Oaklands Ethanol Production Facility Noise Assessment Report

Final Report

for Agri Energy Limited

June 2007

0056132

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Environmental Resources Management Australia Pty Ltd Quality System

FINAL REPORT

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1 INTRODUCTION

Agri Energy Limited (AEL) seeks project approval for the development of an ethanol production facility in a rural area at Oaklands, New South Wales (NSW), under Part 3A of the *Environmental Planning and Assessment Act, 1979 (*EP&A Act). Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by AEL to prepare an environmental assessment for the construction and operation of the ethanol production facility, inclusive of a noise impact assessment.

This assessment has been prepared in accordance with the Department of Environment and Conservation's (DEC's) Industrial Noise Policy (INP), which was published in January 2000. Other relevant guidelines include the DEC's Environmental Noise Control Manual (ENCM 1994) and the DEC's Environmental Criteria for Road Traffic Noise (ECRTN 1999).

The plant will operate 24 hours per day, seven days a week. It is anticipated that the onsite workforce will comprise 32 people, inclusive of six to eight administration staff who will be present during standard working hours. There will typically be three shifts, each staffed with eight persons. Shifts will nominally be 7am to 3pm, 3pm to 11pm and 11pm to 7am.

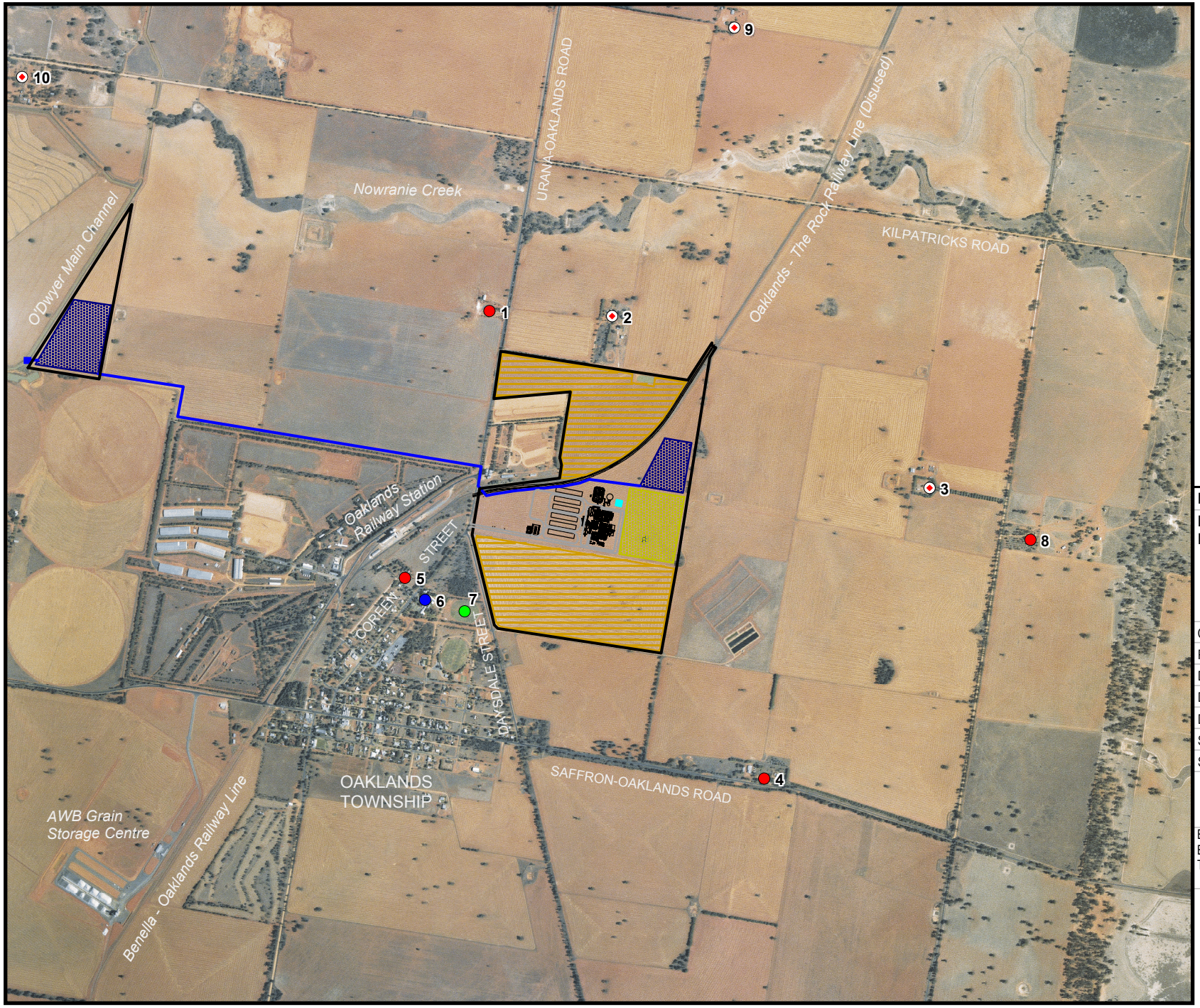
A glossary of technical terms used in this report is presented in *Annex A*.

2 THE EXISTING NOISE ENVIRONMENT

2.1 PROJECT LOCATION

The site of the proposed ethanol production facility is wholly within the local government area of Urana. It is accessed from Coreen Street at a point approximately 350 metres (m) north-east of Oaklands. Oaklands is situated in the Murray region of NSW, approximately 615 kilometres (km) south-west of Sydney and 105km north-west of Albury.

The site is bounded by Coreen Street, Daysdale Street, Urana Road and the Ray Brooks & Co. bulk grain storage and terminal to the west and by agricultural land to the north, east and south. The surrounding area is predominantly agricultural cropping land. Two unoccupied rural dwellings and associated sheds are respectively located approximately 170m north and 1.1km east of the site. Two occupied rural dwellings and associated sheds are located 715m south-west and 170m north-west of the site, respectively. Land on the western side of Daysdale Street, opposite the south-west portion of the site, is occupied by a small area of dense vegetation and a recreational sporting oval, that is at the northern extent of the Oaklands township. Topography is generally flat, as is typical of the surrounding landscape. Nowranie Creek is located approximately 700m north of the site and the O'Dwyer Main Channel is located approximately 2.2km west of the property. An aerial photograph of the site and surrounding area is presented in *Figure 2.1*.



Legend

- 200Ml Raw Water Dam
- 2Ml Stormwater Dam
- 40Ml Effluent Dam
- Irrigation Area
- Water Pump Station and Pipeline
- Site Boundary
- Internal Access Road

- Recreational
- Residence - occupied
- Residence - unoccupied
- School

Figure 2.1

Proposed Site Layout and Receptor Locations

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_AC_GIS02	
Date:	23.02.2007	Drawing Size: A4
Drawn By:	DH	Reviewed By: -
Source:	Aerial: Department of Lands NSW Plant Layout: PDF DWG No: M06075-0321	
Scale:	Refer to Scale Bar	

N

0 400 800m

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2.2 ASSESSED RECEPTORS

Representative noise-sensitive receptors (residences, Oaklands Central School and a recreational sporting oval in Oaklands) used for the assessment are listed in *Table 2.1* and the locations of these receptors are shown on *Figure 2.1*.

Table 2.1 Assessed Sensitive Receptors

Receptor Location	Type	AMG66 Coordinates		Location from Plant	
		Easting	Northing	Compass Point	Distance (km)
1	Residence	425,009	6,066,719	NNW	1.2
2	Residence – unoccupied	425,642	6,066,696	N	1.1
3	Residence – unoccupied	427,286	6,065,819	E	1.7
4	Residence	426,447	6,064,311	SE	1.5
5	Residence – 12 Nixon St	424,586	6,065,336	WSW	1.0
6	School	424,691	6,065,224	SW	0.9
7	Recreational	424,896	6,065,166	SW	0.75
8	Residence	427,809	6,065,554	E	2.2
9	Residence – unoccupied	426,258	6,068,191	NNE	2.6
10	Residence – unoccupied	422,589	6,067,912	NW	3.7

Note that the entire Oaklands Township lies within 2km of the plant in the south-west quadrant.

2.3 BACKGROUND AND AMBIENT NOISE

A background ambient noise survey was developed and implemented for this study. Two representative sites were chosen for long term monitoring, conducted in accordance with the DEC's INP. These sites correspond with Receptor Location 5 (12 Nixon St) and Receptor Location 8 ("Ullina Park"), as shown on *Figure 2.1*.

The results are listed in *Table 2.2* and the logger data is charted in *Annex C*.

Table 2.2 Summary of Measured Background Noise Levels

Measurement Location	Rating Background Level, dB(A)			Ambient Noise Level, dB(A) L_{eq}		
	Day	Evening	Night	Day	Evening	Night
12 Nixon St	32	30	30	44	38	38
"Ullina Park"	30	30	30	50	37	46

1. Data affected by rain and wind speeds of above 5m/s was excluded.
2. Noise levels below 30 dB(A) are presented as 30 dB(A) as stipulated by the INP

Both monitored locations had Rating Background Levels (RBL) below 30 dB(A) during the evening and night, thus the minimum RBL of 30 dB(A) is used for these periods as per the INP. The long term data in *Annex C* demonstrates extremely low background noise at night, and at times is below the instrumentations threshold.

2.4 PREVAILING WEATHER CONDITIONS

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 DEC 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.

2.4.1 *Temperature Inversions*

The default INP parameters for semi-arid areas have been used for this assessment. This is a strong inversion condition of 8°C/100m temperature gradient, with G-class atmospheric stability (stable conditions). No drainage wind is applicable in this case given the flat terrain.

2.4.2 *Prevailing Winds*

The prevailing wind directions to be used in the noise model were determined in accordance with the INP, which requires that winds with an occurrence greater than 30% be assessed. A thorough review of the vector components of the hourly wind data from Bureau of Meteorology (BoM) records at Albury was undertaken. The DEC assessable wind direction is graphically demonstrated in *Annex B*, where the windrose arm exceeds the 30% threshold. The assessable wind speed was also determined in accordance with the intent of the INP and is the upper tenth percentile speed for each of the assessable directions. It is noted that the roses do not depict winds in the range 2.5m/s to 3m/s. This was investigated and it was found that the raw BoM data did not include speeds in this range, and that the speed was either higher or lower. However, it is expected that the selected wind speeds and directions provide for a representative assessment nonetheless.

Based on the review of wind speeds, the assessable wind conditions presented in *Table 2.3* have been modelled. In each case, the values chosen for direction and speed are averages of adjacent wind directions, where the assessable wind direction varies up to 22.5° either side as shown on the windroses in *Annex B*. Note that the assessable wind conditions are the same for Autumn Day and Summer Night.

Table 2.3 Assessable Wind Conditions

Season	Period	Wind Direction	Wind Speed
Autumn	Day	123°	2.2m/s
Winter	Day	91°	2.2m/s
Winter	Evening	22°	2.1m/s
Summer	Night	123°	2.2m/s
Winter	Night	12°	2.0m/s

3 ASSESSMENT CRITERIA

3.1 CONSTRUCTION NOISE

Construction noise is excluded from the DEC's INP. The recommended noise criteria for construction operations are defined in the ECNM and are listed below:

- for construction periods of four weeks and under, the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 20 dB;
- for construction periods of between four and 26 weeks, the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 10 dB; and
- for construction periods greater than 26 weeks, the criteria for a continuously operating noise source would apply, which would generally mean that the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 5 dB.

Site establishment and construction activities at the site are expected to occur for 14 to 16 months. Hence, the L_{10} noise level due to construction should not exceed the existing L_{90} background noise level by more than 5 dB. This essentially mirrors the intrusiveness criterion for operations (with the substitution of L_{10} for L_{eq}). The relevant construction criteria are specified in *Table 3.1*.

Table 3.1 Construction Noise Criteria

Receptor Location	Construction noise criteria, $L_{10,15minute}$ dB(A)		
	<4 weeks (b/g +20)	4 to 26 weeks (b/g +10)	>26 weeks (b/g +5)
1	50	40	35
2	50	40	35
3	50	40	35
4	50	40	35
5	52	42	37
6	52	42	37
7	52	42	37
8	50	40	35
9	50	40	35
10	50	40	35

1. Criteria are based on the assumed minimum RBL of 30 dB(A) (minimum assessable RBL in accordance with Section 3.1 of the DEC's INP), except for Locations 5-7, which are based on a measured day-time RBL of 32 dB(A) at Location 5.

In addition, the ENCM recommends that where construction noise is audible at residential premises, construction activities should be limited to the following times:

- Monday to Friday, 7:00 am to 6:00 pm;
- Saturday, 8:00 am to 1:00 pm, otherwise 7:00 am to 1:00 pm if inaudible at residential premises; and
- no construction on Sundays or public holidays.

3.2 OPERATIONAL NOISE

The DEC, in its INP, gives guidelines for assessing noise from industrial facilities. Assessment criteria depend on the existing amenity of areas potentially affected by a proposed development. The assessment criteria for sensitive receptors near industry are based on the following objectives:

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

In order to ensure that these objectives are met, two separate criteria are prescribed by the DEC. These are the intrusiveness criteria and the amenity criteria and are described in *Sections 3.2.1* and *3.2.2* respectively. A fundamental difference between the intrusiveness and the amenity criteria is that the former is applicable over 15 minutes in any period ($L_{eq,15min}$), while the latter covers the entire assessment period, comprising day, evening and night ($L_{eq,period}$).

3.2.1 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 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.

As the RBL has been assumed to be equal to 30 dB(A) for all receptor locations except for during the day-time at Locations 5, 6 and 7, the project specific intrusiveness criterion for these residential receptors and for all residential receptors during the evening and night-time periods is $L_{Aeq,15min}$ 35 dB(A), as shown in *Table 3.2*. Based on the measurements described in *Section 2.3*, the RBL for Location 5 was calculated to be 32 dB(A) during the day-time. The intrusiveness criteria for the residential receptors are as set out in *Table 3.2*. The INP does not require the application of intrusiveness criteria to non-residential receptors and so intrusiveness criteria have not been determined for Receptors 6 or 7 (Oaklands Central School and recreational sporting oval).

Table 3.2 Project Specific Intrusiveness Criteria for Receptor Locations

Receptor Location	$L_{eq,15min}$ Intrusiveness Noise Goals, dB(A)
	All time periods
1	35
2	35
3	35
4	35
5	37(day), 35(evening & night)
6	n/a
7	n/a
8	35
9	35
10	35

1. Receptors #6 & 7 are non-residential, thus no intrusiveness criteria are required by the INP

3.2.2 Amenity

The DEC's amenity criterion requires industrial noise 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 potentially affected by the proposal are covered by the DEC's rural amenity categories. The DEC's definition for a rural area is:

"*an acoustical environment that is dominated by natural sounds, having little or no road traffic*".

The DEC base amenity criteria for a residential location in a rural area, an area of active recreation and at a school are given in *Table 3.3*. Adjustments to these target levels may apply where the environment has existing industrial noise (excluding the proposal) or high levels of road traffic noise. These are not features of the area surrounding the site and so adjustments to the target levels are not required.

Table 3.3 DEC Base Amenity Criteria

Location	Indicative Area	Time	Recommended L_{eq} period Noise Level dB(A)	
			Acceptable	Maximum
Residential	Rural	Day	50	55
		Evening	45	50
		Night	40	45
School	Outside classroom	When	35 ($_x$ 45 outside)	40 ($_x$ 50 outside)
Recreation	Active Recreation	in Use	55	60

1. A 10dB allowance from outside to inside has been included for the School.

Project specific amenity limits have been derived, based on acceptable $L_{eq,period}$ noise levels from the DEC's INP (as per *Table 3.3*) and are presented in *Table 3.4*. The amenity targets for noise generated by the proposal are higher than the intrusiveness criteria as they apply to noise levels averaged over a longer period of time, for example the nine hour night-time period as opposed to the 15 minute period used for intrusiveness criteria.

Table 3.4 Derived Project Specific Noise Amenity Targets

Receptor Location	Amenity, dB(A) $L_{eq,period}$		
	Day	Evening	Night
1	50	45	40
2	50	45	40
3	50	45	40
4	50	45	40
5	50	45	40
6	45	n/a	n/a
7	55	55	n/a
8	50	45	40
9	50	45	40
10	50	45	40

1. The school is assumed to be used only during the day, and the recreation area during the day and/or evening

3.3 PROJECT SPECIFIC NOISE GOALS

To simplify the assessment procedure it is often appropriate to define a single noise goal for each of the assessment periods (e.g. day, evening and night). This is particularly the case where noise from a project can be considered consistent and it is therefore reasonable to assume that the $L_{eq,15min}$ noise levels from the proposal are approximately equal to the $L_{eq,period}$ noise levels. This is generally the case for processing industries. However, consideration should be given to typical mobile equipment downtime for normal staff breaks and maintenance. This is likely to result in the average noise level for a given day (11 hr) or night (9 hr) period being lower than the predicted worst case $L_{eq,15min}$ noise level (i.e. for every time equipment is not operating, the Leq noise level will decrease). Identification of typical operational downtime is based on discussions with operators and their input into typical mobile plant operations. For example, trucks will be idle waiting to be loaded or unloaded, loaders are idle waiting for trucks to arrive (to load or unload) and mobile equipment will typically not operate during the normal sustenance breaks.

The project specific noise goals have been developed, by adopting the lesser of the amenity and intrusiveness criteria and are presented in *Table 3.5*. The intrusiveness criteria was adopted for all residential receptors as it is the more limiting criteria for these receptors. Intrusiveness criteria do not apply to the school or recreation area and so the amenity criteria were adopted in these instances. It should be noted that as the RBLs for Locations 1, 2, 3, 4, 8, 9 and 10 were the same for day, evening and night-time periods, the project specific criteria derived from RBLs are the same for each period (day, evening and night-time) at these locations.

Table 3.5 Noise Limits

Receptor Location	$L_{eq,15minute}$ Project Specific Criteria, dB(A)		
	Day	Evening	Night
1	35	35	35
2	35	35	35
3	35	35	35
4	35	35	35
5	37	35	35
6	45	n/a	n/a
7	55	55	n/a
8	35	35	35
9	35	35	35
10	35	35	35

3.4 CUMULATIVE NOISE

The cumulative impact of more than one development can be compared against the base amenity criteria given in *Table 3.3*. This is consistent with the INP's holistic approach to industrial noise. However from our site observations, at the receptors assessed, noise levels from the small amount of existing industry in the area do not warrant any adjustment to the amenity criteria. In this instance, as the intrusiveness criteria adopted for the project specific noise goals are lower than the amenity criteria, and the little influence from existing industry in the area, cumulative noise impacts are unlikely.

3.5 SLEEP DISTURBANCE

The above criteria are appropriate for assessing noise from general operations, such as engine noise from mobile or fixed plant. However, given the transient nature of some operations, noise sources such as vehicle starts, door slams, or reversing alarms, the L_{eq} noise level alone would not adequately describe all the potential impacts of the noise in question, hence an additional approach is required, as described below.

The most important impact of transient noises would be to disturb the sleep of nearby residents. While the DEC's INP does not specify a criterion for assessing sleep disturbance, its ECRTN (DEC 1999) indicates that levels below 50 to 55 dB(A) inside residences are unlikely to wake sleeping occupants.

If bedroom windows are open, this corresponds to an external maximum noise level of approximately 60 to 65 dB(A) at a residence. The likely number of noise events per night should also be considered.

However, in this case, this is considerably less stringent than the DEC's previous guideline on sleep disturbance as presented in the ENCM, which recommends that $L_{1,1minute}$ noise from a source should not exceed the existing background noise by more than 15 dB. Depending on the measured background noise, the sleep disturbance criteria for the quietest location could be as low as 45 dB(A)L_1.

The latter more conservative sleep disturbance criterion of 45 db(A)L_1 was adopted for this study.

3.6 ROAD TRAFFIC NOISE CRITERIA

The DEC in it's ECRTN provides external traffic noise goals which can be applied to the proposed development.

Daysdale Street has residences that could potentially be impacted by traffic from the proposal. Daysdale Street is considered sufficiently representative of traffic noise impacts, given that approximately half of the heavy vehicle traffic generated by the facility will use this road (25% will use the Ainsworth Drive bypass of Oaklands and 25% will use Urana-Oaklands Road). For the purpose of this traffic noise assessment, Daysdale Street was classified as a sub-arterial road, given that it comprises a major north-south road for traffic bypassing Oaklands to connect with the major roads to townships and localities to the north, east and south. Sub-arterial roads are defined in the ECRTN as:

'roads handling through-traffic, with characteristically heavy and continuous traffic flows during peak periods. Through-traffic is traffic passing through a locality bound for another locality.'

Thus the following criteria for 'Land use developments with potential to create additional traffic on existing freeways/ arterials' (including sub-arterials) was selected as most suitable for assessment of traffic noise impacts from Daysdale Street:

- DAY-TIME: $L_{Aeq,15hr}$60(A); and
- NIGHT-TIME: $L_{Aeq,9hr}$55B(A).

Furthermore, the ECRTN states that where criteria are already exceeded, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB. Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria.

4 NOISE MODELLING

4.1 PLANT COMPONENTS

The proposed site layout is presented in *Figure 2.1*. The ethanol production plant will be positioned in the central portion of the site. It will have a footprint of approximately 300m x 300m and will include:

- a bunded storage building where all chemicals and products (other than grain and ethanol) stored on the site will be kept;
- a maintenance workshop and store which also includes a crop services facility;
- two 7000 tonne grain storage silos with a maximum height of 35m (these will be the tallest buildings on the site);
- a 1300 tonne shift silo;
- a milling section including two hammermills;
- a fermentation structure;
- a liquefaction and saccharification area;
- a distillation structure and tower;
- a boiler building;
- a cooling tower;
- liquefied natural gas storage;
- a two storey building which houses the ring dryer for drying Wet Distillers Grain and Solubles (WDGS) to produce Dried Distillers Grain with Solubles (DDGS);
- a bunded ethanol storage area which houses two anhydrous ethanol storage tanks, an off-spec storage tank and a gasoline storage tank; and
- a bunded storage building where WDGS and DDGS are stored.

A grain storage area comprising six grain bunkers will be located adjacent to the main buildings. These bunkers will be circumnavigated by a one-way road that is surfaced with a prepared road base foundation.

Site access off Coreen Street will be upgraded and internal roads will be sealed and sufficiently wide to accommodate passing vehicles. There will be a weigh bridge, a light vehicle parking area with 40 spaces and a truck standing area. An office/ administration area will be constructed adjacent to the weighbridge and will comprise a reception area, offices, meeting rooms, bathroom facilities and a first aid room.

4.2 MODELLING SCENARIOS

In order to enable potential noise impacts to be assessed, the list of plant and equipment associated with the proposed ethanol plant was examined, and significant noise sources chosen for inclusion in the model. Lesser sources (with sound power levels 20 dB(A) or more lower than the most significant sources) were omitted from the model, as their contribution at receivers would be negligible. These omitted sources included smaller pumps and fans.

4.3 PLANT NOISE LEVELS

Noise sources included in the model are listed in *Table 4.1*. Sound power levels shown in *Table 4.1* are indicative, drawn from a combination of product literature, ERM's database of sound power levels of similar plant, and prior studies on similar facilities.

Table 4.1 Equipment Sound Power Levels

Plant	Number modelled	Representative Freefield $L_{eq,15minute}$ Sound Power Level, dB(A) (unmitigated)
Hammermill	2	112
Front End Loader	3	110
Conveyor – 20m long	3	96
Screw Conveyor – 12m long	2	93
Cooling Tower Fan	2	92
Blower	1	92
Pump	8	100
Transport Truck	3	107

1. Refer to *Annex D* for spectral data used for noise modelling.
2. L_{eq} levels are for each individual source.

Other items of plant with lower sound power levels would not contribute significantly to the total noise impact at the receptors, and have not been included in the model.

5 PREDICTED NOISE LEVELS

5.1 CALCULATION PROCEDURES

Version 6.3 of the SoundPLAN software was used for noise modelling. The SoundPLAN noise prediction software used takes into account distance, ground effect, atmospheric absorption and topographic detail. Initial calculations were performed with no wind or temperature gradients i.e. calm conditions. The day-time air temperature modelled was 20°C and the day-time relative humidity input to the model was 70%. The night-time air temperature and relative humidity were 10°C and 70% respectively.

The model has assumed flat ground, with no significant topographical features that affect the propagation of noise. This is considered representative of the area. Sources were located at the appropriate locations for fixed plant (as per plant layout drawings), and typical operating locations for mobile plant.

The noise model predicts L_{eq} noise levels, based on equipment sound power levels given in *Annex D.* The results assume all plant and equipment operate simultaneously. The results for day represent the noise impacts for the period from 6am to 10pm and the results for night represent the period from 10pm to 6am. Some plant and equipment (notably the front end loaders and transport trucks) are not operated during the night period. It must be noted that the day-time results include the period from 6am to 7am, which is classified by the DEC as a 'night-time shoulder period' for noise assessment purposes (ref INP Section 3.3).

5.2 CALM WEATHER CONDITION RESULTS

Table 5.1 summarises noise modelling results at each receptor location for calm weather conditions. The modelling results for day-time and night-time noise with the ethanol production plant operating are presented respectively in *Figures 5.1* and *5.2*, in the form of noise contours. Whilst the terrain is relatively flat, the contours deform due to on site structures proposed.

Table 5.1 $L_{eq,15minute}$ *Noise Under Calm Conditions, Unmitigated dB (A)*

Receptor Location	Predicted Level		Project Specific Noise Criteria	
	Day (*Figure 5.1*)	Night (*Figure 5.2*)	Day	Night
1	35	34	35	35
2	**37**	**36**	35	35
3	30	28	35	35
4	31	30	35	35
5	**39**	**37**	37	35
6	40	38	45	n/a
7	41	38	50	n/a
8	26	24	35	35
9	23	21	35	35
10	16	15	35	35

1. Proposal criteria exceedences are in bold.

Examination of the levels in *Table 5.1* indicates that the predicted noise levels are below the Project Specific Noise Criteria at all locations except for minor exceedences of up to 2 dB(A) at Receptors 2 and 5. A difference in noise level of less than approximately 2 dB is generally imperceptible to the human ear. The dominant noise sources from the plant are the hammermills. Treatment of noise emissions from the hammermills is likely to reduce predicted noise levels to or below the criteria at these locations.

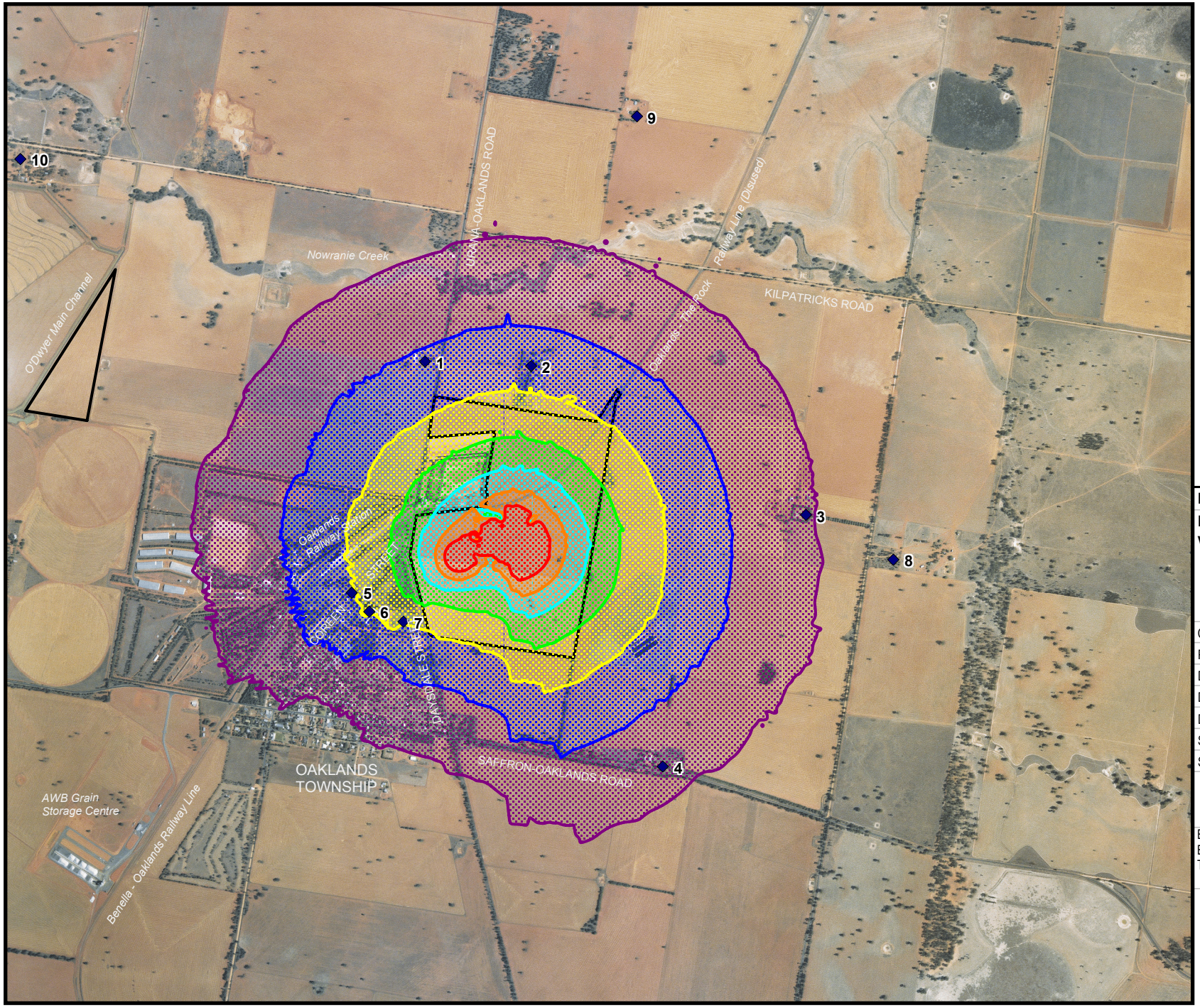

Figure 5.1

Leq Day-Time Noise Contours with Proposal - Calm Weather

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_AC_GIS06	
Date:	09.03.2007	Drawing Size: A4
Drawn By:	DH	Reviewed By: -
Source:	Aerial: Department of Lands NSW	
Scale:	Refer to Scale Bar	

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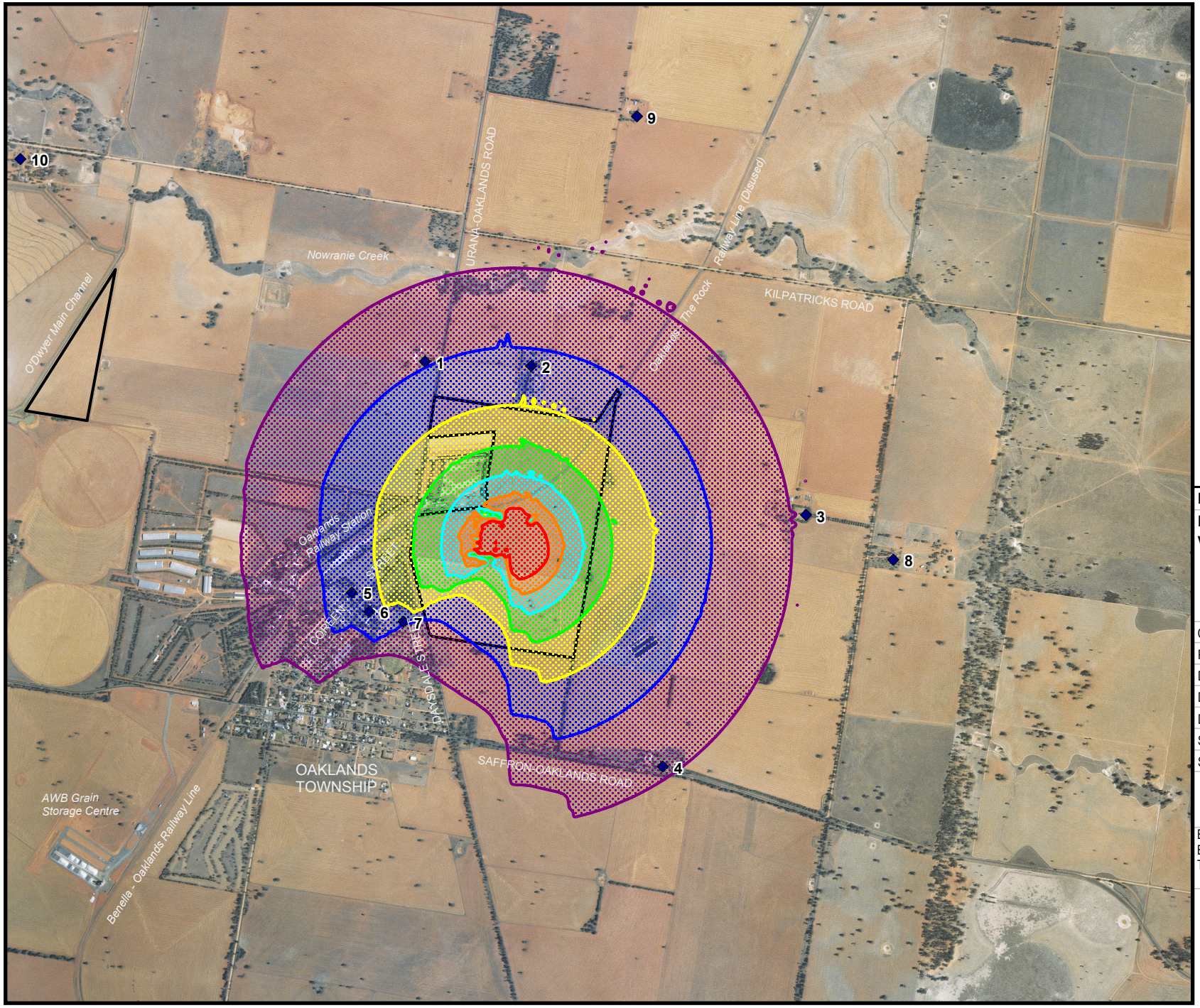

Figure 5.2

Leq Night-Time Noise Contours with Proposal - Calm Weather

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_AC_GIS07	
Date:	09.03.2007	Drawing Size: A4
Drawn By:	DH	Reviewed By: -
Source:	Aerial: Department of Lands NSW	
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5.3 PREDICTED NOISE LEVELS - PREVAILING WEATHER CONDITIONS

Under various wind and temperature gradient conditions, noise levels may increase or decrease compared with calm weather conditions. This is due to refraction of sound propagating through the atmosphere, brought about by a change in sound speed with height. Sound levels increase when the wind blows from source to receiver or under temperature inversion conditions and decrease when the wind blows from receiver to source or under temperature lapse conditions.

There is a premise that if the criterion is met under calm conditions, higher noise under strong winds (>3m/s) is generally acceptable. This is because the ambient noise at properties also increases during such weather conditions and site noise is masked (for example, by wind induced vegetation noise). However, at wind speeds below 3 m/s and under temperature inversions, noise levels are assessable under the DEC's INP. These conditions are labelled *INP weather conditions*.

5.3.1 *Day-time Operational Noise Levels*

The predicted operational noise levels under INP weather conditions during the day are summarised in *Table 5.2*. Three weather conditions were modelled (adverse winds for Autumn Day, Winter Day, Winter Evening), however to demonstrate the worst case scenario, only the maximum noise level predicted for each assessment location is included in the table. The modelling results for Autumn Day, Winter Day and Winter Evening under adverse wind conditions are presented in *Figures 5.3, 5.4* and *5.5*, in the form of noise contours.

Table 5.2 ***$L_{eq,15minute}$ Noise Under Day INP Wind Conditions, Unmitigated dB (A)***

Receptor Location	Predicted Noise Level	Project Specific Noise Criteria
1	**39**	35
2	**40**	35
3	28	35
4	**36**	35
5	**44**	37
6	44	45
7	45	55
8	24	35
9	25	35
10	23	35

1. Predicted noise levels at each assessment location are the maximum of the levels predicted for the three weather conditions modelled (Autumn Day, Winter Day, Winter Evening).
2. Proposal criteria exceedences are in bold.

Table 5.2 shows that day-time noise levels under adverse wind conditions are predicted to exceed the relevant criteria at Locations 1, 2, 4 and 5, by between 1 dB(A) (Receptor Location 4) and 7 dB(A) (Receptor Location 5). As stated in the INP, *"it is recognised that excursions of noise above the intrusiveness criterion during the day would not usually have the same impact as they would at night"*. Furthermore, the predicted noise levels are below the day-time and evening amenity criteria for rural residential (50 dB(A) and 45 dB(A), refer *Table 3.3*). The noise levels at these residences are dominated by the hammermills. Mitigation of noise from the hammermills (to reduce noise emissions by approximately 10 dB(A)) combined with treatment of noise from the front end loaders (to reduce noise emissions by 4 dB(A)) would reduce noise levels experienced at the receptors under day-time INP wind conditions by 2-5 dB(A) (refer *Table 5.3*). The type of mitigation to be applied is described in *Section 6.2*.

Predicted noise levels with the attenuation in place are provided in *Table 5.3*.

Table 5.3 ***$L_{eq,15minute}$ Noise Under Day INP Wind Conditions, Mitigated dB (A)***

Receptor Location	Predicted Noise Level	Project Specific Noise Criteria
1	34	35
2	**36**	35
3	26	35
4	32	35
5	**41**	37
6	41	45
7	43	55
8	20	35
9	21	35
10	19	35

1. Predicted noise levels at each assessment location are the maximum of the levels predicted for the three weather conditions modelled (Autumn Day, Winter Day, Winter Evening).
2. Proposal criteria exceedences are in bold.

Table 5.3 shows that with treatment of noise from the hammermills and front end loaders, the day-time intrusiveness criteria are still marginally exceeded at two locations (Receptors 2 and 5) under adverse wind conditions. However these predicted noise levels are below the amenity criteria.

5.3.2 Night-time Operational Noise Levels

The predicted noise levels under INP weather conditions during the night are summarised in *Table 5.4*. The modelling results for summer and winter night-time noise under adverse wind conditions were combined, with the worst case result for each location presented in *Figure 5.6* in the form of noise contours. The modelling results for night-time noise under strong inversion conditions are presented in *Figure 5.7* in the form of noise contours.

Table 5.4 $L_{eq,15minute}$ *Noise Under Night INP Weather Conditions, Unmitigated dB (A)*

Receptor Location	Predicted Noise Level			Project Specific Noise Criteria
	Strong Inversion (8˚C/100m) (*Figure 5.7*)	INP Wind Conditions – Night		
		Summer	Winter	
1	**36**	**38**	30	35
2	**38**	**39**	31	35
3	31	24	27	35
4	32	25	35	35
5	**38**	**40**	**41**	35
6	39	41	42	n/a
7	39	40	42	n/a
8	27	19	24	35
9	25	24	17	35
10	19	21	13	35

1. Proposal criteria exceedences are in bold.

Table 5.4 shows that night-time operational noise levels under INP weather conditions are predicted to exceed the relevant criteria at three receptor locations, being the residences at locations 1, 2 and 5, by between 1 dB(A) (Receptor Location 1, strong inversion) and 6 dB(A) (Receptor Location 5, winter night adverse winds). The noise levels at these residences are dominated by the hammermills. Mitigation of noise from the hammermills (to reduce noise emissions by approximately 10 dB(A)) would reduce noise levels experienced at the receptors under night-time INP weather conditions by 4-8 dB(A) (refer *Table 5.5*) and enable the Project Specific Noise Criteria to be met. The mitigated noise levels are shown in *Table 5.5*. The type of mitigation to be applied is described in *Section 6.2*.

Table 5.5 $L_{eq,15minute}$ *Noise Under Night INP Weather Conditions, Mitigated dB (A)*

Receptor Location	Predicted Noise Level			Project Specific Noise Criteria
	Strong Inversion (8˚C/100m)	INP Wind Conditions – Night		
		Summer	Winter	
1	30	32	23	35
2	32	33	25	35
3	26	18	21	35
4	27	19	29	35
5	31	33	34	35
6	33	35	34	n/a
7	34	35	36	n/a
8	22	15	18	35
9	19	19	11	35
10	14	16	7	35

Figure 5.3

Leq Day-Time Noise Contours with Proposal - Autumn (Adverse Wind Conditions)

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_AC_GIS09	
Date:	14.03.2007	Drawing Size: A4
Drawn By:	DH	Reviewed By: -
Source:	Aerial: Department of Lands NSW	
Scale:	Refer to Scale Bar	

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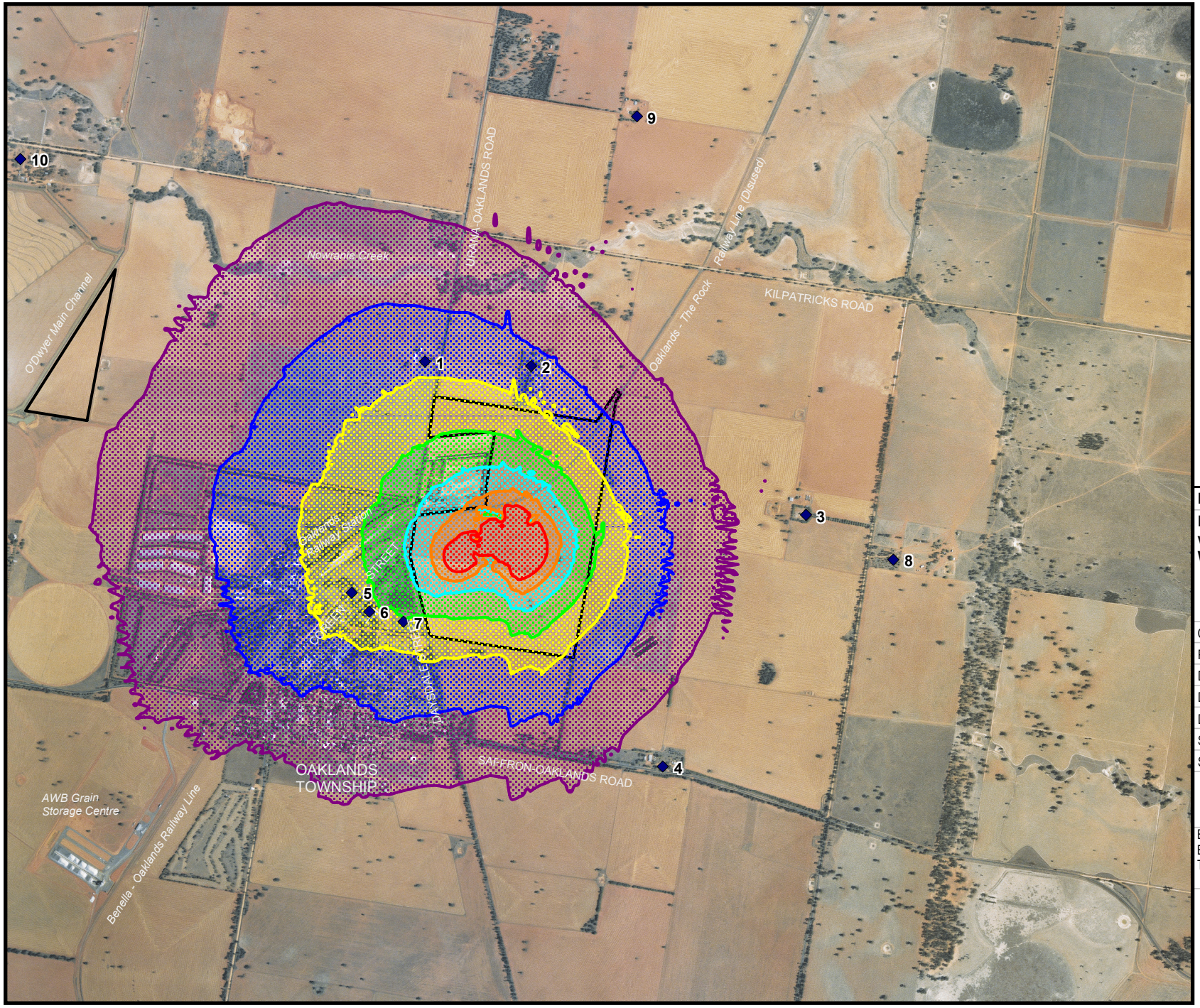

Figure 5.4

Leq Day-Time Noise Contours with Proposal - Winter (Adverse Wind Conditions)

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_AC_GIS10	
Date:	09.03.2007	Drawing Size: A4
Drawn By:	DH	Reviewed By: -
Source:	Aerial: Department of Lands NSW	
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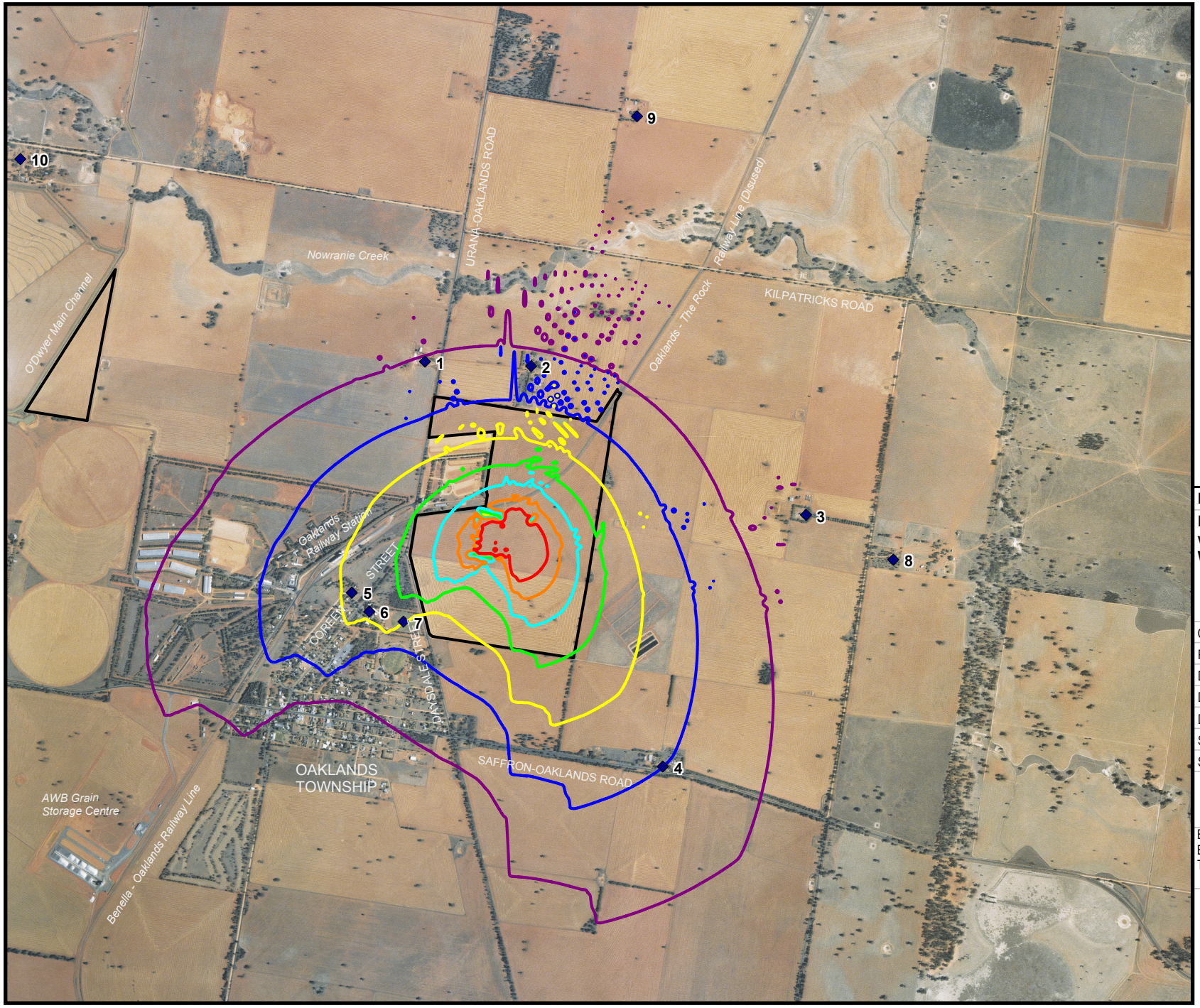

Figure 5.5

Leq Evening Noise Contours with Proposal - Winter (Adverse Wind Conditions)

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_AC_GIS11	
Date:	17.05.2007	Drawing Size: A4
Drawn By:	DH	Reviewed By: -
Source:	Aerial: Department of Lands NSW	
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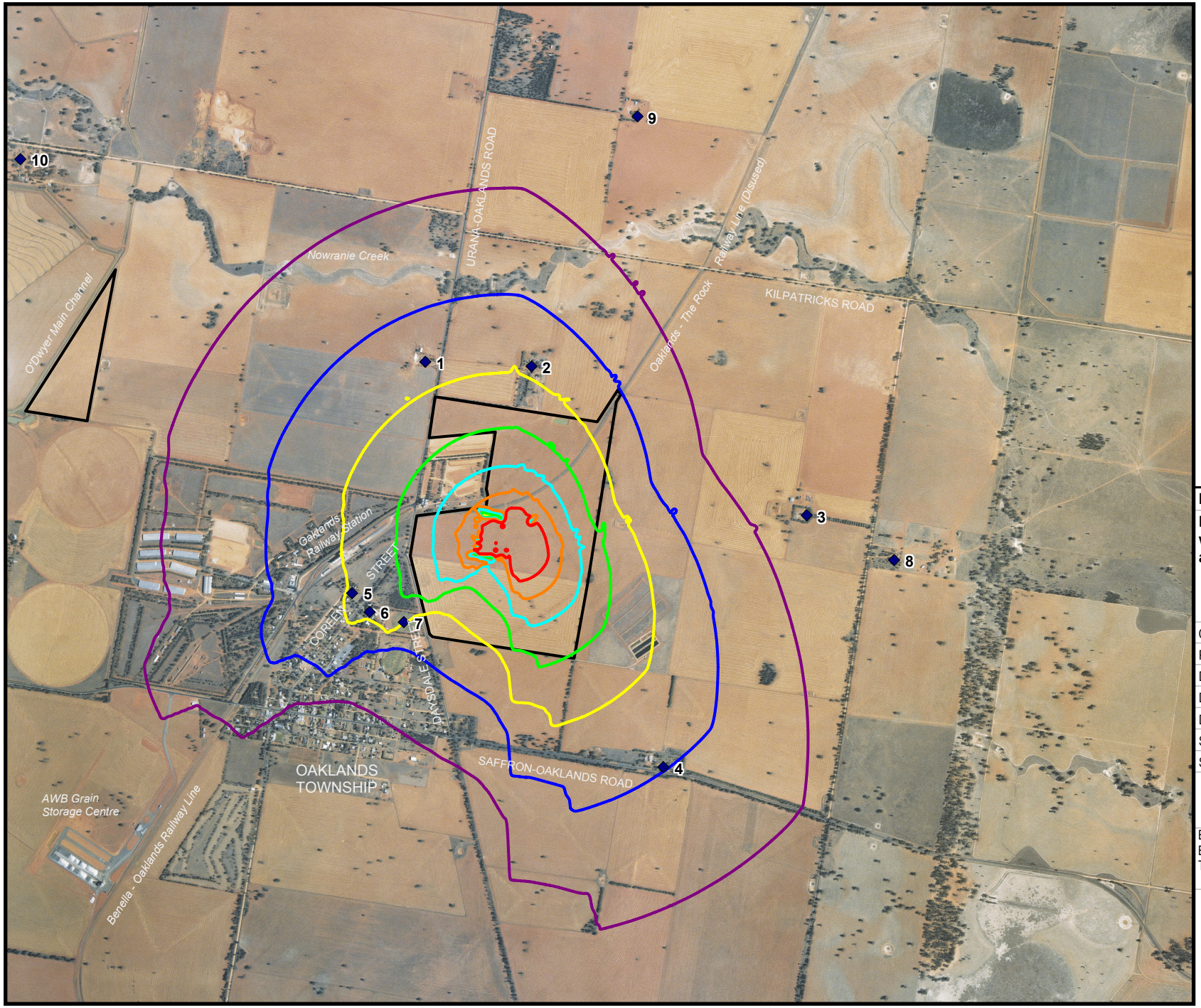

Figure 5.6

Leq Night-Time Noise Contours with Proposal - Combined Summer and Winter (Adverse Wind Conditions)

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_AC_GIS12	
Date:	17.05.2007	Drawing Size: A4
Drawn By:	DH	Reviewed By: -
Source:	Aerial: Department of Lands NSW	
Scale:	Refer to Scale Bar	

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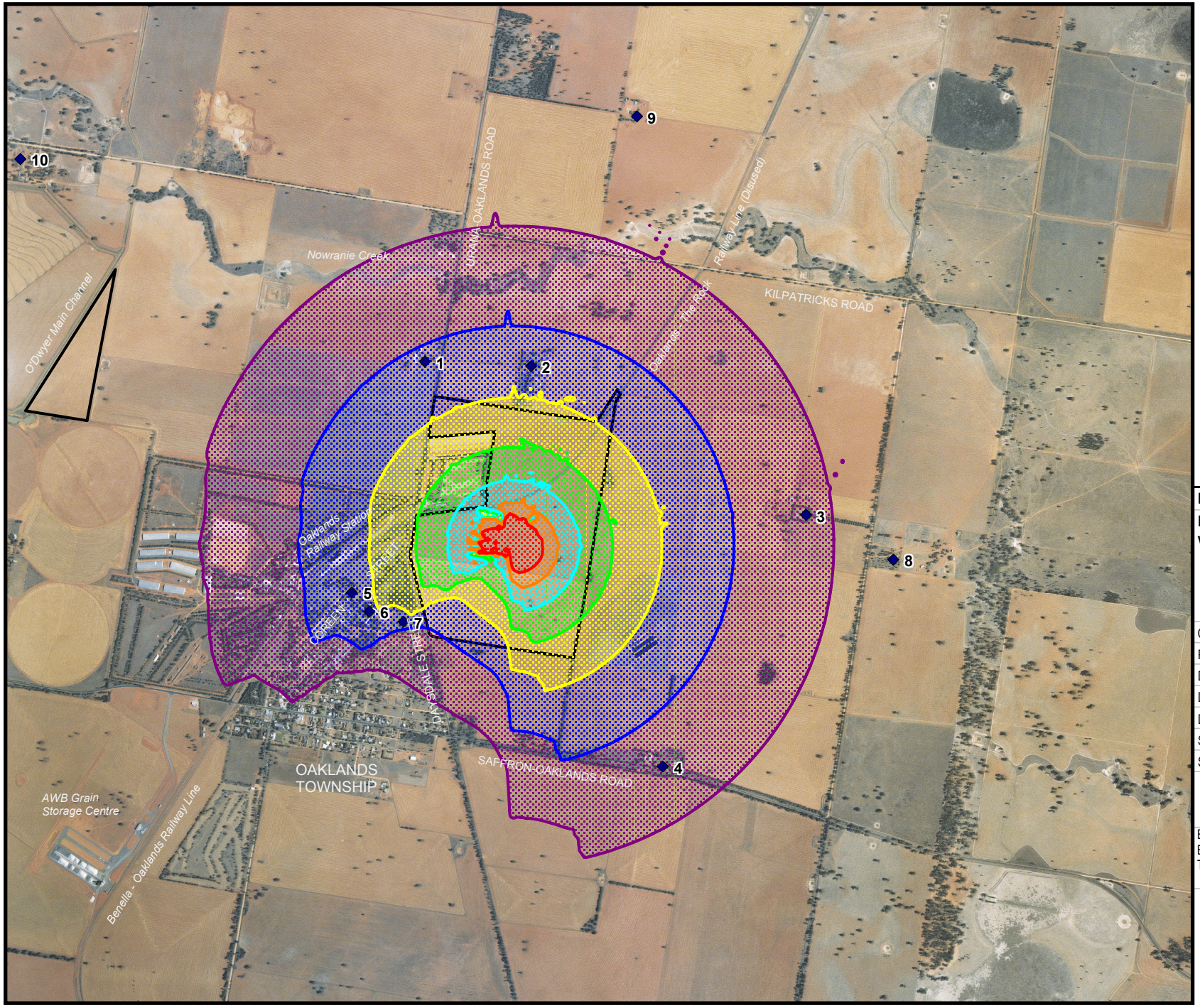

Figure 5.7

Leq Night-Time Noise Contours with Proposal - Strong Inversion

Client:	Agri Energy Limited	
Project:	Oaklands Ethanol Production Facility	
Drawing No:	0056132_AC_GIS08	
Date:	17.05.2007	Drawing Size: A4
Drawn By:	DH	Reviewed By: -
Source:	Aerial: Department of Lands NSW	
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5.3.3 Sleep Disturbance

During the night period, only the plant associated with the fermentation and distillation / separation and milling stages of the facility are expected to operate. As these sources are continuous in nature (pumps, fans, etc), L_{max} noise levels during the night are expected to be similar to the L_{eq} levels predicted above.

Staff shift changes would nominally occur at 11pm and 7am. Predicted L_{max} noise levels from for example, car door slams and engine starts associated with the staff shift change are predicted to be around 30 dB(A) or less at the nearest residence, which complies with DEC sleep disturbance noise criteria of 45 dB(A).

Other noise sources with potential for sleep disturbance (eg front end loaders, deliveries / dispatch of product, etc) are operated between the hours of 6am and 10pm and therefore are generally not expected to cause sleep disturbance. However, during plant operations between the 6am to 7am night-time shoulder period, predicted L_{max} noise levels from the front end loaders (for the worst case INP Weather Conditions i.e. summer night adverse winds) would be approximately 36 dB(A) at the worst-affected residence (Receptor Location 5). This is below the DEC 45 dB(A) sleep disturbance criterion. Noise from operation of the front end loaders will be reduced by application of mitigation measures, as discussed in *Section 6.2*.

Consequently, no sleep disturbance due to the operation of the proposed facility is expected.

5.4 RECREATIONAL AREAS

The operational noise levels are also predicted to meet targets for recreational areas of 55 dB(A) specified in the INP. This is demonstrated in the noise contours (refer *Figures 5.1* to *5.7*), where levels at the recreation area (Receptor 7) to the south-west of the site are generally 45 dB(A) or lower.

5.5 CONSTRUCTION NOISE

5.5.1 Noise Sources

Noise from construction will come from a number of sources. In order to gain some understanding of the types of noise sources, each major construction activity has been described, including examination of the associated noise producing activities.

Road and Hardstand Construction

Road construction is expected to take place as part of construction works. Two concrete agitator trucks, a concrete pump, a vibrator, a bulldozer, a grader and a compactor are expected to be involved in road construction. Such plant could also be considered representative of initial short term earthworks prior to construction.

Plant Construction

Foundations and footings will be prepared for the plant and associated buildings. Process buildings are expected to consist of a structural steel frame and have sheet steel and a sheet steel roof. Materials will be delivered and assembled on site using road trucks. Cranes, grinder, welder and other power tools will be involved in constructing the enclosure. Footings are expected to be concrete poured.

5.5.2 Sound Power Levels of Construction Noise Sources

The sound power levels for noise emitted by the construction equipment were drawn from ERM's database, compiled from experience on previous projects. The sound power levels are specified in *Table 5.6*.

Table 5.6 Representative Sound Power Levels for Construction Equipment

Plant Item	SWL, $L_{10,15minute}$ dB(A)
Concrete Truck	106
Concrete Pump	105
Concrete Vibrator	103
Dozer	114
Grader	108
Compactor	114
Road Truck	101
Crane	106
Grinder	98
Welder	104
Drill	86
Articulated Dump Truck	113
Excavator	110

1. Sound Power Levels reflect the expected L_{10} from 15 minutes practical operation of such equipment. The levels are also generally consistent with sound power levels presented in AS2436.

5.5.3 Construction Noise Modelling Scenarios

As construction activities will vary over a 14 to 16 month period, a number of scenarios were modelled to gain an understanding of not just the maximum noise from the site but also the potential variation. Modelling was conducted for each scenario for the situation where all equipment is operating at the same time, to simulate a worst case scenario day of construction. It should therefore be noted that there will be other days where construction noise would be substantially lower than the scenarios modelled. The scenarios are:

- preparatory earthworks;
- road construction with earthworks occurring simultaneously; and
- building construction with earthworks and road/hardstand construction occurring simultaneously.

Each scenario is expected to occur for a period of less than 26 weeks. Equipment modelled for each scenario is shown in *Table 5.7*.

Table 5.7 Plant Items in Construction Noise Model

Scenario number	Construction Noise Model Scenario	Included Plant Items
1	Preparatory earthworks	2 Articulated Dump Trucks, 2 Excavators, a Truck and a Dozer
2	Road Construction	2 Concrete Trucks, a Concrete Vibrator, a Dozer, a Grader and a Compactor
3	Building Construction	2 Road Trucks, a Crane, a Grinder, Welder and a Drill

5.5.4 Construction Noise Modelling Technique and Results

SoundPLAN software using the CONCAWE model was used to predict noise levels from the construction equipment at representative receptor locations. CONCAWE accounts for the effects of distance, ground affects, air absorption and weather. SoundPLAN also takes account of any shielding that may be present, either from natural features or from buildings and barriers.

The results of the construction noise modelling for representative receptor locations are shown in *Table 5.8*.

Table 5.8 Construction Noise Modelling Results

Receptor Location	Construction Scenario Noise Level, $L_{10, 15minute}$ dB(A)			Criterion, L_{10} dB(A)	
	Preliminary Earthworks	Earthworks plus Road Construction	Earthworks plus Road & Building Construction	< 26 weeks	> 26 weeks
1	33	35	35	40	35
2	35	**36**	**36**	40	35
3	27	28	29	40	35
4	28	29	30	40	35
5	36	**38**	**38**	42	37
6	37	39	39	n/a	n/a
7	39	41	41	n/a	n/a
8	23	24	25	40	35
9	21	22	23	40	35
10	15	16	17	40	35

1. All three scenarios are likely to occur within 26 weeks.
2. Proposal criteria exceedences are in bold.

The results in *Table 5.8* demonstrate that noise levels comply with criteria at all assessment locations if construction were less than 26 weeks. Noise levels of up to 2 dB(A) above the criterion for construction activities lasting longer than 26 weeks may be experienced at locations 2 (abandoned rural residence), and 5 (residence) during the noisiest periods of construction. A difference in noise level of around 2 dB is generally imperceptible to the human ear. Modelling was conducted for the situation where all equipment is operating at the same time, to simulate a worst case scenario day of construction. It should therefore be noted that construction noise would be substantially lower than the scenarios modelled for significant periods of time. The exceedences predicted are not considered to be significant.

5.6 CUMULATIVE NOISE ASSESSMENT

As discussed in *Section 3.4*, the site of the proposed ethanol production facility is in a rural area and existing industrial noise levels do not warrant any adjustment to the amenity criteria at receptors assessed. Therefore, no cumulative industrial noise impacts are expected.

5.7 TRAFFIC NOISE

The traffic analysis for the site indicates that almost half of the traffic generated by the facility will use the existing heavy-vehicle bypass of Oaklands, along Daysdale Street. The residences along Daysdale Street were assumed to be the most-affected residences by traffic noise from the proposal. Based on the existing and predicted traffic flows for Daysdale Street, L_{eq} traffic noise levels have been calculated using the Calculation of Road Traffic Noise (CoRTN) procedure and compared to relevant criteria in accordance with the ECRTN. Day-time noise levels were calculated for Daysdale Street, and although not required to be assessed, the peak 1 hour night-time $L_{eq,1hr}$ traffic noise level for Daysdale Street is also provided, to represent possible impact during the nominal 11pm shift change.

Table 5.9 lists the traffic volumes for Daysdale Street, both existing and with the proposal, for the 7am to 10pm period and the busiest night-time one-hour period, along with the predicted L_{eq} noise levels. As haulage is restricted to day and evening hours and the 6am to 7am shoulder period, the 11pm shift change essentially represents the highest night-time noise impacts. The night-time $L_{eq,1hr}$ levels have been conservatively predicted based on 24 light vehicle movements during the shift change. The results are for a representative receptor 20m from Daysdale Street.

Table 5.9 Predicted Traffic Noise – Daysdale Street (20m)

Scenario	Traffic			L_{eq}, dB(A)	Criteria, dB(A)
	Light	Heavy	Total		
Existing (Day/Evening (7am-10pm))	231	47	278	49 (15 hr)	60
With Proposal (Day/Evening (7am-10pm))	251	223	474	54 (15 hr)	60
AEL 11pm shift change (Peak 1-hour)	24	0	24	46 (1 hr)	-

1. The nearest receptor is modelled at 20m from Daysdale Street.
2. Modelled traffic speed is 60km/h.
3. Traffic data sourced from ERM (2007) traffic report.
4. Criteria is ECRTN criteria for land use developments with potential to create additional traffic on existing arterials (including sub-arterials).

The proposal is expected to result in an increase in traffic noise levels from Daysdale Street of approximately 5 dB(A). However, the predicted $L_{eq,15hr}$ traffic noise levels for Daysdale Street are below the relevant ECRTN criterion of 60 dB(A) for sub-arterial roads. The ECRTN does not provide $L_{eq,1hr}$ criteria for sub-arterial roads, however traffic noise from the night-time shift change is below the stricter night-time $L_{eq,1hr}$ criteria for local roads (50 dB(A)).

6 MITIGATION MEASURES

6.1 CONSTRUCTION NOISE

Mitigation measures to reduce construction noise experienced at the potentially worst affected residence can be included in a noise management plan, potentially prepared as part of the *Construction Environmental Management Plan* for the project. This would include:

- informing potentially affected residents in advance as to the extent and timing of potentially noisier construction activities and responsibly advising when noise levels during such works may be relatively high;
- where known to be readily available, deploying plant having lower noise emission levels;
- maintaining plant to ensure rated noise emission levels are not exceeded;
- providing a contact telephone number via which the public may seek information or make a complaint. A log of complaints should be maintained and actioned by the site superintendent in a responsive manner;
- undertaking construction activities in accordance with AS2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites"; and
- adhering to the following ENCM time limits for construction activities where construction noise is audible at residential premises:
    - Monday to Friday, 7:00 am to 6:00 pm;
    - Saturday, 8:00 am to 1:00 pm, otherwise 7:00 am to 1:00 pm if inaudible at residential premises; and
    - no construction on Sundays or public holidays.

6.2 *OPERATIONAL NOISE*

In order to reduce the night-time noise levels at the affected residences at Locations 1, 2 and 5 to comply with DEC criteria, the noise emissions from the highest-contributing noise sources can be reduced. Reduction in noise from the hammermills (the dominant noise source during the night) by 10 dB(A), by the addition of lagging or an acoustic enclosure or barrier would enable the criteria to be met during the night at all receptors and under all conditions, as demonstrated in *Table 5.5*. Such an enclosure or hood can be of a sandwich construction consisting of sheet metal outer skins with acoustic insulation in the cavity. Limiting heavy vehicle and truck movements to the hours of 6am to 10pm as proposed will also mitigate noise impacts during the night.

During the detailed design stage of the proposal, additional mitigation measures will be investigated to reduce day-time noise experienced at these residences from front end loaders and trucks. The measures investigated will include treatment of front end loaders with a noise suppression kit. Reduction in noise from the hammermills by 10 dB(A) as described above, combined with treatment of noise from the front end loaders to achieve a 4dB(A) reduction in their noise levels would enable reduction in noise levels at receptors, such that the day-time intrusiveness criteria are only marginally exceeded at two locations (Receptors 2 and 5) under adverse wind conditions.

On-site plant and equipment is to be properly maintained to ensure rated noise emission levels are not exceeded. A contact telephone number will be provided on a sign on the site fence for the public to seek information or make a noise complaint. A log of noise complaints shall be maintained and actioned in a responsive manner.

7 *CONCLUSION*

This study has considered the potential noise impacts of the proposal. The acoustic assessment included modelling of all major items of plant and equipment. The study had the following features:

- ambient noise levels measured in the Oaklands area are generally low, with RBLs mostly below the DEC 30 dB(A) minimum;
- noise criteria derived in accordance with the DEC's INP;
- site-specific hourly meteorological data analysed in accordance with the DEC's INP;
- noise modelling addressing the DEC's INP with regard to weather effects.

The noise modelling has shown that for operation of the facility under calm weather conditions all receptor locations except for the residences at Locations 2 and 5 experience noise levels below the DEC's noise goals. The exceedence is minor, 2 dB(A) or less in each case. With appropriate design and implementation of mitigation measures described in *Section 6.2*, noise at these locations may be reduced to within criteria.

Conservative modelling has also shown that under worst case INP-derived weather conditions during operation of the ethanol facility, noise levels exceed the DEC noise goals at residences at Locations 1, 2, 4 and 5. Mitigation of noise from the hammermills would enable this level to be reduced to meet the DEC noise goals during the night. Mitigation of noise from the hammermills and front end loaders would enable the day-time noise level to be reduced such that the intrusiveness criteria are only marginally exceeded at two residences.

Noise mitigation will be applied as part of the Statement of Commitments for the proposal and will ensure that operational noise complies with DEC criteria of 35 dB(A) at all times during the night and does not exceed 35-41 dB(A)$L_{eq,\ 15min}$ during the day at all residences.

Sleep disturbance and cumulative noise impact due to the proposal are not considered likely. Traffic noise levels are predicted to increase, but remain below relevant criteria.

REFERENCES

ERM (2007), **Oaklands Ethanol Production Facility – Traffic Impact Assessment** Prepared for Agri Energy Limited.

DEC (2000), **Industrial Noise Policy** NSW DEC.

DEC (1999), **Environmental Criteria for Road Traffic Noise** NSW DEC.

DEC (1994), **Environmental Noise Control Manual** NSW DEC.

Annex A

Glossary

A number of technical terms used in this report describe various noise levels from the mine. These are explained in *Table A.1*.

Table A.1 Glossary of Terms

Term	Description
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.
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.
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.
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 indicates what an average person perceives about noise levels in practice:

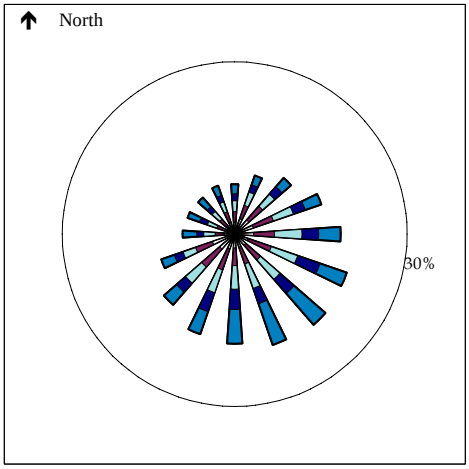
- noise differences of less than approximately 2 dB are generally imperceptible; and
- a difference of around 10 dB seems to be a doubling or halving of loudness.

Annex B

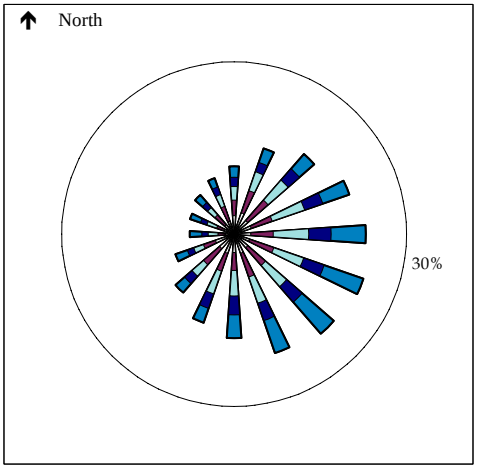
Vector Wind Roses

Day

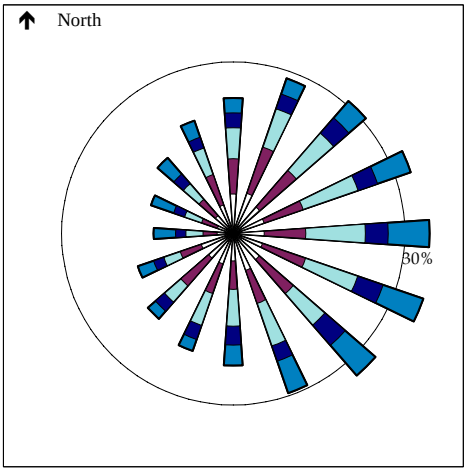
Summer



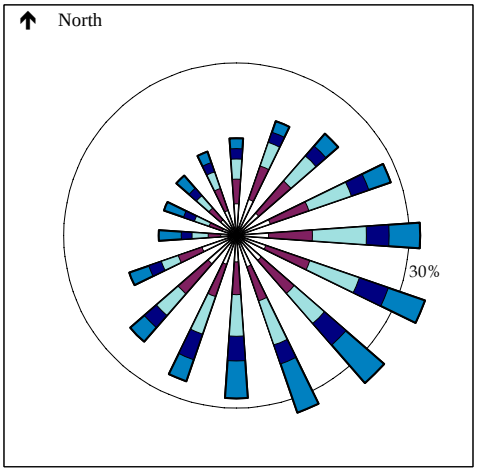
Spring



Winter



Autumn

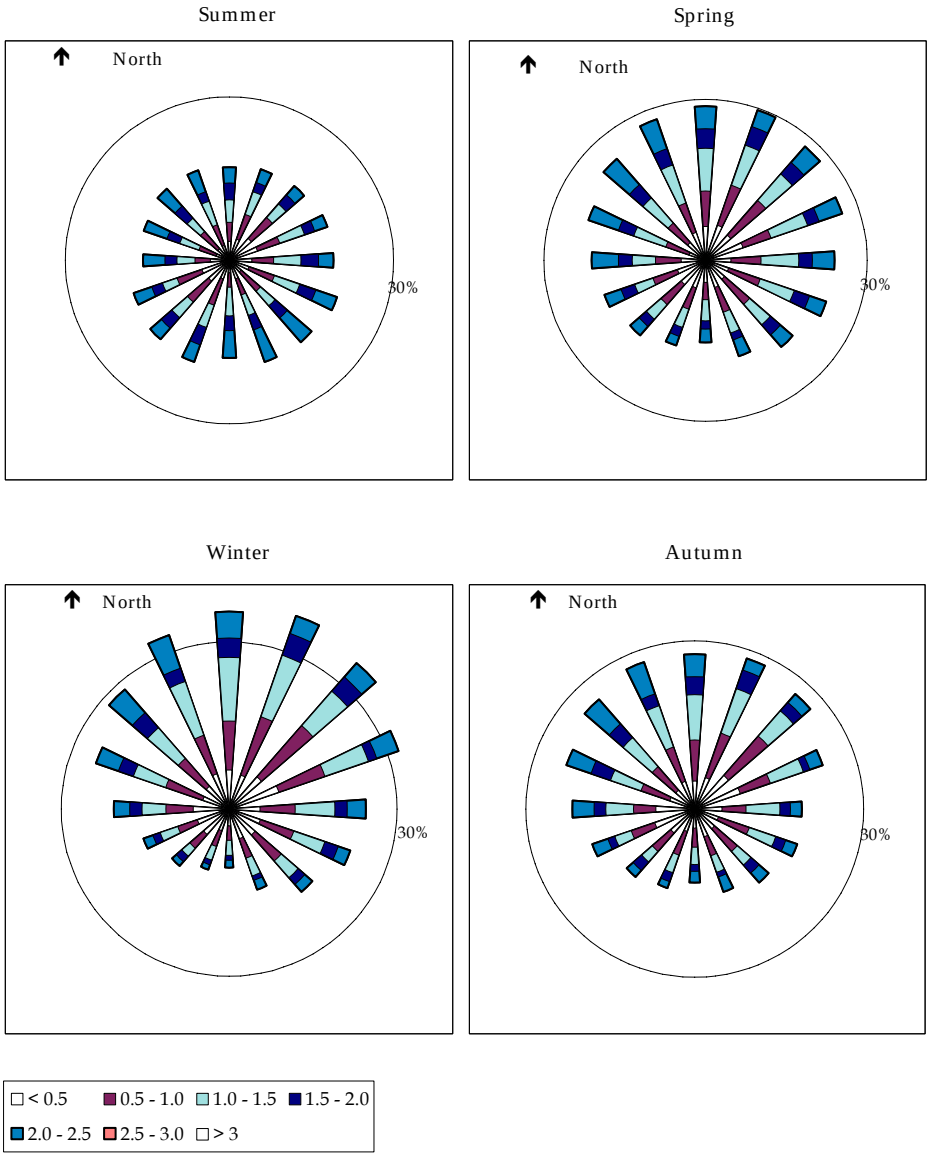


< 0.5 | 0.5 - 1.0 | 1.0 - 1.5 | 1.5 - 2.0 | 2.0 - 2.5 | 2.5 - 3.0 | > 3

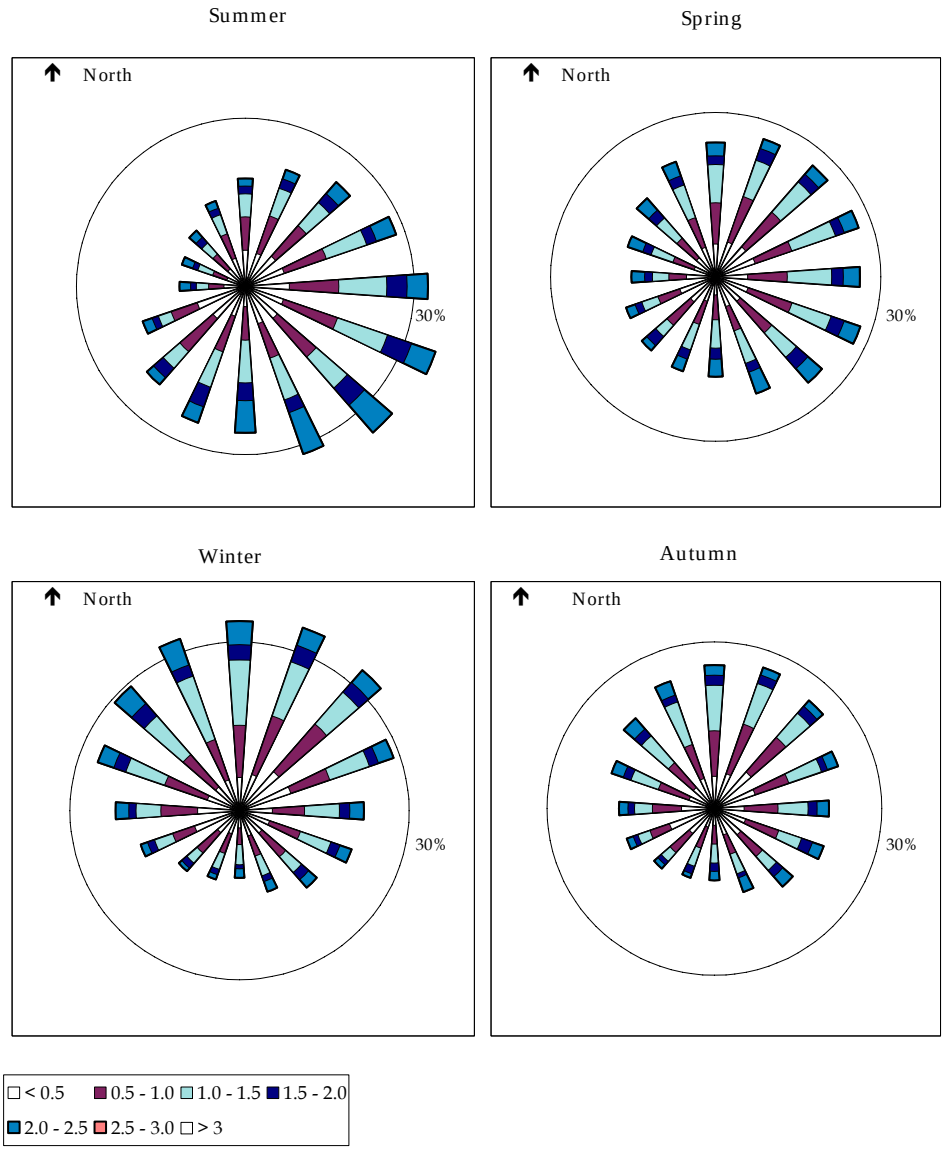
Data Source: NSW Bureau of Meteorology, Albury AWS
Data Range: hourly, 01-01-01 to 03-09-06

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

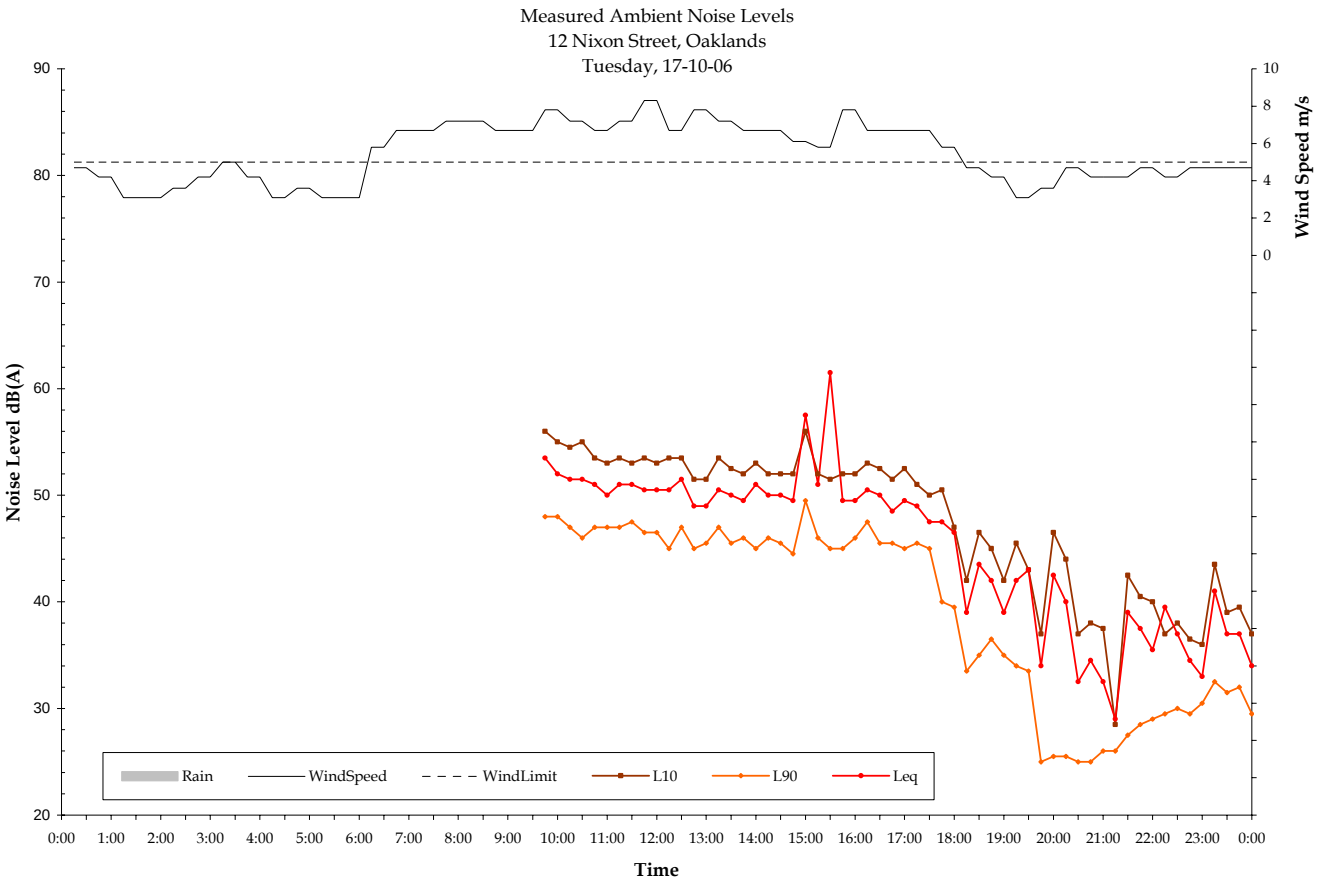
Annex C

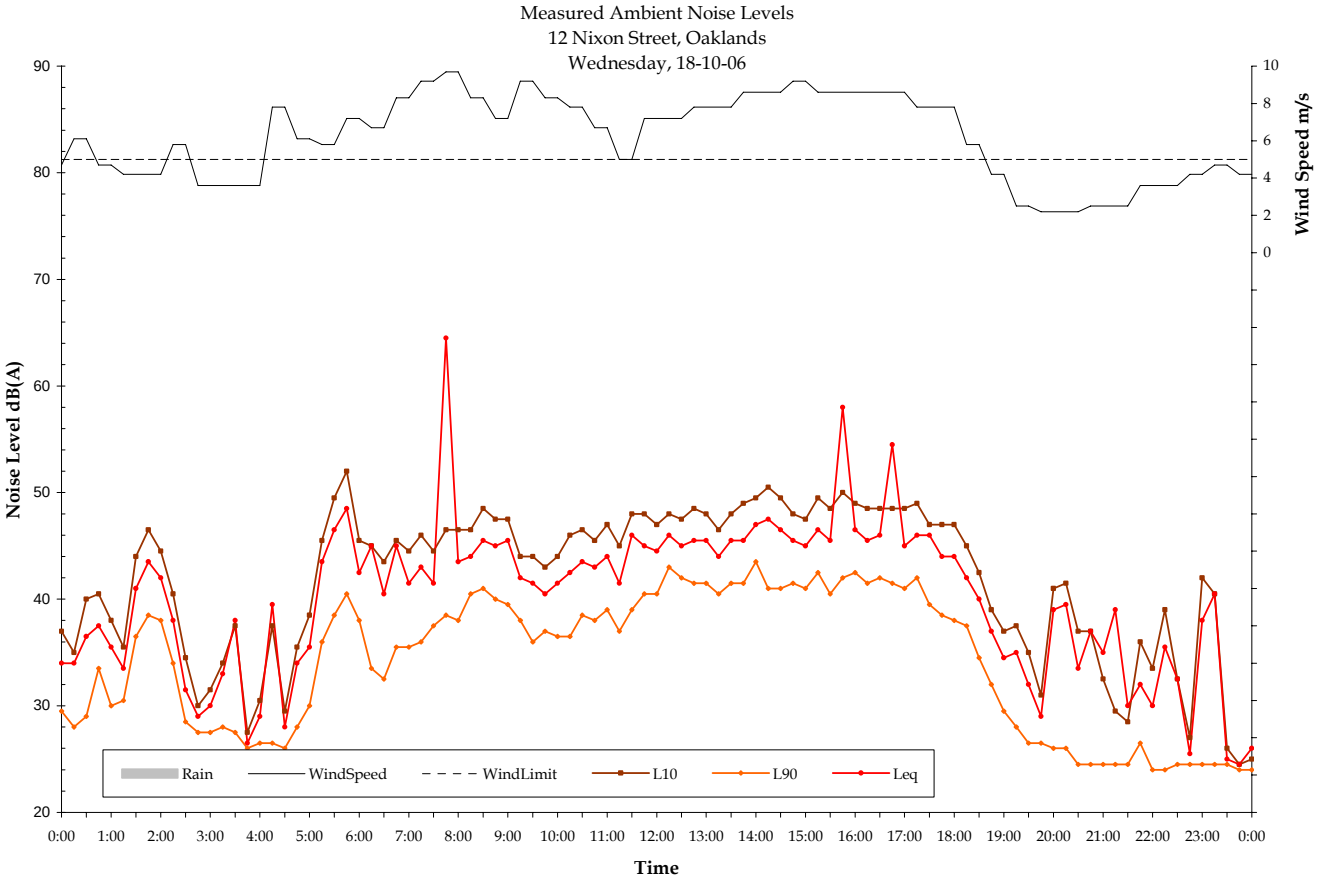
Noise Monitoring

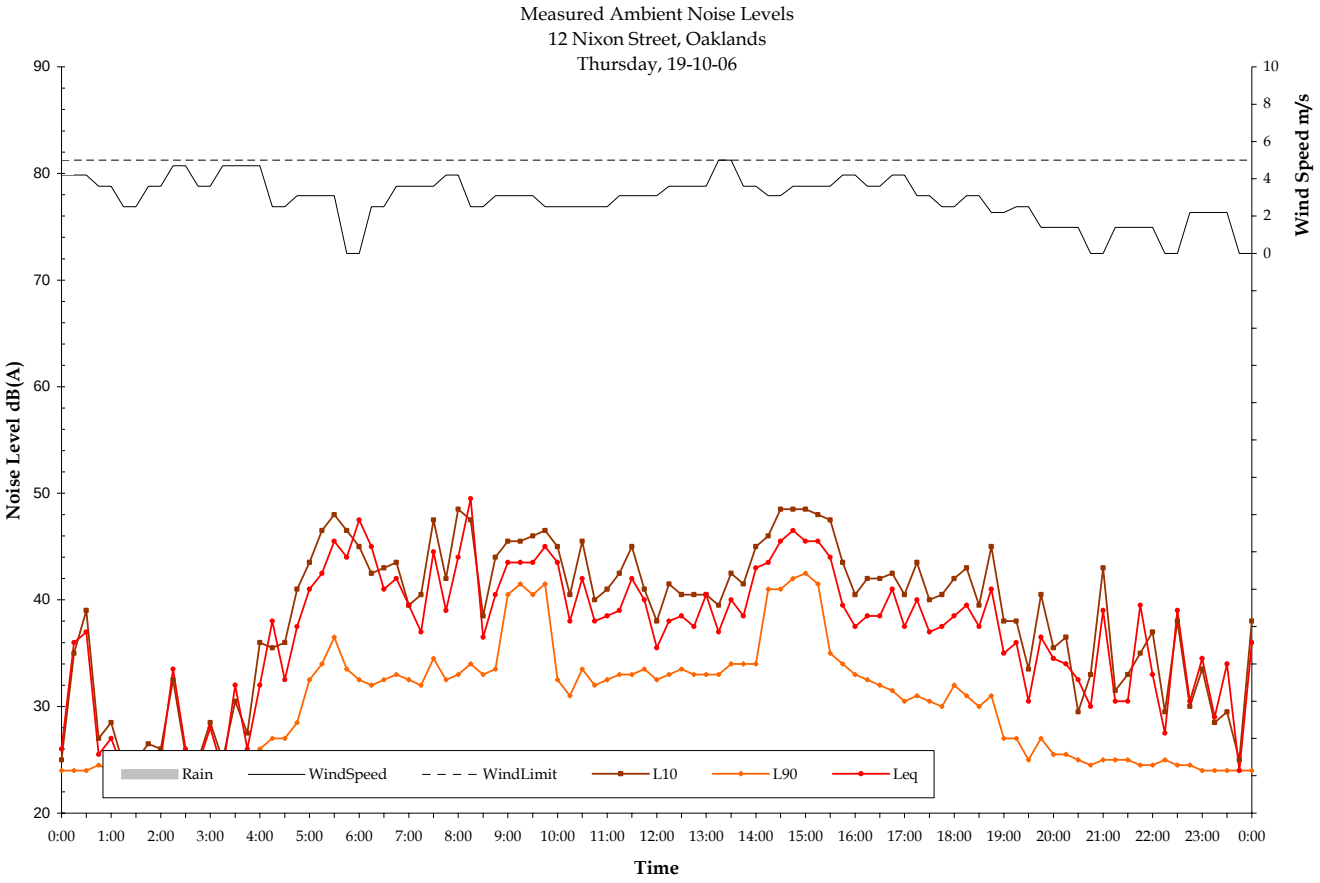
Table C.1 Summary of Measured Noise Levels at 12 Nixon Street, Oaklands with Wind Speed Exclusion Limit of 5m/s

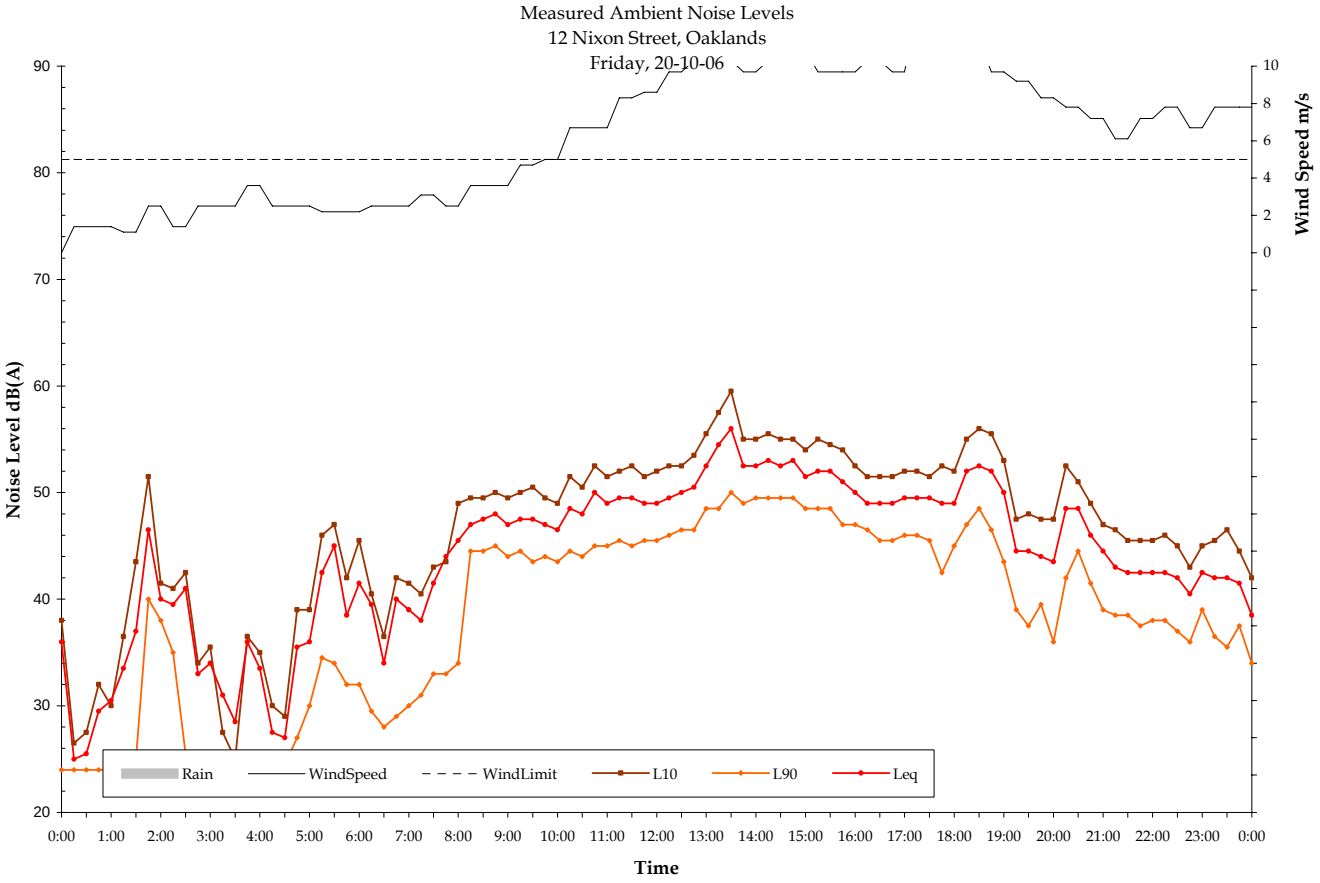
Date	Assessment Background Level, dB(A)			Ambient Noise Level, dB(A) $L_{Aeq,period}$		
	Day	Evening	Night	Day	Evening	Night
Tuesday, 17-10-06	0	25	0	0	39.6	0
Wednesday, 18-10-06	0	24.5	24	0	35.7	38.8
Thursday, 19-10-06	31	24.5	24	42.1	36.4	38
Friday, 20-10-06	0	0	0	0	0	0
Saturday, 21-10-06	0	0	25	0	0	36.3
Sunday, 22-10-06	29	24	24	38.9	37.4	39.9
Monday, 23-10-06	33	24.5	24	43.2	37.7	37.1
Tuesday, 24-10-06	0	25	24	0	40.3	38
Wednesday, 25-10-06	0	0	0	0	0	0
Thursday, 26-10-06	31.5	25.5	24	47.4	36.1	36.9
Friday, 27-10-06	0	0	0	0	0	0
Saturday, 28-10-06	0	0	24.5	0	0	36.4
Sunday, 29-10-06	30.5	24	23.5	40.2	33	35.9
Monday, 30-10-06	31.5	24	23.5	46.1	35.7	38.2
Tuesday, 31-10-06	32.5	24	23.5	42.8	37.4	37
Wednesday, 01-11-06	0	25	0	0	42.6	0
Thursday, 02-11-06	0	0	0	0	0	0
Rating Background Level	31.5	24.5	24			
Average				43.9	38.2	37.7

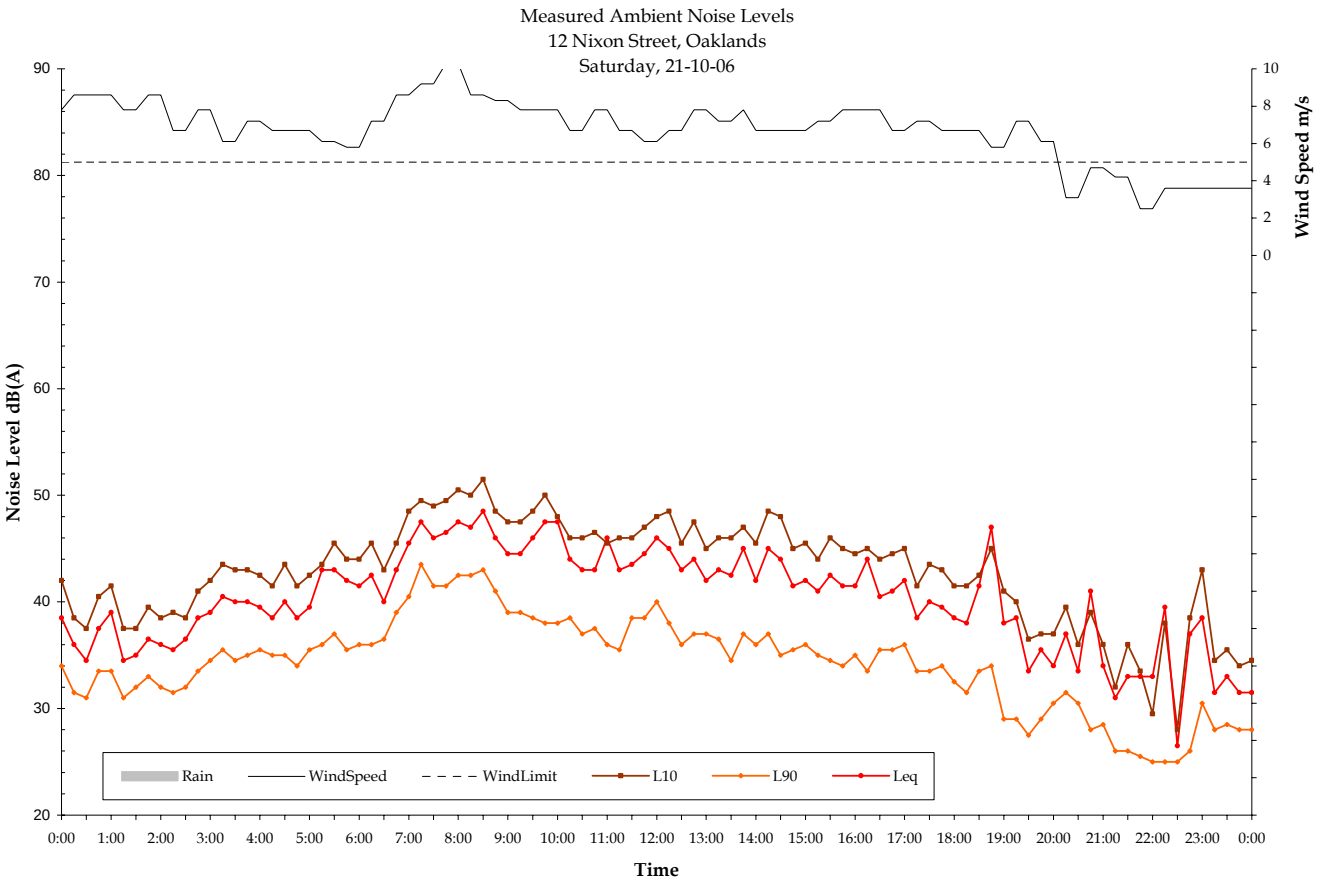
1. Wind speed exclusion limit was 5.0m/s.
2. "0" indicates periods excluded due to weather or logger operation

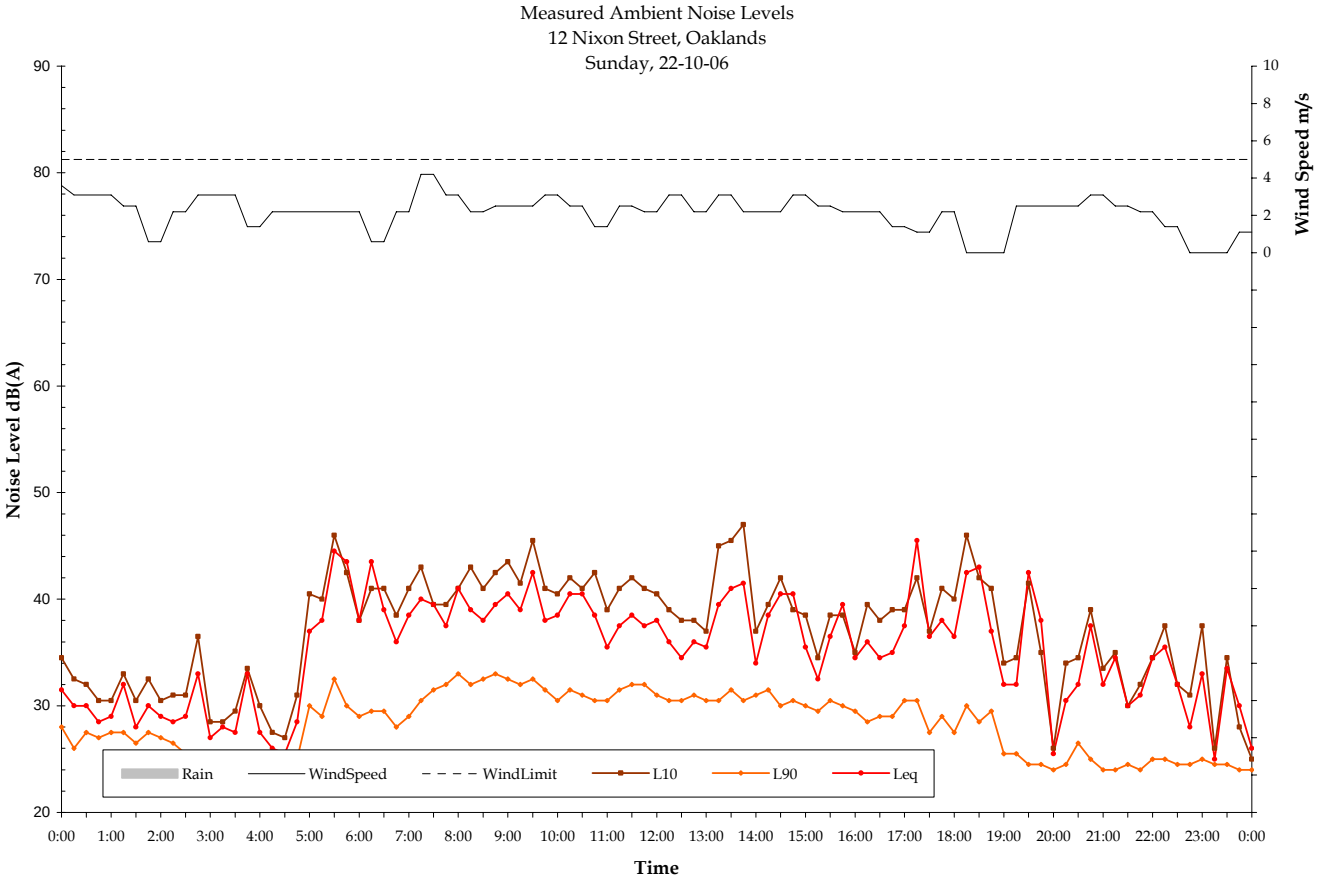

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Tuesday, 17-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq

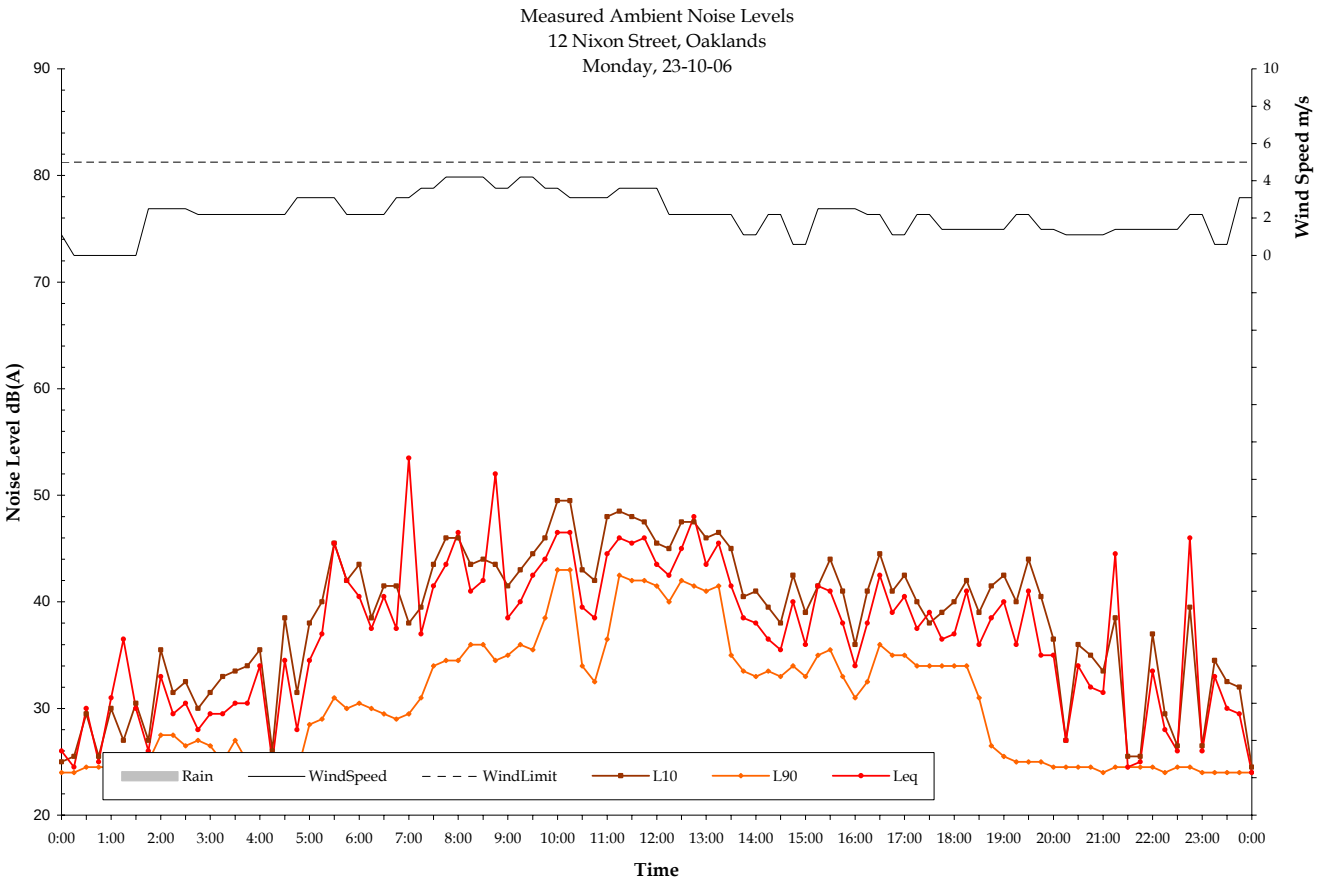

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Wednesday, 18-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq

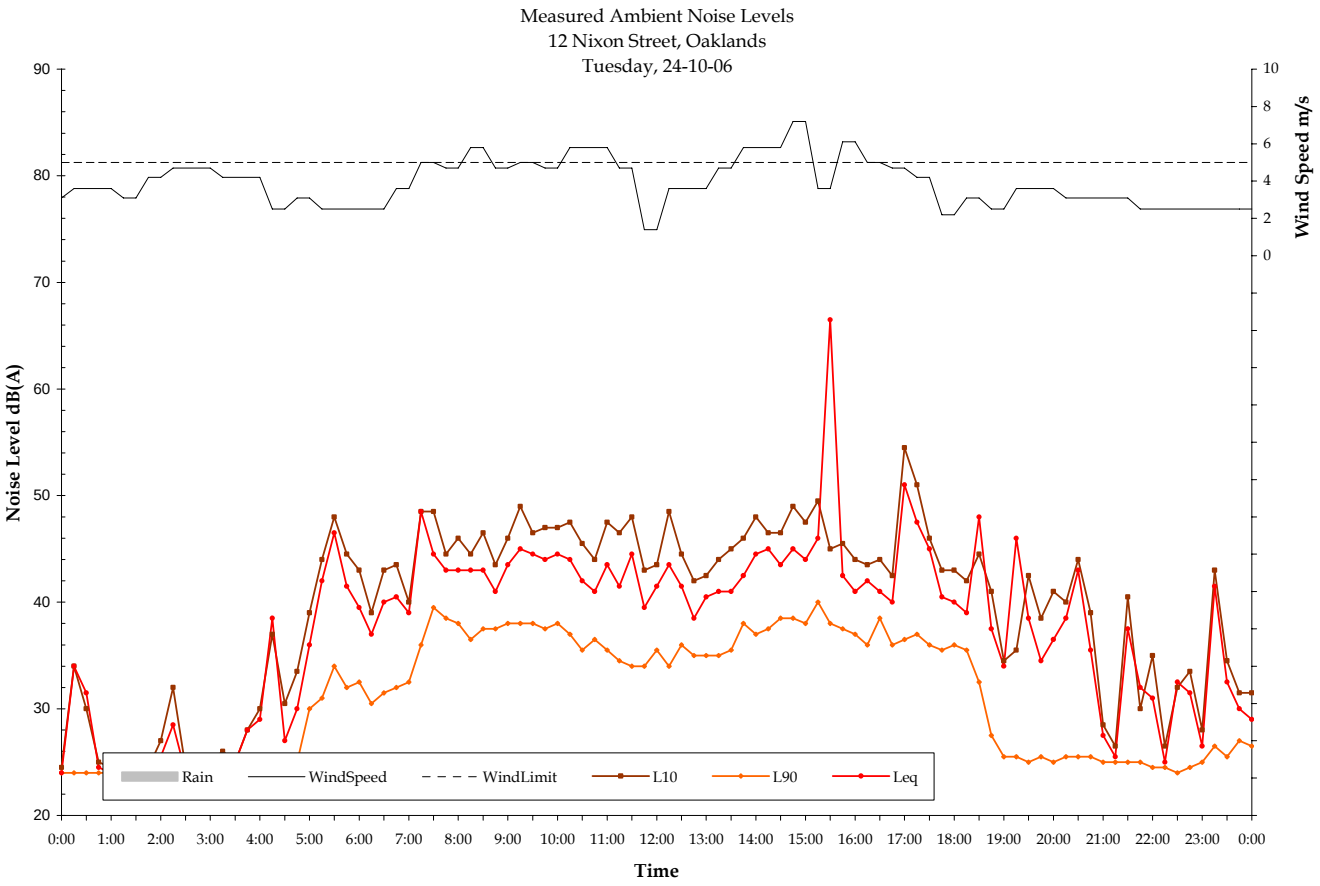

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Thursday, 19-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

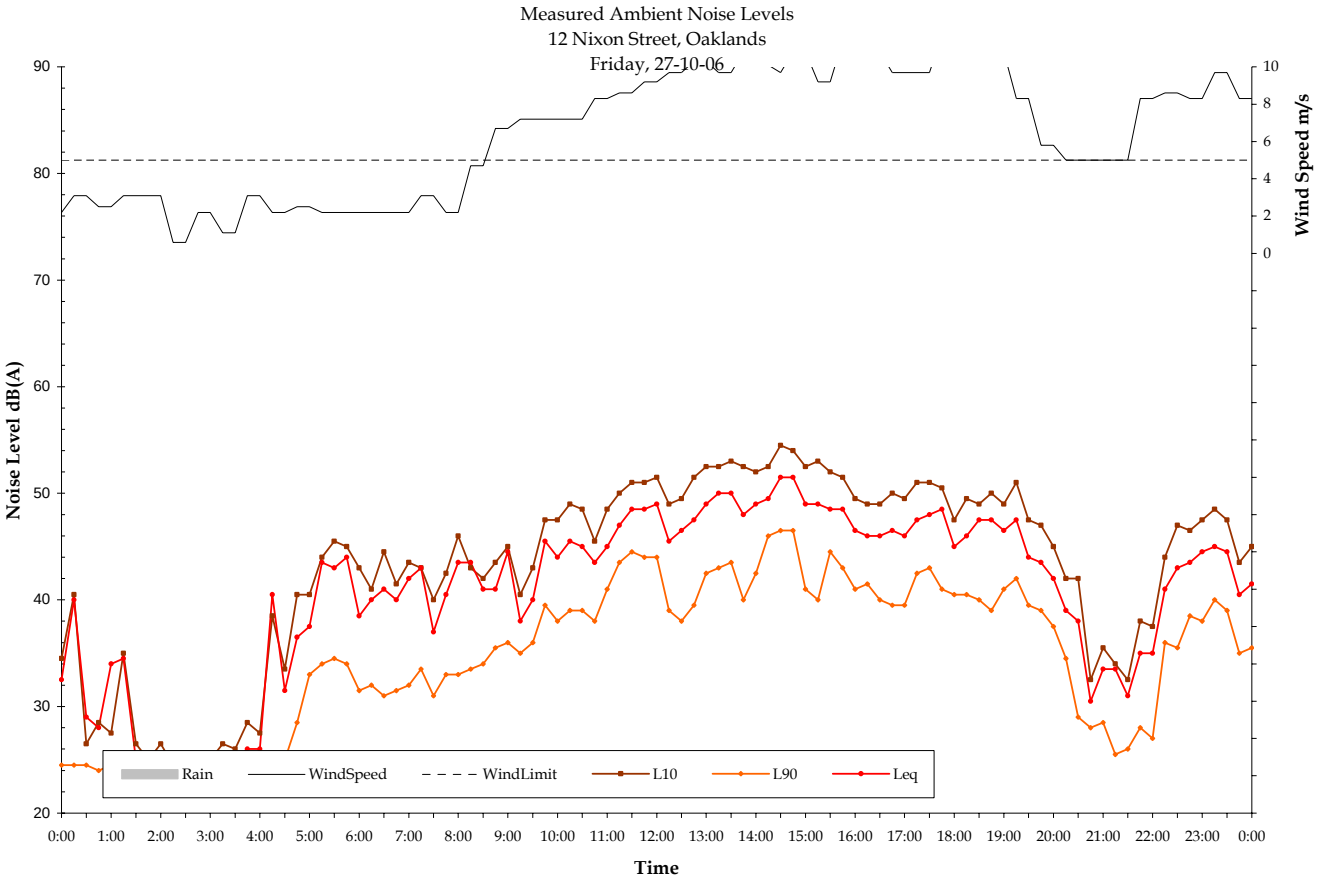

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Friday, 20-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

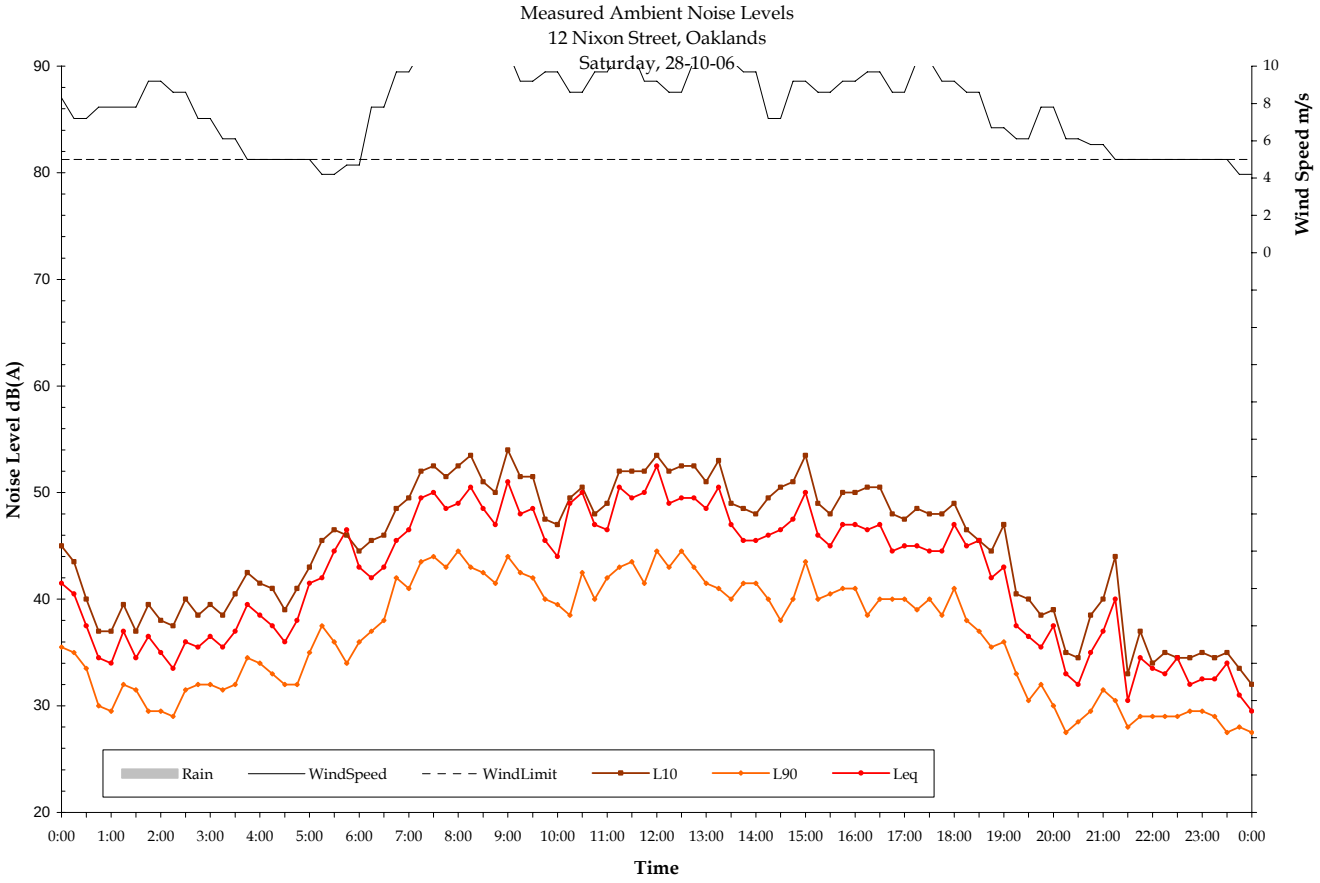

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Saturday, 21-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq

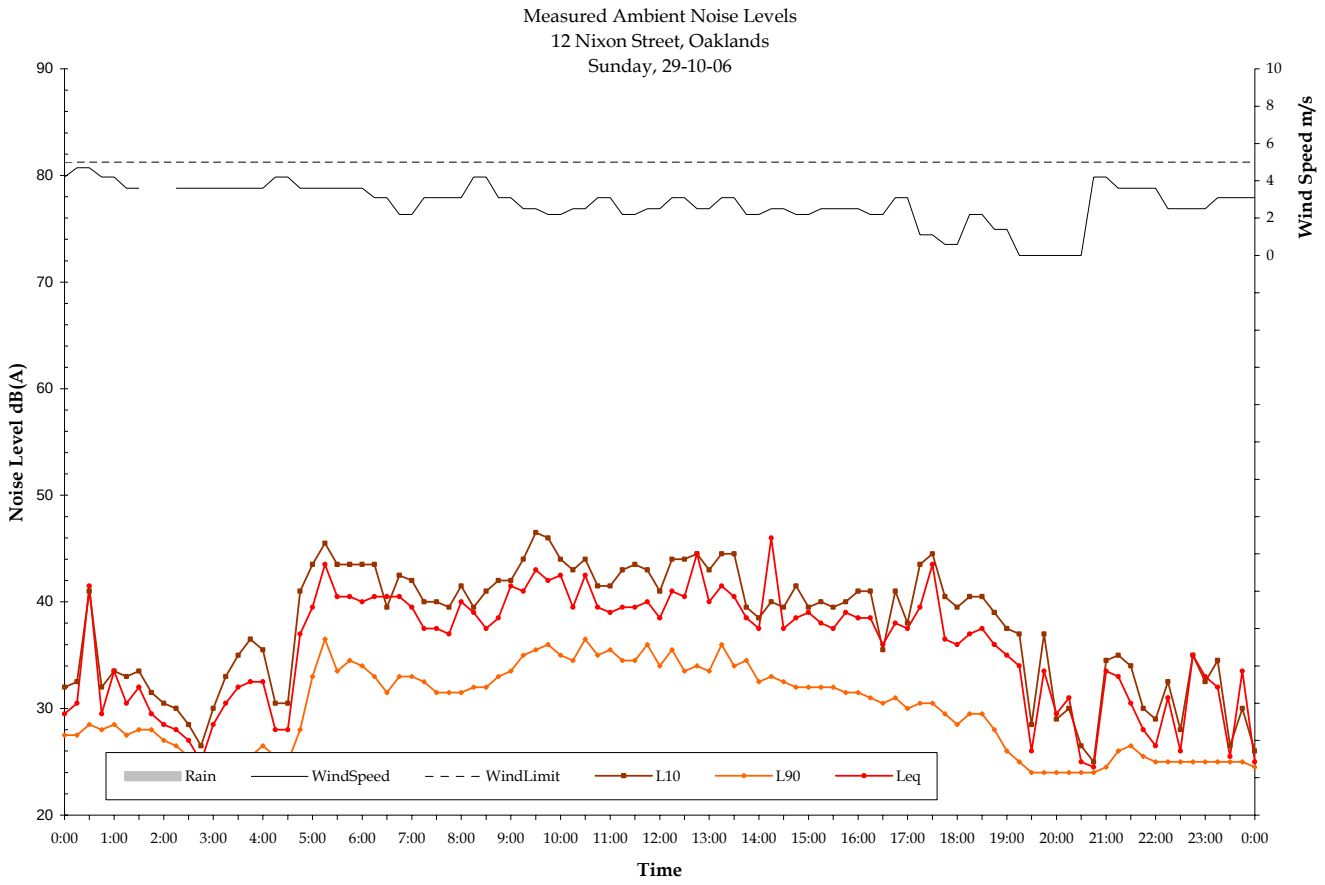

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Sunday, 22-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq

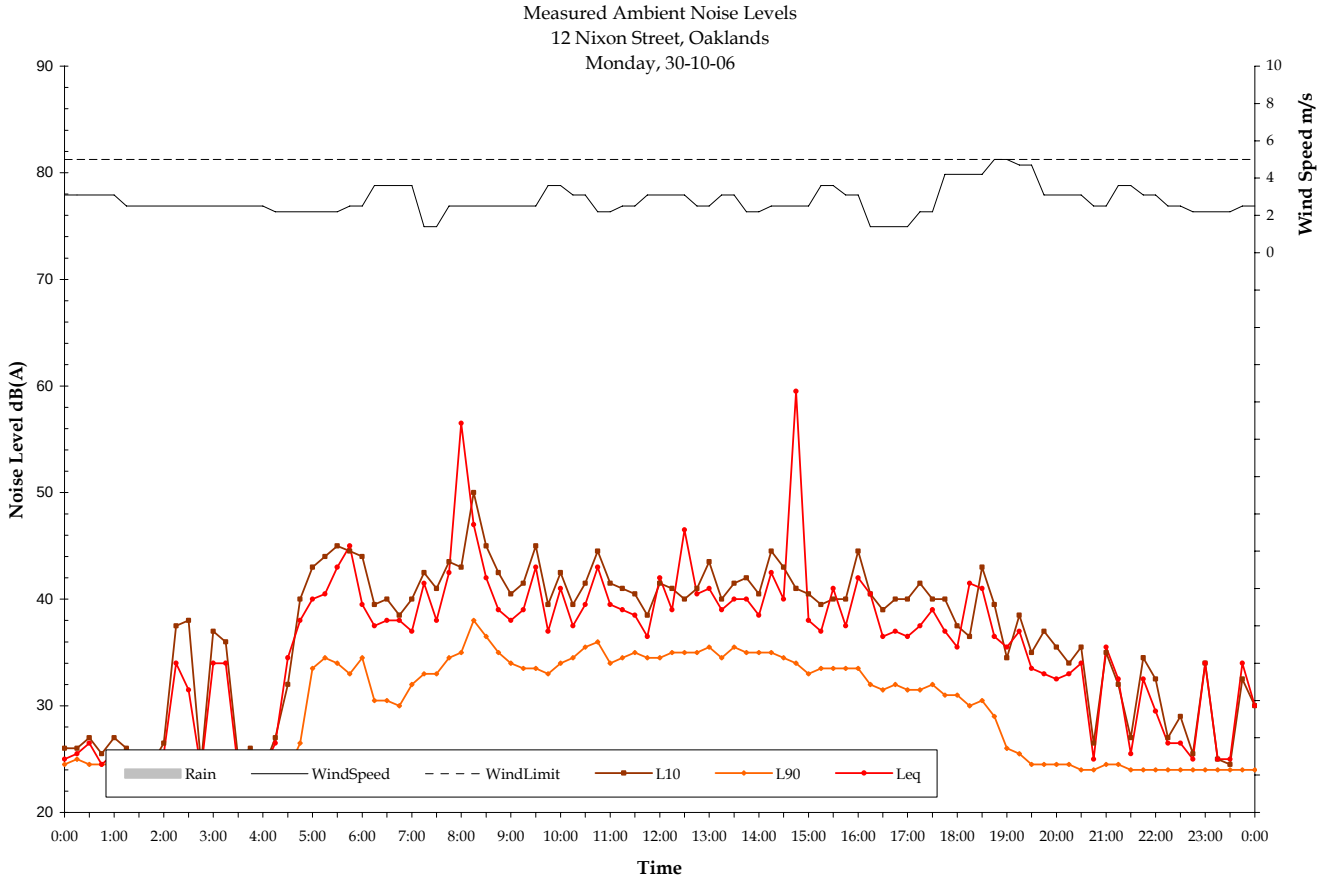

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Monday, 23-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

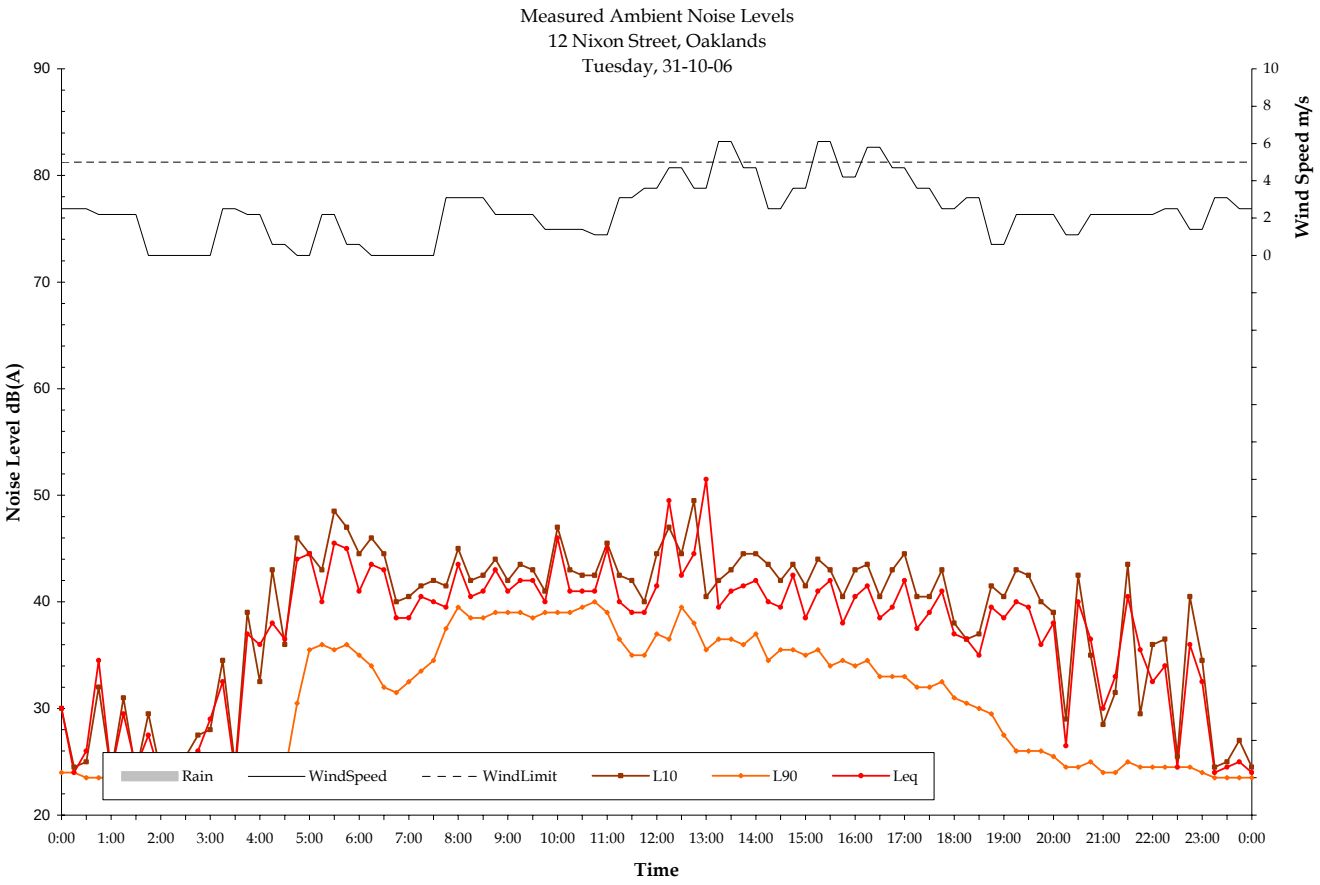

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Tuesday, 24-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

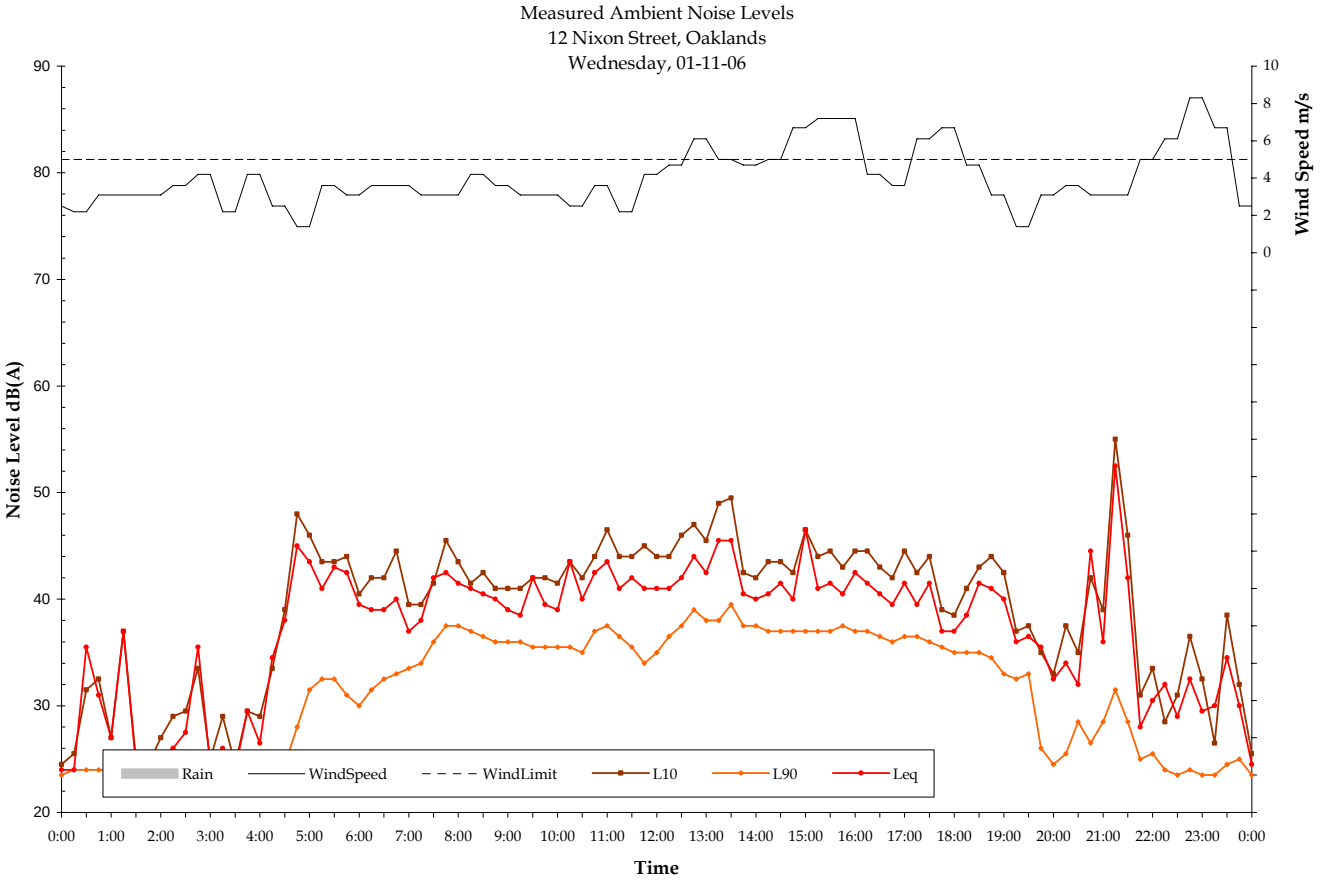

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Friday, 27-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Saturday, 28-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Sunday, 29-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Monday, 30-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Tuesday, 31-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq


Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Wednesday, 01-11-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq

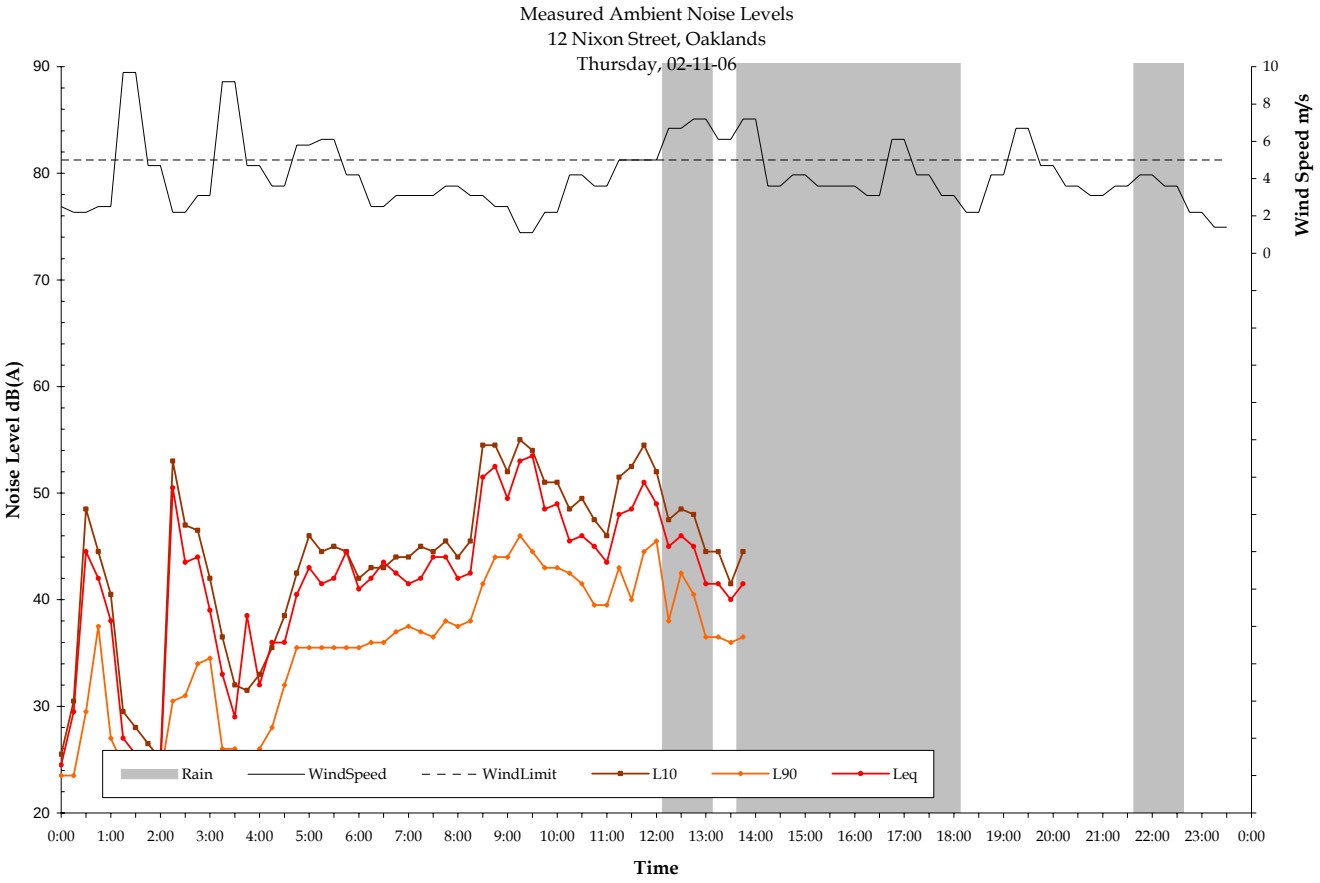
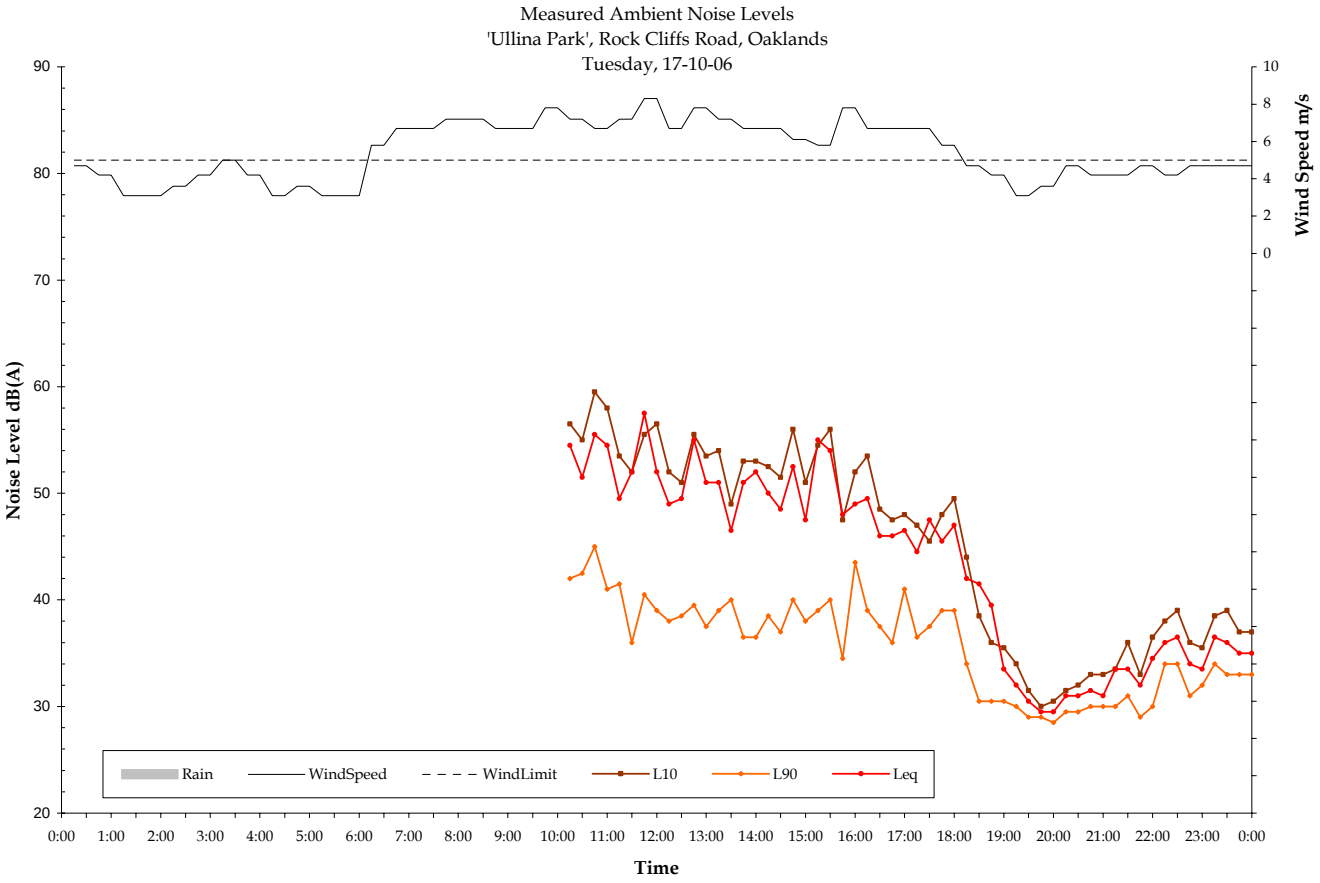
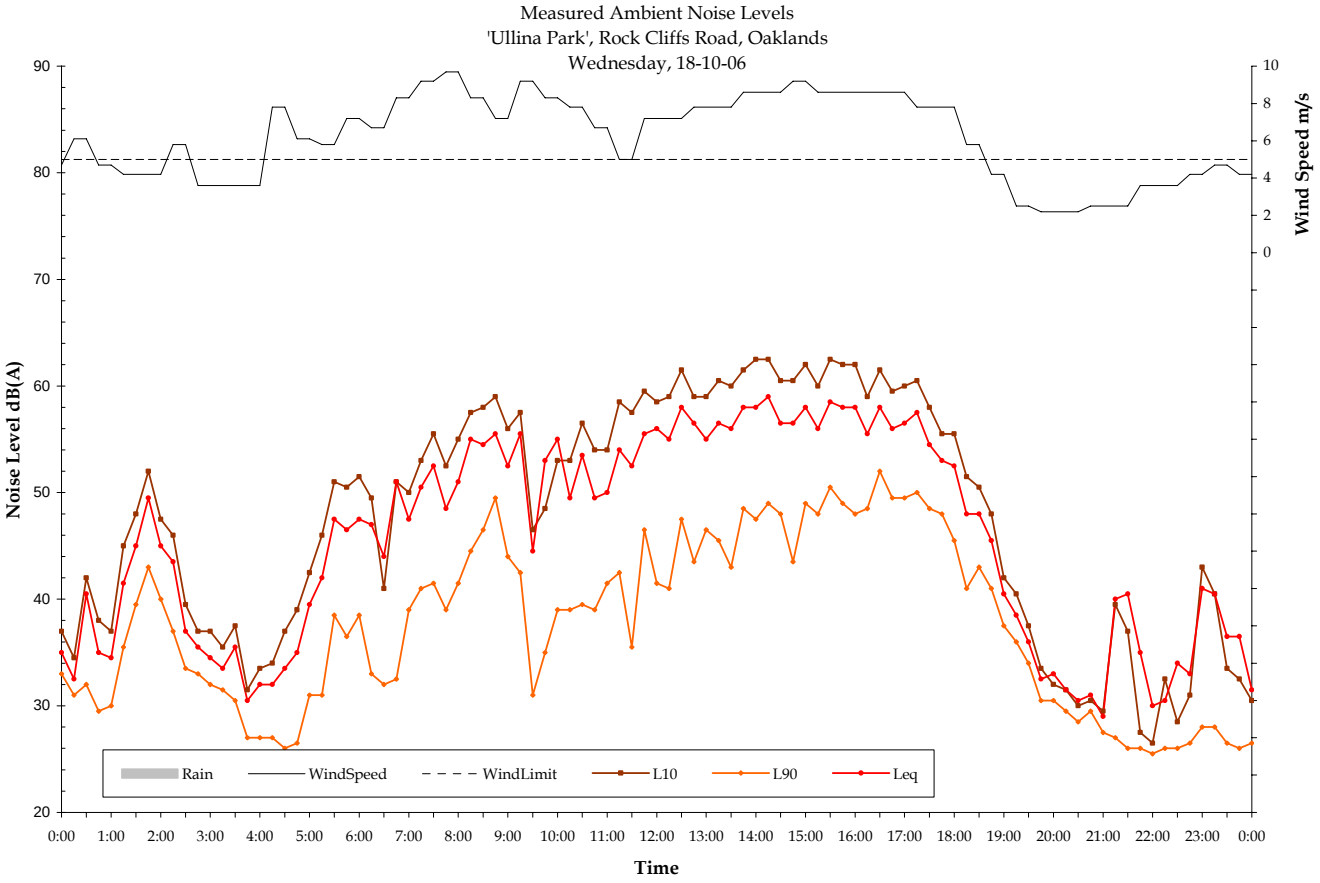

Measured Ambient Noise Levels
12 Nixon Street, Oaklands
Thursday, 02-11-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq

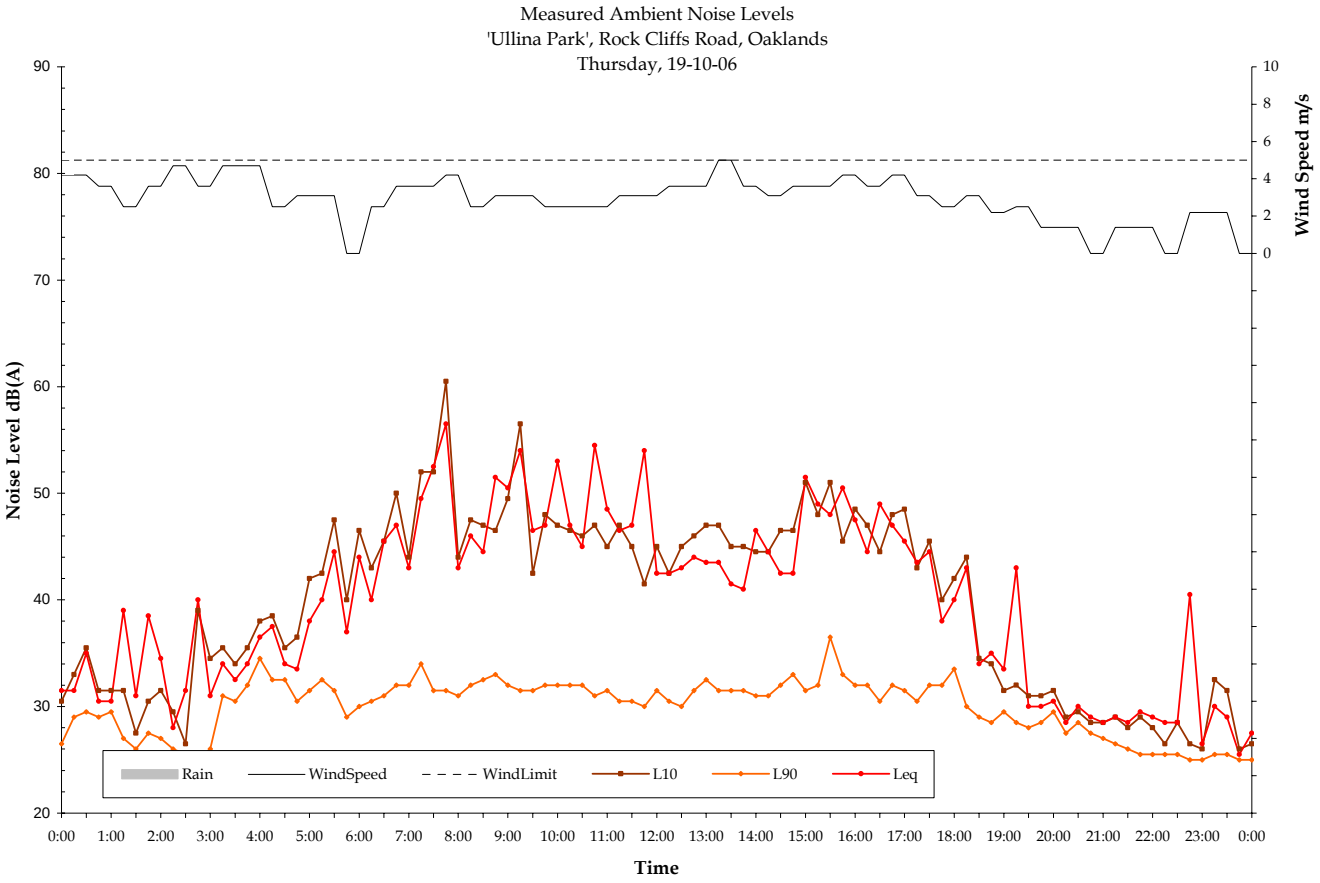
Table C.2 Summary of Measured Noise Levels at "Ullina Park", Rock Cliffs Rd, Oaklands with Wind Speed Exclusion Limit of 5m/s

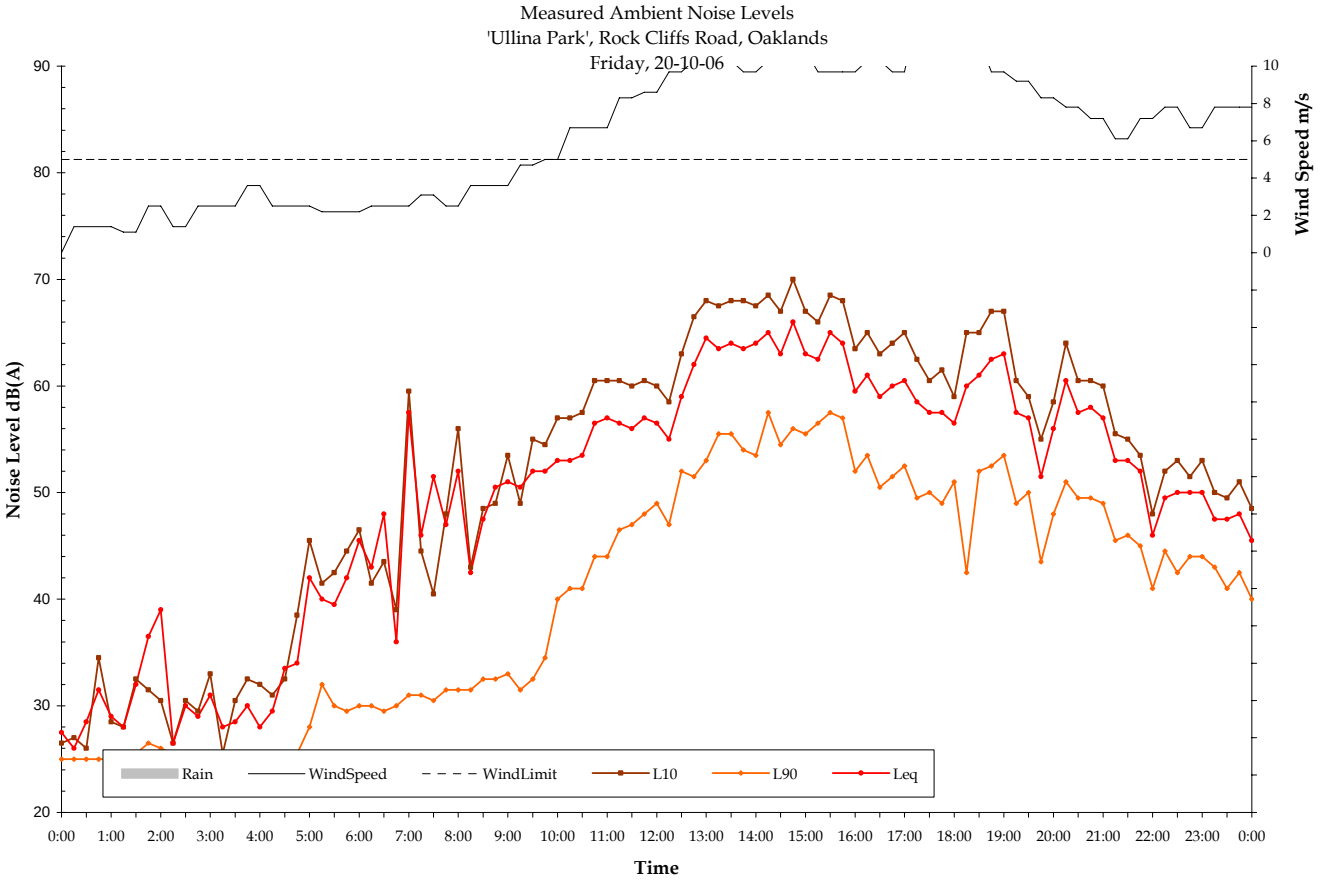
Date	Assessment Background Level, dB(A)			Ambient Noise Level, dB(A) $L_{Aeq,period}$		
	Day	Evening	Night	Day	Evening	Night
Tuesday, 17-10-06	0	29	0	0	35.7	0
Wednesday, 18-10-06	0	26	26	0	38.2	39.1
Thursday, 19-10-06	30.5	25.5	25	48.8	35.5	43.4
Friday, 20-10-06	0	0	0	0	0	0
Saturday, 21-10-06	0	0	25.5	0	0	43.7
Sunday, 22-10-06	29.5	25	25	46	39.3	49.5
Monday, 23-10-06	30	25	25	52.9	36.4	52.3
Tuesday, 24-10-06	0	27	26	0	36.6	39.8
Wednesday, 25-10-06	0	0	0	0	0	0
Thursday, 26-10-06	30	25.5	24.5	46.4	39.7	39.6
Friday, 27-10-06	0	0	0	0	0	0
Saturday, 28-10-06	0	0	25.5	0	0	37.8
Sunday, 29-10-06	28	25	24.5	53.2	35.7	45.5
Monday, 30-10-06	28.5	24.5	0	45.6	34.4	0
Rating Background Level	29.8	25.5	25			
Average				50	37.2	46.2

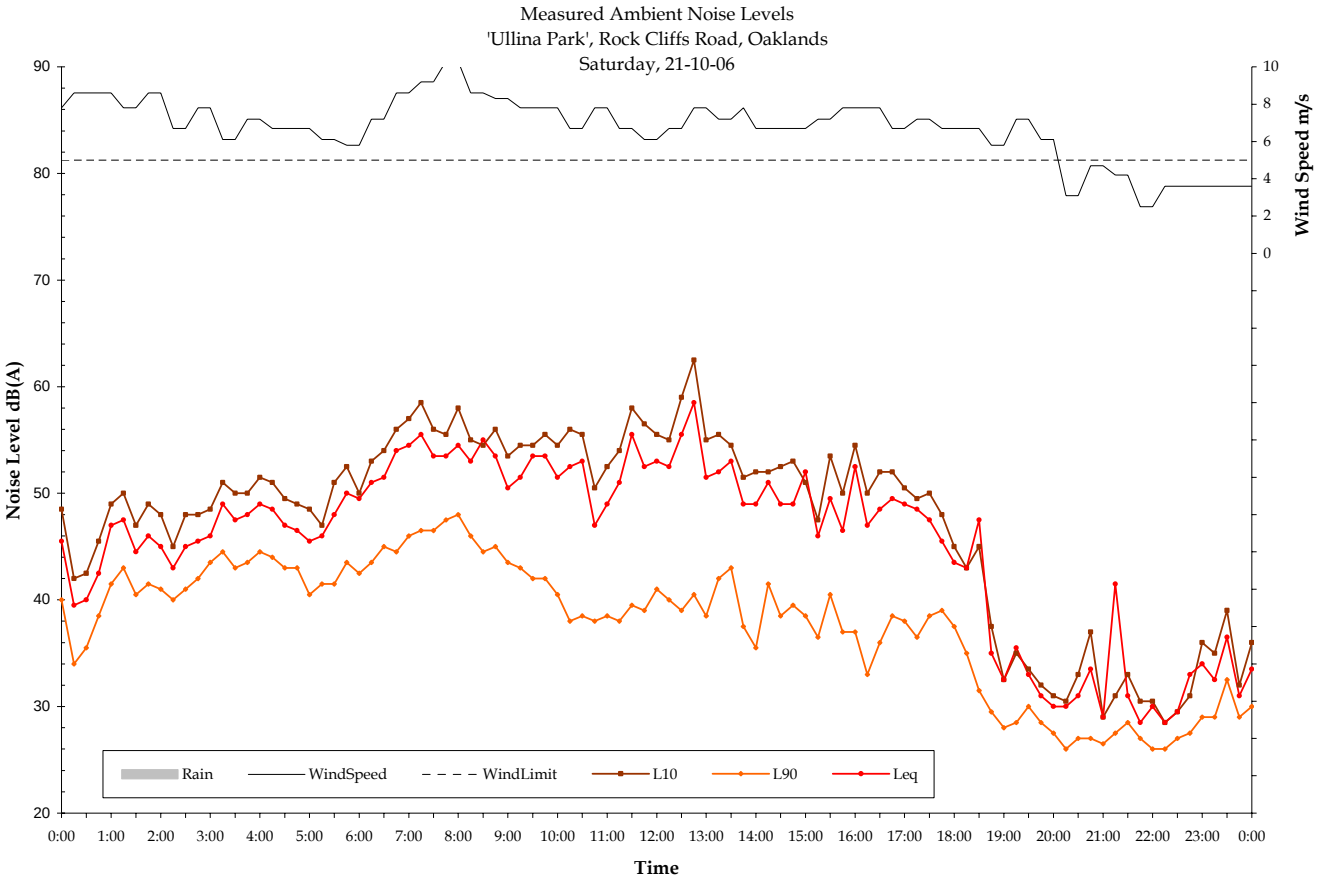
1. Wind speed exclusion limit was 5.0m/s
2. "0" indicates periods excluded due to weather or logger operation

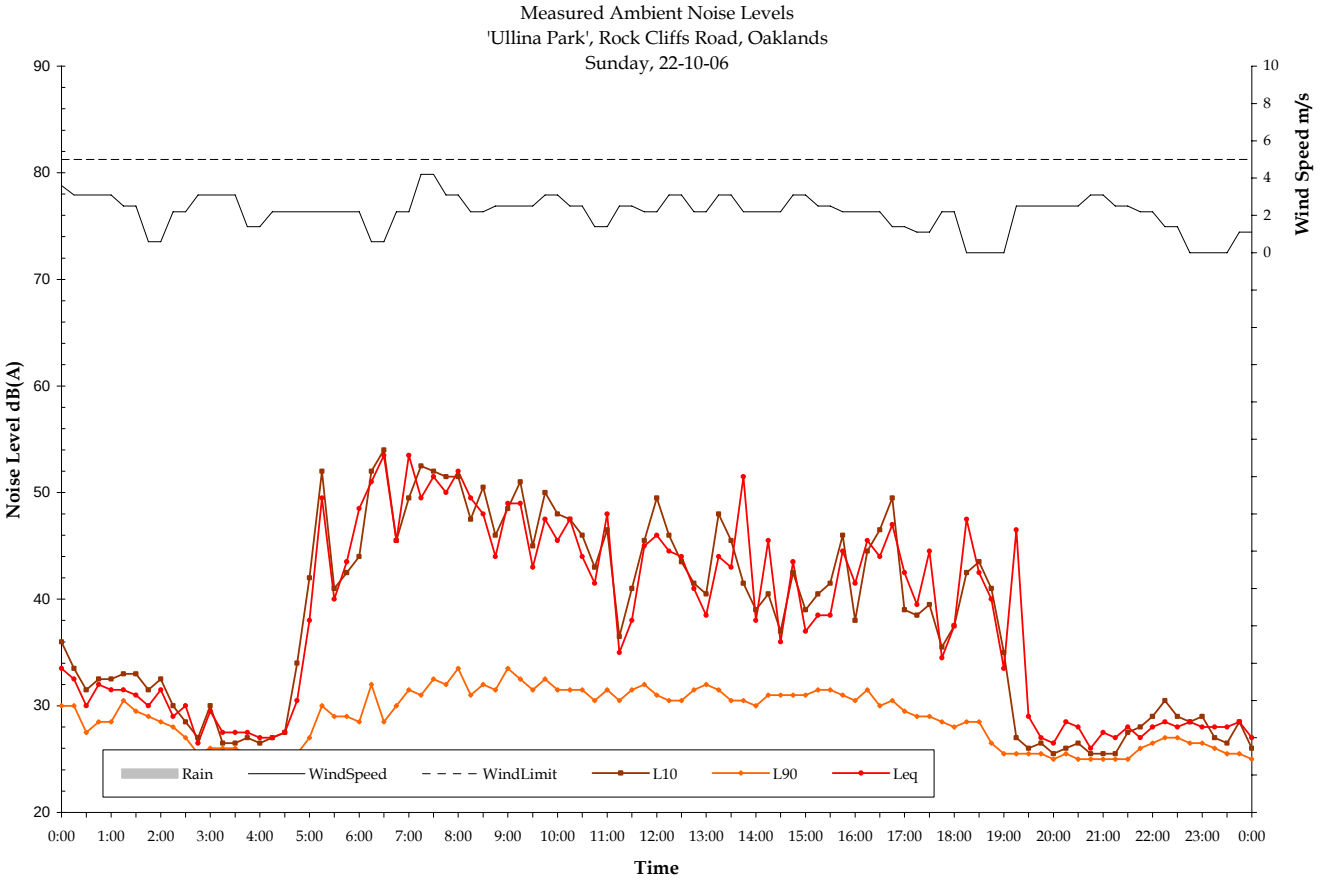

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Tuesday, 17-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

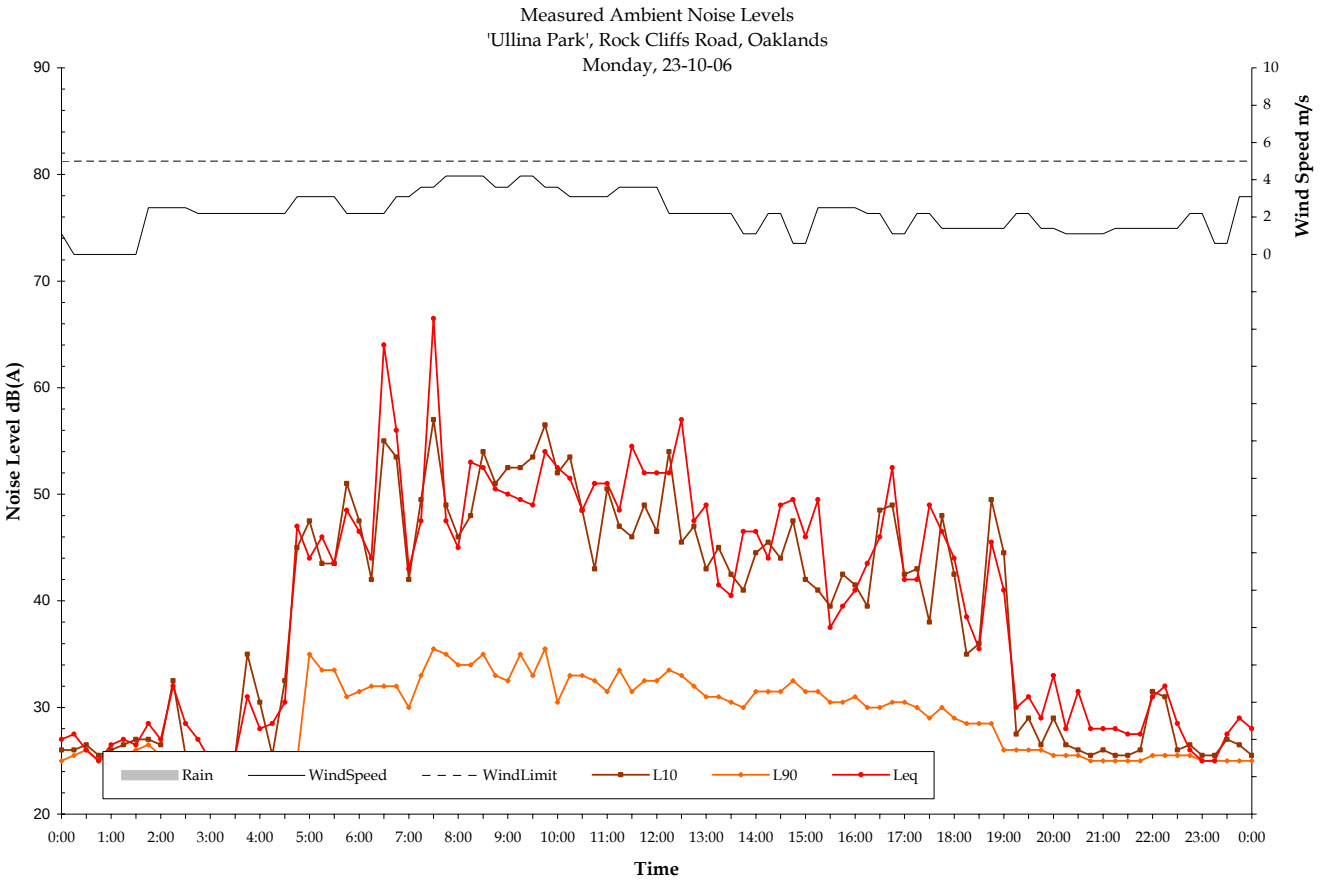

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Wednesday, 18-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

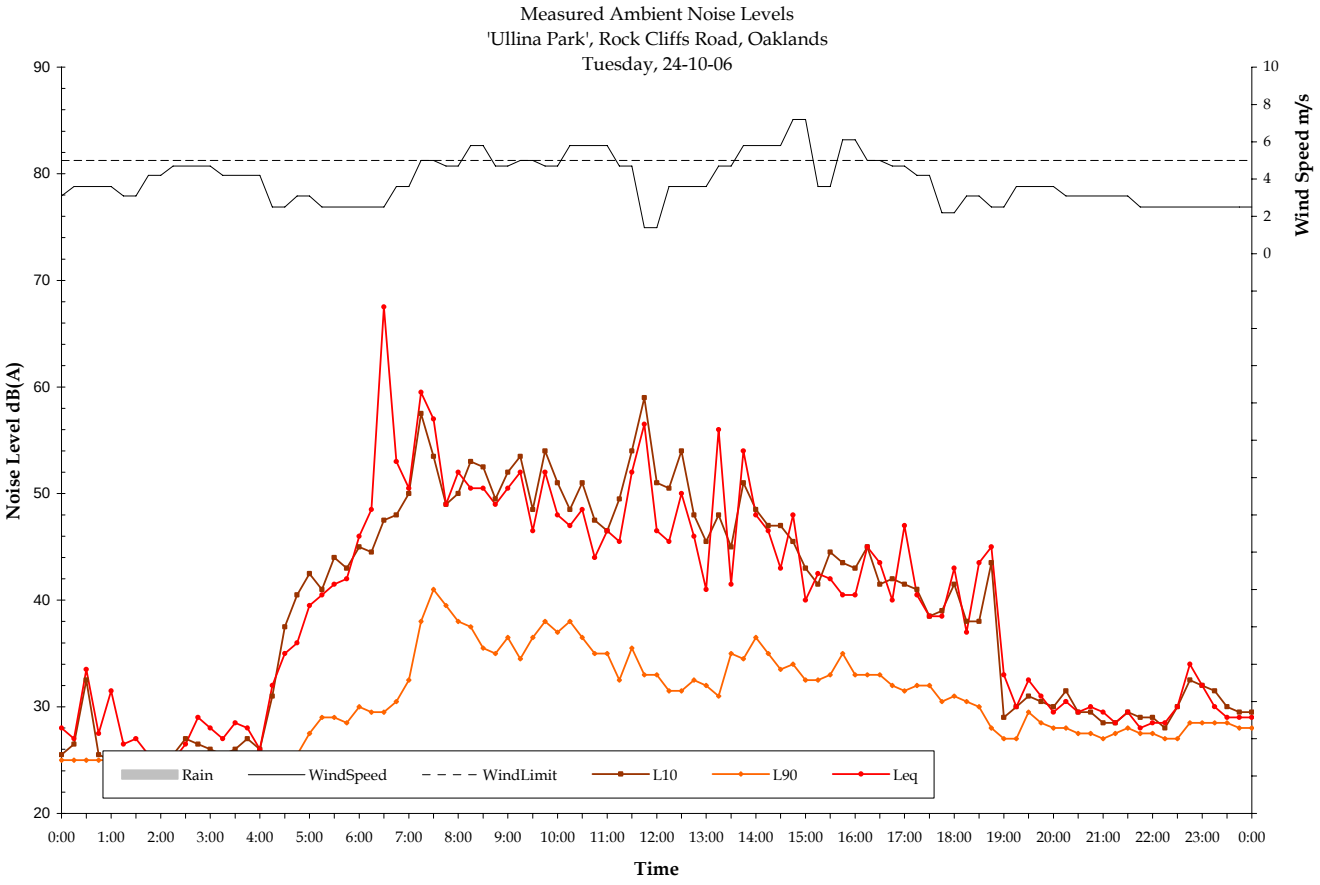

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Thursday, 19-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq

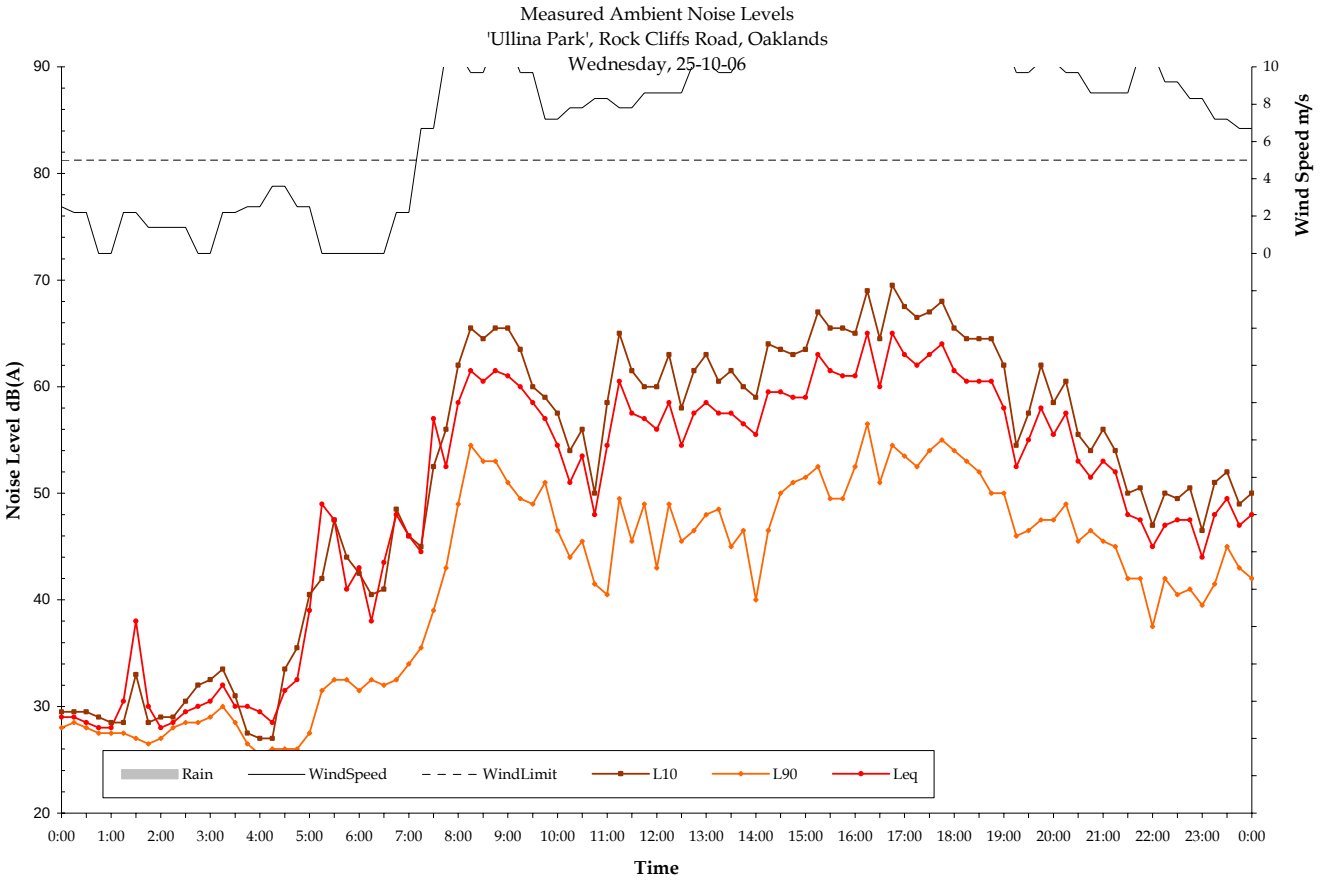

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Friday, 20-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq

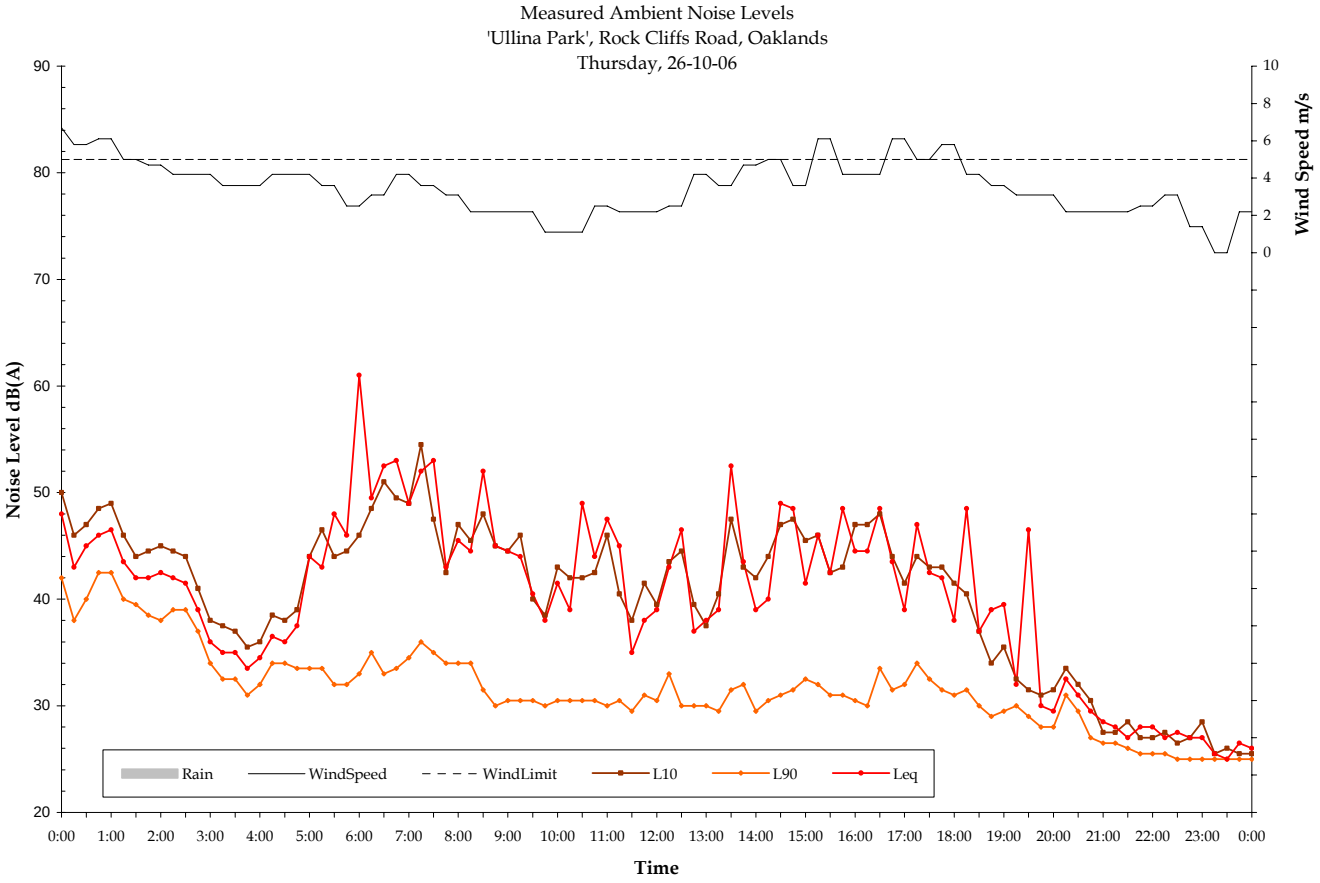

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Saturday, 21-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

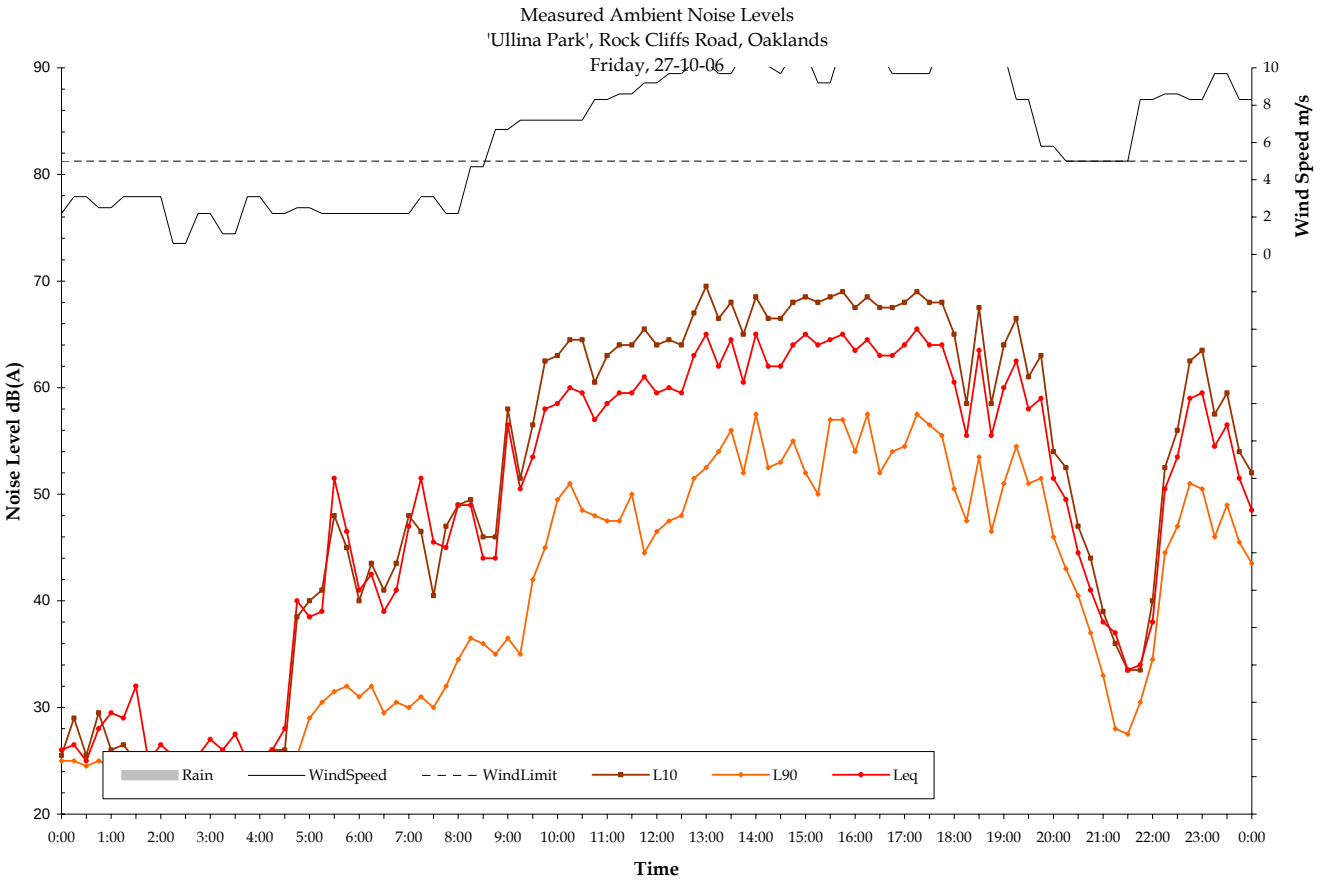

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Sunday, 22-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

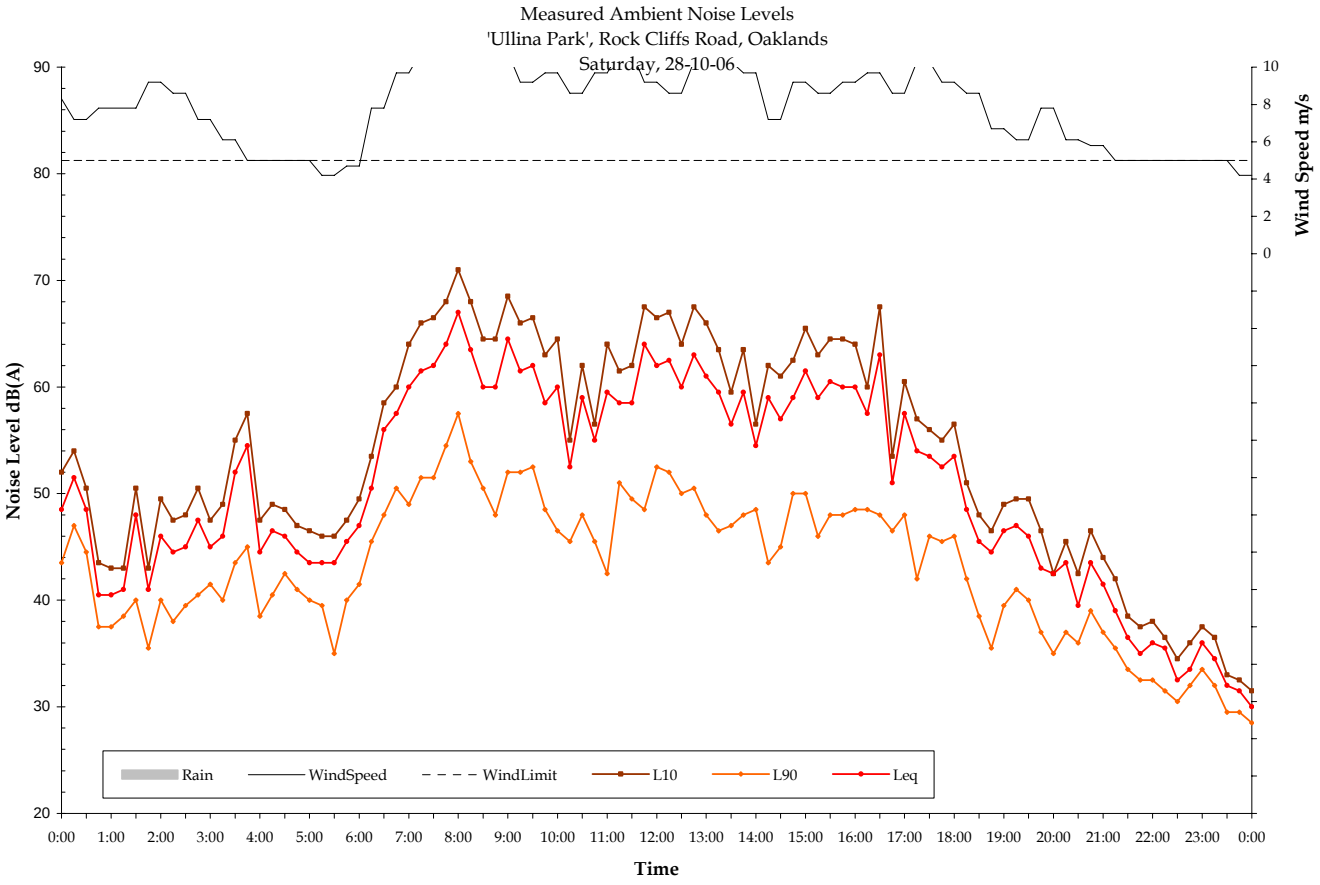

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Monday, 23-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

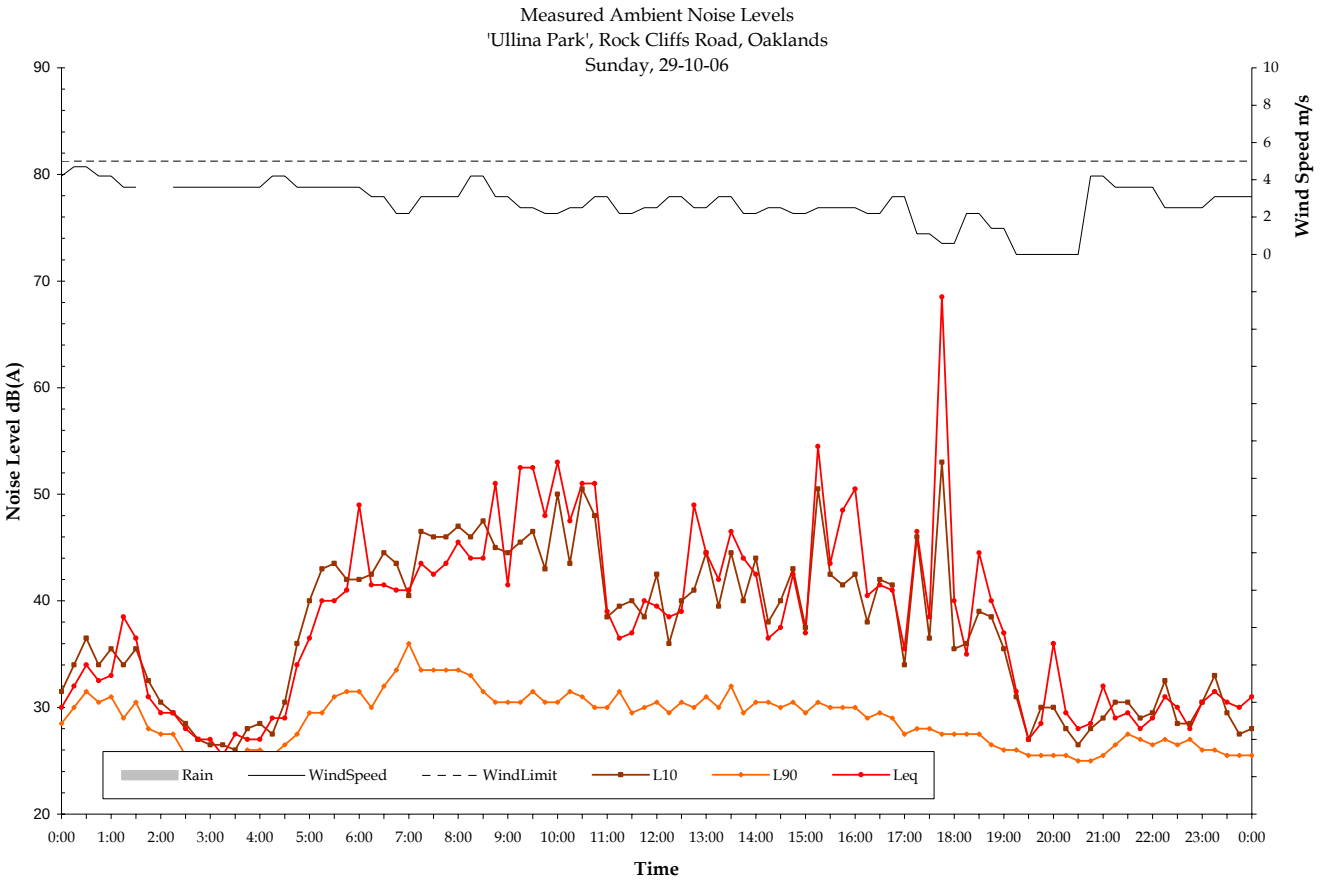

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Tuesday, 24-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

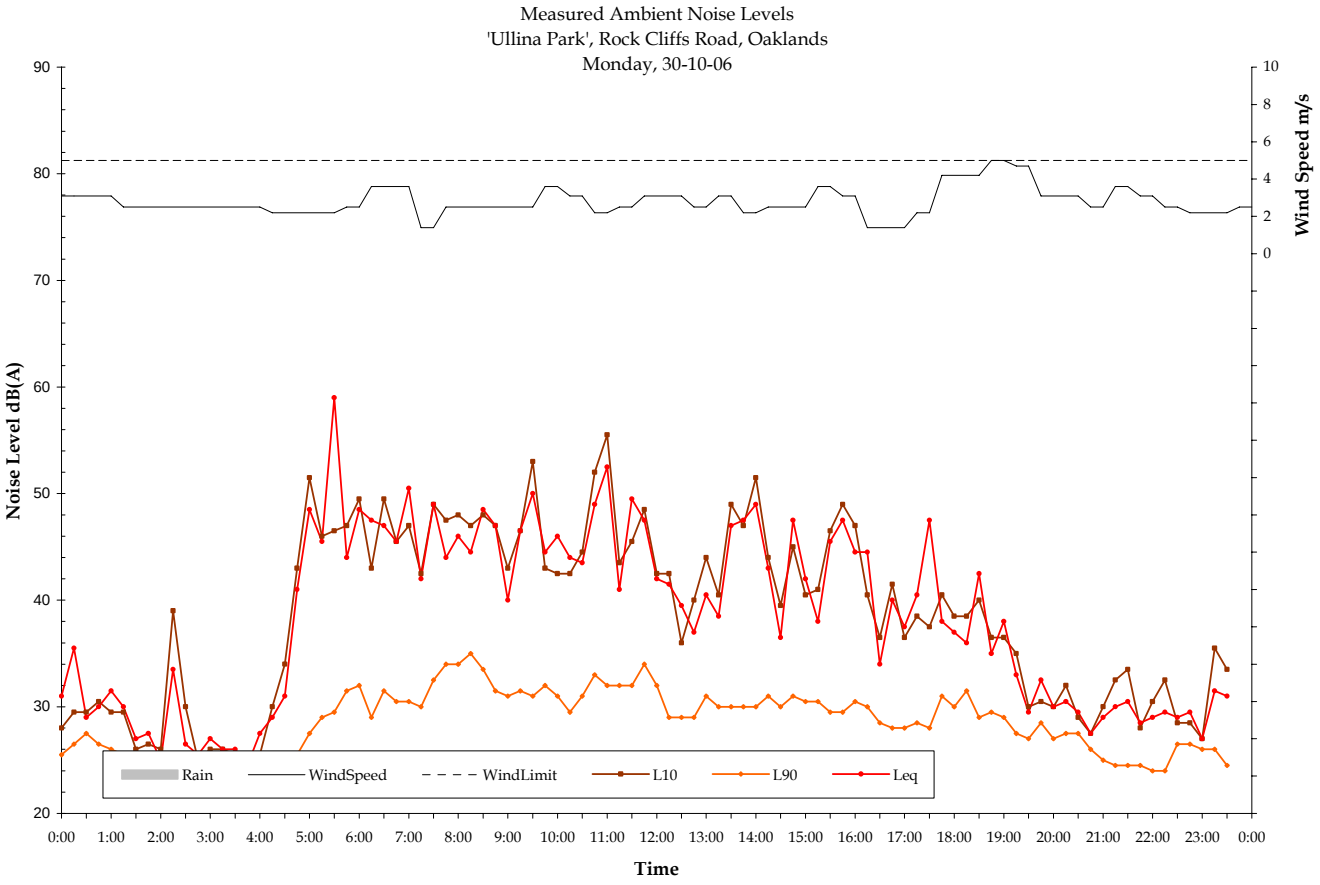

Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Wednesday, 25-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Thursday, 26-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Friday, 27-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq


Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Saturday, 28-10-06
Noise Level dB(A)
Wind Speed m/s
Time
Rain
WindSpeed
WindLimit
L10
L90
Leq


Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Sunday, 29-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
'Ullina Park', Rock Cliffs Road, Oaklands
Monday, 30-10-06
Noise Level dB(A)
Wind Speed m/s
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

Annex D

Sound Power Spectral Data

Table D.1 Source Sound Power Spectra

Source	Lw	63	125	250	500	1	2	4	8
		Hz	Hz	Hz	Hz	kHz	kHz	kHz	kHz
Conveyor	96	74	85	89	91	91	87	81	70
Screw conveyor	93	59	65	71	86	89	87	79	74
Hammermill	112	74	85	102	107	107	105	101	94
Front End Loader	110	78	93	103	104	105	103	97	89
Cooling tower fans	92	65	70	75	86	87	85	81	71
Blower - dryer	92	65	70	75	86	87	85	81	71
Pump	99	64	92	81	88	96	93	85	73
Transport truck	107	80	95	98	102	102	96	85	75

1. All levels are dB(linear)

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