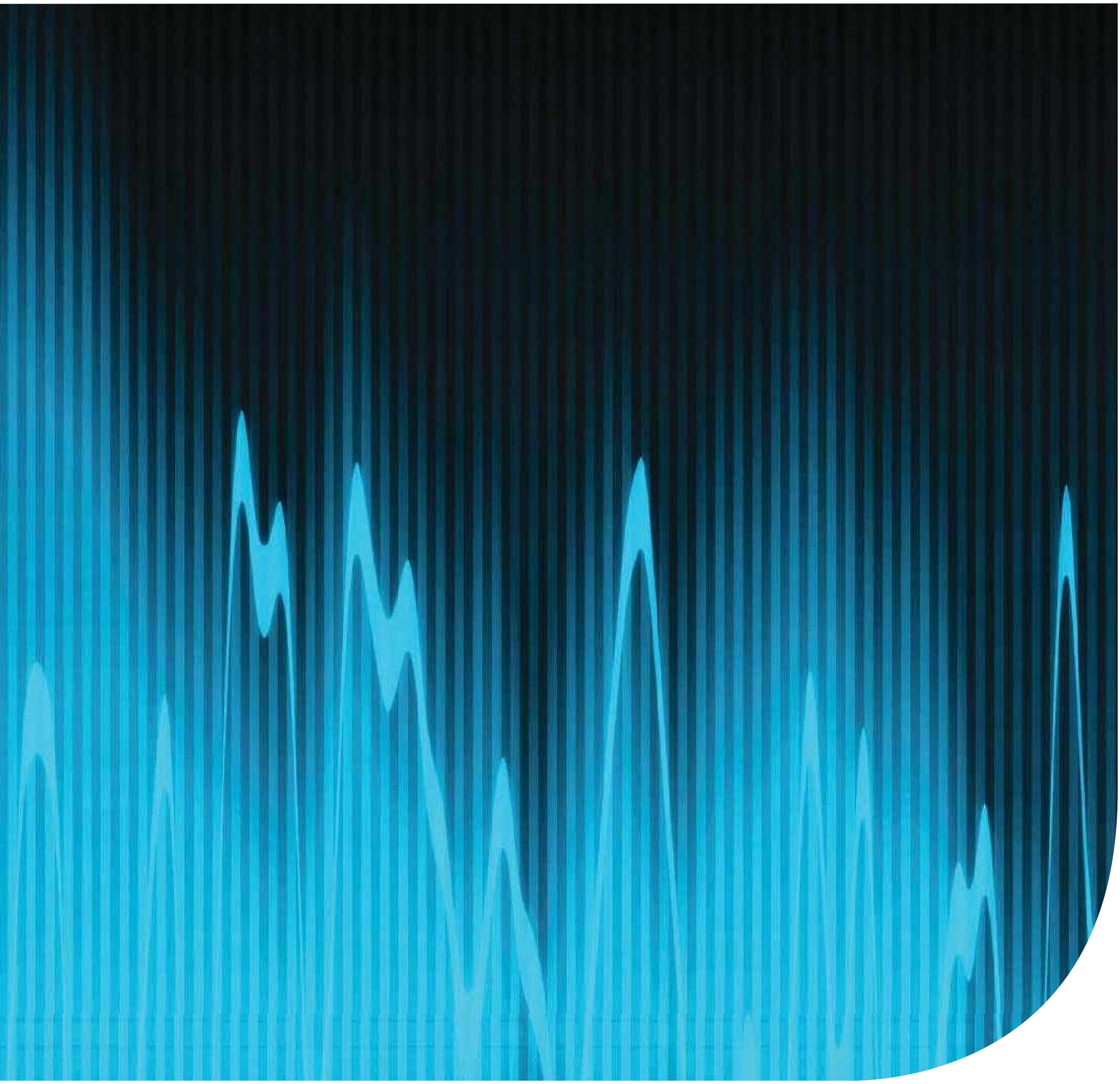
Mascot Residential Planning Proposal

Acoustic Assessment

Prepared for NSW Land and Housing Corporation | 27 November 2017



Mascot Residential Planning Proposal

Acoustic Assessment

Prepared for NSW Land and Housing Corporation | 27 November 2017

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065

T +61 2 9493 9500
F +61 2 9493 9599
E info@emmconsulting.com.au

www.emmconsulting.com.au

Mascot Residential Planning Proposal

Final

Report J17113RP1 | Prepared for NSW Land and Housing Corporation | 27 November 2017

Prepared by	**Daniel Weston**	Approved by	**Najah Ishac**
Position	Associate	Position	Director
Signature		Signature	
Date	27 November 2017	Date	27 November 2017

Document Control

Version	Date	Prepared by	Reviewed by
1	27 November 2017	D.Weston	N.Ishac

EMM

T +61 (0)2 9493 9500 | F +61 (0)2 9493 9599

Ground Floor | Suite 01 | 20 Chandos Street | St Leonards | New South Wales | 2065 | Australia

www.emmconsulting.com.au

Table of contents

Table of contents *(Cont'd)*

Appendices

Tables

Figures

1 Introduction

1.1 Overview

EMM Consulting Pty Limited (EMM) has been commissioned by NSW Land and Housing Corporation (LaHCR) to complete an acoustic assessment for a planning proposal to provide higher density public and affordable housing on an existing residential site at the corner of Botany Road and Coward Street, Mascot (the 'project'). The noise assessment has been prepared to accompany a planning proposal being prepared by LaHCR.

This report has assessed:

- road traffic noise intrusion into habitable areas from Coward Street and Botany Road which is a classified road;
- aircraft noise intrusion from Sydney Kingsford Smith Airport operations into internal habitable and other noise sensitive areas; and
- noise intrusion from other potential noise sources such as Port Botany.

This assessment has been completed with reference to the following:

- Botany Bay Development Control Plan (DCP), 2013;
- NSW Department of Planning (DoP) 2008, *Development Near Rail Corridors and Busy Roads – Interim Guideline*;
- NSW EPA 2011, *Road Noise Policy* (RNP);
- NSW Department of Infrastructure and Regional Development, *The National Airports Safeguarding Framework (NASF), Guideline A*, 2016;
- Australian Standard AS 2021-2015 *"Acoustics - Aircraft noise intrusion - Building siting and construction*.";
- Australian/New Zealand Standard AS/NZS 2107-2000 *"Acoustics - Recommended design sound levels and reverberation times for building interiors"*; and
- Australian Standard AS 1055-1997 *"Acoustics - Description and Measurement of Environmental Noise."*

1.2 Glossary

Several technical terms are discussed in this report. These are explained in Table 1.1.

Table 1.1 Glossary of acoustic terms

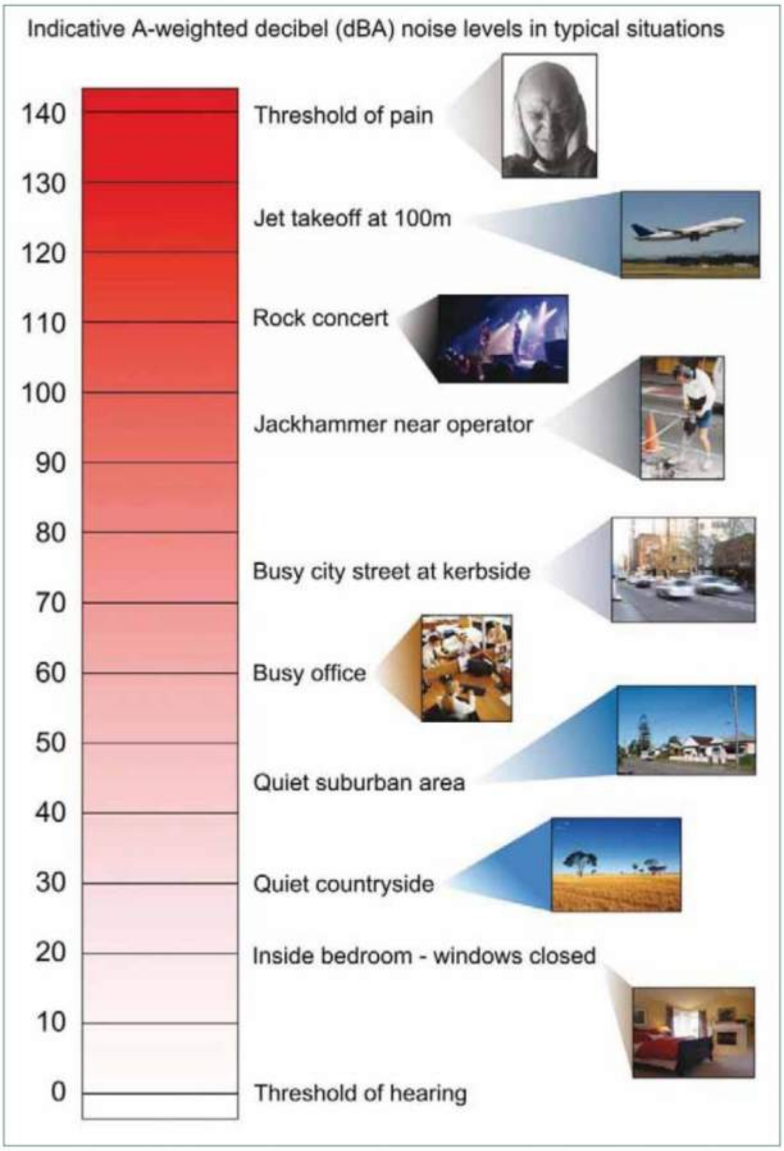
Term	Description
ASA	Air Services Australia
ANR	Aircraft noise reduction
Curfew	Defined as the hours 11pm to 6am
dB	Unit of sound in decibels
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the ‘A-weighted’ scale. This attempts to closely approximate the frequency response of the human ear.
DL	The distance in metres from the closer end of the runway to the intersection of the extended runway centre-line and a line drawn perpendicular to the extended runway centre-line and passing through the building site, known as the 'sideline projection' (refer to AS 2021 - 2015 Figure 3.1).
DS	The distance in metres from the building site to the extended runway centre-line along a line drawn perpendicular to the extended runway centre-line and passing through the building site, known as the 'sideline projection' (refer to AS 2021 - 2015 Figure 3.1).
DT	The distance in metres from the further end of the runway to the intersection of the runway centre-line and a line drawn perpendicular to the extended runway centre-line and passing through the building site, known as the 'sideline projection' (refer to AS 2021 - 2015 Figure 3.1).
L_{90}	Commonly referred to as the background noise level. The noise level exceeded 90% of the time.
L_{eq}	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The $L_{eq(15min)}$ descriptor refers to an L_{eq} noise level measured over a 15 minute period.
L_{max}	The maximum root mean squared sound pressure level received during a measuring interval.
L_{Smax}	Maximum noise level with slow time response.
NEF (or ANEF)	Noise Exposure Forecast, is an index for predicting the cumulative exposure to aircraft noise during a particular future year, generally 10 to 20 years from the date of issue, based on a firm forecast of aircraft operations. This shows the average daily aircraft noise exposure for that period and is usually presented graphically in the form of noise contours.
NEI (or ANEI)	Noise Exposure Index, is an index for calculating the cumulative exposure to aircraft noise during a specified time period, based on historical data, where exact types and numbers of aircraft, which used the aerodrome, are known. This shows the average daily aircraft noise exposure for that period and is usually presented graphically in the form of noise contours.

It is useful to have an appreciation of decibels, the unit of noise measurement. Table 1.2 gives an indication as to what an average person perceives about changes in noise level.

Table 1.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times as loud (or quarter) as loud

Examples of common noise levels are provided in Table 1.2.



Source: RTA Environmental Noise Management Manual (RTA, 2001)

Figure 1.1 Common noise levels

2 Background

2.1 Site description

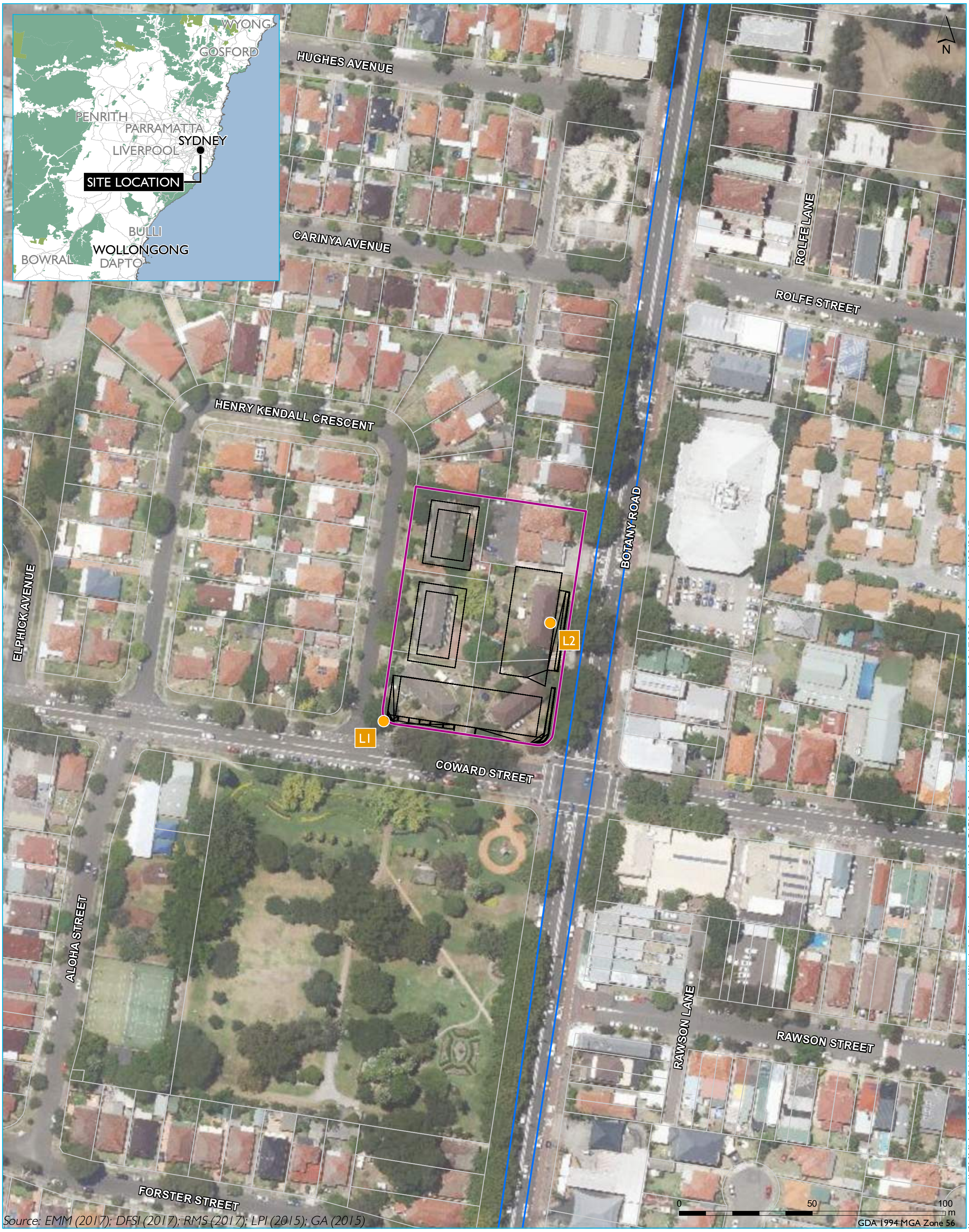
The site is located in Mascot (approximately 6km south of the Sydney CBD) within 750 m of Mascot train station, and is well serviced by buses to the Sydney CBD, and Westfield Eastgardens and beyond. The site is part of Bayside Local Government Area (LGA).

The site is known as 776 & 792-794 Botany Rd & 33-37 Henry Kendall Crescent, Mascot and is legally described as Lots A, B, C, D & E in DP 36472 and Lot 1 in DP 271248. The total site area is approximately 5,770m^2 and consists of five lots owned by LaHCR and one lot owned by NSW Health Infrastructure. The site contains five two-storey apartment buildings and the Mascot Ambulance Station.

The site is exposed to road traffic noise from Botany Road and Coward Street. Botany Road is a Roads and Maritime Service (RMS) classified road.

The site also lies between the Sydney Kingsford Smith Airport aircraft noise exposure forecast (ANEF) 20 and 25 contours (based on the latest published ANEF contained in the Sydney Airport Master Plan 2033) and is situated below the north east departure flight path for runway 34R.

The site layout is shown in Figure 2.1. The site location with respect to Sydney Kingsford Smith Airport ANEF contours and flight paths is provided in Figure 2.2 and Figure 2.3, respectively.



\\emmsvr1\EMM\Jobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02_Maps\N001_SiteLocation_20170901_01.mxd 1/09/2017

KEY

Site boundary

Site detail

Logger location

NSW State classified road

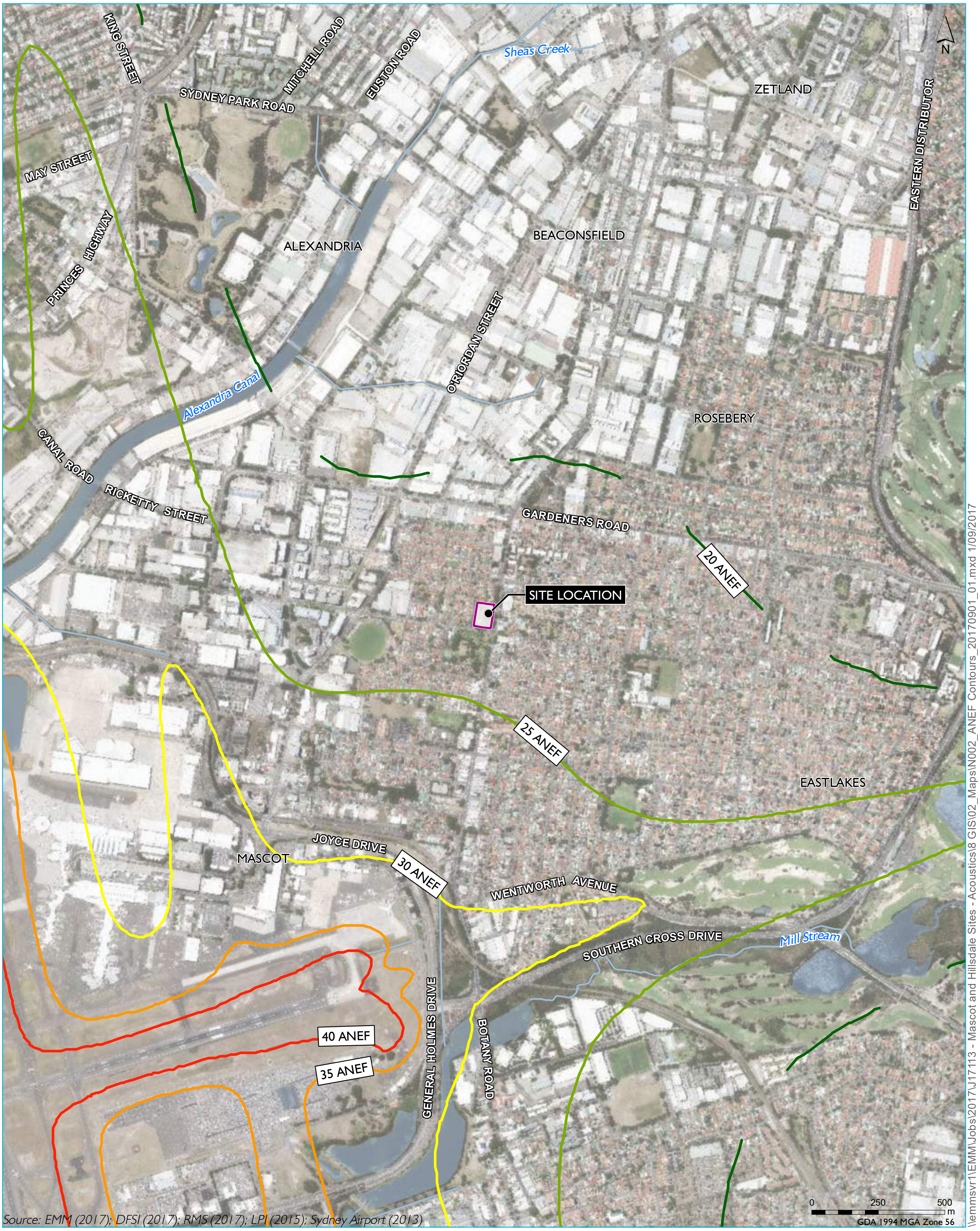
Cadastral boundary

Site location

Mascot site

Acoustic assessment

Figure 2.1



KEY

Site boundary

Watercourse / drainage line

Waterbody

ANEF 2033

20 ANEF

25 ANEF

30 ANEF

35 ANEF

40 ANEF

Site location and Sydney Kingsford Smith ANEF contours

Mascot site
Acoustic assessment
Figure 2.2

Source: EMM (2017); DFSI (2017); Sydney Airport (2013)

\\emmsvr1\EMM\Jobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02_Maps\N003_FlightPAths_20170901_01.mxd 1/09/2017

KEY

Site boundary

Site location and Sydney Kingsford Smith flight paths

Mascot site
Acoustic assessment
Figure 2.3

2.2 Project description

The proposed scheme includes the following:

- basement car-parking;
- mix of ground floor retail tenancies fronting Botany Road and residential apartments or terraces fronting Coward Street and Henry Kendall Crescent;
- residential apartments on upper floors on three separate blocks, one forming a “L” shape fronting Botany Road and Coward Street and two conventional rectangular blocks fronting Henry Kendall Crescent; and
- central courtyard and open space.

Basement, ground floor and typical upper floor plans are provided in Figure 2.4

Figure 2.4 Plans of the proposed Mascot scheme

3 Existing acoustic environment

Long-term, unattended noise monitoring was conducted at two locations within the site, denoted as L1 and L2 (indicated in Figure 2.1). Both logger locations were selected to capture road traffic noise levels from Botany Road and Coward Street, respectively.

The monitoring was conducted using two Acoustic Research Laboratories Type 2 EL-215 noise loggers (serial number 194449 (L1) and Y (L2)). In general, the procedures described in Australian Standard AS 1055-1997 *Acoustics - Description and Measurement of Environmental Noise* and the INP (EPA, 2000) where adhered to. Logger L1 was installed from Friday 16 to Monday 26 June 2017 (total of 11 days) and Logger L2 was installed onsite from Monday 21 August 2017 to Wednesday 6 September 2017 (total of 17 days). Both monitoring locations were selected to exclude extraneous noise sources, such as air-conditioning.

The noise loggers were programmed to record statistical noise level indices continuously in 15 minute intervals, including the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and L_{Aeq} parameters. Calibration of the equipment was checked prior to and following the monitoring. Drift in calibration did not exceed ±0.5 dB. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Monitoring data affected by adverse meteorological conditions such as high winds (greater than 5m/s at microphone height) or rain was excluded. Where applicable, other uncharacteristic noise events have also been excluded from the assessment in accordance with the methods provided in the INP. Weather data was sourced from Bureau of Meteorology automatic weather station (AWS) at Sydney airport (ID: 066037). The results of the long-term unattended noise monitoring are summarised in Table 3.1. Daily statistical data and charts are provided in Appendix A.

Table 3.1 Unattended long term noise monitoring result summary

Location	Measured background noise level, RBL, dB(A)[1]			Measured L_{eq}, dB(A)[2]	
	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am	Day 7 am to 10 pm	Night 10 pm to 7 am
L1 – Coward Street	54	61	44	66	60
L2 – Botany Road	59	54	43	70	65

Notes: 1. RBL analysed in accordance with INP.

2. Leq (period) is the average for the week of data collected. Representative of the free-field noise level at the logger position.

Noise levels at both logger locations were dominated by road traffic noise from the respective roads to which they were installed. For Botany Road, the recorded day and night road traffic noise level was 70 $L_{Aeq,15hour}$ and 65 $L_{Aeq,9hour}$, respectively. For Coward Street, the recorded day and night road traffic noise level was 66 $L_{Aeq,15hour}$ and 60 $L_{Aeq,9hour}$, respectively.

4 Regulatory context

4.1 General noise provisions

Botany Bay Council Development Control Plan (DCP) 2013 (Amendment 7) provides a number of requirements for residential apartment buildings that must be considered in an approvals process. Of relevance to this planning proposal, the DCP provides the following requirement with regards to noise impact on the development itself:

C2 New dwellings shall be designed and constructed to comply with the criteria specified in Table 7 for all noise intrusion from external noise sources (including mechanical services noise from within the development itself).

C3 Where the height of the proposed development is higher than the existing height of the localised building stock (and the proposed development has a direct line of sight to the seaport and/or the airport) an acoustic assessment by an accredited acoustic consultant is required which takes into account noise from the operations of Port Botany and Sydney Kingsford Smith Airport.:

Table 7 of Part 4C as referenced in condition C2 of the DCP provides the following internal noise limits for "all intrusion from external noise sources".

Table 7 External noise intrusion criteria

Internal area	***Time***	***Repeatable maximum $L_{Aeq(1hour)}$ with closed windows and doors***	***Repeatable maximum $L_{Aeq(1hour)}$ with open windows and doors***
Living areas	*Day or night*	*< 40 dBA*	*< 50 dBA*
Sleeping areas	*Day or night*	*< 40 dBA*	*< 50 dBA*

4.2 Road traffic noise

4.2.1 Botany Bay Development Control Plan 2013

Botany Bay Council Development Control Plan (DCP) 2013 (Amendment 7) provides the following requirement on road noise for residential apartment buildings:

C8 Development on land which is on or is within 100 metres of a railway corridor, a classified road or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RMS) must consider the requirements of the Development Near Rail Corridors and Busy Roads - Interim Guideline (19 December 2008) in accordance with cl.87(3) and cl.102(3) of SEPP (Infrastructure) 2007. An acoustic report prepared by a certified acoustic consultant must be submitted at development application stage to demonstrate compliance with this Guideline.

4.2.2 Development near Rail Corridors and Busy Roads – Interim Guidelines

Guidance for the specification of internal noise levels of habitable rooms is prescribed in Department of Planning's (DoP) *Development near Rail Corridors and Busy Roads – Interim Guidelines* (2008) ('the guideline').

The guideline assists in the planning, design and assessment of development in, or adjacent to, rail corridors and busy roads and supports the Infrastructure SEPP. The guidelines are mandatory for residential developments proposed adjacent to busy roads with an Annual Average Daily Traffic (AADT) of greater than 40,000 vehicles.

The guideline outlines internal criterion levels for Clause 87 (Rail) and Clause 102 (Road) of the State Environmental Planning Policy (SEPP) for Infrastructure (Infrastructure SEPP):

> *"If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:*
>
> *- in any bedroom in the building : 35 dB(A) at any time 10 pm–7 am; and*
>
> *- anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40 dB(A) at any time."*

Table 3.1 of the guideline clarifies that the noise criteria above are to be determined as an $L_{eq,15hr}$ for the daytime and $L_{eq,9hr}$ for the night time period.

The guideline allows noise levels of up to 10 dB above the noise limits when open windows and/or doors are open for natural ventilation. This equates to a noise limit of 45 dB, $L_{eq,9hr}$ for bedrooms and 50 dB, $L_{eq,15hr}$ for other habitable space.

4.2.3 Road noise policy

The NSW EPA's *Road Noise Policy* (RNP)(EPA 2011) has been reviewed and is designed to quantify the noise intrusion from the road network on existing receptors. As this project is currently in the rezoning phase with no impacts to existing receptors, the RNP criteria are not applicable to this assessment.

4.3 Aircraft noise

4.3.1 Botany Bay Local Environmental Plan 2013

Botany Bay Council Local Environmental Plan (LEP) 2013, Clause 6.9, provides the following requirements on aircraft noise for residential developments:

> "**Development in areas subject to aircraft noise**
>
> *(1) The objectives of this clause are as follows:*
>
> *(a) to prevent certain noise sensitive developments from being located near the Kingsford Smith Airport and its flight paths,*
>
> *(b) to assist in minimising the impact of aircraft noise from that airport and its flight paths by requiring appropriate noise attenuation measures in noise sensitive buildings,*
>
> *(c) to ensure that land use and development in the vicinity of that airport do not hinder or have any other adverse impacts on the ongoing, safe and efficient operation of that airport.*

(2) This clause applies to development that:

(a) is on land that:

(i) is near the Kingsford Smith Airport, and

(ii) is in an ANEF contour of 20 or greater, and

(b) the consent authority considers is likely to be adversely affected by aircraft noise.

(3) Before determining a development application for development to which this clause applies, the consent authority:

(a) must consider whether the development will result in an increase in the number of dwellings or people affected by aircraft noise, and

(b) must consider the location of the development in relation to the criteria set out in Table 2.1 (Building Site Acceptability Based on ANEF Zones) in AS 2021—2000, and

(c) must be satisfied the development will meet the indoor design sound levels shown in Table 3.3 (Indoor Design Sound Levels for Determination of Aircraft Noise Reduction) in AS 2021—2000.

(4) In this clause:

***ANEF contour** means a noise exposure contour shown as an ANEF contour on the Noise Exposure Forecast Contour Map for the Sydney (Kingsford Smith) Airport prepared by the Department of the Commonwealth responsible for airports.*

***AS 2021—2000** means AS 2021—2000 Acoustics - Aircraft noise intrusion - Building siting and construction.*

4.3.2 Botany Bay Development Control Plan 2013

Botany Bay Council Development Control Plan (DCP) 2013 (Amendment 7) provides the following requirement on aircraft noise for residential apartment buildings:

C5 New dwellings on land within the Australian Noise Exposure Forecast (ANEF) Contour 20 or higher will be designed and constructed in accordance with current Australian Standard AS 2021 (Acoustic Aircraft Noise Intrusion-Building siting and Construction) and Part 3J - Development Affecting Operations at Sydney Airport. Applicants are to address the compliance in the Development Application.

C6 New or higher density residential development which, in the opinion of Council is considered to be aircraft noise sensitive will be not supported where the property is located within the 30+ ANEF contour.

C7 The introduction of noise abatement measures to achieve compliance with the current AS 2021 must be integrated into the design of the building.

The site is located within the ANEF 20 contours and therefore an acoustic assessment in accordance with AS 2021-2015 is required.

4.3.3 AS 2021-2015

The fundamental tool used for building site planning purposes around aerodromes in respect of acoustics is Australian Standard *AS 2021 - 2015 Acoustics - Aircraft noise intrusion - Building siting and construction*. The standard works on the principle of whether a building site is considered to be 'acceptable', 'conditionally acceptable' or 'unacceptable'. To do this the Australian Noise Exposure Forecast (ANEF) noise contour map is needed, which is a reflection of the aerodrome's noise footprint on the surrounding environment. The ANEF map is a function of both the noise levels from various aircraft that are forecast to use the site as well as the quantity of aircraft movements.

Our approach to the assessment of aircraft noise for the site included adopting the guidelines in AS 2021. This was aided by the available existing ANEF contour map for Sydney Kingsford Smith Airport operations (ie ANEF 2033 as published in the Sydney Airport Master Plan of 2014).

This standard recommends a screening type of approach initially to determine the acceptability of a building site. This is defined as shown in Table 4.1, which is a reproduction of Table 2.1 in AS 2021 as are the associated notes that follow the table.

Table 4.1 Building site acceptability based on ANEF zones (AS 2021)

Building Type	**ANEF Zone of site**		
	Acceptable	**Conditionally Acceptable**	**Unacceptable**
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Notes: *1. The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight paths. Because of this, the procedure of Clause 2.3.2 may be followed for building sites outside but near to the 20 ANEF contour.*

2. Within 20 ANEF to 25 ANEF, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate (see also Figure A1 of Appendix A).

3. There will be cases where a building of a particular type will contain spaces used for activities which would generally be found in a different type of building (e.g. an office in an industrial building). In these cases Table 2.1 should be used to determine site acceptability, but internal design noise levels within the specific spaces should be determined by Table 3.3.

4. This Standard does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable, it is recommended that such development should achieve the required ANR determined according to Clause 3.2. For residences, schools, etc., the effect of aircraft noise on outdoor areas associated with the buildings should be considered.

5. In no case should new development take place in green field sites deemed unacceptable because such development may impact airport operations.

The definitions of the terms in Table 4.1 are as follows:

Acceptable

"If from Table 2.1, the building site is classified as 'acceptable', there is usually no need for the building construction to provide protection specifically against aircraft noise. However, it should not be inferred that aircraft noise will be unnoticeable in areas outside the ANEF 20 contour. (See Notes 1, 2 and 3 of Table 2.1)."

Conditionally acceptable

"If from Table 2.1, the building site is classified as 'conditionally acceptable', the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedure of Clauses 3.1 and 3.2, and the aircraft noise attenuation to be expected from the proposed construction should be determined in accordance with Clause 3.3 (See Notes 1 and 3 of Table 2.1)."

Unacceptable

"If, from Table 2.1 the building site is classified as 'unacceptable', construction of the proposed building should not normally be considered. Where in the community interest redevelopment is to occur in such areas, e.g. a hotel in the immediate vicinity of an aerodrome, refer to the notes to Table 2.1."

The site is located between the ANEF 20 and 25 contours which renders the proposed residential components of the development as "conditionally acceptable". Other possible uses such as ground floor retail are "acceptable" and therefore further detailed consideration is usually not required.

i L_{Smax} noise levels

If a building site is within a 'conditionally acceptable' ANEF zone, it is necessary to quantify the typical representative L_{Smax} noise level from aircraft passing over that site. The representativeness of noise data should reflect typical events at the aerodrome, which can be ambiguous in some cases, particularly when trying to estimate future operations and associated impacts. Fortunately for Sydney Airport this is relatively straightforward because of its well established flight path movements, runways and aircraft types. For the site, the main influencing events will be aircraft departures on runway 34R (refer Figure 2.3).

ii Internal design goals

Where a site is 'conditionally acceptable', AS 2021 recommends that buildings be designed to achieve internal noise levels no greater than identified maximum values when aircraft pass overhead.

Table 4.2 reproduces recommended internal maximum noise levels for various spaces found in AS 2021 Table 3.3. These are the L_{Smax} or maximum noise level inside habitable spaces, with residential buildings understandably attracting one of the strictest criterion.

For residential buildings, it is only necessary to consider aircraft noise levels of greater than 60 dB(A)L_{Smax} as an external level of 60 dB(A) is reduced to 50 dB(A) inside with a partially open window or door. This is the strictest residential criterion which applies to sleeping areas and dedicated lounges.

Table 4.2 Indoor design sound levels

Building type and activity	Indoor L_{Smax} Design Sound Level, dB(A)
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathroom, toilets, laundries	60
Commercial buildings, offices and shops	
Private offices conference rooms	55
Drafting, open offices	65
Typing, data processing	70
Shops, supermarkets, showrooms	75

AS 2021 defines the 'aircraft noise level' at Section 1.5.2 as:

> *"The arithmetic average of the maximum sound levels occurring during a series of flyovers by a specific aircraft type and load conditions measured in A-weighted decibels (dB(A))using the S time-weighting of a sound level meter."*

In our review we adopt AS 2021's aircraft noise reduction (ANR) definition, which is:

> *"A calculated or measured value. For design purposes, the arithmetic difference between the aircraft noise level at a site and the indoor design level, as described in Clause 3.2.2. For measurement purposes, the difference between the exterior and indoor sound levels as determined in accordance with Appendix C."*

The amount of noise reduction is the difference between the outside L_{Smax} aircraft noise level and the indoor L_{Smax} design level taken from Table 2.2.

The ANR sets building fabric acoustic performance requirements to confirm the viability of developing sites for their intended use. For example, if an ANR of 20 were needed for sleeping areas (ie a typical external L_{Smax} of 70 dB(A)), standard dwelling construction would suffice so long as BCA ventilation requirements were satisfied. If an ANR of 40 were needed, this would require considerable modifications to standard dwelling construction, while ANR 30 would be somewhere in between. This review has assessed the appropriateness of the site for residential land uses.

5 Road traffic noise assessment

5.1 Road traffic volumes

Existing traffic volumes (2017) and projected traffic volumes for 10 years (2027) are provided in Table 5.1.

Botany Road has a current AADT volume of approximately 26,833. Internal noise criteria provided in the infrastructure SEPP are therefore recommended only for the project given they are above 20,000 AADT; however they are non-mandatory as they do not trigger the AADT 40,000 mandatory assessment requirement.

Coward Street road traffic volumes are below the 20,000 trigger for a recommended noise assessment. Notwithstanding, because most of the development is impacted by road traffic noise from Botany Road, a overall approach to assessing road traffic noise has been adopted which considered noise from both Botany Road and Coward Street.

Table 5.1 Modelled traffic volumes and assumptions

Road	Period	2017 traffic volumes[1]		2027 traffic volumes[2]		Speed limit (km/h)
		AADT	%HV	AADT	%HV	
Botany Road	Day	20796	5.1%	25350	5.1%	60
	Night	6037	0.8%	7360	0.8%	60
Coward Street	Day	8143	5.1%	9926	5.1%	50
	Night	2364	0.8%	2882	0.8%	50

Notes *1. Traffic volumes for Botany Road are based on RMS published AADT volumes. Traffic volumes for Coward Street are based on intersection traffic counts conducted by EMM as described in the traffic impact assessment for the project.*

2. Projected traffic volumes are based on a 2% annual increase.

3. The day versus night road traffic volume split has been determined using road traffic noise logger data. The resulting split from this analysis was 78% of AADT to occur during the day and 22% to occur during the night.

5.2 Noise modelling method

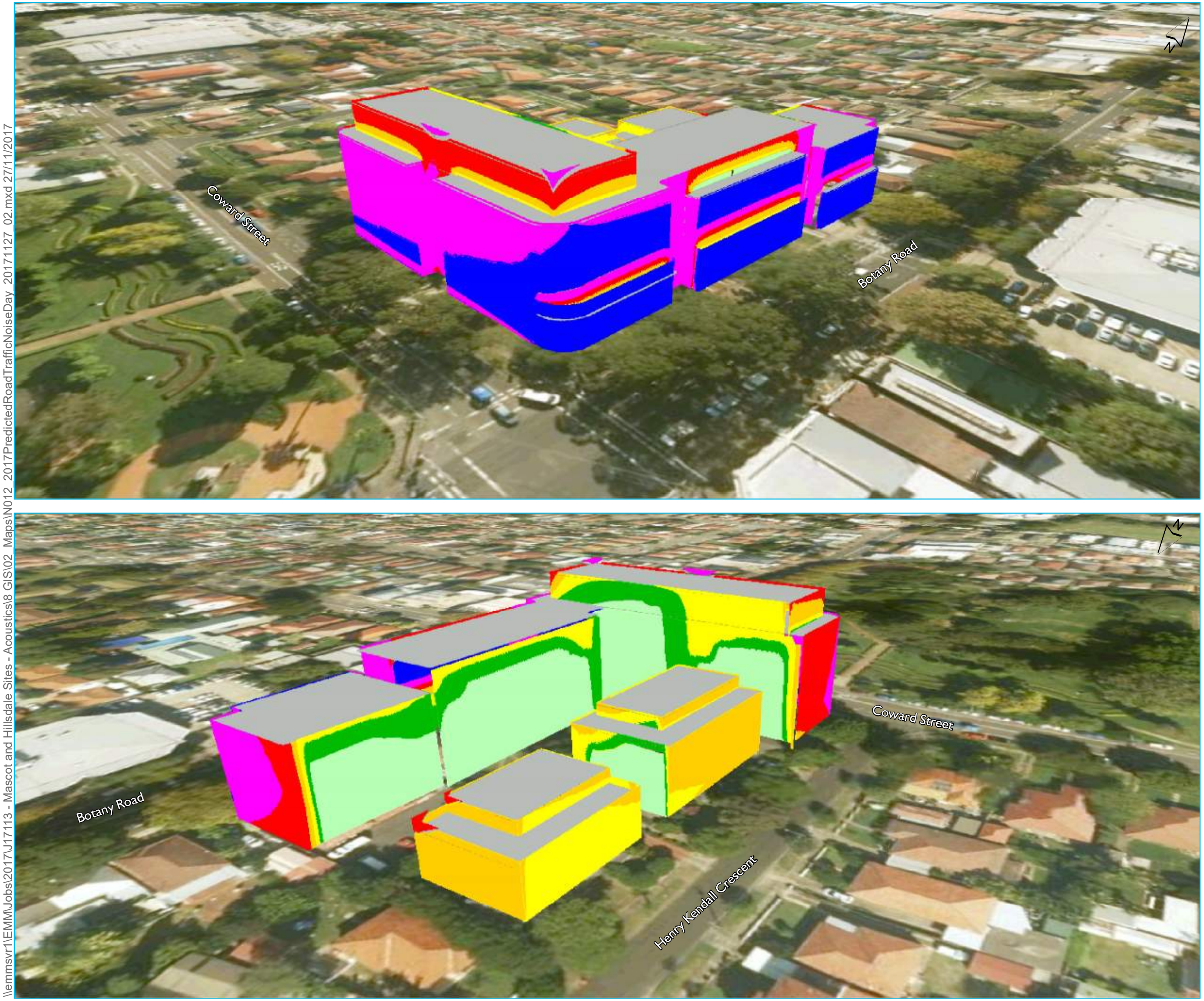
Road traffic noise has been calculated using the *Calculation of Road Traffic Noise* (CORTN) algorithm, developed by the UK Department of Transport. In summary, this method incorporates consideration of traffic flow volume, average speed, percentage of heavy vehicles, and road gradient to establish noise source strength, and includes attenuation via spherical spreading (or cylindrical in the case of a line source such as a road), soft ground, atmospheric absorption and screening from buildings or barriers.

Brüel and Kjær Predictor noise modelling software (version 11.0) was used to develop a noise prediction model based on the above method. Road traffic noise levels were predicted at the building facades for 2017 and 2027 scenarios using the road traffic volumes and vehicle speeds in Table 5.1. Noise levels were predicted for day (7am to 10pm) and night (10pm to 7am) periods.

The road traffic noise model was calibrated to the road traffic noise levels measured at L1 and L2 (refer Figure 2.1 and Table 3.1) and therefore provides a calibrated representation of existing and, by extension, future road traffic noise levels across the development.

5.3 Noise modelling results

Predicted road traffic noise levels are provided for 2017 and 2027 day and night scenarios in Figure 5.1 to 5.4. The contours for the day and night represent the $L_{eq(15\text{-hour})}$ and $L_{eq(9\text{-hour})}$ descriptors, respectively. They are representative of noise levels at the facade and include a +2.5 dB facade correction to account for a diffuse sound field.



KEY

Noise levels (dB(A))

- < 45
- 45-50
- 50-55
- 55-60
- 60-65
- 65-70
- 70-75

Source: EMM (2017)

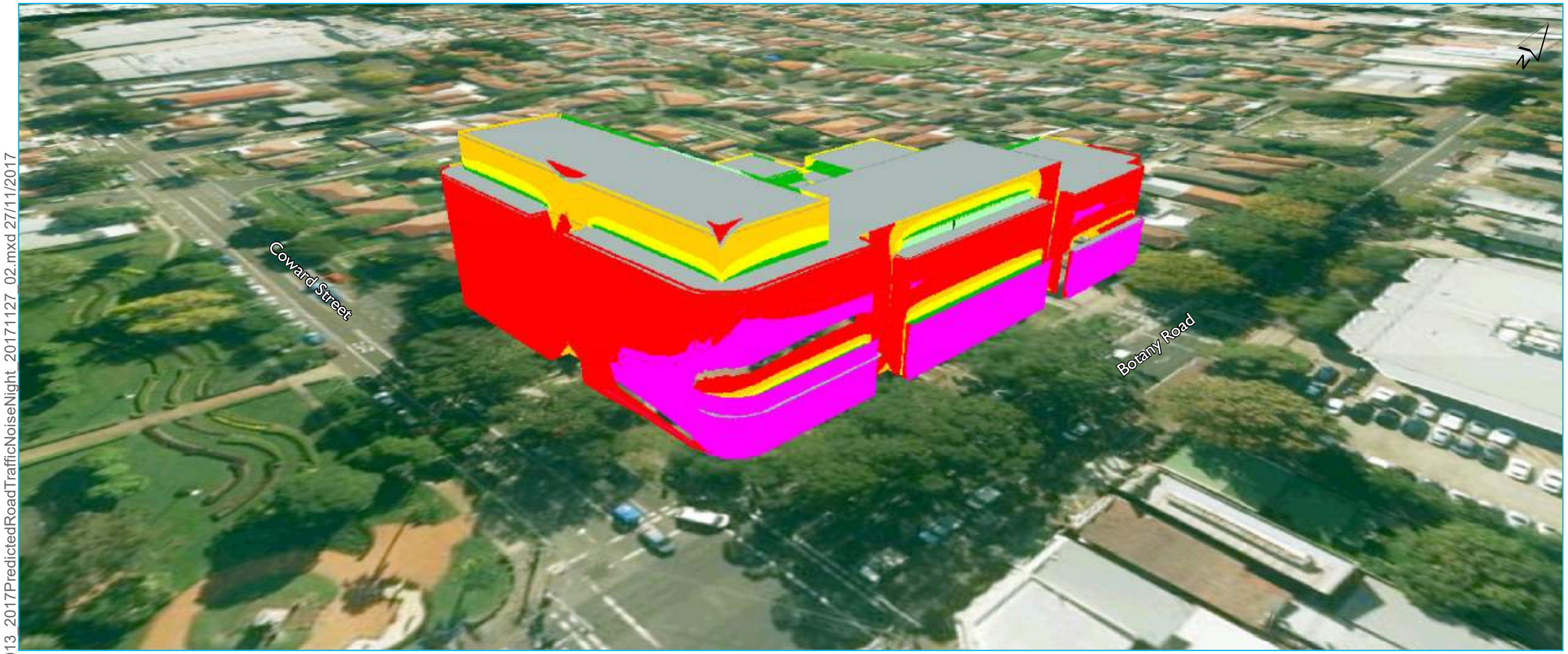
GDA 1994 MGA Zone 56

2017 predicted road traffic noise levels, day, LAeq,15hour

Mascot and Hillsdale sites

Figure 5.1

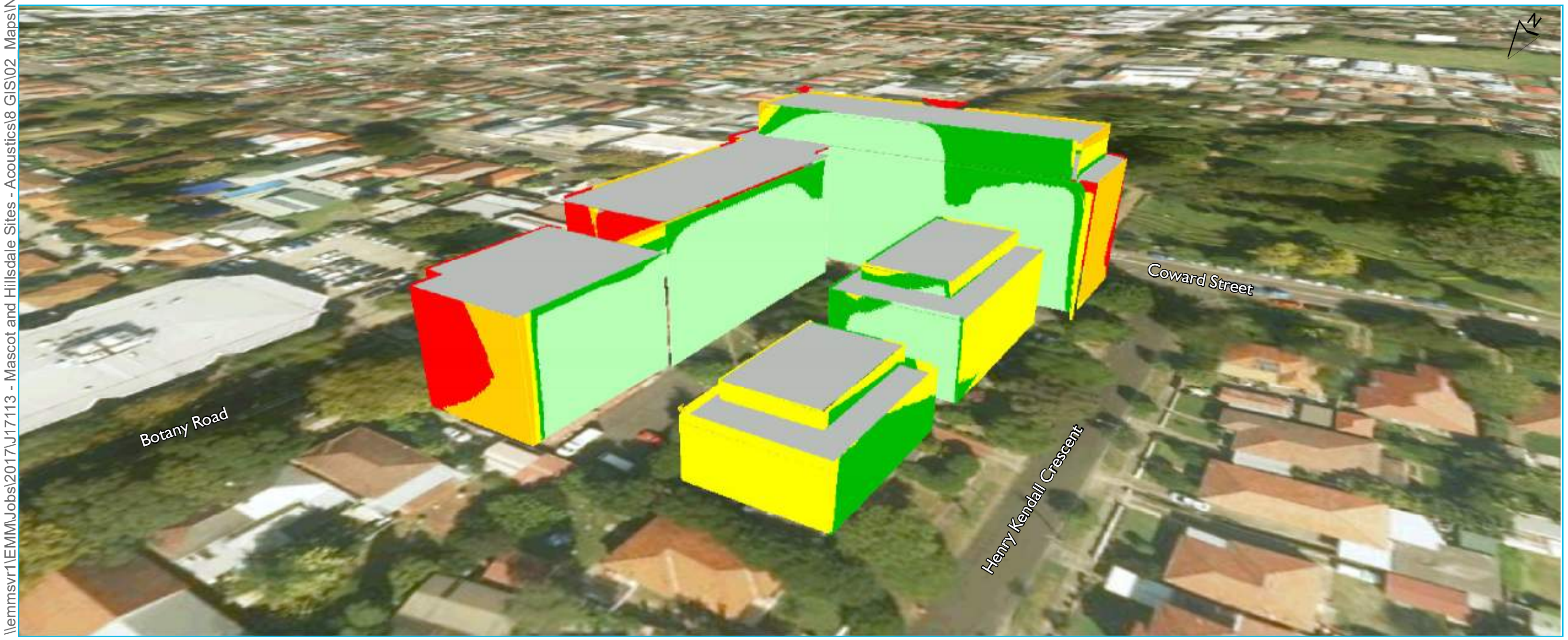
EMM



KEY

Noise levels (dB(A))

- < 45
- 45-50
- 50-55
- 55-60
- 60-65
- 65-70
- 70-75



Source: EMM (2017)

GDA 1994 MGA Zone 56

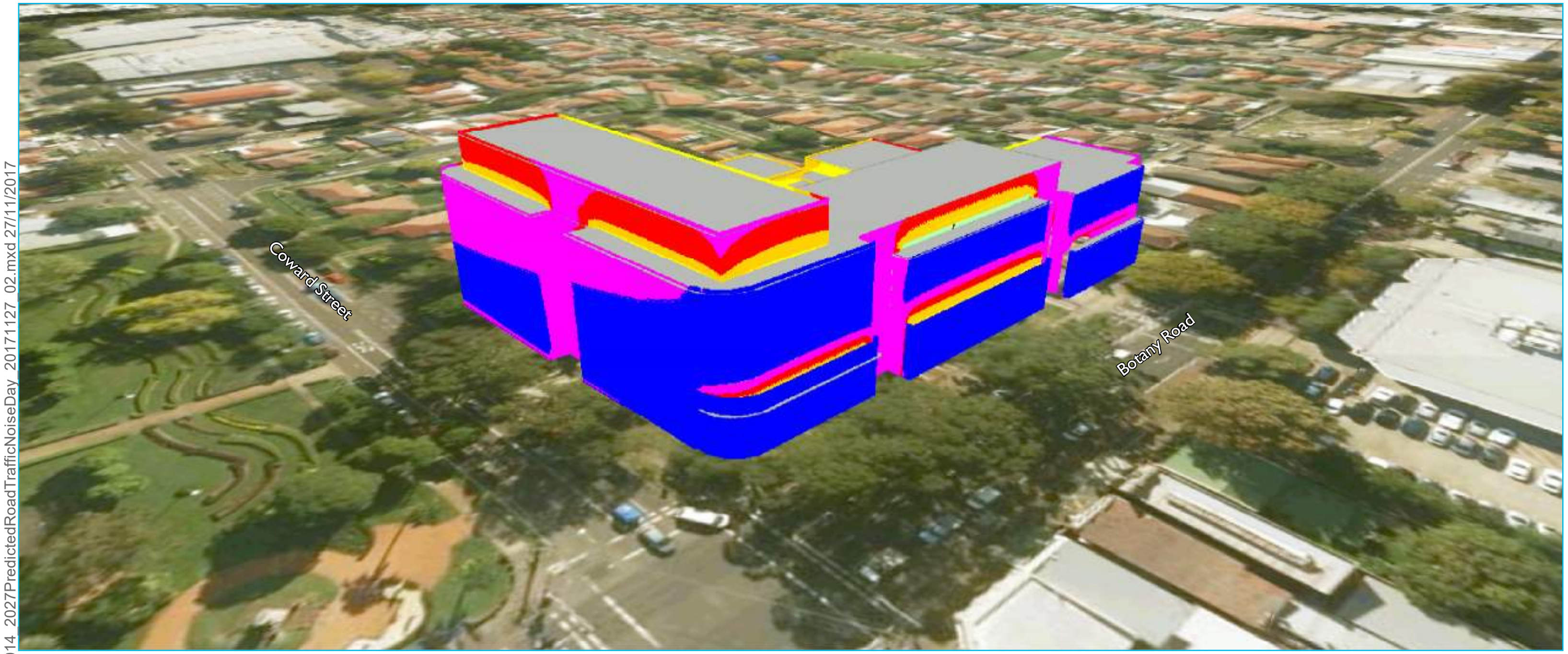
2017 predicted road traffic noise levels, night, LAeq,9hour

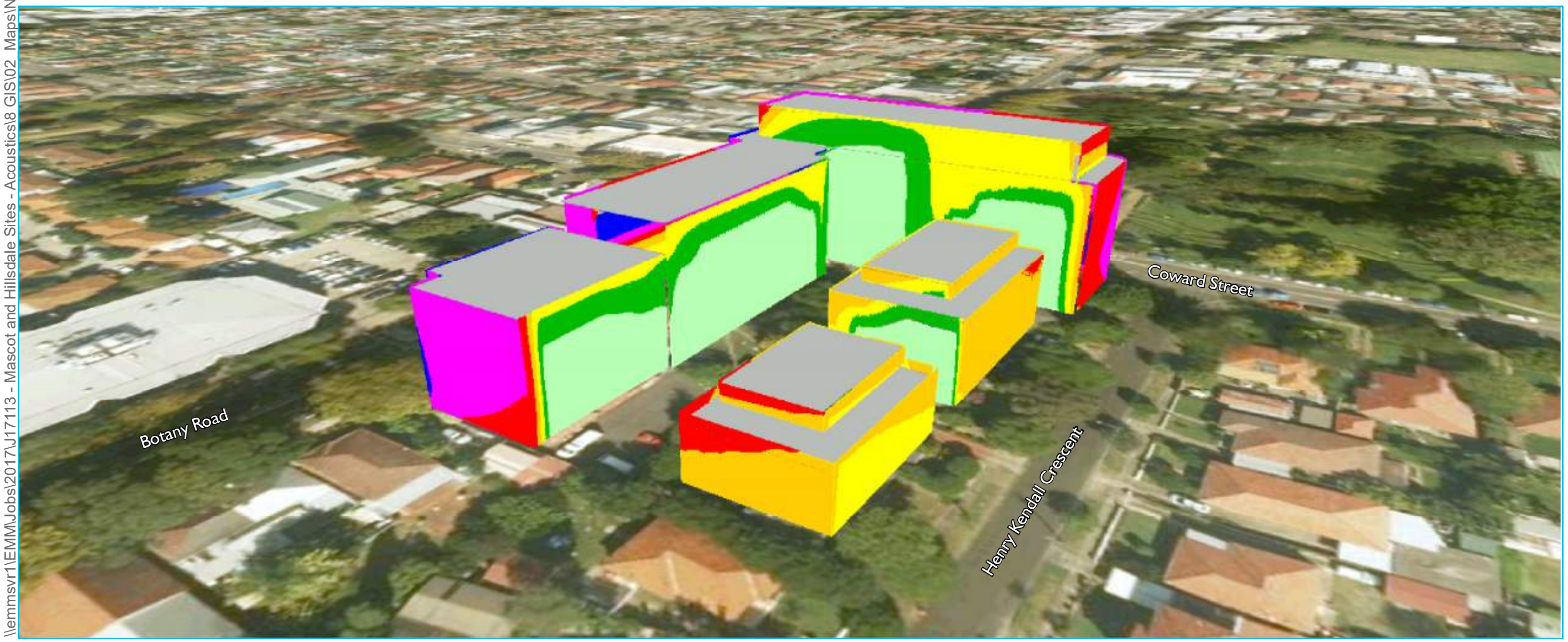
Mascot and Hillsdale sites

Figure 5.2

EMM

\emmsvr1\EMMJobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02_Maps\N013_2017PredictedRoadTrafficNoiseNight_20171127_02.mxd 27/11/2017





Source: *EMM (2017)*

GDA 1994 MGA Zone 56

KEY

Noise levels (dB(A))

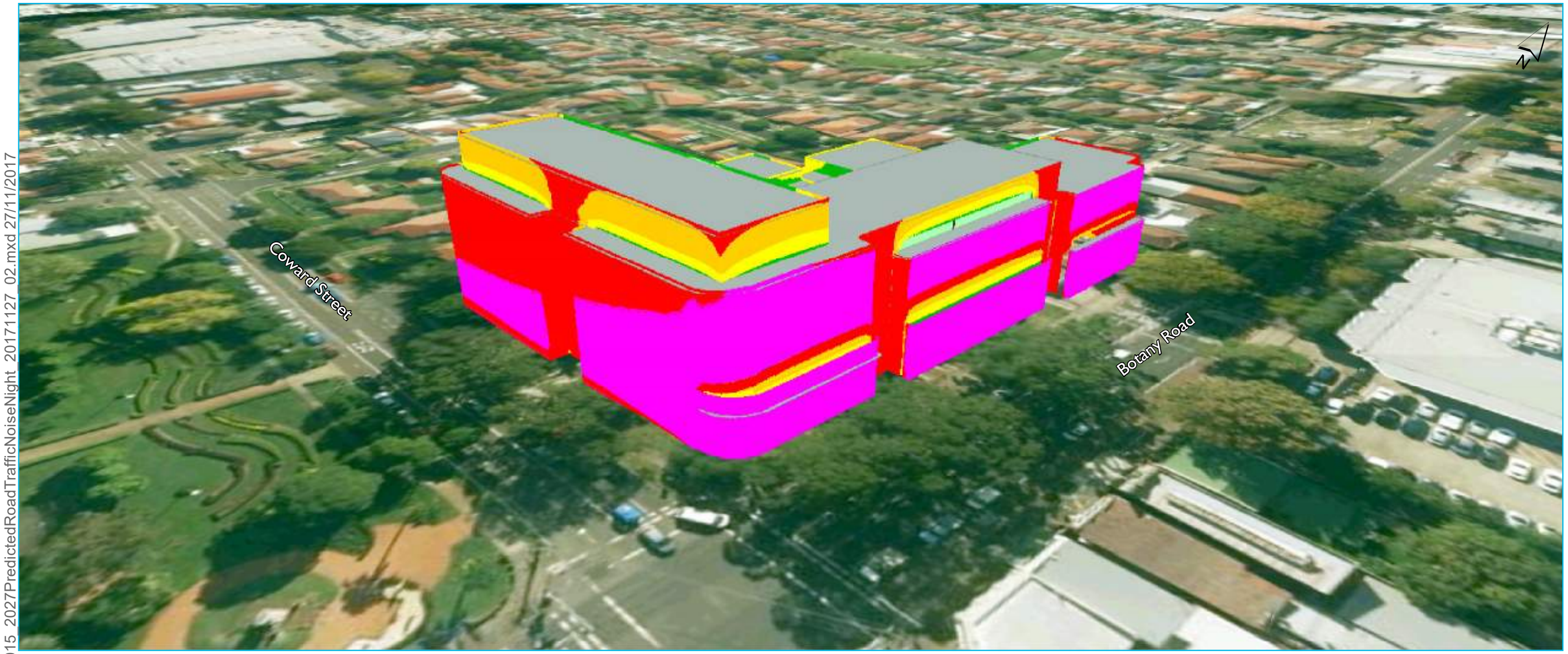
- < 45
- 45-50
- 50-55
- 55-60
- 60-65
- 65-70
- 70-75

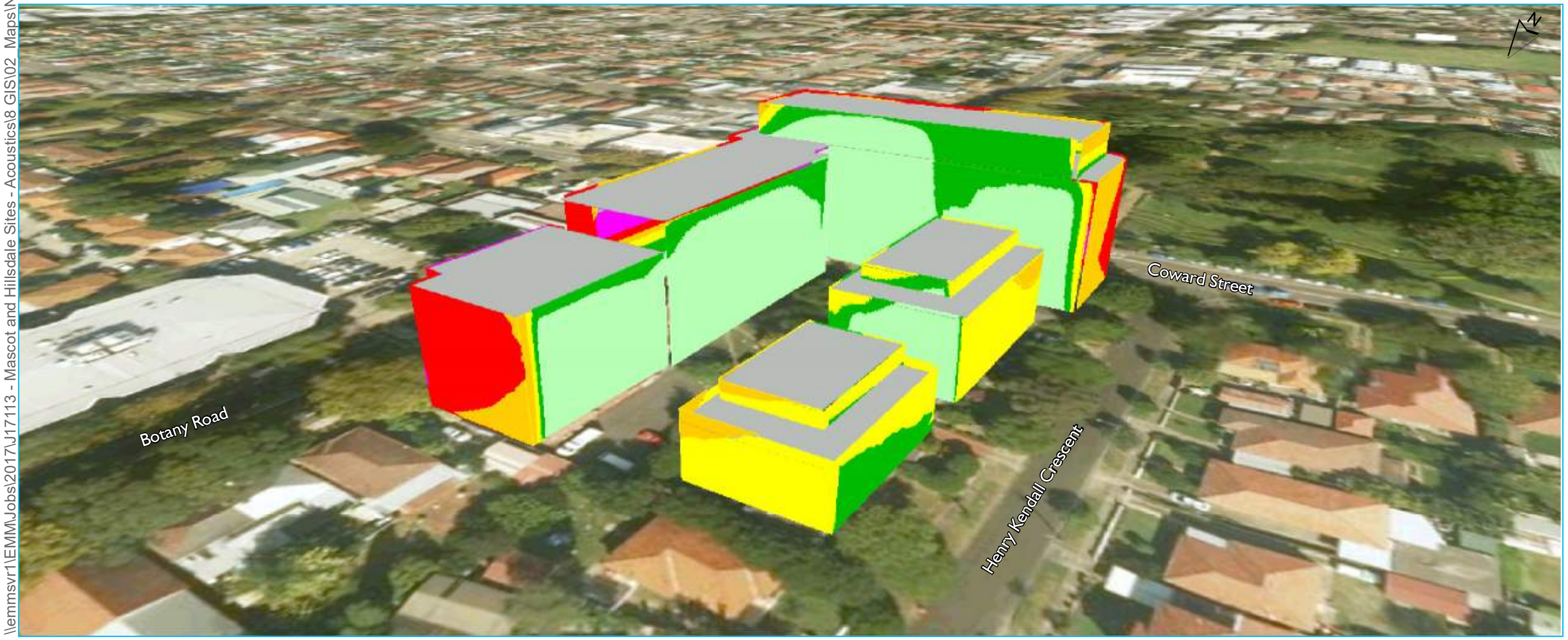
2027 predicted road traffic noise levels, day, LAeq,15hour

Mascot and Hillsdale sites

Figure 5.3

\emmsvr1\EMMJobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02 Maps\N014 2027PredictedRoadTrafficNoiseDay 20171127 02.mxd 27/11/2017





Source: EMM (2017)

GDA 1994 MGA Zone 56

KEY

Noise levels (dB(A))

- < 45
- 45-50
- 50-55
- 55-60
- 60-65
- 65-70
- 70-75

2027 predicted road traffic noise levels, night, LAeq,9hour

Mascot and Hillsdale sites

Figure 5.4

EMM

\\emmsvr1\EMM\Jobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02_Maps\N015_2027PredictedRoadTrafficNoiseNight_20171127_02.mxd 27/11/2017

6 Aircraft noise assessment

6.1 Representative aircraft noise levels

The site is located between ANEF 20 and 25 contours based on Sydney Kingsford Smith Masterplan 2033 and therefore an assessment of maximum aircraft noise levels has been completed.

Aircraft noise levels over the site have been calculated using procedures in AS 2021-2015 *"Acoustics - Aircraft noise intrusion - Building siting and construction*." AS 2021-2015 provides extensive tabulated data for numerous aircraft types showing average maximum noise levels for departures and arrivals based on a matrix of runway and flight line offset distances to a site (DS, DL and DT – refer glossary in Section for definitions).

The site is most affected by departure aircraft using runway 34R (Figure 2.3). Aircraft types that depart from runway 34R are listed in the *Sydney Airport Master Plan 2013, 2033 ANEF for Sydney Airport* contours provide in Appendix B.

Calculated aircraft noise levels based on AS2021-2015 and applicable aircraft types are:

- Airbus A330 (typically 6am to 11pm) departures at 88 dBA L_{Smax}
- Airbus A340 (typically 6am to 11pm) departures at 86 dBA L_{Smax}
- Boeing 777 (typically 6am to 11pm) departures at 85 dBA L_{Smax}

As shown above, the upper end of the range of noise levels across the site can be expected from Airbus A330 aircraft at 88 dB(A), LSmax. Appendix B indicates that this aircraft is the most frequent for this flight path. It therefore provides a fair representation of the maximum aircraft noise level exposure across the site. Airbus 340 and Boeing 777 are very infrequent and in any case generate lesser aircraft noise levels in comparison to Airbus 330.

6.2 Aircraft noise reduction

The method for calculating the aircraft noise reduction (ANR) value for new building elements provided in AS2021-2015 has been adopted for the project, together with spectral data contained in our database on typical aircraft. The overall ANR of a building is the external aircraft noise level less the AS 2021 internal noise goal. Based on an external aircraft noise level of 88 dBA, this results in an ANR of:

- 38 for bedrooms and dedicated lounges;
- 33 for other habitable spaces; and
- 28 for toilets, bathrooms and laundries.

The aircraft noise attenuation required of each component is determined from the equation:

$ANA_c = ANR + 10 \log10 [(S_c/S_f) ´ (3/h) ´ 8TN] - K_c$

where:

Sc/Sf is the surface area ratio of the component (c) element to that of the floor (f)

h is the room height

T is the room's reverberation time

N is the number of components present in the external envelope of the room or space

Kc is the orientation effect (as defined in AS 2021)

7 Recommendations

7.1 General

This section provides a general overview of building constructions and ventilation options to control road and aircraft noise intrusion. Specific recommendations relevant to the scheme and typical floor plans are provided in Section 7.2 and 7.3.

7.1.1 Building envelope

Table 7.1 lists acoustic performance ratings (weighted sound reduction index, Rw) for external building elements for five categories which are provided in the guideline (DoP 2008). In terms of buildability and cost, category 1 constructions are the least onerous and category 5 constructions are most onerous. Example constructions for each building element for each of the five categories are provided in the following sections. The three main elements (windows, facade and roof) are provided only as these constitute the most relevant for the proposal (eg medium to high density apartment type buildings). Note that doors in apartments would typically lead to balconies and are therefore categorised with 'windows/sliding doors'.

Table 7.1 Acoustic performance of building elements

Category of Noise control treatment	Rw of building elements (minimum assumed)				
	Windows/Sliding Doors	Facade	Roof	External Door	Floor
1	24	38	40	28	29
2	27	45	43	30	29
3	32	52	48	33	50
4	35	55	52	33	50
5	43	55	55	40	50

Notes: 1. Floor Rw only apply to ground floor.

Source: "Development near rail corridors and busy roads - Interim guideline", NSW Department of Planning, December 2008.

i Windows/Sliding doors

Table 7.2 provides construction examples for windows and sliding doors to achieve desired minimum Rw values as shown. It should be noted that these are minimum values and that other construction options may exist that achieve the same or higher ratings.

Table 7.2 Typical sound reductions provided by external building elements - windows/ doors

Category	Min Rw	Construction
1	24	Openable with minimum 4mm monolithic glass and standard weather seals
2	27	Openable with minimum 6mm monolithic glass and full perimeter acoustic seals
3	32	Openable with minimum 6.38mm laminated glass and full perimeter acoustic seals
4	35	Openable with minimum 10.38mm laminated glass and full perimeter acoustic seals
5	43	Openable Double Glazing with separate panes: 5mm monolithic glass, 100mm air gap, 5mm monolithic glass with full perimeter acoustic seals.
	46	Openable Double Glazing with separate panes: 6mm monolithic glass, 100mm air gap, 4mm monolithic glass with full perimeter acoustic seals.
	47	Openable Double Glazing with separate panes: 6mm monolithic glass, 150mm air gap, 4mm monolithic glass with full perimeter acoustic seals.

Source: 1. "Development near rail corridors and busy roads - Interim guideline", NSW Department of Planning, December 2008, and EMM database.

ii Facade

Table 7.3 provides construction examples for facades to achieve desired minimum Rw values as shown. It should be noted that these are minimum values and that other construction options may exist that achieve the same or higher ratings. For example, brick veneer is found in many of the categories listed.

Table 7.3 Typical sound reductions provided by external building elements - facade

Category	Min Rw	Construction
1	38	**Timber Frame or Cladding:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally.
		Brick Veneer: 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.
		Double Brick Cavity: 2 leaves of 110mm brickwork separated by 50mm gap.
2	45	**Timber Frame or Cladding:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally with R2 insulation in wall cavity.
		Brick Veneer: 110mm brick, 90mm timber stud frame or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.
		Double Brick Cavity: 2 leaves of 110mm brickwork separated by 50mm gap.
3	52	**Brick Veneer:** 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.
		Double Brick Cavity: 2 leaves of 110mm brickwork separated by 50mm gap.

Table 7.3 Typical sound reductions provided by external building elements - facade

Category	Min Rw	Construction
4	55	**Brick Veneer:** 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, R2 insulation batts in wall cavity, 10mm standard plasterboard internally.
		Double Brick Cavity: 2 leaves of 110mm brickwork separated by 50mm gap with cement render to the external face of the wall and cement render or 13mm plasterboard direct fixed to internal faces of the wall.
5	55	**Double Brick Cavity:** 2 leaves of 110mm brickwork separated by 50mm gap with cement render to the external face of the wall and cement render or 13mm plasterboard direct fixed to internal faces of the wall.

Source: 1. "Development near rail corridors and busy roads - Interim guideline", NSW Department of Planning, December 2008.

iii Roof/ceiling

Table 7.4 provides construction examples for roof/ceilings to achieve desired minimum Rw values as shown. It should be noted that these are minimum values and that other construction options may exist that achieve the same or higher ratings.

Table 7.4 Typical sound reductions provided by external building elements – roof/ceiling

Category	Min Rw	Construction
1	40	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R1.5 insulation batts in roof cavity.
2	43	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R2 insulation batts in roof cavity.
		Low slope metal roof, timber or steel purlins, furring channels, 2 x 16mm Gyprock Fyrchek plasterboard, R2.5 insulation batts in roof cavity.
3	48	Pitched concrete or terracotta tile or sheet metal roof with sarking, 1 layer of 13mm sound-rated plasterboard fixed to ceiling joists, R2 insulation batts in roof cavity.
4	52	Pitched concrete or terracotta tile or sheet metal roof with sarking, 2 layers of 10mm sound-rated plasterboard fixed to ceiling joists, R2 insulation batts in roof cavity.
5	55	Pitched concrete or terracotta tile or sheet metal roof with sarking, 2 layers of 10mm sound-rated plasterboard fixed to ceiling joist using resilient mounts, R2 insulation batts in roof cavity

Source: 1. "Development near rail corridors and busy roads - Interim guideline", NSW Department of Planning, December 2008 OR 'The red Book' CSR 2004.

iv Podiums, balconies and courtyards

Balconies that are fully enclosed with operable glazing or louvres (eg winter gardens) provide an increased level of acoustic performance compared to conventional open balconies. These can be particularly affective with aircraft noise where the large cavity produced more affectively attenuates low frequency noise. For example, if winter gardens were situated off bedrooms, this would reduce the glazing requirement from category 5 (ie large cavity double glazing) to category 1 to 2 (4 to 6 mm single glazing).

7.1.2 Ventilation

i Natural ventilation

Opening windows and doors is the most conventional method of providing natural ventilation. It is commonly accepted that a partially standard sliding open window or door will still provide 10 dB of external to internal sound reduction.

The United Kingdom Department of Food and Rural Affairs (DEFRA) commissioned extensive research into the sound attenuation provided by different window types and opening orientations. In summary, this study found that increased sound insulation can be achieved with window opening and orientation adjustments. Figure 7.1 shows the different windows types that were evaluated. The results show that the comparative level difference ($D_{,A,road}$) for road traffic noise is increased by 3 dB with solutions A-1, A-2, C-2 and E and 4 dB with solution F when compared to a standard sliding window solution such as D-2. In principle, it is therefore reasonable to infer that an external to internal sound reduction of 13 to 14 dB is feasible for a window where the opening is restricted and orientated partially away from the point of direct incidence of the noise source.

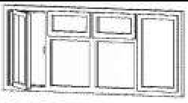
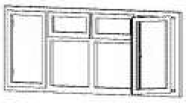
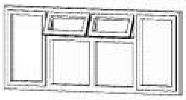
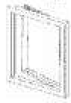
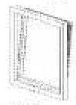
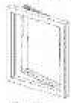
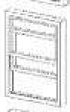
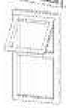
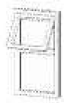
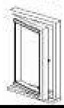
Window ID	Measurement D_w $(C ; C_{tr})$.	Opening Illustration	Comparative Level Difference (dBA) $D_{A,road}$	$D_{A,rail}$	$D_{A,air}$	$D_{A,music}$
A-1	18(-1; -2)		17	17	18	16
A-2	18(-1; -2)		17	17	18	16
A-3	16(-1; -2)		14	14	16	16
B	14(-1; -2)		12	12	14	15
C-1	17(-1; -1)		16	16	17	19
C-2	18(0; -1)		17	17	19	20
C-3	17(0; -1)		16	16	18	19
C-4	17(-1; -2)		15	15	17	18
D-1	18(-1; -2)		16	16	18	18
D-2	16(-1; -2)		14	14	16	17
D-3	20(-3; -4)		16	16	18	18
E	17(0; 0)		17	17	18	18
F	18(0; -1)		18	18	18	18
G	15(0; 0)		15	15	15	17

Figure 7.1 Comparison of sound reduction provided by different window openings

Winter gardens with offset window openings and internal soffit acoustic absorption can in principle provide an external to internal sound reduction of up to 20 dB. Again this could be increased in principle to 23 to 24 dBA with careful selection of window type.

ii Alternate means of ventilation

In some instances, external noise levels will simply be too high to allow a natural ventilation strategy using conventional methods described above. Where this is the case, alternate means of ventilation conforming to National Construction Code and relevant Australian Standards will be required to allow occupants to leave windows and doors closed, when so desired.

The most common form of alternate ventilation in instances where high sound reduction value is needed is a full mechanical system with fresh air reticulation (eg ducted air conditioning).

If natural ventilation is desired, incorporating acoustically attenuated air paths using internally lined transfers ducts would have to be considered in the base building design.

7.2 Road traffic noise

7.2.1 External building treatments – windows closed

The required performance of individual building elements has been calculated using typical floor plans for the project. The calculations conservatively assume 100% glazed facade area.

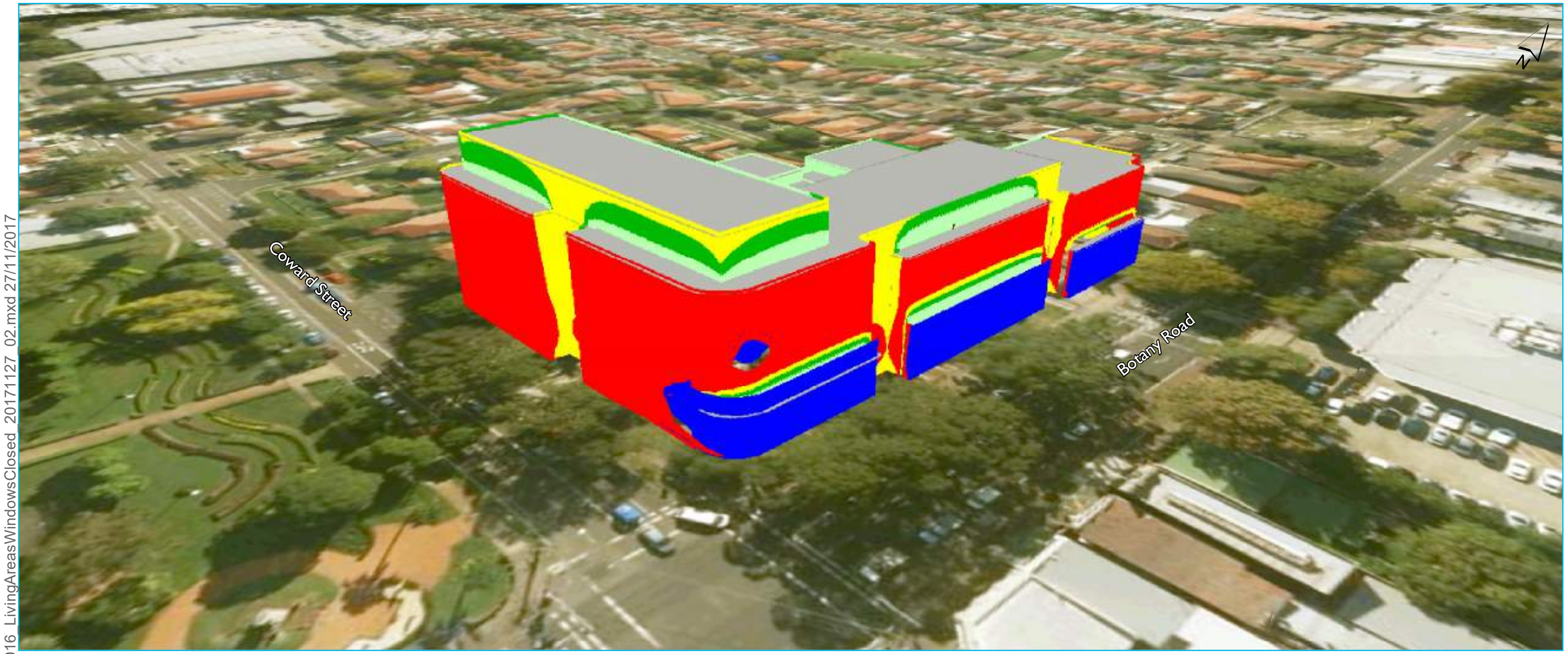
Facade maps have been provided in Figure 7.2 and Figure 7.3 for living areas and bedrooms respectively to demonstrate the level of construction needed to satisfy internal noise level criteria. In principle, if these recommendations are followed as a minimum, both SEPP Infrastructure 2007 and Botany Council DCP requirements for internal L_{Aeq} noise levels would be satisfied.

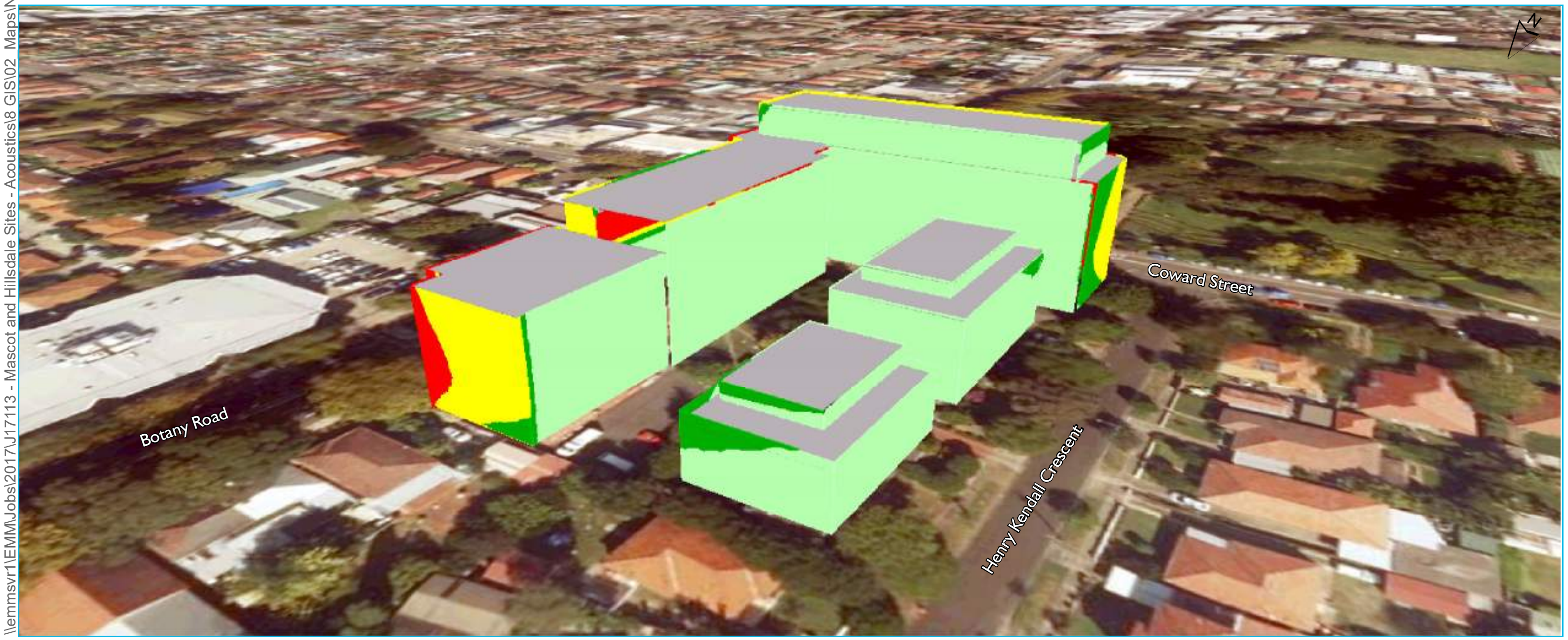
The contours are based on the following typical reductions provided by commercially available glazing solutions in Table 7.5.

Table 7.5 In-principle design requirements to satisfy internal noise levels

Construction category	Indicative construction	Nominal outdoor to indoor road traffic noise reduction
1	Openable with minimum 4mm monolithic glass and standard weather seals	20 dBA
2	Openable with minimum 6mm monolithic glass and full perimeter acoustic seals	24 dBA
3	Openable with minimum 6.38mm laminated glass and full perimeter acoustic seals	28 dBA
4	Openable with minimum 10.38mm laminated glass and full perimeter acoustic seals	32 dBA
5	Openable Double Glazing with separate panes: 5mm monolithic glass, 100mm air gap, 5mm monolithic glass with full perimeter acoustic seals	37 dBA

It is important to note that a combination of building materials and treatments could be used to achieve internal noise criteria. The calculations herein are indicative only and are provided to demonstrate that internal noise level limits can be achieved with feasible engineering solutions. A review of external building construction and its ability to satisfy internal noise limits would have to be conducted at the development application stage once the project is developed in more detail.





KEY
- Category 1 construction
- Category 2 construction
- Category 3 construction
- Category 4 construction
- Category 5 construction

Building treatments, living areas, windows closed

Mascot and Hillsdale sites

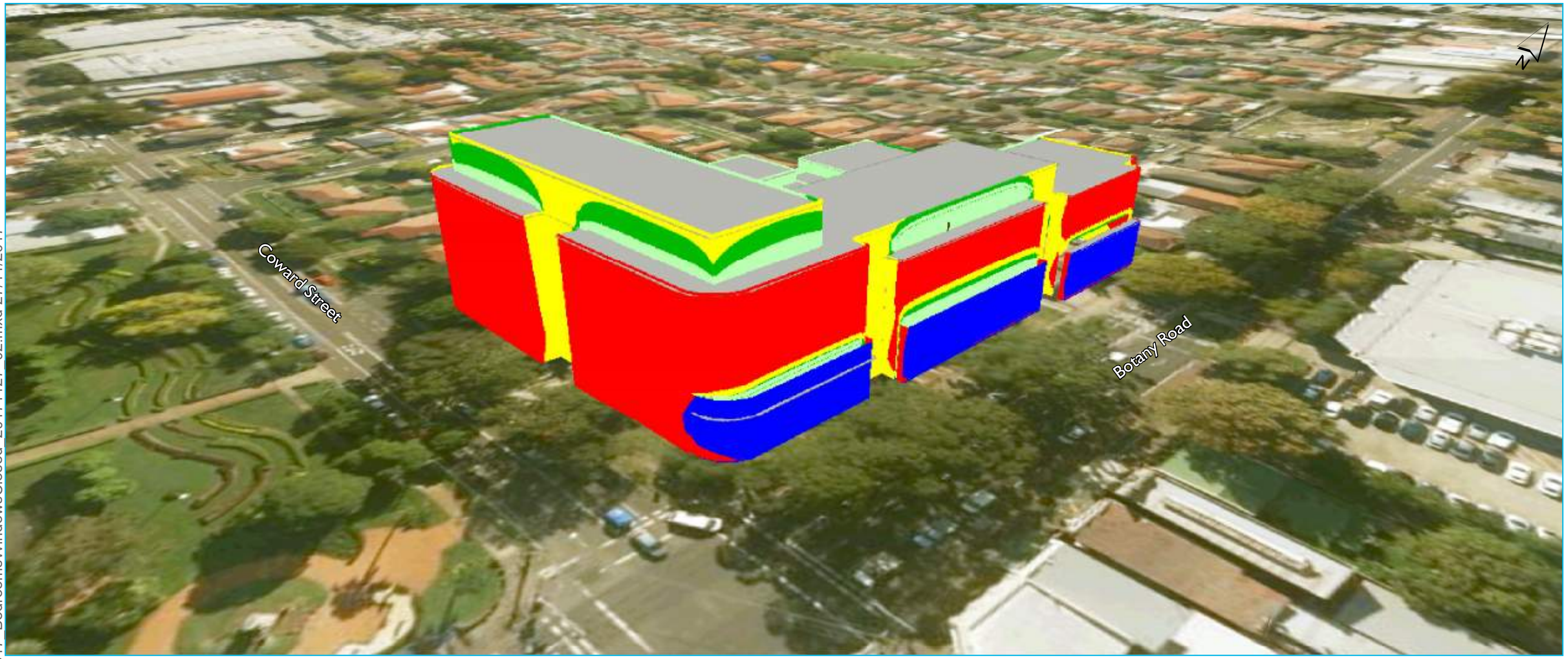
Figure 7.2

EMM

Source: EMM (2017)

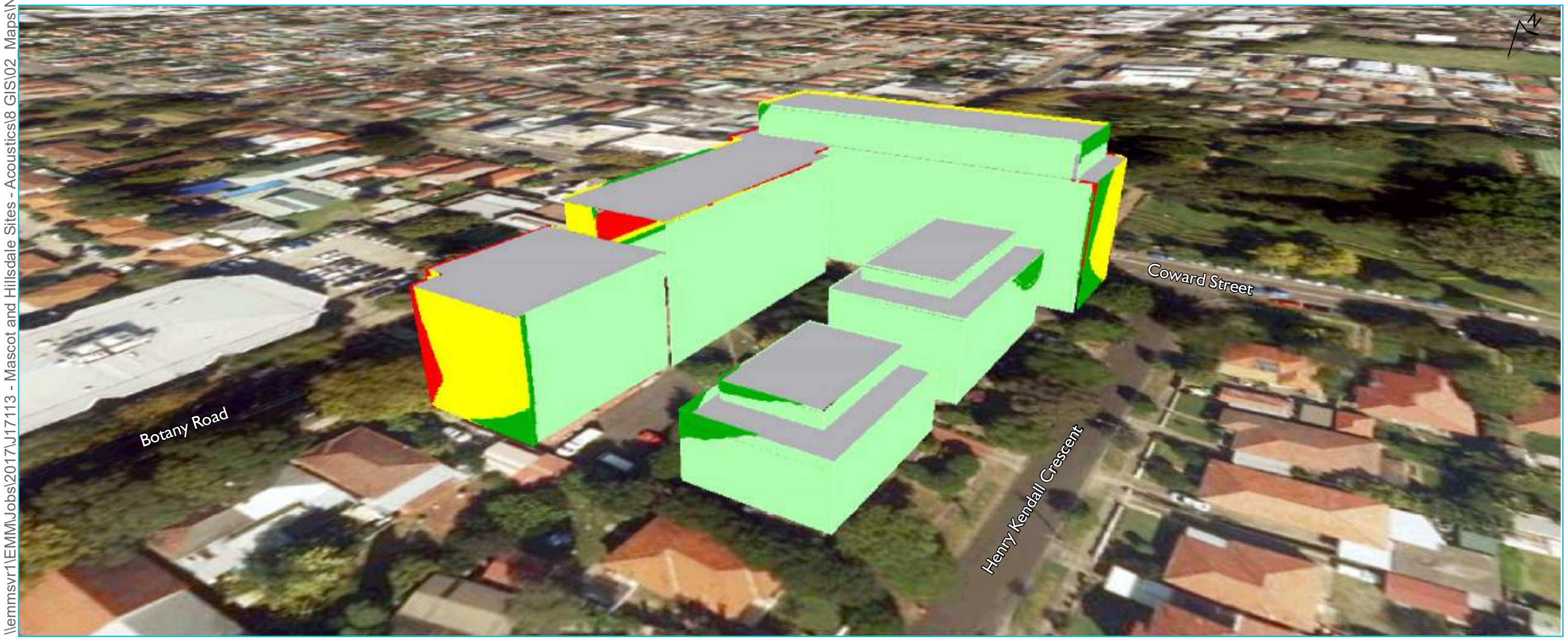
GDA 1994 MGA Zone 56

\\emmsvr1\EMMJobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02_Maps\N016_LivingAreasWindowsClosed_20171127_02.mxd 27/11/2017



KEY

- Category 1 construction
- Category 2 construction
- Category 3 construction
- Category 4 construction
- Category 5 construction



Building treatments, bedrooms, windows closed

Mascot and Hillsdale sites

Figure 7.3

Source: EMM (2017)

GDA 1994 MGA Zone 56

\\emmsvr1\EMMJobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02 Maps\N017 BedroomsWindowsClosed 20171127 02.mxd 27/11/2017

7.2.2 Ventilation – windows open

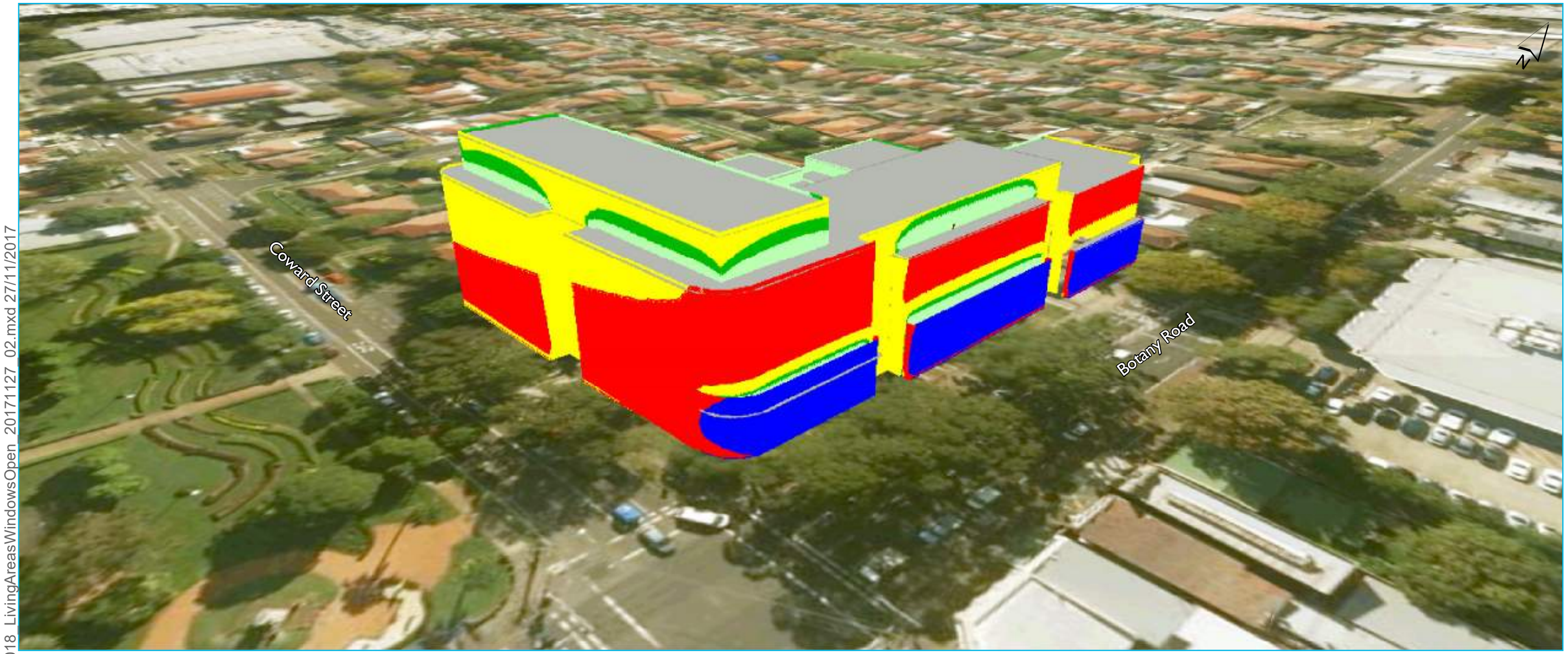
SEPP Infrastructure 2007 and Botany Council DCP both allow relaxed internal noise criteria where natural ventilation using open windows or doors are used. Several natural ventilation options have been evaluated based on the nominal outdoor to indoor road traffic noise reductions shown in Table 7.6. These are commonly accepted in-principle noise reductions achieved by open windows or doors solutions.

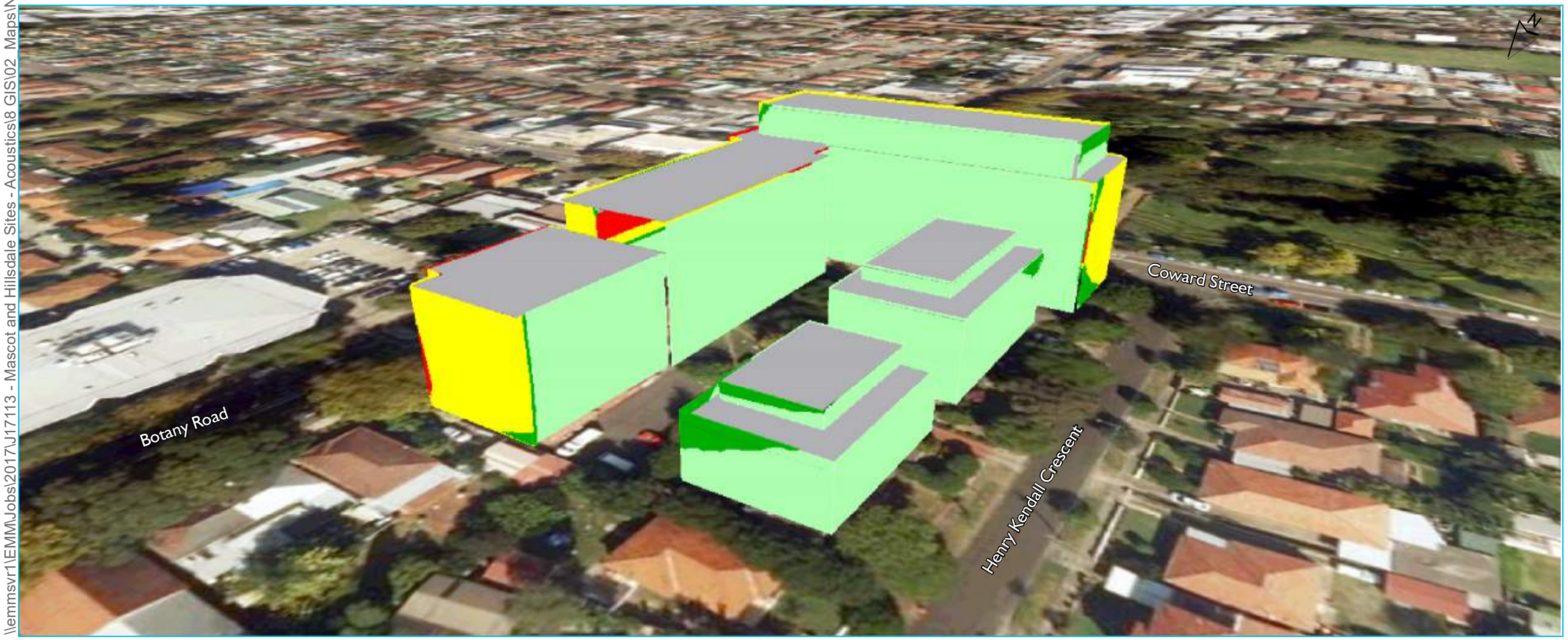
Facade maps have been provided in Figure 7.4 and Figure 7.5 for living areas and bedrooms respectively to demonstrate which natural ventilation strategies would satisfy internal noise level criteria. These calculations are based on room and building element geometry from a typical floor plan of the scheme. In principle, if these recommendations are followed as a minimum, both SEPP Infrastructure 2007 and Botany Council DCP requirements for internal L_{Aeq} noise levels would be satisfied.

Where internal noise limits are exceeded by more than 10 dB after considering all possible open window/door scenarios, alternate means of ventilation conforming to National Construction Code and relevant Australian Standards will be required. The most common form of alternate ventilation in instances where high sound reduction value is needed is a full mechanical system with fresh air reticulation (eg ducted air conditioning). If natural ventilation is desired, incorporating acoustically attenuated air paths using internally lined transfers ducts would have to be considered in the base building design.

Table 7.6 In-principle noise reductions provided by typical natural ventilation strategies

Natural ventilation solution	Nominal outdoor to indoor road traffic noise reduction
Standard open window	10 dBA
Open window with shielded open area orientation	13 dBA
Winter garden with offset standard open windows and soffit acoustic treatment	20 dBA
Winter garden, offset window openings and shielded open area orientation, soffit acoustic treatment	23 dBA





KEY

- Standard open window
- Open window with sheilded open area orientation
- Winter garden with offset standard open windows and soffit acoustic treatment
- Winter garden, offet window openings and shielded open area orientation, soffit acoustic treatment
- Alternate means of ventilation highly likely

Source: EMM (2017)

GDA 1994 MGA Zone 56

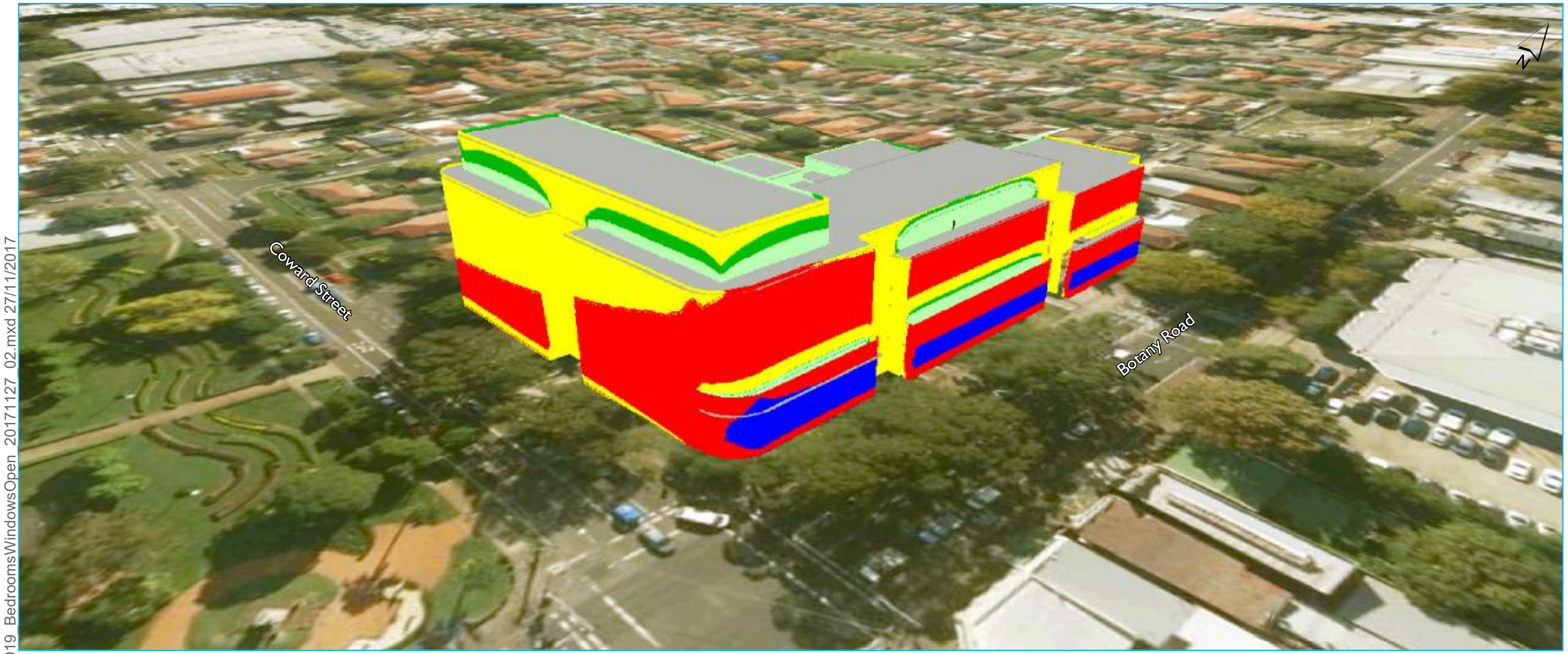
\\emmsvr1\EMM\Jobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02_Maps\N018_LivingAreasWindowsOpen_20171127_02.mxd 27/11/2017

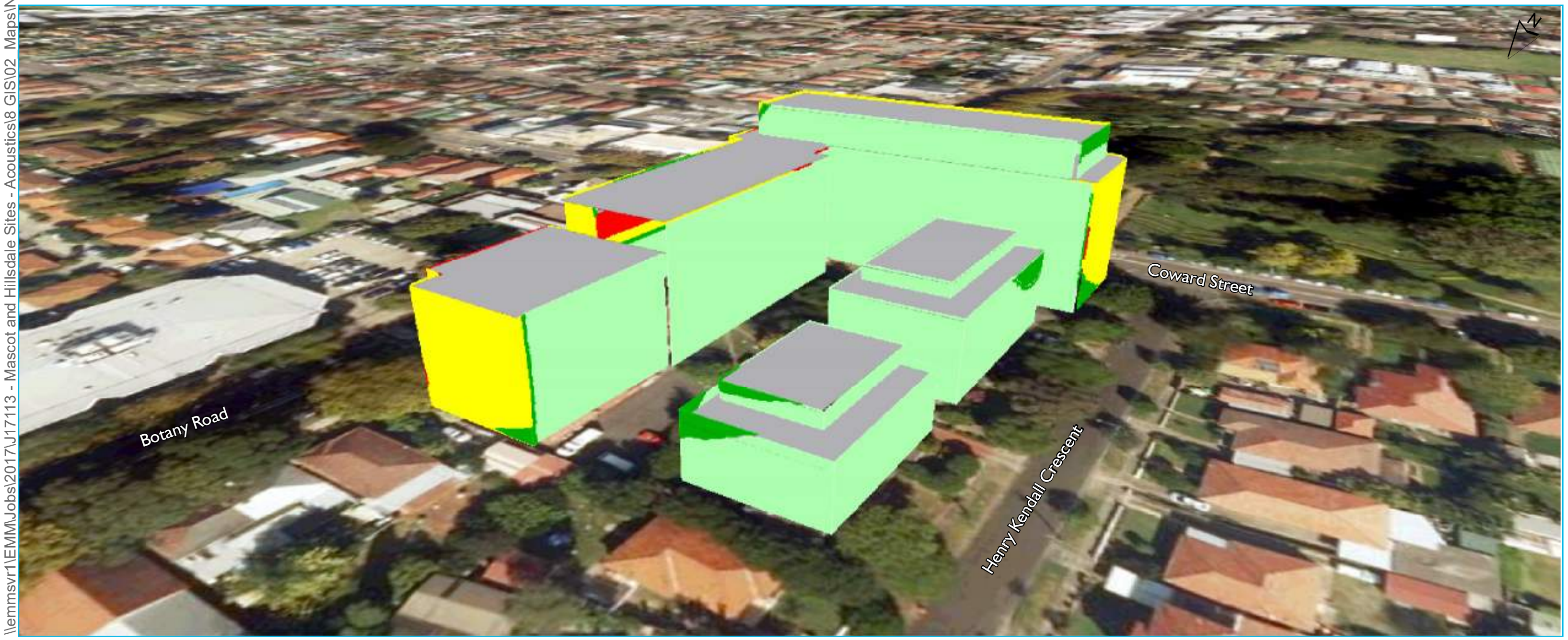
Building treatments, living areas, windows open

Mascot and Hillsdale sites

Figure 7.4

EMM





Source: EMM (2017)

GDA 1994 MGA Zone 56

KEY

- Standard open window
- Open window with sheilded open area orientation
- Winter garden with offset standard open windows and soffit acoustic treatment
- Winter garden, offet window openings and shielded open area orientation, soffit acoustic treatment
- Alternate means of ventilation highly likely

Building treatments, bedrooms, windows open

Mascot and Hillsdale sites

Figure 7.5

EMM

\\emmsvr1\EMMJobs\2017\J17113 - Mascot and Hillsdale Sites - Acoustics\8 GIS\02_Maps\N019_BedroomsWindowsOpen_20171127_02.mxd 27/11/2017

7.3 Aircraft noise

7.3.1 Building treatments

The required performance of individual building elements has been calculated using typical floor plans for the project. A top floor apartment has been selected as this represents a worst case scenario acoustically whereby the roof provides an additional element for aircraft noise to penetrate. The calculations conservatively assume 100% glazed facade area. The resulting performance requirements for external building elements are provide in Table 7.7.

It is important to note that a combination of building materials and treatments could be used to achieve internal noise criteria. The calculations herein are indicative only and are provided to demonstrate that internal noise level limits can be achieved with feasible engineering solutions. A review of external building construction and its ability to satisfy internal aircraft noise limits would have to be conducted at the development application stage once the project is developed in more detail.

Table 7.7 In-principle design requirements to satisfy AS 2021-2015 internal noise levels

Room	External building element	Indicative building category	Minimum performance requirement	Indicative construction
Kitchen/living	Roof/ceiling	Category 5	Rw 55	150 mm formed concrete roof with ceiling layers below OR Sheet metal roof with sarking, 2 layers of 10mm sound-rated plasterboard fixed to ceiling joist using resilient mounts, R2 insulation batts in roof cavity.
	Glazing	Category 4	Rw 37	12.38 mm laminated glazing in well sealed aluminium frame
Bed and dedicated lounges	Roof/ceiling	Category 5	Rw 55	150 mm formed concrete roof with ceiling layers below OR Sheet metal roof with sarking, 2 layers of 10mm sound-rated plasterboard fixed to ceiling joist using resilient mounts, R2 insulation batts in roof cavity.
	Glazing	Category 5	Rw 47	Operable double glazing with separate panes: 6mm monolithic glass, 100mm air gap, 4mm monolithic glass with full perimeter acoustic seals.
Bathrooms and laundries	Roof/ceiling	Category 1	Rw 40	Minimum 100 mm formed concrete roof with ceiling layers below
	Glazing	n/a	n/a	n/a – there areas are typically not positioned at building facades.

Lower categories can be adopted for glazing if the area is reduced. In practice this may not be feasible due to other design limitations (eg natural light design criteria).

7.3.2 Ventilation

Windows and doors will need to remain closed in order to satisfy AS2021-2015 recommended internal noise levels. Therefore, alternate means of ventilation conforming to National Construction Code and relevant Australian Standards will be required to allow occupants to leave windows and doors closed, when so desired.

The most common form of alternate ventilation in instances where high sound reduction value is needed is a full mechanical system with fresh air reticulation (eg ducted air conditioning).

If natural ventilation is desired, incorporating acoustically attenuated air paths using internally lined transfers ducts would have to be considered in the base building design.

8 Conclusion

EMM has completed an acoustic assessment for a medium to high density residential planning proposal at the corner of Botany Road and Coward Street, Mascot. Road traffic and aircraft noise have been identified as potential site constraints. The assessment has been prepared to demonstrate that the subject site is suitable for the proposed use and with respect to meeting local and state government requirements on environmental noise.

In summary, the proposal is predicted to satisfy relevant standard and guidelines on road traffic and aircraft noise, with appropriate controls in place. Aircraft noise is predicted to present the highest noise impact on the site. Therefore, if recommendations to mitigate aircraft noise levels are adopted, it can be inferred that internal road traffic noise criteria will also be met.

Appendix A

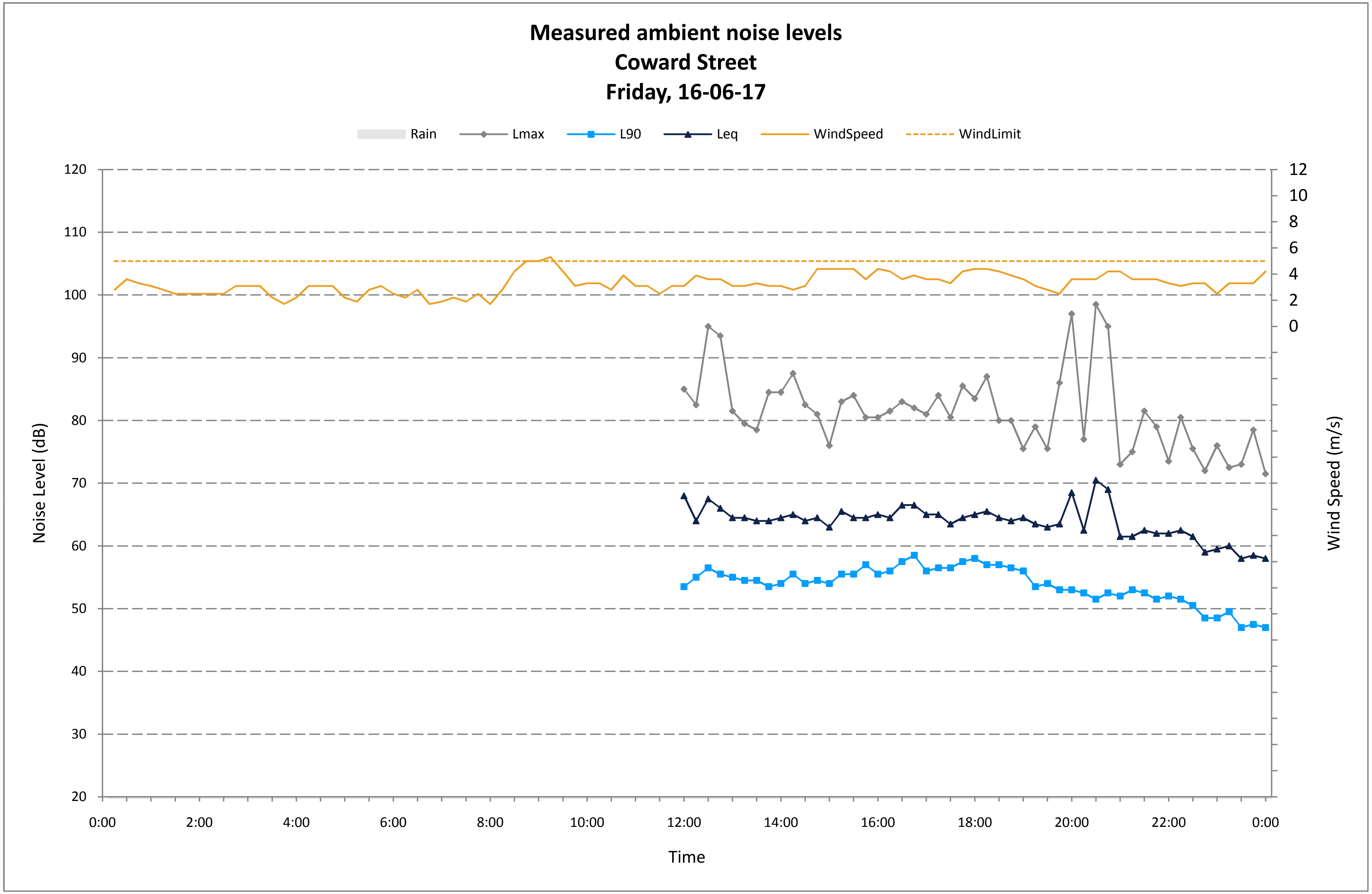
Daily noise logger results and charts

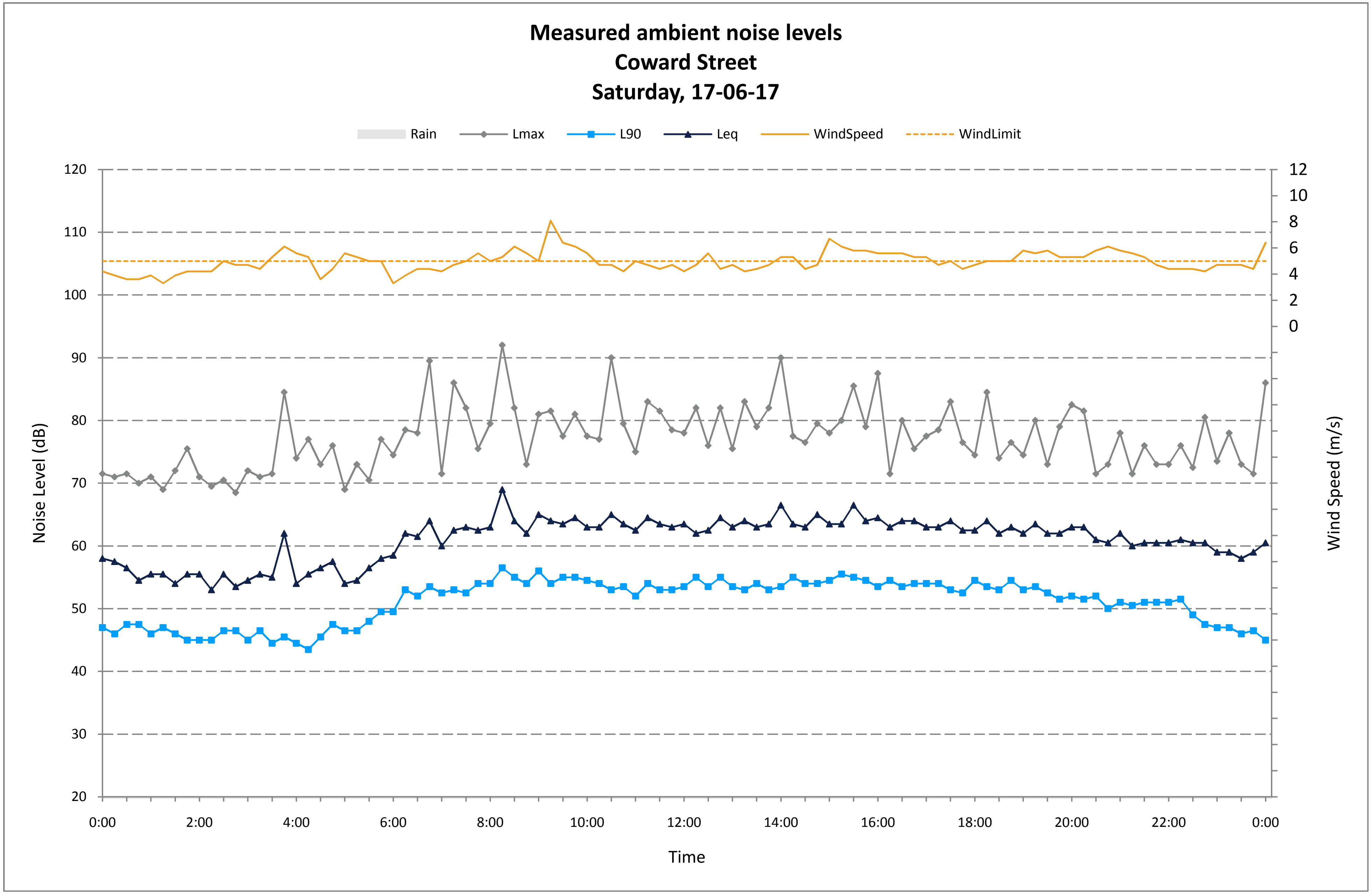
Table A.1 Summary of daily noise logging results – Coward St, dB

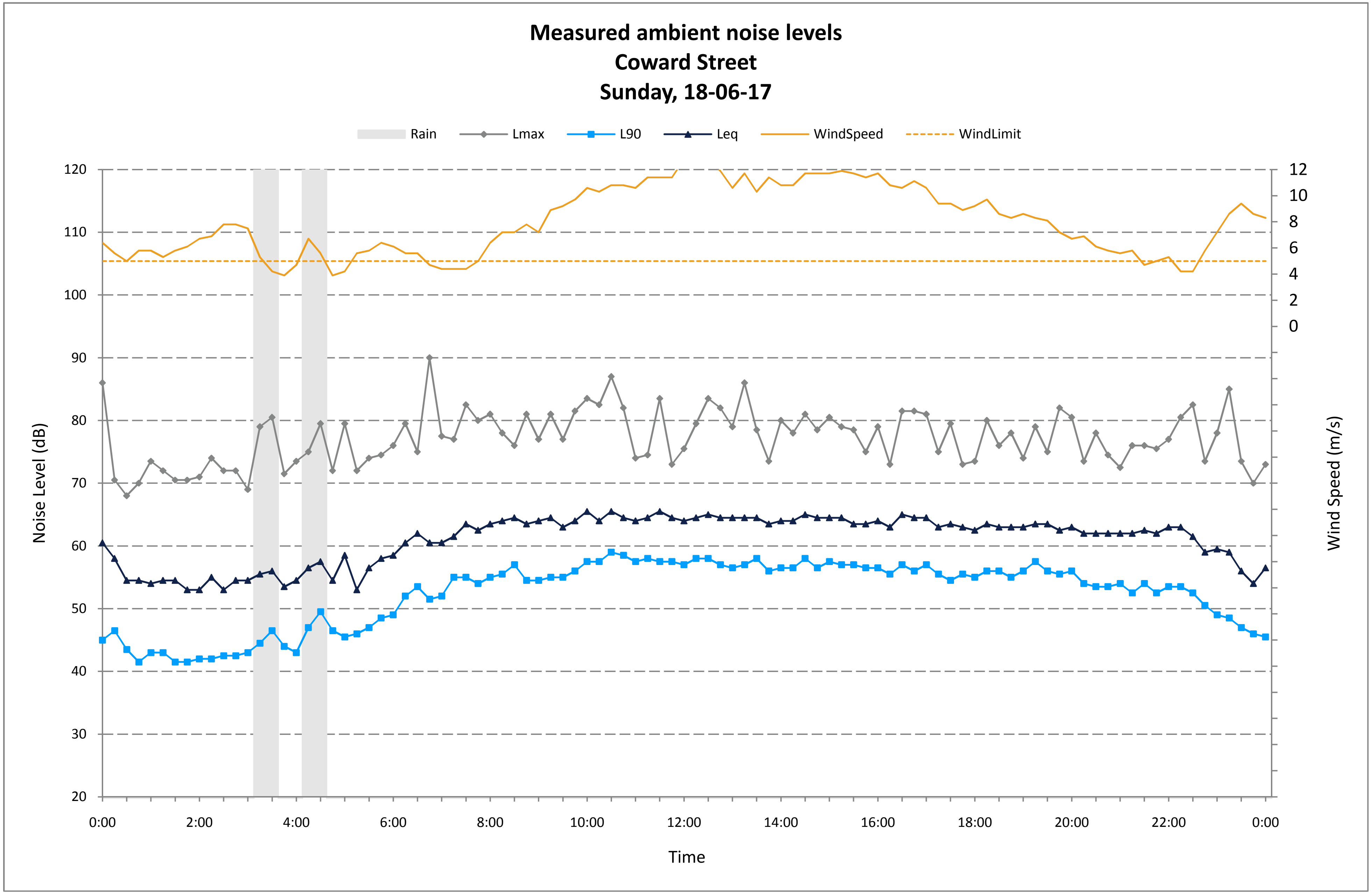
Date	ABL Day	ABL Evening	ABL Night	L_{Aeq} 15hr day	L_{Aeq} 9hr night
Friday, 16-06-17	-	52	45	-	58
Saturday, 17-06-17	53	51	42	64	58
Sunday, 18-06-17	-	53	45	0	60
Monday, 19-06-17	56	51	44	64	61
Tuesday, 20-06-17	54	50	43	65	61
Wednesday, 21-06-17	56	52	47	66	62
Thursday, 22-06-17	53	50	41	64	62
Friday, 23-06-17	54	53	44	67	59
Saturday, 24-06-17	54	52	43	66	58
Sunday, 25-06-17	53	49	0	66	-
Monday, 26-06-17	-	-	-	-	-
Overall (RBL)/$L_{Aeq\ (period)}$[1]	54	51	44	66	60

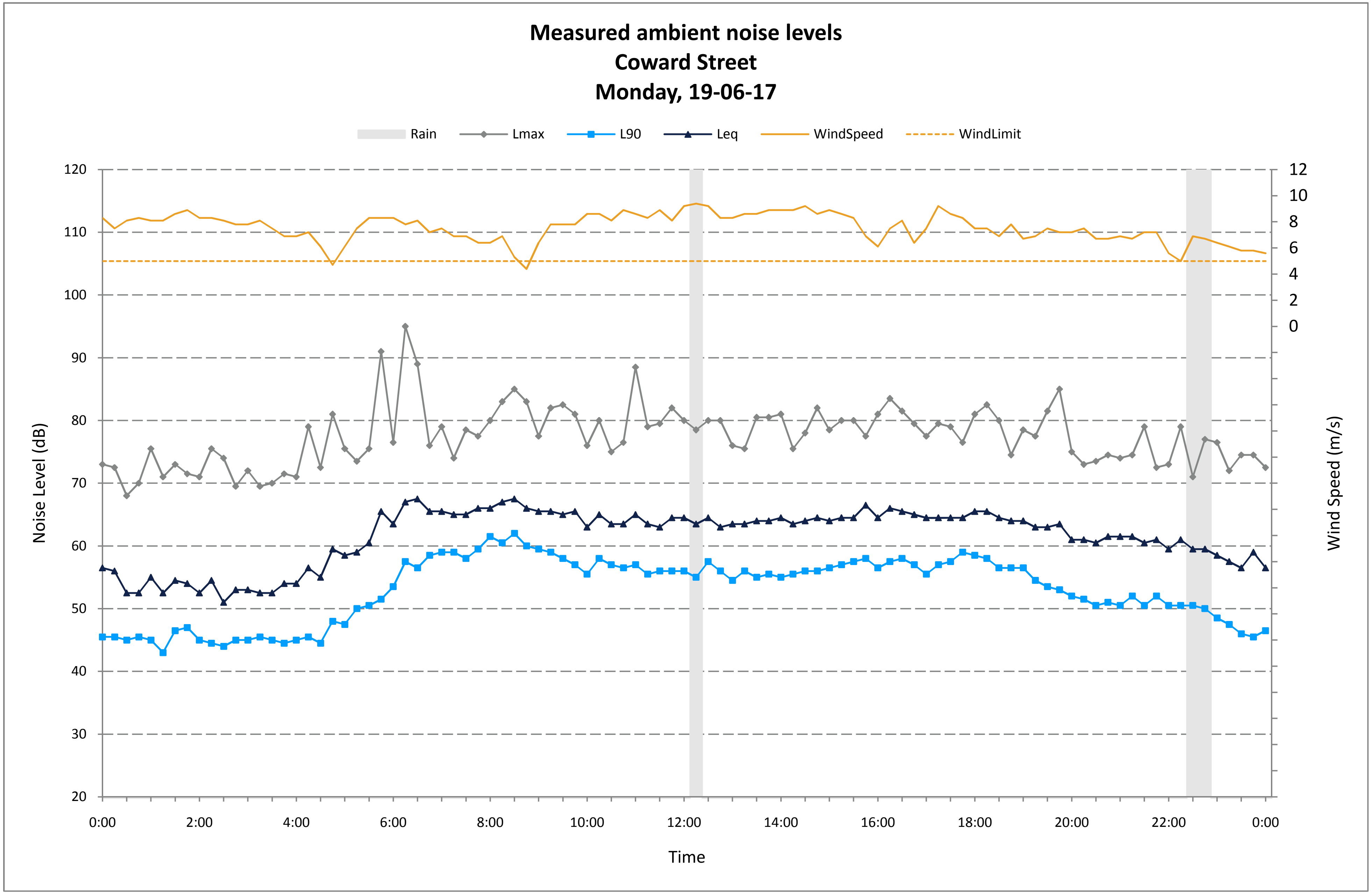
Notes: "-" indicates too few data samples.

1. Excludes data recorded on Sundays.

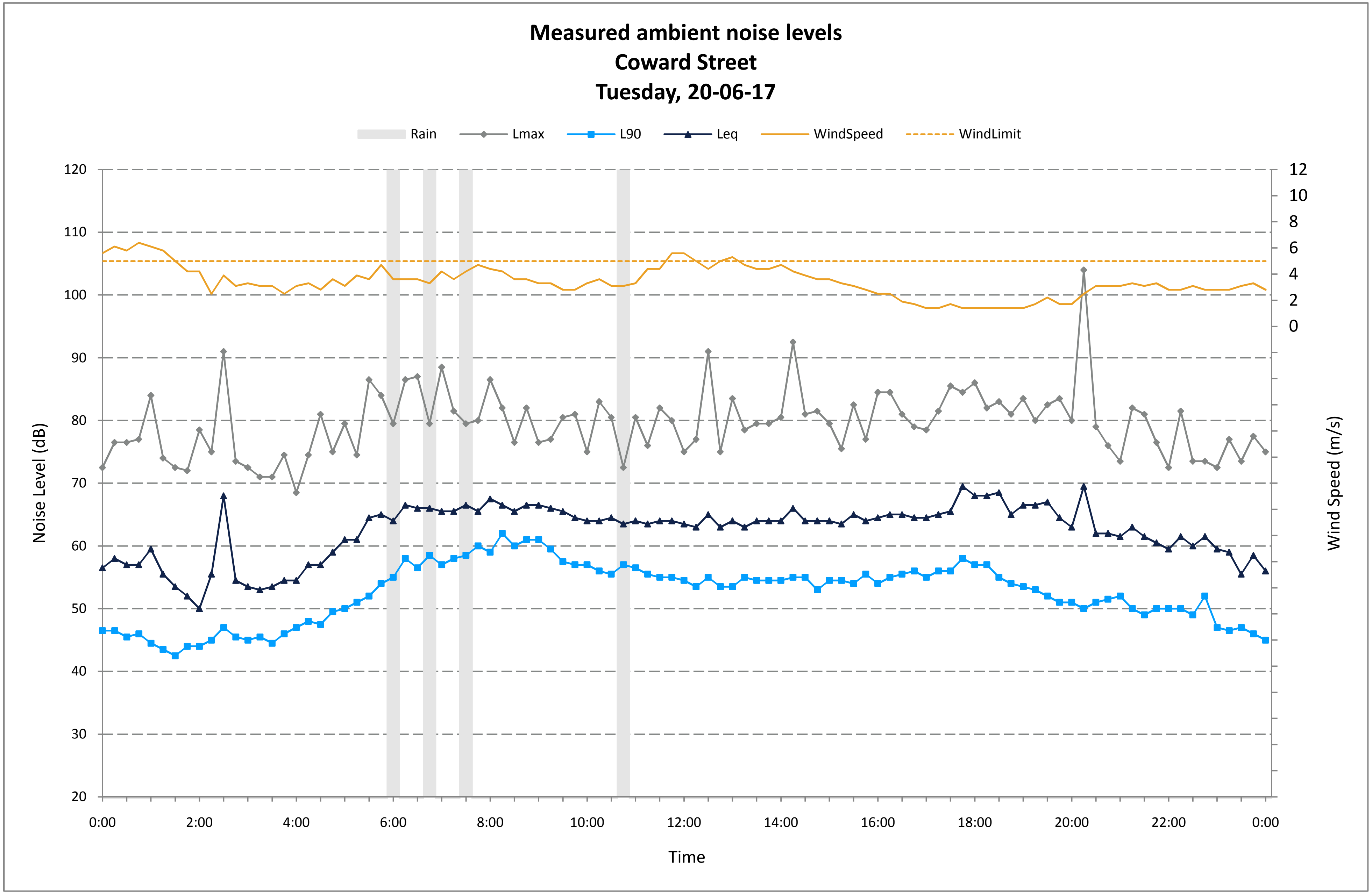

Measured ambient noise levels
Coward Street
Friday, 16-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

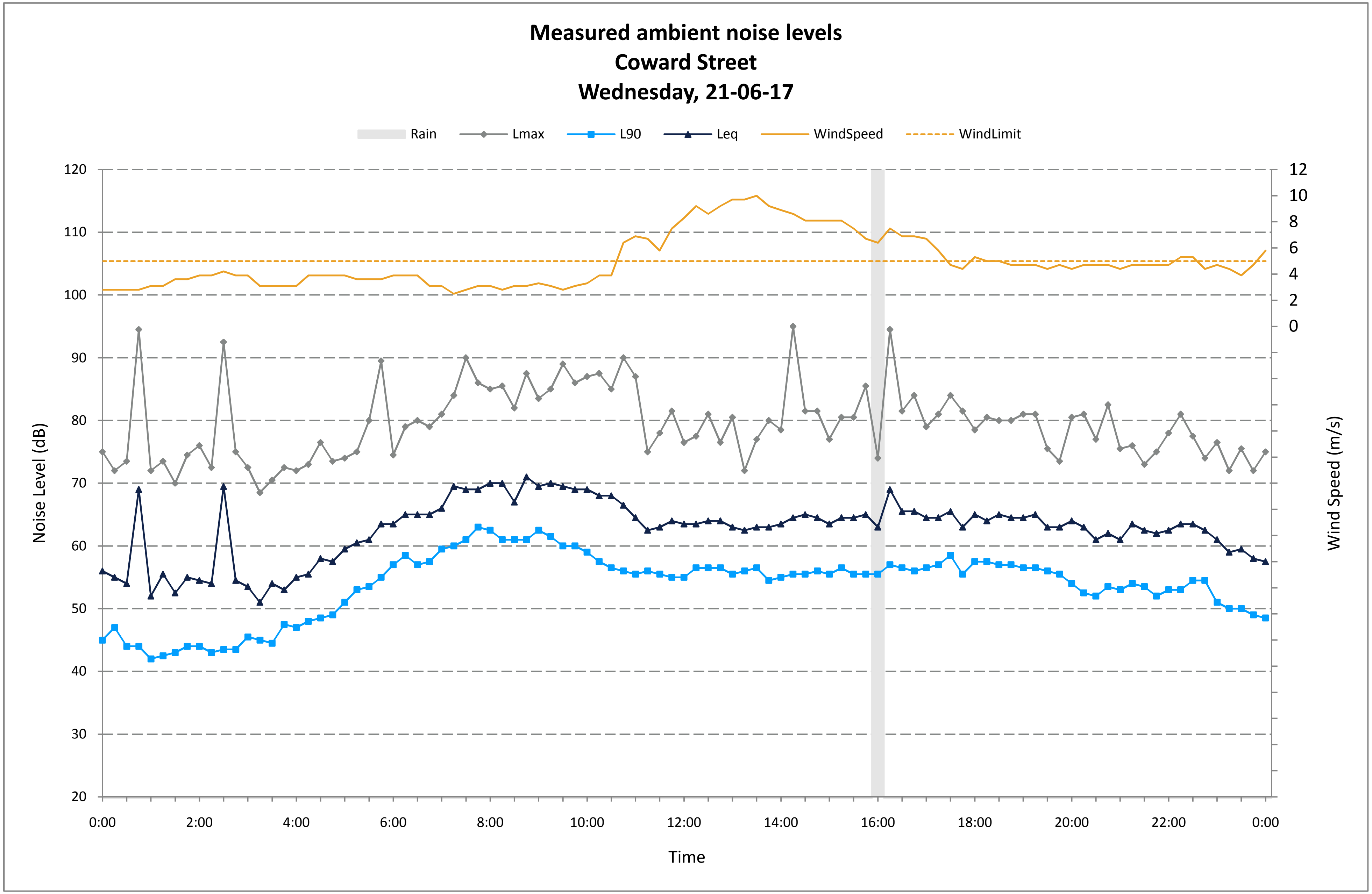

Measured ambient noise levels
Coward Street
Saturday, 17-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time


Measured ambient noise levels
Coward Street
Sunday, 18-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

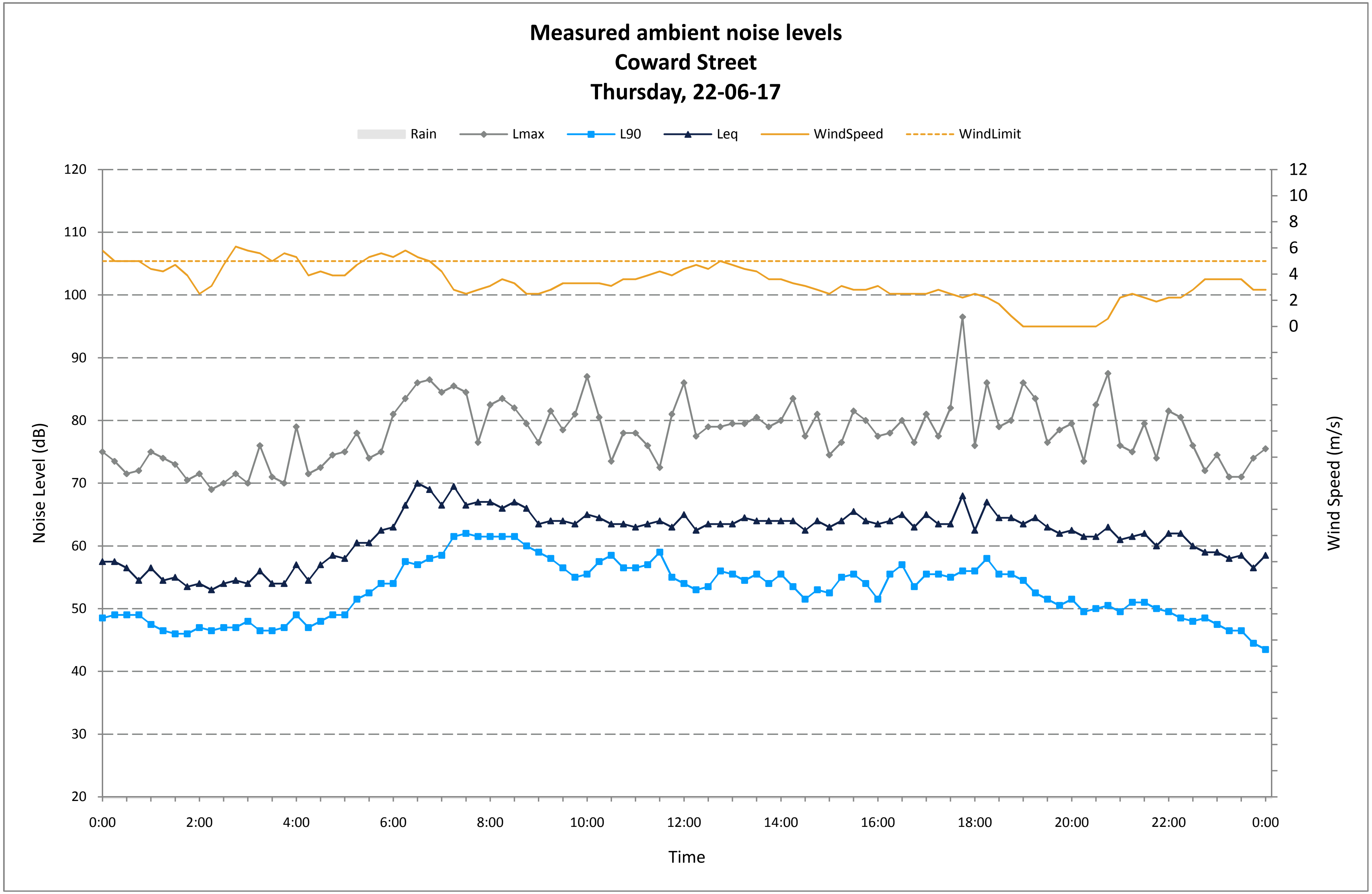


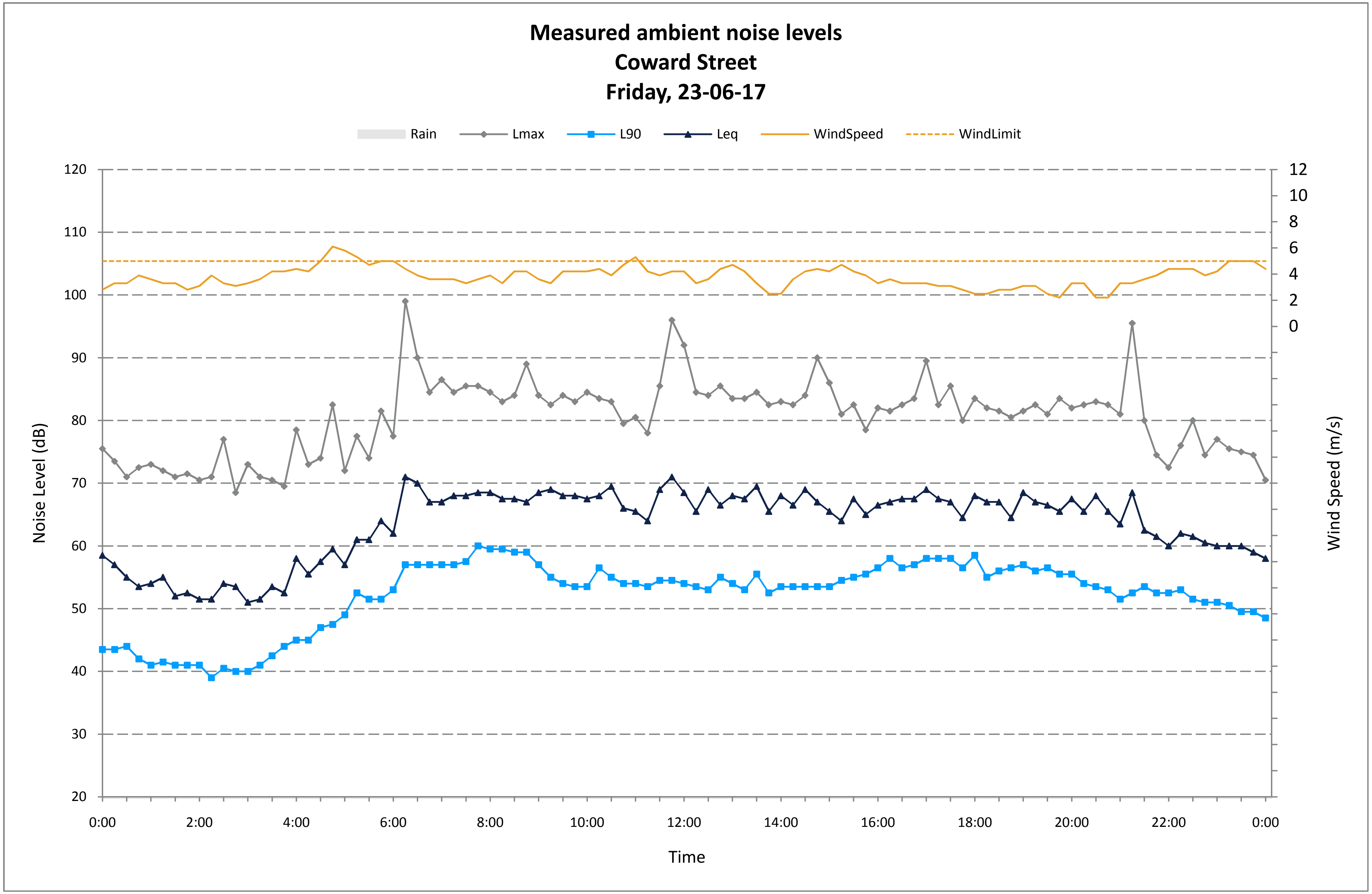
Measured ambient noise levels
Coward Street
Monday, 19-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

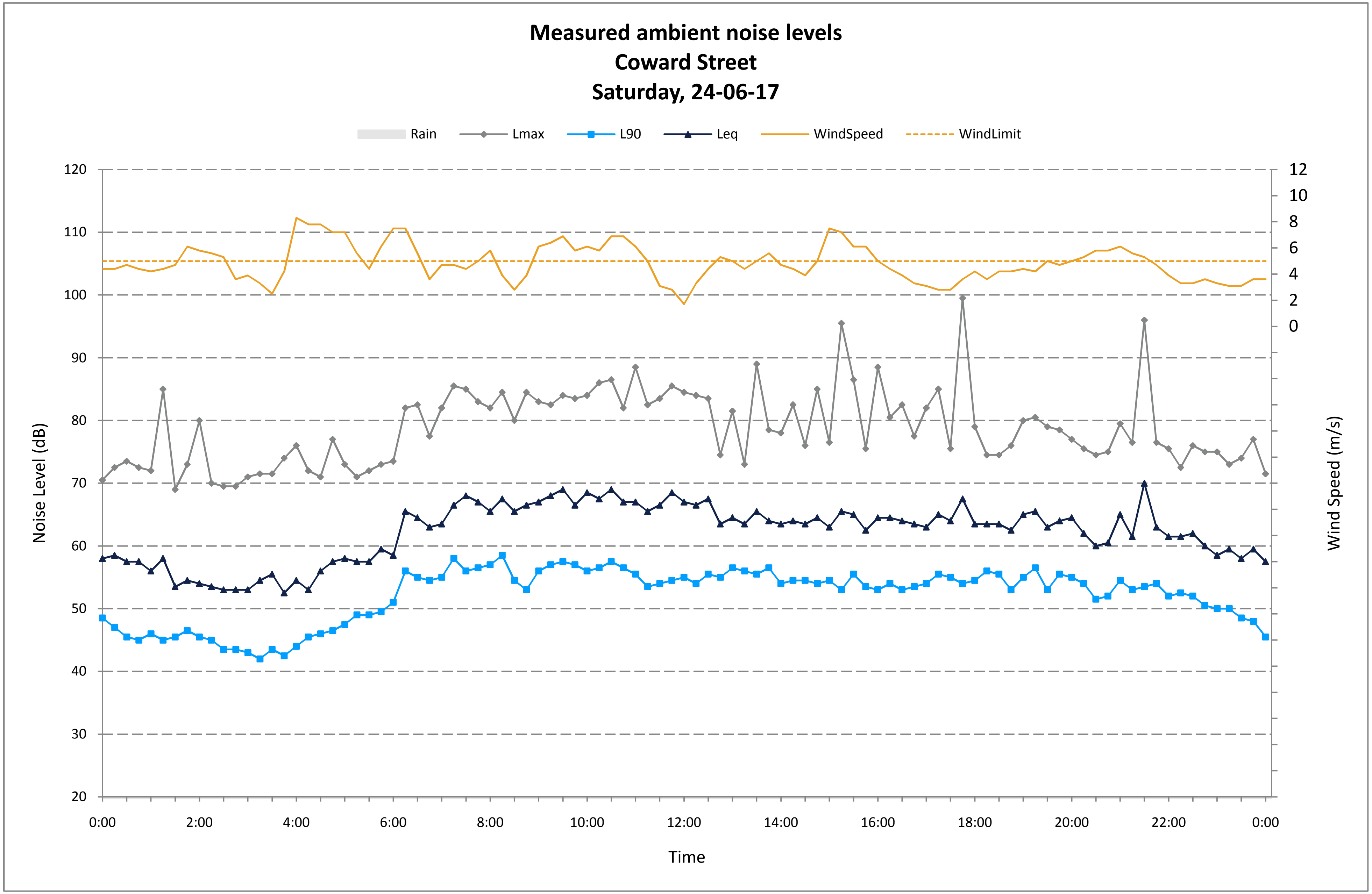

Measured ambient noise levels
Coward Street
Tuesday, 20-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

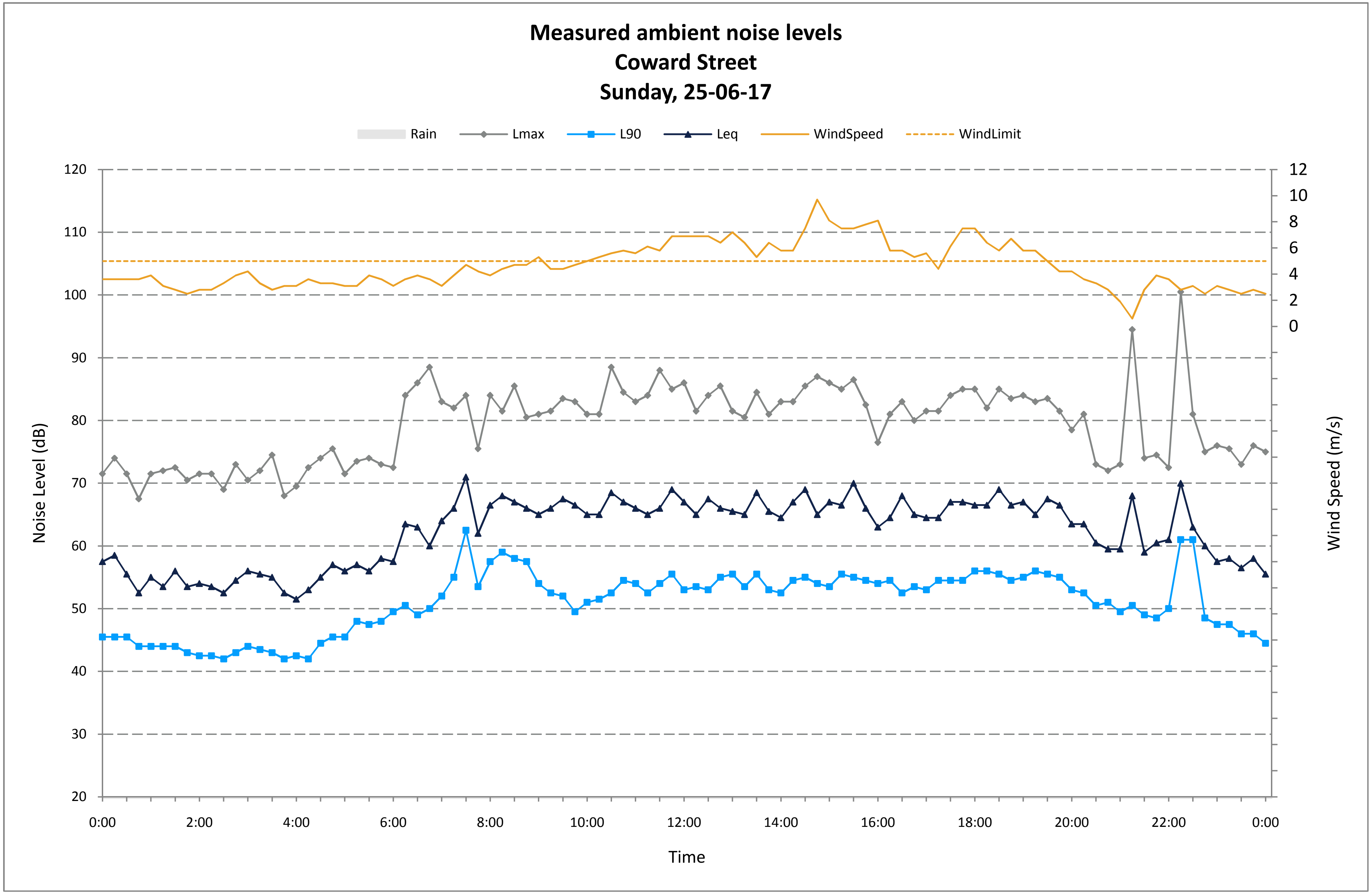


Measured ambient noise levels
Coward Street
Wednesday, 21-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

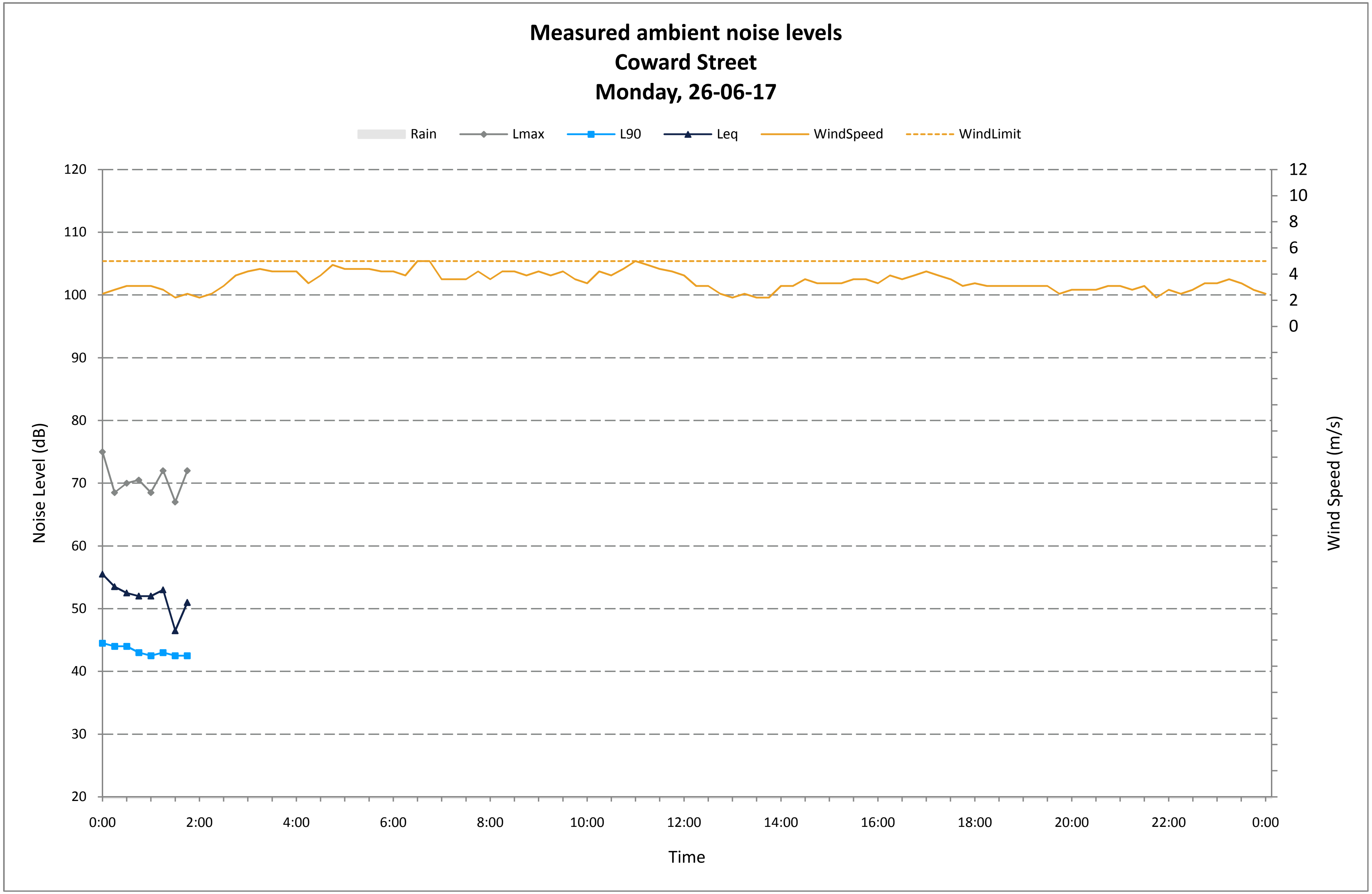

Measured ambient noise levels
Coward Street
Thursday, 22-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00


Measured ambient noise levels
Coward Street
Friday, 23-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00


Measured ambient noise levels
Coward Street
Saturday, 24-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00



Measured ambient noise levels
Coward Street
Sunday, 25-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time



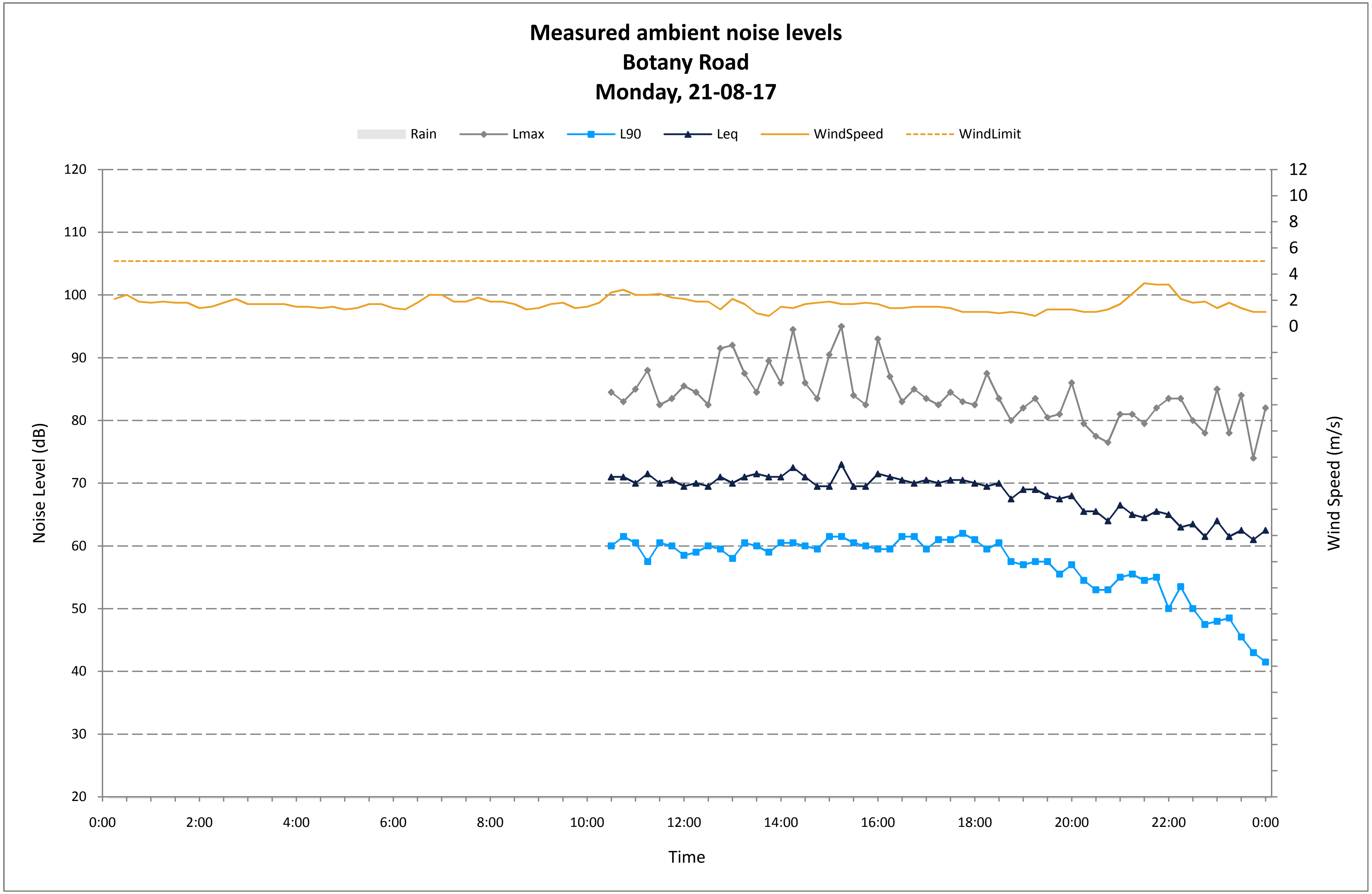
Measured ambient noise levels
Coward Street
Monday, 26-06-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

Table A.2 Summary of daily noise logging results – Botany Rd, dB

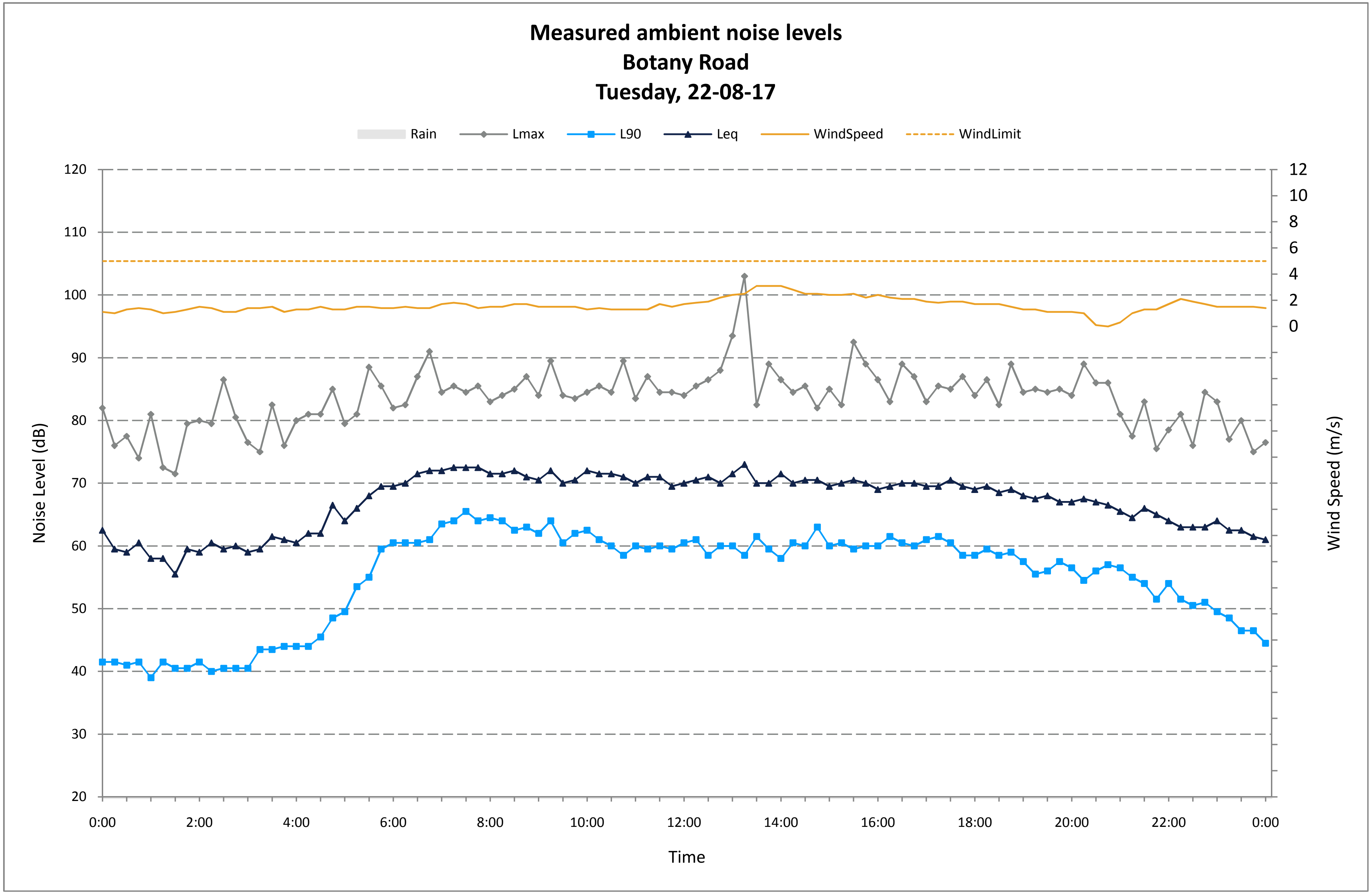
Date	ABL Day	ABL Evening	ABL Night	L_{Aeq} 15hr day	L_{Aeq} 9hr night
Monday, 21-08-17	-	53	41	-	65
Tuesday, 22-08-17	59	54	41	70	66
Wednesday, 23-08-17	59	55	44	71	66
Thursday, 24-08-17	60	55	45	70	65
Friday, 25-08-17	60	55	45	70	64
Saturday, 26-08-17	57	54	43	69	64
Sunday, 27-08-17	-	55	45	-	65
Monday, 28-08-17	60	53	43	70	66
Tuesday, 29-08-17	59	53	42	70	66
Wednesday, 30-08-17	59	56	44	70	65
Thursday, 31-08-17	60	56	44	70	65
Friday, 01-09-17	60	54	42	70	65
Saturday, 02-09-17	57	51	42	70	63
Sunday, 03-09-17	53	53	42	68	65
Monday, 04-09-17	60	51	41	70	66
Tuesday, 05-09-17	59	53	44	70	65
Wednesday, 06-09-17	-	-	-	-	-
Overall (RBL)/$L_{Aeq\ (period)}$[1]	59	54	43	70	65

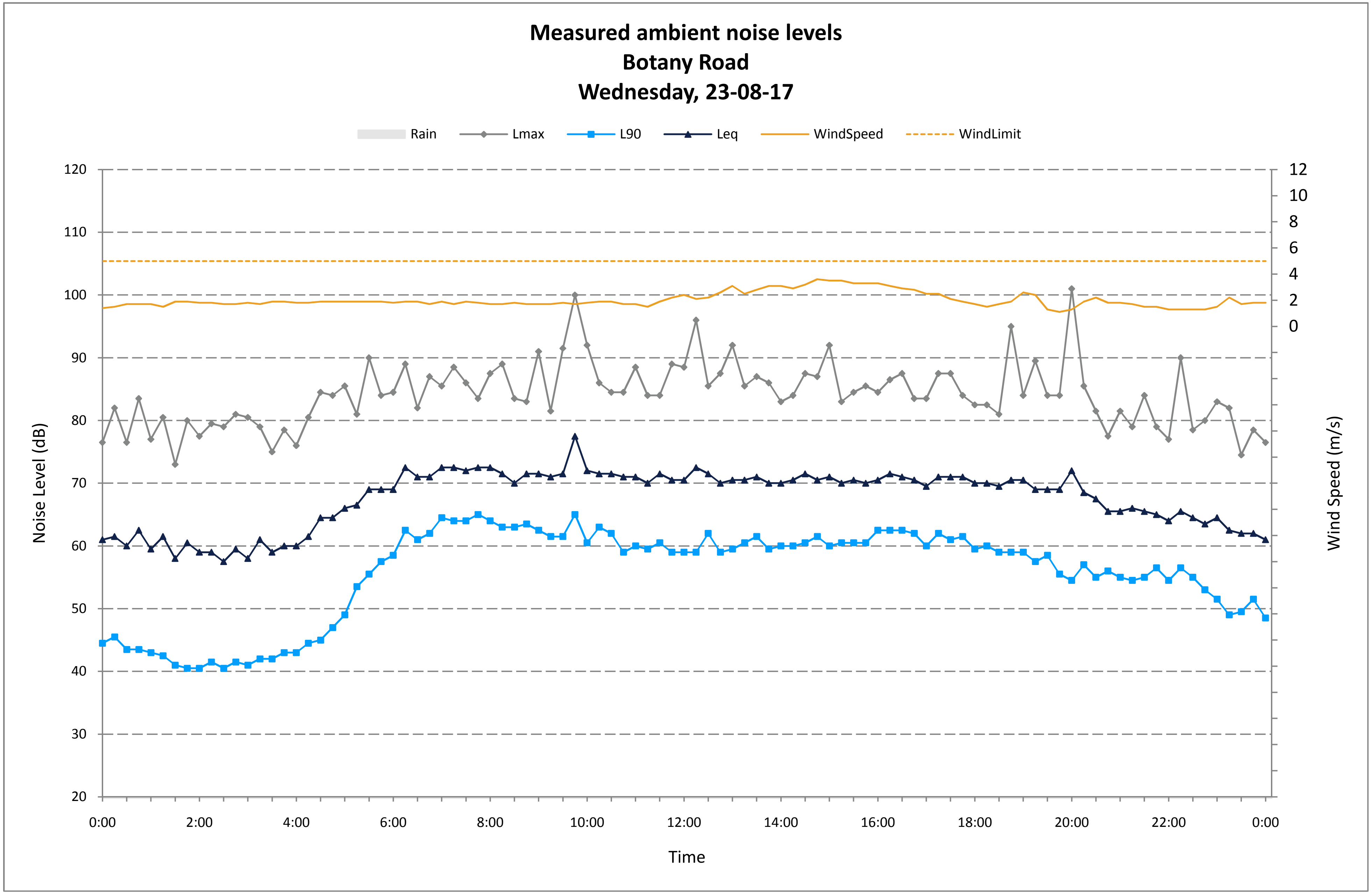
Notes: "-" indicates too few data samples.

1. Excludes data recorded on Sundays.

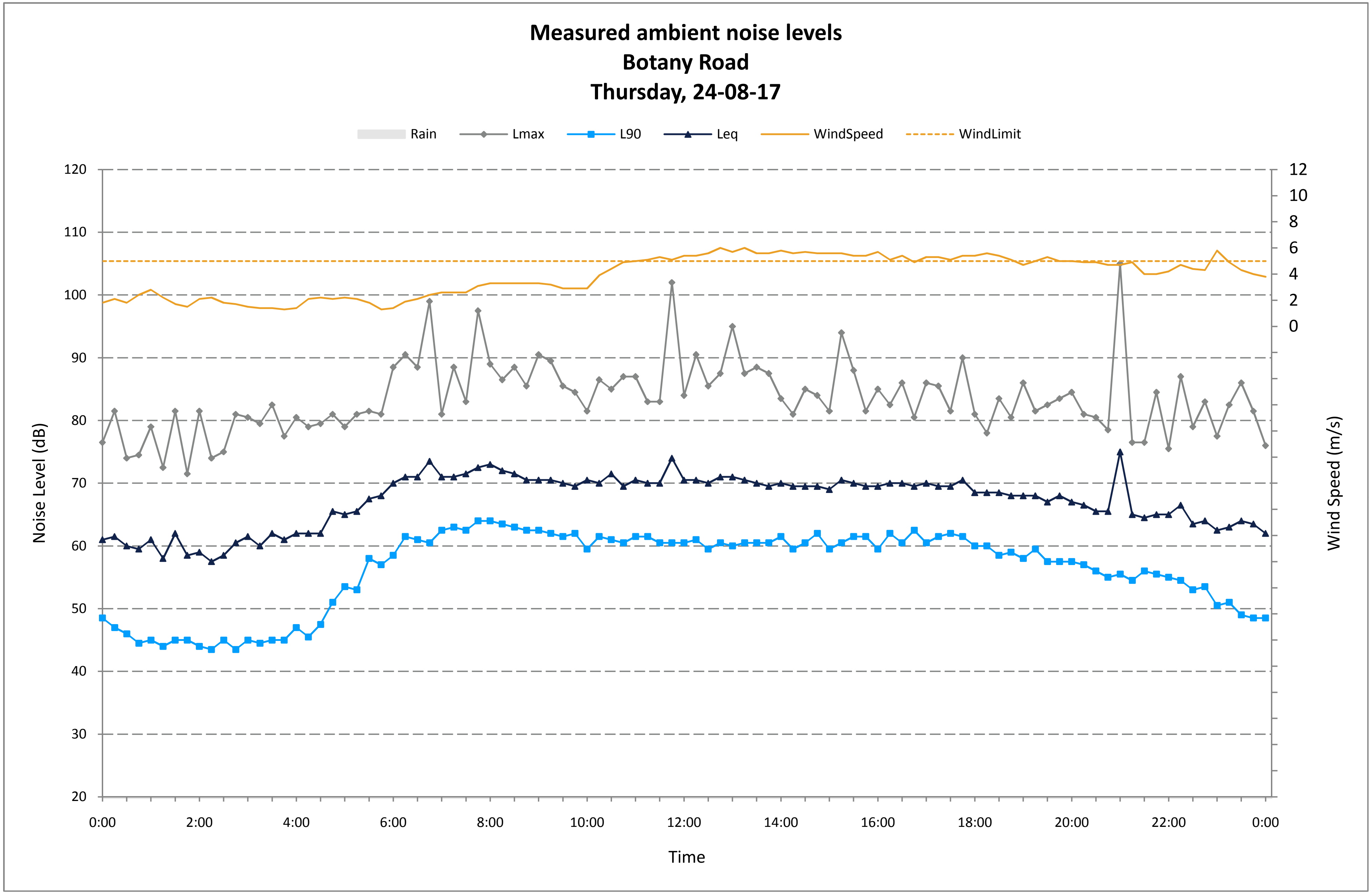


Measured ambient noise levels
Botany Road
Monday, 21-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
Wind Speed (m/s)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

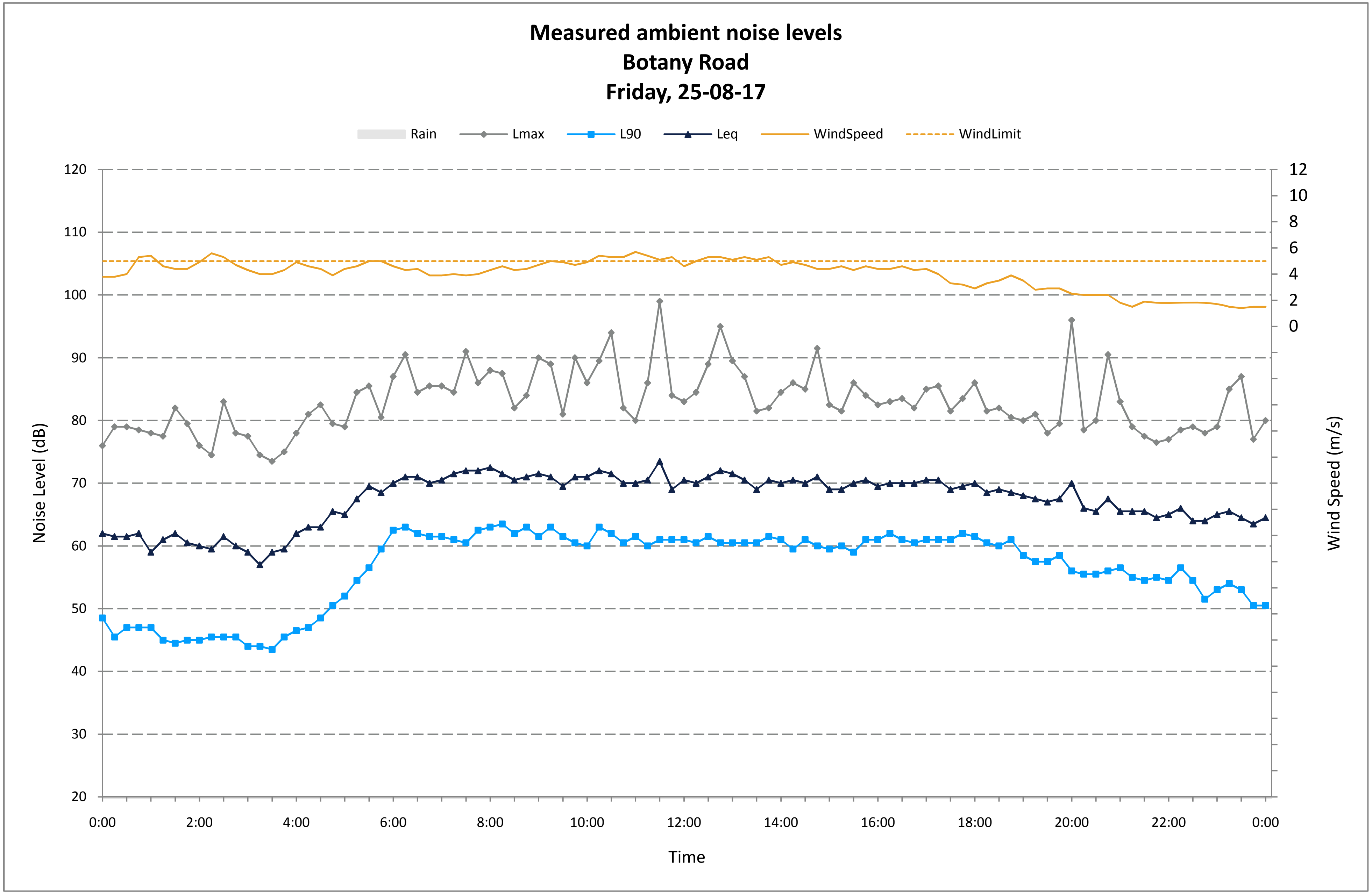

Measured ambient noise levels
Botany Road
Tuesday, 22-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

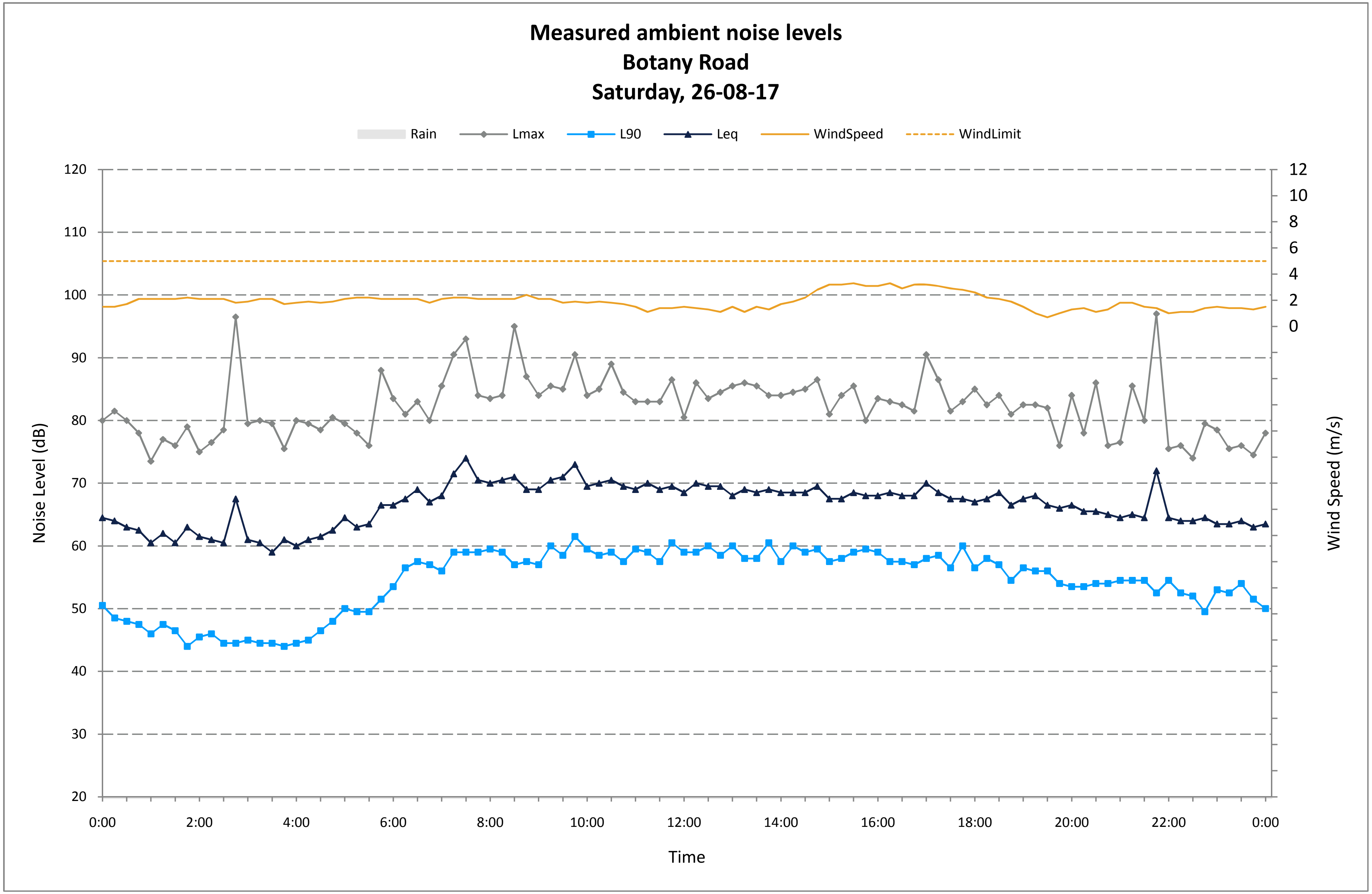


Measured ambient noise levels
Botany Road
Wednesday, 23-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

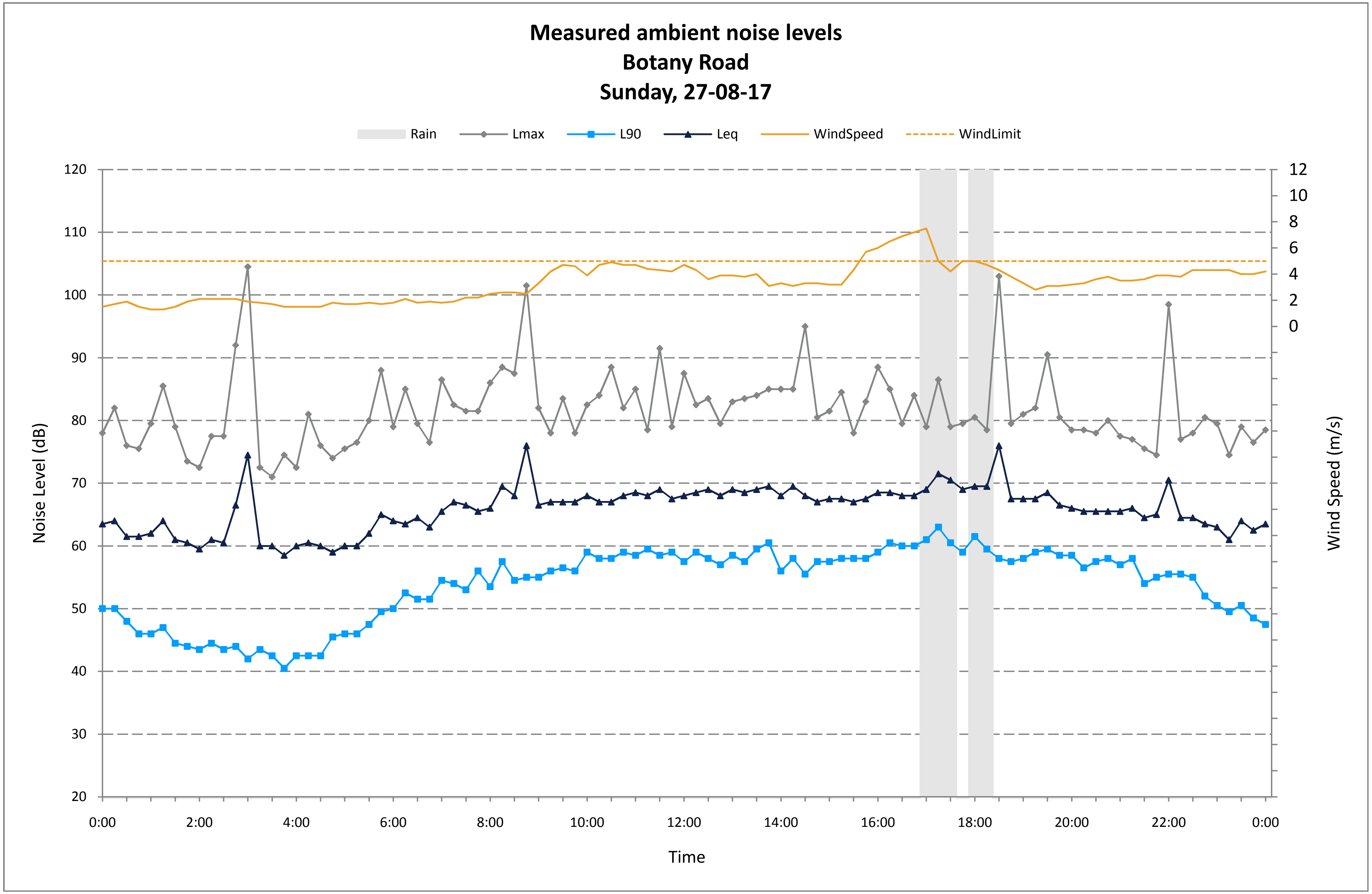


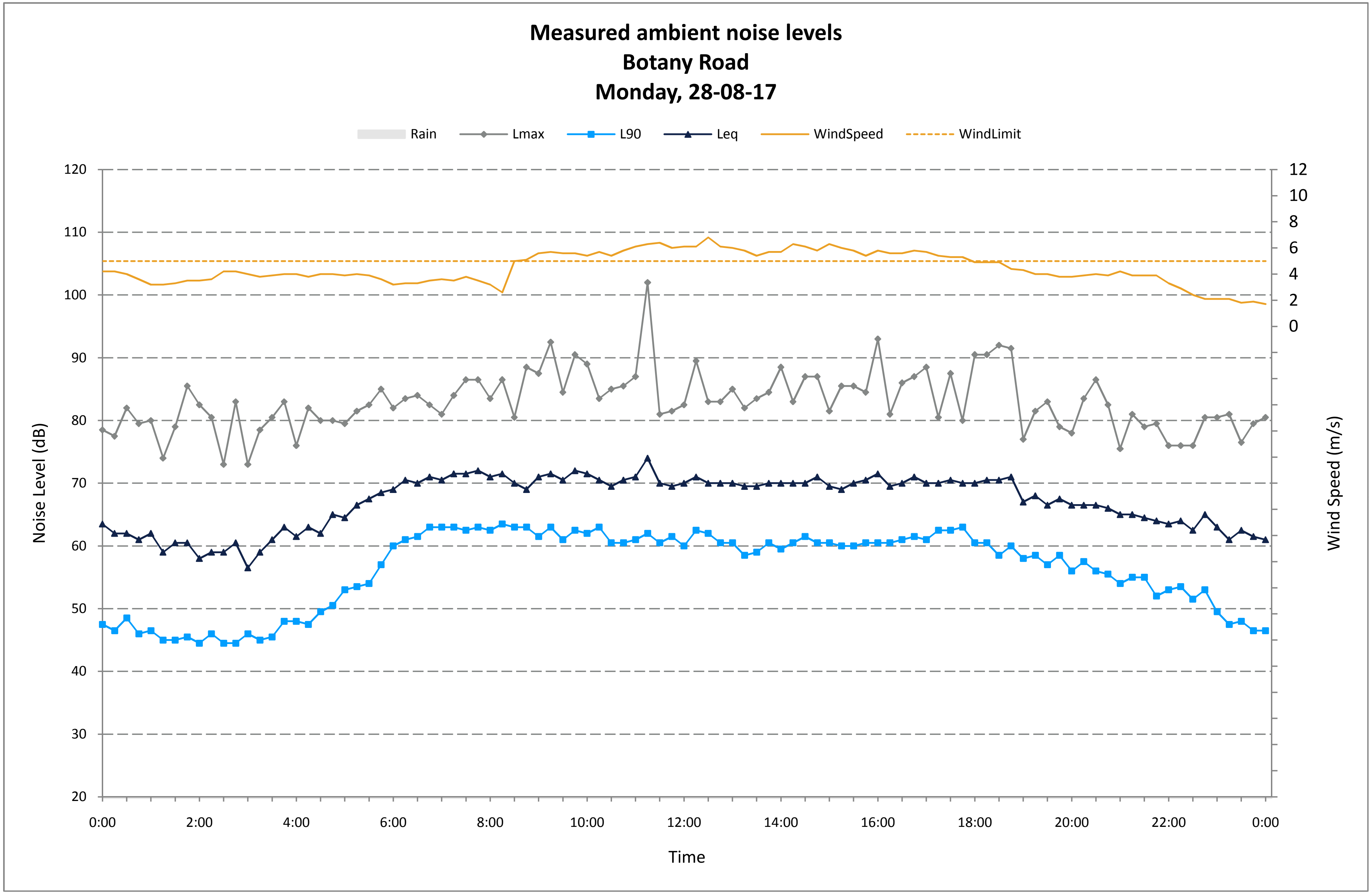
Measured ambient noise levels
Botany Road
Thursday, 24-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time


Measured ambient noise levels
Botany Road
Friday, 25-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

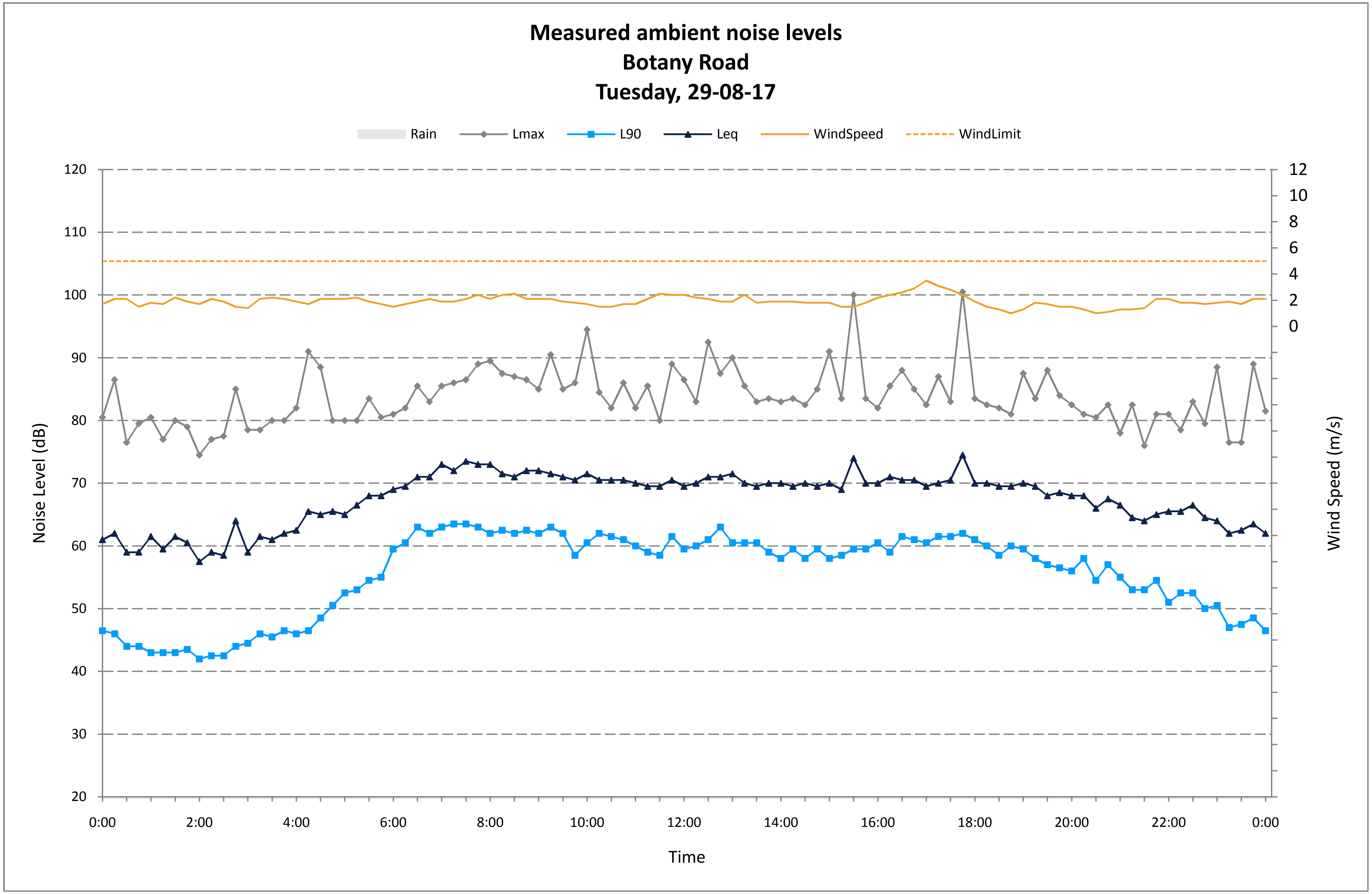


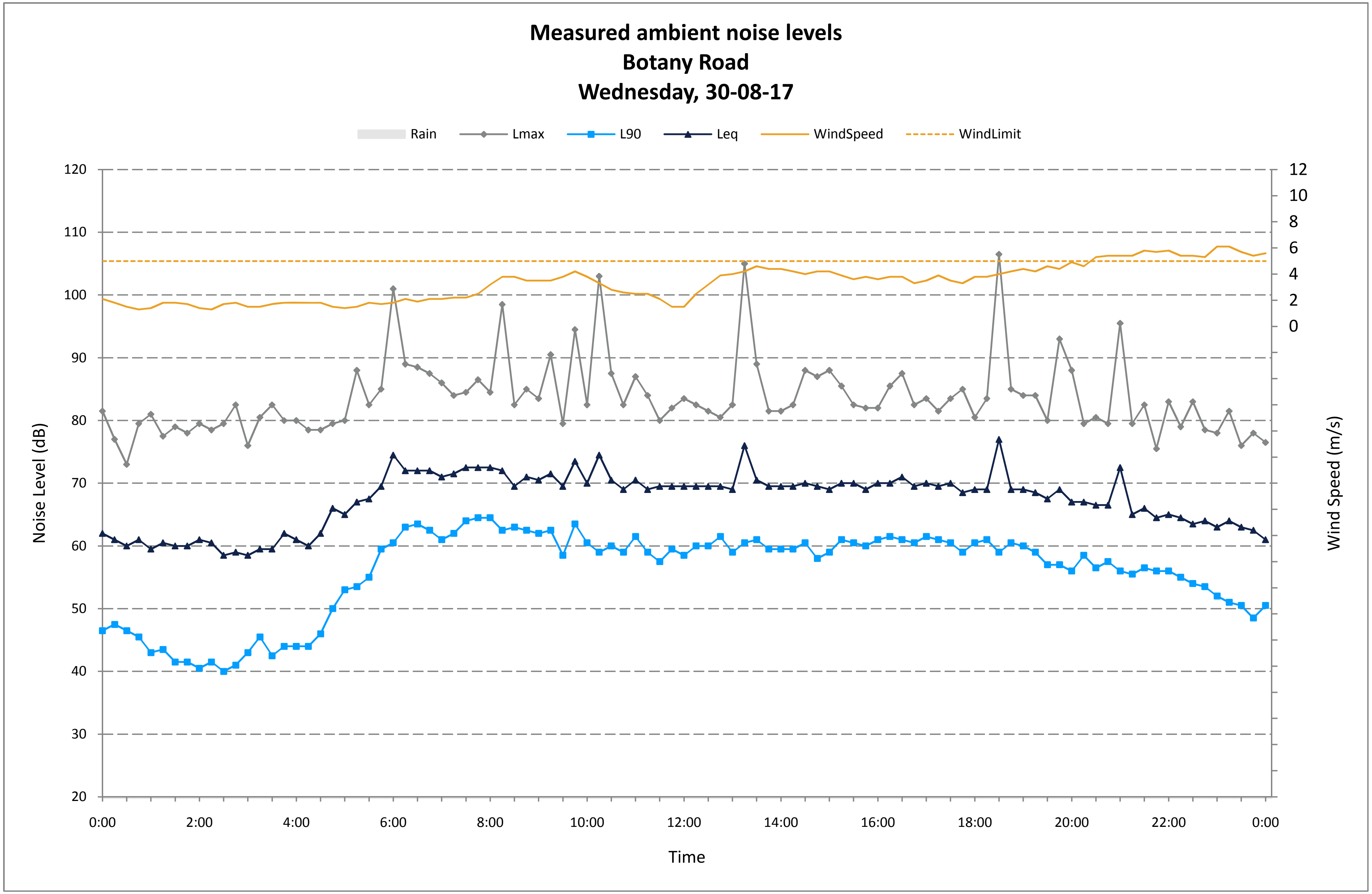
Measured ambient noise levels
Botany Road
Saturday, 26-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
Time
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

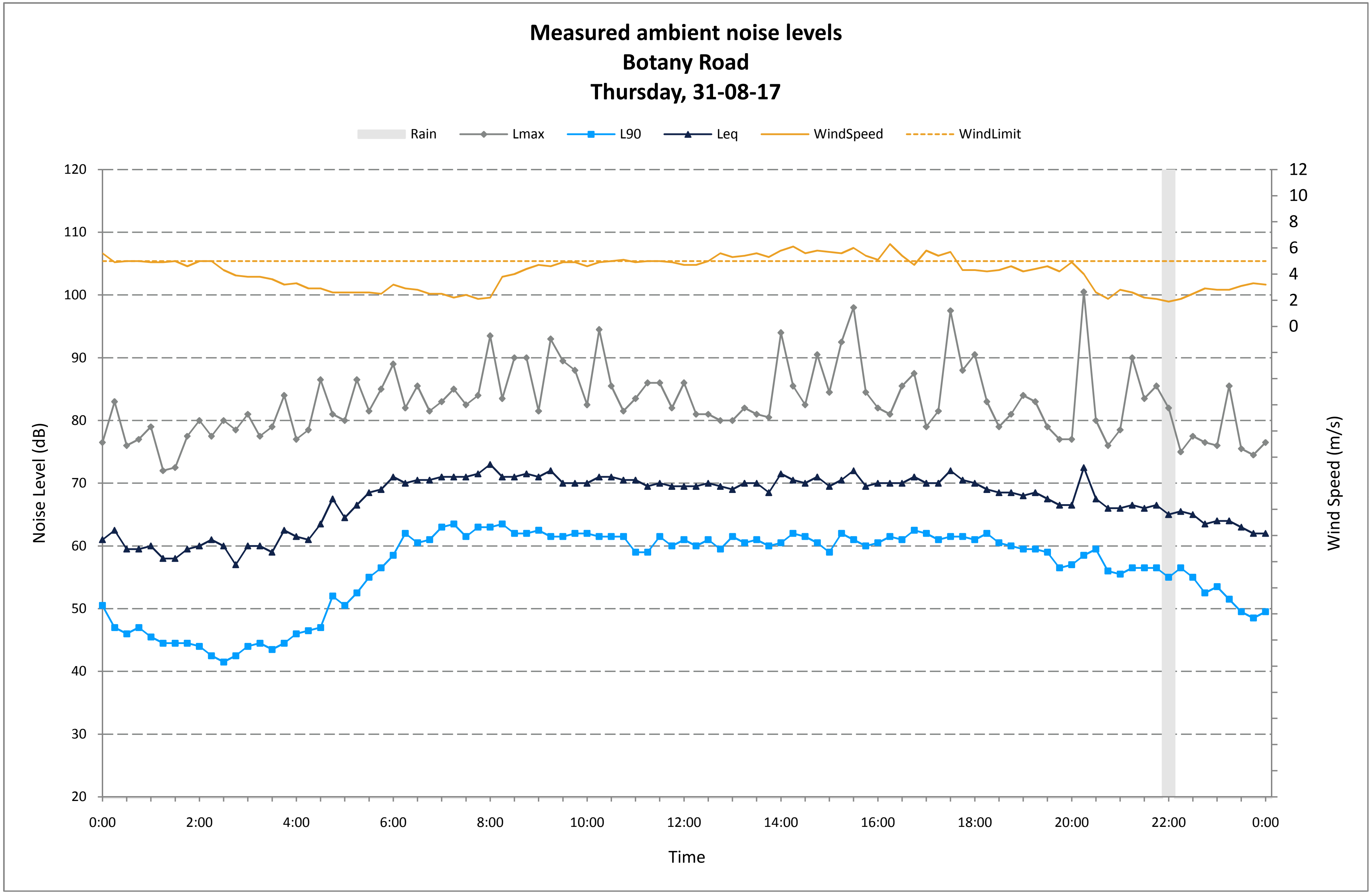

Measured ambient noise levels
Botany Road
Sunday, 27-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time



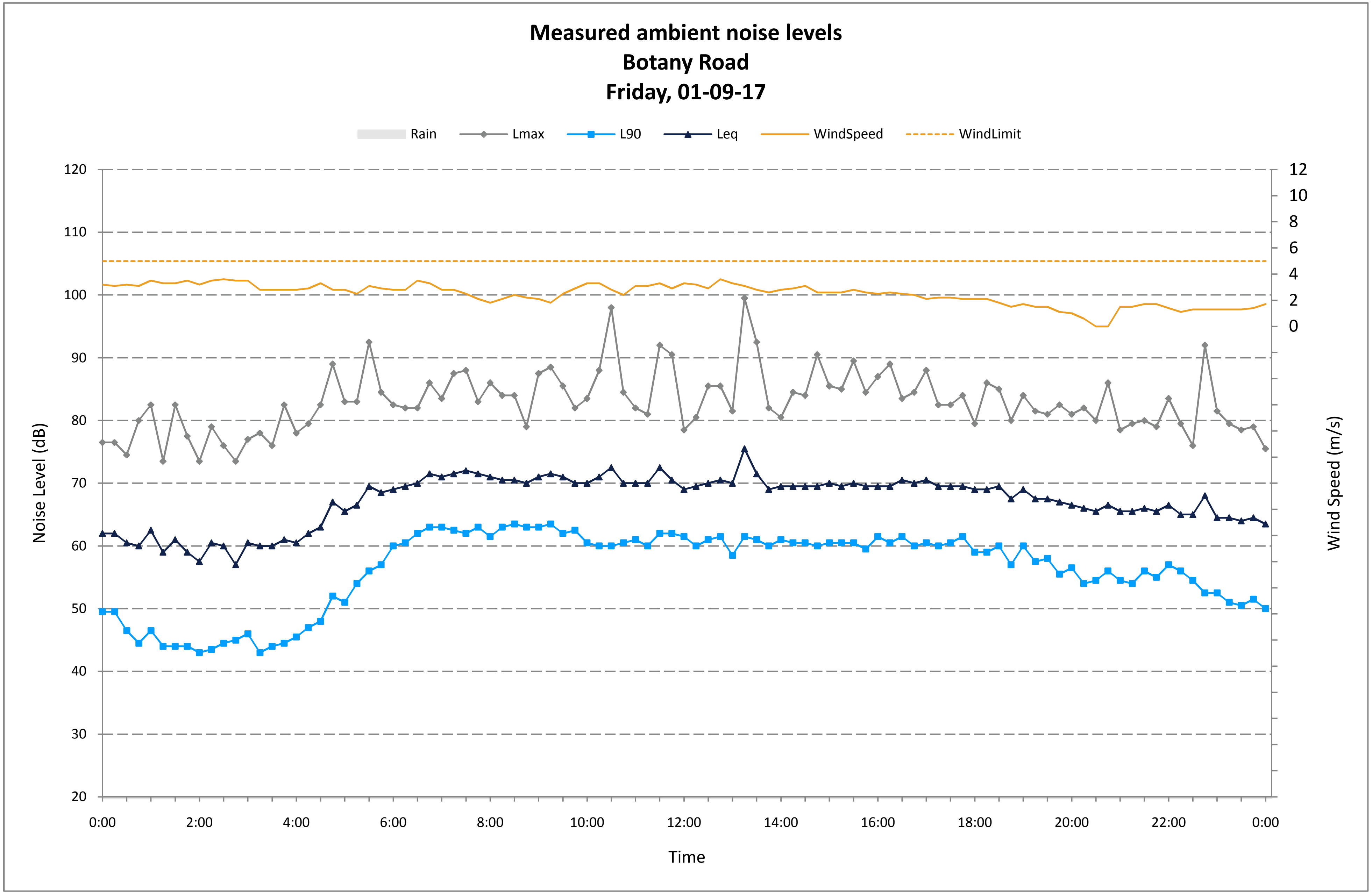
Measured ambient noise levels
Botany Road
Monday, 28-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time


Measured ambient noise levels
Botany Road
Tuesday, 29-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

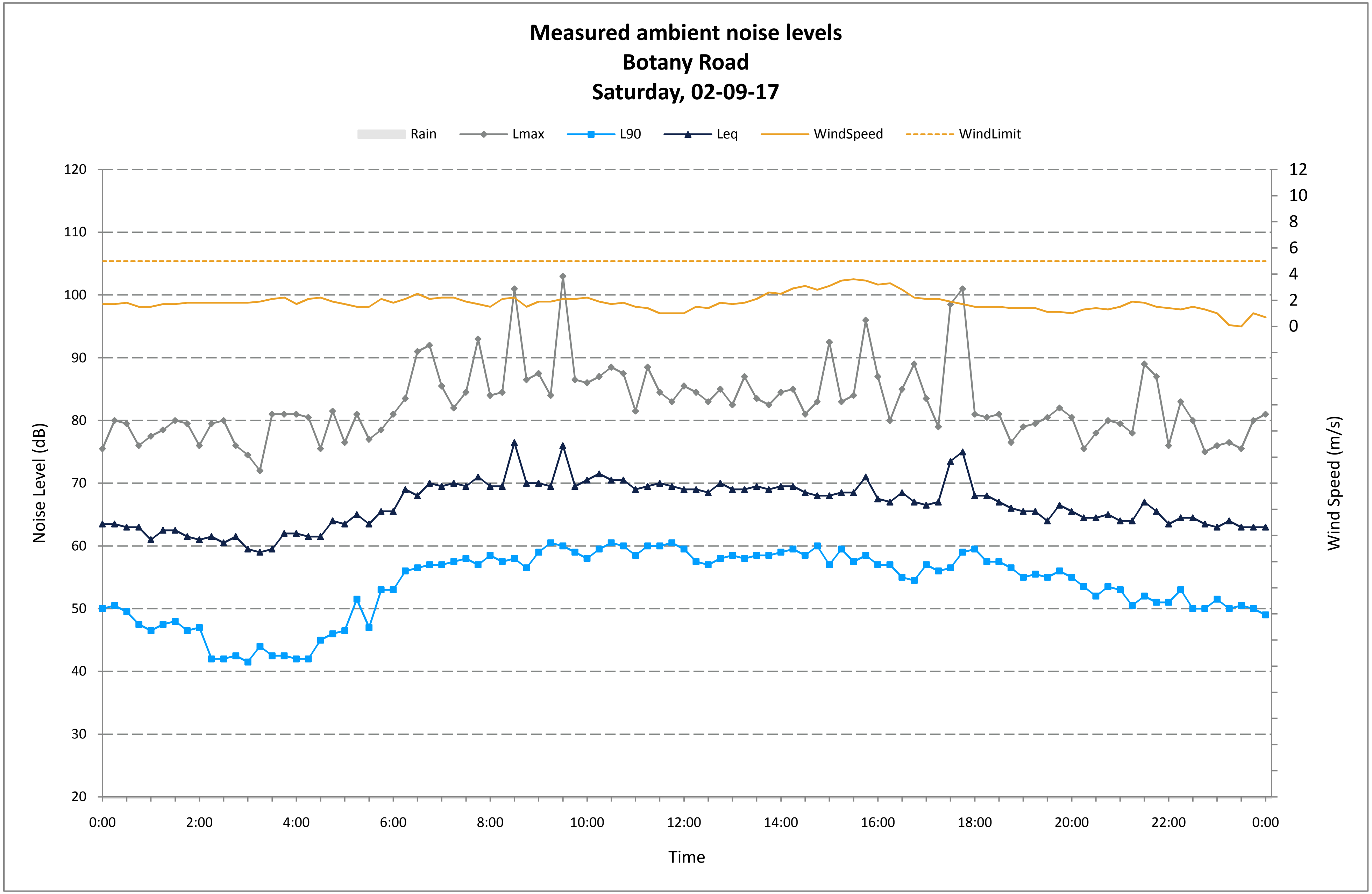

Measured ambient noise levels
Botany Road
Wednesday, 30-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00



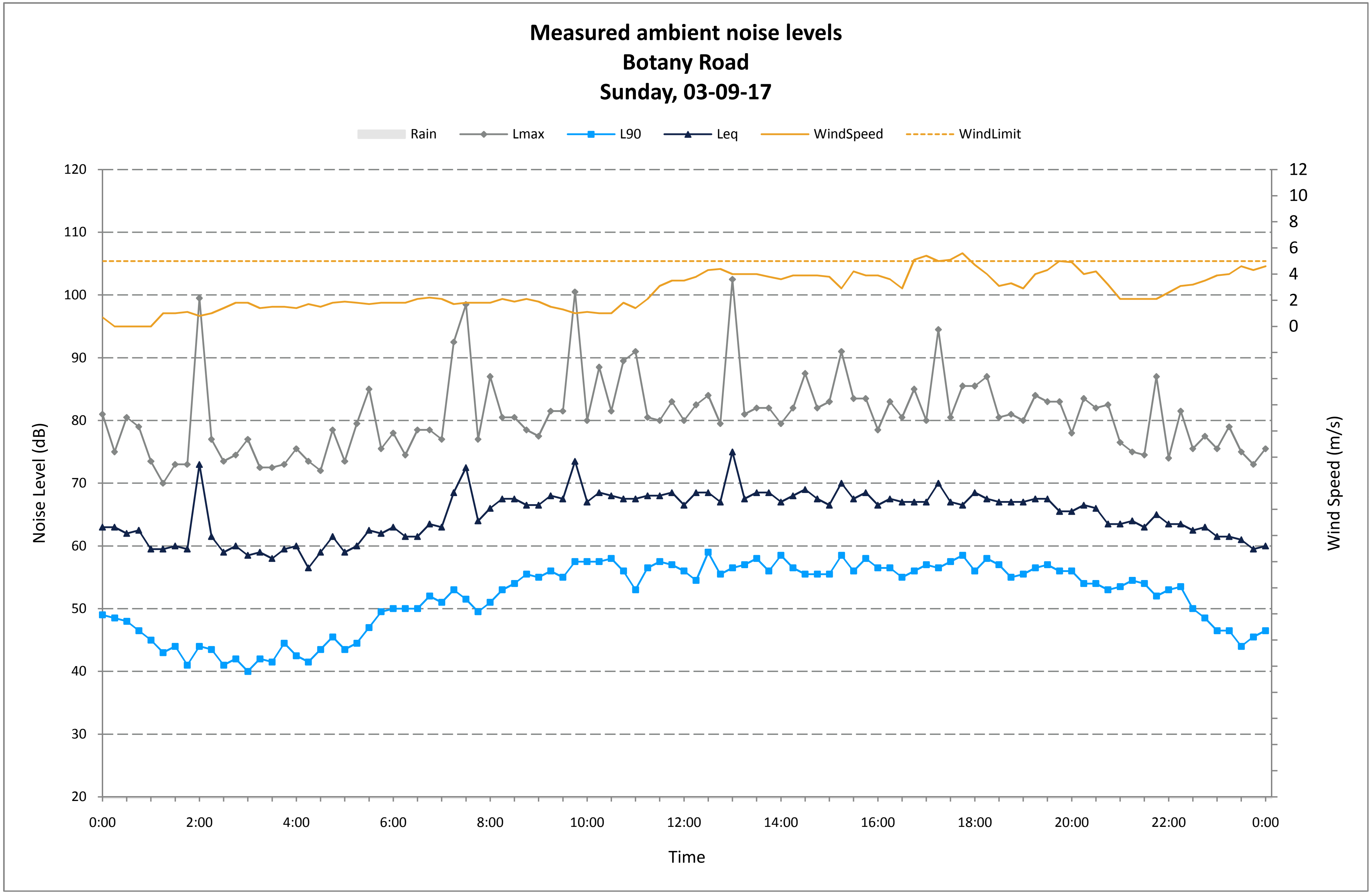
Measured ambient noise levels
Botany Road
Thursday, 31-08-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time



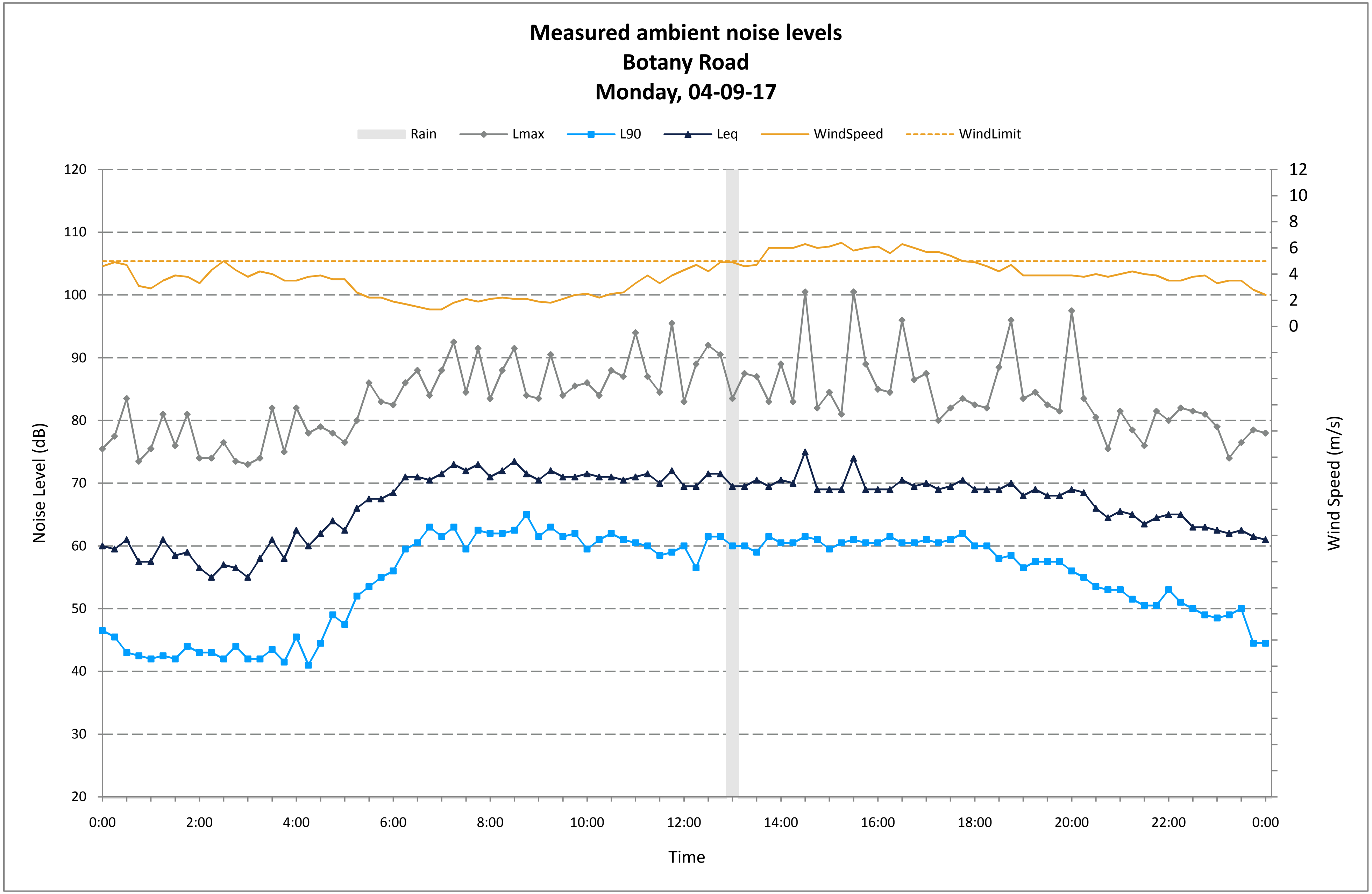
Measured ambient noise levels
Botany Road
Friday, 01-09-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time



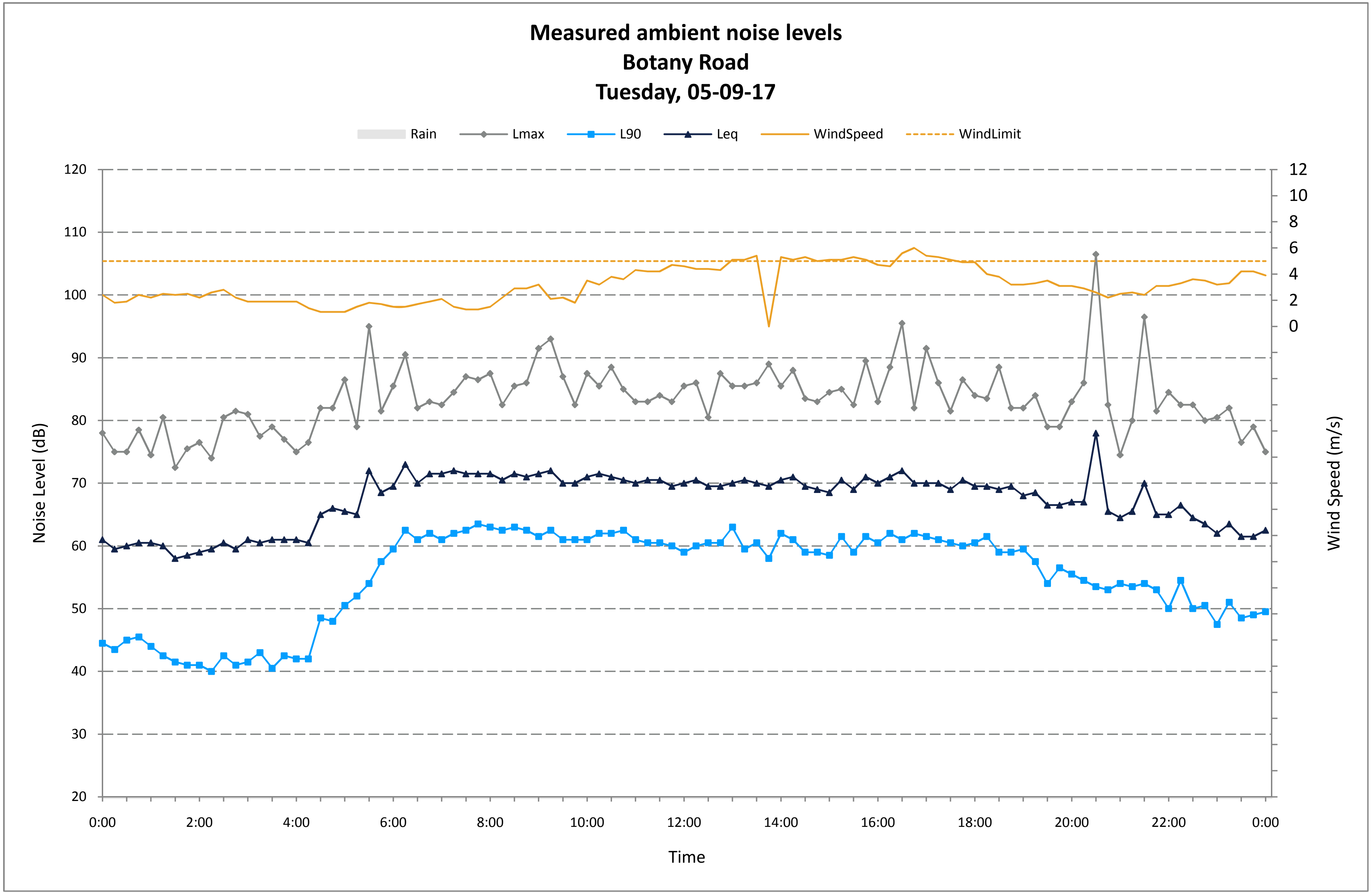
Measured ambient noise levels
Botany Road
Saturday, 02-09-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

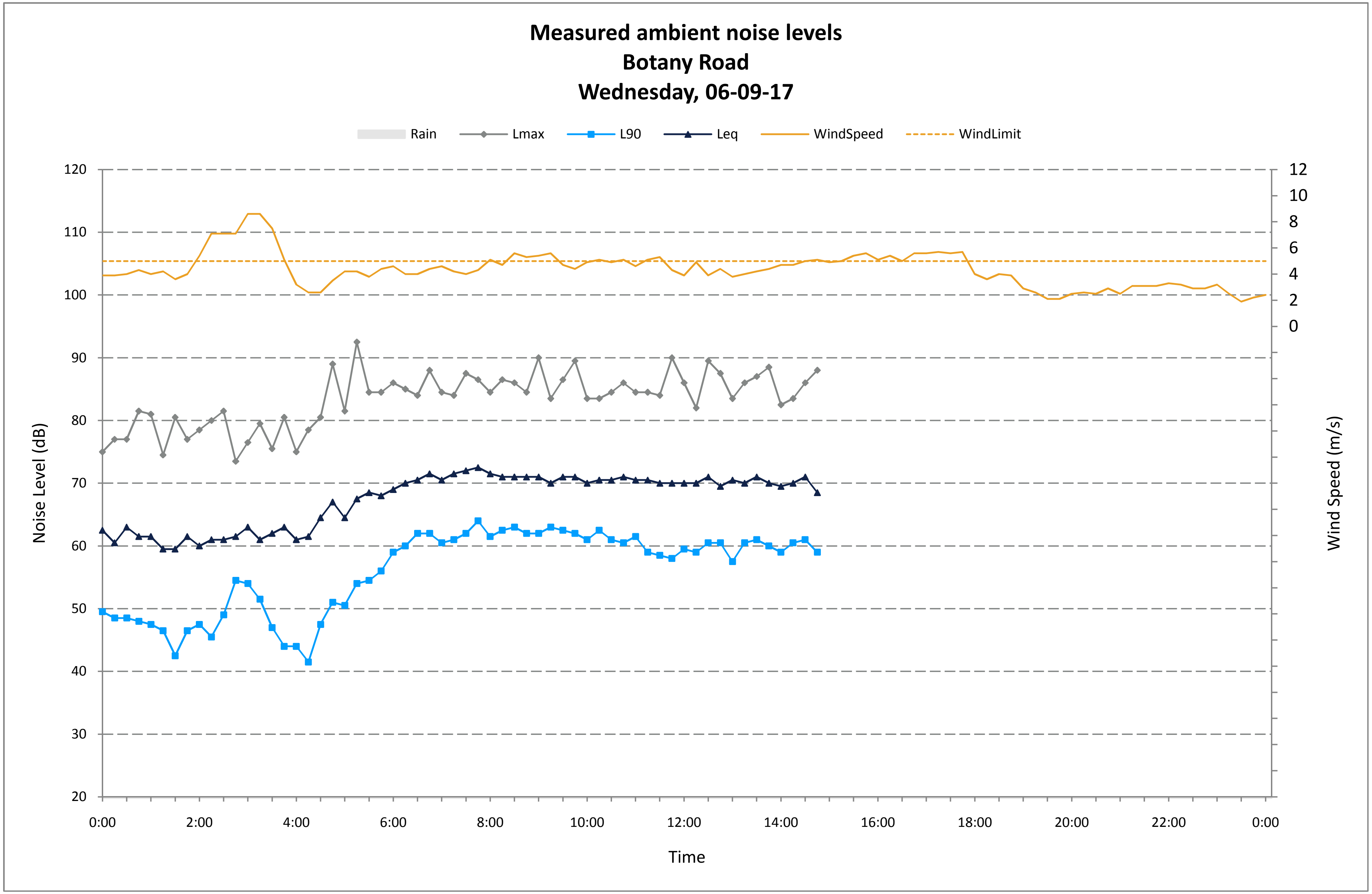


Measured ambient noise levels
Botany Road
Sunday, 03-09-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time



Measured ambient noise levels
Botany Road
Monday, 04-09-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

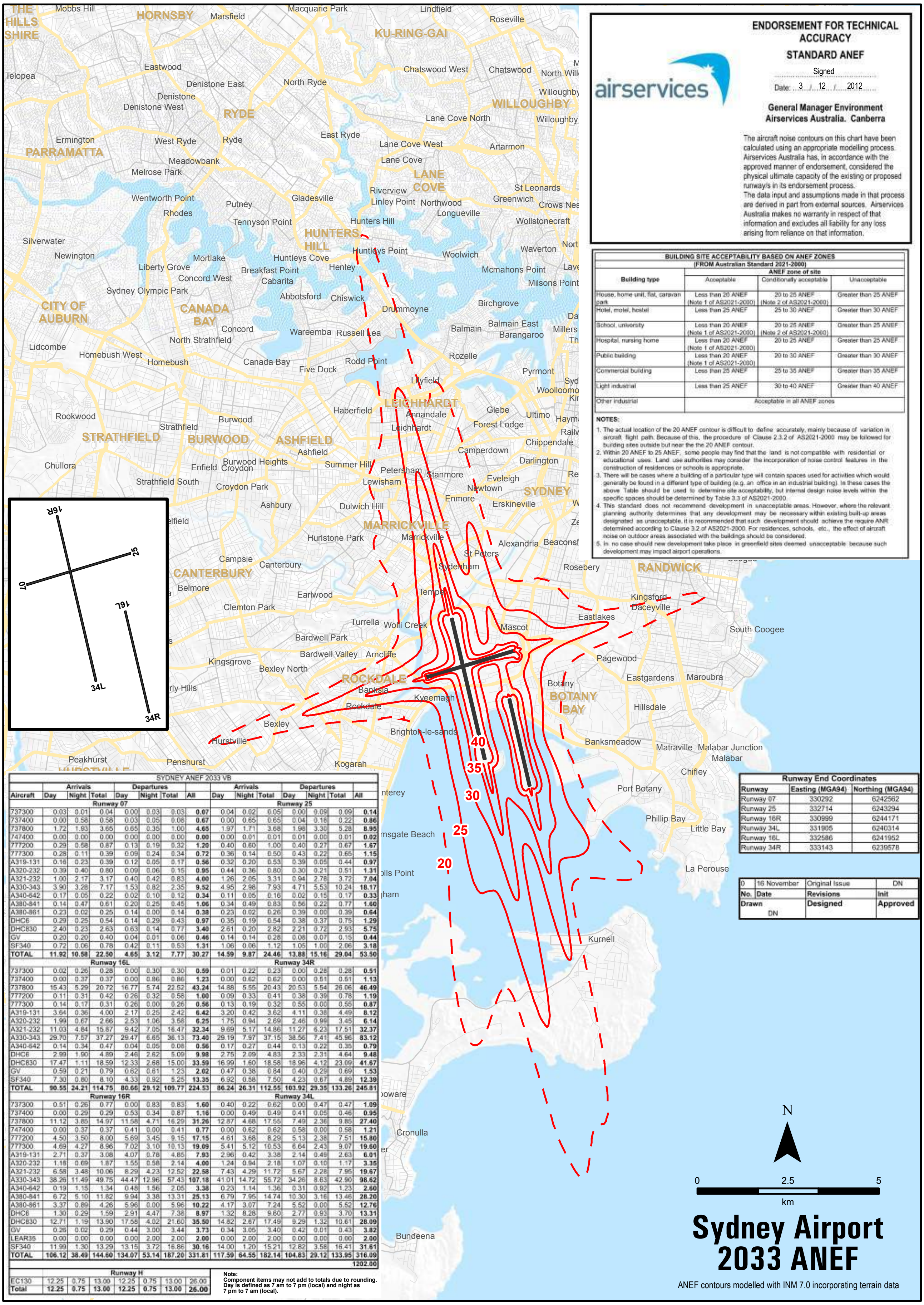

Measured ambient noise levels
Botany Road
Tuesday, 05-09-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00



Measured ambient noise levels
Botany Road
Wednesday, 06-09-17
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
120
110
100
90
80
70
60
50
40
30
20
Wind Speed (m/s)
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time

Appendix B

Sydney Kingsford Smith Airport ANEF 2033 Contours



Sydney Airport 2033 ANEF

ANEF contours modelled with INM 7.0 incorporating terrain data

ENDORSEMENT FOR TECHNICAL ACCURACY

STANDARD ANEF

Signed

Date: 3 / 12 / 2012

General Manager Environment
Airservices Australia. Canberra

The aircraft noise contours on this chart have been calculated using an appropriate modelling process. Airservices Australia has, in accordance with the approved manner of endorsement, considered the physical ultimate capacity of the existing or proposed runway/s in its endorsement process.
The data input and assumptions made in that process are derived in part from external sources. Airservices Australia makes no warranty in respect of that information and excludes all liability for any loss arising from reliance on that information.

BUILDING SITE ACCEPTABILITY BASED ON ANEF ZONES
(FROM Australian Standard 2021-2000)

Building type	ANEF zone of site		
	Acceptable	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF (Note 1 of AS2021-2000)	20 to 25 ANEF (Note 2 of AS2021-2000)	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF (Note 1 of AS2021-2000)	20 to 25 ANEF (Note 2 of AS2021-2000)	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF (Note 1 of AS2021-2000)	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF (Note 1 of AS2021-2000)	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 25 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

NOTES:

1. The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight path. Because of this, the procedure of Clause 2.3.2 of AS2021-2000 may be followed for building sites outside but near the the 20 ANEF contour.
2. Within 20 ANEF to 25 ANEF, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider the incorporation of noise control features in the construction of residences or schools is appropriate.
3. There will be cases where a building of a particular type will contain spaces used for activities which would generally be found in a different type of building (e.g. an office in an industrial building). In these cases the above Table should be used to determine site acceptability, but internal design noise levels within the specific spaces should be determined by Table 3.3 of AS2021-2000.
4. This standard does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable, it is recommended that such development should achieve the require ANR determined according to Clause 3.2 of AS2021-2000. For residences, schools, etc., the effect of aircraft noise on outdoor areas associated with the buildings should be considered.
5. In no case should new development take place in greenfield sites deemed unacceptable because such development may impact airport operations.

SYDNEY ANEF 2033 VB

	Arrivals			Departures				Arrivals			Departures			
Aircraft	Day	Night	Total	Day	Night	Total	All	Day	Night	Total	Day	Night	Total	All
Runway 07								**Runway 25**						
737300	0.03	0.01	0.04	0.00	0.03	0.03	**0.07**	0.04	0.02	0.05	0.00	0.09	0.09	**0.14**
737400	0.00	0.58	0.58	0.03	0.05	0.08	**0.67**	0.00	0.65	0.65	0.04	0.18	0.22	**0.86**
737800	1.72	1.93	3.65	0.65	0.35	1.00	**4.65**	1.97	1.71	3.68	1.98	3.30	5.28	**8.95**
747400	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.01	0.01	0.01	0.00	0.01	**0.02**
777200	0.29	0.58	0.87	0.13	0.19	0.32	**1.20**	0.40	0.60	1.00	0.40	0.27	0.67	**1.67**
777300	0.28	0.11	0.39	0.09	0.24	0.34	**0.72**	0.36	0.14	0.50	0.43	0.22	0.65	**1.15**
A319-131	0.16	0.23	0.39	0.12	0.05	0.17	**0.56**	0.32	0.20	0.53	0.39	0.05	0.44	**0.97**
A320-232	0.39	0.40	0.80	0.09	0.06	0.15	**0.95**	0.44	0.36	0.80	0.30	0.21	0.51	**1.31**
A321-232	1.00	2.17	3.17	0.40	0.42	0.83	**4.00**	1.26	2.05	3.31	0.94	2.78	3.72	**7.04**
A330-343	3.90	3.28	7.17	1.53	0.82	2.35	**9.52**	4.95	2.98	7.93	4.71	5.53	10.24	**18.17**
A340-642	0.17	0.05	0.22	0.02	0.10	0.12	**0.34**	0.11	0.05	0.16	0.02	0.15	0.17	**0.33**
A380-841	0.14	0.47	0.61	0.20	0.25	0.45	**1.06**	0.34	0.49	0.83	0.56	0.22	0.77	**1.60**
A380-861	0.23	0.02	0.25	0.14	0.00	0.14	**0.38**	0.23	0.02	0.26	0.39	0.00	0.39	**0.64**
DHC6	0.29	0.25	0.54	0.14	0.29	0.43	**0.97**	0.35	0.19	0.54	0.38	0.37	0.75	**1.29**
DHC830	2.40	0.23	2.63	0.63	0.14	0.77	**3.40**	2.61	0.20	2.82	2.21	0.72	2.93	**5.75**
GV	0.20	0.20	0.40	0.04	0.01	0.06	**0.46**	0.14	0.14	0.28	0.08	0.07	0.15	**0.44**
SF340	0.72	0.06	0.78	0.42	0.11	0.53	**1.31**	1.06	0.06	1.12	1.05	1.00	2.06	**3.18**
TOTAL	**11.92**	**10.58**	**22.50**	**4.65**	**3.12**	**7.77**	**30.27**	**14.59**	**9.87**	**24.46**	**13.88**	**15.16**	**29.04**	**53.50**
Runway 16L								**Runway 34R**						
737300	0.02	0.26	0.28	0.00	0.30	0.30	**0.59**	0.01	0.22	0.23	0.00	0.28	0.28	**0.51**
737400	0.00	0.37	0.37	0.00	0.86	0.86	**1.23**	0.00	0.62	0.62	0.00	0.51	0.51	**1.13**
737800	15.43	5.29	20.72	16.77	5.74	22.52	**43.24**	14.88	5.55	20.43	20.53	5.54	26.06	**46.49**
777200	0.11	0.31	0.42	0.26	0.32	0.58	**1.00**	0.09	0.33	0.41	0.38	0.39	0.78	**1.19**
777300	0.14	0.17	0.31	0.26	0.00	0.26	**0.56**	0.13	0.19	0.32	0.55	0.00	0.55	**0.87**
A319-131	3.64	0.36	4.00	2.17	0.25	2.42	**6.42**	3.20	0.42	3.62	4.11	0.38	4.49	**8.12**
A320-232	1.99	0.67	2.66	2.53	1.06	3.58	**6.25**	1.75	0.94	2.69	2.46	0.99	3.45	**6.14**
A321-232	11.03	4.84	15.87	9.42	7.05	16.47	**32.34**	9.69	5.17	14.86	11.27	6.23	17.51	**32.37**
A330-343	29.70	7.57	37.27	29.47	6.65	36.13	**73.40**	29.19	7.97	37.15	38.56	7.41	45.96	**83.12**
A340-642	0.14	0.34	0.47	0.04	0.05	0.08	**0.56**	0.17	0.27	0.44	0.13	0.22	0.35	**0.79**
DHC6	2.99	1.90	4.89	2.46	2.62	5.09	**9.98**	2.75	2.09	4.83	2.33	2.31	4.64	**9.48**
DHC830	17.47	1.11	18.59	12.33	2.68	15.00	**33.59**	16.99	1.60	18.58	18.96	4.12	23.09	**41.67**
GV	0.59	0.21	0.79	0.62	0.61	1.23	**2.02**	0.47	0.38	0.84	0.40	0.29	0.69	**1.53**
SF340	7.30	0.80	8.10	4.33	0.92	5.25	**13.35**	6.92	0.58	7.50	4.23	0.67	4.89	**12.39**
TOTAL	**90.55**	**24.21**	**114.75**	**80.66**	**29.12**	**109.77**	**224.53**	**86.24**	**26.31**	**112.55**	**103.92**	**29.35**	**133.26**	**245.81**
Runway 16R								**Runway 34L**						
737300	0.51	0.26	0.77	0.00	0.83	0.83	**1.60**	0.40	0.22	0.62	0.00	0.47	0.47	**1.09**
737400	0.00	0.29	0.29	0.53	0.34	0.87	**1.16**	0.00	0.49	0.49	0.41	0.05	0.46	**0.95**
737800	11.12	3.85	14.97	11.58	4.71	16.29	**31.26**	12.87	4.68	17.55	7.49	2.36	9.85	**27.40**
747400	0.00	0.37	0.37	0.41	0.00	0.41	**0.77**	0.00	0.62	0.62	0.58	0.00	0.58	**1.21**
777200	4.50	3.50	8.00	5.69	3.45	9.15	**17.15**	4.61	3.68	8.29	5.13	2.38	7.51	**15.80**
777300	4.69	4.27	8.96	7.02	3.10	10.13	**19.09**	5.41	5.12	10.53	6.64	2.43	9.07	**19.60**
A319-131	2.71	0.37	3.08	4.07	0.78	4.85	**7.93**	2.96	0.42	3.38	2.14	0.49	2.63	**6.01**
A320-232	1.18	0.69	1.87	1.55	0.58	2.14	**4.00**	1.24	0.94	2.18	1.07	0.10	1.17	**3.35**
A321-232	6.58	3.48	10.06	8.29	4.23	12.52	**22.58**	7.43	4.29	11.72	5.67	2.28	7.96	**19.67**
A330-343	38.26	11.49	49.75	44.47	12.96	57.43	**107.18**	41.01	14.72	55.72	34.26	8.63	42.90	**98.62**
A340-642	0.19	1.15	1.34	0.48	1.56	2.05	**3.38**	0.23	1.14	1.36	0.31	0.92	1.23	**2.60**
A380-841	6.72	5.10	11.82	9.94	3.38	13.31	**25.13**	6.79	7.95	14.74	10.30	3.16	13.46	**28.20**
A380-861	3.37	0.89	4.26	5.96	0.00	5.96	**10.22**	4.17	3.07	7.24	5.52	0.00	5.52	**12.76**
DHC6	1.30	0.29	1.59	2.91	4.47	7.38	**8.97**	1.32	8.28	9.60	2.77	0.93	3.70	**13.31**
DHC830	12.71	1.19	13.90	17.58	4.02	21.60	**35.50**	14.82	2.67	17.49	9.29	1.32	10.61	**28.09**
GV	0.26	0.02	0.29	0.44	3.00	3.44	**3.73**	0.34	3.05	3.40	0.42	0.01	0.43	**3.82**
LEAR35	0.00	0.00	0.00	0.00	2.00	2.00	**2.00**	0.00	2.00	2.00	0.00	0.00	0.00	**2.00**
SF340	11.99	1.30	13.29	13.15	3.72	16.86	**30.16**	14.00	1.20	15.21	12.82	3.58	16.41	**31.61**
TOTAL	**106.12**	**38.49**	**144.60**	**134.07**	**53.14**	**187.20**	**331.81**	**117.59**	**64.55**	**182.14**	**104.83**	**29.12**	**133.95**	**316.09**
														1202.00

Runway H							
EC130	12.25	0.75	13.00	12.25	0.75	13.00	26.00
Total	**12.25**	**0.75**	**13.00**	**12.25**	**0.75**	**13.00**	**26.00**

Note:
Component items may not add to totals due to rounding. Day is defined as 7 am to 7 pm (local) and night as 7 pm to 7 am (local).

Runway End Coordinates

Runway	Easting (MGA94)	Northing (MGA94)
Runway 07	330292	6242562
Runway 25	332714	6243294
Runway 16R	330999	6244171
Runway 34L	331905	6240314
Runway 16L	332586	6241952
Runway 34R	333143	6239578

0	16 November	Original Issue	DN
No.	**Date**	**Revisions**	**Init**
Drawn DN		**Designed**	**Approved**

This drawing has been prepared to illustrate the Sydney Airport Master Plan and is not intended to serve any other purpose. The drawing must be read in conjunction with the Master Plan.

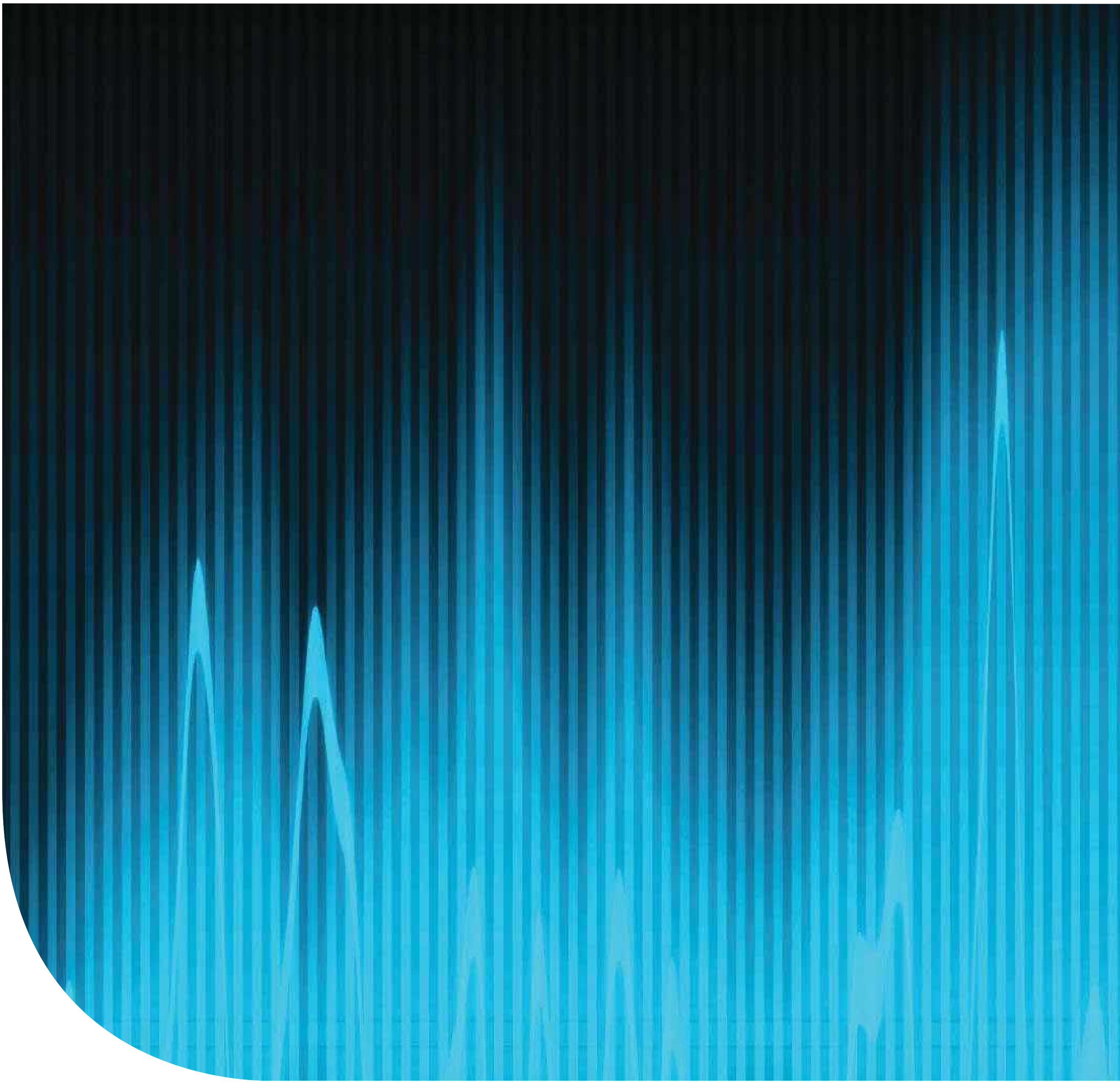
Figure 14.5
2033 ANEF
for Sydney Airport

EMM

SYDNEY
Ground floor, Suite 01, 20 Chandos Street
St Leonards, New South Wales, 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 1, Suite 6, 146 Hunter Street
Newcastle, New South Wales, 2300
T 02 4907 4800 F 02 4907 4899

BRISBANE
Level 4, Suite 01, 87 Wickham Terrace
Spring Hill, Queensland, 4000
T 07 3839 1800 F 07 3839 1866



www.emmconsulting.com.au