria listed in Table 3 should be considered the levels above which some acoustic impact may be noticed by residents. Louder noise levels at a residence do not necessarily imply the noise is unacceptable at that residence.

The INP describes strategies to deal with potential exceedances of the criteria such as:

- best practice noise mitigation measures applied to individual plant items and mine operating procedures;
- adoption of alternative noise criteria based on achievable noise levels and considering other factors such as social worth attached to the development and historical noise levels from existing developments;
- negotiation of offset arrangements with regulators and/or the affected community; and
- acquisition of properties where the predicted or measured noise impacts are unacceptable.

Recent noise assessment practice for greenfield mine sites considers an exceedance of up to 5 dBA above the intrusive or amenity criteria is generally acceptable provided the proponent can show all reasonable and feasible noise control measures and best practice operational noise management measures have been incorporated into the design and operational planning for the development. Residences expected to receive more than 5 dBA above the criteria are typically considered to lie within an area of affectation and are often subject to acquisition by the mine, or are offered other negotiated mitigation options if desired by residents.

Residential properties expected to receive less than 5 dBA above the intrusive or amenity noise criteria are typically considered to fall within a 'management zone' and the proponent is normally expected to implement ongoing management practices and engineering noise control measures to achieve the lowest practical levels at these properties.

The INP recognises that this strategy is not necessarily appropriate for an existing site such as Mannering that has been operating in a substantially unaltered form since the 1960's.

3.6 Sleep Disturbance

Sleep disturbance potentially occurs when short, sharp sounds that intrude above the ambient level can be heard within a bedroom. Common sources of sleep disturbance include road, air and rail traffic, impact sounds from an industrial site, bird calls and voices. Of these sources, only impact sounds originating within the Mannering surface facilities are relevant to this assessment.

Sleep disturbance criteria are sourced from the State Pollution Control Commission (now DEC) Environmental Noise Control Manual (ENCM) which recommends a limit of 15 LA1,1min above the background noise level during the hours 10pm to 7am or to 8am on Sundays and public holidays. According to DEC, this sleep disturbance criterion does not apply to the day and evening periods. While noise levels and character capable of causing sleep disturbance are not well understood at present, this conservative criterion is the most widely accepted for situations of this type.

Sleep disturbance criteria based on the adopted night background noise levels listed in Table 2 of this report are shown in Table 4.

Table 4: Adopted Sleep Disturbance Criteria at Residences, LA1,1min.

Residential Areas	Sleep Disturbance Criteria, LA1,1min
Residences near the Pacific Highway	49
Macquarie Shores Home Village	50
Tall Timbers Road	52

According to the ENCM, sleep disturbance is assessed at a point 1m outside the potentially most affected bedroom window of a residence. For the purposes of this assessment, sleep disturbance is assessed at the closest facade of each residence and at the western boundary of the Macquarie Shores Home Village assuming bedrooms face Mannering's surface facilities.

4 ASSESSMENT

4.1 Weather Conditions

4.1.1 General Discussion

A detailed review of weather conditions that occur in this area has been carried out to assist in determining the effect of various weather conditions on noise propagation from Mannering. Parameters such as air temperature, relative humidity, wind speed profile and vertical temperature gradient can influence noise levels at some distance from a source, while such effects are rarely significant at much shorter distances.

It is commonly understood that winds tend to 'blow' noise and increase received levels downwind from a source. The actual noise enhancement mechanism is related to bending or refraction of sound rays as they pass from one wind speed zone to another or, in real cases, as they pass through a gradually changing wind speed profile. Sound rays travelling in the same direction as the wind tend to be bent towards the ground, while those travelling against the wind tend to be refracted away from the ground. The average radius of curvature of each sound ray can be calculated if the wind speed profile is known.

Wind speeds tend to increase with height in a non-linear fashion, requiring all important wind speed measurements to be taken at a standardised height of 10m above the ground. The wind speed profile, or the variation of wind speed with height, varies depending on the average roughness of the ground

surface and near major changes in ground elevation such as hills and valleys. The actual wind speed and direction varies in a complex way over undulating and forested areas and it would be very difficult to accurately measure or model this situation for a single point in time. This high difficulty level substantially increases when variations in wind conditions over time are considered.

A less complex approach is adopted for noise assessment purposes. This approach assumes a standard wind speed profile occurs over the entire site, resulting in a more easily determined radius of curvature for sound rays that only depends on the wind speed and whether the sound rays are travelling downwind, upwind or at an angle to the wind direction.

It is also commonly understood that temperature inversions tend to increase noise levels at some distance from a source. A temperature inversion is formed when air near the ground is cooler than the air above, which primarily occurs during the night or to a lesser extent during cloudy days away from large bodies of water. Sunny days allow the sun to heat the ground surface which disperses an inversion and creates the opposite effect, known as a temperature lapse.

As cool air is denser than warm air, sound rays are refracted towards the cooler air which is towards the ground for an inversion or away from the ground for a lapse. This effect is the most important reason why sound carries better at night.

Cool air, being heavier, tends to run down hills and pool in valleys. The depth of cool air settling in a valley tends to increase during the night, particularly in winter. In most cases the cold air mass moves down the valley towards the ocean, creating a 'drainage flow'. While water is much heavier than air and faithfully follows the lowest path along the valley, cool air is only marginally heavier than warm air and the moving cool air mass tends to spill out over the width of the valley floor. The speed of this movement depends on site conditions but is typically in the range 1m/s to 2m/s.

The wind speed and direction during a calm night therefore varies depending on the direction of the main valleys in the area and can be vastly different over various areas of a site. The depth of any cool air flows vary depending on terrain conditions. As for gradient winds discussed above, it would be very difficult to measure and model air temperatures and flows over the entire area for a particular point in time and it would be more difficult to model the situation as it changes with time.

A simpler situation is considered for noise modelling, in which a constant temperature gradient above ground level is assumed over the entire site and surrounds. A constant temperature gradient allows an average radius of curvature for sound rays to be determined and, in this case, the radius of curvature is assumed to apply in all directions from the source. Any drainage flows associated with temperature inversions are modelled as a wind speed and direction at an assumed height of 10m above the ground.

Currently available noise modelling software assumes the separate radii of curvature due to winds and inversions have a similar effect on noise propagation and can add together or cancel each other depending on wind direction and relative strength. For the noise model software, sound ray curvature due to an inversion is the same as curvature downwind from a source provided the radii of curvature are the same. Greatest sound ray curvature occurs downwind from a source during inversion conditions, as these effects are cumulative.

This discussion highlights the difficulty of modelling exact weather conditions that occur in the area from time to time. DEC recognises this difficulty and has developed a general assessment procedure for the purpose of noise modelling, as described in the INP, which is intended to represent most real situations for most of the time. Essentially, in cases where such weather effects occur for 30% of the time or more in any season or time period, the INP recommends the following weather effects are modelled:

- A 3°C/100m inversion during the night plus a 2m/s drainage flow from source to receiver where the source is on higher ground; or
- A 3m/s gradient wind.

Detailed inspection of the area shows Mannering's surface facilities are located on ground that slopes gradually downwards towards the north east, towards Chain Valley Bay on Lake Macquarie. A low

ridge running generally from the north west to the south east exists just south of Mannering, which creates a very small cold air catchment during the night. This factor, combined with the temperature moderating effect of nearby Lake Macquarie, means significant temperature inversions and associated drainage flows are unlikely to occur in this area. Any minor drainage flows would be significantly slowed by wooded areas between the Surface Facilities and any residence.

4.1.2 Wind Analysis

The Bureau of Meteorology's closest automatic weather stations are Norah Head, approximately 12km south of Mannering, and Gosford which is approximately 30km to the south west. Data from Norah Head do not necessarily apply to Mannering as Norah Head is an exposed outcrop on the coast, while Gosford is a similar distance inland and is therefore considered more representative of the situation at Mannering provided local topographical differences are considered.

Data from Delta Electricity's Munmorah Power Station weather station, located approximately 4km south of Mannering, were also made available for analysis. Munmorah is noted to be slightly closer to the coast and adjacent to both Lake Munmorah and Budgewoi Lake.

A detailed analysis of available weather records from these three locations, over a period of at least 12 months, has been carried out to indicate appropriate weather parameters for use in this assessment. Data analysis has been carried out according to the following procedure for each monitoring station:

- separate all valid data by season and time period;
- for each season and time period, count and discard wind speeds less than 0.5m/s and greater than 5m/s as these speeds represent either calm or turbulent conditions and do not tend to increase received noise levels, and
- for remaining data, determine the percentage occurrence of wind towards each of the 16 standard compass directions and combine results for up to 5 adjacent directions to identify a common vector component which has the potential to enhance noise in any direction.

This procedure was completed for each location, season and time period with results shown in Tables 5 to 7. Entries in bold font highlight dominant winds occurring for at least 30% of the time in each season or time period.

Norah Head data indicated noise enhancing winds rarely occur, as wind speeds exceed 3m/s and cause turbulence and elevated background noise levels for much of the time. The most common winds are sea breezes from the east but such breezes do not appear in Table 5 as they are generally over 3m/s. The most common winds below 3m/s are offshore westerly breezes, which are more common at night during the cooler months.

Table 5: Noise Enhancing Winds, Norah Head Met Data, 2005/06.

Wind Direction	Occurrence of Noise Enhancing Winds, % of Season and Time Period											
	Summer			Autumn			Winter			Spring		
	Day	Ev	Nt	Day	Ev	Nt	Day	Ev	Nt	Day	Ev	Nt
N	4	4	6	3	5	6	4	4	4	4	3	9
NNE	4	4	5	2	2	2	3	1	1	4	2	5
NE	4	3	4	2	2	1	3	0	1	3	2	3
ENE	3	2	2	2	1	1	2	0	0	3	1	1
E	3	2	2	2	1	1	2	1	0	2	1	1
ESE	2	2	2	2	1	1	2	1	0	2	1	1
SE	2	4	3	3	1	1	3	1	0	2	1	1
SSE	2	5	3	3	1	1	4	2	1	2	1	1
S	2	5	6	4	2	2	5	3	2	2	1	2
SSW	2	5	6	5	2	3	7	4	3	1	1	3
SW	3	5	8	7	3	7	9	6	5	1	2	4
WSW	3	5	13	9	9	19	12	15	17	2	3	9
W	3	4	13	9	11	23	13	17	20	2	4	12
WNW	3	5	12	8	11	22	12	16	18	3	4	14
NW	3	6	12	7	11	22	10	15	18	3	5	14
NNW	4	6	10	5	10	18	8	13	16	4	5	13

Table 6: Noise Enhancing Winds, Gosford Met Data, 2005/06.

Wind Direction	Occurrence of Noise Enhancing Winds, % of Season and Time Period											
	Summer			Autumn			Winter			Spring		
	Day	Ev	Nt	Day	Ev	Nt	Day	Ev	Nt	Day	Ev	Nt
N	16	28	17	19	27	21	22	25	26	13	28	19
NNE	20	25	15	21	23	18	20	21	21	19	27	16
NE	29	19	10	26	11	8	17	11	13	**30**	22	11
ENE	**30**	9	3	24	3	3	12	1	4	**30**	12	6
E	**35**	15	6	26	5	3	16	2	3	**35**	16	10
ESE	**35**	18	12	28	9	5	20	3	3	**38**	19	13
SE	**32**	20	16	28	11	6	25	6	3	**35**	14	17
SSE	21	19	17	22	11	6	25	6	3	22	12	16
S	16	17	17	18	11	7	24	7	3	18	12	14
SSW	9	10	14	13	9	6	20	7	3	12	6	11
SW	5	6	9	10	5	5	18	7	4	6	4	7
WSW	4	4	4	8	4	4	15	5	5	4	7	5
W	5	7	5	9	6	7	17	9	10	5	13	8
WNW	7	15	10	11	19	16	20	18	17	6	19	14
NW	11	27	18	17	27	21	26	28	27	10	**30**	20
NNW	13	27	18	18	27	22	23	26	27	11	**30**	19

Table 6 indicates Gosford experiences dominant easterly sea breezes during the day, particularly during the warmer months, with a mix of wind directions at other times. Westerly winds occur rarely as Gosford is located east of a large mountain range, while dominant night winds tend to occur from the north due to drainage flows down the Narara Creek valley towards Brisbane Water.

Table 7: Noise Enhancing Winds, Munmorah Met Data, 2004/06.

Wind Direction	Occurrence of Noise Enhancing Winds, % of Season and Time Period											
	Summer			Autumn			Winter			Spring		
	Day	Ev	Nt	Day	Ev	Nt	Day	Ev	Nt	Day	Ev	Nt
N	14	**39**	23	21	**32**	23	25	**32**	29	20	**39**	26
NNE	17	**42**	25	22	**31**	23	23	25	19	22	**40**	22
NE	20	**42**	22	21	27	19	18	14	8	23	**35**	17
ENE	22	**37**	17	20	23	17	15	4	2	24	26	12
E	19	**31**	15	18	17	16	12	1	1	20	15	8
ESE	15	18	13	15	12	10	11	1	0	16	11	7
SE	12	20	14	16	14	8	13	1	1	14	13	9
SSE	11	20	19	18	18	9	17	3	2	12	14	11
S	7	20	29	20	22	27	22	16	24	9	16	23
SSW	6	18	**35**	20	**30**	**40**	25	29	**39**	7	22	**33**
SW	5	14	**33**	20	29	**43**	26	**34**	**44**	6	21	**33**
WSW	4	10	**30**	19	28	**46**	27	**42**	**49**	6	19	**33**
W	3	8	27	16	26	**48**	25	**47**	**58**	6	19	**35**
WNW	3	8	19	15	25	**33**	24	**46**	**48**	8	22	28
NW	5	13	16	16	21	22	25	**42**	**39**	10	25	24
NNW	9	22	20	18	27	20	26	**40**	**35**	15	**35**	25

Table 7 indicates daytime winds at Munmorah tend to occur primarily from the north east, although such winds do not remain below 3m/s for at least 30% of the time. Wind speeds tend to drop during the evening and are likely to cause significant noise enhancement to receivers to the south west, while winter evenings tend to bring westerly drainage flows due to local topography combined with the tendency for offshore breezes near the coast at night. Night breezes are dominated by north westerly or westerly drainage flows.

A comparison between results from Norah Head, Gosford and Munmorah leads to the following observations regarding weather conditions around the Mannering surface facilities:

- Daytime winds primarily occur from the east and tend to exceed 3m/s so do not cause noise enhancement to any sensitive receiver,
- Evening winds vary depending on location due to the influence of local topography. Norah Head tends to receive offshore breezes while Gosford data shows breezes from the north west are more common due to topography in that area. Munmorah data indicates evening breezes primarily occur from the north east, despite local topography draining towards the east. As Munmorah is the closest and most representative location, a north easterly evening breeze has been adopted for Mannering.
- Night breezes vary strongly with location. Norah Head receives westerly offshore breezes, Gosford receives north westerly to northerly breezes and Munmorah receives south west to westerly breezes due to topography. With topography around the Mannering site sloping gently downhill towards the north or north east but with no significant catchment to create strong drainage flows, a light south westerly breeze is expected to occur for much of the time during the night and has been adopted for this assessment.

4.1.3 Temperature Inversions

Experience suggests temperature inversions do not occur near large bodies of water such as Lake Macquarie or away from large and well defined valleys where cold air can be concentrated. Analysis of weather data from Centennial's Munmorah weather station indicates mild temperature inversions

occur approximately 11% of the time during the night in winter according to the analysis procedure in Appendix E4 of the INP, which is consistent with previous analysis results in coastal areas. For the purposes of this analysis, 'night' is defined as the period 6pm to 7am as recommended in the INP and a surface roughness of 1m due to the wooded area surrounding the site was considered.

The INP recommends temperature inversions be considered in a noise assessment if they occur for at least 30% of the time during the night in winter. Temperature inversions therefore do not occur regularly in this area, as defined by the INP, and their effect need not be considered in this noise assessment.

4.1.4 Weather Conditions Summary

Results from an analysis of weather conditions in this area imply the following prevailing weather parameters should be included in this assessment.

- Day No wind,
  20°C average air temperature,
  70% relative humidity, and
  -3.0°C/100m lapse representing a typical sunny day.
- Evening 3m/s wind from the north east (45° from north),
  15°C average air temperature,
  70% relative humidity, and
  No vertical temperature gradient.
- Night 1m/s breeze from the south west (225° from north),
  10°C average air temperature,
  80% relative humidity, and
  No vertical temperature gradient.

Noise levels have also been calculated under neutral weather conditions, with no wind and no temperature inversion, for all time periods.

4.2 Operational Noise Sources

The mine has been operating in its current form from an environmental noise level perspective for at least 10 years, apart from a period of time when the mine was placed on care and maintenance. A comprehensive on-site noise survey to determine sound power levels produced by all significant equipment was reported in Caleb Smith Consulting Report 96.1157.R1 dated August 1996 (Caleb Smith report) and, as no significant changes have occurred since this time other than as discussed below, results from this survey would still apply.

The Caleb Smith report included unweighted sound power spectra measured in octave bands from 63Hz to 8kHz inclusive, which covers all relevant audible frequencies, based on measurements using a Larson Davis sound level meter that provided Type 1 accuracy according to AS1259. An extract from Caleb Smith's Table 5.2.1, excluding modelled source location coordinates that are not relevant to this assessment, is presented in Table 8.

Table 8 shows the loudest noise source within Mannering's surface facilities is the rotary breaker, followed by the main conveyor siren and the MCCF exhaust fan. The rotary breaker has been acoustically treated by enclosing the top and sides since the Caleb Smith report was prepared, resulting in a conservatively estimated 10 dBA noise reduction based on a similar situation at Centennial's Munmorah Colliery. The siren operates occasionally and for only brief periods as the main drift conveyor starts and has therefore been modelled with a sound power level 18 dBA lower than shown in Table 8 to approximate an average (LAeq) level over a 15 minute period. Centennial staff advised the MCCF exhaust fan no longer operates and will not operate in the future, resulting in this source being omitted from the assessment, while significant noise from the workshop from hammering or a

similar activity is assumed to occur less than 10% of the time and has therefore been reduced by 10 dBA.

Table 8: Measured Sound Power Levels 1996.

Source		Octave Band Centre Frequency, dB(Lin)								Lin
No.	Title	63	125	250	500	1k	2k	4k	8k	Total
101	Main Vent Fan Drive End	100	100	95	89	86	84	80	76	103
102	Main Vent Fan Drive End	100	100	95	89	86	84	80	76	103
103	Main Vent Fan Inlet End	94	92	94	81	79	77	74	74	98
104	Compressor Shed	105	106	109	108	107	102	104	98	115
201	Raw Coal Breaker	112	115	118	120	119	117	110	97	125
301	Coal Handling Plant South Door	100	102	104	106	108	109	103	93	114
302	Coal Handling Plant North Door	100	102	104	106	108	109	103	93	114
303	Coal Handling Plant East Wall	93	95	97	99	101	102	96	86	107
304	Coal Handling Plant West Wall	93	95	97	99	101	102	96	86	107
305	CHP Exhaust Fan	103	115	116	112	109	104	96	88	120
306	Coal Falling on Stockpile	93	94	92	91	92	96	100	99	105
401	Conveyor Main Siren	101	96	94	91	113	119	112	105	121
402	Conveyor Line Siren	89	82	77	70	89	93	78	76	96
403	Conveyor Line Siren	89	82	77	70	89	93	78	76	96
404	Conveyor Line Siren	89	82	77	70	89	93	78	76	96
405	Conveyor Sec. 1	100	102	101	101	97	93	89	86	108
406	Conveyor Sec. 2	95	97	96	96	92	88	84	81	103
407	Conveyor Sec. 3	88	90	89	89	85	81	77	74	96
501	Large Forklift	93	103	103	101	101	99	94	83	109
502	Workshop Grinding/Hammering	107	111	111	104	97	93	92	89	115

Table 9: Modelled Sound Power Levels.

Source	Octave Band Centre Frequency, dB(Lin)								Lin	A
	63	125	250	500	1k	2k	4k	8k	Total	Total
Main Vent Fan Drive End	100	100	95	89	86	84	80	76	103	93
Main Vent Fan Drive End	100	100	95	89	86	84	80	76	103	93
Main Vent Fan Inlet End	94	92	94	81	79	77	74	74	98	88
Compressor Shed	105	106	109	108	107	102	104	98	115	112
Raw Coal Breaker	102	105	108	110	109	107	100	87	115	113
MCCF South	100	102	104	106	108	109	103	93	114	110
MCCF North	100	102	104	106	108	109	103	93	114	110
MCCF East	93	95	97	99	101	102	96	86	107	103
MCCF West	93	95	97	99	101	102	96	86	107	103
Conveyor Main Siren	83	78	76	73	95	101	94	87	103	104
Conveyor Sec. 1	100	102	101	101	97	93	89	86	108	102
Conveyor Sec. 2	95	97	96	96	92	88	84	81	103	97
Conveyor Sec. 3	88	90	89	89	85	81	77	74	96	90
Forklift or Excavator *	93	103	103	101	101	99	94	83	109	106
Workshop	97	101	101	94	87	83	82	79	105	96

* The forklift near the portal and excavator on the stockpile each operate intermittently. This modelled source covers noise from both machines.

All other identified noise sources have been modelled using the sound power levels determined in 1996. Table 9 shows the modelled sound power levels used in this assessment, with the quietest sources omitted as they make no appreciable difference to received noise levels.

4.3 Mining Noise Levels

4.3.1 Calculation Procedure

Environmental noise levels produced by Mannering's Surface Facilities have been calculated using RTA Technology's Environmental Noise Model (ENM) software. ENM is a general purpose noise modelling package that combines terrain and noise source information with other input parameters such as weather conditions to predict noise levels at specific receiver locations or as contours over a specified receiver area. It is recognised in NSW as the most appropriate choice for situations involving complex topography and a large number of individual noise sources and where a detailed assessment of the effects of atmospheric conditions on noise propagation is required.

The standard ENM package includes data input modules to allow terrain and noise source information to be entered and amended, plus an initial setup page containing terrain and source lists and modelled weather conditions for each scenario. All terrain and source files were prepared for this assessment using a combination of AutoCad and Excel based data then automatically converted to ENM format terrain and source files using specially prepared software. All outputs were obtained using ENM's standard sectioning and contouring algorithms and are presented on a base plan after minor tidying such as closing gaps in the contour lines. All noise contour figures are presented in Appendix A.

4.3.2 Model Calibration

An attended noise survey during the night of 21st and 22nd November 2006 was completed to measure noise levels from the site at the closest receivers, as weather conditions were noted to include a light westerly breeze which was expected to cause some noise enhancement to receiver areas. Results from this survey were used to calibrate the noise model to confirm modelled sound power levels and to check the noise model's noise propagation algorithms over medium density forest areas around the site.

Initial model results calculated with a 1m/s westerly breeze are shown in Table 10, along with the results of attended measurements taken under similar weather conditions. All coal processing equipment is assumed to be operating with no vehicle movements on the site, as no vehicles were audible during the survey. Modelled results have been rounded to the nearest 0.5 dBA.

Table 10: Noise Model Comparison and Calibration, Night, LAeq,15min.

Receiver Area	Model Results	Measured Results	Difference
1. Pacific Highway noise monitor	34.5	34 estimated	-0.5
2. Macquarie Shores Home Village	46.0	44 measured	-2.0
3. Tall Timbers Road noise monitor	41.5	40 estimated	-1.5

Table 10 shows a difference of up to 2dBA between measured and modelled results, with the model over-predicting noise levels to all noise monitoring locations but particularly to the Macquarie Shores Home Village. A smaller difference between measured and modelled results has been noted at the Pacific Highway and Tall Timbers Road monitoring locations, although Mannering's noise contribution could only be estimated, rather than accurately measured, at these locations due to noise from other sources. Insects were the dominant noise source at the Pacific Highway location, with only intermittent Highway traffic allowing noise measurements in the absence of cars, while Vales Point Power Station was the dominant source at the Tall Timbers Road monitoring location where Mannering was audible but not clearly measurable.

As the model slightly over-predicts noise levels from Mannering, which is a mildly conservative situation, no model calibration factors have been applied to the results in this report. It should be noted that ENM is considered to provide noise level predictions that are accurate to within +/-3 dBA in most cases and the calibration check shown in Table 10 has indicated the Mannering model is performing within this normal range.

4.3.3 Calculated Noise Levels

Summary results are shown in Table 11 to closest residences or over 25% of each property, with calculated exceedances of the intrusive noise criteria highlighted in bold font.

Table 11: Summary of Received Noise Levels, LAeq,15min.

Receiver	Weather Conditions, Time Period				Noise Criteria D/E/N
	Neutral Weather		Prevailing Weather		
	Day	Ev, Night	Evening	Night	
Residence 4, O & JO di Rocco	30.5	33.5	**49.0**	31.5	52/48/39
Residence 5, A & M Keighran	29.5	32.5	47.0	31.0	
Residence 6, Swan Hydroponics	32.5	35.0	43.5	34.0	
Residence 7, R Druit (residence)	29.0	33.5	28.5	36.5	43/44/40
Property 7, R Druit (25% of property) *	34.5	38.5	34.5	**42.5**	
Residence 8, Macquarie Shores Village	38.0	**41.5**	37.0	**46.0**	
Residence 9, LF Jeans	33.5	38.5	32.0	**44.5**	42/43/42
Property 10, 12-17 L & J Jeans *	30.0	34.0	28.5	<40	
Residence 11, L & J Jeans	30.5	35.5	29.5	39.5	
Residence 18, L & J Jeans	31.0	36.5	30.0	**43.0**	
Property 19, L & J Jeans *	30.0	34.5	28.5	41.0	
Residence 20, E & K Knight	32.5	37.5	31.5	**44.0**	
Residence 21, Jonita Homes Pty Ltd	32.5	37.0	31.0	**44.0**	
Residence 22, W and D Buchmasser	32.0	37.0	30.5	**44.0**	
Residence 23, P McKee	32.0	36.5	30.5	**43.5**	
Residence 24, J Farrell	31.0	36.0	30.0	**43.5**	
Residence 25, P Kretchmer and E Castle	31.0	36.0	30.0	**43.0**	
Residence 26, A Mearns	31.0	36.0	29.5	**43.0**	
Residence 27, H Gleeson	30.5	35.5	29.5	**42.5**	
Residence 28, C Stead & M Garner	30.5	35.0	29.0	**42.5**	
Residence 29, A O'Keefe	30.0	35.0	29.0	42.0	
Residences 30 to 49	<30	<35	<29	<42	
Residence 50, P & M Davie	30.5	35.5	29.0	42.0	
Residence 51, D Olsen	31.0	36.0	29.5	**42.5**	
Residence 52, D Poulson & K Toope	31.5	36.5	30.0	**43.0**	
Residence 53, H & J Beukers	32.0	37.0	31.0	**43.0**	
Residence 54, A Taylor-Stewart	32.0	37.0	31.0	**42.5**	
Residence 55, G Kettles	32.0	37.0	31.0	**42.5**	
Residence 56, R & E Brokenshire	32.0	37.0	31.0	**42.5**	
Residence 57, B & S Fowler	32.0	37.0	31.0	42.0	
Residences 58 to 76	<32	<37	<31	<42	
Noise Contour Figure, Appendix A	Fig A1	Fig A2	Fig A3	Fig A4	(Table 3)

* Listed noise levels for unoccupied or large properties are calculated over 25% of the property.

Mannering operational noise levels have been modelled under both neutral and prevailing weather conditions for day, evening and night time periods. Each set of results represents normal operation including intermittent vehicle movements within Mannering's Surface Facilities. Noise criteria in Table 11 are identical to those shown in Table 3. Noise contour figures for each modelled scenario are included in Appendix A.

Table 11 shows no exceedances of the daytime noise criteria, with calculated exceedances of the evening noise criteria by 1 dBA at Residence 4 (de Rocco, Rutleys Road) during prevailing weather conditions. Reference to Figure A3 indicates no other Pacific Highway residences are affected by Mannering noise.

Table 11 also shows the Macquarie Shores Home Village and 19 separate residences are expected to receive night noise levels over the intrusive criteria during noise enhancing weather conditions, while the Home Village is marginally affected by Mannering noise under neutral weather conditions. Figure A4 indicates the 40 dBA contour covers approximately 85% of the Home Village during prevailing conditions, although shielding from closest cabins is likely to reduce the area of affectation to cover less than 50% of dwellings within the Village and such shielding has not been considered in the model or reflected in the noise contours. Figure A4 also shows the 42 dBA contour covers or intersects 18 suburban lots fronting Tall Timbers Road and Karoola Avenue in Chain Valley Bay.

4.3.4 Summary of Affected Receivers

A summary of affected residences (ie those receiving noise levels over the intrusive criteria listed in Table 3), in the absence of acoustic shielding provided by western cabins within the Home Village, is presented below assuming the Macquarie Shores Home Village contains approximately 150 separate relocatable dwellings.

When considering each relocatable home within Macquarie Shores Home Village as a separate dwelling, these results indicate Mannering is expected to affect 69 dwellings up to 3 dBA, 50 dwellings up to 5 dBA and 33 dwellings up to 6 dBA above the intrusive criteria.

Mannering only affects approximately 33 relocatable dwellings within Macquarie Shores Home Village by up to 1 dBA above the night amenity criterion, with all other dwellings receiving acceptable noise amenity levels in all time periods. Properties 1 to 3 are unoccupied or are used for industrial purposes and are therefore unaffected by the Project, while all rural residential properties not listed in Table 12 are outside the area of affectation.

4.3.5 Delta Electricity's Overland Conveyor

The overland conveyor from Mannering to Vales Point Power Station is owned and operated by Delta Electricity, although it is acknowledged that it would not be required if Mannering ceased operations. It can therefore be argued that noise from the conveyor should be included in this assessment.

The main overland conveyor is approximately 930m long and runs north from the Mannering site to a small transfer station. A second shorter conveyor runs from the transfer station in a north westerly direction to Delta Electricity's coal stockpiles. Noise from the first conveyor is considered as it is longer and closer to residences.

Noise measurements have not been taken around the overland conveyor. Based on previous noise measurements on other sites, most conveyors produce a sound power level in the range 75 dBA to 80 dBA per metre length, or a total sound power level of up to 109 dBA over the 930m length.

A separate noise model scenario with a source producing 109 dBA located in the centre of the conveyor indicates a received noise level of up to 37 LAeq,15min at Residence 9 and 36 LAeq,15min at closest Tall Timbers Road residences, during noise enhancing weather conditions at night. These results should be compared to calculated noise levels in the range 42 to 44.5 LAeq,15min under the same weather conditions at these residences, as shown in Table 11. It is therefore clear that the

overland conveyor, if it should be considered in this assessment, produces a noise level at least 6 dBA below all Mannering sources at all residences and would therefore not cause a significant cumulative noise impact while operating with Mannering.

Table 12: Summary of Affected Receivers Compared to Intrusive Criteria.

Noise Impact	Affected Receivers
Minor impact up to 3 dBA over intrusive criteria	Residence 4, Orfeo and Joan Olive di Rocco (by 1 dBA evening)
	Property 7, Ross Druit (by 2.5 dBA over 25% at night)
	Residence 8, Macquarie Shores Home Village, approx 32% or 48 dwellings (by 0 to 3 dBA night)
	Residence 9, Leonard Frederick Jeans (by 2.5 dBA night)
	Residence 18, Leonard & Joan Jeans (by 1 dBA night)
	Residence 20, Edward & Katrina Knight (by 2 dBA night)
	Residence 21, Jonita Homes Pty Ltd (by 2 dBA night)
	Residence 22, Wayne and Donna Buchmasser (by 2 dBA night)
	Residence 23, Peter McKee (by 1.5 dBA night)
	Residence 24, John Farrell (by 1.5 dBA night)
	Residence 25, Peter Kretchmer and Elizabeth Castle (by 1 dBA night)
	Residence 26, Alexander Mearns (by 1 dBA night)
	Residence 27, Harold Gleeson (by 0.5 dBA night)
	Residence 28, Chris Stead and Michelle Garner (by 0.5 dBA night)
	Residence 29, Alan O'Keefe (by <0.5 dBA night)
	Residence 50, Peter and Marie Davie (by <0.5 dBA night)
	Residence 51, David Olsen (by 0.5 dBA night)
	Residence 52, Daniel Poulson and Kate Toope (by 1 dBA night)
	Residence 53, Hild and Jeanette Beukers (by 1 dBA night)
	Residence 54, Ashleigh Taylor-Stewart (by 0.5 dBA night)
	Residence 55, Gregory Kettles (by 0.5 dBA night)
	Residence 56, Ronald and Eunice Brokenshire (by 0.5 dBA night)
	Residence 57, Barry and Shirley Fowler (by <0.5 dBA night)
Moderate impact 3 to 5 dBA over intrusive criteria	Residence 8, Macquarie Shores Home Village, approx 33% or 50 dwellings (by 3 to 5 dBA night)
Stronger impact 5 to 6 dBA over intrusive criteria	Residence 8, Macquarie Shores Home Village, approx 22% or 33 dwellings (by 5 to 6 dBA night)

4.4 Sleep Disturbance

Disturbance to sleep can occur when a short, sharp noise that is clearly audible over the background noise level occurs near a residence. While the background noise level to be considered is the level that exists at the time the noise is audible, this level is difficult to predict and the measured long term background noise levels shown in Table 2 of this Report have been used to determine sleep disturbance criteria.

The conveyor start siren is the only source associated with Mannering's surface facilities that has the potential to disturb a resident's sleep. The siren produces a measured sound power level of 122 dBA compared to a normal operating sound power level of 119 dBA for all other equipment associated with the Mannering Surface Facilities as shown in Table 9. The siren would therefore increase noise levels from the site by no more than 4 dBA and would produce a maximum noise level of 51 LA1,1min at the closest Macquarie Shores Home Village boundary compared to the sleep disturbance criterion of 55 LA1,1min, assuming it is located in an area of the site exposed to these dwellings.

As the siren is understood to be located on the western side of the rotary breaker, it would be at least partially shielded from closest residences and noise from the siren would be more than 4 dBA below the sleep disturbance criterion under prevailing weather conditions during the night. No sleep disturbance impacts are therefore expected from Mannering's surface facilities.

4.5 Road Traffic Noise

Traffic noise calculations use the Calculation of Road Traffic Noise (CORTN) method, originally developed by the United Kingdom Department of Transport. The standard CORTN method has been modified for Australian conditions by the NSW RTA and others and has been further modified to account for the current 15 hour daytime and 9 hour night periods referred to in the EPA's Environmental Criteria for Road Traffic Noise.

4.5.1 Traffic Flows

The *Traffic Volume Data for Hunter Region* (NSW Roads & Traffic Authority, 2001) includes vehicle count data on various roads in the Hunter area including Station 05.135 on Rutleys Road north of State Highway 10 (the Pacific Highway). This station is located between the Mannering surface facilities entrance and the Pacific Highway and shows 6603 vehicles per day in 2001. Data for prior years indicates a likely increase to approximately 7000 vehicles per day by 2007 when considering the reduction in vehicle numbers from 1995 to 1998 when the F3 Freeway was extended to Beresfield.

Traffic count data includes vehicle movements associated with Mannering's operations and no increase in traffic movements associated with Mannering is proposed in the future. Main contributors to traffic on Rutleys Road include the Mannering Park residential area and Vales Point Power Station.

4.5.2 Assessment

Relevant traffic noise criteria are listed in Table 1 in the *Environmental Criteria for Road Traffic Noise* (ECRTN) (DEC, 1999). Noise criteria for Situation 8 "Land use developments with the potential to create additional traffic on collector roads" are 60 LAeq,1hr during the day and 55 LAeq,1hr during the night and apply to all traffic including vehicles associated with Mannering. Noise criteria in the ECRTN only apply to residential receivers.

The nearest residential receiver is the di Rocco residence (Property 4) near the corner of Rutleys Road and the Pacific Highway. This residence is located approximately 45m from the edge of the Rutleys Road pavement and is expected to receive 57 LAeq,1hr during the day and 54 LAeq,1hr during the night from Rutleys Road traffic in 2007. Calculated traffic noise levels from Rutleys Road are acceptable compared to the recommended ECRTN noise criteria.

5 CONCLUSION

This assessment shows the existing Mannering Surface Facilities currently produce calculated exceedances of up to 6 dBA, but typically less than 3 dBA, above recommended intrusive noise criteria at some of the closest residential receivers. Most exceedances occur during noise enhancing weather conditions and therefore only occur intermittently, although minor exceedances of up to 1.5 dBA above the night intrusive noise criterion occur at closest relocatable homes within the Macquarie Shores Home Village during neutral weather conditions.

Exceedances of the recommended amenity criteria are limited to a minor 1 dBA exceedance at closest homes within the Macquarie Shores Home Village during noise enhancing conditions at night. Noise levels are within the amenity criteria for most of the time for these residents and at all times for all other residences. Recommended amenity criteria implicitly consider possible cumulative noise

impacts from multiple industrial sources, in this case from Mannering and the Vales Point Power Station, so no additional cumulative noise assessment is required.

Mannering has been operating since the 1960's and has changed little in the last 10 years according to information provided by Mannering's Environmental Coordinator, apart from noise control measures in the form of covers and enclosures applied to the rotary breaker in recent years. Residents are therefore accustomed to some audible noise from the Mannering surface facilities and no complaints regarding noise have been received from residents in the last few years.

The INP acknowledges significant variation in reaction to noise usually exists amongst an average population. As the INP aims to protect the majority of people for most of the time, it follows that noise levels over the INP's recommended noise criteria for some of the time would not necessarily affect a large proportion of nearby residents. In this case, many residents would have moved to the area after Mannering was established and would therefore have chosen to accept some audible noise from the site.

Noise monitoring results indicate Mannering is not the only source of environmental noise in this area, with the Vales Point Power Station audible at residences to the north and the Pacific Highway audible at residences to the south. All residences near Mannering therefore receive audible industrial or traffic noise from other sources in the area, which means Mannering noise is a part of the local noise climate rather than the only intrusive noise source in this area.

Sleep disturbance is unlikely to occur as a result of Mannering's activities as no exceedances of the sleep disturbance criteria are expected at any receiver. Traffic noise produced by vehicle movements on Rutleys Road, including some vehicle movements associated with Mannering, is acceptable at all nearby residences.

Mannering has achieved a significant reduction in environmental noise levels from the site by discontinuing use of the MCCF exhaust fan and by substantially enclosing the rotary breaker. These two sources were previously the loudest on the site based on measured sound power levels in 1996. There are no remaining dominant sources associated with Mannering's surface facilities, based on a review of current sound power levels and the character of audible noise from the site, therefore further noise reductions from the site are unlikely to be cost effective and are not recommended.

Based on the results of this assessment and considering historical noise levels from the site, environmental noise levels from the Mannering surface facilities are considered acceptable.

APPENDIX A – NOISE CONTOUR FIGURES

FIGURE	DESCRIPTION
A1	Day, neutral weather conditions
A2	Evening and Night, neutral weather conditions
A3	Evening, prevailing weather conditions
A4	Night, prevailing weather conditions

Figure A1: Day, Neutral Weather Conditions, dBA

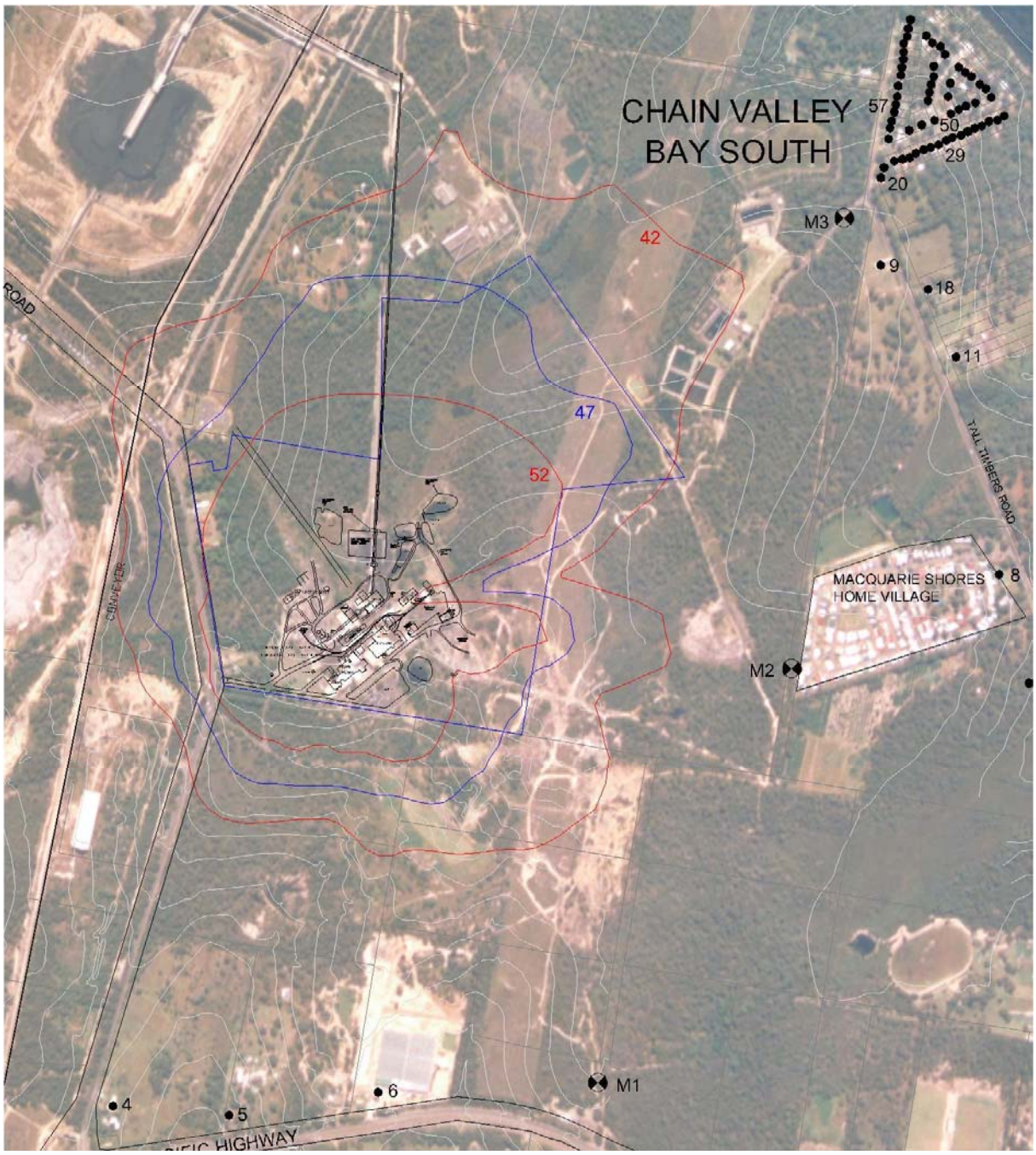


Figure A2: Evening and Night, Neutral Weather Conditions, dBA

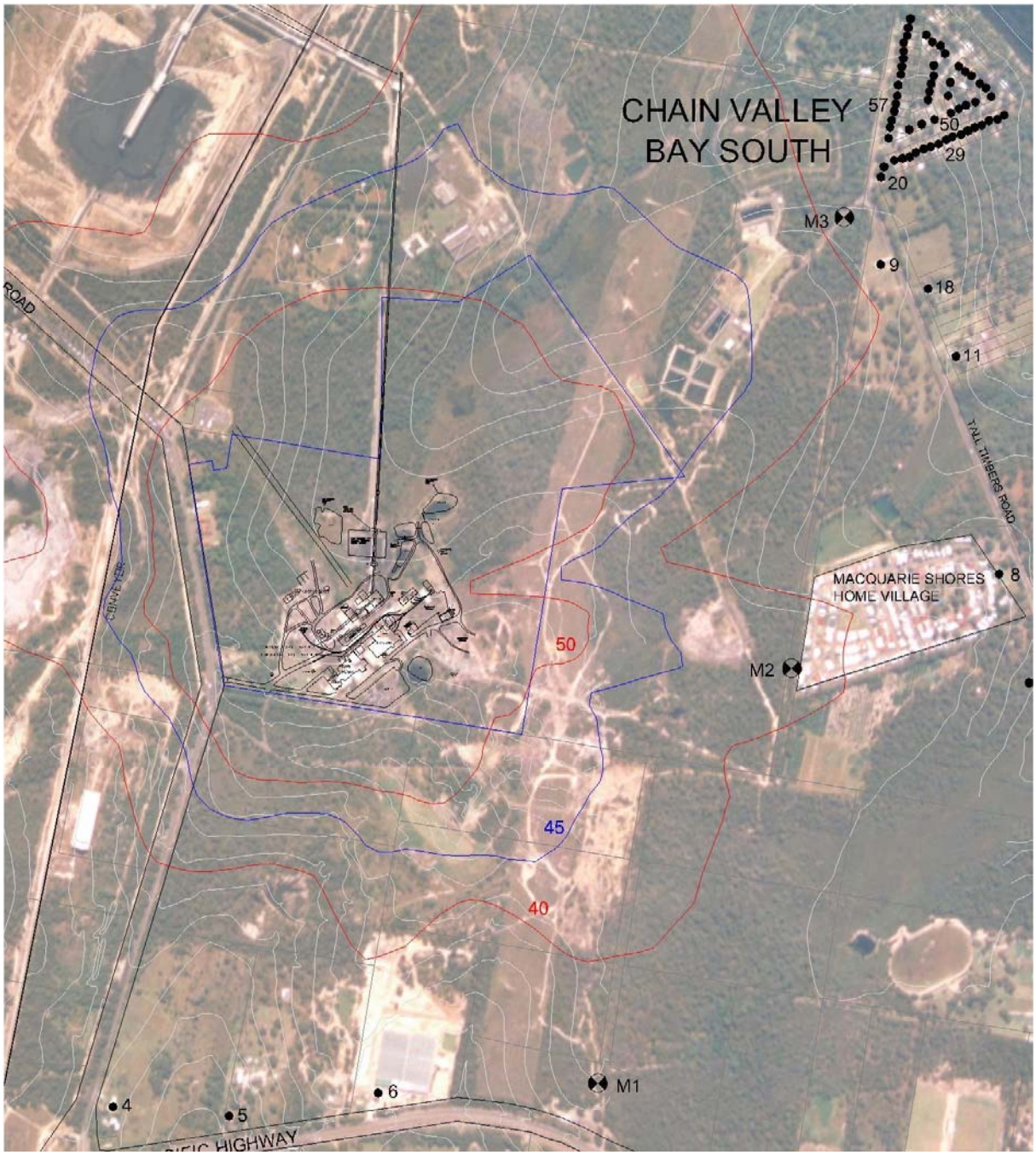


Figure A3: Evening, Prevailing Weather Conditions, dBA

Figure A4: Night, Prevailing Weather Conditions, dBA

APPENDIX B – LONG TERM NOISE MONITORING RESULTS

Environmental noise level charts on the following pages show 15 minute percentile statistics from noise loggers installed at representative locations around the site in October and November 2006, with each chart showing a 24 hour period beginning at 7:00am. The charts also show wind speed and air temperature measured by the Bureau of Meteorology's Norah Head weather station, with original data in 10 minute intervals converted to 15 minute intervals to match the noise data and wind speeds divided by a factor of 2.5 to correct for the inland site location compared to the coastal weather station. Each chart includes:

Lmax - The highest line on the chart, shown with a light line. The Lmax is the maximum dBA noise level measured in each 15 minute period.

L1 - The second highest line on the chart, shown with a medium line and representing the loudest 1 percent of the time (9 seconds) in each 15 minute period.

L10 - The third highest line on each chart without data markers, shown as a light line and representing the loudest 10% of the time (90 seconds) during each 15 minute period.

Leq - the equivalent continuous (acoustic average) noise level in each 15 minute period, shown as a medium line with small data point markers. The Leq can be above or below the L10 line and can, in extreme cases, extend above the L1 line.

Period Leq - the equivalent continuous (acoustic average) noise level in each day, evening or night period, calculated from the average of all 15 minute Leq values in that time period excluding those affected by wind over 5m/s or rain. The Period Leq line is the upper of the two heaviest lines.

L90 - the lowest line on the chart, shown by a solid line, representing the quietest 10 percent of the time in each 15 minute period and accepted as the background noise level. Sections of line shown dotted indicate periods affected by wind over 5m/s or rain.

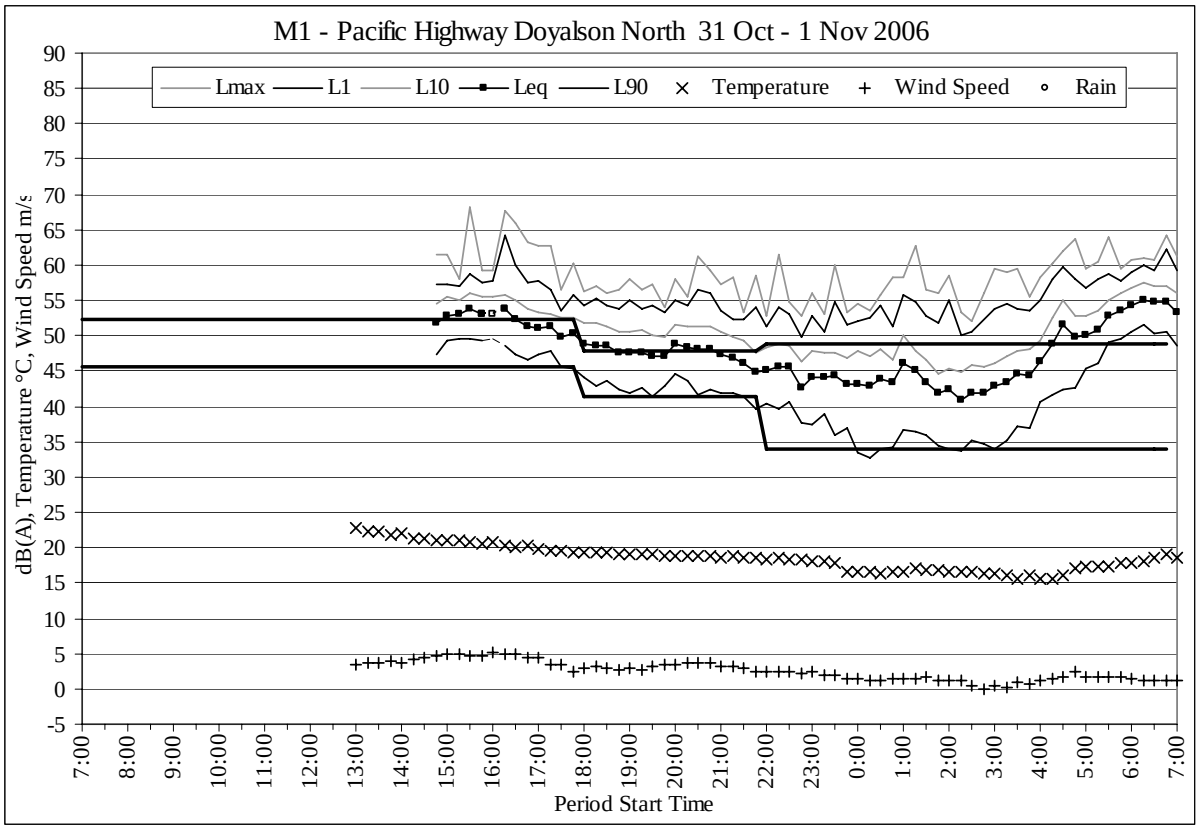
Period L90 - The 'L90 of the 15 minute L90s' for each day, evening and night period, representing the Assessment Background Levels (ABLs) for each period according to the EPA's INP. The Period L90 represents the lowest 10% of all 15 minute L90 values in that time period, excluding those affected by wind or rain, and is shown as the lower of the two heaviest lines.

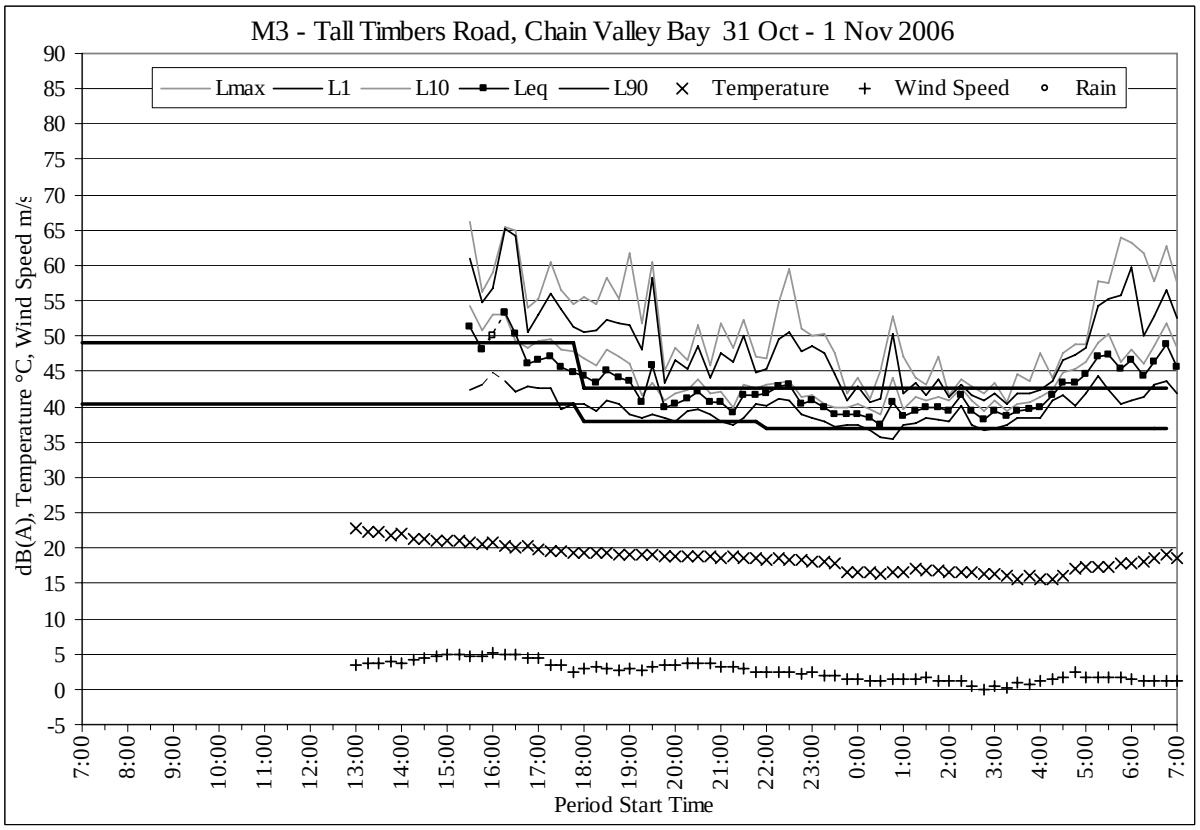
Temperature - Air temperature 10m above the ground as measured at Norah Head. The same results are shown for all monitoring locations.

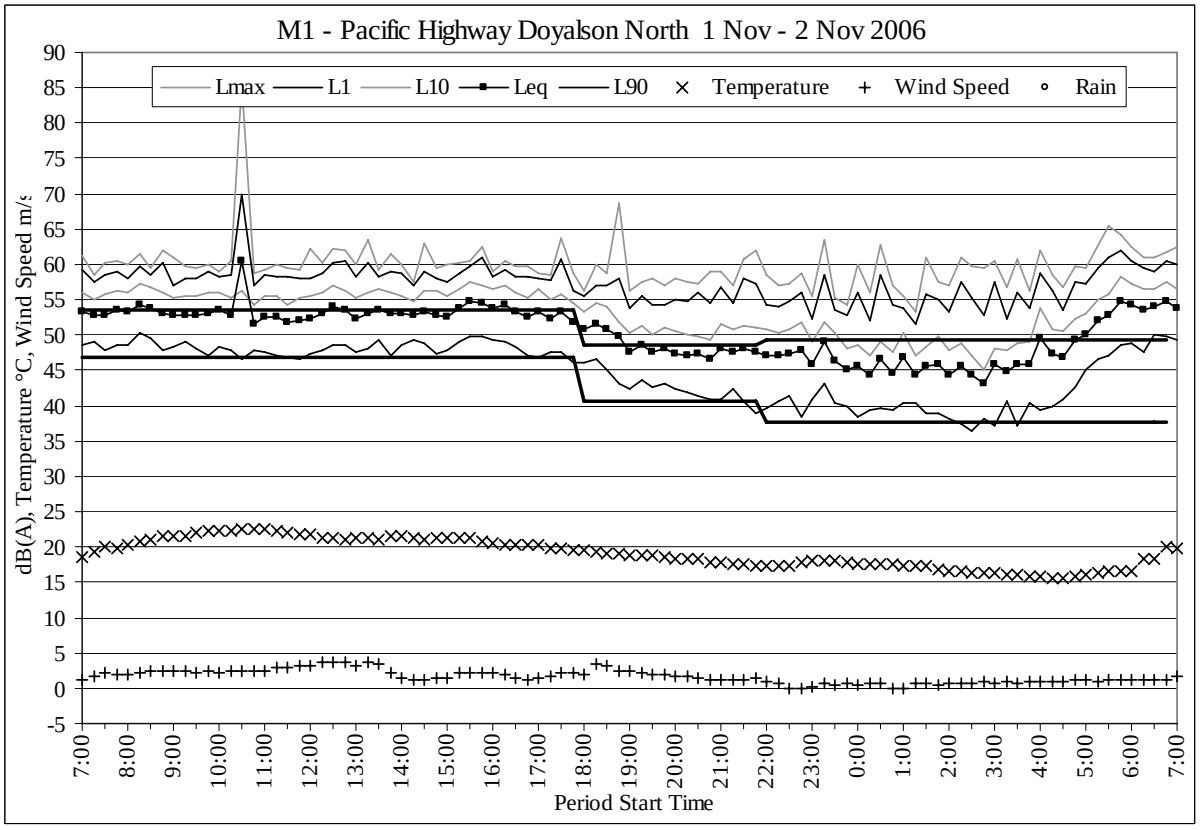
Wind Speed - Wind speed reported by the Bureau of Meteorology's Norah Head weather station, divided by a factor of 2.5. The same results are shown for all monitoring locations.

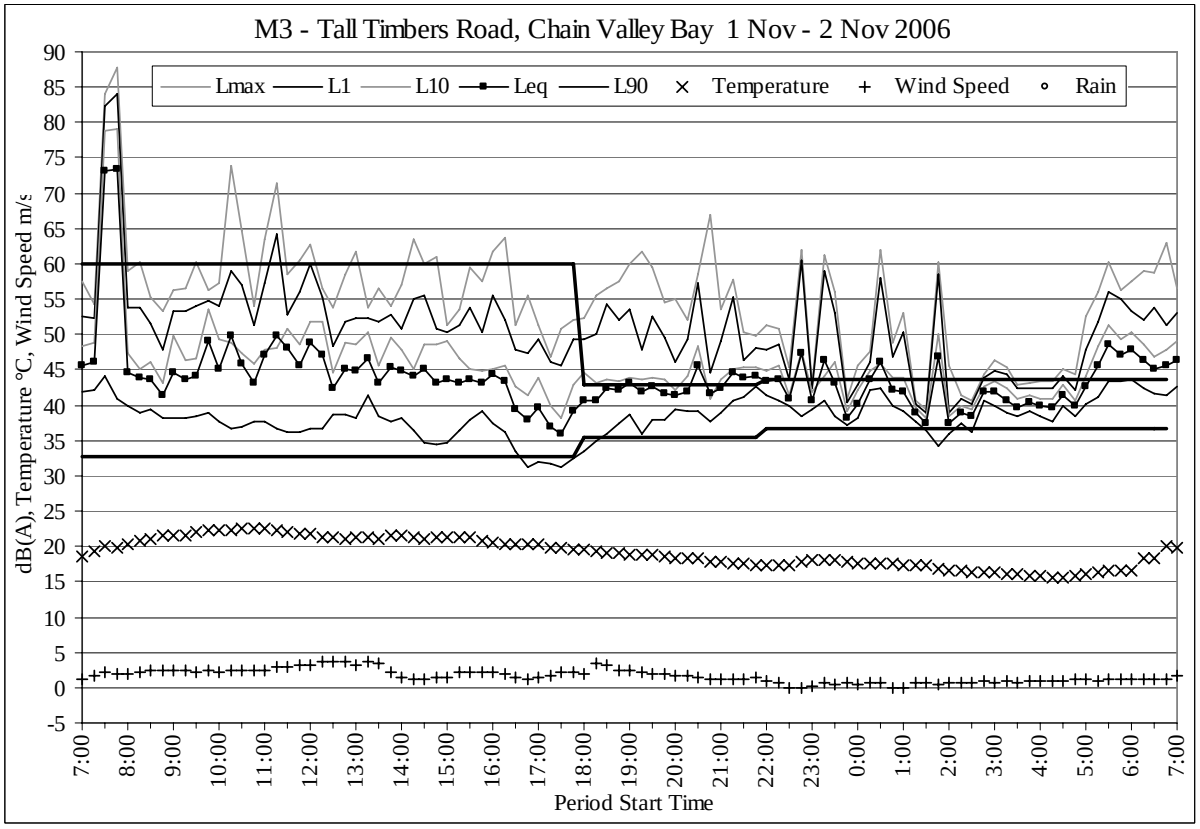
Rain - Occurrence of rain during a 15 minute period as reported by the Bureau of Meteorology's Norah Head weather station. Occasional rain periods are indicated by small circles along the bottom of the charts.

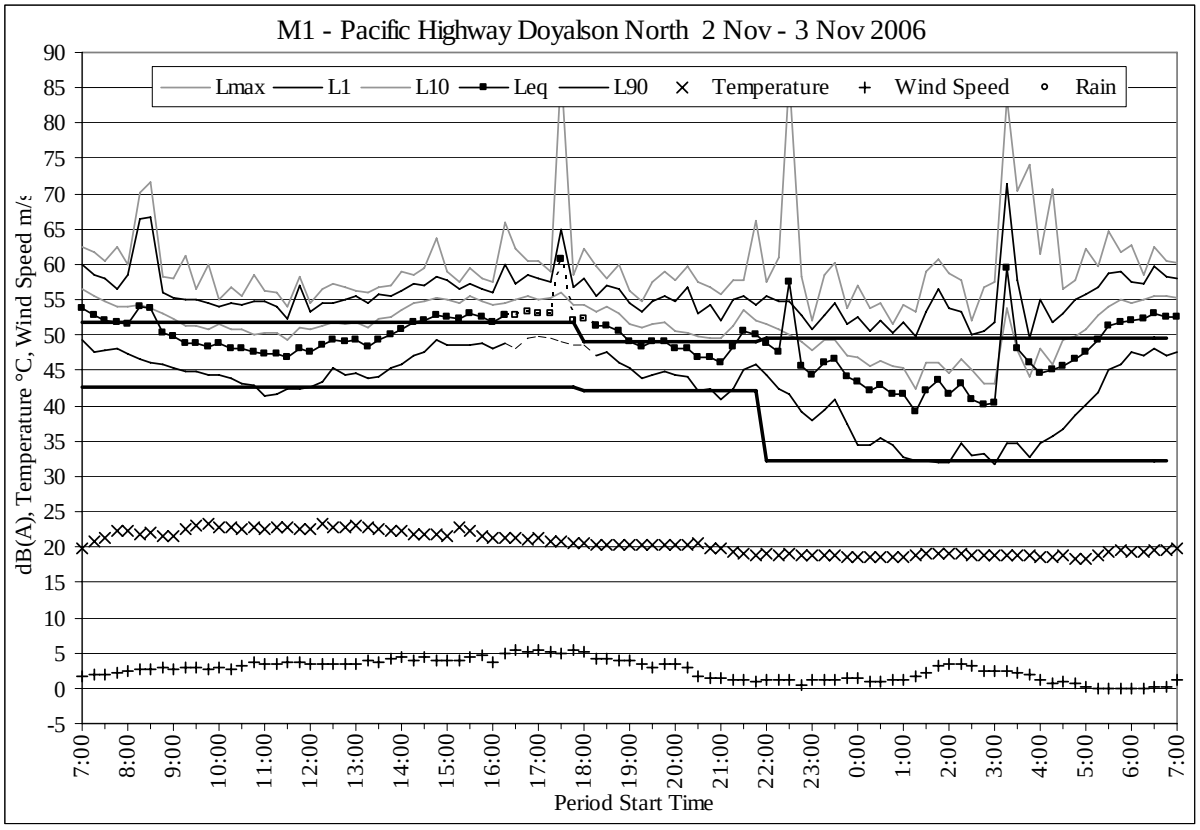
Assessment Background Levels (ABLs) as defined in the INP are included in tabular form after the daily noise logger charts.

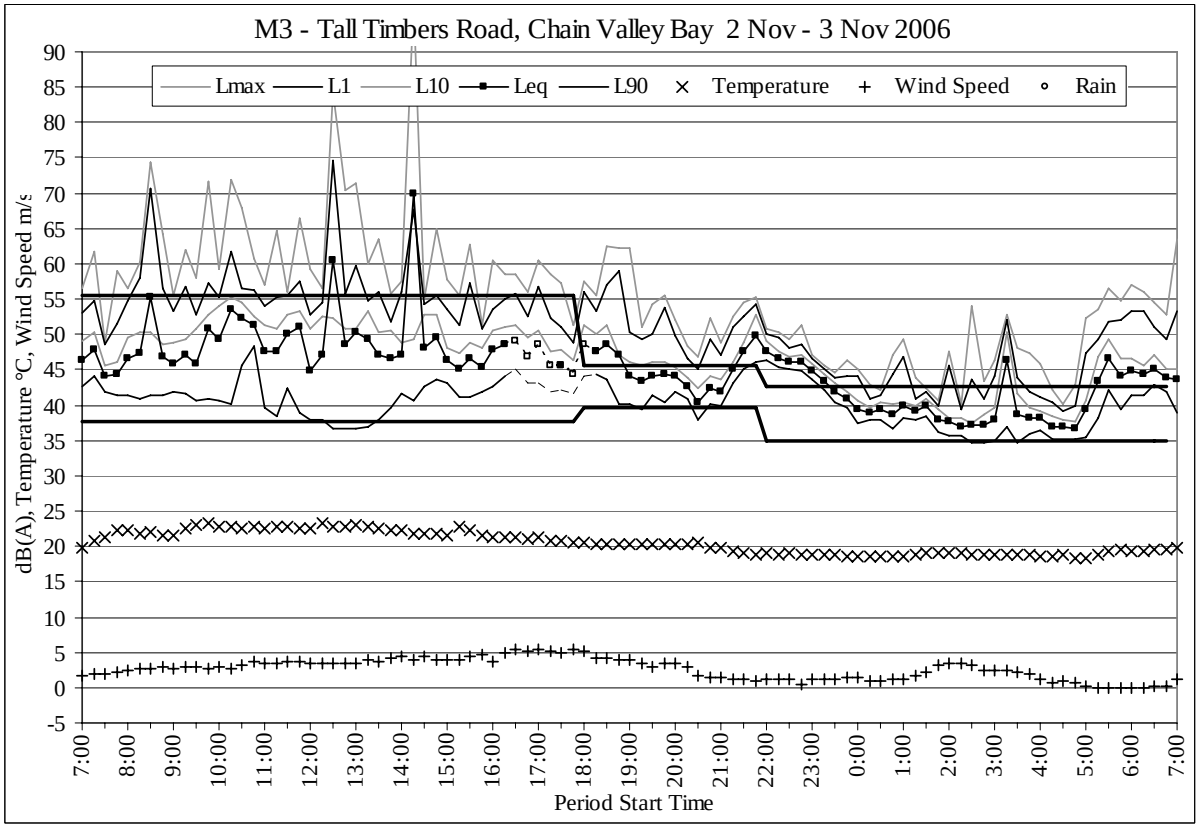

M1 - Pacific Highway Doyalson North 31 Oct - 1 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

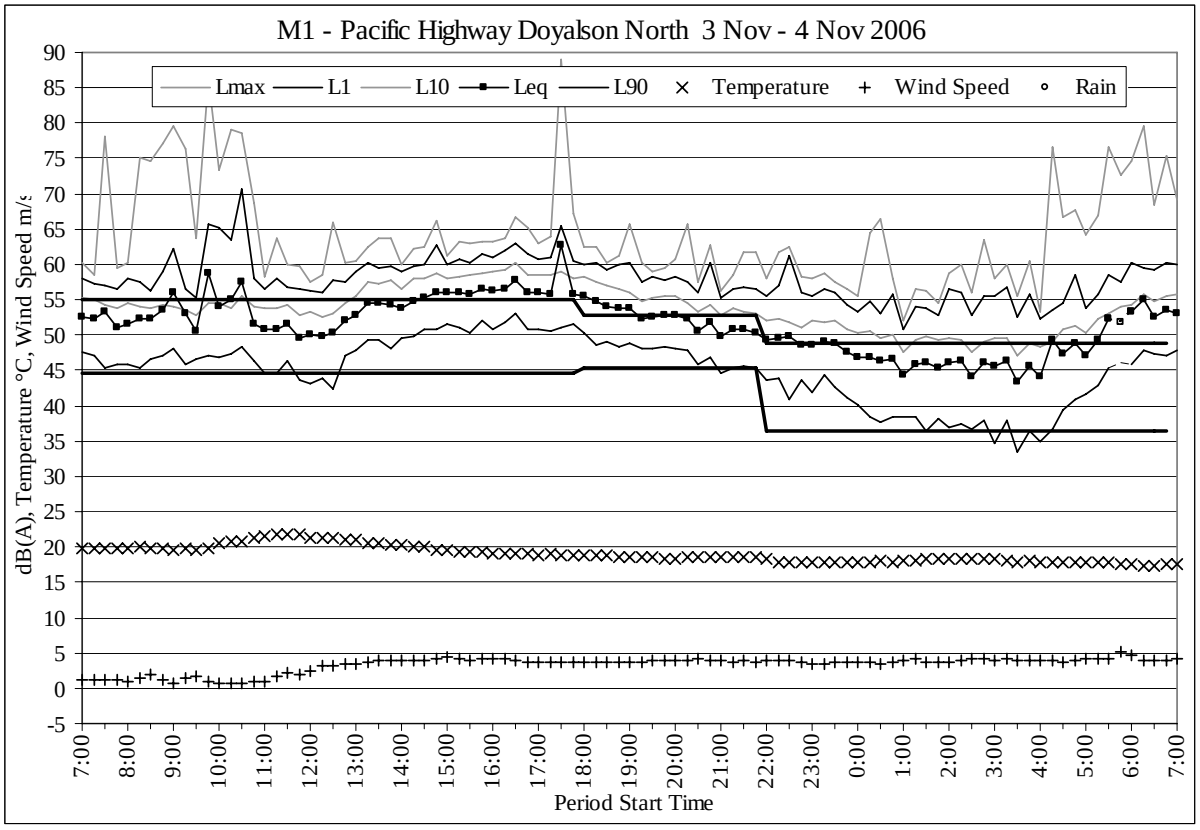

M3 - Tall Timbers Road, Chain Valley Bay 31 Oct - 1 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

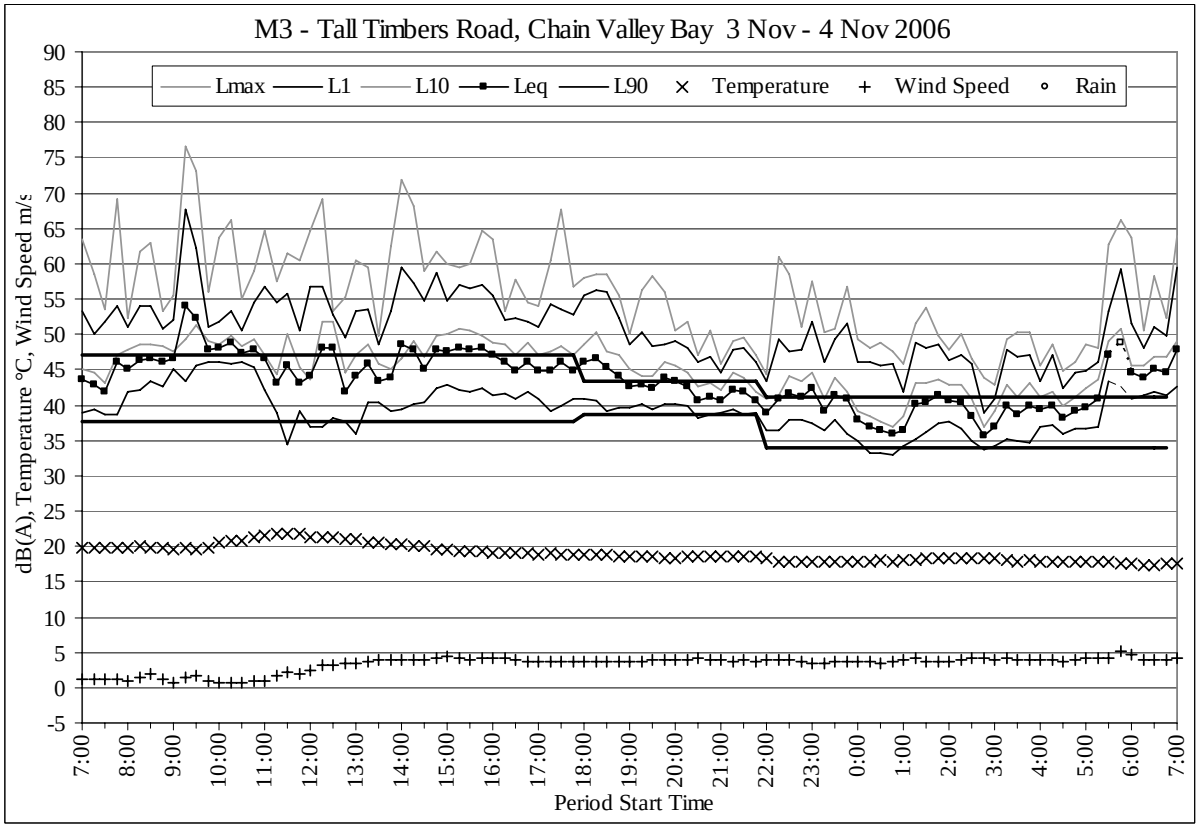

M1 - Pacific Highway Doyalson North 1 Nov - 2 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

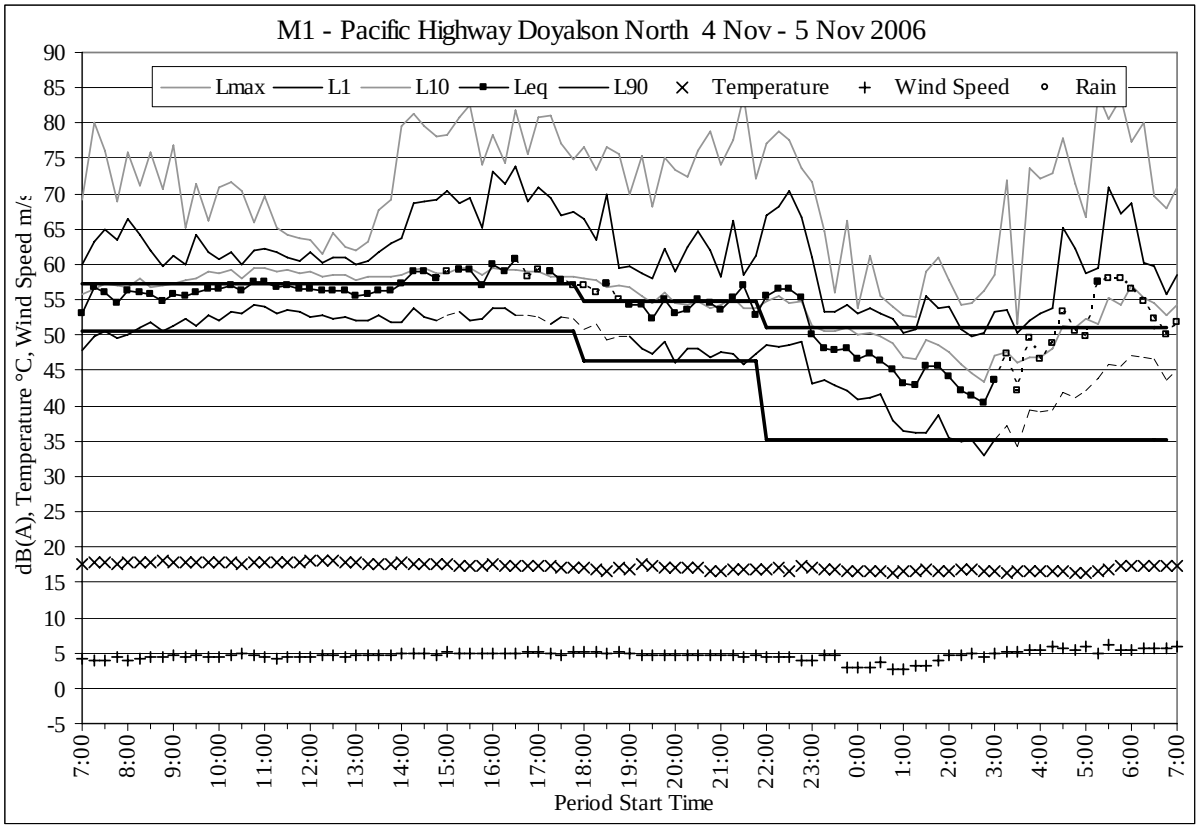

M3 - Tall Timbers Road, Chain Valley Bay 1 Nov - 2 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

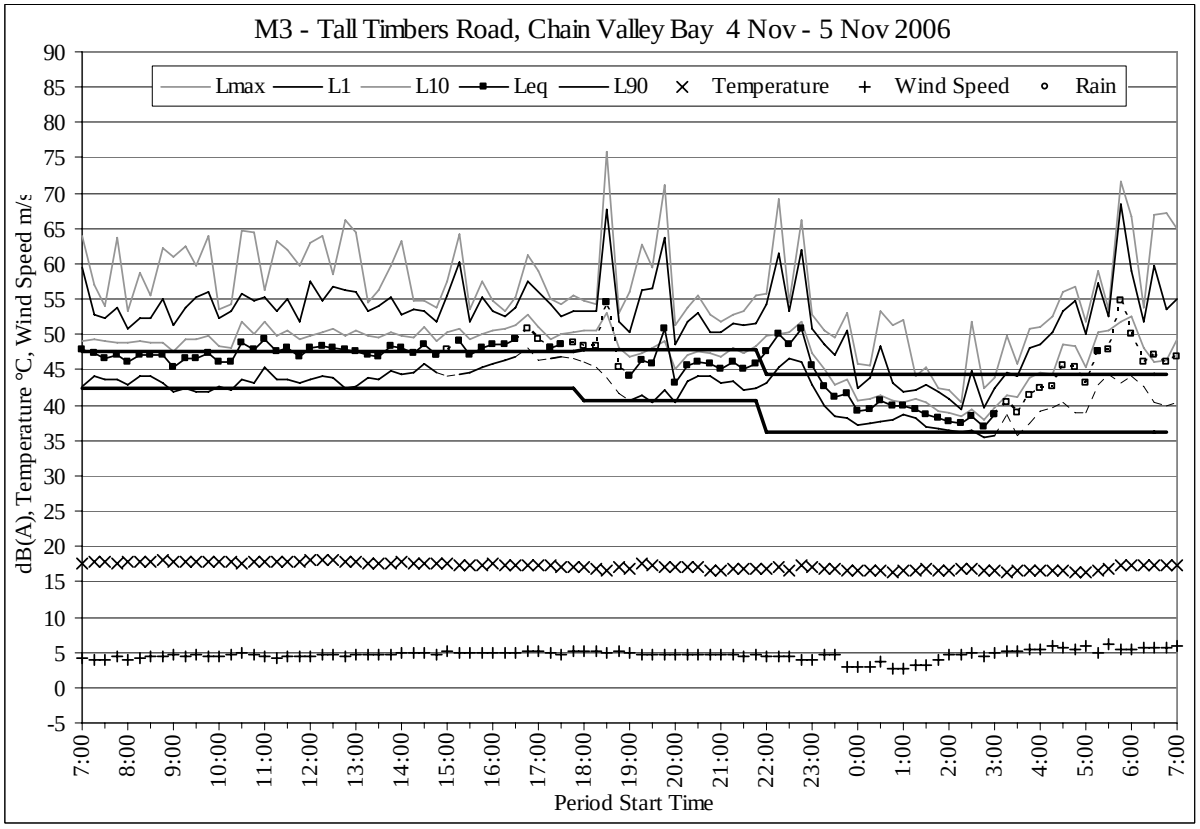

M1 - Pacific Highway Doyalson North 2 Nov - 3 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

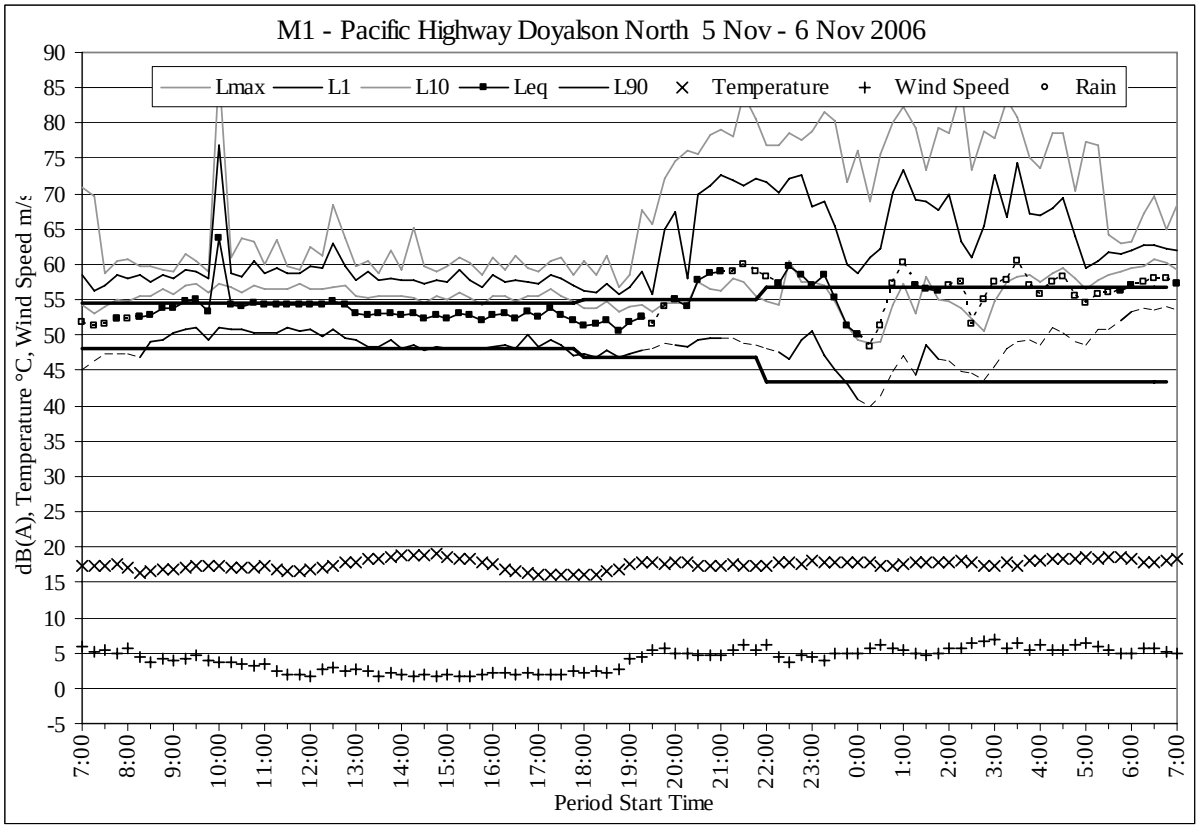

M3 - Tall Timbers Road, Chain Valley Bay 2 Nov - 3 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

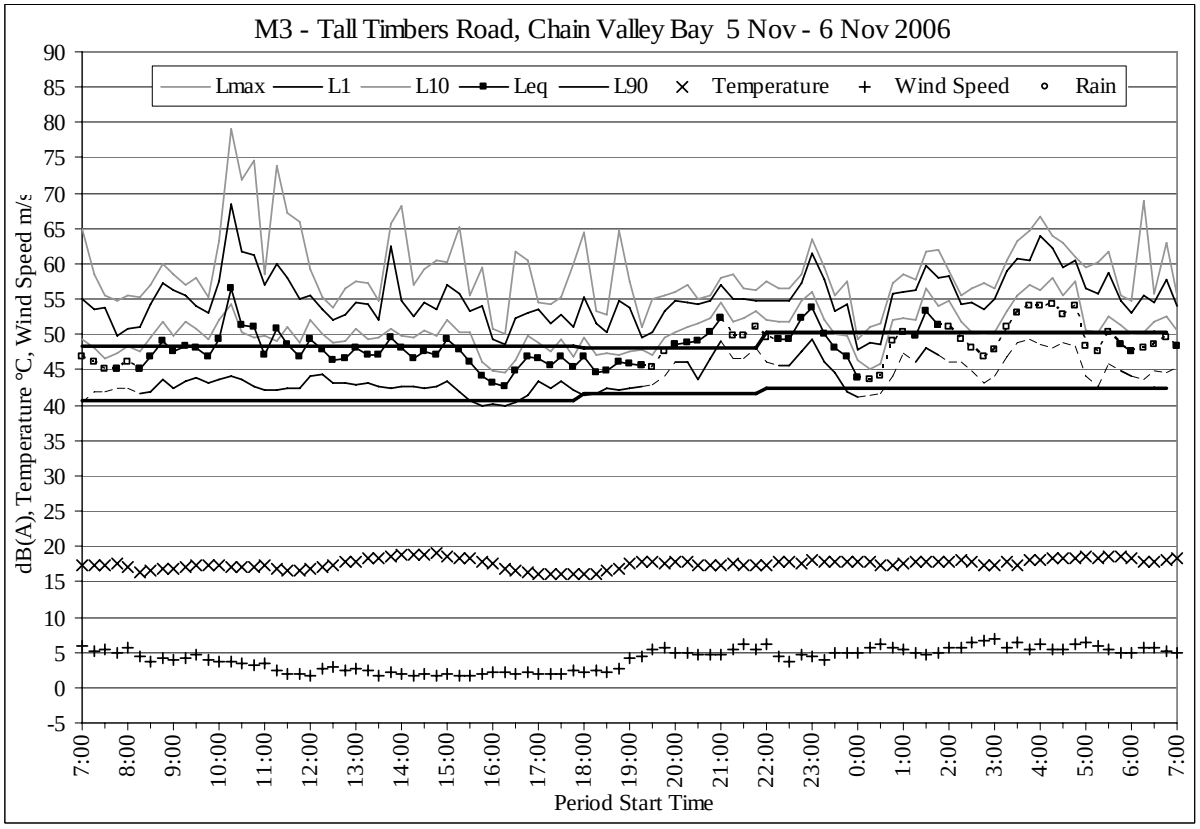

M1 - Pacific Highway Doyalson North 3 Nov - 4 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

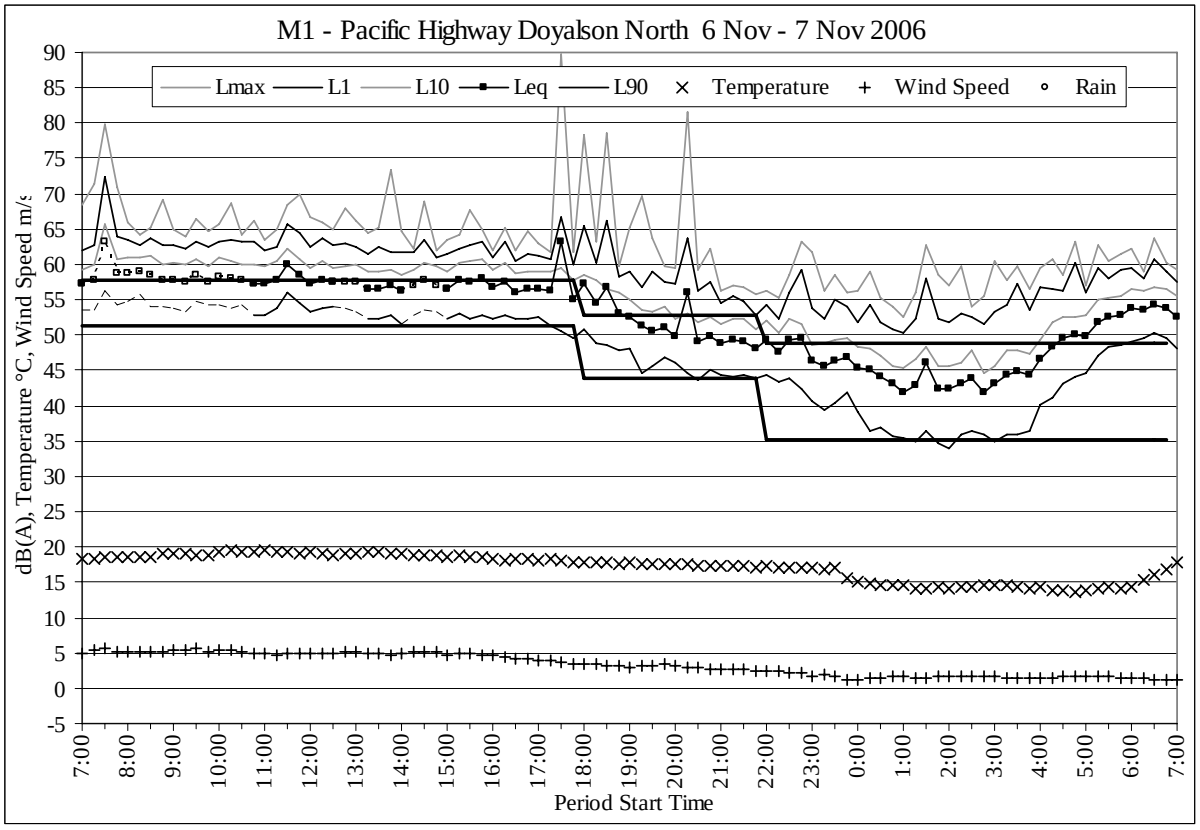

M3 - Tall Timbers Road, Chain Valley Bay 3 Nov - 4 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

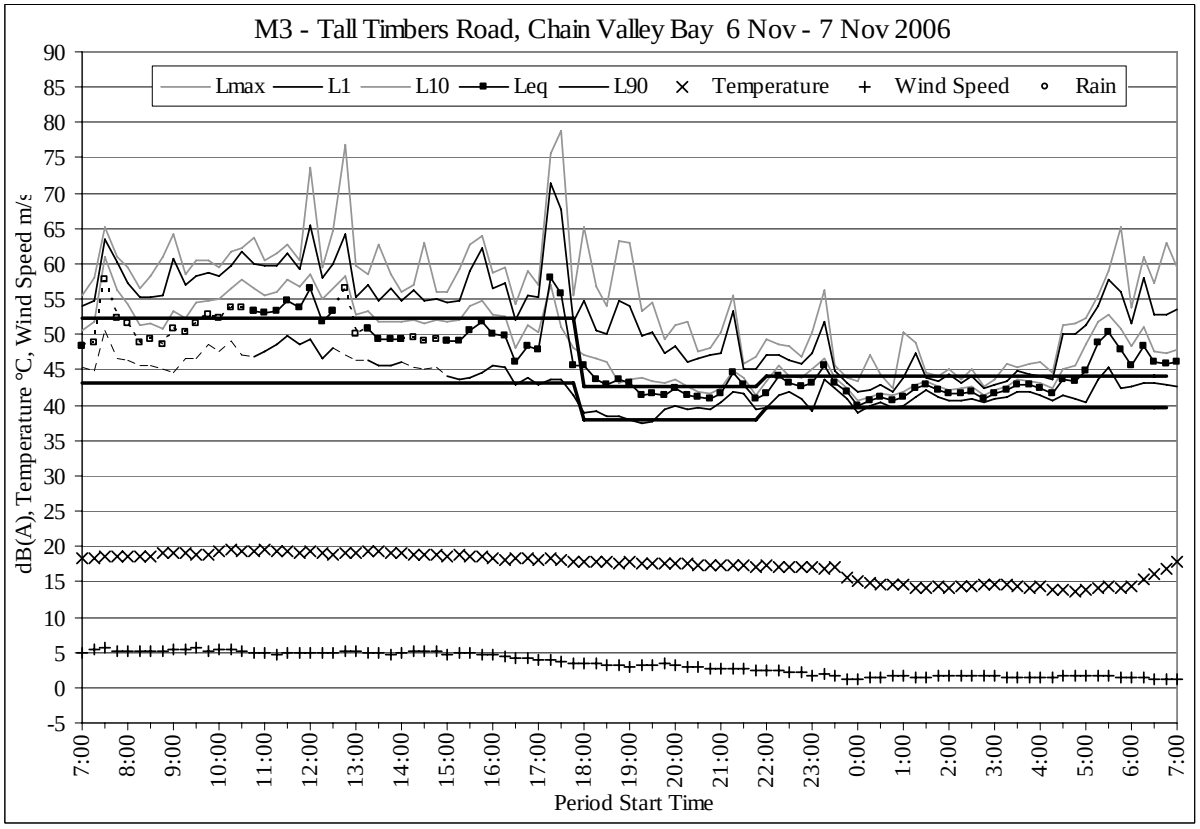

M1 - Pacific Highway Doyalson North 4 Nov - 5 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

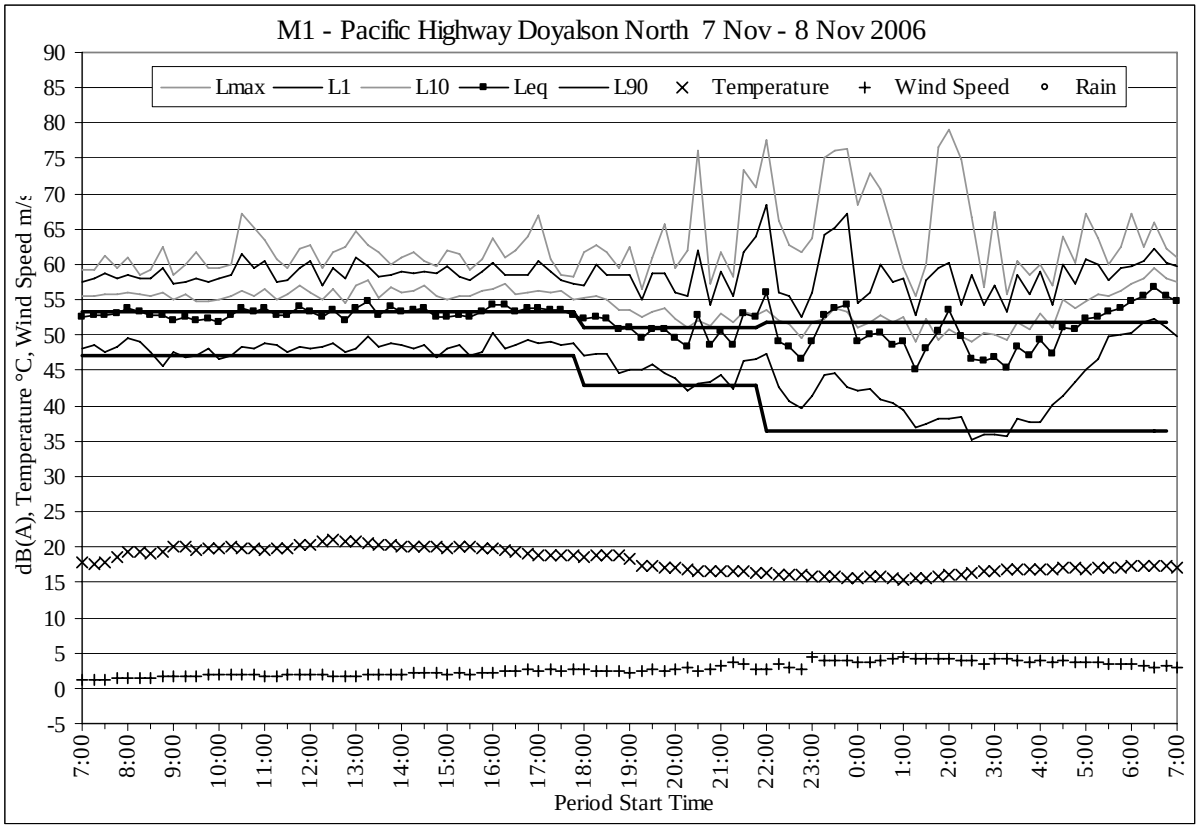

M3 - Tall Timbers Road, Chain Valley Bay 4 Nov - 5 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

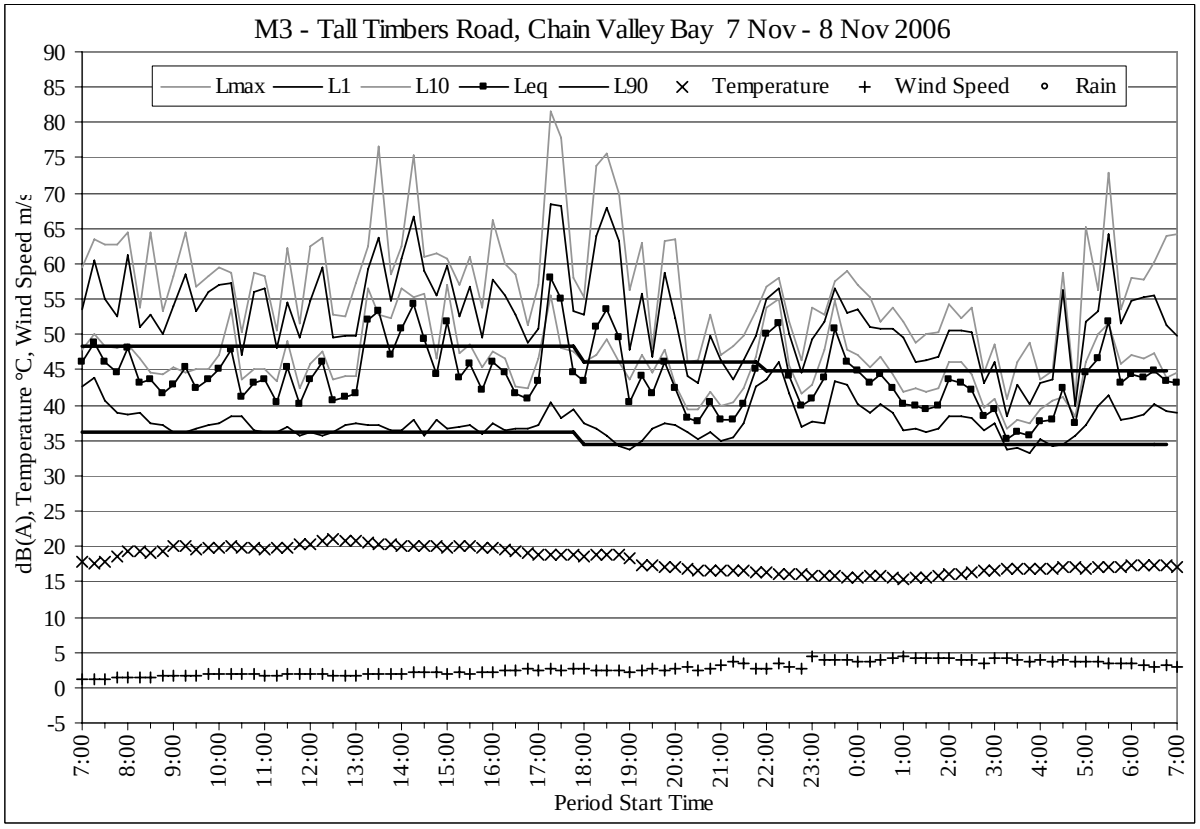

M1 - Pacific Highway Doyalson North 5 Nov - 6 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

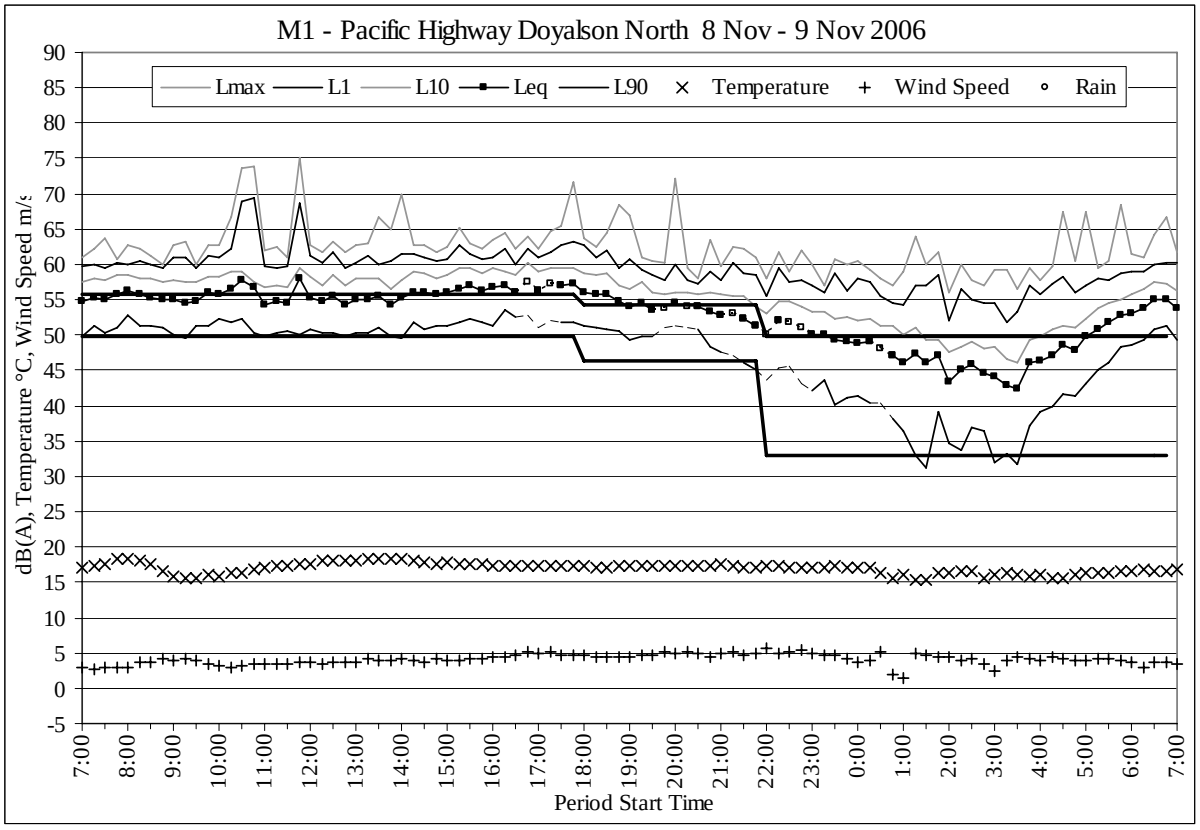

M3 - Tall Timbers Road, Chain Valley Bay 5 Nov - 6 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

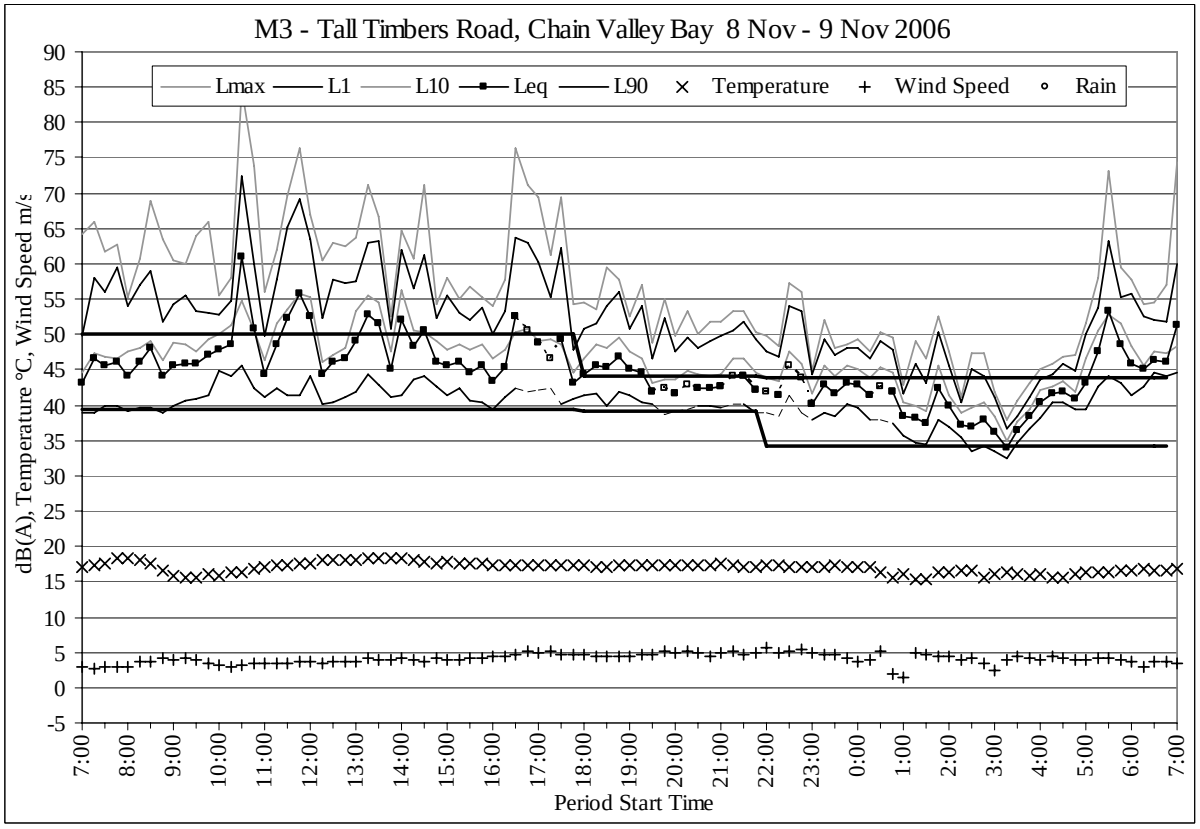

M1 - Pacific Highway Doyalson North 6 Nov - 7 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

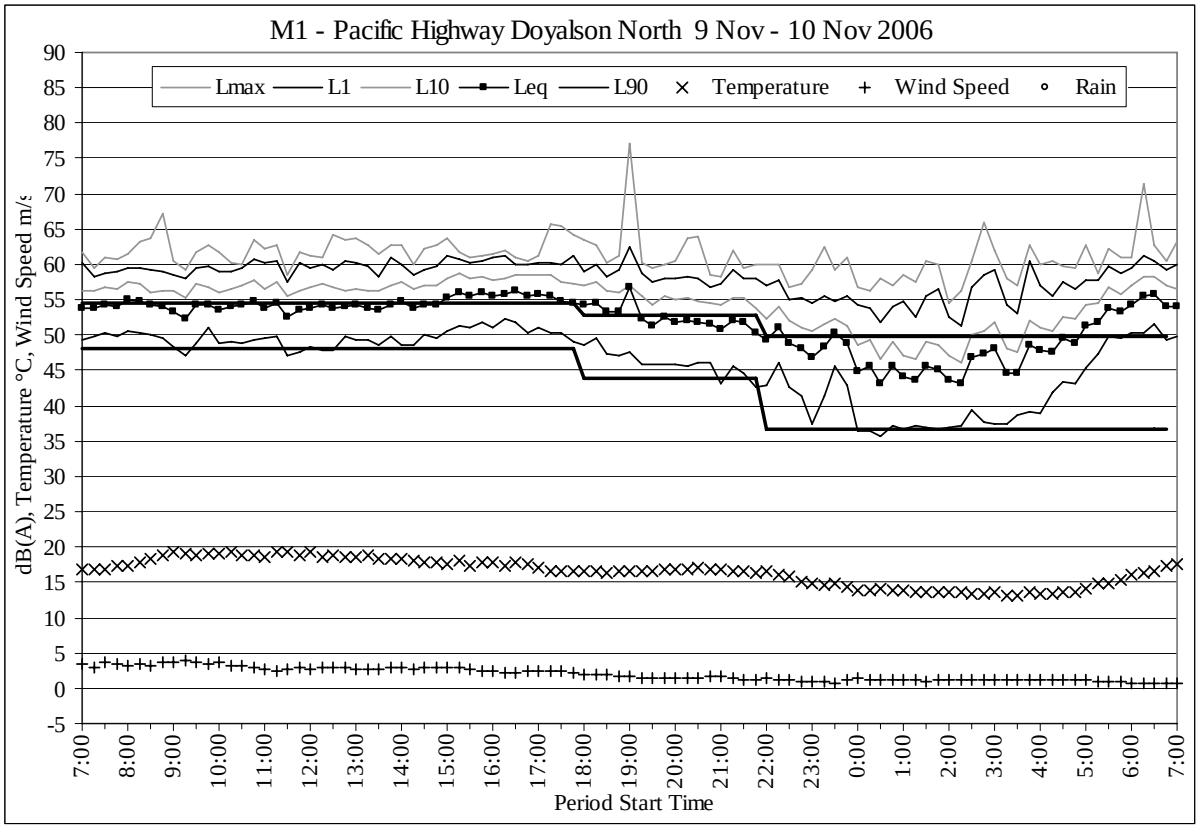

M3 - Tall Timbers Road, Chain Valley Bay 6 Nov - 7 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

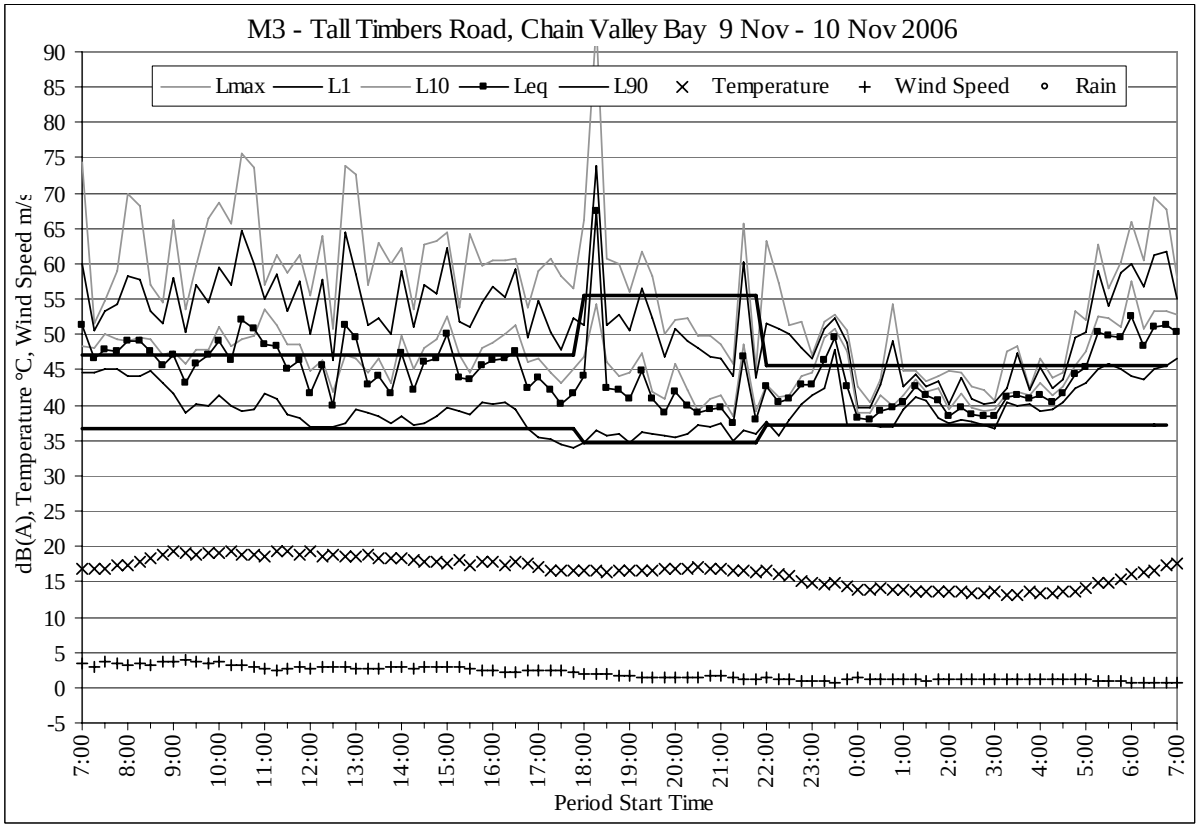

M1 - Pacific Highway Doyalson North 7 Nov - 8 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

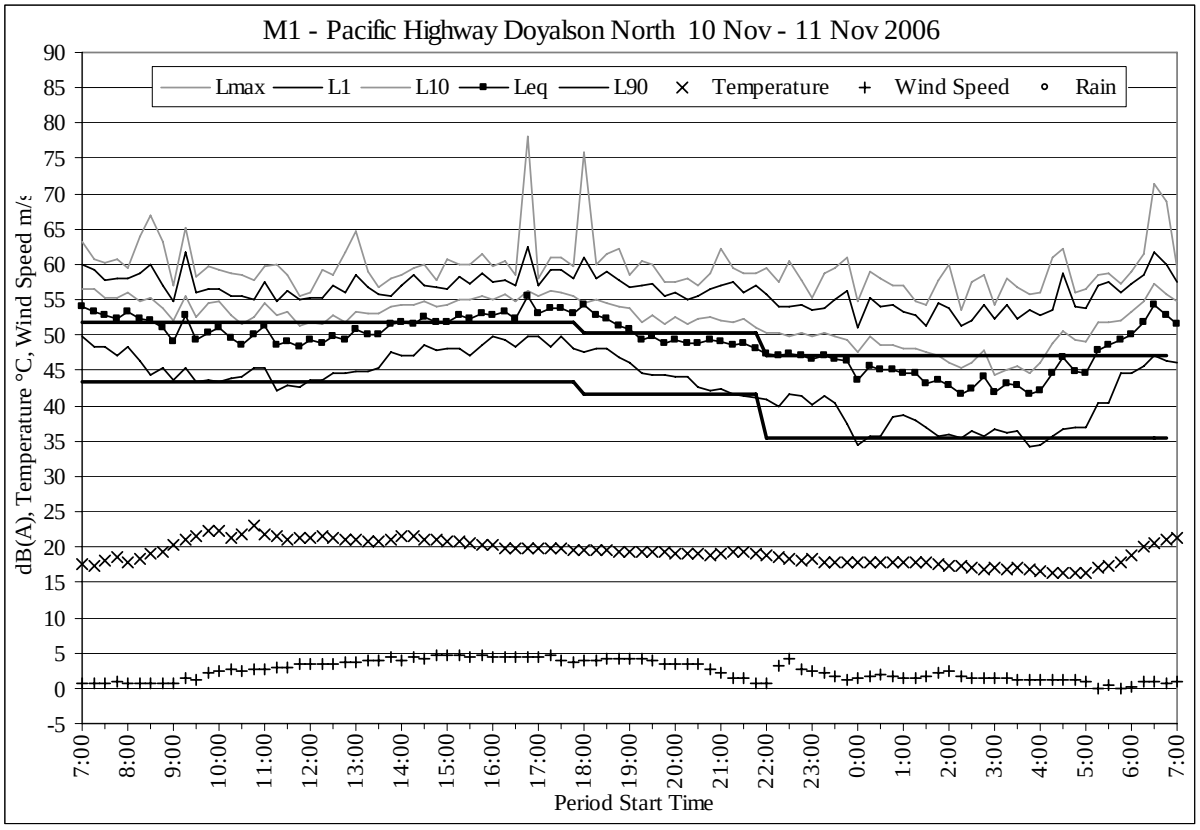

M3 - Tall Timbers Road, Chain Valley Bay 7 Nov - 8 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

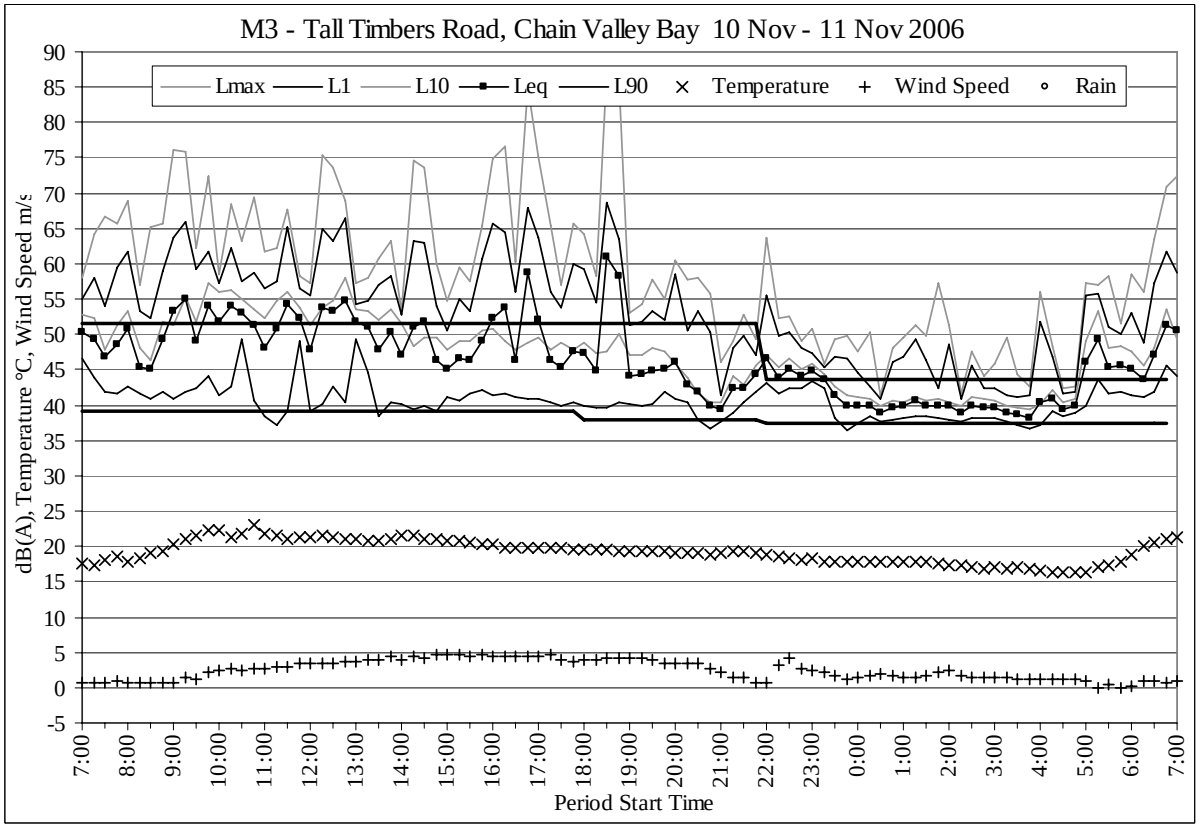

M1 - Pacific Highway Doyalson North 8 Nov - 9 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

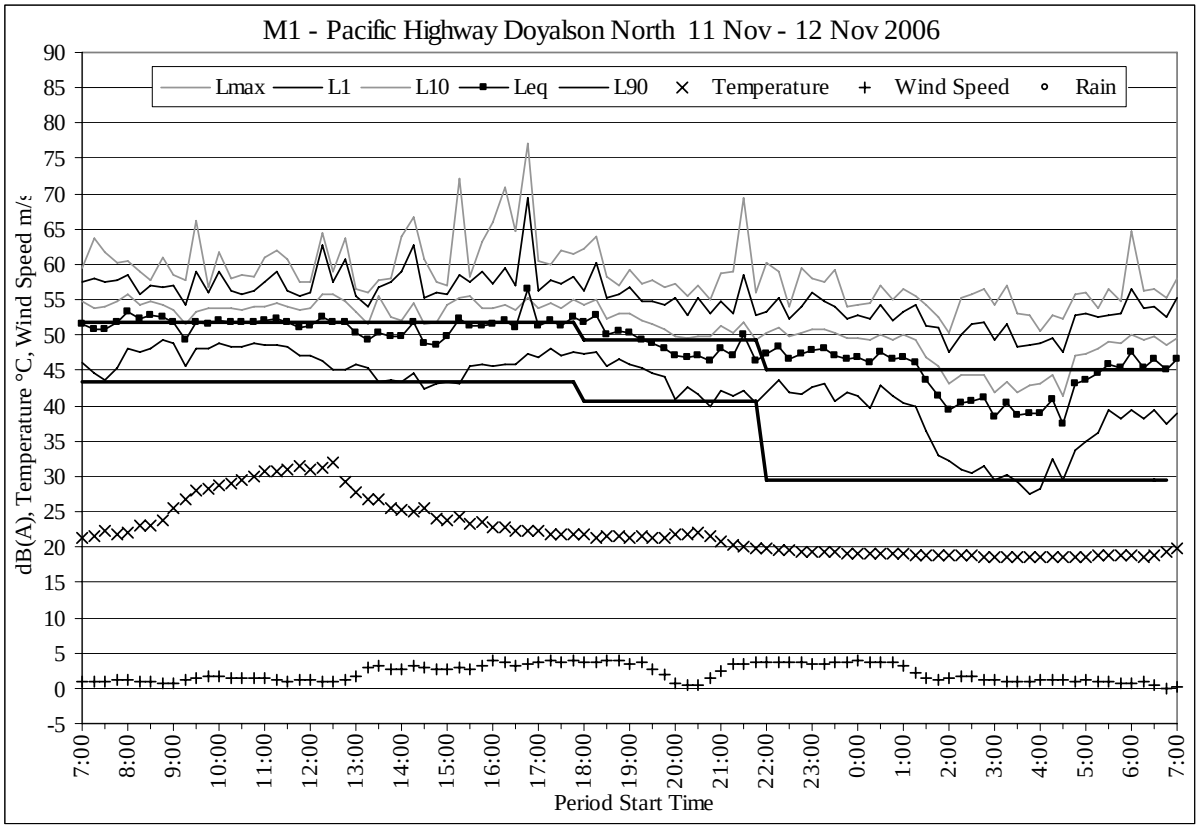

M3 - Tall Timbers Road, Chain Valley Bay 8 Nov - 9 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

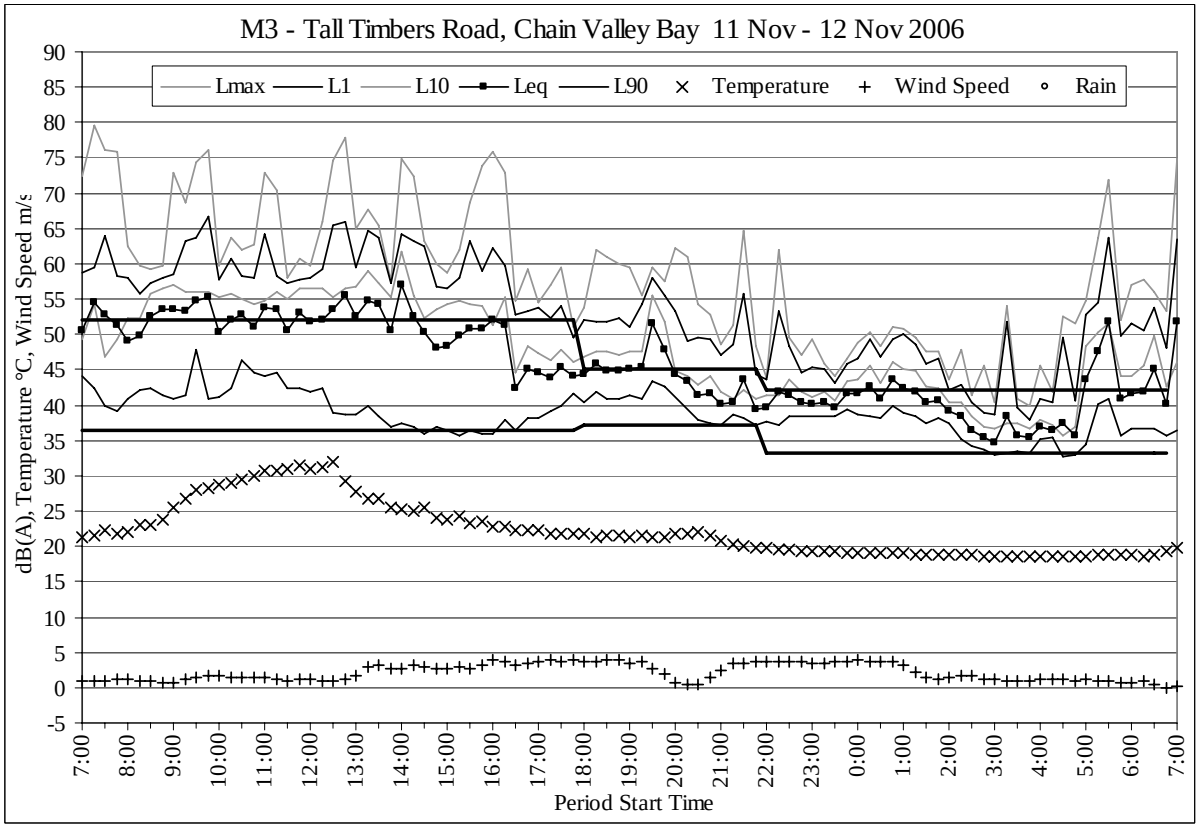

M1 - Pacific Highway Doyalson North 9 Nov - 10 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

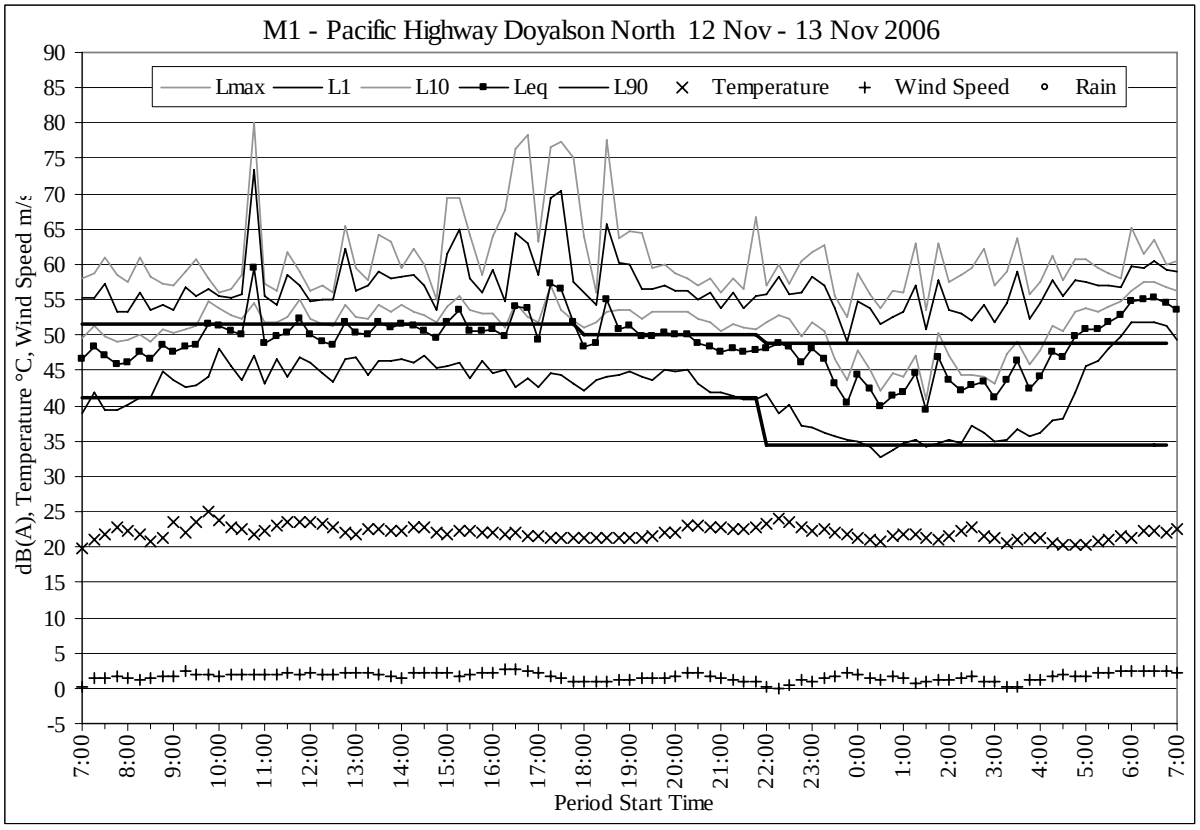

M3 - Tall Timbers Road, Chain Valley Bay 9 Nov - 10 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

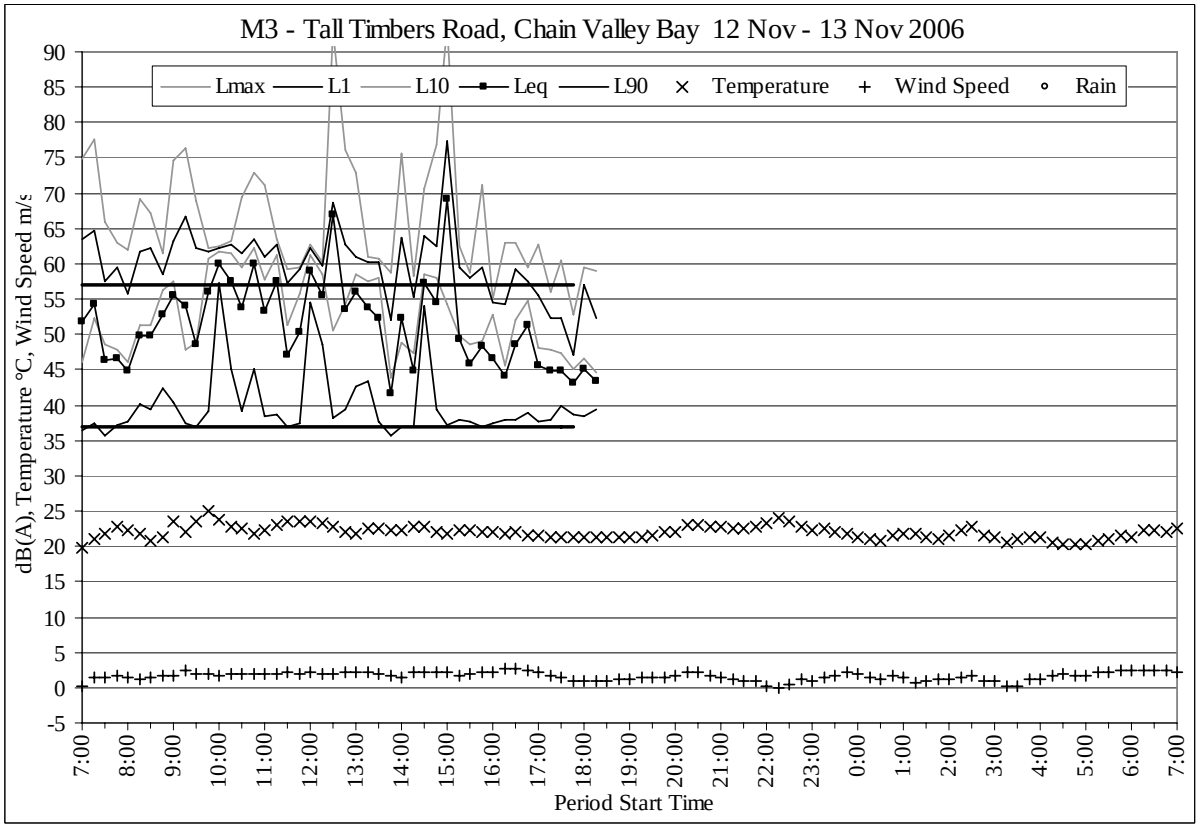

M1 - Pacific Highway Doyalson North 10 Nov - 11 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time


M3 - Tall Timbers Road, Chain Valley Bay 10 Nov - 11 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time


M1 - Pacific Highway Doyalson North 11 Nov - 12 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time


M3 - Tall Timbers Road, Chain Valley Bay 11 Nov - 12 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time


M1 - Pacific Highway Doyalson North 12 Nov - 13 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time


M3 - Tall Timbers Road, Chain Valley Bay 12 Nov - 13 Nov 2006
Lmax
L1
L10
Leq
L90
Temperature
Wind Speed
Rain
dB(A), Temperature °C, Wind Speed m/s
Period Start Time

APPENDIX C – DAILY BACKGROUND NOISE LEVELS (ABLs)

The following tables show daily Assessment Background Levels (ABLs) from the noise loggers installed at each receiver property. Entries in bold font highlight data affected by wind or rain, as defined in the INP, and excluded from the Rating Background Level (RBL) calculations.

Table D1: Background & Ambient Noise Levels, M1 Pacific Highway

Date (October/November 2006)	Background LA90,period			Ambient LAeq,period		
	Day	Evening	Night	Day	Evening	Night
Tuesday 31st – Wednesday 1st	45.6	41.3	33.9	52.2	47.8	48.8
Wednesday 1st – Thursday 2nd	46.9	40.7	37.8	53.6	48.7	49.3
Thursday 2nd – Friday 3rd	**42.6**	42.2	32.3	**51.7**	49.2	49.7
Friday 3rd – Saturday 4th	44.6	45.3	36.4	55.0	52.7	48.9
Saturday 4th – Sunday 5th	50.5	46.2	**35.2**	57.2	54.7	**51.1**
Sunday 5th – Monday 6th	**48.0**	**46.9**	**43.4**	**54.4**	**55.1**	**56.8**
Monday 6th – Tuesday 7th	**51.4**	43.9	35.3	**57.7**	52.8	48.9
Tuesday 7th – Wednesday 8th	47.1	42.8	36.5	53.2	51.2	51.7
Wednesday 8th – Thursday 9th	49.8	46.4	**32.9**	55.8	54.3	**49.7**
Thursday 9th – Friday 10th	48.1	43.9	36.7	54.5	52.9	49.9
Friday 10th – Saturday 11th	43.4	41.6	35.6	51.8	50.4	47.1
Saturday 11th – Sunday 12th	43.4	40.6	29.4	51.7	49.2	45.2
Sunday 12th – Monday 13th	41.1	41.2	34.5	51.6	50.0	48.9
Weekly Median	46.7	42.8	34.4	54.5	51.8	49.3

Table D2: Background & Ambient Noise Levels, M2 Macquarie Shores Home Village

Date (October/November 2006)	Background LA90,period			Ambient LAeq,period		
	Day	Evening	Night	Day	Evening	Night
Tuesday 31st – Wednesday 1st	41.4	37.5	36.2	52.0	41.3	44.1
Wednesday 1st – Thursday 2nd	33.3	35.0	37.0	42.4	41.6	44.2
Thursday 2nd – Friday 3rd	**39.7**	39.0	34.6	**49.0**	45.8	43.7
Friday 3rd – Saturday 4th	34.5		32.8	45.7		41.3
Saturday 4th – Sunday 5th	43.1	41.3	**35.7**	48.1	46.9	**45.0**
Sunday 5th – Monday 6th	**39.0**	**43.3**		**48.2**	**52.6**	
Monday 6th – Tuesday 7th						
Tuesday 7th – Wednesday 8th		39.7	32.9		50.3	42.5
Wednesday 8th – Thursday 9th	37.8		**38.2**	44.3		**46.9**
Thursday 9th – Friday 10th	38.6		36.1	46.6		42.9
Friday 10th – Saturday 11th	37.9			46.1		
Saturday 11th – Sunday 12th	32.7			45.0		
Sunday 12th	35.9			43.7		
Weekly Median	37.8	39.0	35.3	47.0	46.5	43.3

* Missing data are due to a loose microphone cable that intermittently disconnected the signal to the instrument. Results charts in Appendix B have not been provided for this monitor. While only partial data have been obtained at this location, available results shown in Table D2 plus a comparison between these results and the other two locations combine to provide sufficient confidence in the results for the purposes of this assessment.

Table D3: Background & Ambient Noise Levels, M3 Tall Timbers Road

Date (October/November 2006)	Background LA90,period			Ambient LAeq,period		
	Day	Evening	Night	Day	Evening	Night
Tuesday 31st – Wednesday 1st	40.3	37.9	36.9	49.1	42.6	42.7
Wednesday 1st – Thursday 2nd	32.8	35.5	36.8	59.9	42.8	43.7
Thursday 2nd – Friday 3rd	**37.6**	39.7	35.1	**55.5**	45.7	42.6
Friday 3rd – Saturday 4th	37.8	38.6	33.9	47.0	43.3	41.0
Saturday 4th – Sunday 5th	42.4	40.5	**36.2**	47.7	47.8	**44.3**
Sunday 5th – Monday 6th	**40.7**	**41.6**	**42.3**	**48.3**	**48.2**	**50.3**
Monday 6th – Tuesday 7th	**43.2**	37.8	39.8	**52.3**	42.7	44.2
Tuesday 7th – Wednesday 8th	36.1	34.5	34.4	48.3	46.1	44.8
Wednesday 8th – Thursday 9th	39.4	39.2	**34.1**	50.1	44.1	**43.9**
Thursday 9th – Friday 10th	36.8	34.8	37.1	47.1	55.6	45.6
Friday 10th – Saturday 11th	39.2	37.9	37.4	51.5	51.5	43.7
Saturday 11th – Sunday 12th	36.4	37.3	33.2	52.2	45.2	42.2
Sunday 12th	36.9	0.0	0.0	57.1	0.0	0.0
Weekly Median	37.4	37.9	36.8	53.4	48.5	43.6