

Appendix I

# Noise and vibration impact assessment (Renzo Tonin & Associates)



# THE MACQUARIE RIVER TO ORANGE PIPELINE PROJECT

## CONSTRUCTION AND OPERATIONAL NOISE AND VIBRATION ASSESSMENT FOR EA

TF332-01F02 (REV 5) ORANGE DROUGHT RELIEF PIPELINE.DOC

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Prepared for:

ORANGE CITY COUNCIL

Attention: MR JOHN MARSHALL



## DOCUMENT CONTROL

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# 1 INTRODUCTION

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## 1.1 Purpose of this report

Orange City Council proposes to undertake the Macquarie River to Orange Pipeline Project (referred to in this report as 'the project'). This report has been prepared to provide an assessment of the noise and vibration impacts of the project as an input to the environmental assessment. The environmental assessment is being prepared in accordance with the requirements of Part 3A of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act).

The report addresses the requirements of the Director-General of the NSW Department of Planning and Infrastructure (the Director-General's Requirements) dated 24 March 2011.

## 1.2 Project overview

The project is one step to improving the water security for Orange. It involves construction and operation of infrastructure required to transfer approximately 12 ML/day of water a distance of approximately 37 km from the Macquarie River to the Suma Park Dam at Orange.

The infrastructure required to transfer the water includes an offtake and pump stations, an underground pipeline (approximately 37 km in length), an discharge structure, and ancillary infrastructure (power supply).

In summary, the project would involve construction and operation of the following infrastructure:

- 37 km of 375 mm diameter water rising main between the Macquarie River and Suma Park Dam.
- An offtake structure and pump station located at the upper Macquarie River.
- Two booster pump stations and break tanks along the pipeline route.
- Power supply to pumps and other infrastructure.
- Telemetry controls to enable remote operation of the infrastructure including pumps and valves, etc.
- A discharge structure at the Suma Park Dam.

## 1.3 The Location of the Project

The proposed offtake structure would be located on the south side of the Macquarie River immediately upstream of the confluence with Boshes Creek. The water carried along the pipeline would discharge into the Suma Park Reservoir at Orange via the discharge structure, located approximately 10 m east of the existing saddle dam (at the north-west corner of the dam wall)..

The proposed route for the pipeline contains road reserves, including Ophir Rd and Long Point Rd. In most (up to 70% of the route) areas the pipeline would need to cross private land. It is

proposed that the majority of the pipeline would be underground and would not impact on farming or other land uses.

The project would be located in both the Orange and Cabonne local government areas. The majority of the pipeline would be located in the Cabonne local government area.

## **1.4 Hours of Operation**

### 1.4.1 Construction

Typical hours of construction would be in accordance with standard hours stipulated in the NSW Office of Environment and Heritage's (OEH) 'Interim Construction Noise Guideline' (ICNG). The standard hours of construction as per the ICNG are 7.00am to 6.00pm Monday to Friday, 8.00am to 1.00pm on Saturdays and no work permitted on Sundays or Public Holidays.

Construction of the pipeline is expected to take approximately 12 to 18 months to complete.

### 1.4.2 Operation

It is anticipated that the pipeline system, including pumps and valves, may operate at any time in accordance with the operating rules defined for the project.

## **1.5 Scope and Structure of Report**

### 1.5.1 Scope of Report

This report will present an assessment of construction noise and vibration issues and operational noise issues associated with the project.

#### Construction Noise Issues

It is anticipated that noise from the construction of the pipeline will essentially emanate from the three main sources, outlined below.

- **Construction noise** during open excavation of pipeline trenches, drilling and laying of pipes and construction of ancillary infrastructure e.g. pump stations, power supply, intake and outlet;
- **Blasting overpressure** from blasts during the excavation of rock (if normal blasting is required); and
- **Road traffic noise** from additional truck movements and other road vehicles associated with the construction of the pipeline. Vehicle will access the route of the proposed pipeline via The Lookout Road and Ophir Road.

#### Construction Vibration Issues

Activities undertaken on the site during construction may cause ground vibration, depending on the type of activities undertaken.

Ground vibration from normal blasting during the excavation of rock is potentially significant. Vibration from blasting is also assessed in this report.

#### Operational Noise Issues

Noise during the operation of the pipeline will predominantly be from three main sources, outlined below.

- **Pump station noise** from pumps, dosing equipment, valve, etc; and
- **Road traffic noise** from additional road traffic associated with the operation of the pipeline system. Road traffic may include service vehicles and trucks used for the maintenance of the pipeline system.

It is anticipated that the pipeline system, including pumps and valves, may operate at any time in accordance with the operating rules defined for the project. Therefore, operational noise will be assessed for the day, evening and night periods.

#### 1.5.2 Director General's Requirements for Noise and Vibration Assessment

The Department of Planning and Infrastructure Director General's Requirements (DGRs) relating to noise and vibration is shown below:

*"Include as assessment of noise and vibration impacts during construction and operation and in a cumulative context with existing development. The assessment must take into account the following guidelines, as relevant: Industrial Noise Policy (EPA, 2000), Assessing Vibration: A Technical Guideline (DECC, 2006) and Interim Construction Noise Guideline (DECC, 2009). The assessment is to identify sensitive receptors that have the potential to be impacted by the project and the likely impacts; and include a framework for the mitigation, management and monitoring of impacts during construction and operation (as relevant) with specific reference to noise and vibration-intensive construction works/activities (drilling, blasting, bulk excavation) and heavy vehicle movements."*

The DGRs, the NSW Office of Environment and Heritage's (OEH – formerly DECCW) submissions and the NSW Land and Property Management Authority's (LPMA) submissions require noise and vibration to be assessed for the operation and construction of the project. In order to assess noise and vibration during the construction and operation stages of the project, the following policies, guidelines and standards will be referenced:

- NSW 'Industrial Noise Policy' (INP) (EPA 2000)
- OEH's 'Interim Construction Noise Guidelines' (ICNG) 2009

- OEH's 'Assessing Vibration: A Technical Guideline' 2006
- OEH's ' Road Noise Policy' (RNP) 2011
- DIN 4150-3 (1999) 'Structural vibration – Effects of vibration on structures'
- ANZECC 'Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990'

Further to the above, the sections of this report that address the DGRs for the noise and vibration impacts of the project are as follows.

- *"Include as assessment of noise and vibration impacts during construction and operation and in a cumulative context with existing development"* – refer to Section 3, Section 4 and Section 5 of this report.
- *"Identify sensitive receptors that have the potential to be impacted by the project and the likely impacts"* – refer to Section 2.3, Section 3.3 and Section 4.3 of this report.
- *"Include a framework for the mitigation, management and monitoring of impacts during construction and operation (as relevant) with specific reference to noise and vibration-intensive construction works/activities (drilling, blasting, bulk excavation) and heavy vehicle movements"* – refer to Section 3.2.4 and Section 3.6 of this report.

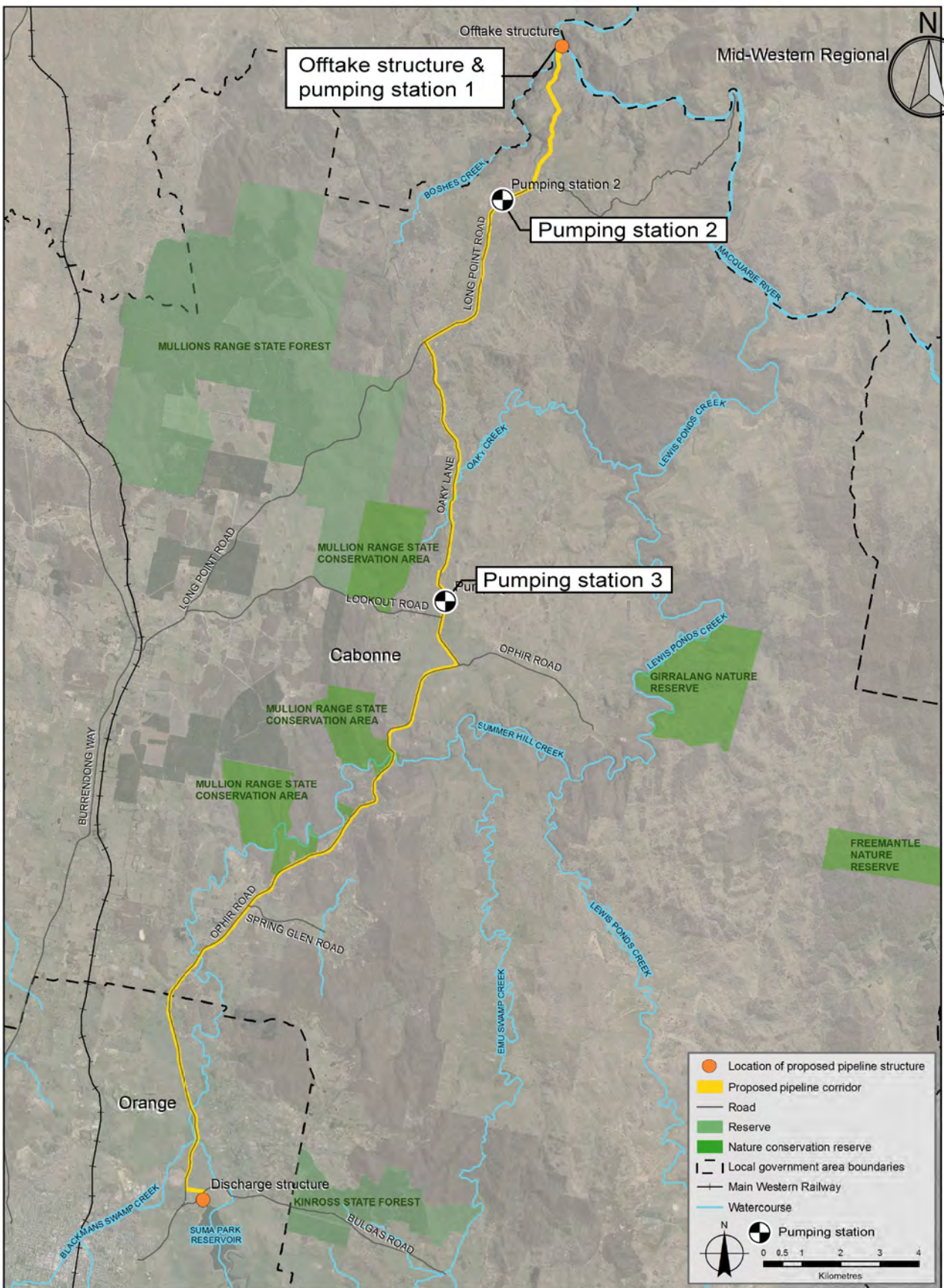
### 1.5.3 Structure of Report

Section 2 of the report presents the noise monitoring results conducted for this project and discusses the existing acoustic environment of the project area.

Section 3 deals with the construction phase of the project. The criteria for construction noise, construction vibration and blasting impacts specific to this project are determined. Predictions of construction noise, construction vibration and blasting impacts based on the proposed activities during construction works are presented and compared to the nominated criteria. Recommendations for reducing the impacts during the construction stage are provided.

Section 4 deals with the operational phase of the project. The criteria for operational noise specific to this project are determined. Predictions of operational noise based on the proposed operations are presented and compared to the nominated criteria.

Section 5 of the report discusses the impacts of road traffic on the surrounding road networks during the construction and operational phases of the project.



**Figure 1 - Locality Plan**

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*inspired to achieve*

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**Project: Orange Drought Relief Pipeline**

**Date : 13/07/12**

**Scale: NTS**

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## 2 EXISTING ACOUSTIC ENVIRONMENT

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Background noise varies over the course of any 24 hour period, typically from a minimum at 3am in the morning to a maximum during morning and afternoon traffic peak hours. Therefore, the NSW INP requires that the level of background and ambient noise be assessed separately for the daytime, evening and night-time periods. The INP defines these periods as follows:

- **Day** is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.
- **Evening** is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.
- **Night** is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays.

Given that construction of the project is to take place during daytime hours only, then the daytime background noise levels are required for the purpose of setting construction noise goals.

For the assessment of operational noise, the period with the lowest background noise level will be used for a conservative assessment since it is anticipated that the pipeline system may operate at any time during the day, evening or night periods.

### 2.1 Noise Monitoring Locations

Noise monitoring is to be taken at the nearest or potentially most affected residential locations. In this case the nearest and potentially most affected locations where noise monitoring was undertaken were as follows. The monitoring locations are shown in Figure 1.

- **Location M1 – 1771 Long Point Road, Orange**

Front yard along the northern boundary of the property and **in the 'free field'**. Noise environment is dominated by natural sounds. Noise data represents the ambient and background noise levels for residences on Long Point Road and close to pump station 2. This location is approximately 1,100m from the project.

- **Location M2 – Oakey Lane, Orange**

Along the eastern side of Oakey Lane adjacent to the property fence line and **in the 'free field'**. Noise environment is dominated by natural sounds and occasional traffic noise along Oakey Lane. Noise data represents the ambient and background noise levels for residences close to pump station 3 and along Oakey Lane. This location is approximately 5m from the project

- **Location M3 – 1235 Ophir Road, Orange**

Front yard along the southern boundary of the property, in the 'free field' and approximately 165m from Ophir Road. Noise environment is dominated by natural sounds and occasional distant traffic noise from Ophir Road. Noise data represents the ambient and background noise levels for residences along Ophir Road. This location is approximately 150m from the project.

- **Location M4 – Fishing Hut (along Macquarie River)**

Rear of fishing hut facing Macquarie river and in the 'free field'. Noise environment is dominated by natural sounds and water flow noise from Macquarie River. Noise data represents the ambient and background noise levels for residences close to Macquarie River and pump station 1. This location is approximately 760m from the project

- **Location M5 – Macquarie River**

Near the location of the proposed offtake structure of the project and in the 'free field'. Noise environment is dominated by natural sounds and water flow noise from Macquarie River. This location is approximately 100m from the project.

To quantify the existing ambient noise environment, long-term (unattended) noise monitoring was conducted between Tuesday 15<sup>th</sup> and Wednesday 30<sup>th</sup> November 2011 at Locations M1, M2 and M3, and between Wednesday 30<sup>th</sup> November and Thursday 8<sup>th</sup> December 2011 at Locations M4 and M5.

Appendix A of this report presents a description of acoustic terms. Appendix B details the noise monitoring methodology and the graphical recorded output from long term noise monitoring is included in Appendix G. The graphs in Appendix G were analysed to determine an assessment background level (ABL) for each day, evening and night period in each 24 hour period of noise monitoring, and based on the median of individual ABLs an overall single Rating Background Level (RBL) for the day, evening and night period is determined over the entire monitoring period in accordance with the NSW INP.

## **2.2 Existing Background & Ambient Noise Levels**

Existing background and ambient noise levels are presented in Table 2.1 below.

The noise monitors were positioned outdoors in the open (ie away from building facades). Operational noise from the site should be assessed away from the facade at the potentially most affected residential boundaries and therefore the representative noise levels listed in Table 2.1 are directly applicable.

**Table 2.1 – Measured Existing Background (L<sub>90</sub>) & Ambient (L<sub>eq</sub>) Noise Levels, dB(A)**

Location	L <sub>90</sub> Background Noise Levels			L <sub>eq</sub> Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Location M1	27	30	29	44	49	46
Location M2	28	30	26	45	42	41
Location M3	30	32	28	56	48	43
Location M4	33	41	39	44	49	48
Location M5	47	49	51	52	56	52

Notes: 1. Where measured level L<sub>A90</sub> is less than 30dB(A) this will be set to 30dB(A) in accordance with NSW INP p24

The noise monitoring locations M1, M2 and M3 were selected based on the location of the pump stations during the first iteration of the design. It was found that the background noise levels are representative of residences in a rural environment with day time and night time background noise levels at 30dB(A) or below. The identified receivers along surrounding the pipeline route are all classified as rural under INP guidelines. Based on page 24 of the INP, where background noise levels are less than 30dB(A), the minimum applicable background noise level is recommended to be 30dB(A). This minimum background noise level has been adopted for all receivers, except at the fishing hut, along the pipeline route. As the recommended minimum background noise level has been adopted for a conservative assessment, additional noise monitoring was considered unnecessary.

Therefore Locations M1, M2, and M3 are considered representative of the background and ambient noise environments for all residential receivers potentially impacted upon by the project, except for the fishing hut near the Macquarie River, which is represented by Location M4. Location M5 is located in a non-habitable area and therefore is not considered representative of any affected sensitive receivers.

### 2.3 Noise sensitive receivers

The potentially impacted noise receivers were identified based on site surveys conducted along the pipeline route and aerial photography of the area. Receivers were identified for the assessment of noise and vibration impacts where the properties are located within 1km of the proposed pipeline.

As the pipeline is predominantly located in rural areas outside of the Orange township, the majority of potentially impacted receivers are residential type properties. Other receivers identified include the Orange Resource Recovery Centre, which is an industrial complex on Ophir Road, and Banjo Patterson Park, which is classified as a passive recreational space.

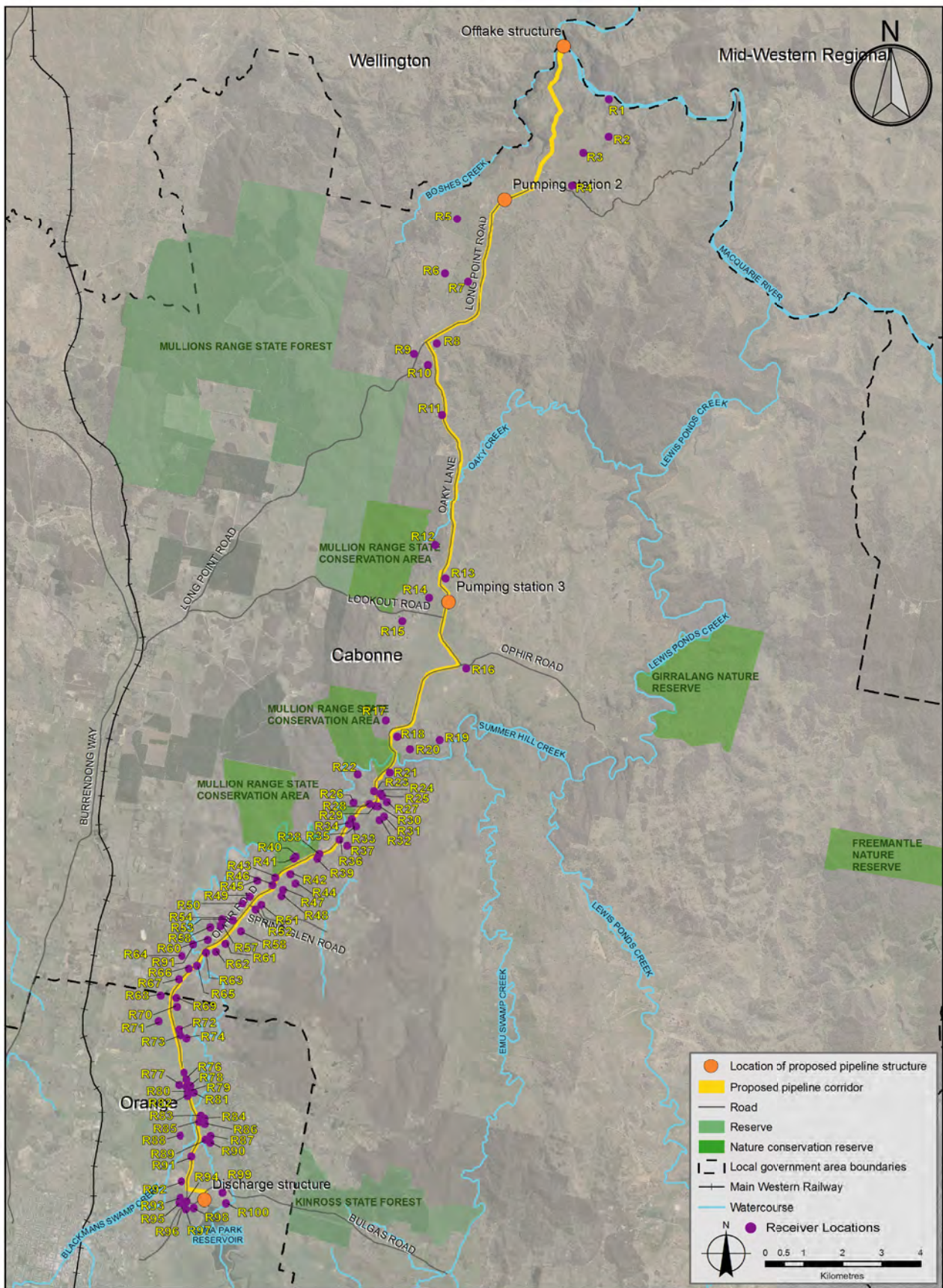
The identified noise receivers and their coordinates are presented in the table below.

**Table 2.2 - Property IDs and Coordinates (MGA55)**

	<b>Property ID</b>	<b>Easting (m)</b>	<b>Northing (m)</b>
R1	Fishing Hut	709520.4	6345285
R2	1771 Long Point Rd	709525.3	6344322
R3	Dungunnin	708877.6	6343907
R4	1829 Long Point Rd	708596.3	6343058
R5	108 Boshes Creek Rd	705644.3	6342174
R6	Honeberg	705345.9	6340765
R7	1433 Long Point Rd	705940.1	6340560
R8	1204 Long Point Rd	705151.6	6338968
R9	1129 Long Point Rd	704571.3	6338697
R10	1148 Long Point Rd	704930.3	6338416
R11	569 Oakey Ln	705303.8	6337150
R12	79 DP46515	705155.8	6333800
R13	6 Oakey Lane	705428.3	6332944
R14	206 Lookout Rd	705012.8	6332441
R15	249 Lookout Rd	704329.6	6331835
R16	1998 Ophir Rd	705976.3	6330651
R17	1721 Ophir Rd	703931.9	6329296
R18	1718 Ophir Rd	704227.3	6328881
R19	1780 Ophir Rd	705313.9	6328804
R20	1704 Ophir Rd	704554	6328561
R21	1606 Ophir Rd - Ophir Cabins	704045.7	6327956
R22	30 DP750372	703224.7	6327904
R23	1519 Ophir Rd	703643.2	6327460
R24	1544 Ophir Rd	703811.5	6327392
R25	1506 Ophir Rd	703852.9	6327339
R26	1504 Ophir Rd	703975.6	6327183
R27	1504 Ophir Rd	703530.6	6327131
R28	1500 Ophir Rd	703685	6327078
R29	1502 Ophir Rd	703744.4	6327070
R30	1488 Ophir Rd	703907	6326809
R31	1486 Ophir Rd	703791.5	6326716
R32	1465 Ophir Rd	703121.4	6327159
R33	1423 Ophir Rd	703082.1	6326735
R34	1413 Ophir Rd	703011.2	6326611
R35	1408 Ophir Rd	703194.1	6326556
R36	1365 Ophir Rd	702770.5	6326207
R37	1378 Ophir Rd	702970.6	6326054
R38	1295 Ophir Rd	702262.5	6325839
R39	1266 Ophir Rd	702209.6	6325719
R40	1237 Ophir Rd	701653.9	6325764

	<b>Property ID</b>	<b>Easting (m)</b>	<b>Northing (m)</b>
R41	1235 Ophir Rd	701606.8	6325714
R42	1236 Ophir Rd	701524.9	6325311
R43	1173 Ophir Rd	701137.1	6325222
R44	1099 Ophir Rd	700673.2	6325141
R45	1149 Ophir Rd	701064.3	6325029
R46	1174 Ophir Rd	701657.2	6325075
R47	1144 Ophir Rd	701338	6324908
R48	1142 Ophir Rd	701300.8	6324750
R49	1097 Ophir Rd	700490.1	6324731
R50	1587 Ophir Rd	700302.4	6324553
R51	33 Spring Glen Rd	700786.7	6324520
R52	22 Spring Glen Rd	700639.7	6324399
R53	1015 Ophir Rd	700059.5	6324122
R54	1001 Ophir Rd	699781.7	6324147
R55	1010 Ophir Rd	700271.2	6323851
R56	999 Ophir Rd	699746.1	6323980
R57	965 Ophir Rd	699484	6323942
R58	14 Winter Lane	699873.5	6323529
R59	911 Ophir Rd	699425.3	6323626
R60	241 Cullya Rd	699049.1	6323505
R61	926 Ophir Rd	699632.1	6323321
R62	914 Ophir Rd	699380.7	6323298
R63	230 Cullya Rd	698753.1	6323206
R64	870 Ophir Rd	699150.7	6322960
R65	841 Ophir Rd	698945.2	6322882
R66	809 Ophir Rd	698676.8	6322611
R67	Pearce Ln	698212.1	6322189
R68	746 Ophir Rd	698612.3	6322133
R69	744 Ophir Rd	698630.4	6321902
R70	671 Ophir Rd	698161.1	6321535
R71	670 Ophir Rd	698696.9	6321324
R72	658 Ophir Rd	698732	6321182
R73	664 Ophir Rd	698900	6321097
R74	548 Ophir Rd	698836.4	6320200
R75	346 Ophir Rd	698707.4	6319881
R76	538 Ophir Rd	698905.4	6320029
R77	1 Kennett Pl	698910.5	6319844
R78	2 Kennett Pl	699011.6	6319864
R79	8 Kennett Pl	698944.4	6319711
R80	7 Kennett Pl	699015.5	6319736
R81	6 Kennett Pl	699100.1	6319686

	<b>Property ID</b>	<b>Easting (m)</b>	<b>Northing (m)</b>
R82	494 Ophir Rd	698942	6319601
R83	7 Old Regret Rd	699284.3	6319101
R84	8 Old Regret Rd	699380.2	6319030
R85	6 Old Regret Rd	699241.6	6318940
R86	5 Old Regret Rd	699385.9	6318891
R87	345 Ophir Rd	698751.9	6318579
R88	57 Rossi Dr	699536.5	6318583
R89	44 Rossi Dr	699410.8	6318483
R90	58 Rossi Dr	699532	6318407
R91	Banjo Patterson Park	699050.5	6318049
R92	Orange Resource Recovery Centre	698788.5	6317408
R93	223 Ophir Rd	698766.2	6316985
R94	210 Ophir Rd	698941.4	6316895
R95	193 Ophir Rd	698739.7	6316865
R96	7 Bulgas Rd	698852.5	6316819
R97	12 Bulgas Rd	698924.2	6316707
R98	30 Bulgas Rd	699125.7	6316732
R99	134 Bulgas Rd	699857.9	6317126
R100	150 Bulgas Rd	699944.4	6316860



**Figure 2 - Receiver Locations**

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**Project: Orange Drought Relief Pipeline**

**Date : 13/07/12**

**Scale: NTS**

**Ref : TF332-01P02 (rev 1)**

### 3 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

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#### 3.1 Construction Noise & Vibration Criteria

##### 3.1.1 Construction Noise Management Levels

The NSW Office of Environment and Heritage's (OEH – formerly DECCW) 'Interim Construction Noise Guideline' (ICNG – July 2009) is currently only issued as an interim guideline, although it is being referred to as OEH's standard policy for assessing construction noise on new projects.

The key components of the ICNG that can be incorporated into this assessment include:

- i) Use of  $L_{Aeq}$  as the descriptor for measuring and assessing construction noise.

In recent years NSW noise policies including INP and the RNP have moved to the primary use of  $L_{Aeq}$  over any other descriptor. As an energy average,  $L_{Aeq}$  provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the  $L_{A10}$  descriptor.

Consistent with the latest guideline (ICNG) the use of  $L_{Aeq}$  as the key descriptor for measuring and assessing construction noise may follow a 'best practice' approach.

- ii) Application of feasible and reasonable noise mitigation measures

As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.

Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects, including the cost of the measure.

- iii) Quantitative and qualitative assessment

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment.

A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria.

A qualitative assessment is recommended for small projects with a short-term duration where works are not likely to affect an individual or sensitive land use for more than three weeks in total. It focuses on minimising noise disturbance through the implementation of feasible and reasonable work practices, and community notification.

Given the significant scale of the construction works proposed for the project, a quantitative assessment is carried out herein, consistent with the ICNG's requirements.

## Management Levels

Table 3.1 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied. The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

**Table 3.1 - Noise at Residences Using Quantitative Assessment**

Time of Day	Management Level LAeq (15 min)*	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> <li>Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> <li>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.</li> </ul>
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. <ul style="list-style-type: none"> <li>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ol style="list-style-type: none"> <li>times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences)</li> <li>if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li> </ol> </li> </ul>
Outside recommended standard hours	Noise affected RBL + 5dB(A)	<ul style="list-style-type: none"> <li>A strong justification would typically be required for works outside the recommended standard hours.</li> <li>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> <li>Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.</li> <li>For guidance on negotiating agreements see section 7.2.2.</li> </ul>

\* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

The proposed construction works will be restricted to the recommended standard hours of construction in the ICNG; ie. 7.00am to 6.00pm Monday to Friday, 8.00am to 1.00pm on Saturdays and no work permitted on Sundays or Public Holidays.

Based on the above table, the monitored background noise levels and that all construction works will be conducted during the standard construction hours, the applicable noise management levels are **40dB(A)** for all residential receivers potentially impacted upon by the project and **43dB(A)** for the fishing hut near the Macquarie River.

#### Sensitive Land Use

Table 3.2 below (reproduced from Table 3 of the ICNG) sets out the noise management levels for various sensitive land use developments. It is noted that passive type recreational areas are the only sensitive land uses potentially impacted upon by the construction of the project.

**Table 3.2 - Noise at Other Sensitive Land Uses Using Quantitative Assessment**

Land use	Management Level, $L_{Aeq}$ (15 min) (applies when land use is being utilised)
Passive recreation areas	External noise level – 60dB(A)

This is applicable at Banjo Patterson Park located on Ophir Road, Orange.

#### Industrial Premises

The Orange Resource Recovery Centre is an industrial premise located on Ophir Road, Orange, and in accordance with Section 4.1.3 of the ICNG, industrial properties should be assessed for construction noise impacts. The noise management levels presented in the ICNG for commercial and industrial premises are reproduced in Table 3.3 below.

**Table 3.3 – Noise at Commercial Premises Using Quantitative Assessment**

Type of Premises	Management level, $L_{Aeq}$ (15 min)
Industrial	External noise level = 75 dB(A)

### 3.1.2 Construction Vibration Criteria

The effects of ground vibration on buildings near construction sites may be broadly defined by the following three categories:

1. Disturbance to building occupants - Vibration in which the occupants or users of the building are inconvenienced or possibly disturbed,
2. Effects on building contents - Vibration where the building contents may be affected, and,

3. Effects on building structures - Vibration in which the integrity of the building or structure itself may be prejudiced.

**Category 1 – Disturbance to Building Occupants**

For disturbance to human occupants of buildings, we refer to the DEC’s ‘Assessing Vibration; a technical guideline’, published in February 2006. This document provides criteria which are based on the British Standard BS 6472-1992, ‘Evaluation of human exposure to vibration in buildings (1-80Hz)’.

Vibration sources are defined as *Continuous, Impulsive or Intermittent*. Section 2 of the technical guideline defines each type of vibration as follows:

**‘Continuous** vibration continues uninterrupted for a defined period (usually throughout the day-time and/or night-time).

**Impulsive** vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.

**Intermittent** vibration can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude’.

The criteria is to be applied to a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

*‘Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).’*

Preferred and maximum values for continuous and impulsive vibration are defined in table 2.2 of the guideline and are reproduced below specific to the type of receivers surrounding the proposed pipeline.

**Table 3.4 – Preferred and Maximum Weighted rms Values for Continuous and Impulsive Vibration Acceleration (m/s<sup>2</sup>) 1-80Hz**

Location	Assessment period <sup>1</sup>	Preferred values		Maximum values	
		z axis	x & y axis	z axis	x & y axis
<b>Continuous vibration</b>					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010

Location	Assessment period <sup>1</sup>	Preferred values		Maximum values	
		z axis	x & y axis	z axis	x & y axis
<b>Impulsive vibration</b>					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

Notes: 1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am

Intermittent vibration is to be assessed using vibration dose values (VDVs). The VDV method is a fourth power approach which is more sensitive to peaks in the acceleration waveform and makes corrections to the criteria based on the duration of the source's operation. The VDV can be calculated using the overall weighted rms acceleration of the vibrating source in each orthogonal axis and the total period during which the vibration may occur. Weighting curves are provided in each orthogonal axis in the guideline. Preferred and maximum VDV values are defined in Table 2.4 of the guideline and are reproduced below.

**Table 3.5 – Acceptable Vibration Dose Values for Intermittent Vibration (m/s<sup>1.75</sup>)**

Location	Daytime <sup>1</sup>		Night-time <sup>1</sup>	
	Preferred values	Maximum values	Preferred values	Maximum values
Residences	0.20	0.40	0.13	0.26

Notes: 1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am

### **Category 2 – Effects on building contents**

The typical frequency range of construction induced ground vibration is approximately 8 Hz to 100 Hz. Over this range the threshold of visible movement of building contents such as plants, pictures, blinds etc is approximately 0.5 mm/s. At vibration levels higher than 0.9 mm/s, audible rattling of loose objects such as crockery can be expected.

### **Category 3 – Structural damage to buildings**

Currently there exists no Australian Standard for assessment of structural building damage caused by vibrational energy. Therefore, reference is made to both the British and German standards below which are relevant to the assessment of structural damage.

#### British Standard

British Standard 7385: Part 2 "Evaluation and measurement of vibration in buildings", can be used as a guide to assess the likelihood of building damage from ground vibration. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

BS7385 recommends that the peak particle velocity is used to quantify vibration and specifies damage criteria for frequencies within the range 4Hz to 250Hz, which is the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended. The levels from the standard are given below in Table 3.6.

**Table 3.6 – BS 7385 Structural Damage Criteria**

Group	Type of Structure	Peak component particle velocity, mm/s		
		4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings		50	
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15 to 20	20 to 50	50

The peak vibration limits set for minimal risk of 'cosmetic' damage are: 15mm/s for un-reinforced or light framed structures, for example residential or light commercial buildings (Line 2; increasing as the frequency content of the vibration increases) and 50mm/s for reinforced or framed structures, for example industrial and heavy commercial buildings (Line 1; constant across all frequencies). 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

These values relate to transient vibrations and to low rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50%.

The levels set by this standard are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular types of buildings. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls.

This standard states that it considers sources of vibration including blasting, demolition, piling, ground treatments, compaction, construction equipment, tunnelling, road and rail traffic and industrial machinery.

As stated in the standard, it sets guide values for building vibration based on the lowest levels above which damage has been credibly demonstrated. That is, it gives guidance on the levels of vibration above which building structures could be damaged.

#### German Standard

The German standard DIN 4150 - Part 3 - "Structural vibration in buildings - Effects on Structures", also provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration. This standard too, presents recommended maximum limits over a range of frequencies measured in any direction at the foundation or in the plane of the uppermost floor.

The minimum 'safe limit' of vibration at low frequencies for residential dwellings, which are representative of the surrounding receivers, is 5mm/s and for particularly sensitive structures

(eg historical with preservation orders etc), is 3mm/s. These limits increase as the frequency content of the vibration increases. These values are presented in Table 3.7 below and are generally recognised to be conservative.

**Table 3.7 – DIN 4150-3 Structural Damage Criteria**

Group	Type of Structure	Vibration Velocity, mm/s			
		At Foundation at Frequency of			Plane of Floor Uppermost Storey
		< 10Hz	10Hz - 50Hz	50Hz - 100Hz	All Frequencies
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (eg buildings under a preservation order)	3	3 to 8	8 to 10	8

### 3.1.3 Blasting Criteria

The blasting criteria relevant to this project are presented in The Australian and New Zealand Environment and Conservation Council's (ANZECC) 'Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990'.

Section 2.1 of the ANZECC document, relating to airblast overpressure, states:

*"2.1.1 The recommended maximum level for airblast overpressure is 115dB(Lin Peak).*

*2.1.2 The level of 115 dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months. However, the level should not exceed 120 dB(Lin Peak) at any time."*

Section 2.2 of the ANZECC document, relating to ground vibration, states:

*"2.2.1 The recommended maximum level for ground vibration is 5mm/sec peak particle velocity (ppv).*

*2.2.2 The ppv level of 5 mm/sec may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/sec at any time.*

Therefore, Table 3.8 below summarises the requirements of the ANZECC guidelines.

**Table 3.8 – ANZECC Criteria for Blasting Activity**

Assessment	Criteria Type	Receiver Type	Specific Noise or Vibration Limit
Airblast Overpressure	Blasting Noise	Noise Sensitive Sites (eg. residences, hospitals, schools)	115 dB(Lin Peak)

Assessment	Criteria Type	Receiver Type	Specific Noise or Vibration Limit
Ground Vibration	Blasting Vibration	Noise Sensitive Sites (eg. residences, hospitals, schools)	5 mm/s peak particle velocity (ppv)

## 3.2 Proposed Construction Noise & Vibration Sources

### 3.2.1 Noise Sources

The following table lists construction plant and equipment likely to be used by the contractor to carry out the necessary construction work for this project.

**Table 3.9 – Proposed Construction Noise Sources, dB(A) re. 1pW**

Plant Item	Plant Description	L <sub>Aeq</sub> Sound Power Level
<b>Offtake Structure and Pumping Station 1</b>		
1	30t Excavator	107
2	Rock Breaker Attachment	117
3	Sheetpile Vibrating Attachment	116
4	Bulldozer	109
5	Grader	107
6	Micro-Tunneling Drilling Rig	110
7	Diesel Generators (x2)	100
8	Shaft Drive Petrol Pump	99
9	Multiple Handheld Electrical Equipment	90
<b>Pipeline</b>		
10	30t Excavator for pipeline digging	107
11	20t Excavator for pipe laying	107
12	20t Excavator for pipeline backfilling	107
13	Shaft Drive Petrol Pump	99
<b>Intermediate Booster Pumping Stations</b>		
14	20t Excavator	107
15	15t All Terrain Mobile Crane	110
16	Diesel Generators (x2)	100
<b>Crossings</b>		
17	30t Excavator	107
18	Diesel Pump	99
19	Shaft Drive Petrol Pump	99
20	Petrol Generator	100
21	HDD Drilling Rig	111
<b>Discharge Structure</b>		
22	20t Excavator	107
23	Petrol Generator	100

The sound power levels for the majority of activities presented in the above table are based on maximum levels given in Table A1 of Australian Standard 2436 - 2010 "Guide to Noise and

Vibration Control on Construction, Demolition and Maintenance Sites", information from past projects and information held in our library files.

### 3.2.2 Vibration Sources

Typical vibration levels from construction equipment most likely to cause significant vibration are summarised below. The information was sourced from a variety of reference materials available in the Renzo Tonin & Associates library.

**Table 3.10 – Typical Ground Vibration Generated by Construction Plant**

Activity	Typical ground vibration
Excavators	Typical ground vibration from excavators range from 1mm/s to 2mm/s at distances of approximately 5m and at distances greater than 20m, vibration levels are usually below 0.2mm/s.
Vibratory rollers	Ground vibration caused by vibratory rollers can range up to 1.5mm/s at distances of 25m. The highest levels of vibration usually occur as the roller is brought to rest and the frequency of the centrifugal forces passes through resonance with the natural frequency of the roller/ground/structure. Machinery should therefore not be brought to rest when in the vicinity of susceptible buildings, especially dwellings. Higher levels could occur at closer distances, however, no damage would be expected for any building at distances greater than approximately 12m (for a medium to heavy roller).
Compactors	Compactors typically generate 20mm/s at distances of approximately 5m, 2mm/s at distances of 15m. At distances greater than 30m, vibration are usually below 0.3mm/s.
Truck traffic	Typical vibration from heavy trucks passing over normal (smooth) road surfaces generate relatively low vibration levels in the range of 0.01 - 0.2mm/s at the footings of buildings located 10 - 20m from a roadway. Very large surface irregularities can cause levels up to five to ten times higher. In general, ground vibration from trucks is usually imperceptible in nearby buildings. The rattling of windows and other loose fittings that is sometimes reported is more likely to be caused by airborne acoustic excitation from very low frequency (infrasonic) noise radiated by truck exhausts and truck bodies. While this may cause concern to the occupants, the phenomenon is no different from the rattling caused by wind or people walking or jumping on the floor and fears of structural damage or even accelerated ageing are usually unfounded.

### 3.2.3 Blasting Methods

The usual method of blasting involves the placement of explosives in an arranged grid of holes drilled into the rock over a defined area. The explosives are detonated in a delayed fashion in order to reduce the resulting noise and vibration. Thus, a blast comprises the detonation of explosives in a small group of holes, followed by a time delay of approximately 15ms, followed by detonation for the next group of holes, and so on. Additionally, delays may also occur for explosives separated vertically within each hole. The amount of explosive detonated in any given 15ms time delay is denoted by the maximum instantaneous charge (MIC). The MIC influences the peak noise and vibration levels achieved.

The prediction of blast noise and vibration levels due to normal blasting is therefore based on the recommended allowable MIC to meet the relevant criteria at the nearby receivers described in Section 3.1.3.

### **3.3 Predicted Construction Noise**

Noise emissions during construction activities (excluding blasting activities, which is addressed separately in Section 3.5) were predicted to the nearest and potentially most affected receiver locations, defined as residences within 1,000m of the construction corridor. Noise emissions were determined by modelling the noise sources, receiver locations and topographical features of the intervening area using the CadnaA (version 4.2) noise modelling computer program. The program calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site.

The noise prediction model takes into account:

- Location of noise sources and receiver locations;
- Height of sources and receivers;
- Separation distances between sources and receivers;
- Attenuation from barriers (natural and purpose built).

The computer program is endorsed by the OEH and its environmental noise predictions have been verified on many past occasions in the field.

Noise levels were calculated at the identified receiver locations from the construction site considering the worst case scenario of all plant operating simultaneously (excluding line drilling, which will only be used for creek crossings).

Construction noise levels for each activity have been predicted for the nearest affected residential receiver and are presented in Table 3.11 below. It is noted that construction noise levels predicted here include acoustic losses due to distance, land topography and shielding from intervening structures only. Additional specific noise control treatments for the construction plant and equipment are not considered. It is recommended that all plant items have their noise emission levels measured before they are used on site as a check against noise predictions.

Furthermore, noise levels at receivers will vary significantly over the total construction program due to the transient nature of the construction activities and the large range of plant and equipment that could be used.

**Table 3.11 – Predicted L<sub>Aeq</sub> Noise Levels During Construction, dB(A)**

Receiver	Noise Management Level	Predicted L <sub>Aeq</sub> Construction Noise Levels					Maximum Exceedance
		Offtake Structure and Pump Station 1	Pipeline	Intermediate Booster Pump Stations	Crossings	Discharge Structure	
R1	Fishing Hut	43	40	32	-	-	-
R2	1771 Long Point Rd	40	-	33	-	-	-
R3	Dungunnin	40	-	40	-	-	-
R4	1829 Long Point Rd	40	-	28	-	-	-
R5	108 Boshes Creek Rd	40	-	34	30	-	-
R6	Honeberg	40	-	34	-	-	-
R7	1433 Long Point Rd	40	-	41	-	-	1
R8	1204 Long Point Rd	40	-	58	-	-	18
R9	1129 Long Point Rd	40	-	41	-	-	1
R10	1148 Long Point Rd	40	-	45	-	-	5
R11	569 Oakey Ln	40	-	50	-	-	10
R12	79 DP46515	40	-	41	-	-	1
R13	6 Oakey Lane	40	-	66	33	-	26
R14	206 Lookout Rd	40	-	42	40	-	2
R15	249 Lookout Rd	40	-	34	33	-	-
R16	1998 Ophir Rd	40	-	52	31	-	12
R17	1721 Ophir Rd	40	-	44	-	-	4
R18	1718 Ophir Rd	40	-	55	-	-	15
R19	1780 Ophir Rd	40	-	36	-	-	-
R20	1704 Ophir Rd	40	-	42	-	-	2
R21	1606 Ophir Rd - Ophir Cabins	40	-	65	-	-	25

Receiver	Noise Management Level	Predicted L <sub>Aeq</sub> Construction Noise Levels					Maximum Exceedance	
		Offtake Structure and Pump Station 1	Pipeline	Intermediate Booster Pump Stations	Crossings	Discharge Structure		
R22	30 DP750372	40	-	41	-	-	-	1
R23	1519 Ophir Rd	40	-	60	-	-	-	20
R24	1544 Ophir Rd	40	-	57	-	-	-	17
R25	1506 Ophir Rd	40	-	55	-	-	-	15
R26	1504 Ophir Rd	40	-	50	-	-	-	10
R27	1504 Ophir Rd	40	-	60	-	32	-	20
R28	1500 Ophir Rd	40	-	66	-	-	-	26
R29	1502 Ophir Rd	40	-	61	-	-	-	21
R30	1488 Ophir Rd	40	-	45	-	-	-	5
R31	1486 Ophir Rd	40	-	43	-	-	-	3
R32	1465 Ophir Rd	40	-	47	-	38	-	7
R33	1423 Ophir Rd	40	-	62	-	45	-	22
R34	1413 Ophir Rd	40	-	67	-	51	-	27
R35	1408 Ophir Rd	40	-	54	-	48	-	14
R36	1365 Ophir Rd	40	-	69	-	46	-	29
R37	1378 Ophir Rd	40	-	49	-	43	-	9
R38	1295 Ophir Rd	40	-	66	-	37	-	26
R39	1266 Ophir Rd	40	-	61	-	35	-	21
R40	1237 Ophir Rd	40	-	49	-	32	-	9
R41	1235 Ophir Rd	40	-	50	-	32	-	10
R42	1236 Ophir Rd	40	-	54	-	-	-	14
R43	1173 Ophir Rd	40	-	61	-	36	-	21
R44	1099 Ophir Rd	40	-	44	-	43	-	4

Receiver	Noise Management Level	Predicted L <sub>Aeq</sub> Construction Noise Levels					Maximum Exceedance	
		Offtake Structure and Pump Station 1	Pipeline	Intermediate Booster Pump Stations	Crossings	Discharge Structure		
R45	1149 Ophir Rd	40	-	63	-	38	-	23
R46	1174 Ophir Rd	40	-	44	-	-	-	4
R47	1144 Ophir Rd	40	-	47	-	37	-	7
R48	1142 Ophir Rd	40	-	47	-	38	-	7
R49	1097 Ophir Rd	40	-	51	-	51	-	11
R50	1587 Ophir Rd	40	-	49	-	50	-	10
R51	33 Spring Glen Rd	40	-	50	-	46	-	10
R52	22 Spring Glen Rd	40	-	53	-	47	-	13
R53	1015 Ophir Rd	40	-	53	-	40	-	13
R54	1001 Ophir Rd	40	-	44	-	37	-	4
R55	1010 Ophir Rd	40	-	50	-	38	-	10
R56	999 Ophir Rd	40	-	47	-	36	-	7
R57	965 Ophir Rd	40	-	43	-	36	-	3
R58	14 Winter Lane	40	-	55	-	40	-	15
R59	911 Ophir Rd	40	-	50	-	40	-	10
R60	241 Cullya Rd	40	-	45	-	47	-	7
R61	926 Ophir Rd	40	-	53	-	45	-	13
R62	914 Ophir Rd	40	-	62	-	54	-	22
R63	230 Cullya Rd	40	-	43	-	43	-	3
R64	870 Ophir Rd	40	-	69	-	47	-	29
R65	841 Ophir Rd	40	-	65	-	43	-	25
R66	809 Ophir Rd	40	-	62	-	37	-	22
R67	Pearce Ln	40	-	48	-	32	-	8

Receiver	Noise Management Level	Predicted L <sub>Aeq</sub> Construction Noise Levels					Maximum Exceedance	
		Offtake Structure and Pump Station 1	Pipeline	Intermediate Booster Pump Stations	Crossings	Discharge Structure		
R68	746 Ophir Rd	40	-	52	-	32	-	12
R69	744 Ophir Rd	40	-	50	-	32	-	10
R70	671 Ophir Rd	40	-	46	-	-	-	6
R71	670 Ophir Rd	40	-	51	-	-	-	11
R72	658 Ophir Rd	40	-	52	-	-	-	12
R73	664 Ophir Rd	40	-	46	-	30	-	6
R74	548 Ophir Rd	40	-	60	-	37	-	20
R75	346 Ophir Rd	40	-	54	-	40	-	14
R76	538 Ophir Rd	40	-	57	-	39	-	17
R77	1 Kennett Pl	40	-	62	-	42	-	22
R78	2 Kennett Pl	40	-	52	-	42	-	12
R79	8 Kennett Pl	40	-	61	-	44	-	21
R80	7 Kennett Pl	40	-	54	-	44	-	14
R81	6 Kennett Pl	40	-	50	-	45	-	10
R82	494 Ophir Rd	40	-	77	-	47	-	37
R83	7 Old Regret Rd	40	-	52	-	47	-	12
R84	8 Old Regret Rd	40	-	48	-	44	-	8
R85	6 Old Regret Rd	40	-	56	-	44	-	16
R86	5 Old Regret Rd	40	-	48	-	42	-	8
R87	345 Ophir Rd	40	-	43	-	44	-	4
R88	57 Rossi Dr	40	-	45	-	44	-	5
R89	44 Rossi Dr	40	-	49	-	49	-	9
R90	58 Rossi Dr	40	-	45	-	45	-	5

Receiver	Noise Management Level	Predicted L <sub>Aeq</sub> Construction Noise Levels					Maximum Exceedance	
		Offtake Structure and Pump Station 1	Pipeline	Intermediate Booster Pump Stations	Crossings	Discharge Structure		
R91	Banjo Patterson Park	60	-	65	-	45	30	6
R92	Orange Resource Recovery Centre	75	-	56	-	36	35	-
R93	223 Ophir Rd	40	-	45	-	32	36	5
R94	210 Ophir Rd	40	-	47	-	32	40	7
R95	193 Ophir Rd	40	-	41	-	-	36	1
R96	7 Bulgas Rd	40	-	44	-	31	38	4
R97	12 Bulgas Rd	40	-	42	-	31	38	2
R98	30 Bulgas Rd	40	-	47	-	31	43	7
R99	134 Bulgas Rd	40	-	35	-	32	-	-
R100	150 Bulgas Rd	40	-	-	-	-	-	-

Notes: 1. Predicted noise levels are based on a worst case scenario where all construction plant and equipment are operating concurrently for each activity

From Table 3.11 above, construction noise levels for the proposed activities are predicted to exceed the noise management levels at most receiver locations. Large exceedances are predicted for activities associated with the construction of the pipeline, with the property at 494 Ophir Rd predicted to exceed the highly noise affected level of 75dB(A) as stipulated in the ICNG. Therefore, in accordance with the ICNG, respite periods for this property may be required and determined through consultation with the resident.

Assuming a construction rate of 1-2km per week for the pipeline works, the potential of the noise impacts at each identified receiver is not expected to occur for more than 2 weeks. However, construction of the pump stations, break tanks and associated power supply will have noise impacts at identified receivers for longer durations.

Therefore, to minimise noise impacts, feasible and reasonable noise mitigation measures are recommended in Section 3.6 below.

### 3.4 Predicted Construction Vibration

The relationship between vibration and the probability of causing human annoyance or damage to structures is complex. This complexity is mostly due to the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (eg dimensions, materials, type and quality of construction and footing conditions). The intensity, duration, frequency content and number of occurrences of a vibration are all important aspects in both the annoyances caused and the strains induced in structures.

As the pattern of vibration radiation is very different to the pattern of airborne noise radiation, and is very site specific, **below are some indicative minimum 'buffer' distances based on some recent projects used to avoid human discomfort during construction activities, assuming construction activity is not 'continuous'.**

**Table 3.12 – Recommended Minimum Buffer Distances for Construction Plant**

Plant Item	Recommended Minimum Buffer Distance (m)
Drilling	5
Bulldozer	5
Excavator	10
Truck movements	10
Rock Breaker (heavy)	15
Sheet piling	20

The table above represents minimum buffer distances between residential premises along the pipeline route and various construction plant including rock breakers, drills, bulldozers, excavators, truck movements and sheet piling. Plant operating within these buffer distances

could exceed the set limits for human comfort. Vibration levels from other equipment are unlikely to exceed the set limits.

Since the human comfort criteria are more stringent than the structural damage criteria, vibration from construction plant and equipment associated with the proposed road works are not expected to cause structural damage to dwellings.

Furthermore, due to distances varying throughout the pipeline route and the nature of the area and its landscape, vibration levels are not expected to be of concern for construction activities occurring during construction hours. However, should residences be located within the above buffer distances, more accurate buffer distances should be determined on site for critical residences by measuring vibration emission levels from each plant item prior to its operation.

However, during construction, should the plant to receiver distance be less than the buffer distances determined through measurements, alternative construction methods or equipment should be used.

### 3.5 Predicted Noise & Vibration Due to Blasting

Rock formations are located along the proposed pipeline route. Wherever rock is encountered, blasting may be required. Critical receivers are scattered near areas of the proposed pipeline route which require excavation of the rock. The allowable MIC required for different distances before the set criteria are exceeded has been determined. The allowable MIC was calculated using a spreadsheet developed by Renzo Tonin & Associates.

**Table 3.13 – Allowable MIC to Achieve Compliance at Different Distances**

Description	Criteria	Allowable MIC (kg)					
		20m	40m	60m	80m	100m	120m
Airblast Overpressure	115dB(Lin peak)	0.0004	0.005	0.02	0.05	0.12	0.23
Airblast Overpressure	120dB(Lin peak)	0.002	0.027	0.12	0.32	0.7	1.34
Ground Vibration	5mm/s (ppv)	1.27	5.06	11.38	20.24	31.62	45.53

The ANZECC guidelines allow for the level of 115 dB to be exceeded on up to 5% of the total number of blasts over a period of 12 months, provided the level does not exceed 120 dB(Lin Peak) at any time. As there are a limited number of blasts for the construction of the pipeline, it is considered reasonable to allow a maximum limit of 120dB.

From Table 3.13, the allowable MIC for airblast overpressure is generally lower than that for ground vibration. Therefore the allowable MIC for airblast overpressure is the limiting parameter for blasting. The distance of the nearest residences and buildings from the blasting zone should be compared to the table above as a guide for determining the allowable MIC.

## 3.6 Recommendations

### 3.6.1 Construction Noise Mitigation

The following recommendations provide in-principle noise control solutions to reduce noise impacts to residential receivers during the construction of the proposed pipeline. Where actual construction activities differ from those assessed in this report, more detailed design of noise control measures may be required once specific items of plant and construction methods have been chosen and assessed on site.

The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Acoustic treatment may be applied directly to the noise source (eg mufflers or quieter plant and equipment), or to the site (eg noise barriers or site management plans). Since the predicted noise exceedances are large, in order to reduce noise levels to residential receivers, a combination of acoustic treatment is recommended.

### 3.6.2 Noise Control Kits

For some of the construction plant listed in Table 3.9, it may be necessary for them to be fitted with 'noise control kits'.

Such 'noise control kits' comprise:

- high performance 'residential-grade' exhaust mufflers,
- additional engine cowling / enclosure lined inside with sound absorbent industrial-grade foam, and
- air intake and discharge silencers / louvres.

The requirement of fitting 'noise control kits' onto the identified plant, shall be confirmed once each plant is tested prior to its regular use on site.

### 3.6.3 General Engineering Noise Controls

Implementation of noise control measures, such as those suggested in Australian Standard 2436-2010 "Guide to Noise Control on Construction, Demolition and Maintenance Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix C presents typical examples of noise reductions achievable after treatment of various noise sources. Table C3 in Appendix C presents the relative effectiveness of various forms of noise control treatment.

Table 3.14 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

**Table 3.14 – Relative Effectiveness of Various Forms of Noise Control, dB(A)**

Noise Control Method	Practical Examples	Typical noise reduction possible in practice		Maximum noise reduction possible in practice	
		AS 2436	Renzo Tonin & Assoc.	AS 2436	Renzo Tonin & Assoc.
Distance	Doubling of distance between source and receiver	6	6	6	6
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	5 to 10	5 to 10	20	20
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	5 to 10	5 to 10	15	15
Engine Silencing	Residential class mufflers	15 to 25	10 to 20	50	30
Substitution by alternative process	Use electric motors in preference to diesel or petrol	-	15 to 25	-	40

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436, for this assessment.

Table 3.15 below identifies possible noise control measures, which are applicable on the majority of plant and equipment likely to be used on site during construction.

**Table 3.15 – Noise Control Measures for Likely Plant & Equipment**

Plant Description	Screening	Acoustic Enclosures	Silencing	Alternative Process
Excavator	✓	x	✓	✓
Rock-breaker	✓	x	✓	x
Sheet Piling	✓	x	✓	✓
Dump Trucks	✓	x	✓	x
Delivery Trucks	✓	x	✓	x
Concrete Truck	✓	x	✓	x
Bulldozer	✓	x	✓	x
Grader	✓	x	✓	x
Mobile Crane	✓	x	✓	✓
Pumps	✓	✓	✓	✓
Generators	✓	✓	✓	x
HDD Drilling Rig	✓	x	✓	x
Micro-Tunnelling Drill Rig	✓	x	✓	x

To ensure efficient noise attenuation performance is achieved using any of the methods listed above, it is recommended acoustic engineers work closely with the contractor and carry out preliminary testing prior to commencement of works.

In addition to the above, screening of machinery to be fixed on site should give regard to the following:

- Screens to be as close as possible to the noise source.
- The extent of noise reduction required of the noise screen as a whole as perceived from any potentially affected receiver.
- No gaps should be present between noise screen panels or between the noise screen and the ground.

In addition to physical noise controls, the following general noise management measures should be followed:

- Plant and equipment should be properly maintained
- **Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits** fitted to machines to ensure they perform as intended
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel
- Avoid any unnecessary noise when carrying out manual operations and when operating plant
- Any equipment not in use for extended periods should be switched off
- Noise compliance monitoring for all major equipment and activities on site should be undertaken prior to their commencement of work on site.
- In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits. See Appendix F for an example of a complaint handling procedure and form.
- Good relations with people living in the vicinity of the construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.

- Provide the community, reasonably ahead of time, information such as total building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. This can be provided through media such as letterbox drops, meetings, a dedicated website or individual contact. With respect to respite periods, liaison with affected residences to identify least affected periods and the best timing for implementing respite periods should be considered. This is particularly important for properties predicted to exceed the highly noise affected level of 75dB(A), such as the property at 494 Ophir Road.
- Where noise level exceedances cannot be avoided, then consideration should be given to implementing time restrictions and/or providing periods of respite for residents.

#### 3.6.4 Construction Vibration Mitigation

The following feasible and reasonable in-principle vibration control measures are provided to minimise vibration impact from construction activities to the nominated occupancies and to **meet OEH's human comfort vibration limits:**

- The proper implementation of a construction noise and vibration management plan is required to avoid adverse vibration disturbance to affected occupancies. Consultation with stakeholders is recommended and should be aimed at providing a communication path directly to the contractor.
- All residential stakeholders within the vicinity of the proposed construction works should be notified prior to the commencement of substantial construction where vibration may be perceptible during construction activities.
- A management procedure will be implemented to deal with vibration complaints. Each complaint will be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences. An example of a vibration complaint management procedure and complaint form is presented in Appendix F of this report.
- Carry out vibration testing of actual equipment on site to determine acceptable site-specific buffer distances to sensitive occupancies.
- Carry out additional vibration monitoring as specified in Appendix E when construction activities are at the nearest point to the nominated occupancies and within the buffer distance determined. This monitoring may signal to the contractor by way of a buzzer or flashing light etc, when levels approach / exceed the recommended limits in nearby occupancies.
- Carry out periodic monitoring at all critical or sensitive areas when complaints arise, and the vibration levels are to be tested for compliance with the set vibration limits. This

monitoring should be undertaken in accordance with the vibration monitoring described in Appendix E.

- Where vibration is found to be excessive and exceed the applicable limits, management measures may be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods, establishment of safe buffer zones and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.
- Before, during and after the construction work we recommend preparation of a dilapidation report on the state of the existing buildings within the vicinity of the construction zone.

## 4 OPERATIONAL NOISE ASSESSMENT

Operational noise from the proposed pipeline will be from the pump station to be located at the Macquarie River and the two booster pumps to be located along the pipeline route.

### 4.1 Operational Noise Criteria

Noise impact from the general operation of the proposed pipeline is assessed against the NSW Industrial Noise Policy (INP). The assessment procedure in terms of the INP has two components:

- Controlling intrusive noise impacts in the short term for residences
- Maintaining noise level amenity for particular land uses for residences and other land uses.

In accordance with the INP, noise impact should be assessed in terms of both intrusiveness and amenity.

#### 4.1.1 Intrusiveness Criteria

According to the NSW INP, the intrusiveness of a mechanical noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the  $L_{Aeq}$  descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5dB(A). It is noted that this is applicable to residential properties only.

Therefore, the intrusiveness criterion for residential noise receptors as summarised in the INP is as follows:

$$L_{Aeq, 15 \text{ minute}} \leq \text{Rating Background Level (L}_{A90}) + 5 \text{ dB(A)}$$

Based on the monitored background noise levels presented in Section 2.2, the intrusiveness criteria for the potentially most affected residential receiver locations are presented below.

**Table 4.1 – Intrusiveness Noise Criteria, dB(A)**

Receiver	Intrusiveness Criteria – $L_{Aeq,15min}$
Fishing Hut	38
Affected residential receivers	35

Notes: 1. Intrusiveness criteria only applicable for residential receivers

#### 4.1.2 Amenity Criteria

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the NSW INP, the applicable parts of which are reproduced below.

Nearby critical receivers consists of residential properties situated in a rural area. Based on the nature of these receivers, the amenity criteria ( $L_{Aeq}$ ) for rural residential properties will be applied.

Furthermore, given that the pipeline and pump stations will operated continuously 24 hours per day, the night time period would be the most stringent period for the application of the amenity criteria.

**Table 4.2 – Applicable Amenity Noise Criteria**

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq}$ Noise Level, dB(A)	
			Acceptable	Maximum
Residence	Rural	Night	40	45
Area specifically reserved for passive recreation	All	When In Use	50	55
Industrial premises	All	When In Use	70	75

Notes: 1. Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays.  
2. Only the night period is assessed as the pipeline is to operate 24 hours and the night period is the most critical.

#### 4.1.3 Summary

In assessing noise impact of industrial noise sources, both components must be taken into account for residential receivers. In most cases, only one will become the limiting criterion and form the project specific noise levels (PSNLs) for the noise source.

The applicable PSNLs (including intrusive and amenity criteria) are presented in the table below.

**Table 4.3 – INP Project Specific Noise Levels, dB(A)**

Receiver	Intrusiveness Criteria	Amenity Criteria
	$L_{Aeq,15min}$	$L_{Aeq,period}$
Fishing Hut (Receiver R1)	38	40
Affected residential receivers	35	40
Banjo Patterson Park (Receiver R91)	-	50
Orange Resource Recovery Centre (Receiver R92)	-	70

Note: PSNLs are in bold. Intrusiveness criterion not applicable for R91 and R92 as these are not residential receivers.

The above table shows that the limiting criteria, and thus the PSNLs, are the intrusiveness criteria for all residential receivers while the amenity criteria are applicable for Receivers R91 and R92.

## 4.2 Industrial Noise Source

As mentioned previously, there will three permanent pumping stations which comprises of the river intake pumping station located at the Macquarie River and two booster pumping stations

along the route of the pipeline. Operational noise from the proposed pump stations will impact on a limited number of receivers close to each pumping station. It is anticipated that the pump stations may operate at any time.

The intake pumping station will house two river off-take pumping station lift pumps, two river off-take pumping station booster pumps and two filtrations units, with a total power consumption of 780kW. The booster pumping stations will each house a balance tank and two booster pumps with a total power consumption of 405kW each. Based on the proposed specifications of the plant and equipment, the estimated internal sound pressure levels within the pumping station building, based on currently provided information, would be a total of 100dB(A) within the intake pumping station building and 99dB(A) within each booster pumping station building.

The pumping station buildings, which will house the associated pumping equipment and ancillaries, will be fabricated from tilt-up concrete panels, block work or brick, and fitted with a structural steel roof. It is assumed that any penetrations and openings to the pumping stations will be sealed air tight to maintain the acoustic integrity of the pumping station buildings. As the choice of construction material has not been finalised the noise reduction from the building fabric has not been included and the sound pressure levels are assumed to be 92dB(A) at 1m for the intake pumping station building and 91dB(A) at 1m for each booster pumping station building.

### 4.3 Predicted Noise Levels for Typical Site Operation

Noise emissions from the operation of the pipeline due to the pump stations were modelled to the nearest receivers using the CadnaA (version 4.2) noise modelling computer program. The noise model accounts for the noise source, receiver location, distance and topographical features between source and receiver. CadnaA calculates the contribution of the noise sources at the nominated receiver and allows for the prediction of the total noise from a site. The computer program is endorsed by the OEH and its environmental noise predictions have been verified on many past occasions in the field.

The nearest potentially affected receivers to the proposed pump stations are identified in Table 4.4.

**Table 4.4 - Nearest Receivers to Pumping Stations**

Receiver	Nearest Pump Station	Approximate Distance to Nearest Pump Station (m)
Fishing Hut	Pump Station 1	1,615m
1829 Long Point Rd	Pump Station 2	1,540m
108 Boshes Creek Rd	Pump Station 2	1,470m
6 Oakey Ln	Pump Station 3	790m
206 Lookout Rd	Pump Station 3	575m
249 Lookout Rd	Pump Station 3	1,195m

Based on the assumptions presented in Section 4.2 above, operational noise levels from the pumping stations impacting the nearest affected receiver locations were predicted to be less than 20dB(A). This is well below both the background noise level and the nominated criteria. Therefore, it is expected that the operation of the pumping stations will be inaudible at all receivers.

## **5 CUMULATIVE NOISE IMPACTS**

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### **5.1 Cumulative Construction Noise**

At present there are no known construction activities or projects that would result in cumulative construction noise impacts when combined with the construction works associated with the project. If and when future construction works not associated with the project arise in the surrounding area of the pipeline corridor, the cumulative noise impact from all construction activities would need to be considered.

### **5.2 Cumulative Operational Noise**

Predicted operational noise levels from the pumping stations and ancillary services were found to be well below the background noise levels at residential areas close to the pump stations. Therefore the noise impacts from the operation of the project would not contribute to the existing acoustic environment and not cumulative noise impacts would be experienced at nearby residences.

## 6 ROAD TRAFFIC NOISE ASSESSMENT

### 6.1 Acoustic Criteria

Ophir Road, Burrendong Way, Oakey Lane, Long Point Road, Bulgas Road and Lookout Road are adjacent to the majority of the proposed pipeline route and traffic associated with the construction and operation of the pipeline system will use these roads to gain access. Ophir Road is categorised as an 'arterial' road as it connects the city of Orange with western parts of NSW, Burrendong Way is classified as a arterial road providing an alternative route to the Mitchell Highway between Orange and Wellington, while Oakey Lane, Long Point Road, Bulgas Road and Lookout Road are categorised as 'local' roads.

The NSW Road Noise Policy (RNP) is used to assess the potential traffic noise impact from traffic associated with the project travelling on public roads. Table 3 of the RNP is divided up into different land use developments and road categories and lists the respective criteria for each case. The applicable sections are presented below.

**Table 6.1 – Road Traffic Noise Criteria for Project Traffic Route**

Road category	Type of project/land use	Assessment criteria, dB(A)	
		Day (7am-10pm)	Night (10pm-7am)
Freeway / arterial / sub-arterial roads	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by the land use developments	L <sub>Aeq(15hr)</sub> 60 dB(A)	L <sub>Aeq(9hr)</sub> 55 dB(A)
Local Roads	6. Existing residences affected by additional traffic on existing local road generated by land use developments	L <sub>Aeq(1hr)</sub> 55 dB(A)	L <sub>Aeq(1hr)</sub> 50 dB(A)

According to the RNP, where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria presented above. Examples of applicable noise mitigation strategies include appropriate location of private access roads to the construction sites, regulating time of use, using clustering, using 'quiet' vehicles and/or constructing noise barriers.

In all cases, traffic arising from the project should not lead to an increase in existing noise levels of more than 2dB(A).

### 6.2 Noise Sources

#### 6.2.1 Construction Traffic

Construction traffic will consists mainly of trucks entering and leaving work sites at various locations along the route and employee vehicles accessing the work sites. The estimated amount of traffic movements are taken from the Traffic and Transport Assessment prepared by Samsa Consulting (dated February 2011).

Due to the constraints with crossing Oakey Creek (along Oakey Lane) in wet weather, the road transport routes required to access the project site along two distinct areas in the south and the north are as follows:

- Southern section access via Ophir Road, Lookout Road and Oakey Lane, south of Oakey Creek crossing as well as Bulgas Road near Suma Park Dam; and
- Northern section access via Burrendong Way, Long Point Road and Oakey Lane, north of Oakey Creek crossing.

The existing traffic volumes along the road transport routes provided by Samsa Consulting are present in Table 6.2 and Table 6.3 below.

**Table 6.2 - Existing Traffic Volumes - Southern Section Access**

Traffic Scenario		Ophir Road	Lookout Road	Oakey Lane (south)	Bulgas Road
Daily Traffic	LV	2,300	50	10	90
	HV	277	5	4	10
Hourly (Peak) Traffic	LV	250	9	9	18
	HV	30	1	1	1

**Table 6.3 - Existing Traffic Volumes - Northern Section Access**

Traffic Scenario		Burrendong Way	Long Point Road	Oakey Lane (north)
Daily Traffic	LV	4,550	120	10
	HV	500	16	4
Hourly (Peak) Traffic	LV	500	25	9
	HV	50	5	1

The predicted traffic generation from the construction works, as presented in the traffic study, is 70 light vehicles per day and 50 heavy vehicles per day, with peak hour traffic flows of 35 light vehicles per hour and 18 heavy vehicles per hour. It is noted that the predicted volumes from the traffic study are based on a worst case maximum along either the southern or northern section access routes.

Comparing the predicted construction traffic generation against the existing traffic volumes on Ophir Road and Burrendong Way, it can be seen that there will be a negligible increase to the existing traffic volumes. Therefore the associated traffic noise increase from construction traffic along Ophir Road and Burrendong Way is negligible.

For the local roads – Lookout Road, Oakey Lane, Bulgas Road and Long Point Road – construction traffic as a result of the project would increase the existing traffic volumes significantly, which in turn would significantly increase the existing traffic noise levels to affected receiver locations.

Therefore, based on the above worst case construction traffic generation, the required minimum buffer distances in order to comply with the nominated local roads criteria presented in Section 6.1 are provided in Table 6.4 below.

**Table 6.4 – Buffer Distances to Comply with RNP Criteria**

Road	Road Classification	RNP Noise Criteria	Minimum Buffer Distance
Lookout Road	Local	L <sub>Aeq, 1hr</sub> 55dB(A)	80m
Oakey Lane	Local		80m
Bulgas Road	Local		80m
Long Point Road	Local		120m

Based on the above table, minimum buffer distances of up to 80m are required in order to comply with the relevant RNP noise criteria for residences located along Lookout Road, Oakey Lane, Bulgas Road and Long Point Road.

From site visits and aerial photos, it is observed that most residential dwellings along Lookout Road, Oakey Lane and Long Point Road are greater than minimum buffer distance from the road. Therefore, road traffic noise levels as a result of construction traffic are expected to comply at these residences.

Several residential dwellings along Bulgas Road are located within 80m from the road kerb. However, construction traffic along Bulgas Road will be limited to construction traffic associated with the construction of the discharge structure at Suma Dam. It is anticipated that the construction traffic generation will be much lower than the worst case maximum volumes used in the assessment. Also the construction traffic generation on Bulgas Road, will be temporary in nature with an anticipated duration of less than 6 months.

Where residential dwellings are located within the above minimum buffer distances from the road, then feasible and reasonable noise mitigation options presented in Section 6.1 above should be considered.

#### 6.2.2 Operational Traffic

During the operation of the pipeline system, traffic movements will be mainly from 4WD utilities and 3-tonne trucks for maintenance works. Scheduled maintenance visits will typically occur one to two times a week. As a result, vehicle movements are anticipated to be minimal and would not differ to existing traffic on the roads.

Therefore, road traffic noise due to the operation of the project is not expected to adversely impact residences along the transport routes.

## **7 CONCLUSION**

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Renzo Tonin & Associates have completed an assessment of noise and vibration impacts during the construction and operational phases of the proposed Macquarie Orange Pipeline Project between Macquarie River and Suma Park Dam.

Noise associated with the construction of the pipeline was determined to generally exceed the set criteria at various receivers along the route of the pipeline. In-principle noise control measures have been recommended to reduce noise to more acceptable levels.

Construction vibration has also been assessed and buffer distances for plant and equipment causing high vibration levels have been provided to minimise adverse vibration impacts, should they occur.

Noise from the operation of the pumping stations located at the Macquarie River and two locations along the pipeline route have been predicted based on noise levels estimated from the available specifications for the pumping plant and equipment. Noise levels were predicted to comply with the relevant INP noise criteria at all the receiver locations nearest to the pump stations.

It is expected that blasting during the construction of the pipeline may occur. Therefore appropriate MIC levels have been predicted to allow compliance with the set criteria for noise and vibration due to blasting.

An assessment of traffic noise levels on Ophir Road, Oakey Lane and Lookout Road due to construction and operational traffic has been undertaken. Buffer distances have been presented in order for construction traffic to comply with the RNP noise criteria. Additional traffic from the operation of the pipeline is not expected to significantly increase existing traffic noise levels on Ophir Road, Oakey Lane and Lookout Road.

## APPENDIX A - GLOSSARY OF ACOUSTIC TERMS

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The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

<i>Acoustic Barrier</i>	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc used to reduce noise, without eliminating it.
<i>Adverse Weather</i>	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
<i>Air-borne Noise</i>	This refers to noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise and receiver.
<i>Ambient Noise</i>	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
<i>Assessment Period</i>	The period in a day over which assessments are made.
<i>Assessment Point</i>	A point at which noise measurements are taken or estimated.
<i>Audible Range</i>	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
<i>Background Noise</i>	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the <b>L<sub>90</sub></b> noise level (see below).
<i>Barrier</i>	See "acoustic barrier", a solid object used to attenuate sound.
<i>Character, acoustic</i>	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.

## *Decibel [dB]*

The level of noise is measured objectively using a Sound Level Meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen. The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound is heard.

The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping.

Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels. The following are examples of the decibel readings of every day steady or quasi-steady sounds;

0dB	the faintest sound we can hear
20dB	quiet bedroom at night or recording studio
30dB	quiet library or quiet location in the country
40dB	living room
50dB	typical office space or ambience in the city at night
60dB	normal conversational speech
70dB	a car passing by
80dB	kerbside of a busy road
90dB	truck passing by
100dB	nightclub
110dB	rock band or 2m from a jackhammer
120dB	70m from a jet aircraft
130dB	threshold of pain
140dB	25m from a jet aircraft

## *dB(A): A-weighted decibels*

The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective

loudness of the noise.

***Diffraction***

The distortion around solid obstacles of waves travelling past.

***Fluctuating Noise***

Noise that varies continuously and to an appreciable extent over the period of observation. It can also include intermittent noise. As a guide, when the level varies noticeably by more than 5 dB over a period of less than one minute, the noise is considered to be fluctuating.

***Free-field***

**An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.**

***Frequency***

Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.

***Ground-borne noise***

Ground-borne noise propagating through the ground as vibration and then radiated by vibrating building elements such as wall and floor surfaces. This noise is normally noticeable only in areas that are well protected from airborne noise.

***Impulsive noise***

Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.

***Intermittent noise***

The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.

***Loudness***

A 3dB increase represents a doubling of the sound pressure, however an increase of about 10dB is required before the sound will subjectively appear to be twice as loud. That is, a sound of 85dB is twice as loud as a sound of 75dB which is twice as loud as a sound of 65dB and so on. That is, the sound of 85dB is four times as loud as a sound of 65dB. The smallest change which can be readily heard is approximately 2dB. An increase beyond 5dB is considered to represent the level at which a change in loudness begins to be clearly perceived.

***L<sub>max</sub>***

The maximum sound pressure level measured over a given period.

***L<sub>min</sub>***

The minimum sound pressure level measured over a given period.

***L<sub>av. max</sub>***

The average of the maximum noise levels in a sample.

<i>L<sub>1</sub></i>	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
<i>L<sub>10</sub></i>	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
<i>L<sub>90</sub></i>	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the <i>L<sub>90</sub></i> noise level expressed in units of dB(A).
<i>L<sub>eq</sub></i>	The “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
<i>Low-frequency noise</i>	Containing major components within the low frequency range (20Hz – 250Hz) of the frequency spectrum.
<i>Microphone</i>	An electro acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
<i>Nature, acoustic</i>	The innate or essential quality of the noise. That which makes one noise distinguishable from another (e.g. the spoken voice from the sound of a dog barking, a telephone ringing from the sound of a gun).
<i>Noise</i>	Sound which a listener does not wish to hear.
<i>Noise Monitor</i>	See “sound level meter”.
<i>NRC</i>	The <i>Noise Reduction Coefficient</i> is the arithmetic average, rounded off to the nearest multiple of 0.05 of the sound absorption coefficients at 250, 500, 1kHz and 2kHz for a specific material and mounting condition.
<i>Quality, acoustic</i>	An attribute, characteristic or property of the noise, its duration, its time-varying characteristics or its frequency content. Examples are the “screech” of screaming, the “rumble” of an airconditioner, the “dripping” of a tap.
<i>Reflection</i>	Sound wave changed in direction of propagation due to a solid object obscuring its path.
<i>R<sub>w</sub></i>	The <i>Weighted Sound Reduction Index</i> or <i>R<sub>w</sub></i> is a measure of the noise reduction property of the partition, a higher rating implying a higher sound reduction performance.
<i>SEL</i>	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain <i>L<sub>eq</sub></i> sound levels over any period of time and can be used for predicting noise at various

locations.

<i>Sound</i>	A fluctuation of air pressure which is propagated as a wave through air.
<i>Sound Absorption</i>	The ability of a material to absorb sound energy through its conversion into thermal energy.
<i>Sound Level Meter</i>	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
<i>Sound Pressure Level</i>	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
<i>Sound Power Level</i>	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
<i>STC</i>	Sound Transmission Class. This is a measure of the extent of sound reduction of noise going through a building element, presented as a rating or class. It denotes the sound attenuation properties of walls, floors and ceilings used to construct building spaces. The higher the STC the better the sound reducing performance of the construction.
<i>Structure-borne noise</i>	This refers to noise which is generated by vibrations induced in the ground and/or structure. These vibrations excite walls and slabs in buildings and cause them to radiate noise. This type of noise can not be attenuated by barriers or walls but requires the interposition of a resilient (neoprene, springs etc.) break between the source and the receiver.
<i>Tonal noise</i>	Containing a prominent frequency and characterised by a definite pitch.

## APPENDIX B - NOISE MONITORING METHODOLOGY

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### B.1 Noise Monitoring Equipment

All long term noise monitoring was conducted using RTA Technology noise loggers. The noise monitoring equipment used here complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as a Type 2 instrument suitable for field use.

A noise monitor consists of a sound level meter and a computer housed in a weather resistant enclosure. Ambient noise levels were recorded at a rate of 10 samples per second. Every 15 minutes, the data is processed statistically and stored in memory. The equipment was calibrated prior and subsequent to the measurement period using a Bruel & Kjaer Type 4230 calibrator. No significant drift in calibration was observed.

The equipment used for the short term, attended noise measurements was a Brüel & Kjær Type 2250 precision sound level analyser. Statistical noise levels were acquired in both overall and octave band frequencies. This instrument complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters – Part 2: Integrating - averaging" and is designated as Type 1 instrument having accuracy suitable for field and laboratory use.

The sound level analyser was calibrated prior and subsequent to the measurements using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed.

### B.2 Meteorology during Monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s) or rain were excluded from the recorded data in accordance with the INP. The Bureau of Meteorology provided meteorological data, which is considered representative of the site, for the duration of the noise monitoring period.

### B.3 Noise vs Time Graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the  $L_{10}$ ,  $L_{90}$ , and  $L_{eq}$  levels. The statistical descriptors  $L_{10}$  and  $L_{90}$  measure the noise level exceeded for 10% and 90% of the sample measurement time. The  $L_{eq}$  level is the equivalent continuous noise level or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels at the noise monitoring locations in Appendix G illustrate these concepts.

Noise levels are commonly measured in units of A-weighted decibels or dB(A). The "A-weighting" refers to standardised amplitude versus frequency curve used to "weight" sound measurements to represent the response of the human ear. The human ear is less sensitive to

low pitch sound than it is to high pitch sound. Overall A-weighted measurements quantify sound with a single number to represent how people subjectively hear different frequencies at different levels.

Background noise is the term used to describe the noise measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample time period. This is represented as the **L<sub>90</sub>** noise level.

## **APPENDIX C - SPECIFICATION FOR DETERMINING THE SOUND POWER LEVELS OF CONSTRUCTION PLANT**

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### **C.1 SCOPE**

This document specifies methods for determination of sound power levels for construction plant including earthmoving equipment and other ancillary plant and equipment used during construction.

### **C.2 REFERENCED STANDARDS**

- Australian Standard 1259 – 1990: “Acoustics - Sound Level Meters”,
- Australian Standard 2012.1-1990: “Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - stationary test condition - Part 1: Determination of compliance with limits for exterior noise”
- ISO 6395: “Acoustics & Measurement of airborne noise emitted by earthmoving machinery - Dynamic test conditions”
- AS1217.5-1985: “Acoustics – Determination of sound power levels of noise sources – Part 5 – Engineering methods for free-field conditions over a reflecting plane”
- AS1217.7-1985: “Acoustics – Determination of sound power levels of noise sources – Part 5 – Survey method”

### **C.3 TESTING PROCEDURES – EARTHMOVING MACHINERY**

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking acoustic measurements.

Each significant plant item shall be tested in terms of both the ‘stationary’ and the ‘dynamic’ testing procedures detailed below.

All sound level meters used must be Type 1 instruments as described in Australian Standard 1259.2-1990 “Acoustics - Sound Level Meters” and calibrated to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The calibration of the meters shall be checked in the field before and after the noise measurement period.

#### **C.3.1 STATIONARY TESTING**

Stationary measurements shall be performed on all earthmoving plant according to the method of AS2012.1-1990.

In addition to measuring overall A-weighted noise levels, octave band frequency  $L_{Aeq,T}$  noise levels shall also be measured at each measurement location from 63Hz to 8kHz inclusive. Background noise shall also be recorded in the same octave band frequency range, and corrections to measured octave-band noise levels shall be applied as described in Table 1 of AS2012.1-1990.

Each plant item should be tested in isolation, without any other noisy plant on site operating. Where this cannot be done for practical reasons, then the noise of the plant being tested shall be at least 5dB greater than the background noise from other nearby plant, both in terms of the overall A-weighted level and in all octave band frequencies.

Measured octave-band  $L_{Aeq,T}$  noise levels shall also be processed as described in Section 8 of that Standard to establish octave-band sound power levels.

The overall A-weighted sound power levels to be determined shall be in terms of both the  $L_{Aeq,T}$  and  $L_{A10,T}$  noise metrics. The measurement sample time shall be selected so that it is representative of the operating cycle/s of the plant being tested.

Where the plant tested or noise measurements are taken within 3.5 metres of large walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

All measured noise level data and determined sound power levels shall be included in the test reports.

### C.3.2 DYNAMIC TESTING

Details of equipment operation during testing will vary depending on the equipment type. Dynamic measurements shall be performed on all earthmoving plant according to the method in International Standard ISO 6395.

In addition to measuring overall A-weighted noise levels, octave band frequency  $L_{Aeq,T}$  noise levels shall also be measured at each measurement location from 63Hz to 8kHz inclusive. Background noise shall also be recorded in the same octave band frequency range, and corrections to measured octave-band noise levels shall be applied as described in International Standard ISO 6395.

Each plant item should be tested in isolation, without any other noisy plant on site operating. Where this cannot be done for practical reasons, then the noise of the plant being tested shall be at least 5dB greater than the background noise from other nearby plant, both in terms of the overall A-weighted level and in all octave band frequencies.

Measured octave-band  $L_{Aeq,T}$  noise levels shall also be processed to establish octave-band sound power levels.

Where the plant tested or noise measurements are taken within 3.5 metres of large walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

The overall A-weighted sound power levels to be determined shall be in terms of both the  $L_{Aeq,T}$  and  $L_{A10,T}$  noise metrics. The measurement sample time shall be selected so that it is representative of the operating cycle/s of the plant being tested.

All measured noise level data and determined sound power levels shall be included in the test reports.

#### **C.4 TESTING PROCEDURES – OTHER CONSTRUCTION PLANT**

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking acoustic measurements.

All sound level meters used must be Type 1 instruments as described in Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters". **The calibration of the meters shall be checked** in the field before and after the noise measurement period.

Noise measurements shall be performed on all non-earthmoving construction plant according to the methods of either AS1217.5-1985 or AS1217.7-1985, whichever is applicable to the items of plant being tested.

Machinery shall be operated at high idle speed. In the case of drilling, boring and rock-breaking machines, the testing location shall allow for these machines to be operated in rock of characteristics that are typical for the project site.

In addition to measuring overall A-weighted noise levels, octave band frequency  $L_{Aeq,T}$  noise levels shall also be measured at each measurement location from 63Hz to 8kHz inclusive. Background noise shall also be recorded in the same octave band frequency range, and corrections to measured octave-band noise levels shall be applied as described in Table 1 of AS2012.1-1990.

Each plant item should be tested in isolation, without any other noisy plant on site operating. Where this cannot be done for practical reasons, then the noise of the plant being tested shall be at least 5dB greater than the background noise from other nearby plant, both in terms of the overall A-weighted level and in all octave band frequencies.

Measured octave-band  $L_{Aeq,T}$  noise levels shall also be processed as described in Section 8 of that Standard to establish octave-band sound power levels.

The overall A-weighted sound power levels to be determined shall be in terms of both the  $L_{Aeq,T}$  and  $L_{A10,T}$  noise metrics. The measurement sample time shall be selected so that it is representative of the operating cycle/s of the plant being tested.

Where the plant tested or noise measurements are taken within 3.5 metres of large walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

All measured noise level data and determined sound power levels shall be included in the test reports.

## APPENDIX D - SPECIFICATION FOR CONSTRUCTION NOISE MONITORING

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### D.1 SCOPE

This document specifies methods for undertaking noise monitoring during the construction phase of the project.

### D.2 REFERENCED STANDARDS & GUIDELINES

- Australian Standard 1259-1990: "Acoustics - Sound Level Meters",
- Australian Standard 1055-1989 "Acoustics - Description and Measurement of Environmental Noise",
- NSW Environment Protection Authority's "Environmental Noise Control Manual", and
- NSW Environment Protection Authority's "Industrial Noise Policy".

### D.3 TESTING PROCEDURES

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking acoustic measurements.

All noise monitoring equipment used must be at least Type 2 instruments as described in Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and calibrated to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The calibration of the monitoring equipment shall also be checked in the field before and after the noise measurement period, and in the case of long-term noise monitoring, calibration levels shall be checked at minimum weekly intervals.

Long-term noise monitoring equipment or Noise Loggers, consist of sound level meters and computers housed in weather resistant enclosures. The operator may either retrieve the data at the conclusion of each monitoring period either in person or via a telephone modem if the logger is fitted with a mobile phone option. The nominated long-term environmental noise level monitors are to be of the RTA Technology Pty Ltd [phone (02) 8218 0500] type or equivalent.

All environmental noise measurements shall be taken with the following meter settings:

- Time Constant – FAST (ie 125 milliseconds)
- Frequency Weightings – A-weighting
- Sample Period – 15 minutes

All outdoor noise measurements shall be undertaken with a windscreen over the microphone. Windscreens reduce wind noise at the microphones.

Measurements of noise should be disregarded when it is raining and the wind speed is greater than 5 m/s (18 km/hr).

#### **D.4 LONG-TERM (UNATTENDED) MONITORING**

Noise monitoring shall be undertaken in accordance with the environmental noise measurement requirements stipulated in the reference standards and documents listed above.

Noise monitoring equipment shall be placed at positions which have unobstructed views of general site activities, whilst shielded as much as possible from non-construction site noise (eg. road traffic, rail noise and other surrounding noise).

Noise levels are to be recorded at a minimum rate of 10 samples per second. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum range of noise metrics to be stored in memory for later retrieval is the following A-weighted noise levels:  $L_{min}$ ,  $L_{90}$ ,  $L_{eq}$ ,  $L_{10}$ ,  $L_1$  and  $L_{max}$ .

Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Meteorological conditions such as wind velocity, wind direction and rainfall shall also be either monitored on site or recorded from the nearest weather station to the project site, over the entire noise monitoring period.

#### **D.5 SHORT-TERM (ATTENDED) MONITORING**

Attended short-term noise monitoring shall be conducted at noise receiver locations with closest proximity to the construction activities.

Short-term noise monitoring shall be conducted within the first month of commencement of construction works, and then every 1 to 2 months thereafter, dependent on the level of complaint from construction activities.

All attended short-term noise monitoring shall be recorded over 15 minute sample intervals. Noise levels are to be recorded at a minimum rate of 10 samples per second. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum range of noise metrics to be stored in memory and reported are the following A-weighted noise levels:  $L_{min}$ ,  $L_{90}$ ,  $L_{eq}$ ,  $L_{10}$ ,  $L_1$  and  $L_{max}$ .

Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Outdoor noise monitoring is to be undertaken with the microphone at a height of 1.2 – 1.5m from the ground, unless noise measurements are taken from a balcony or verandah, in which case the same microphone height shall apply off the floor.

Conditions such as wind velocity, wind direction, temperature, relative humidity and cloud cover shall also be recorded during short-term noise monitoring.

Noise monitoring shall be undertaken in accordance with the environmental noise measurement requirements stipulated in the reference standards and documents listed above.

The following information shall be recorded:

- Date and time of measurements
- Type and model number of instrumentation
- Results of field calibration checks before and after measurements
- Description of the time aspects of each measurement (ie sample times, measurement time intervals and time of day)
- Sketch map of area
- Measurement location details and number of measurements at each location
- Weather conditions during measurements
- Operation and load conditions of the noise sources under investigation
- Any adjustment made for presence or absence of nearby reflecting surfaces
- Noise due to other sources (eg traffic, aircraft, trains, dogs barking, insects etc)

## **APPENDIX E - SPECIFICATION FOR CONSTRUCTION VIBRATION MONITORING**

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### **E.1 SCOPE**

This document specifies methods for undertaking vibration monitoring during the construction phase of the project.

### **E.2 REFERENCED STANDARDS & GUIDELINES**

- AS 2775 Mechanical Mounting of Accelerometers
- AS 2670.2 Part 2: Evaluation of human exposure to whole body vibration
- EPA ENCM Chapter 174 – Vibration in Buildings
- DIN 4150.3 Structural Vibration in Buildings – Effects on Structures
- BS 7385:1 Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings
- BS 7385:2 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Groundborne Vibration
- ISO 4866 Mechanical Vibration & Shock – Vibration of Buildings – Guidelines for the Management of the Vibrations and Evaluation of their Effects on Buildings

### **E.3 TESTING PROCEDURES**

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking vibration measurements.

All vibration monitoring equipment used must be calibrated at least once every two years to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The monitoring system should also have a measurement frequency range down to 1Hz.

Long-term vibration monitoring equipment or Vibration Loggers consist of a computer unit connected by cable to a triaxial vibration transducer which senses vertical, axial and horizontal vibration. Vibration levels are continuously monitored, and the data is processed statistically and stored in the computer memory. The operator may either retrieve the data at the conclusion of each monitoring period either in person or via a telephone modem if the logger is fitted with a mobile phone option. The nominated long-term Vibration Loggers are to be of the RTA Technology Pty Ltd [phone (02) 8218 0570] type or equivalent.

### E.3.1 LONG-TERM (UNATTENDED) MONITORING

Vibration monitoring shall be undertaken at vibration sensitive locations determined to fall **within the 'buffer distances' established for each item of plant during the commencement of use** of each plant on site.

Vibration monitoring shall be undertaken over the following period(s):

- Continuously whilst the vibrating plant is operational within the pre-determined **'buffer distances' from the potentially affected building.**

Vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant.

Vibration levels are to be recorded at a minimum rate of 10 samples per second. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum range of vibration metrics to be stored in memory for later retrieval is the following:

- Vector-sum root-mean-square (rms) – maximums and statistical metrics
- Vector-sum peak-particle velocity (ppv) – maximums and statistical metrics.

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above. The following notes of importance are included here:

- Vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant.
- The surface should be solid and rigid in order to best represent the vibration levels entering the structure of the building under investigation
- The vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces
- The vibration sensor or transducer shall be directly mounted to the vibrating surface using bees wax or a magnetic mounting plate onto a steel plate or bracket either fastened or glued to the surface of interest
- Where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length shall be driven into solid ground adjacent to the building of interest and the vibration sensor or transducer shall be mounted on that.

### E.3.2 SHORT-TERM (ATTENDED) MONITORING

Where vibration complaints or requests from relevant authorities are received, attended short-term vibration monitoring shall also be conducted at the requested location and at any other relevant vibration receiver location with closest proximity to the construction activities.

Short-term vibration monitoring shall be used to supplement long-term vibration monitoring undertaken at nearby locations, and to check whether or not the vibration levels measured by the long-term vibration monitors are caused by construction activities carried out on site.

All attended short-term vibration monitoring shall be recorded over 15 minute sample intervals. Vibration levels are to be recorded at a minimum rate of 10 samples per second. The minimum range of vibration metrics to be stored in memory and reported are the following:

- root-mean-square (rms) – maximums and statistical levels
- peak-particle velocity (ppv) – maximums and statistical levels.

In addition to measuring and reporting overall vibration levels, statistical vibration levels shall also be measured and reported in third-octave band frequencies from 1Hz to 250Hz.

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above. The following notes of importance are included here:

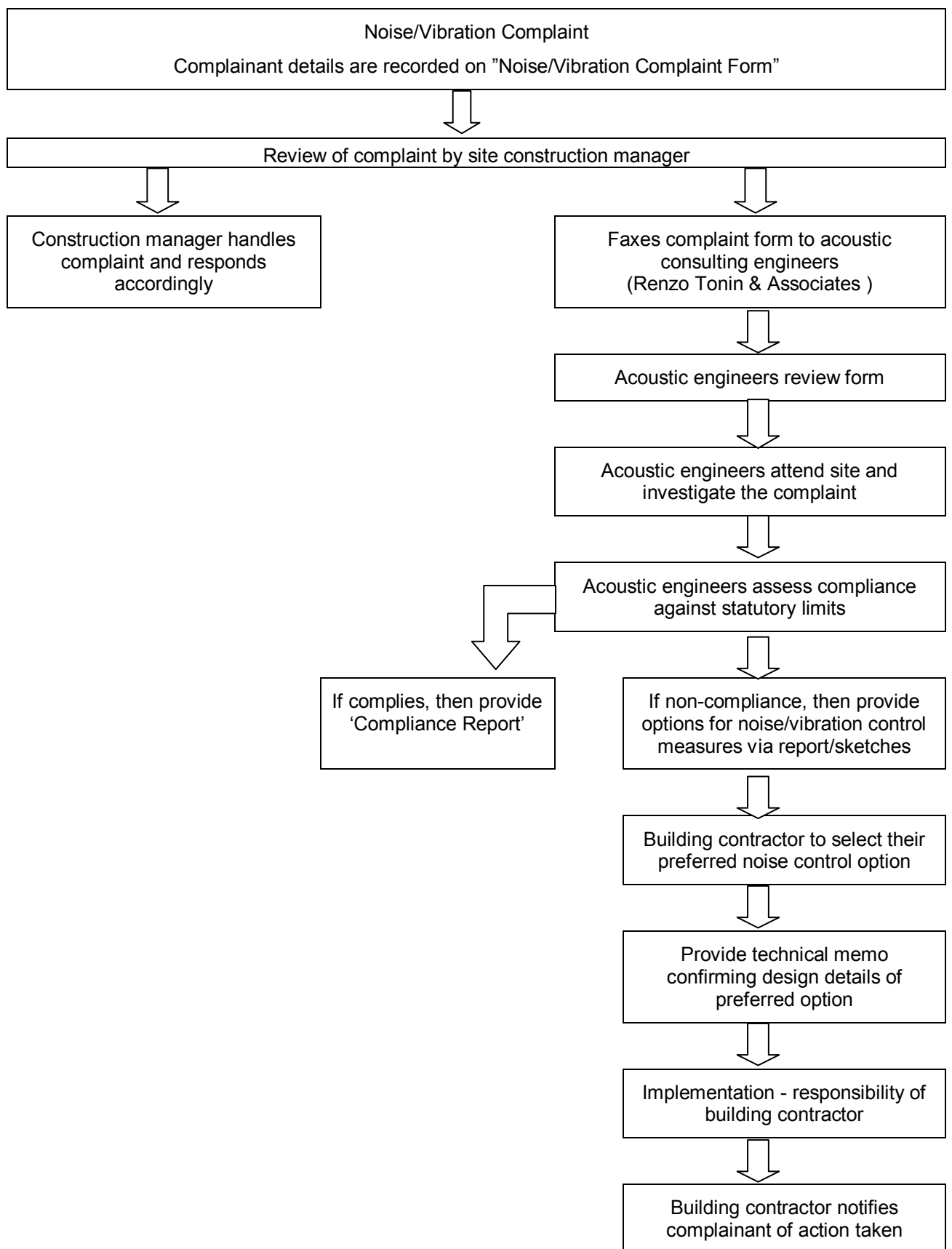
- vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant.
- the surface should be solid and rigid in order to best represent the vibration levels entering the structure of the building under investigation
- the vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces
- the vibration sensor or transducer shall be directly mounted to the vibrating surface using either bees wax or a magnetic mounting plate onto a steel washer, plate or bracket which shall be either fastened or glued to the surface of interest
- where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length shall be driven into solid ground adjacent to the building of interest, and the vibration sensor or transducer shall be mounted on that.

The following information shall be recorded:

- Date and time of measurements
- Type and model number of instrumentation

- Description of the time aspects of each measurement (ie sample times, measurement time intervals and time of day)
- Sketch map of area
- Measurement location details and number of measurements at each location
- Operation and load conditions of the vibrating plant under investigation
- Possible vibration influences from other sources (eg domestic vibrations, other mechanical plant, traffic, etc)

## APPENDIX F - NOISE / VIBRATION COMPLAINT MANAGEMENT PROCEDURE



## NOISE/VIBRATION COMPLAINT FORM

### COMPLAINANT'S DETAILS

<b>Date :</b>		<b>Received by (tick a box) :</b>	Phone <input type="checkbox"/>	Written in <input type="checkbox"/>	Person <input type="checkbox"/>
<b>Complaint Received By:</b>		<b>Complainant's Name:</b>			
<b>Complainant's Address:</b>					
<b>Complainant's Contact Numbers:</b>	<b>Home:</b>		<b>Work:</b>		<b>Mob:</b>

### COMPLAINT DETAILS

**Describe when the problem occurred (date and time), what equipment caused the complaint (if known) and where person was standing when he/she experienced the noise/vibration:**

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### INVESTIGATION

**Question foreman responsible on site and obtain information on what equipment or processes would most likely have caused the complaint:**

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**Please fax this form to Renzo Tonin & Associates Pty Ltd for processing after obtaining approval from the Project Manager - Fax: (02) 8218 0501**

## APPENDIX G - NOISE MONITORING RESULTS

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**Oakey Lane, Orange**

**BACKGROUND & AMBIENT NOISE MONITORING RESULTS  
NSW DECCW's 'INDUSTRIAL NOISE POLICY', 2000**

Day	L <sub>A90</sub> Background Noise Levels <sup>5</sup>			L <sub>Aeq</sub> Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Tuesday-15-November-2011	-	28	23	-	36	37
Wednesday-16-November-2011	-	-	-	-	-	-
Thursday-17-November-2011	26	26	25	45	38	42
Friday-18-November-2011	28	30	25	45	39	39
Saturday-19-November-2011	-	30	33	-	39	42
Sunday-20-November-2011	-	28	23	-	43	39
Monday-21-November-2011	26	-	26	42	-	43
Tuesday-22-November-2011	-	-	-	-	-	-
Wednesday-23-November-2011	-	-	-	-	-	-
Thursday-24-November-2011	-	-	-	-	-	-
Friday-25-November-2011	-	-	-	-	-	-
Saturday-26-November-2011	-	-	30	-	-	41
Sunday-27-November-2011	33	32	28	47	42	38
Monday-28-November-2011	30	31	30	45	46	40
Tuesday-29-November-2011	-	-	-	-	-	-
<b>Representative Level</b>	<b>28</b>	<b>30</b>	<b>26</b>	<b>45</b>	<b>42</b>	<b>41</b>

Notes:

1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Partial day's monitoring
5. Assessment Background Level (ABL)
6. Rating Background Level (RBL) for L90 and logarithmic average for Leq

noise logger results

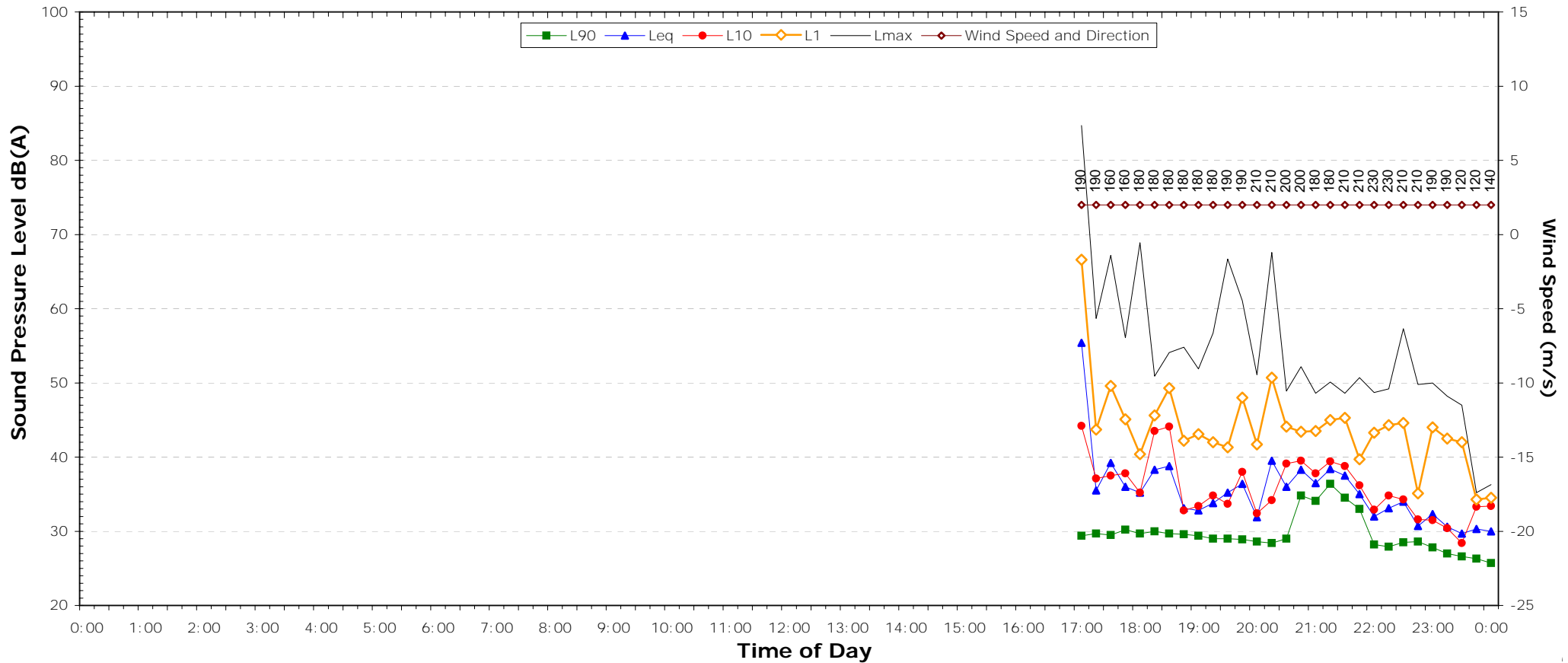
25

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SOLUTIONS

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Tuesday, 15 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	28.4	23.4
Leq (see note 3)	-	36.5	36.8

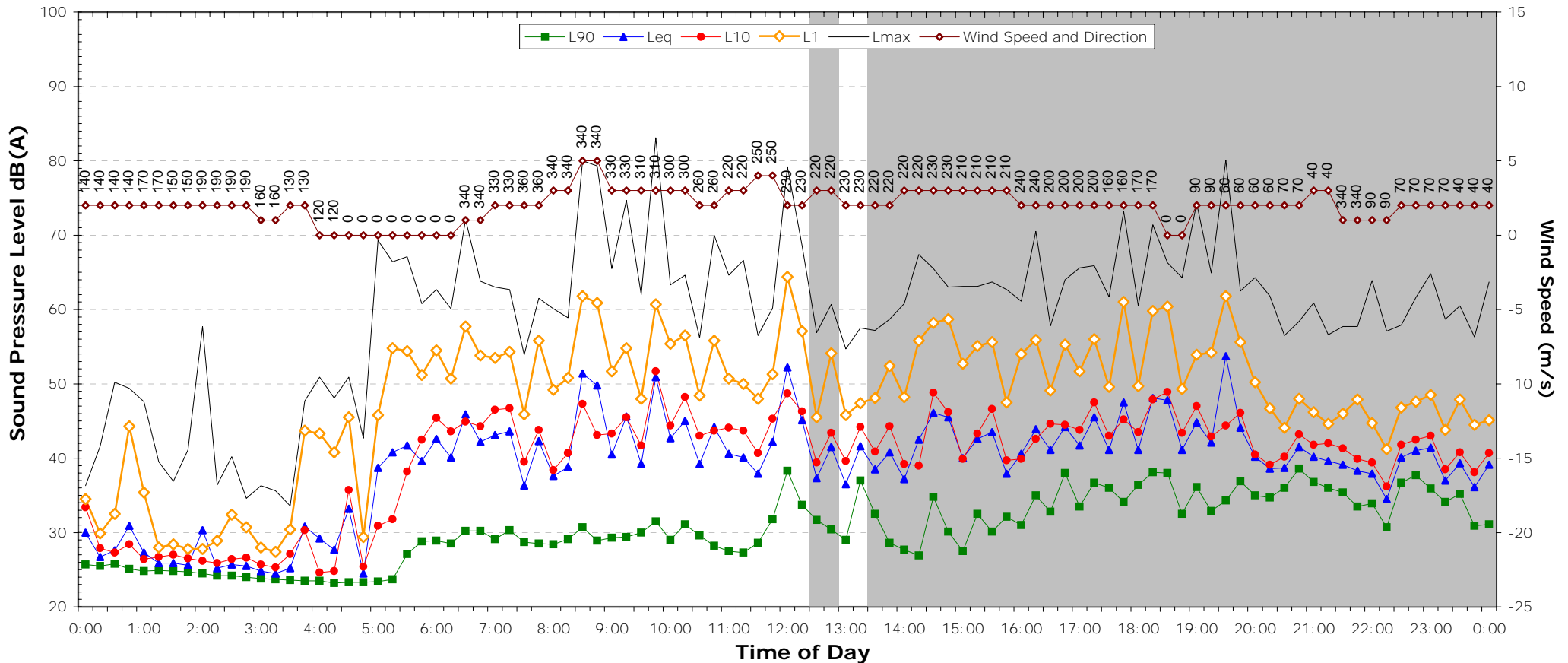
#### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Wednesday, 16 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

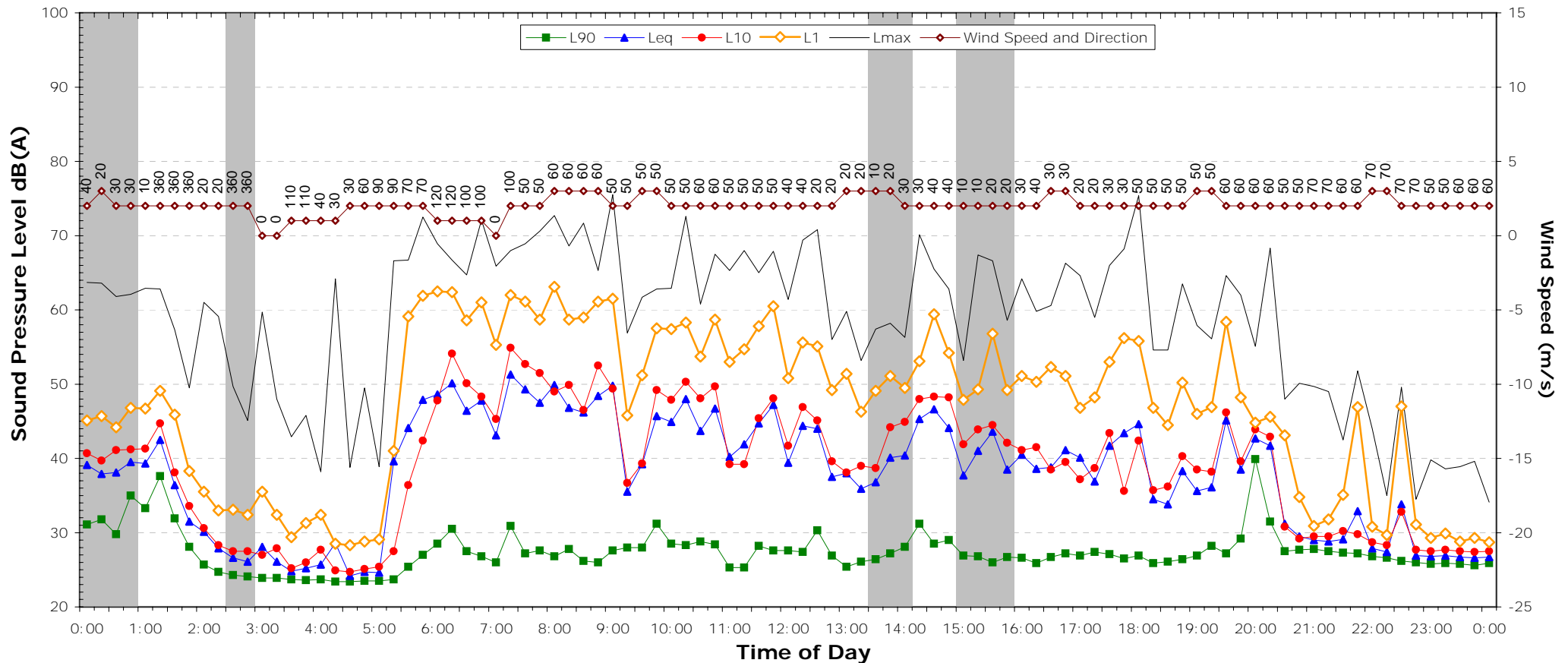
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

Oakey Lane, Orange

Thursday, 17 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	25.9	26.1	24.7
Leq (see note 3)	45.3	37.9	42.5

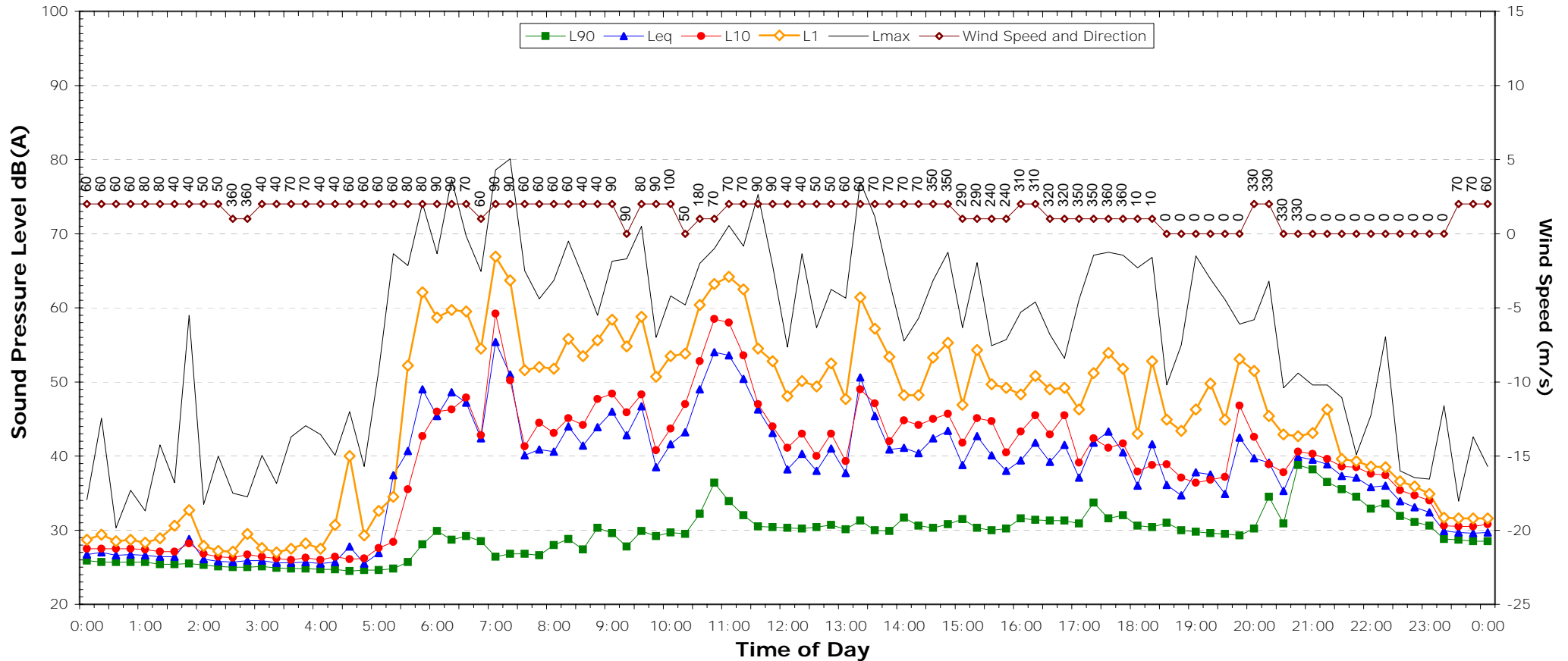
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Friday, 18 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	27.8	29.5	25.4
Leq (see note 3)	45.4	38.6	39.4

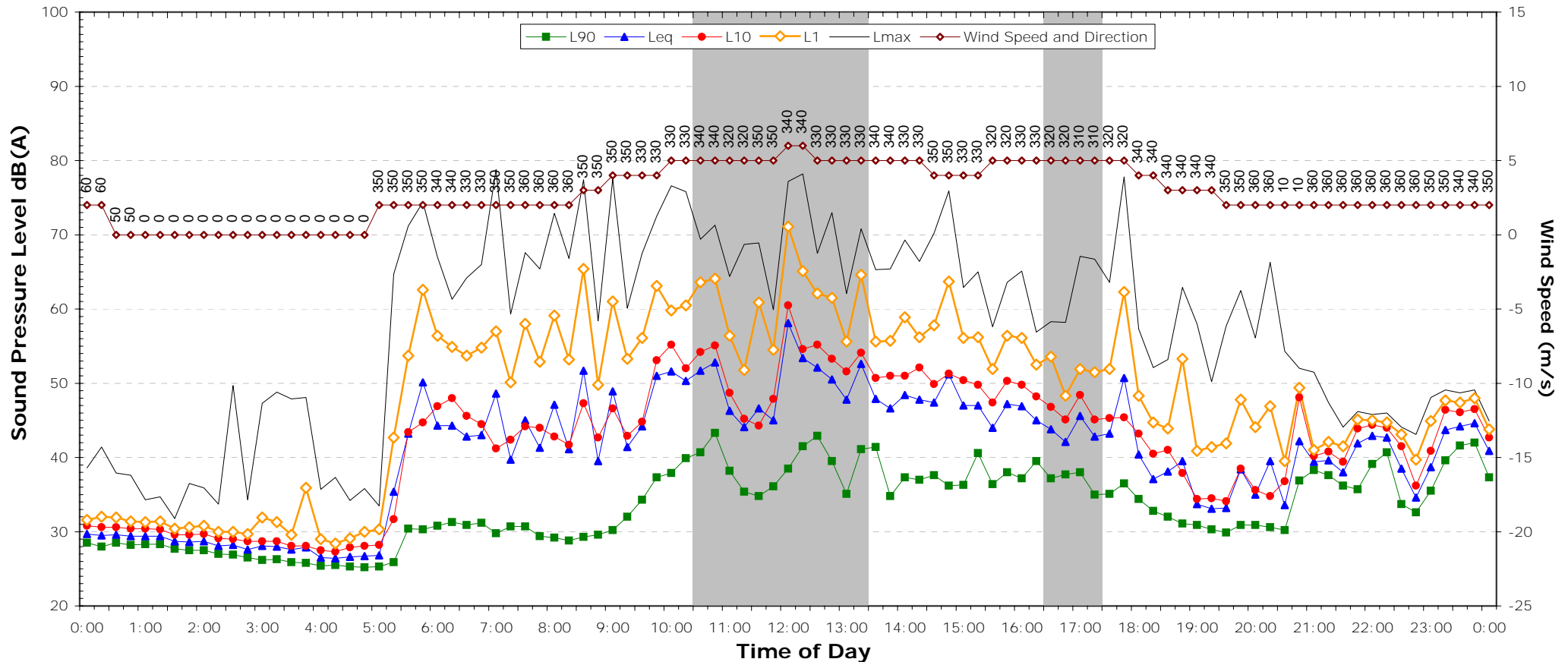
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Saturday, 19 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	30.2	32.6
Leq (see note 3)	-	38.9	42.2

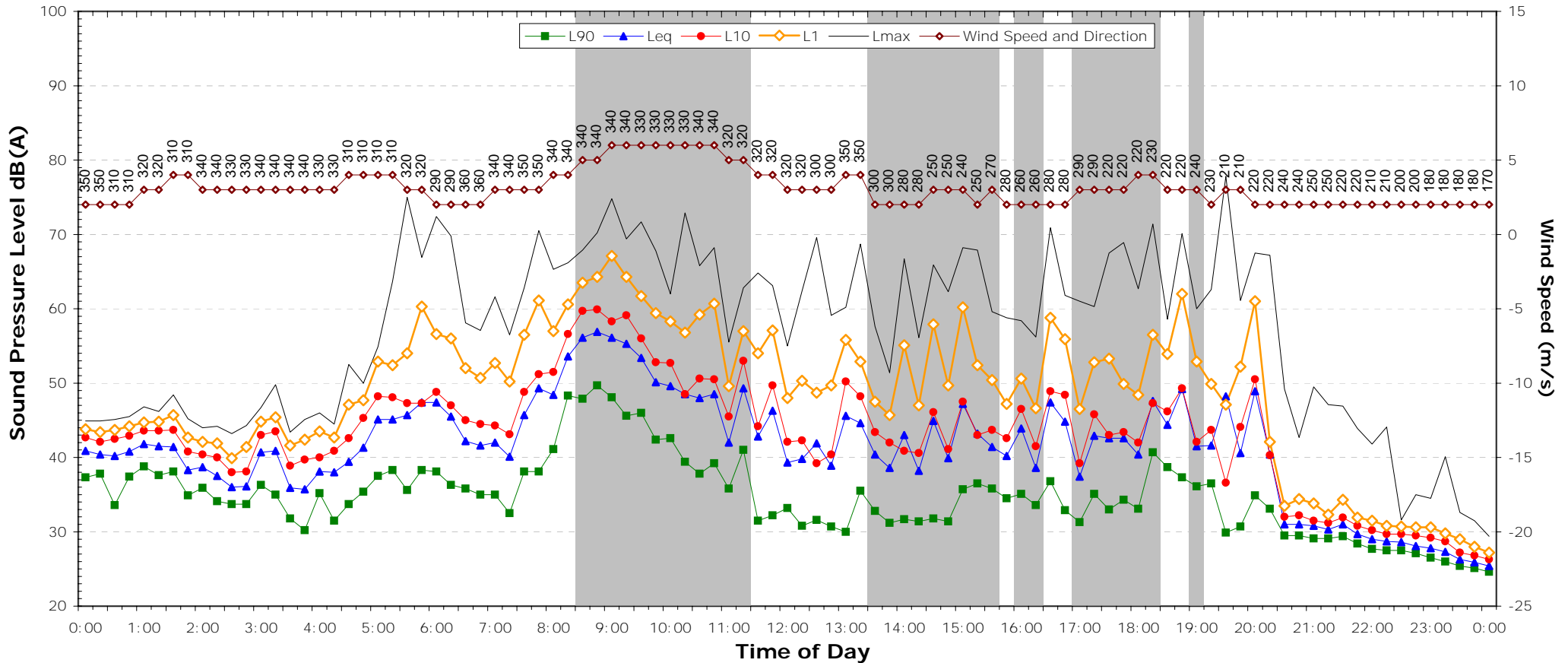
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Sunday, 20 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	28.4	23.1
Leq (see note 3)	-	43.3	38.8

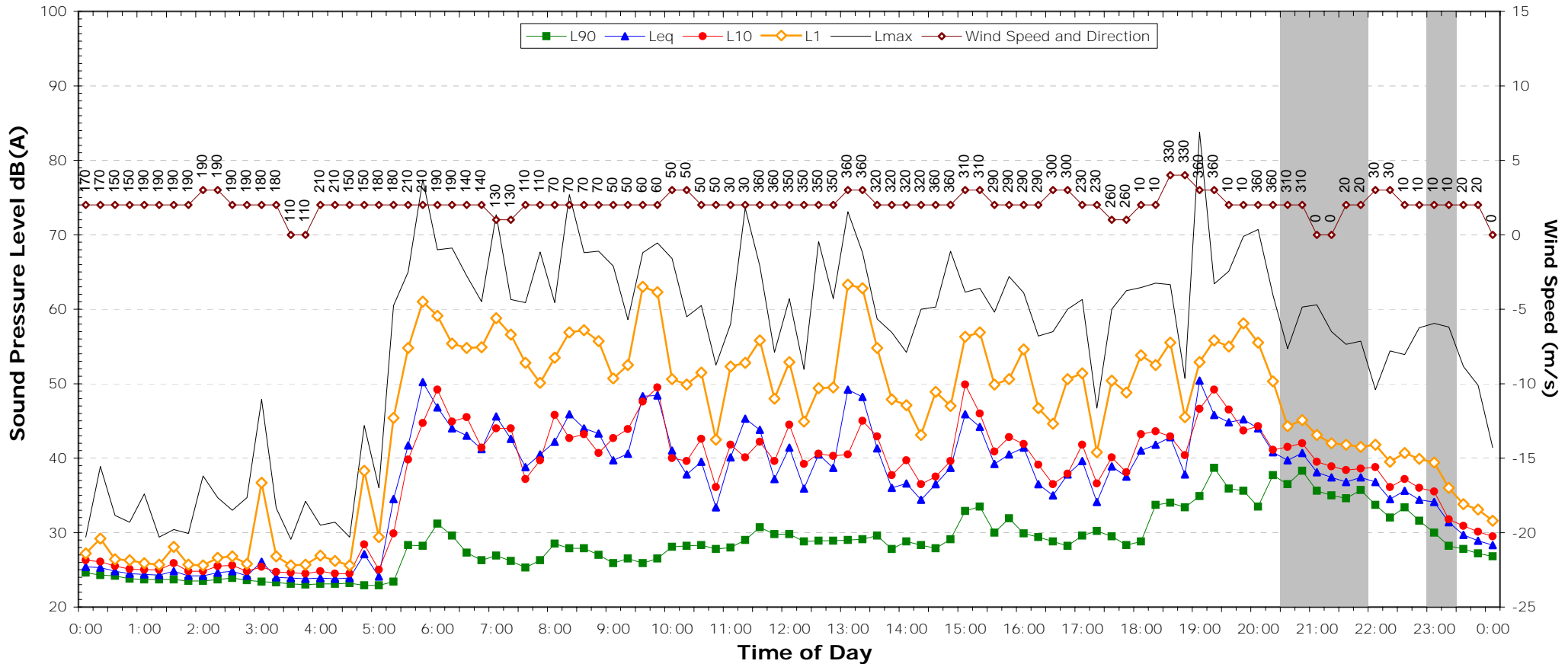
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Monday, 21 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	26.3	-	25.5
Leq (see note 3)	42.4	-	43.1

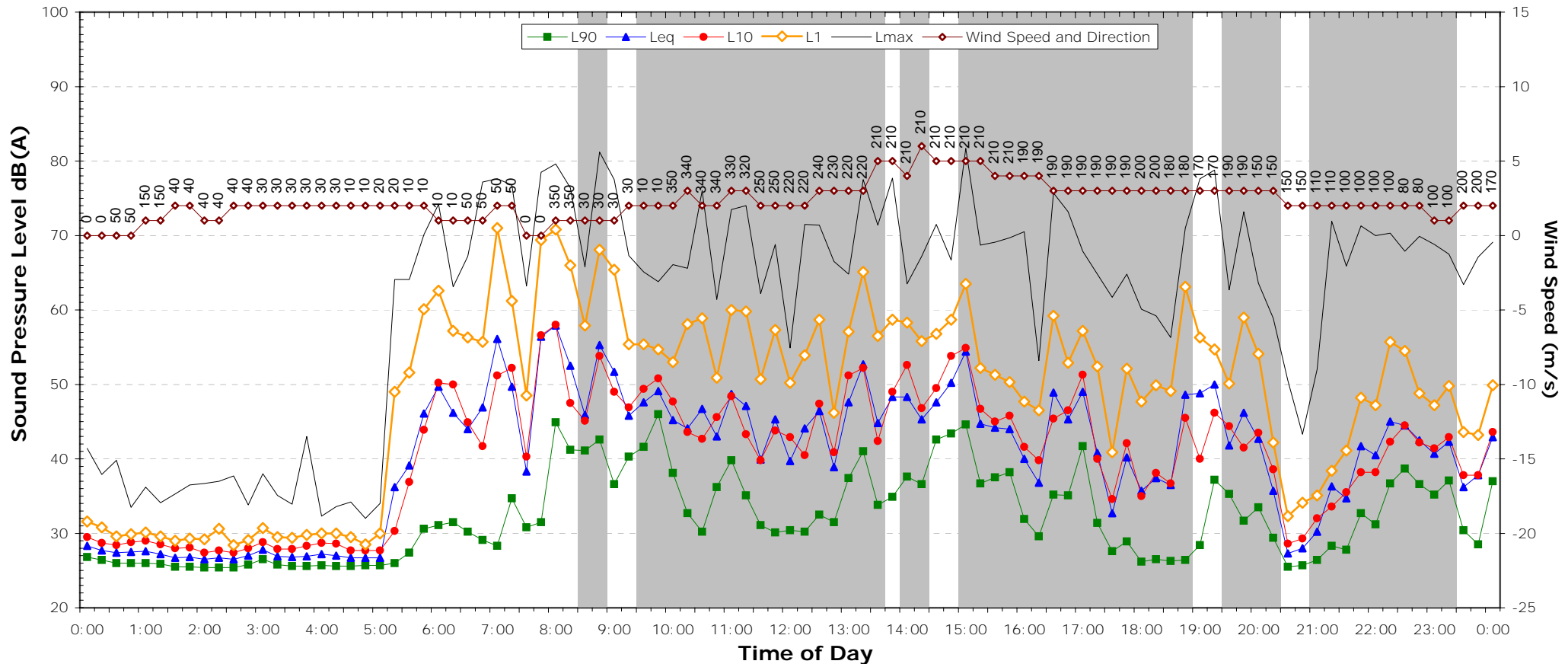
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Tuesday, 22 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

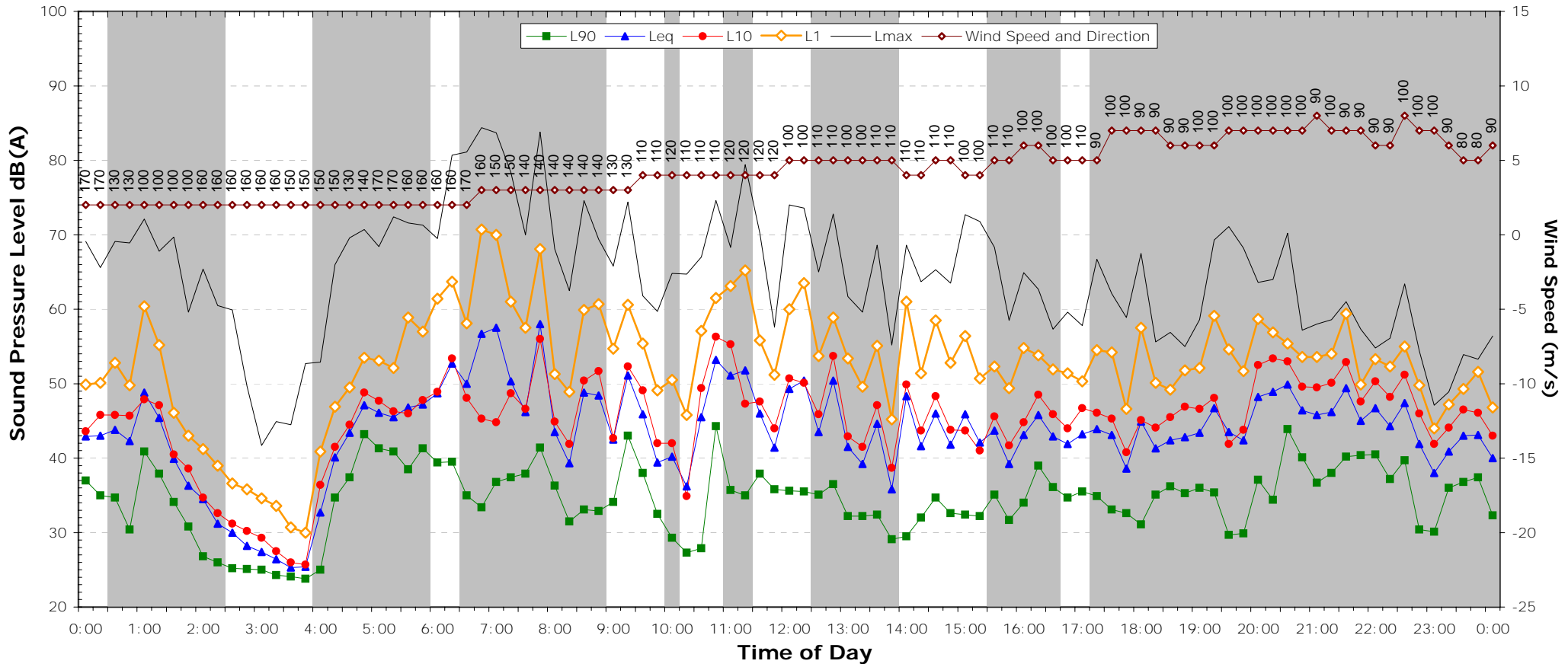
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Wednesday, 23 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

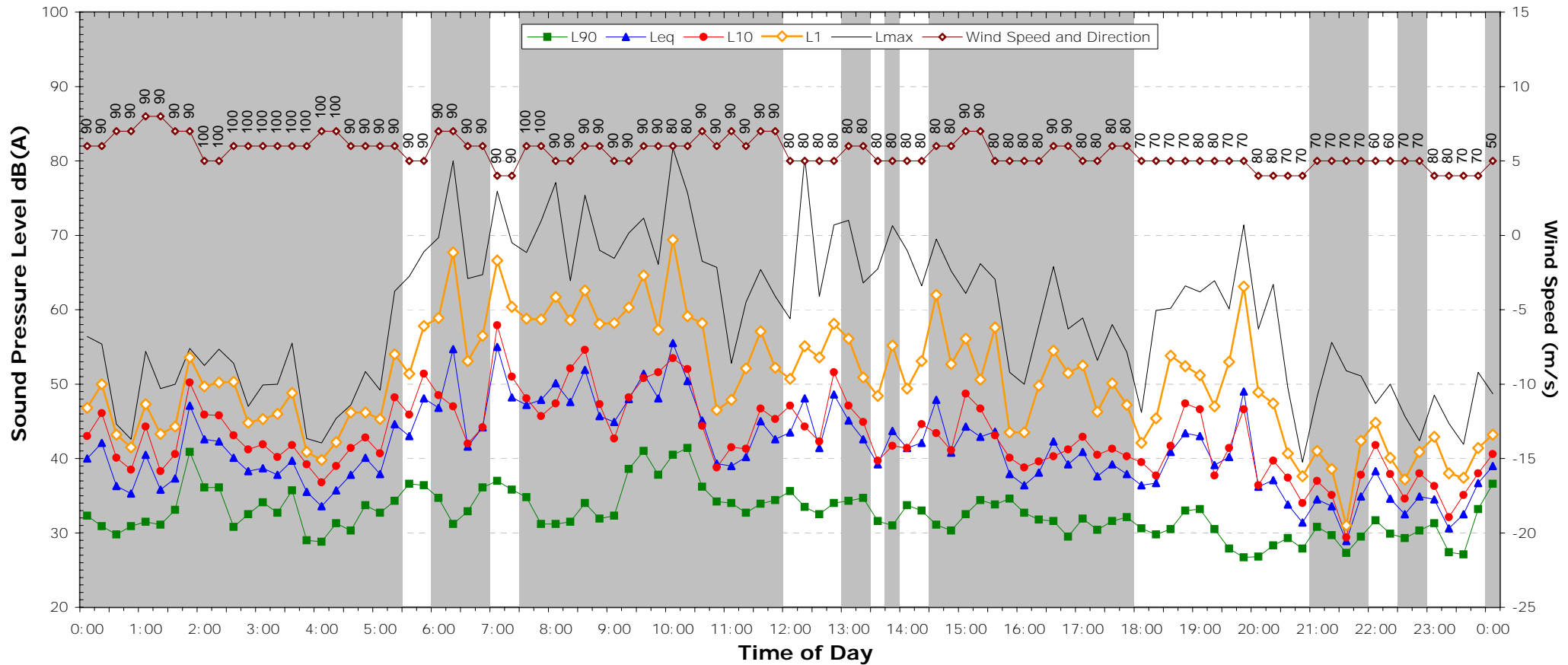
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Thursday, 24 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

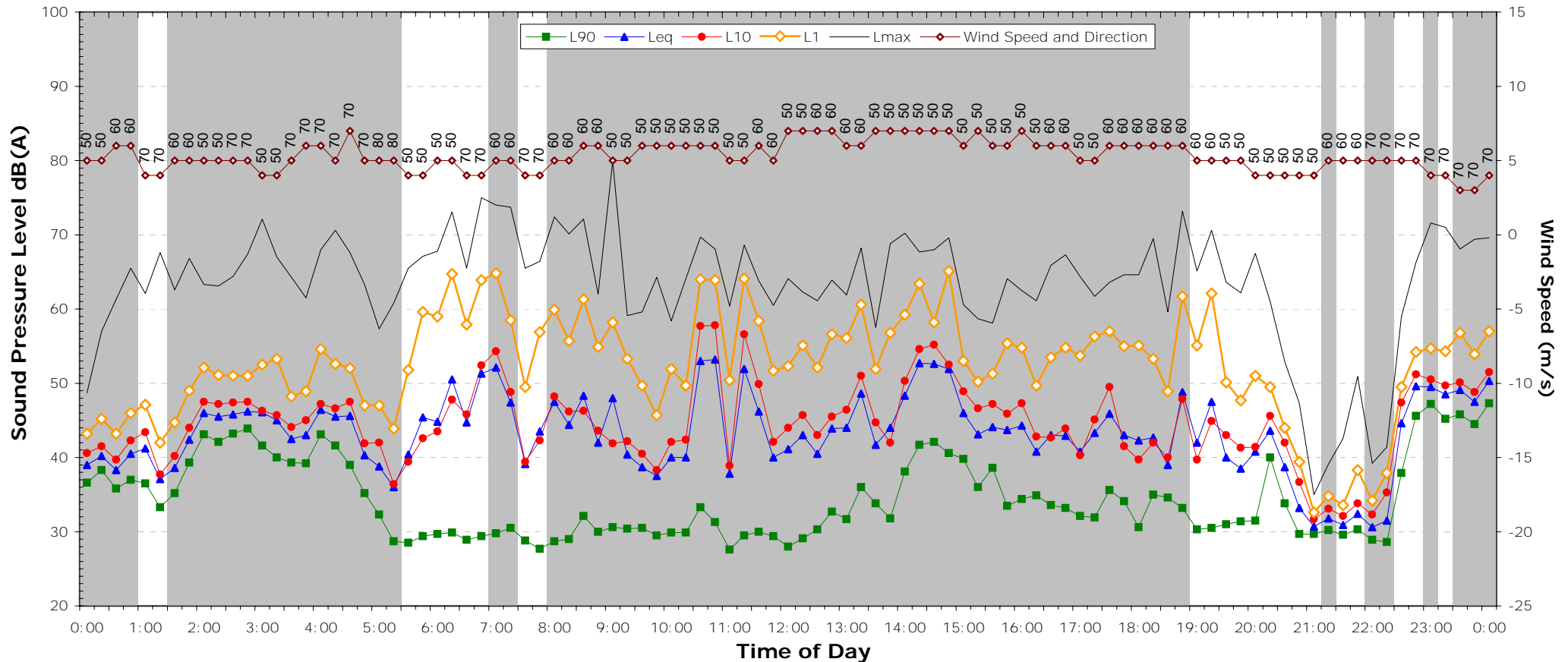
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Friday, 25 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

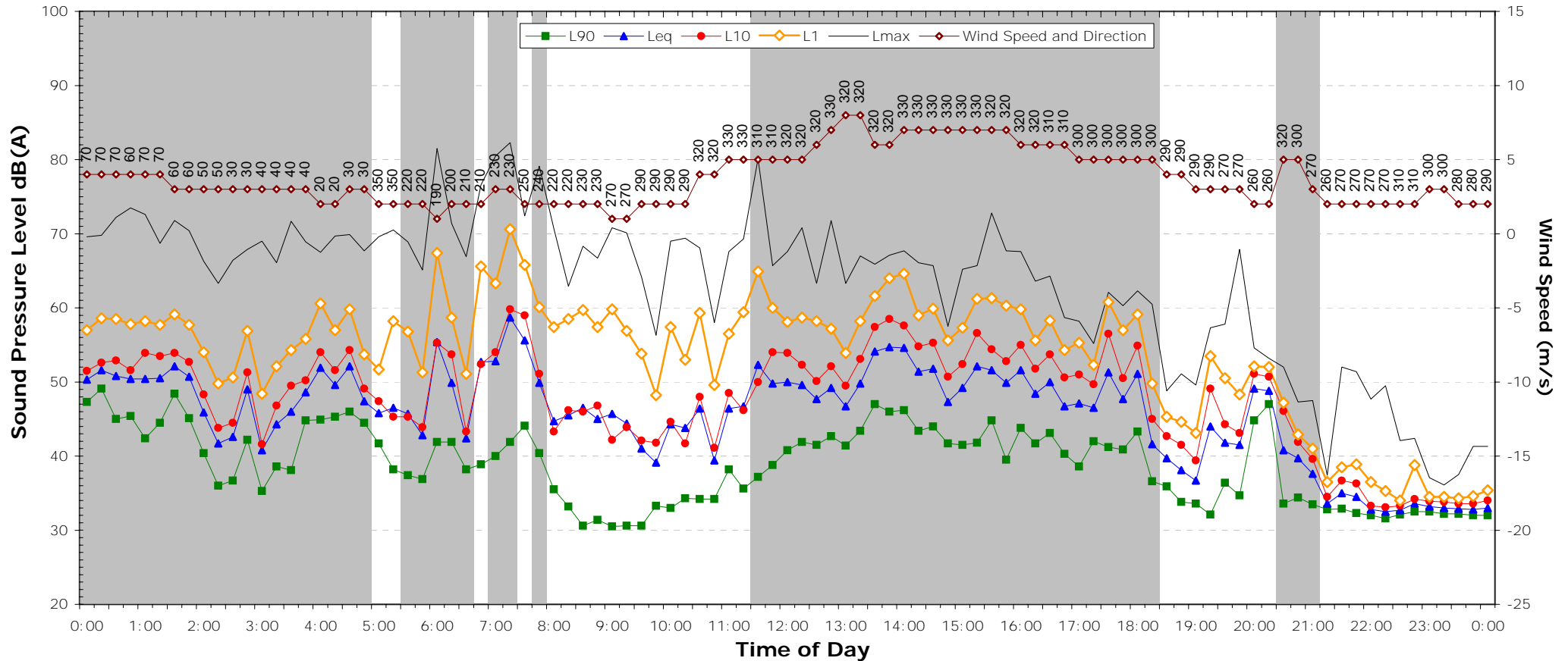
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Saturday, 26 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	29.5
Leq (see note 3)	-	-	40.8

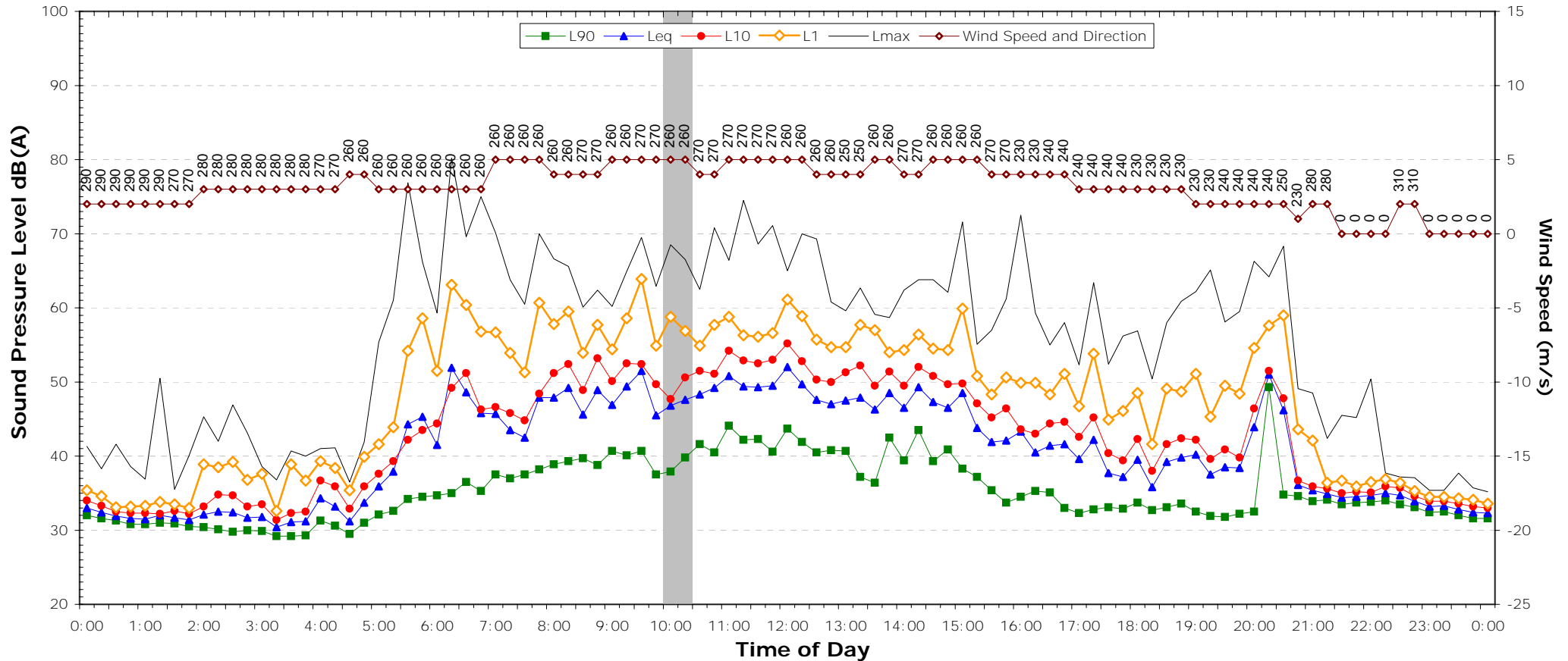
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Sunday, 27 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	33.1	31.9	27.5
Leq (see note 3)	47.3	42.2	38.2

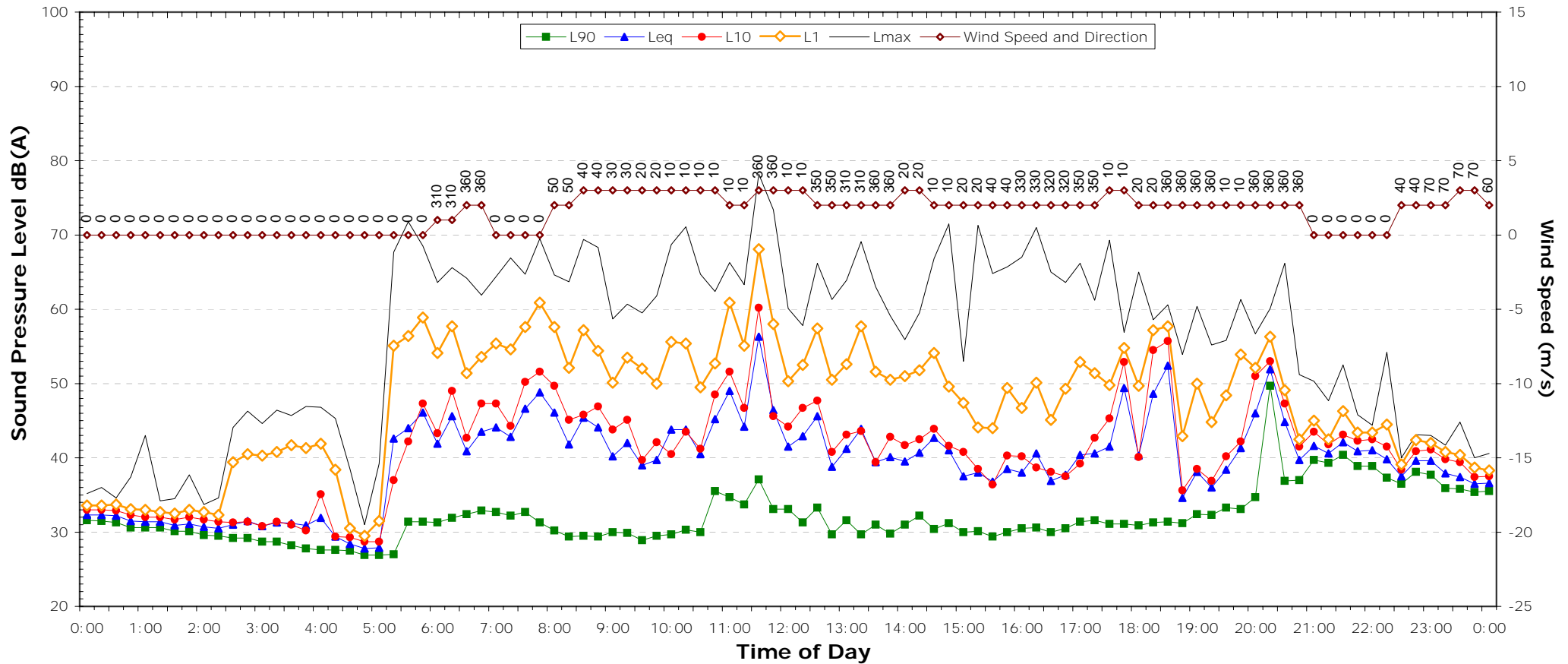
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Oakey Lane, Orange

### Monday, 28 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	29.5	31.3	30.0
Leq (see note 3)	44.8	45.6	40.0

**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)



**1771 Long Point Road, Orange**

**BACKGROUND & AMBIENT NOISE MONITORING RESULTS  
NSW DECCW's 'INDUSTRIAL NOISE POLICY', 2000**

Day	L <sub>A90</sub> Background Noise Levels <sup>5</sup>			L <sub>Aeq</sub> Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Tuesday-15-November-2011	-	27	28	-	46	45
Wednesday-16-November-2011	-	-	-	-	-	-
Thursday-17-November-2011	27	28	28	42	47	45
Friday-18-November-2011	27	29	29	42	43	43
Saturday-19-November-2011	-	28	31	-	37	40
Sunday-20-November-2011	-	31	28	-	47	41
Monday-21-November-2011	27	-	29	39	-	39
Tuesday-22-November-2011	-	-	-	-	-	-
Wednesday-23-November-2011	-	-	-	-	-	-
Thursday-24-November-2011	-	-	-	-	-	-
Friday-25-November-2011	-	-	-	-	-	-
Saturday-26-November-2011	-	-	45	-	-	50
Sunday-27-November-2011	32	32	34	47	47	48
Monday-28-November-2011	27	33	35	44	48	47
Tuesday-29-November-2011	-	37	-	-	56	-
Wednesday-30-November-2011	-	-	-	-	-	-
<b>Representative Level</b>	<b>27</b>	<b>30</b>	<b>29</b>	<b>44</b>	<b>49</b>	<b>46</b>

Notes:

1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Partial day's monitoring
5. Assessment Background Level (ABL)
6. Rating Background Level (RBL) for L90 and logarithmic average for Leq

noise logger results

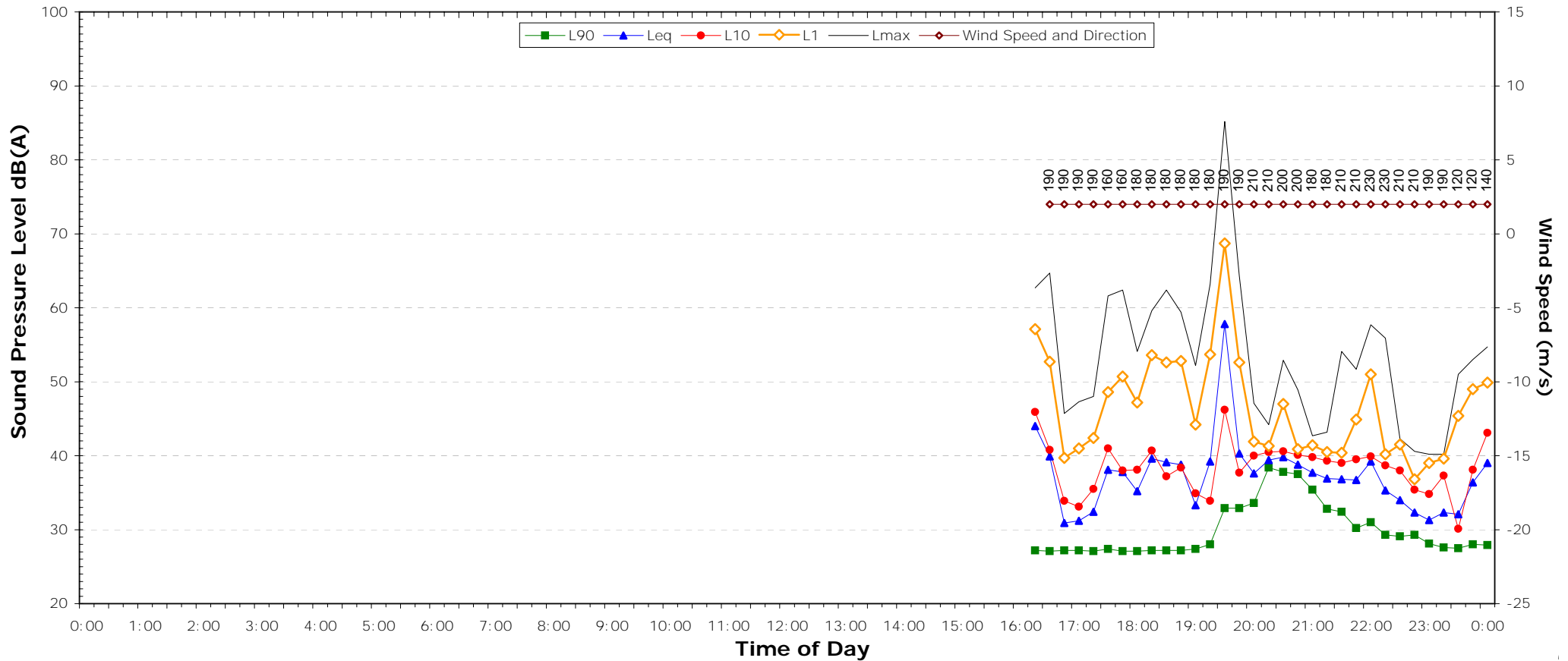
25

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PRACTICE

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Tuesday, 15 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	27.2	27.5
Leq (see note 3)	-	46.5	45.0

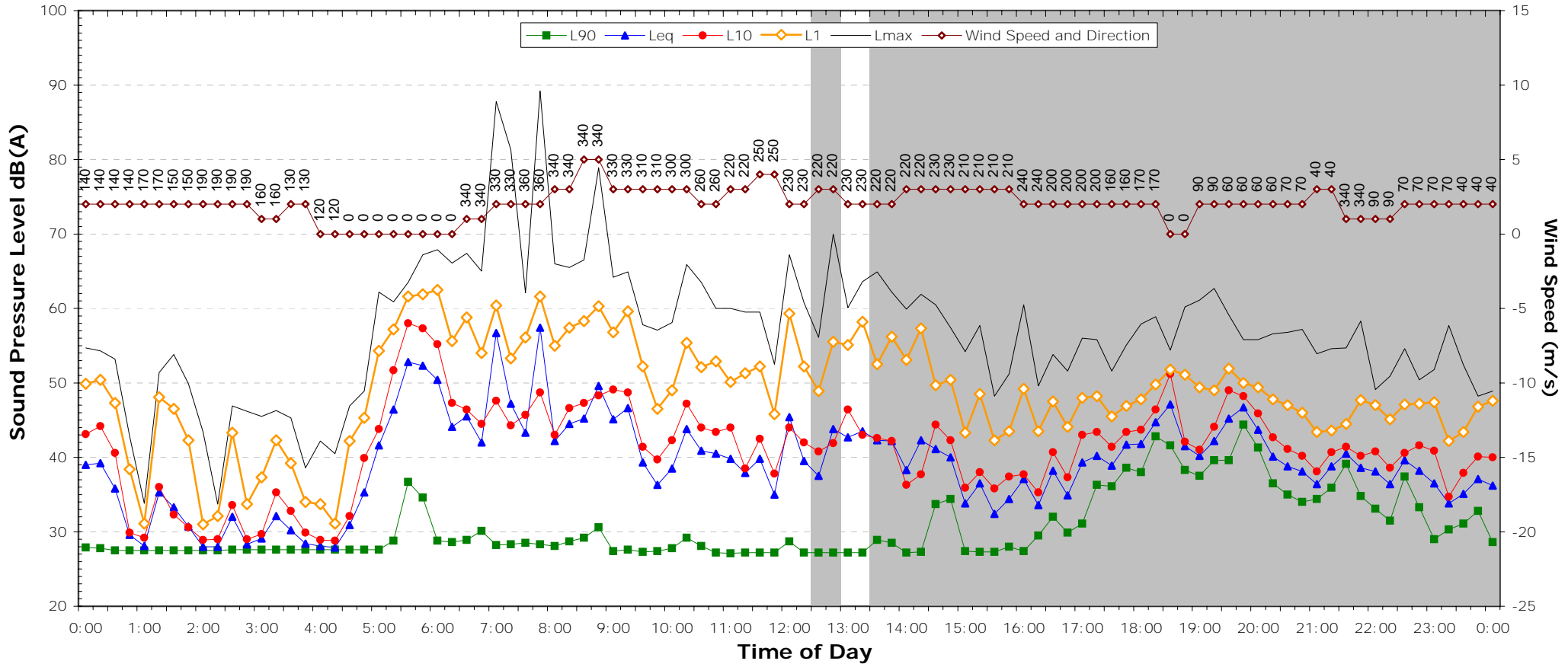
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Wednesday, 16 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

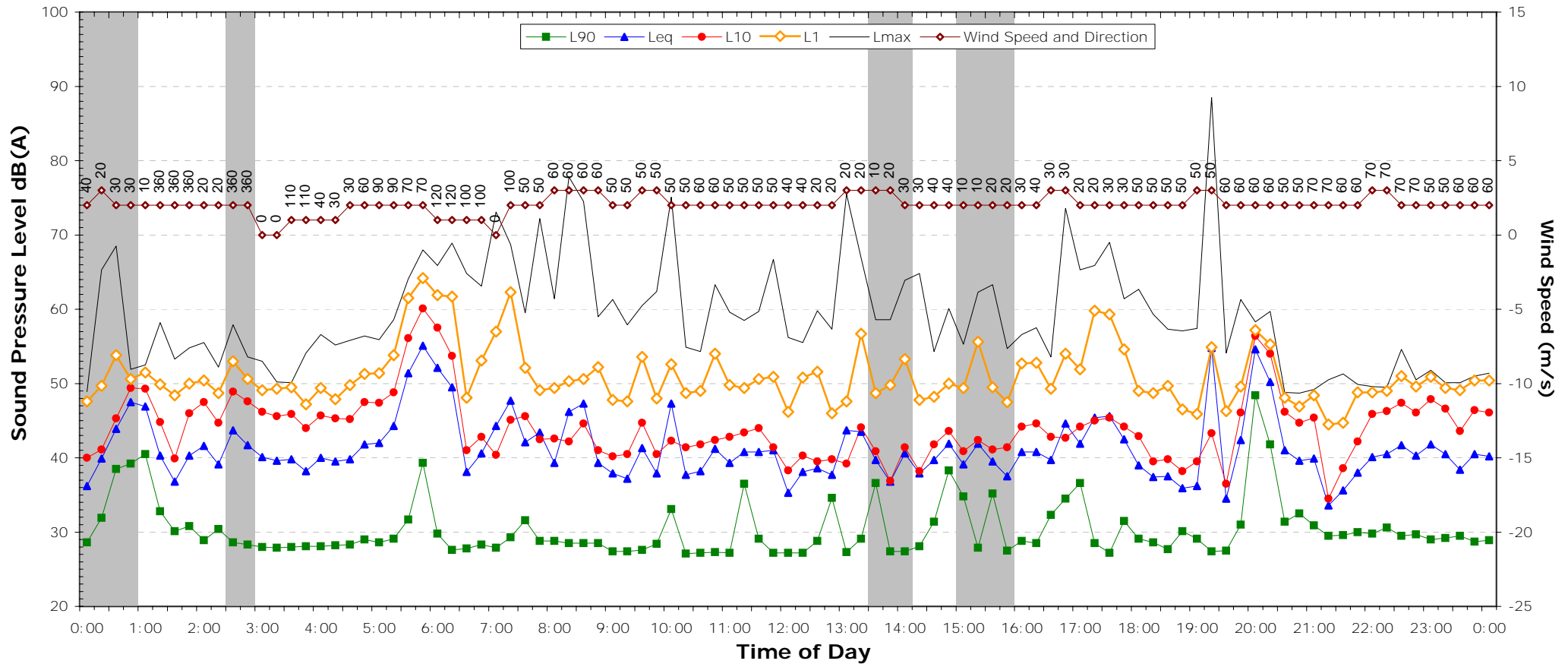
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Thursday, 17 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	27.2	27.5	28.1
Leq (see note 3)	42.4	46.9	44.6

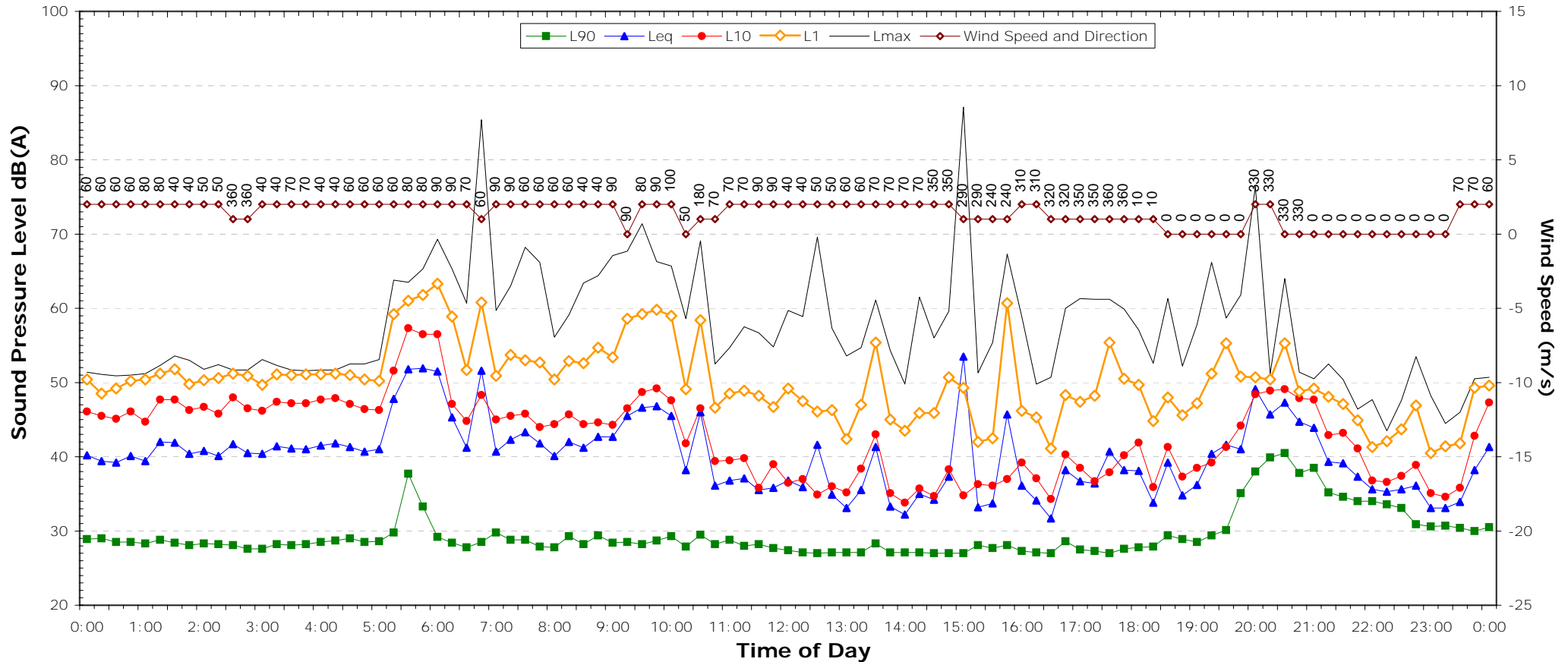
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Friday, 18 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	27.0	28.5	29.4
Leq (see note 3)	42.2	42.8	43.0

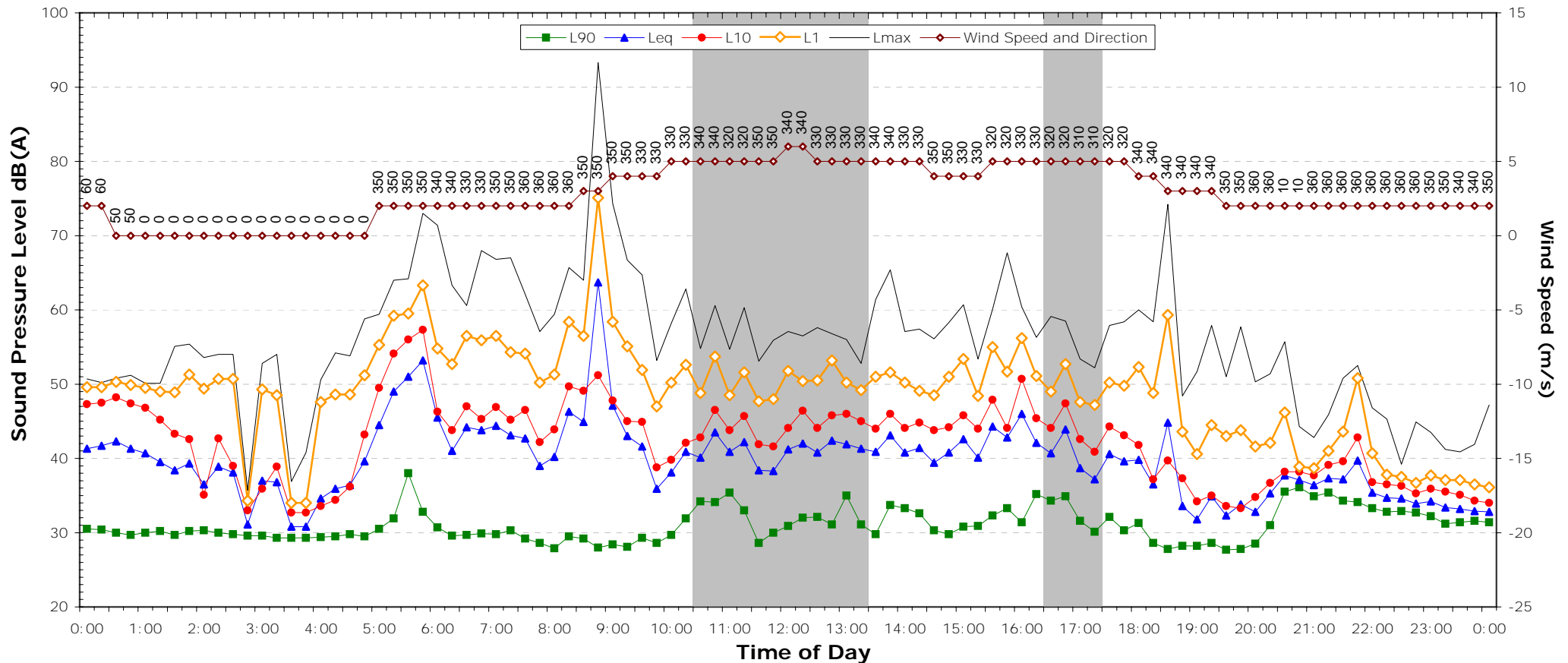
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Saturday, 19 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	27.8	30.7
Leq (see note 3)	-	37.5	40.3

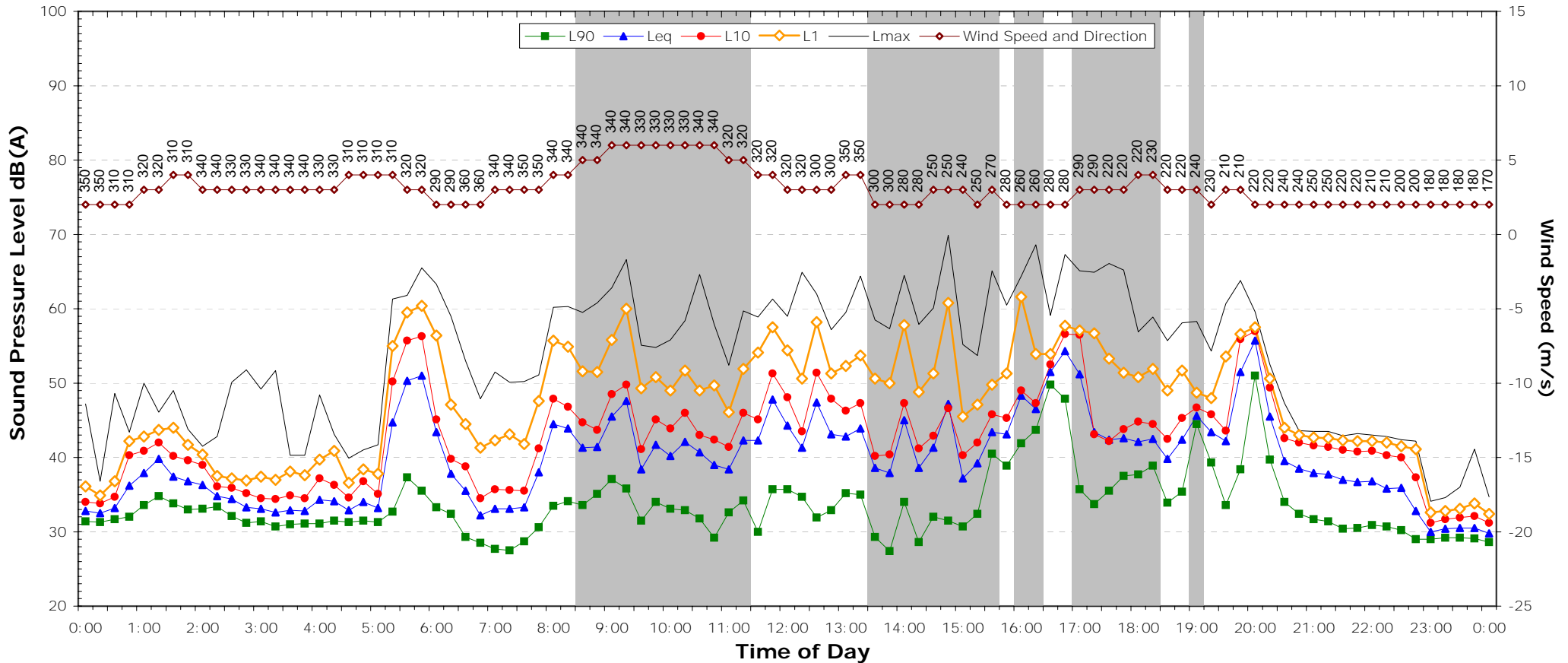
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Sunday, 20 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	30.5	27.8
Leq (see note 3)	-	46.7	40.8

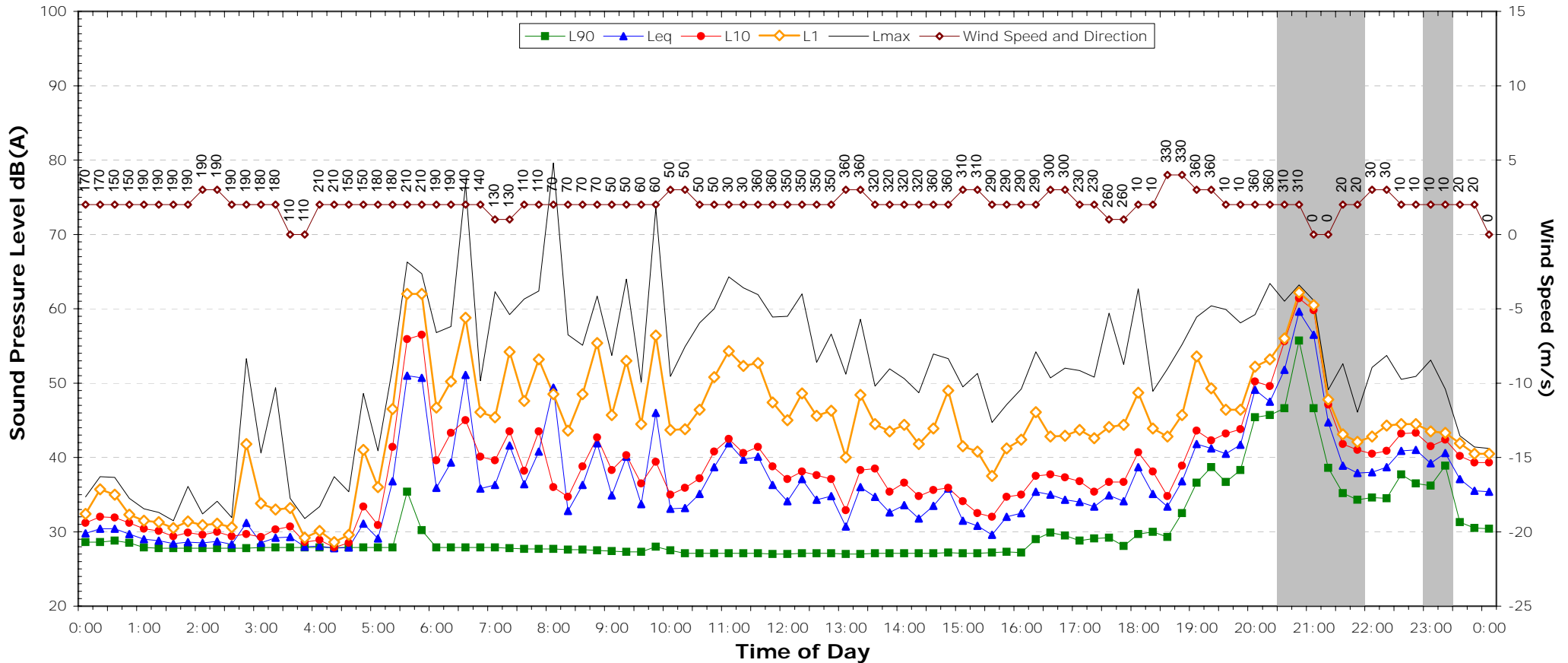
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Monday, 21 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	27.1	-	29.4
Leq (see note 3)	38.6	-	39.5

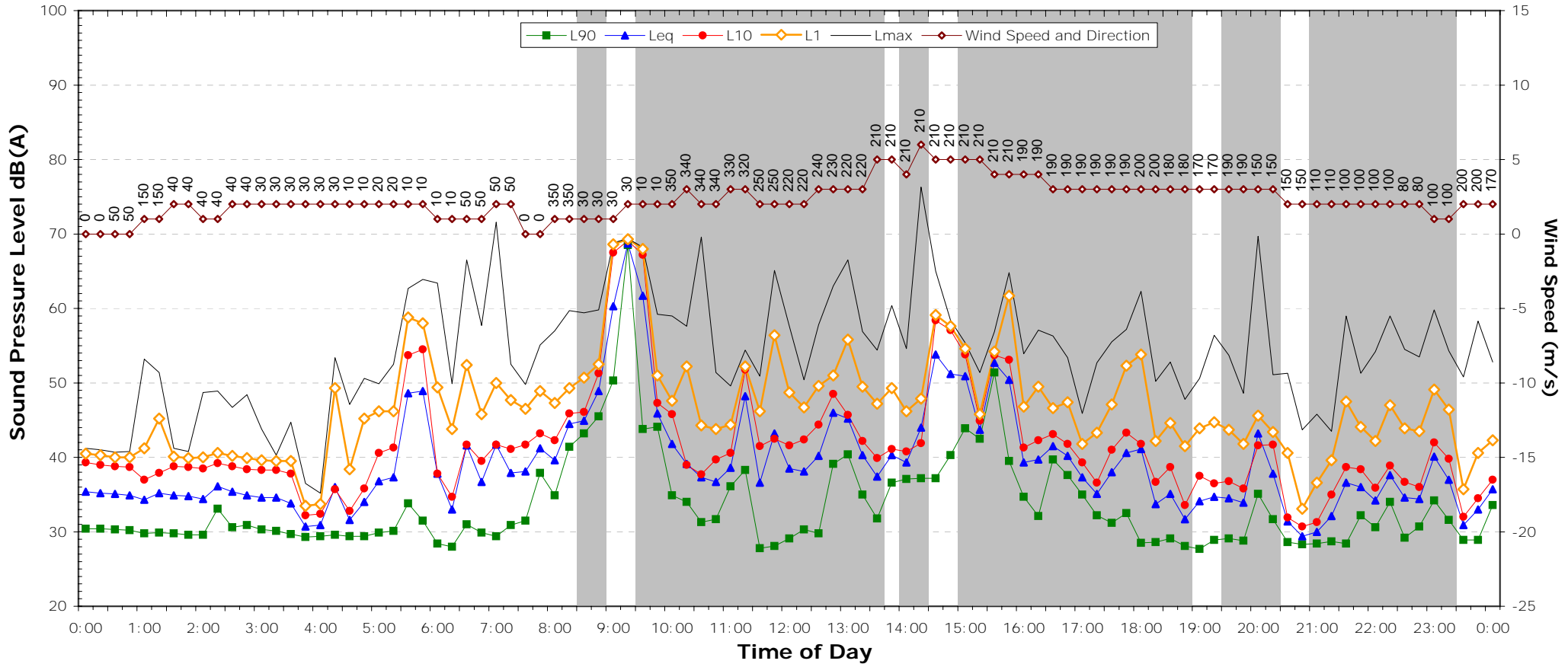
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Tuesday, 22 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

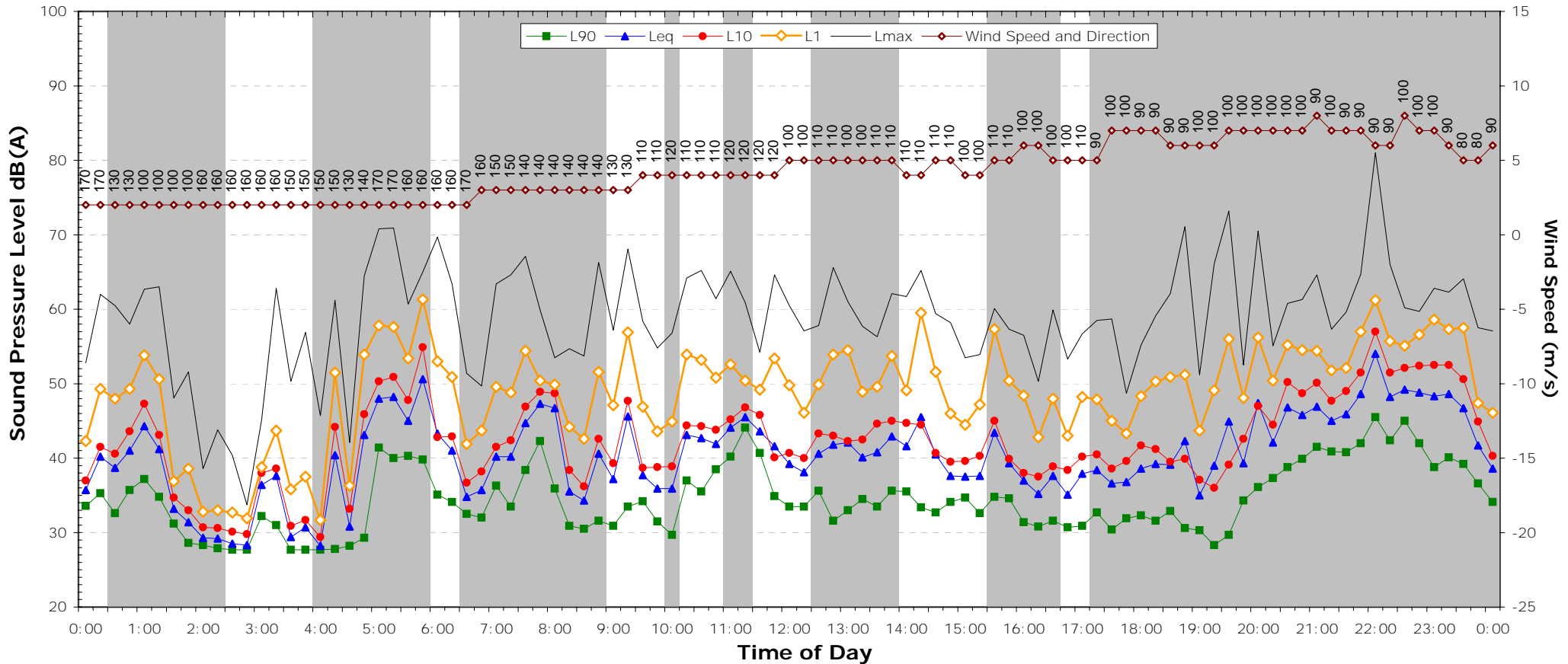
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Wednesday, 23 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

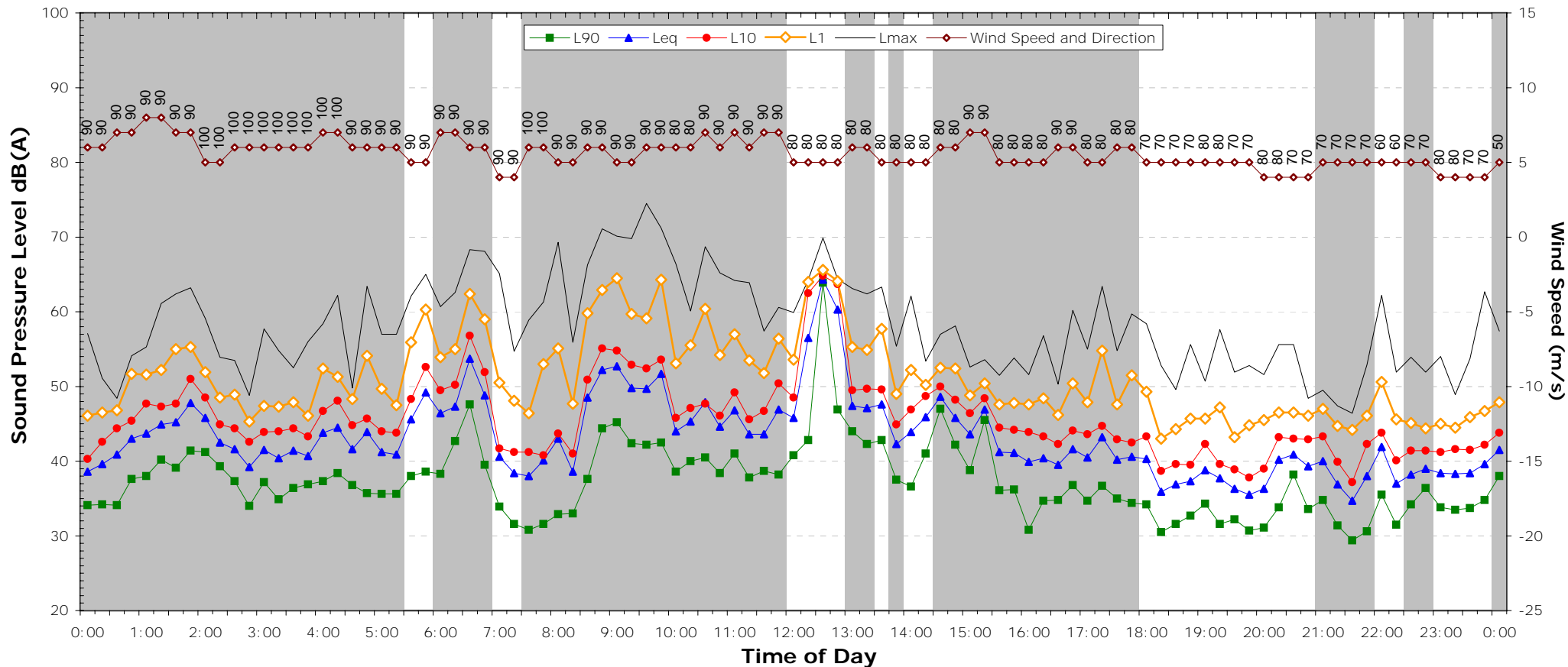
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Thursday, 24 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

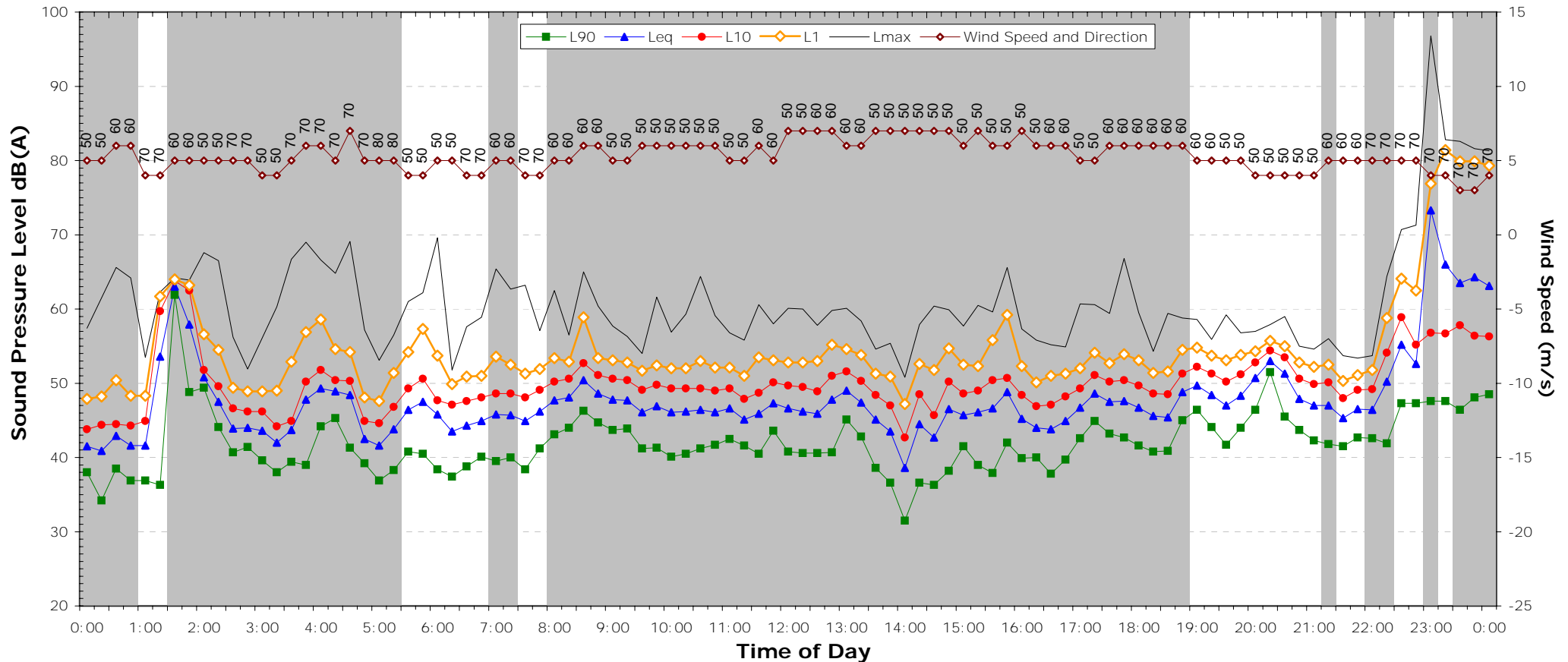
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Friday, 25 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

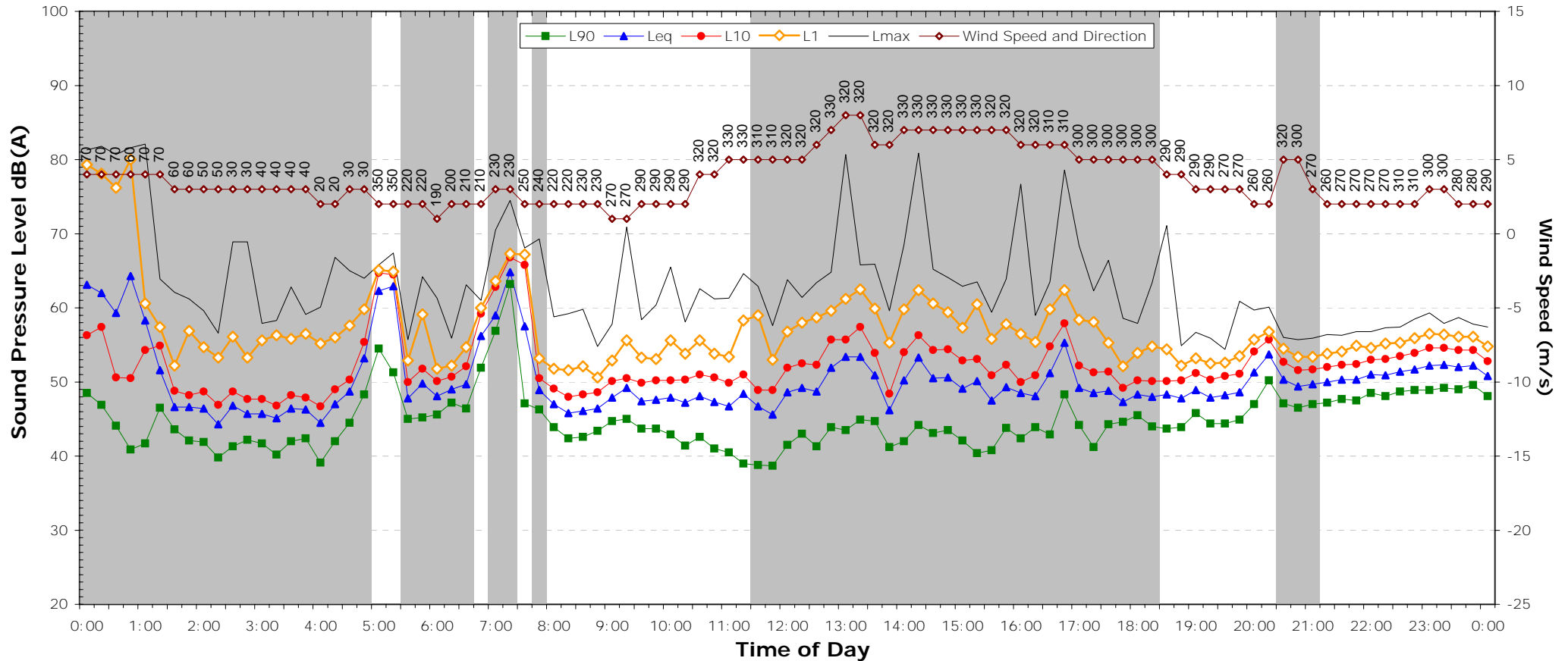
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Saturday, 26 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	44.7
Leq (see note 3)	-	-	50.4

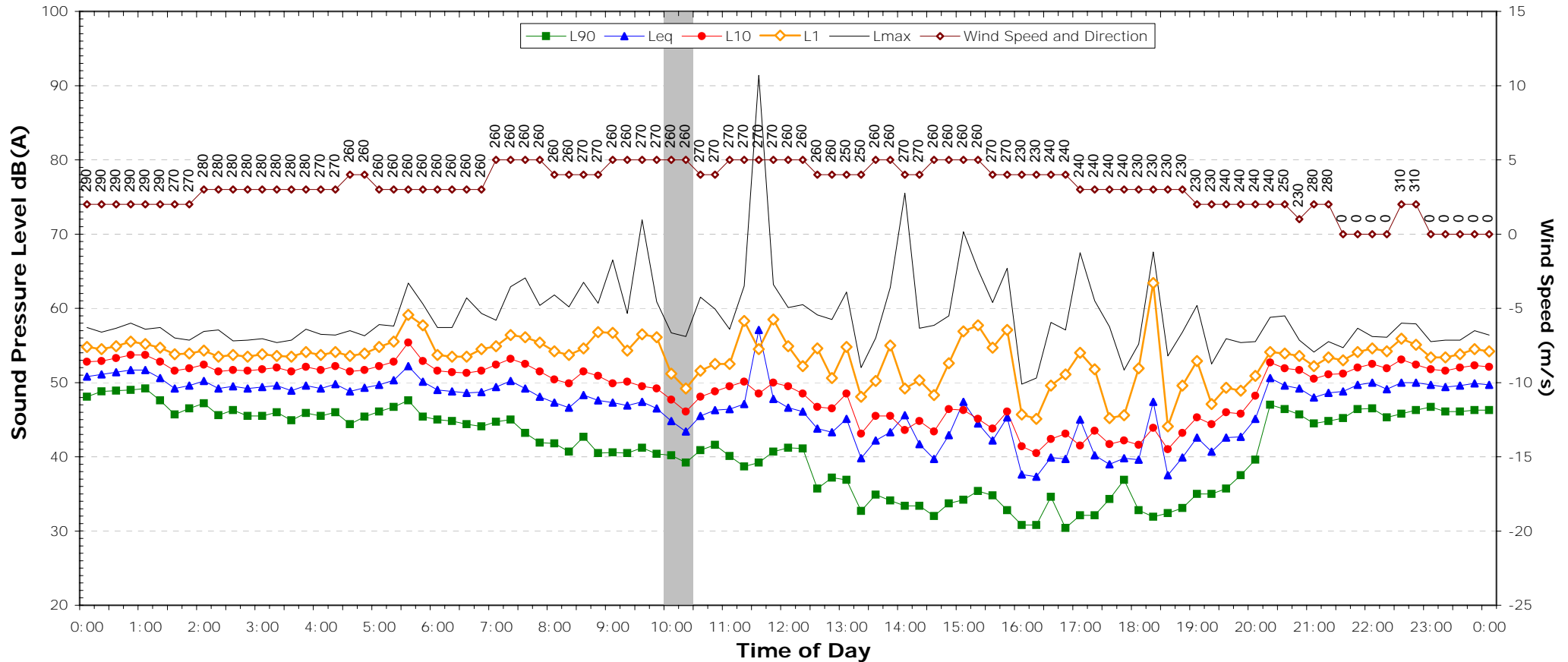
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Sunday, 27 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	32.1	32.4	34.1
Leq (see note 3)	46.7	47.3	47.8

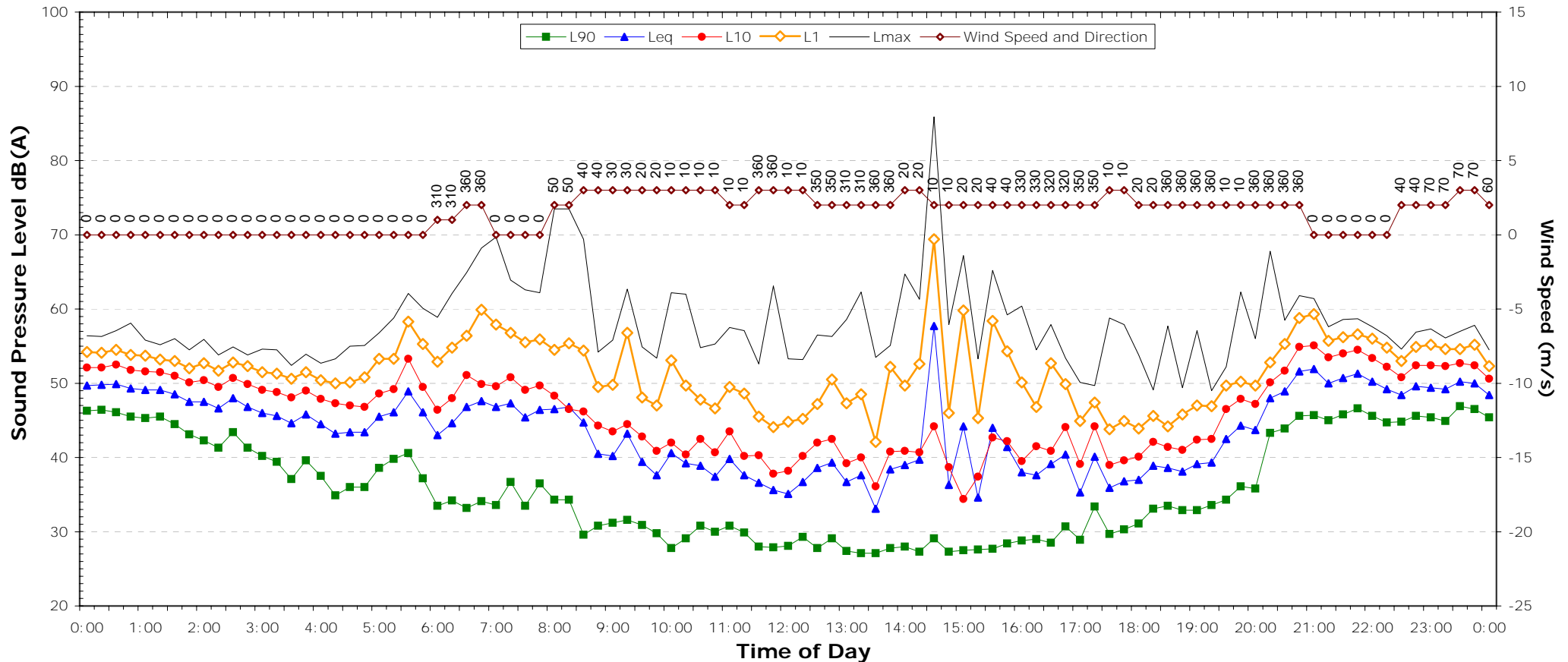
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Monday, 28 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	27.4	32.9	34.5
Leq (see note 3)	44.2	48.0	47.5

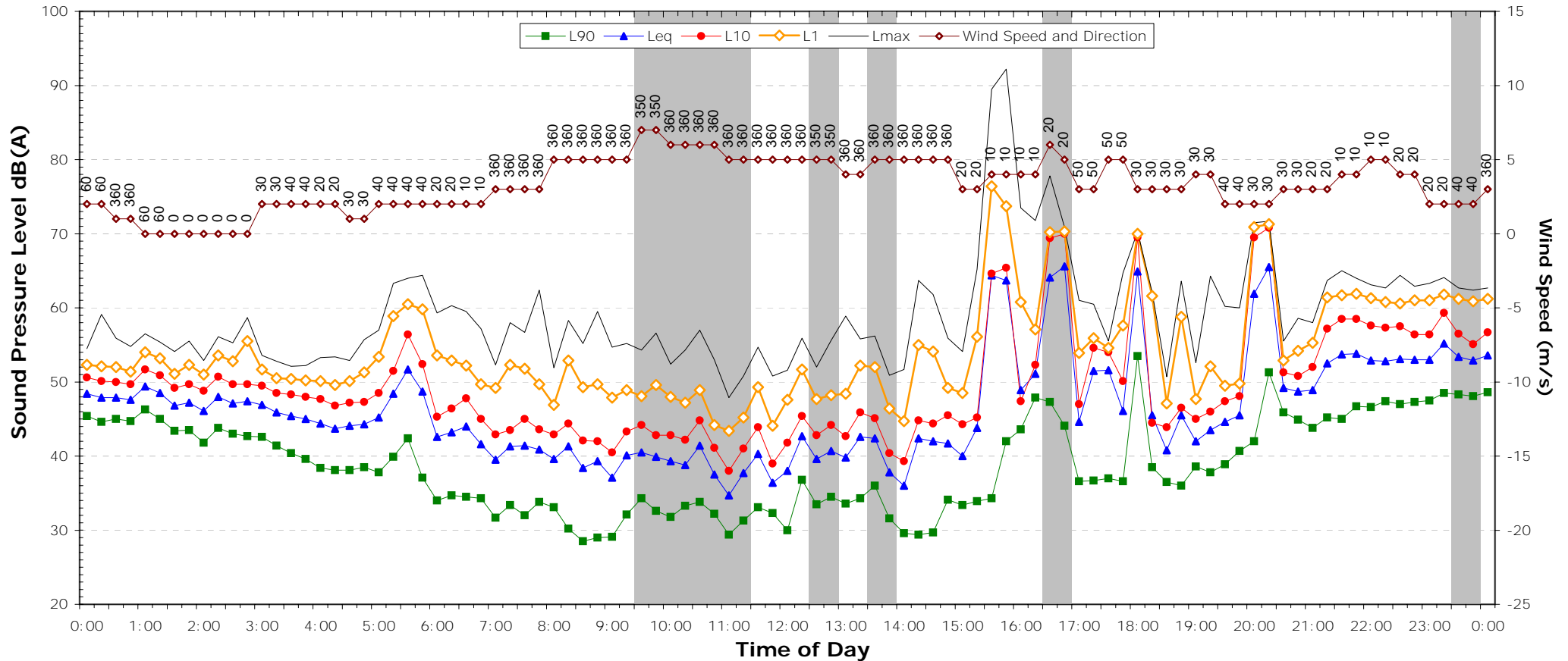
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Tuesday, 29 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	36.5	-
Leq (see note 3)	-	56.0	-

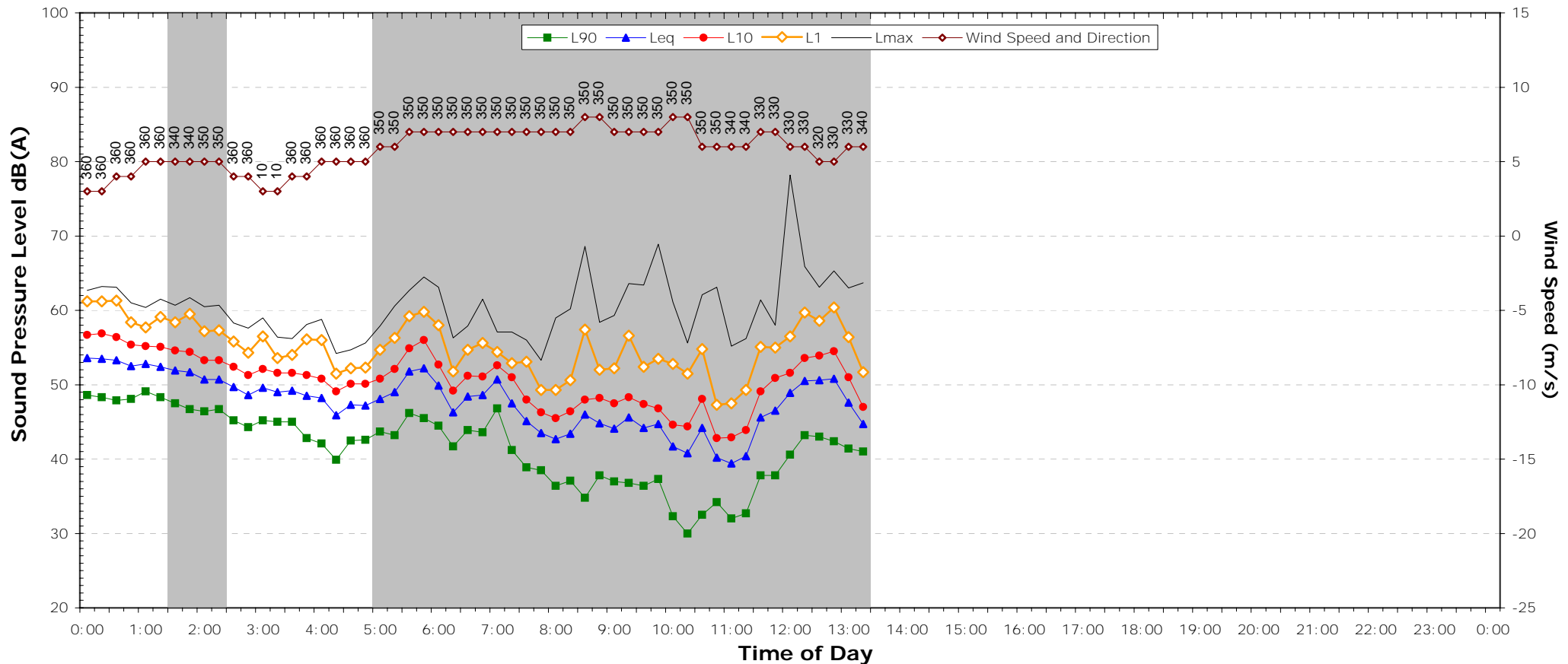
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1771 Long Point Road, Orange

### Wednesday, 30 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

1235 Ophir Road, Orange

**BACKGROUND & AMBIENT NOISE MONITORING RESULTS  
NSW DECCW's 'INDUSTRIAL NOISE POLICY', 2000**

Day	L <sub>A90</sub> Background Noise Levels <sup>5</sup>			L <sub>Aeq</sub> Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Tuesday-15-November-2011	-	31	26	-	41	45
Wednesday-16-November-2011	-	-	-	-	-	-
Thursday-17-November-2011	28	28	26	48	43	56
Friday-18-November-2011	30	32	27	48	44	46
Saturday-19-November-2011	-	33	28	-	46	52
Sunday-20-November-2011	-	29	26	-	44	47
Monday-21-November-2011	30	-	28	48	-	45
Tuesday-22-November-2011	-	-	-	-	-	-
Wednesday-23-November-2011	-	-	-	-	-	-
Thursday-24-November-2011	-	-	-	-	-	-
Friday-25-November-2011	-	-	-	-	-	-
Saturday-26-November-2011	-	-	37	-	-	56
Sunday-27-November-2011	37	36	35	49	48	56
Monday-28-November-2011	32	35	36	62	55	54
Tuesday-29-November-2011	-	35	-	-	46	-
Wednesday-30-November-2011	-	-	-	-	-	-
<b>Representative Level</b>	<b>30</b>	<b>32</b>	<b>28</b>	<b>56</b>	<b>48</b>	<b>53</b>

Notes:

1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Partial day's monitoring
5. Assessment Background Level (ABL)
6. Rating Background Level (RBL) for L90 and logarithmic average for Leq

noise logger results

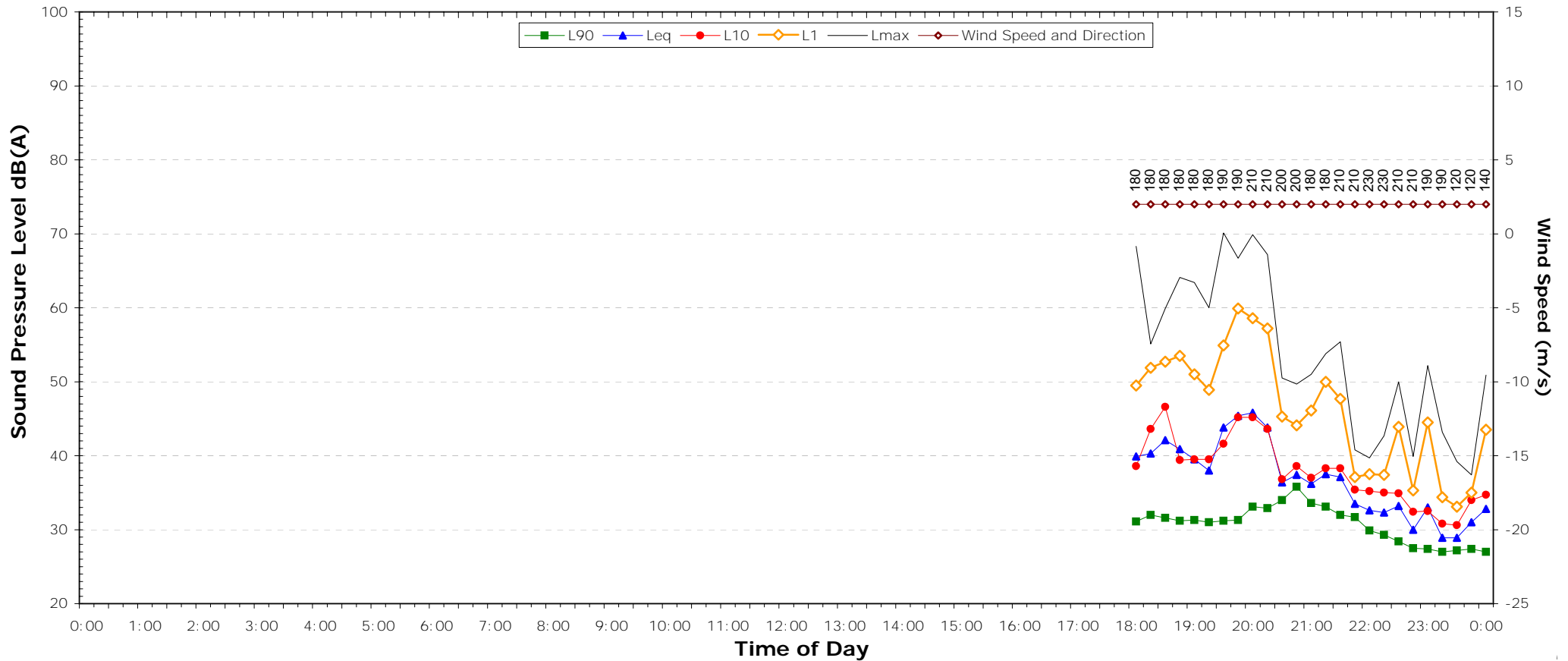
25

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SOLUTIONS

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Tuesday, 15 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	31.0	26.0
Leq (see note 3)	-	41.1	44.7

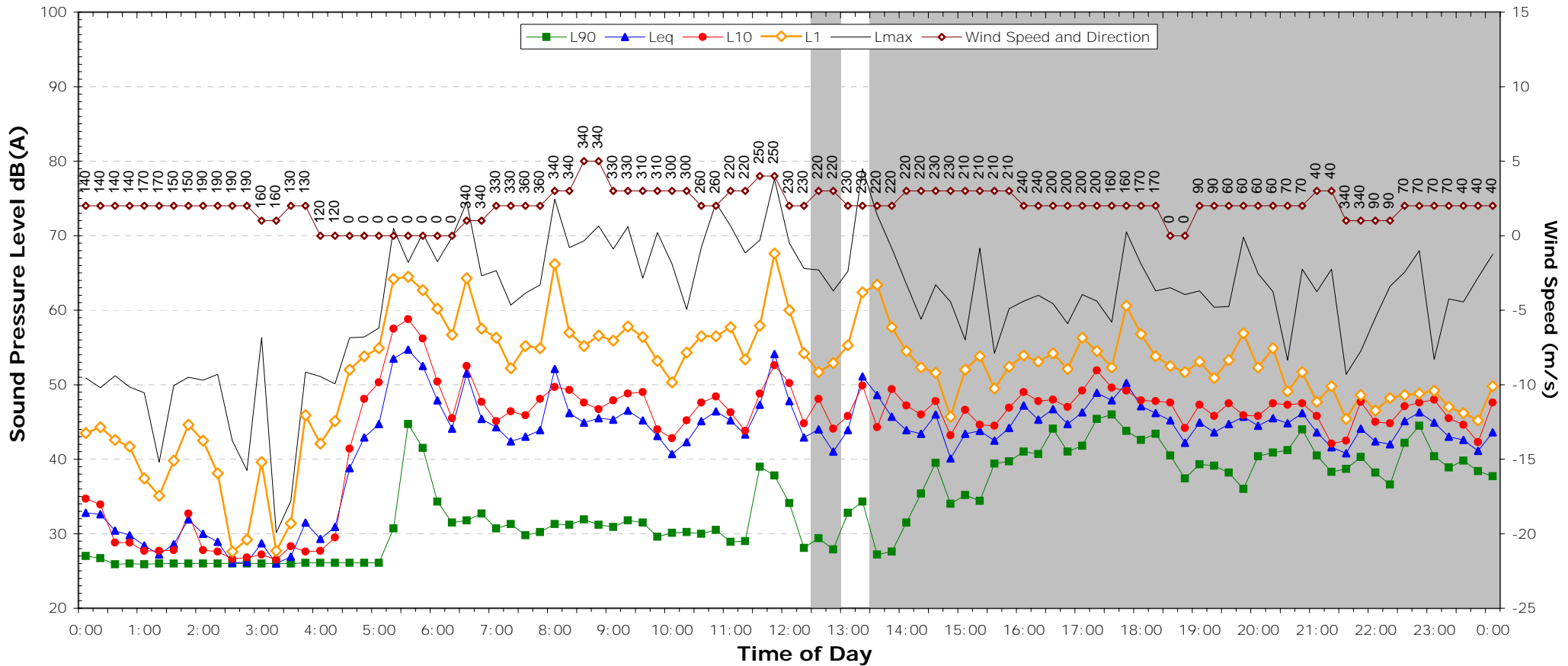
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Wednesday, 16 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

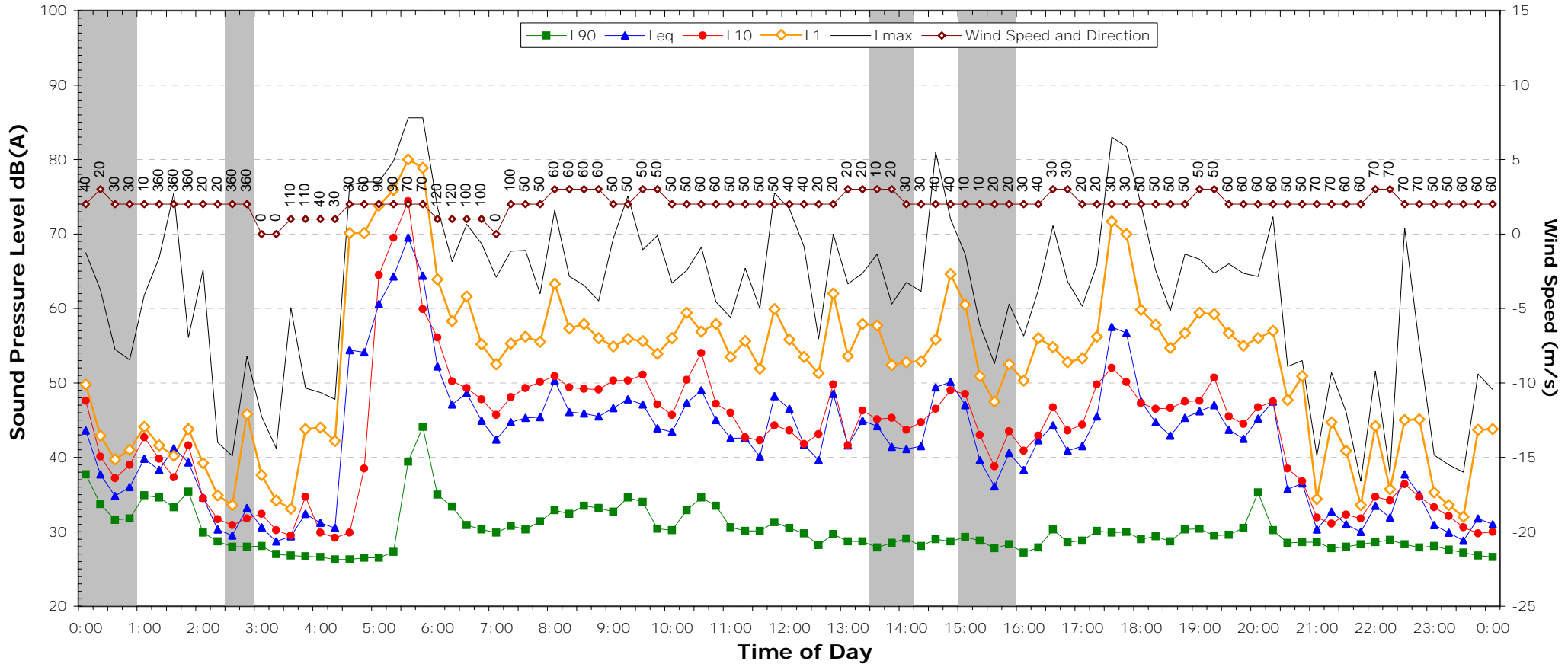
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Thursday, 17 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	28.2	28.0	26.2
Leq (see note 3)	48.1	43.0	55.7

**NOTES:**

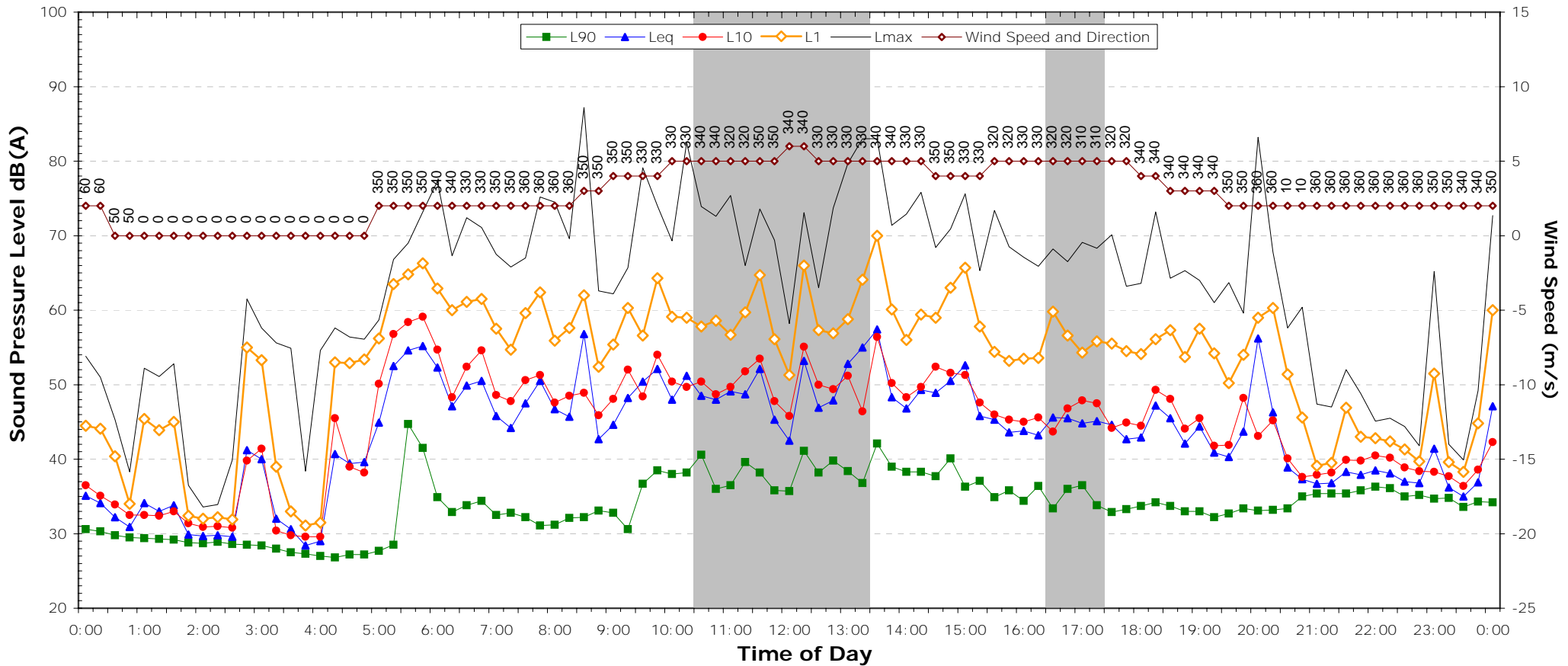
1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)



# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Saturday, 19 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	32.7	28.0
Leq (see note 3)	-	46.3	52.5

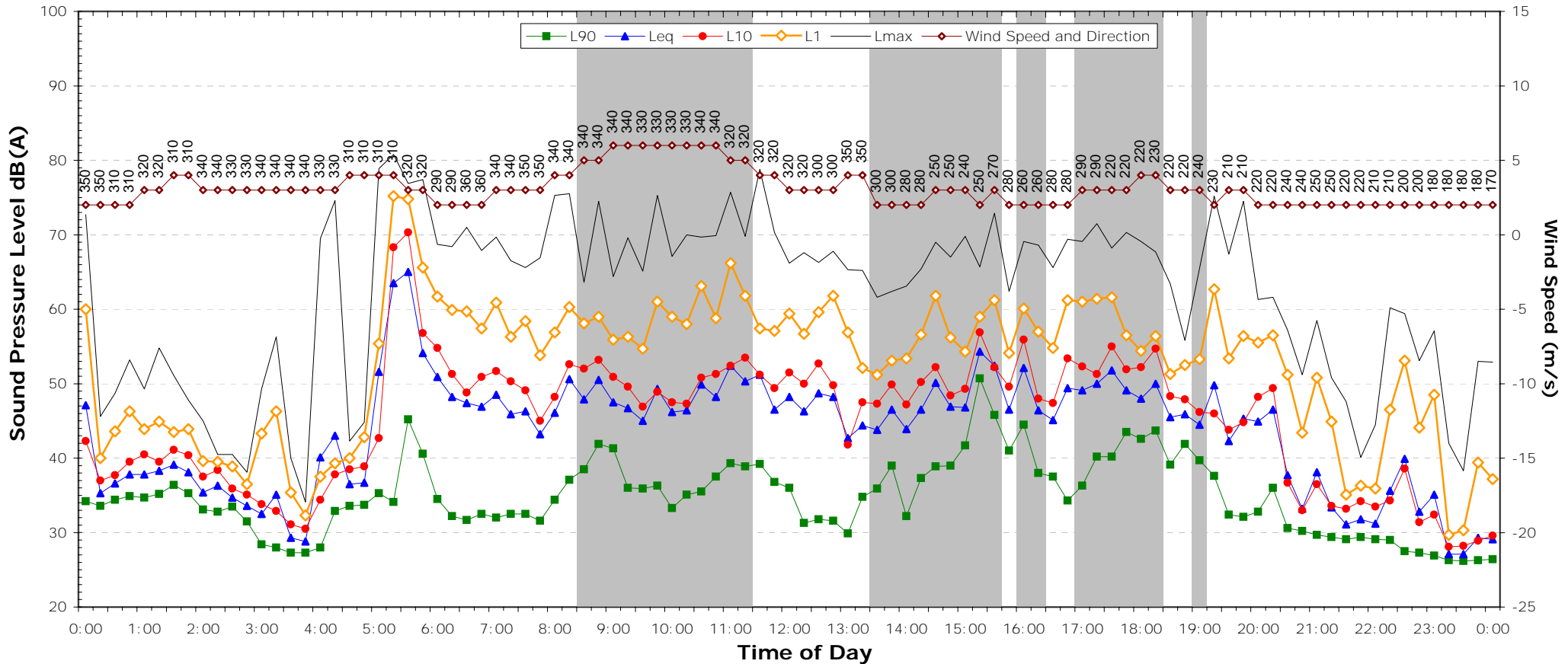
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Sunday, 20 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	29.1	26.2
Leq (see note 3)	-	43.6	46.5

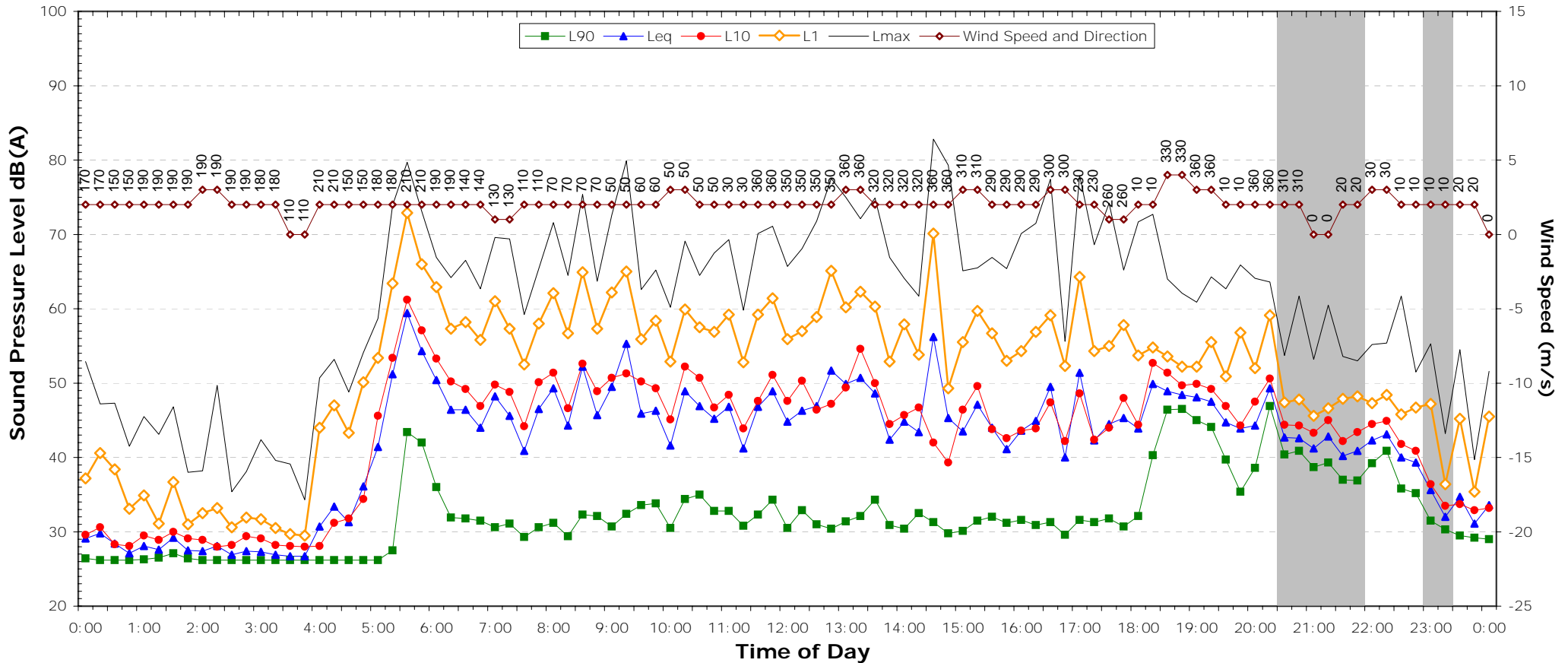
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Monday, 21 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	30.1	-	27.5
Leq (see note 3)	48.1	-	45.2

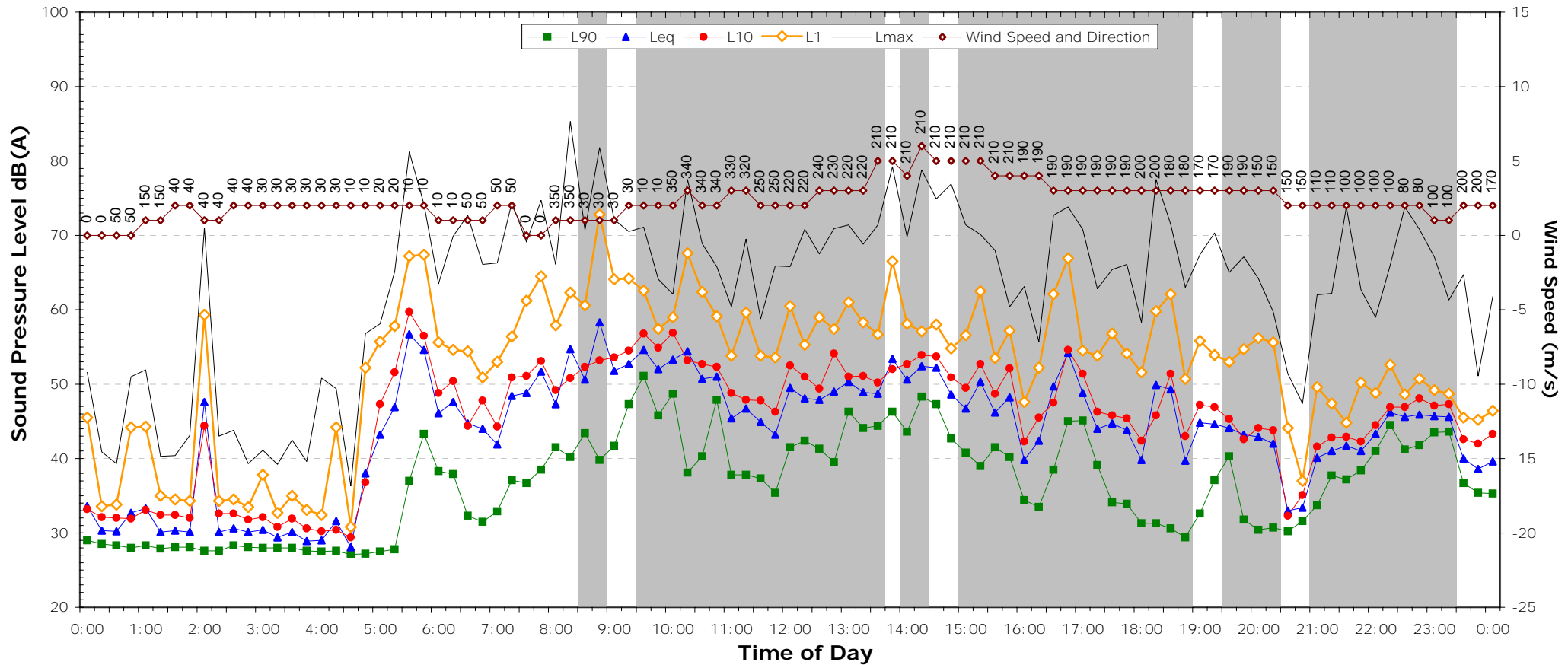
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Tuesday, 22 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

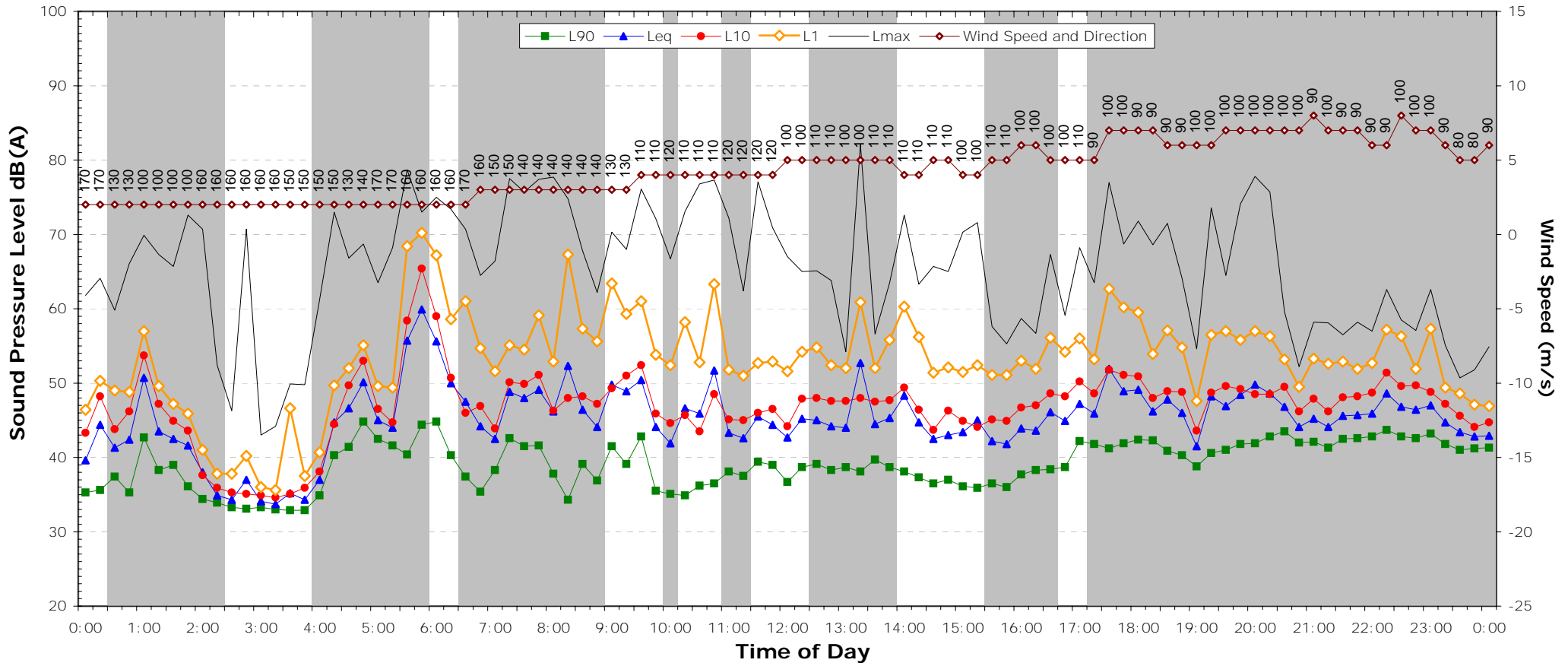
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Wednesday, 23 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

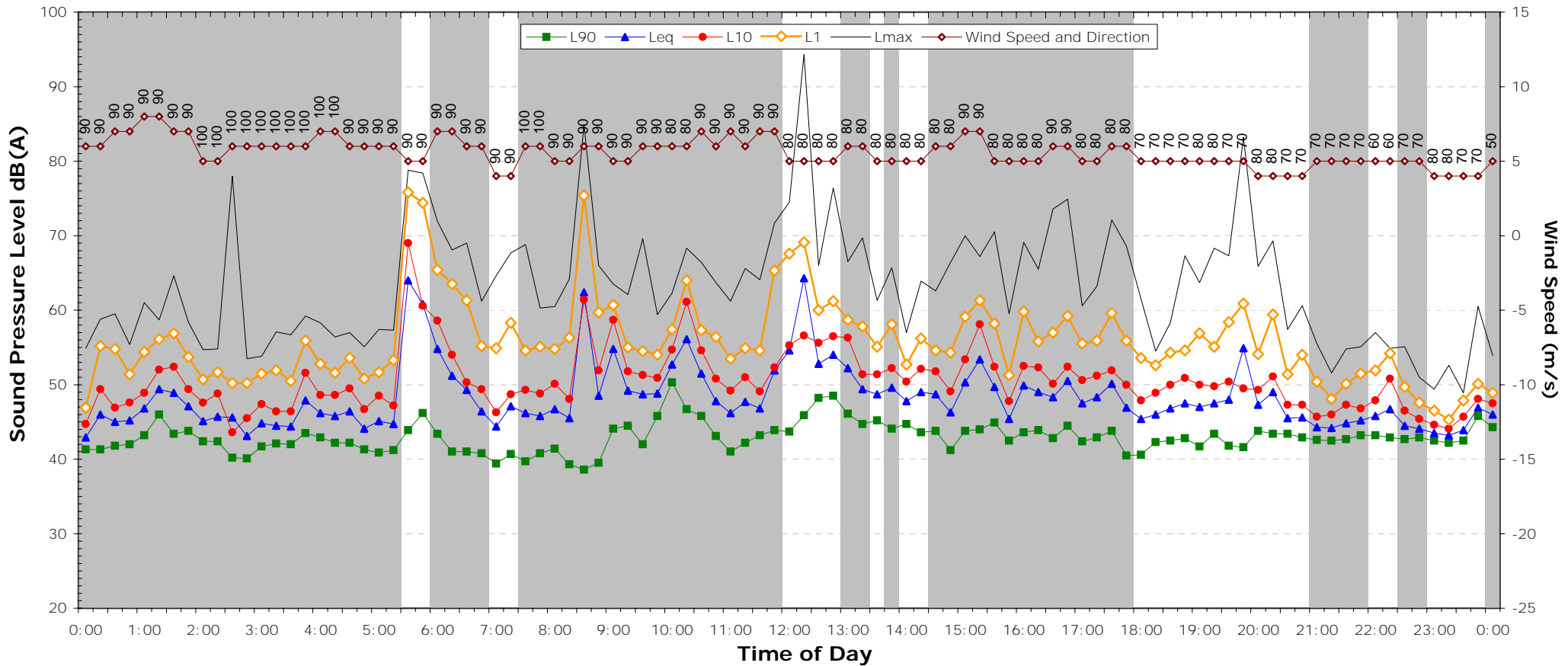
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Thursday, 24 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

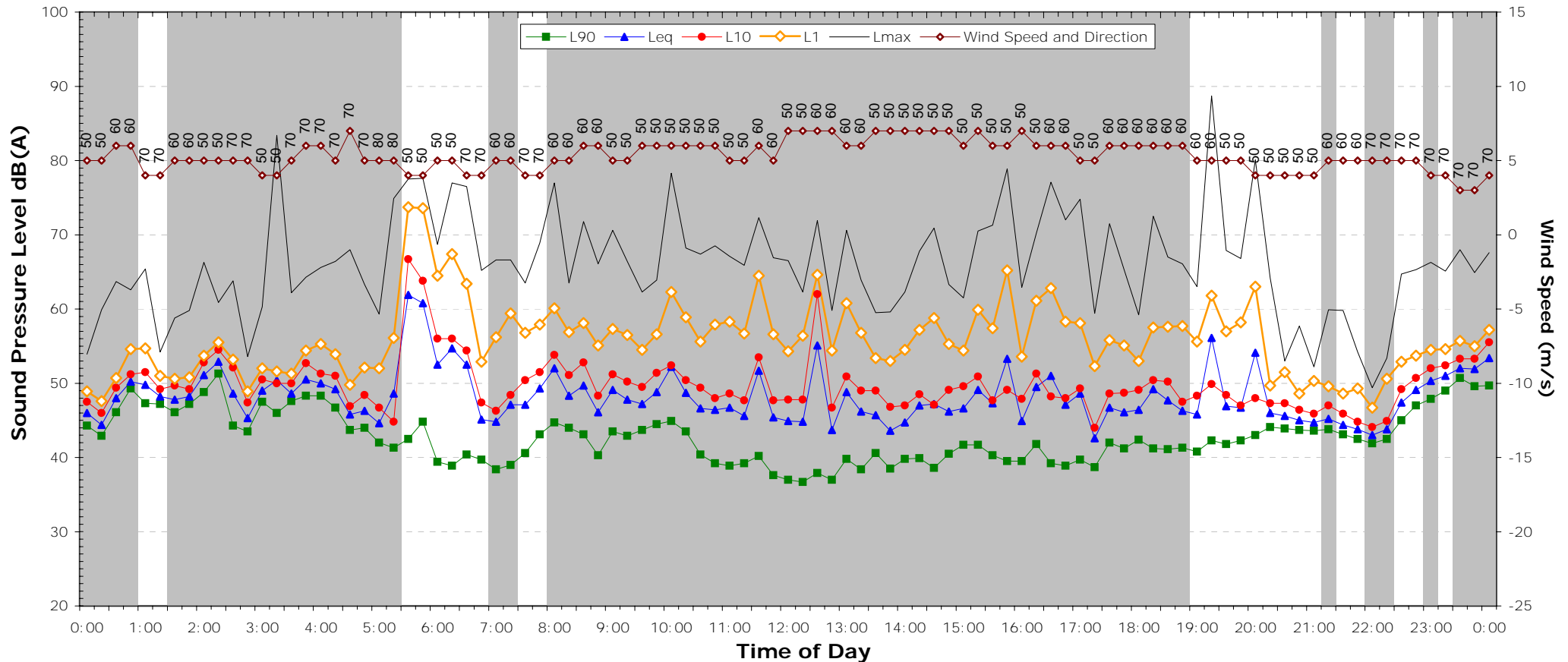
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Friday, 25 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

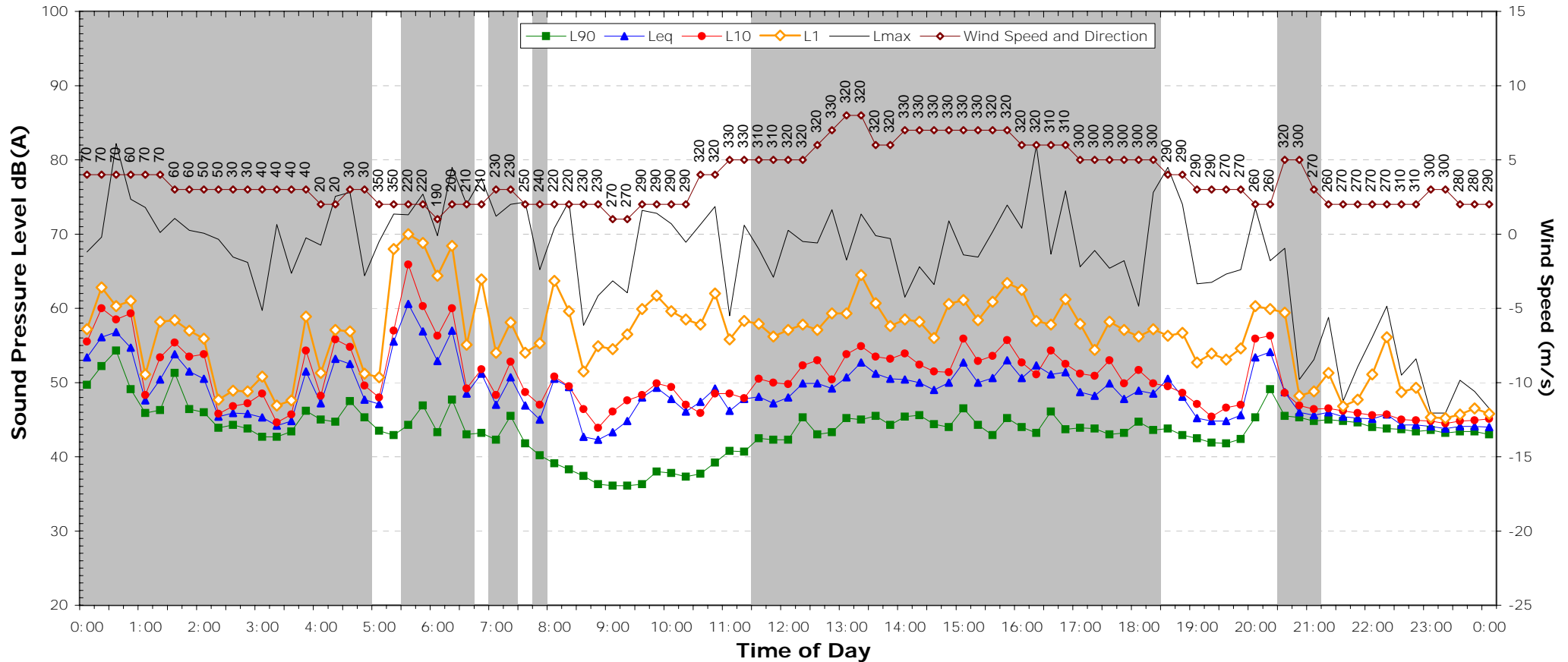
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
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4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Saturday, 26 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	36.5
Leq (see note 3)	-	-	55.9

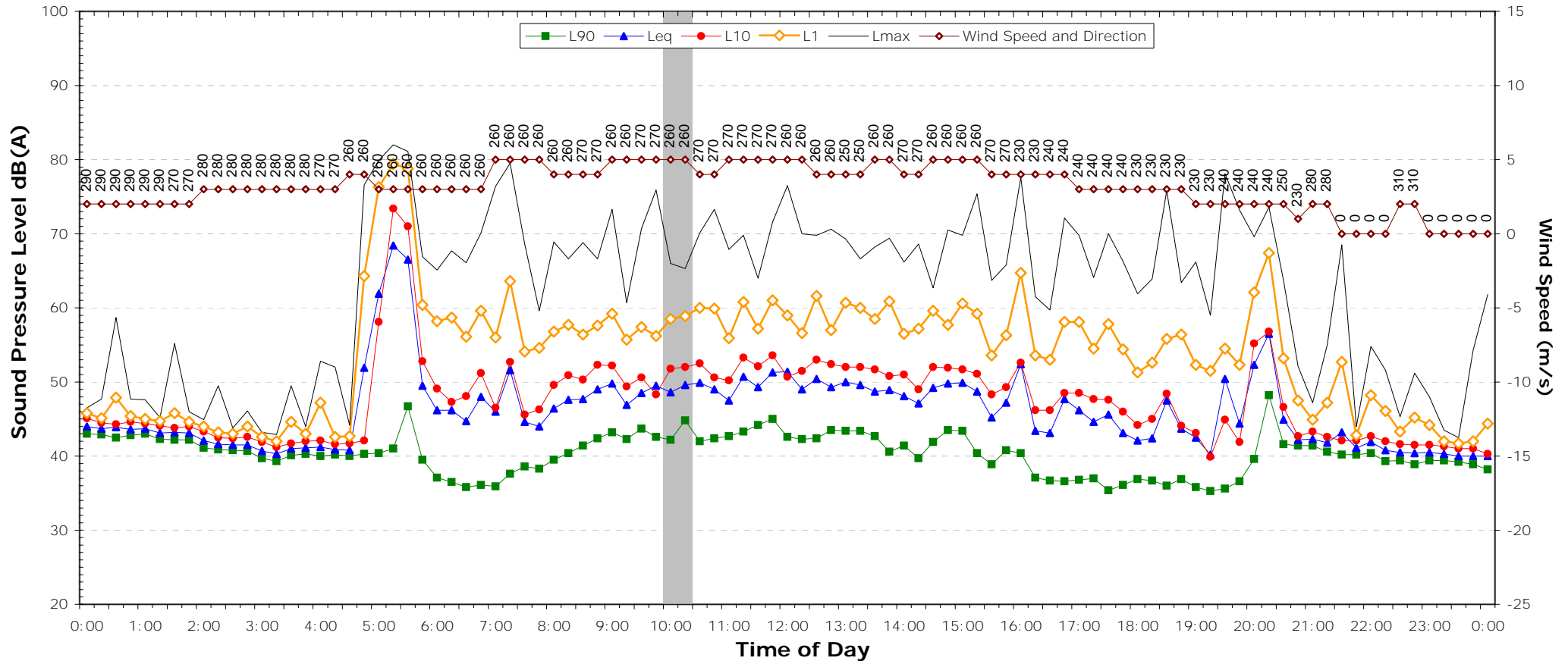
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
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4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Sunday, 27 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	36.8	35.6	35.3
Leq (see note 3)	48.6	48.0	56.3

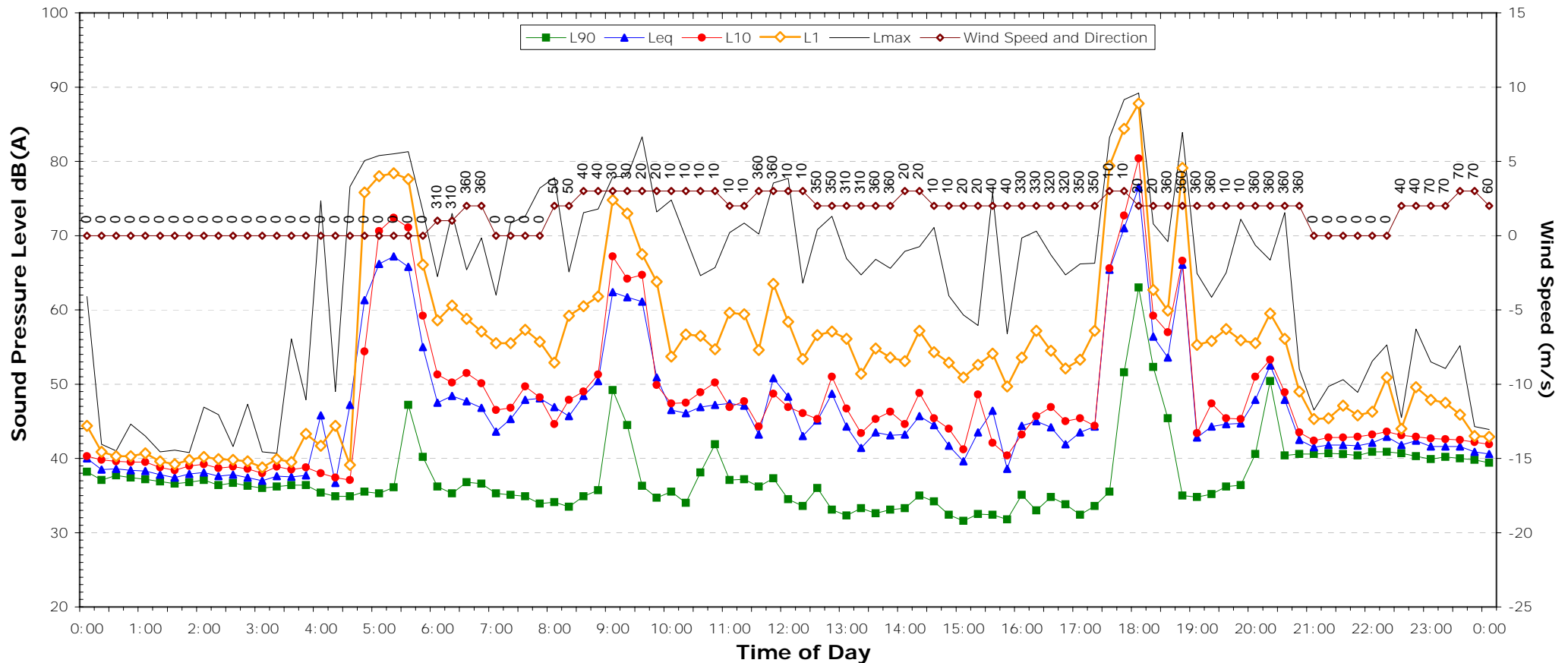
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Monday, 28 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	32.4	35.0	35.8
Leq (see note 3)	61.8	55.2	54.2

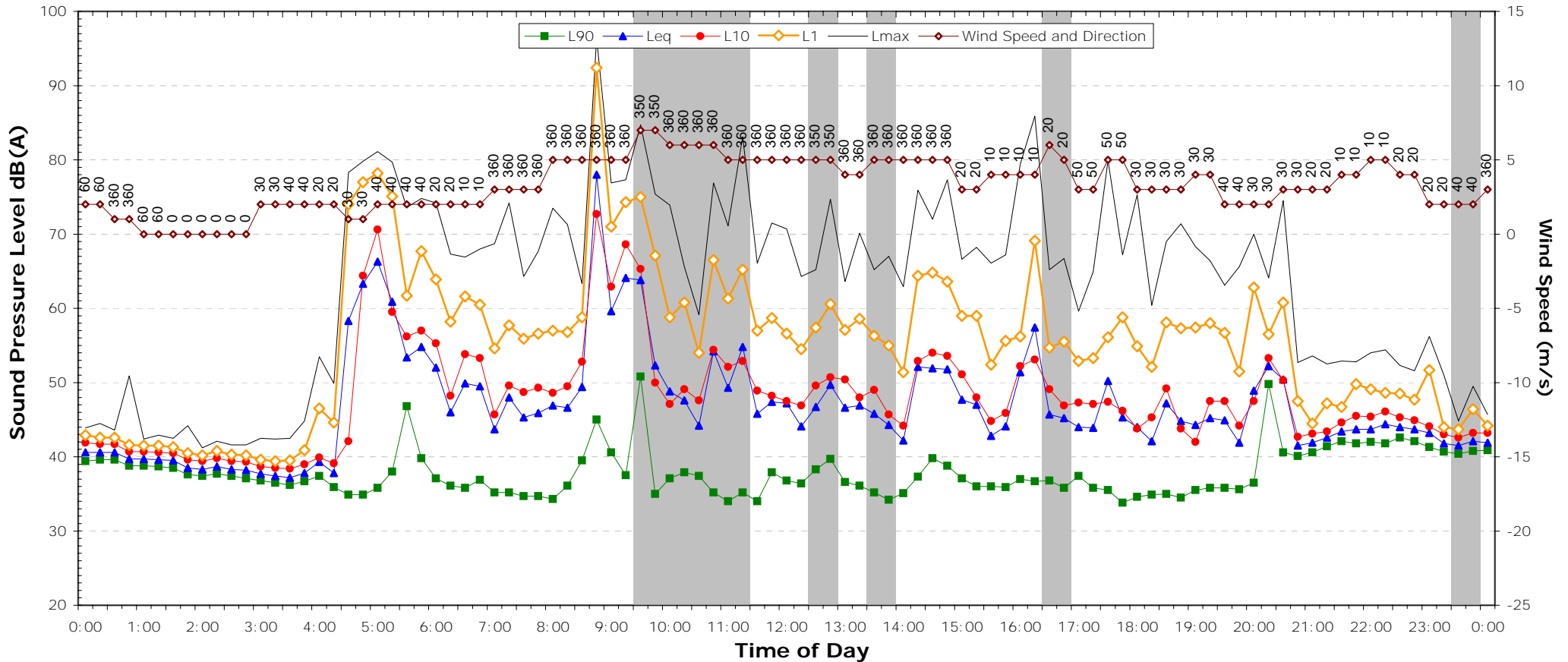
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Tuesday, 29 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	34.9	-
Leq (see note 3)	-	46.3	-

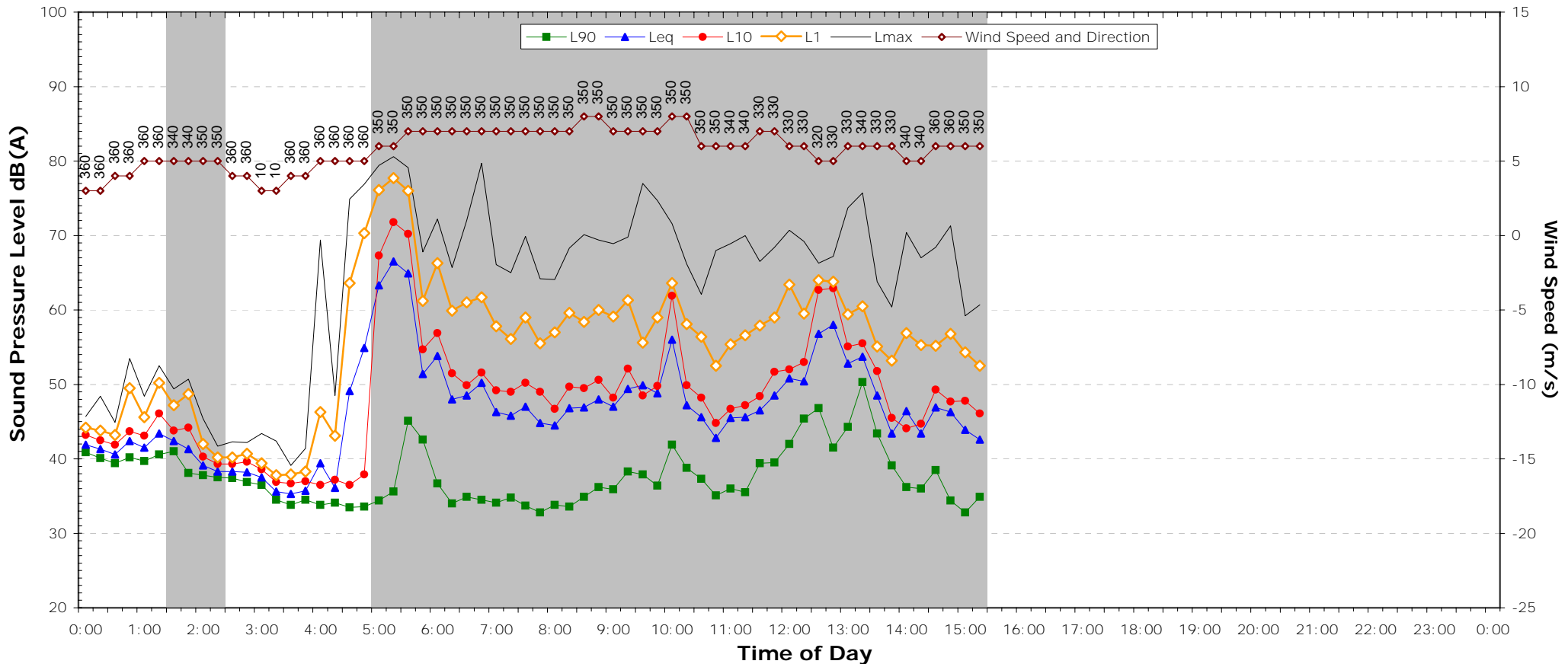
**NOTES:**

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2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax - Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## 1235 Ophir Road, Orange

### Wednesday, 30 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

**NOTES:**

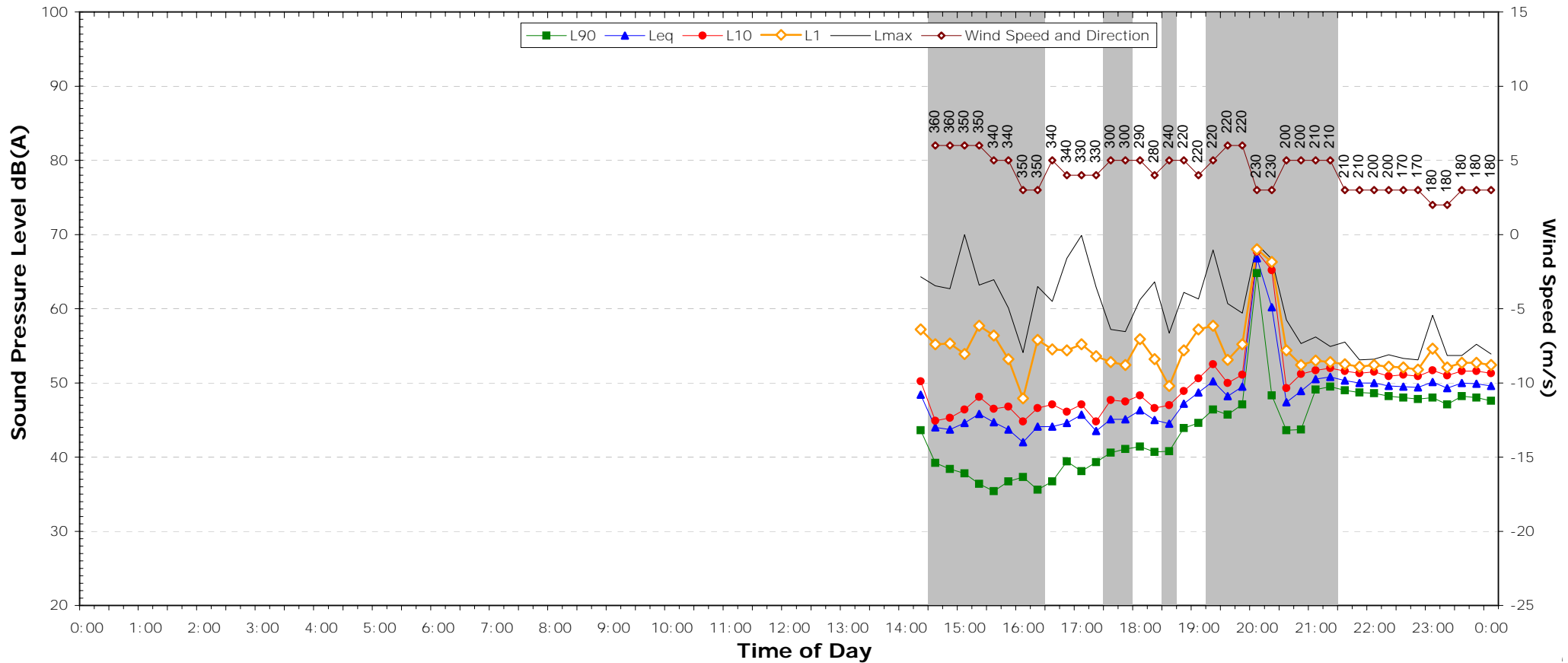
1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)



# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

### Wednesday, 30 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	43.7
Leq (see note 3)	-	-	50.8

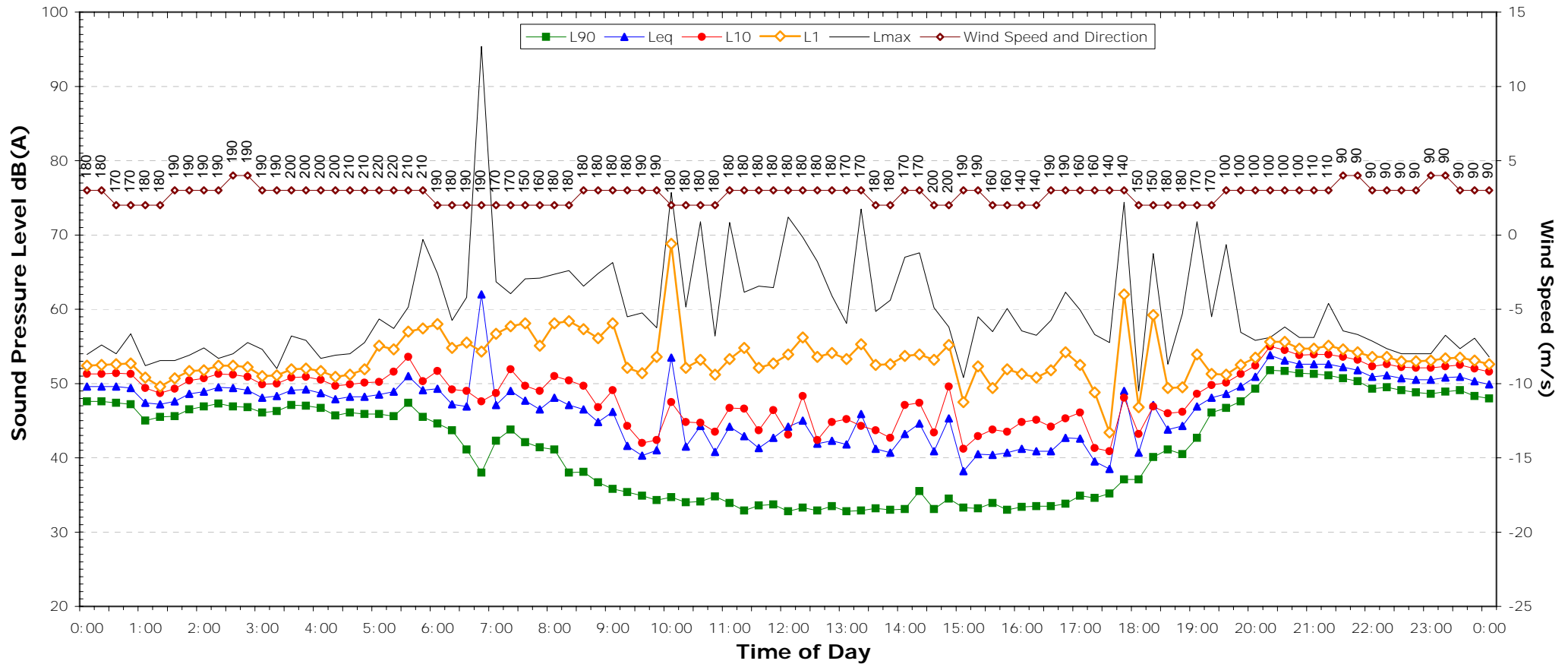
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

Thursday, 1 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	32.9	40.5	40.6
Leq (see note 3)	44.7	50.8	48.9

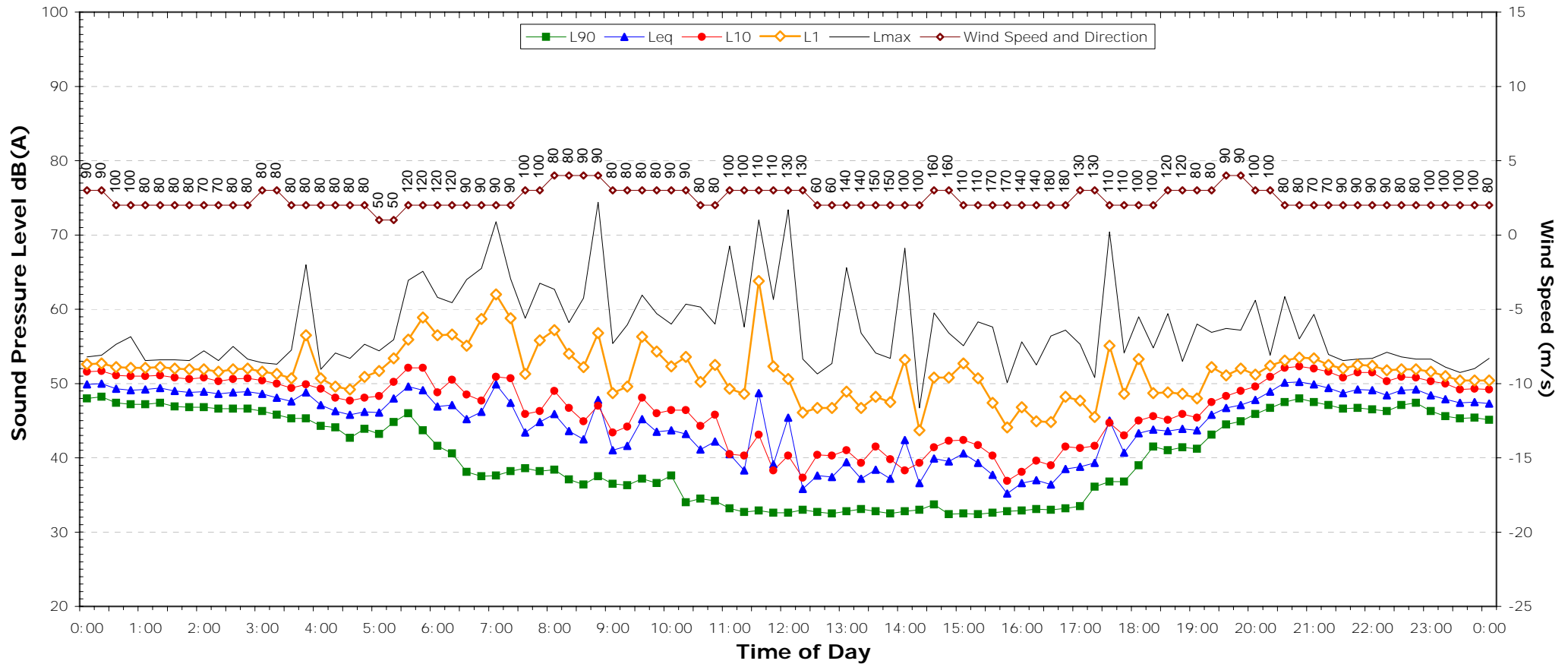
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

Friday, 2 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	32.5	41.2	37.7
Leq (see note 3)	42.3	48.0	47.0

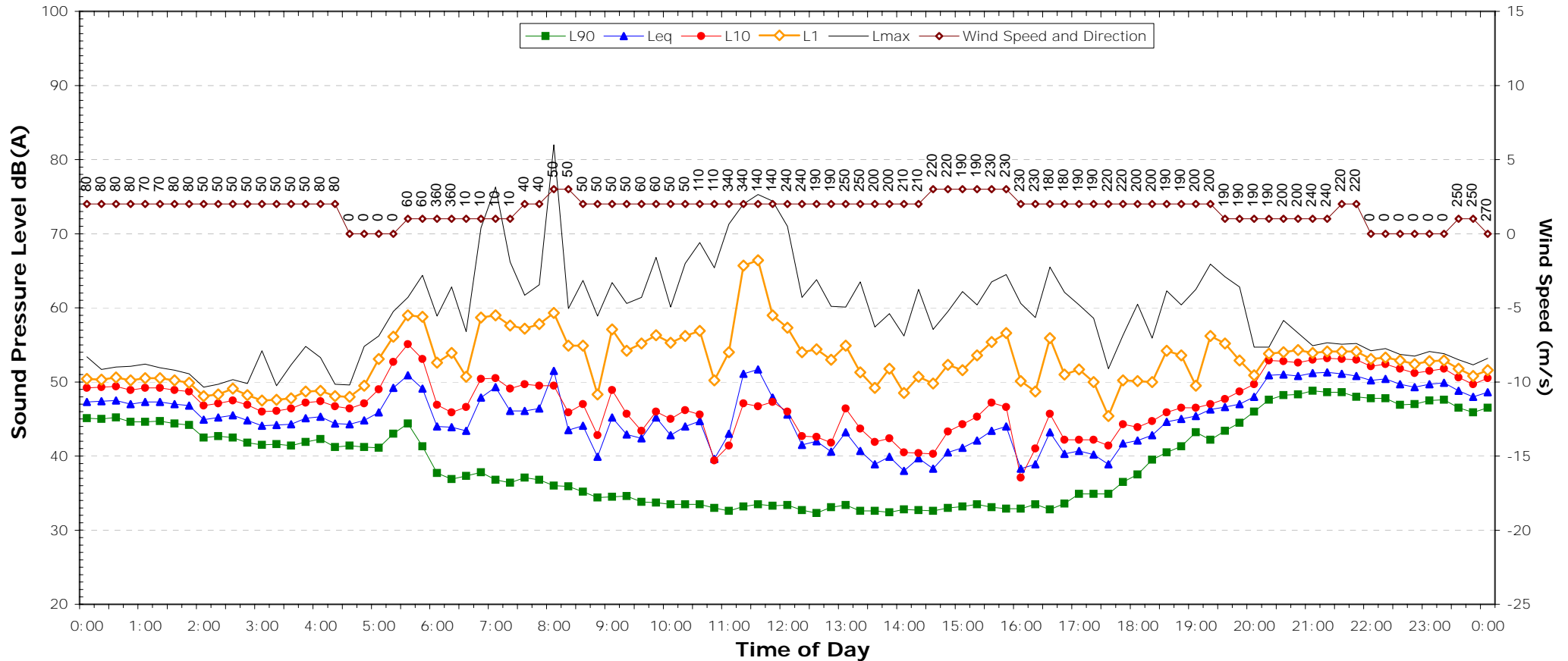
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time L<sub>max</sub> values are shown only where L<sub>max</sub> > 65dB(A) and where L<sub>max</sub>-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

Saturday, 3 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	32.6	40.5	39.3
Leq (see note 3)	44.4	49.1	47.5

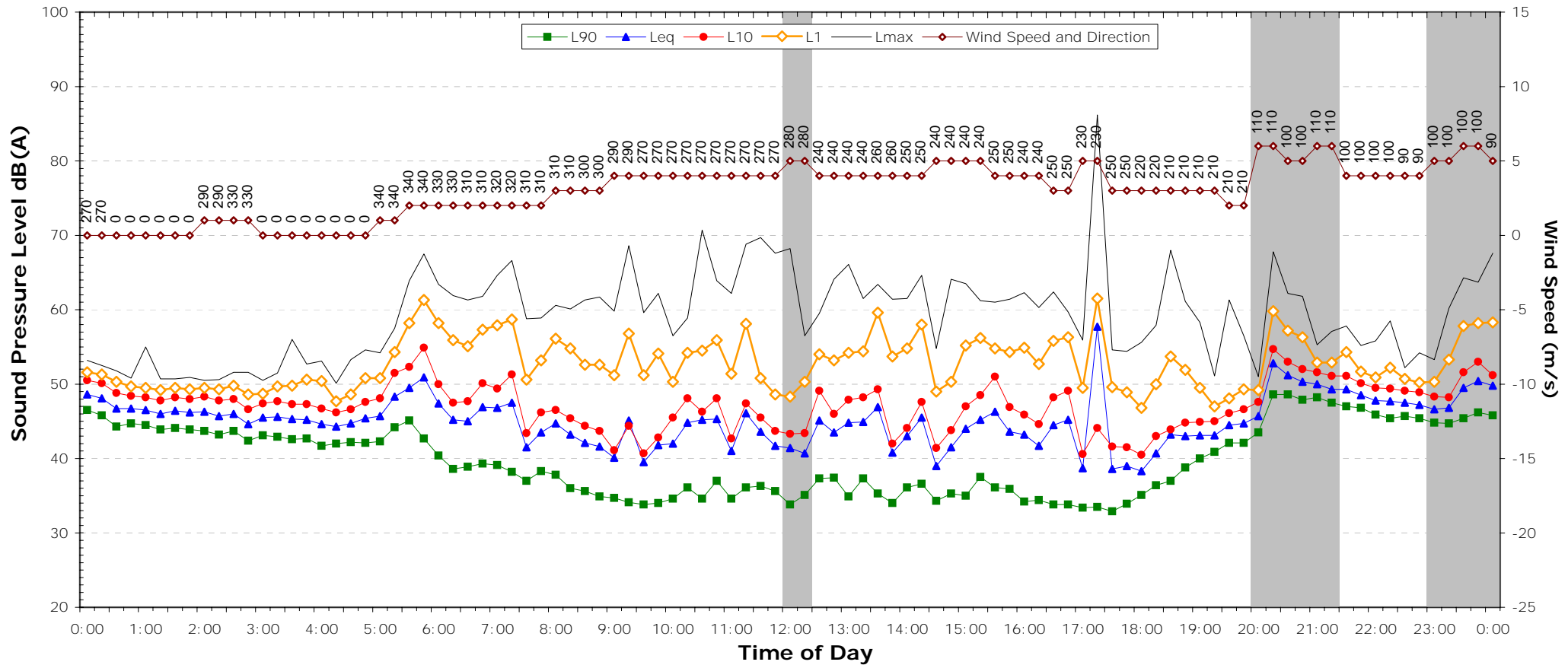
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

Sunday, 4 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	33.8	-	-
Leq (see note 3)	45.6	-	-

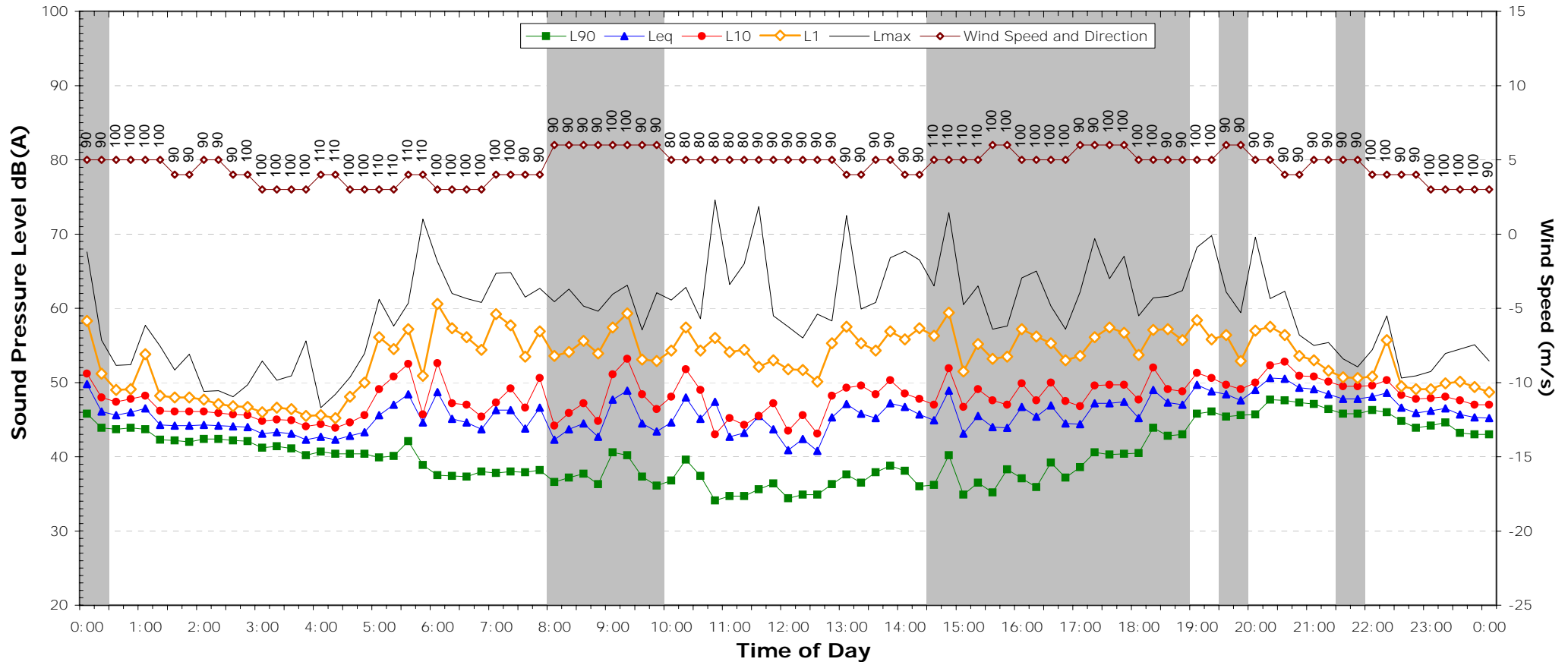
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

Monday, 5 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	37.8
Leq (see note 3)	-	-	45.2

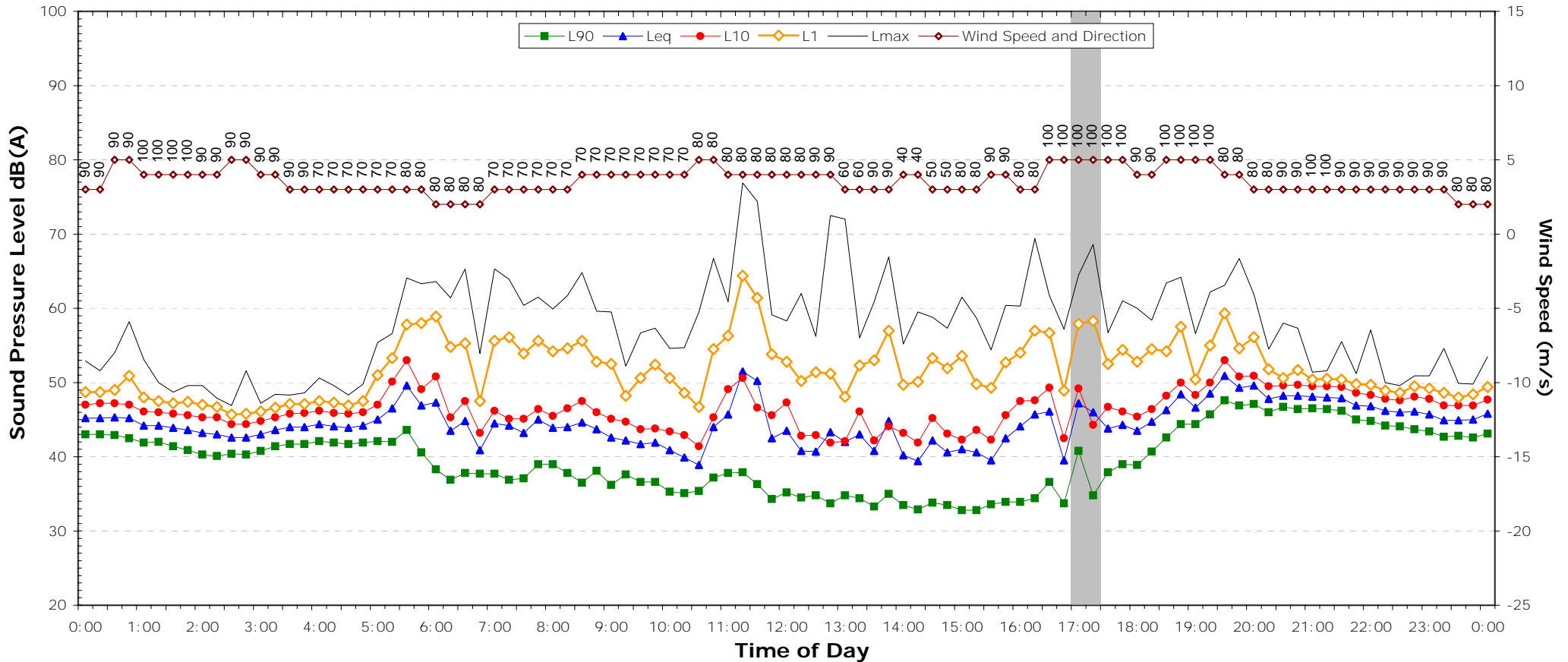
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

### Tuesday, 6 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	33.5	42.6	37.6
Leq (see note 3)	43.9	48.1	44.9

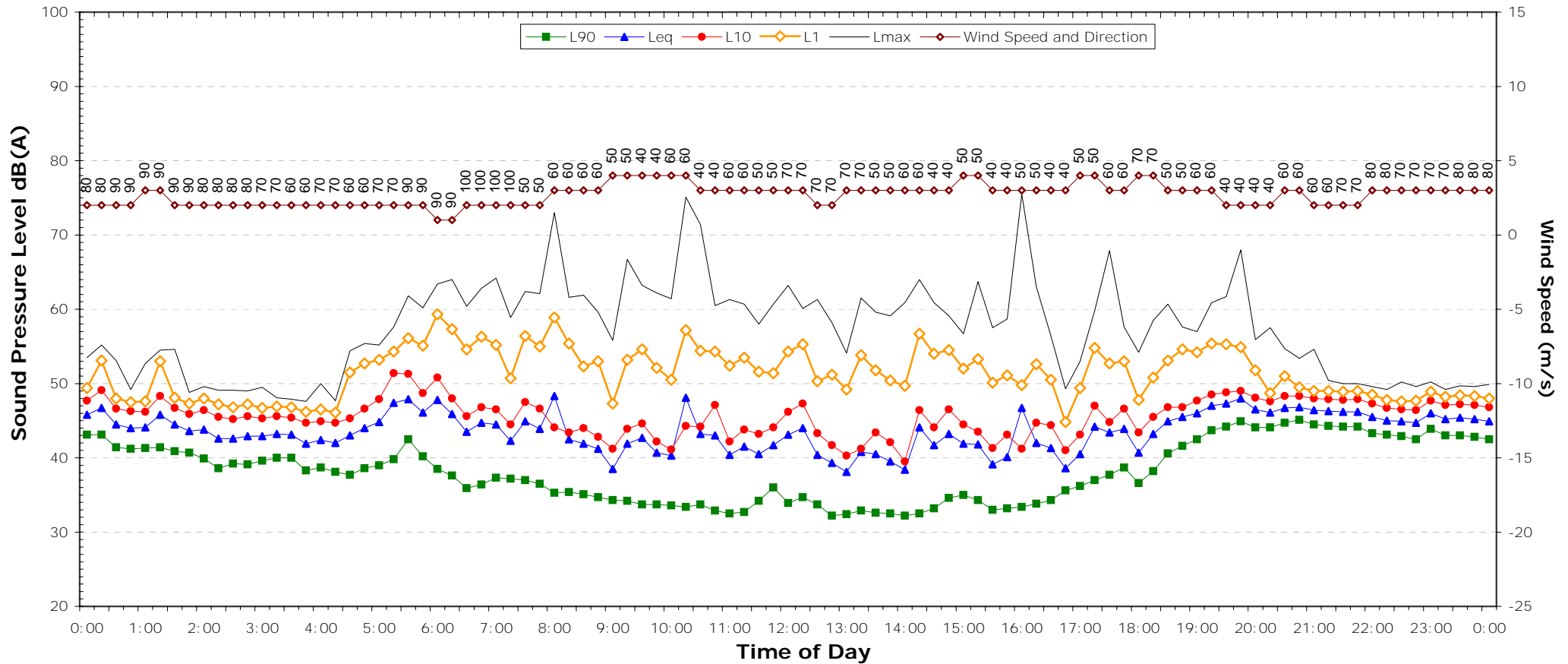
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

Wednesday, 7 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	32.5	40.6	40.2
Leq (see note 3)	42.6	46.3	46.0

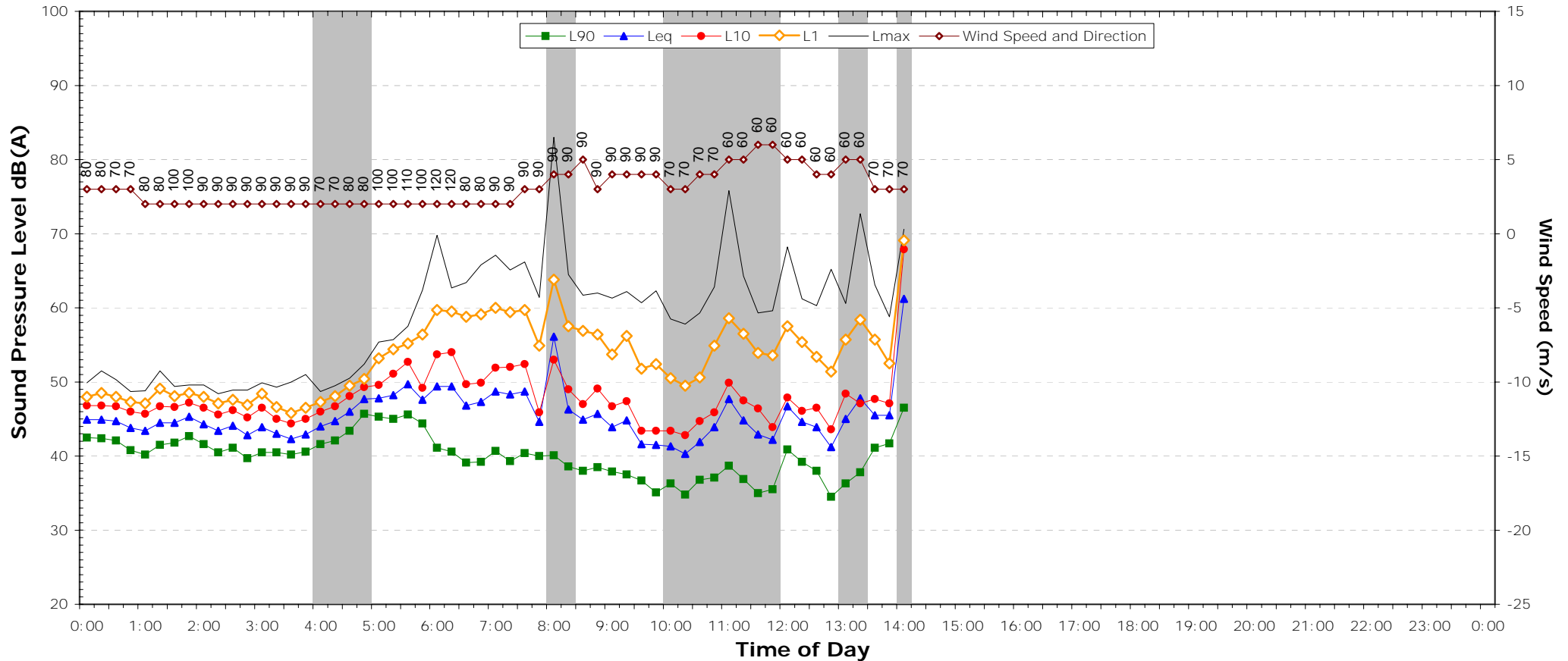
### NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## Fishing Hut

### Thursday, 8 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	-
Leq (see note 3)	-	-	-

**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

## River Intake Option 2

### BACKGROUND & AMBIENT NOISE MONITORING RESULTS NSW DECCW's 'INDUSTRIAL NOISE POLICY', 2000

Day	L <sub>A90</sub> Background Noise Levels <sup>5</sup>			L <sub>Aeq</sub> Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Wednesday-30-November-2011	-	-	52	-	-	53
Thursday-01-December-2011	48	49	51	50	62	52
Friday-02-December-2011	47	50	51	51	51	52
Saturday-03-December-2011	47	49	51	55	51	53
Sunday-04-December-2011	46	-	-	52	-	-
Monday-05-December-2011	-	-	50	-	-	53
Tuesday-06-December-2011	46	48	50	50	50	51
Wednesday-07-December-2011	46	48	-	50	50	-
Thursday-08-December-2011	-	-	-	-	-	-
Friday-09-December-2011	-	-	-	-	-	-
Saturday-10-December-2011	-	-	-	-	-	-
Sunday-11-December-2011	-	-	-	-	-	-
Monday-12-December-2011	-	-	-	-	-	-
Tuesday-13-December-2011	-	-	-	-	-	-
Wednesday-14-December-2011	-	-	-	-	-	-
Thursday-15-December-2011	-	-	-	-	-	-
<b>Representative Level</b>	<b>47</b>	<b>49</b>	<b>51</b>	<b>52</b>	<b>56</b>	<b>52</b>

Notes:

1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Partial day's monitoring
5. Assessment Background Level (ABL)
6. Rating Background Level (RBL) for L90 and logarithmic average for Leq

noise logger results

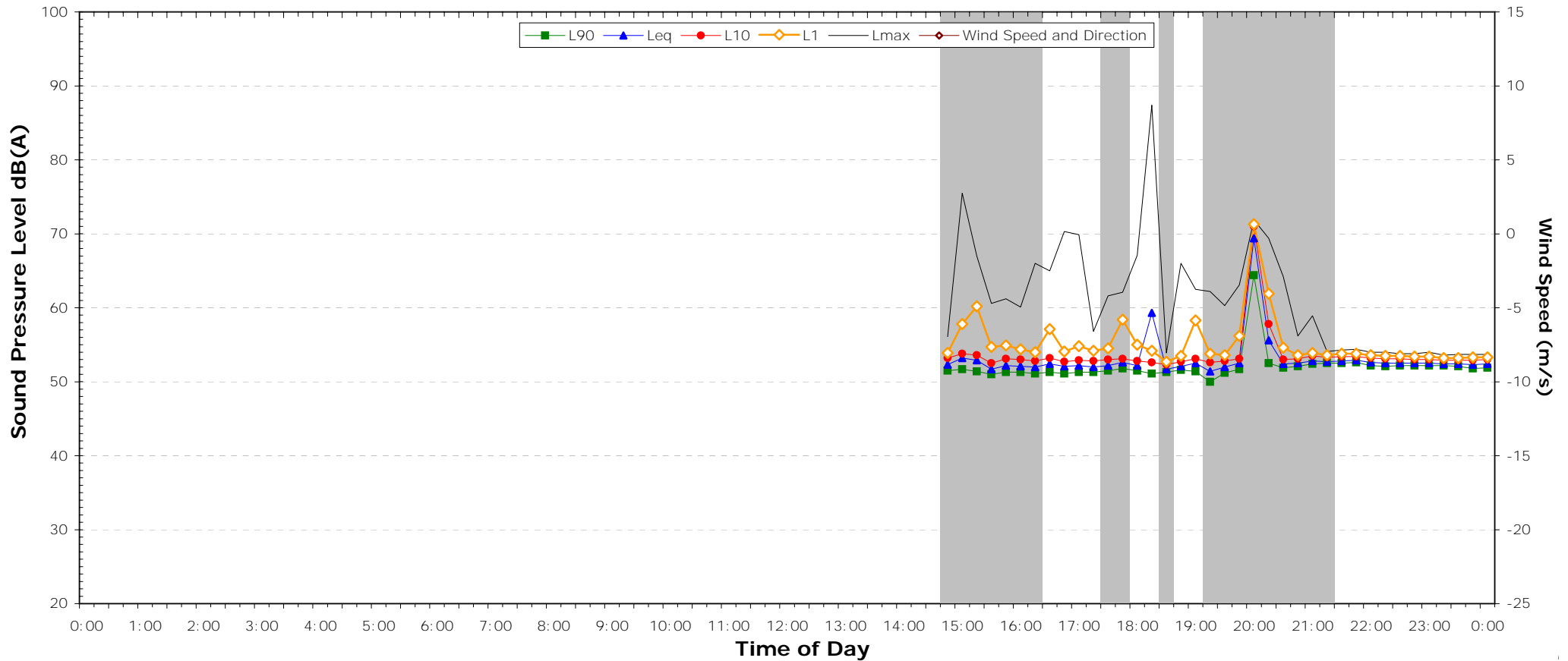
25

1992-2007  
ACQUISITION  
ENGINEERING  
SOLUTIONS

# EXISTING AMBIENT NOISE LEVELS

## River Intake Option 2

### Wednesday, 30 November 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	51.7
Leq (see note 3)	-	-	52.6

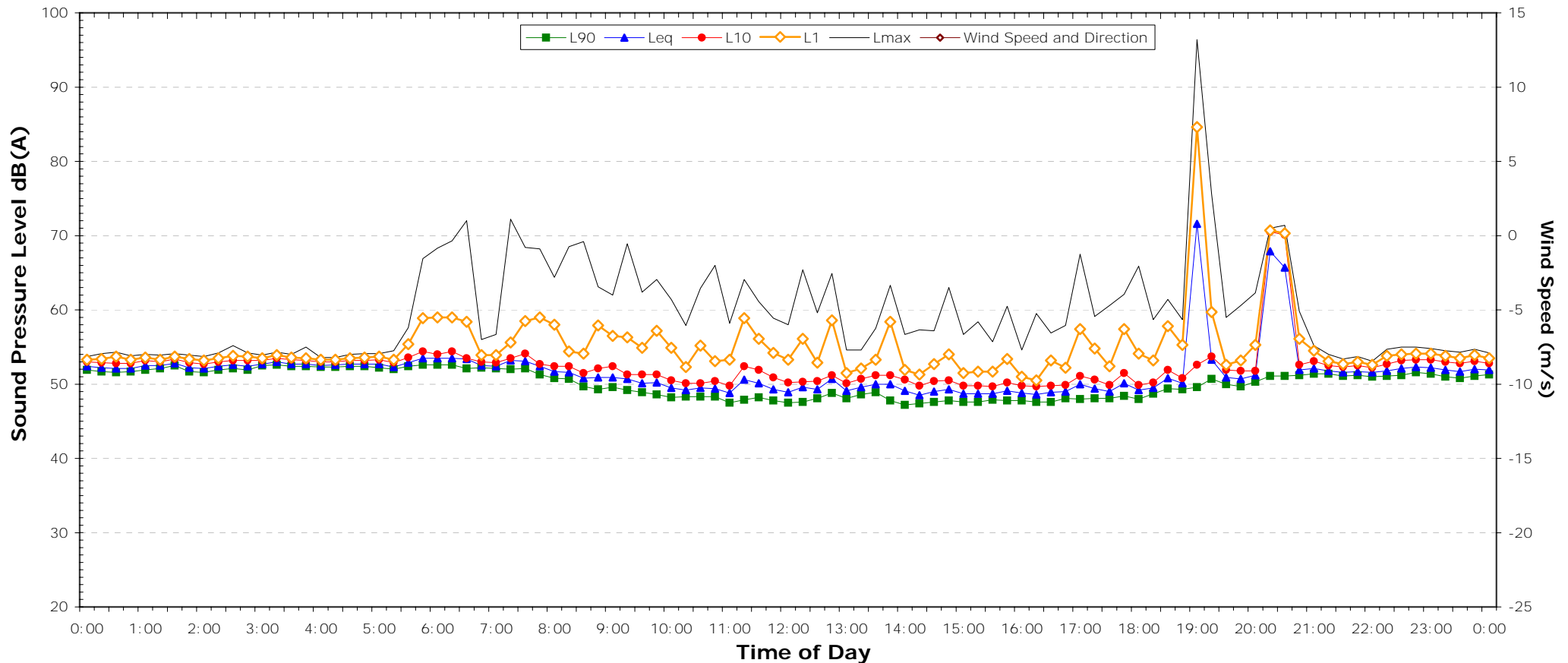
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## River Intake Option 2

### Thursday, 1 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	47.6	49.3	51.1
Leq (see note 3)	50.0	62.1	52.5

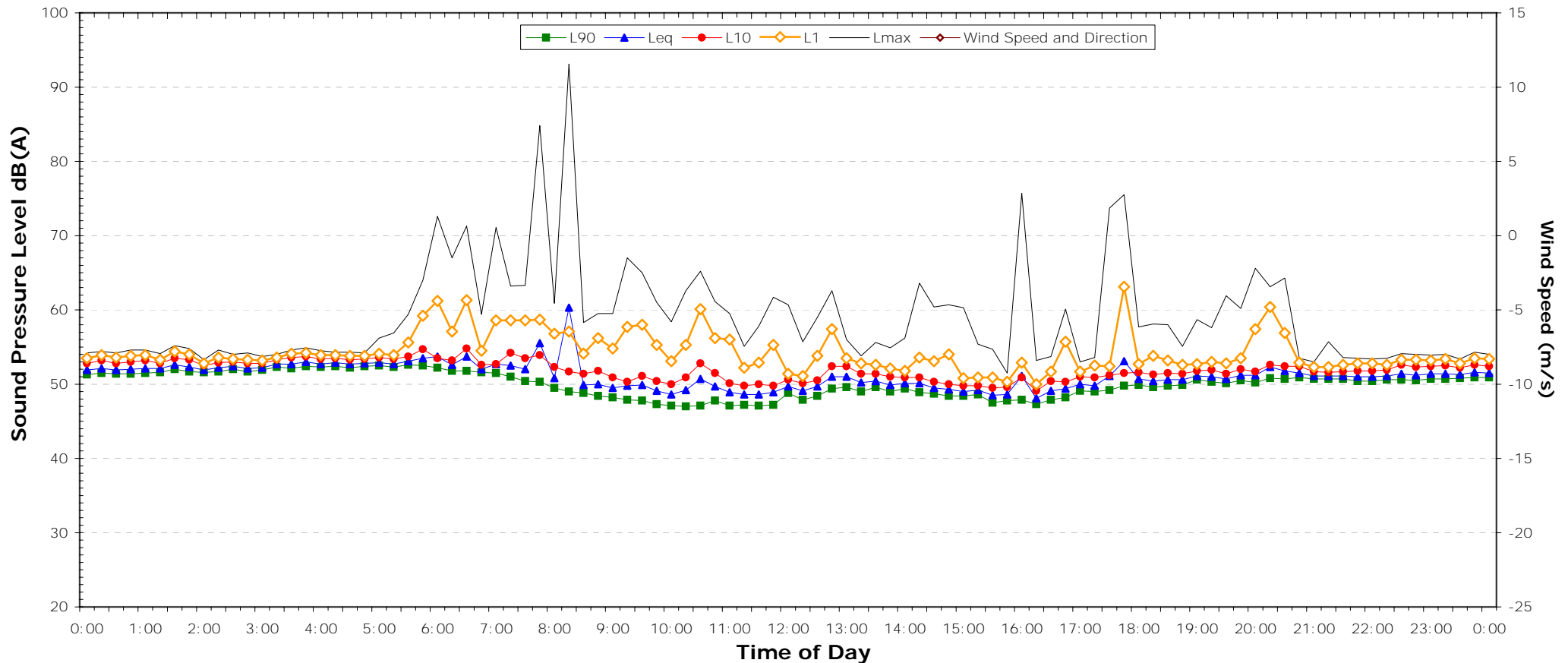
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## River Intake Option 2

### Friday, 2 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	47.1	49.8	50.7
Leq (see note 3)	51.1	51.1	51.9

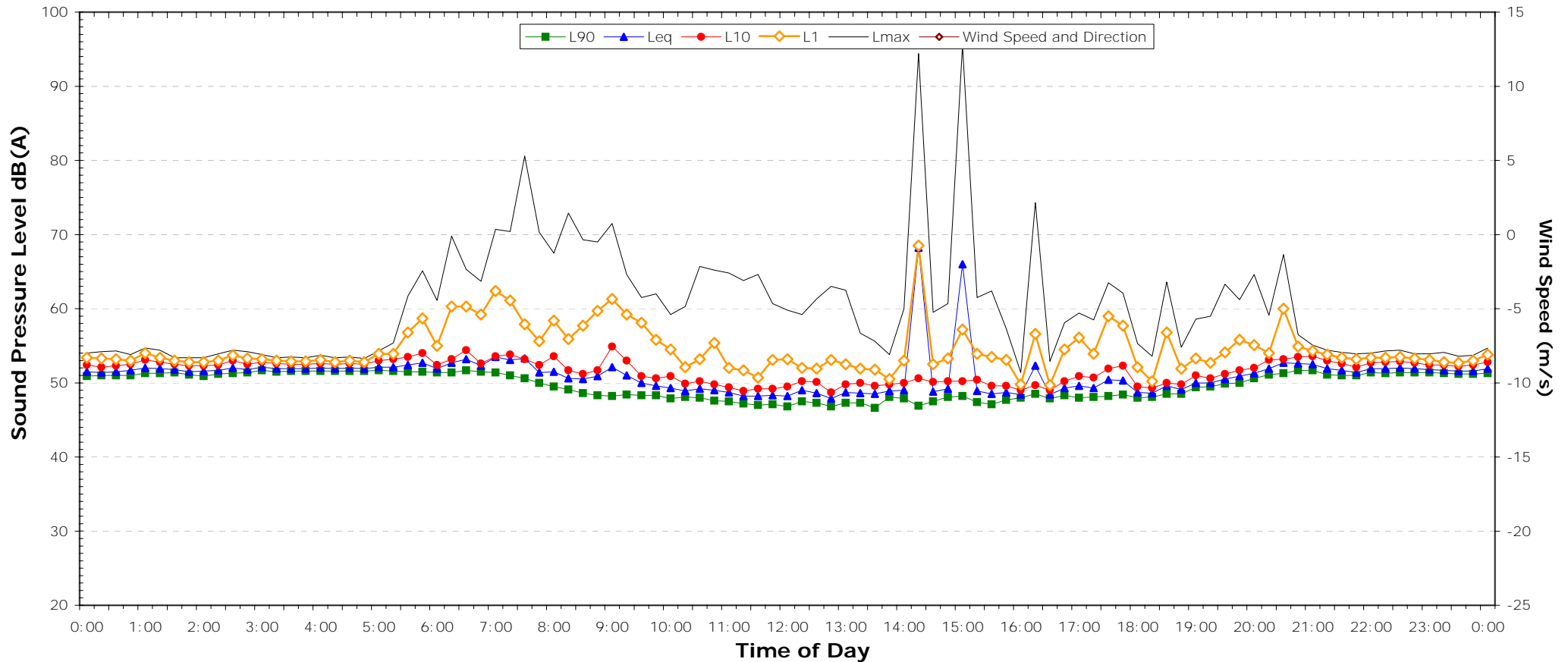
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## River Intake Option 2

### Saturday, 3 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	47.0	48.5	51.0
Leq (see note 3)	55.2	51.2	53.2

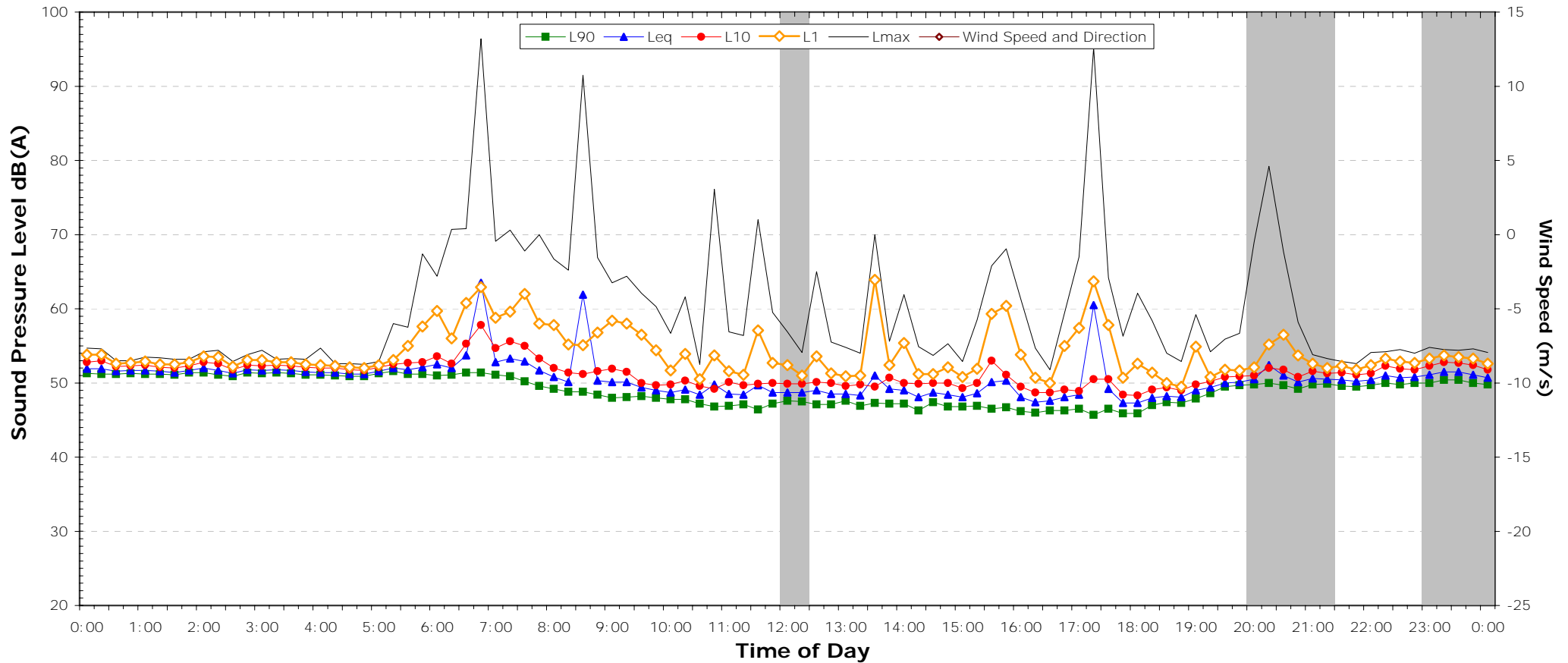
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## River Intake Option 2

### Sunday, 4 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	46.2	-	-
Leq (see note 3)	51.7	-	-

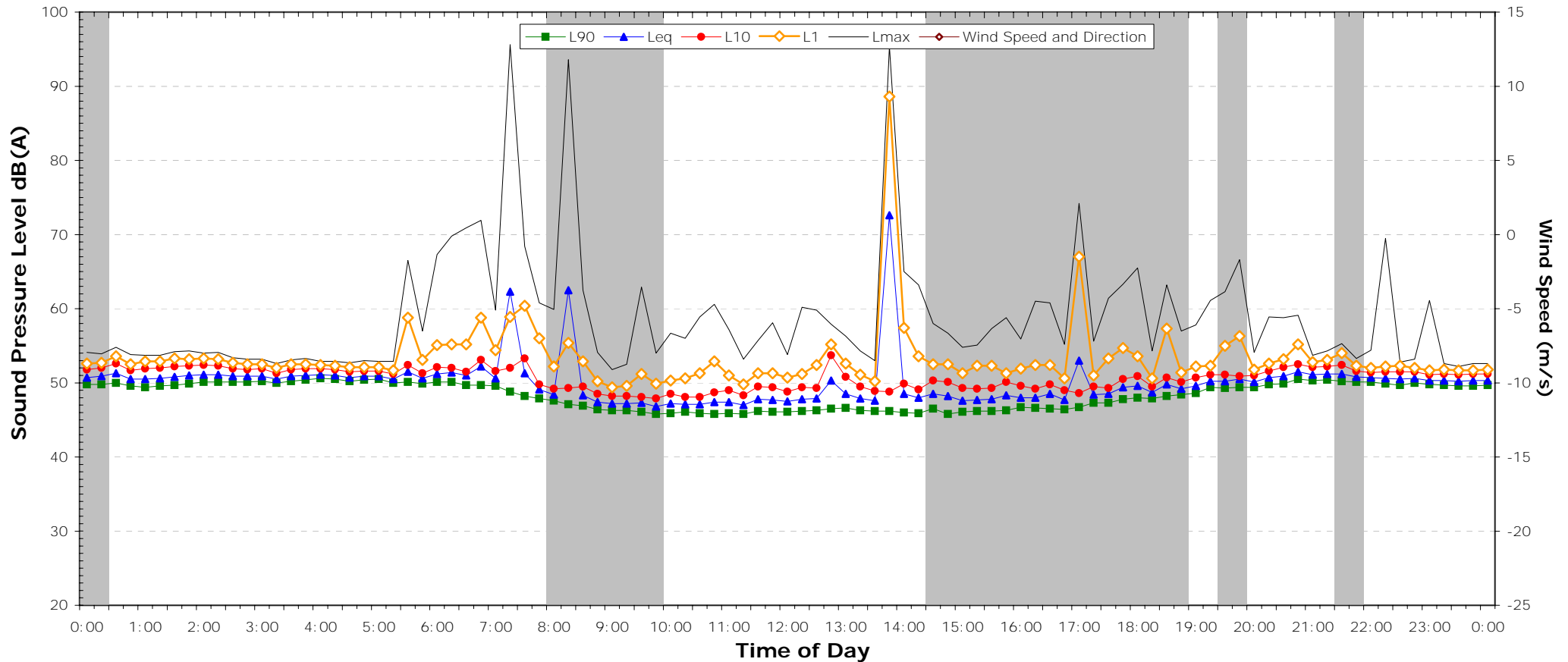
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## River Intake Option 2

### Monday, 5 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	-	-	49.6
Leq (see note 3)	-	-	53.1

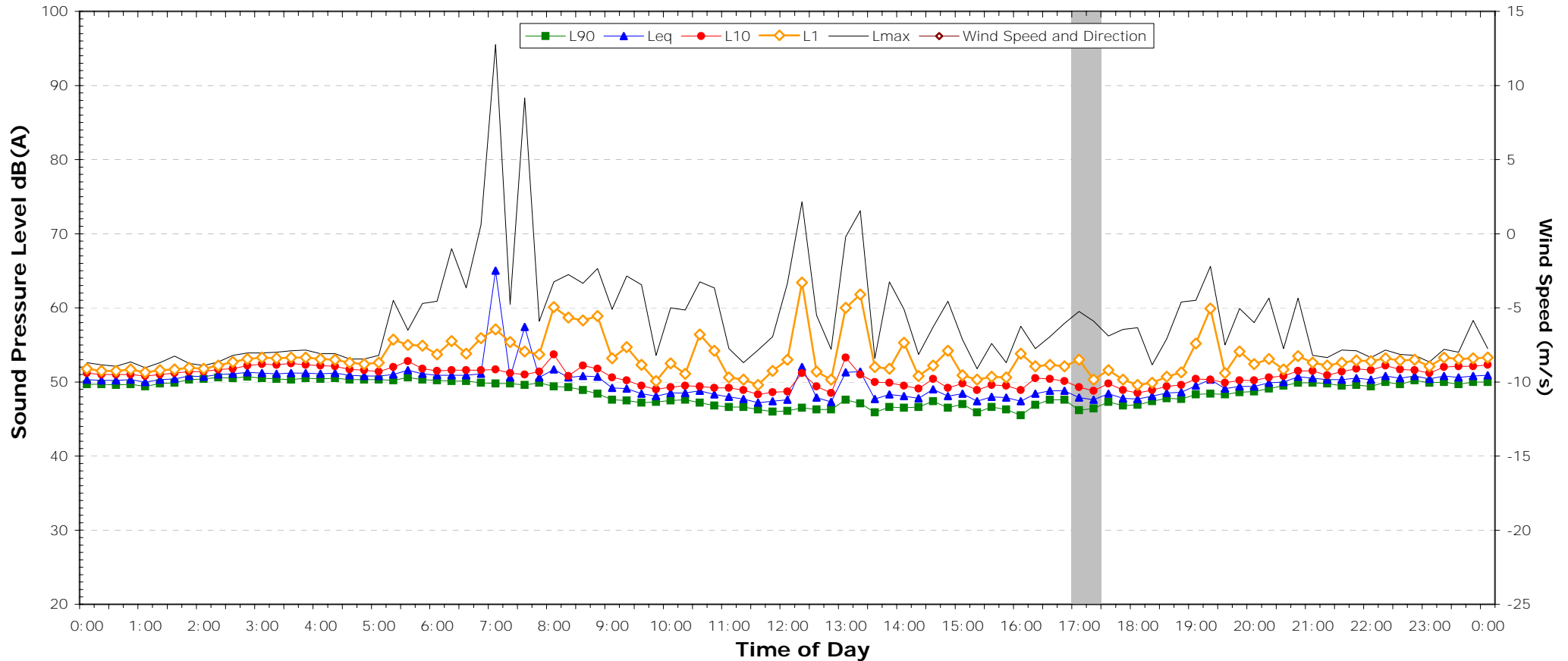
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## River Intake Option 2

### Tuesday, 6 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	46.1	47.7	49.9
Leq (see note 3)	49.6	49.8	51.1

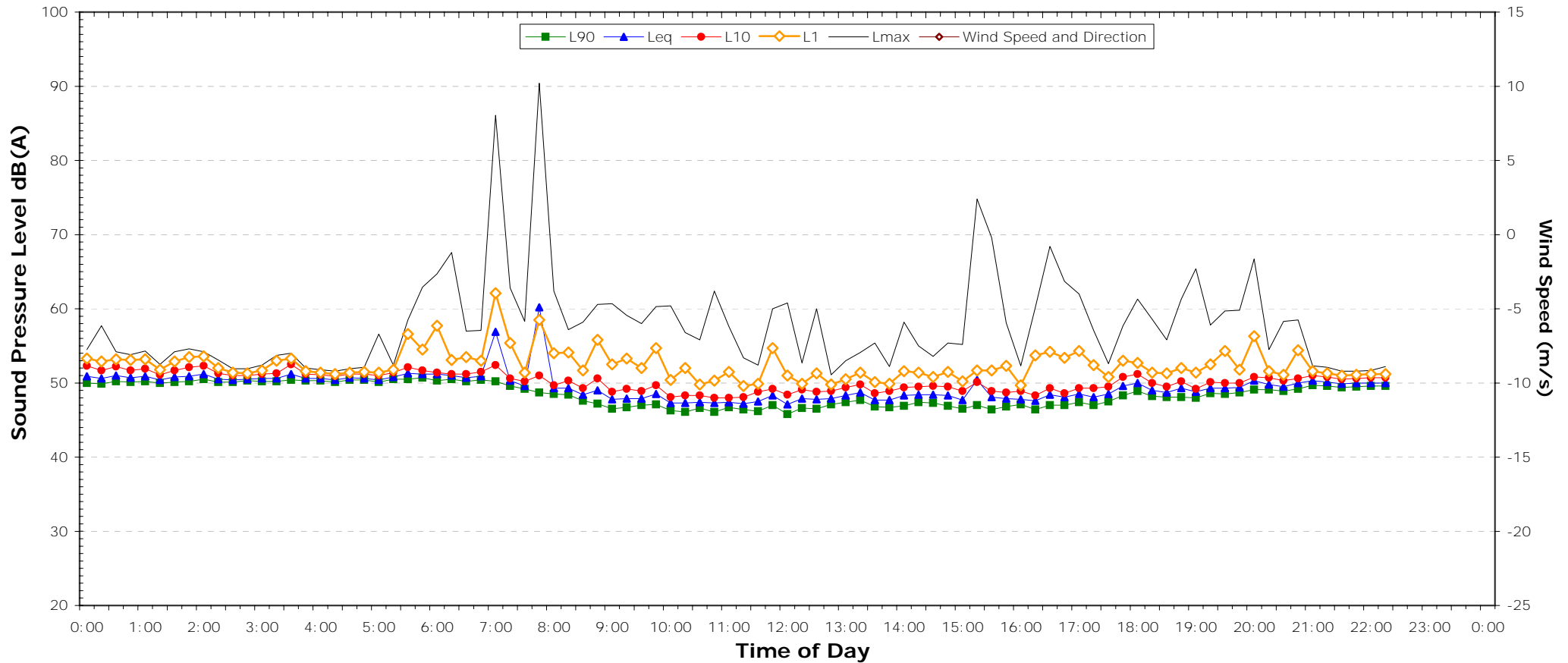
**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

# EXISTING AMBIENT NOISE LEVELS

## River Intake Option 2

### Wednesday, 7 December 2011



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night <sup>2</sup>
	7am-6pm	6pm-10pm	10pm-7am
L <sub>90</sub>	46.3	48.1	-
Leq (see note 3)	49.6	49.6	-

**NOTES:**

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.
2. "Night" relates to period from 10pm on this graph to 7am on the following graph.
3. Graphed data measured in free-field; tabulated results facade corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)