Acoustics
Vibration
Structural Dynamics

SYDNEY INTERNATIONAL EQUESTRIAN CENTRE

Noise Assessment for Permanent Events

24 March 2020

NSW Office of Sport c/- Creative Planning Solutions

TK611-01F02 Sydney International Equestrian Centre (r5).docx

Sydney Melbourne Brisbane Gold Coast Kuwait Singapore
Renzo Tonin & Associates ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

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1 Introduction

The NSW Office of Sport is preparing a Development Application (DA) to Fairfield City Council to obtain consent for permanent events, other than equestrian related events, at the Sydney International Equestrian Centre located in Horsley Park. Renzo Tonin & Associates was engaged to undertake a noise assessment, as part of the DA submission, to determine the capacity of the facility to host the non-equestrian events.

This report assesses the noise impacts from the proposed permanent events at the Sydney International Equestrian Centre by quantifying noise emission to nearby sensitive receivers in accordance with the relevant noise criteria. Where relevant, recommendations have been made for noise mitigation and management. The permanent events are proposed to occur in the following locations:

1. Hacking Arena
2. Main Arena 1
3. Indoor Arena 5.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Project description

2.1 Site description

The Sydney International Equestrian Centre is a world-class event venue set on 96 hectares of parkland and is located on the corner of the M7 Motorway and The Horsley Drive in Horsley Park. The site contains two road frontages, with access via Saxony Road to the south and The Horsley Drive to the north. The nearest residential receivers are located to the east along Cook Road and Martin Road, and to the west along Wallgrove Road.

Figure 1 presents an aerial photograph of the subject site and surrounding area.

2.2 Development proposal

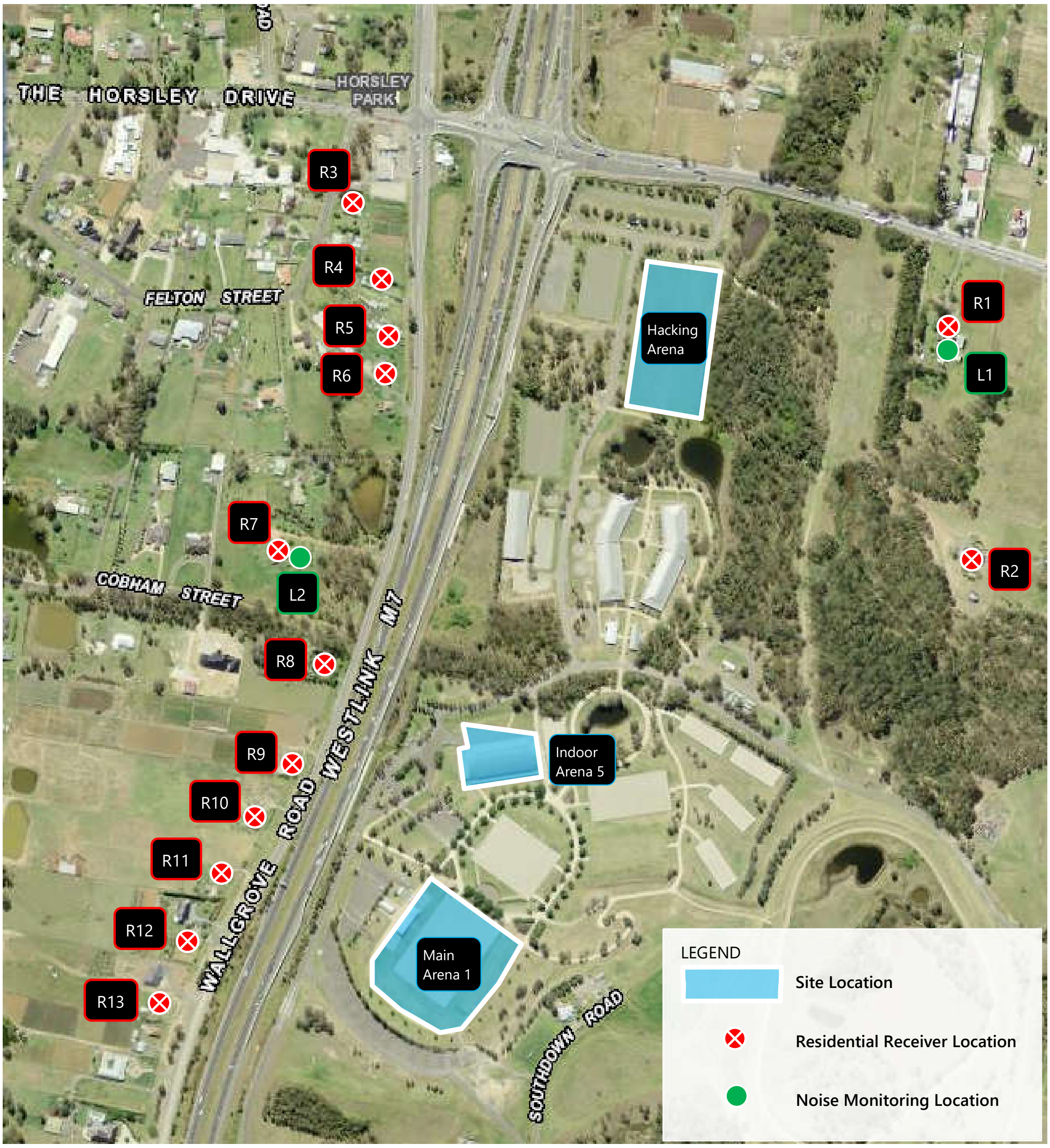
The Sydney International Equestrian Centre currently has approval for only equestrian-related events to be undertaken at the subject site. Since that time, event operators have lodged individual development application with Fairfield City Council for one-off events at the site, such as mud runs /obstacle courses. Given the success of these events, the NSW Office of Sports now wishes to seek consent from Fairfield City Council for permanent and varied events at the site.

The non-equestrian permanent events that may be hosted by the venue include:

- Fun runs
- Mud runs
- Festivals
- School concerts
- Gathering of religious nature
- Machinery / agricultural / hobbyist trade shows
- School cross country runs
- Emergency services training
- Defence force training
- Dog shows
- Rodeos

For assessment purposes operational noise modelling scenarios will consider permanent events such as fun runs and festivals, which are considered representative of the noise impacts from the broad events at the centre. Operational noise modelling considers the use of the Hacking Arena, Main Arena 1 and Indoor Arena 5 which are the venue locations closest to the identified noise sensitive receivers and permanent event held at these locations will potentially result in the greatest noise impact to the identified noise sensitive receivers. It is noted that potentially other venue locations may be used for permanent events.

Figure 1 – Site, receiver and noise monitoring locations



2.3 Acoustic assessment methodology

In order to assess the potential noise impact from the proposal, the following methodology was used:

- Identify nearest most potentially affected receiver locations
- Determine existing background noise levels at the nearest most potentially affected receiver locations
- Use measured background noise levels to establish noise goals in accordance with the relevant noise criteria
- Using predictive noise modelling and determine the extent of noise emission from the project at nearby premises
- Assess noise emission from the site against the relevant noise criteria
- Where noise emission from the site may exceed the relevant noise criteria, provide recommendations to reduce noise impacts from the site during the proposed permanent events.

3 Noise sensitive receivers

The nearest noise sensitive receiver locations have been identified and are presented in Figure 1 and outlined in Table 3.1.

Table 3.1 – Receiver locations

ID	Receiver Type	Address	Description
R1	Residential	1662 The Horsley Drive	Residential dwelling located approximately 278m east of the Hacking Arena
R2	Residential	1673-1674 The Horsley Drive	Residential dwelling located approximately 362m southeast of the Hacking Arena
R3	Residential	13-17 Felton Street	Residential dwelling located approximately 365m west of the Hacking Arena
R4	Residential	553-559 Wallgrove Road	Residential dwelling located approximately 310m west of the Hacking Arena
R5	Residential	545-551 Wallgrove Road	Residential dwelling located approximately 290m west of the Hacking Arena
R6	Residential	529-543 Wallgrove Road	Residential dwelling located approximately 295m west of the Hacking Arena
R7	Residential	501-511 Wallgrove Road	Residential dwelling located approximately 460m southwest of the Hacking Arena and 300m northwest of the Indoor Arena 5
R8	Residential	489-499 Wallgrove Road	Residential dwelling located approximately 177m west of the Indoor Arena 5
R9	Residential	477-487 Wallgrove Road	Residential dwelling located approximately 200m west of the Indoor Arena 5 and 225m northwest of the Main Arena 1
R10	Residential	467-475 Wallgrove Road	Residential dwelling located approximately 255m southwest of the Indoor Arena 5 and 210m northwest of the Main Arena 1
R11	Residential	455-465 Wallgrove Road	Residential dwelling located approximately 210m west of the Main Arena 1
R12	Residential	447-453 Wallgrove Road	Residential dwelling located approximately 240m west of the Main Arena 1
R13	Residential	437-445 Wallgrove Road	Residential dwelling located approximately 275m west of the Main Arena 1

4 Existing acoustic environment

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 'Noise Policy for Industry' (NPfI, Environment Protection Authority 2017) requires that the level of background and ambient noise be assessed separately for the daytime. Evening and night-time periods. The NPfI 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.

4.1 Noise measurement locations

Noise measurements are ideally carried out at the nearest or most potentially affected locations surrounding a development. An alternative, representative location should be established in the case of access restrictions or if a safe and secure location cannot be identified. Furthermore, representative locations may be established in the case of multiple receivers as it is usually impractical to carry out measurements at all locations surrounding a site.

The long-term noise monitoring locations are shown in Figure 1 and outlined in Table 4.1.

Table 4.1 – Noise monitoring locations

ID	Address	Description
L1	1662 The Horsley Drive, Horsley Park	The noise monitor was located within the backyard of the property, approximately 40m from the dwelling and placed in the free-field (ie. away from any buildings). The noise environment at this location is considered representative of receiver locations to the east of the equestrian centre site, namely Receivers R1 and R2.
L2	501-511 Wallgrove Road, Horsley Park	The noise monitor was located within the front yard of the property, approximately 16m from the dwelling and placed in the free-field. The noise environment at this location is considered representative of receiver locations to the west of the equestrian site, namely Receivers R3 to R13.

4.2 Long-term noise monitoring results

Long-term noise monitoring was carried out from Thursday 20th June to Thursday 4th July 2019. The long-term noise monitoring methodology is detailed in Appendix B, and noise level-vs-time graphs of the data are included in Appendix C.

Table 4.2 presents the overall single L_{90} Rating Background Levels (RBL) and representative ambient L_{eq} noise levels for each assessment period, determined in accordance with the NPfI.

Table 4.2 – Long-term noise monitoring results, dB(A)

ID	Address	L_{A90} Background noise levels			L_{Aeq} Ambient noise levels		
		Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]
L1	1662 The Horsley Drive Horsley Park	46	46	41	53	52	51
L2	501-511 Wallgrove Road, Horsley Park	55	52	46	59	58	57

Notes:
1. Day: 7:00am - 6:00pm Monday to Saturday and 8:00am - 6:00pm Sundays & Public Holidays
2. Evening: 6:00pm - 10:00pm Monday to Sunday & Public Holidays
3. Night: 10:00pm - 7:00am Monday to Saturday and 10:00pm - 8:00am Sundays & Public Holidays.

5 Meteorology

Certain meteorological conditions may increase noise levels by focusing sound-wave propagation paths at a single point. Such refraction of sound waves occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level) and where there is a wind gradient (that is, wind velocities increasing with height) with wind direction from the source to the receiver.

Temperature inversions occurring within the lowest 50 metres (m) to 100 m of atmosphere can affect noise levels measured on the ground. Temperature inversions are most commonly caused by radiative cooling of the ground at night leading to the cooling of the air in contact with the ground. This is especially prevalent on cloudless nights with little wind. Air that is somewhat removed from contact with the ground will not cool as much, resulting in warmer air aloft than nearer the ground.

Similarly, when significant wind exists, the conditions can significantly affect noise levels at receptor points downwind of a noise source. This would depend, however, on the particular direction and the velocity of the wind at that time. It should also be noted that although wind can increase noise emission levels as perceived from a downstream assessment point, background noise also tends to increase as a result of increased wind activity. This often causes masking of potential increases in intrusive noise.

The NSW EPA's NPfI recommends that project noise criteria are to apply under weather conditions characteristic of an area. These conditions may include calm, wind and temperature inversions. In this regard, the increase in noise that results from atmospheric temperature inversions and wind effects may need to be assessed. The noise levels predicted under characteristic meteorological conditions for each receiver are then compared with the criteria, to establish whether the meteorological effect will cause a significant impact.

The NSW EPA's NPfI permits two approaches for assessing these effects: use of default parameters and use of site-specific parameters.

- When using default parameters, general meteorological values are used to predict noise levels, foregoing detailed analyses of site-specific meteorological data. This approach assumes that meteorological effects are conservative, in that it is likely to predict the upper range of increases in noise levels. Actual noise levels may be less than predicted.
- The use of site-specific parameters is a more detailed approach, which involves analysing site meteorological data to determine whether inversion and/or wind effects are significant features warranting assessment. Where assessment is warranted, default parameters are available for use in predicting noise or, where preferred, measured values may be used instead. The use of site-specific parameters provides a more accurate prediction of noise increases due to meteorological factors.

For this assessment, the more detailed approach using site-specific meteorological parameters was conducted. Weather data was provided taken from the Horsley Park automatic weather station for the year 2019.

5.1 Temperature Inversions

Assessment of impacts from temperature inversions is confined to the winter night-time period, as this is the time likely to have temperature inversions and produce the greatest impact on amenity of nearby residences. As some events operates at night-time, there is potential for noise impact due to inversions and further consideration of these effects is required.

For a conservative assessment the occurrence of temperature inversions has been considered in this assessment and the default F class temperature inversion parameter has been considered in the noise modelling.

5.2 Wind Effects

The NPfI specifies a procedure for assessing the significance of wind effects, and a default wind speed to be used in the assessment where these effects are found to be significant. The procedure requires that wind effects be assessed where wind is a feature of the area. The assessment considers each of the four seasons and assessment periods (day, evening, and night) individually.

Wind is considered to be a feature where source-to-receiver wind speeds (at 10 m height) of 0.5 to 3 metres per second (m/s) occur for 30% of the time or more in any assessment period (day, evening and night) in any season. Winds with velocities less than 0.5 m/s (calm conditions) and greater than 3 m/s (at 10 m height), are not included in the calculations of wind occurrence.

Analysis of the wind data was undertaken using the EPA's Noise Enhancement Wind Analysis program to determine if wind is a 'feature' of the area as defined by the NPfI. The program determines whether there are prevailing source-to-receiver wind conditions. The results of the analysis are presented in Table 5.1 below.

Table 5.1 – Percentage of Wind Records (up to 3 m/s) from Subject Site to Receiver, %

Direction	Summer			Autumn			Winter			Spring		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
N	8.2	15.8	28.8	12.6	28.9	27.1	8.7	16.7	12.0	8.6	22.0	26.0
NE	11.9	23.0	**31.1**	15.7	**30.2**	**30.8**	6.9	13.7	**31.9**	0.0	0.0	0.0
E	6.0	4.7	13.0	14.3	12.9	22.0	20.0	29.0	**37.6**	7.6	6.6	21.7
SE	12.2	2.6	4.7	17.1	9.3	12.9	23.4	24.3	25.2	11.7	3.3	10.3
S	20.0	9.4	8.0	19.9	18.3	18.1	18.1	7.3	7.5	0.0	0.0	0.0
SW	20.5	24.2	9.0	16.8	9.4	1.1	8.7	4.0	1.8	17.7	19.3	5.4
W	10.1	28.5	11.4	8.6	13.6	1.0	4.8	6.2	0.6	11.9	24.8	6.3
NW	14.2	28.3	19.1	15.7	21.5	7.4	8.9	8.7	1.1	12.9	23.5	9.6

Direction	Summer			Autumn			Winter			Spring		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night

Notes Bold denotes greater than 30% occurrence of wind scenario.

The results above indicate that there are greater than 30% occurrence of winds between 0.5 m/s and 3 m/s (source-to-receiver component) for certain directions. Therefore, there are prevailing wind conditions in accordance with the NPfI, and wind effects are considered in this assessment for the directions.

5.3 Summary of Meteorological Assessment Conditions

Based on the findings in Section 5.1 and Section 5.2, Table 5.2 below presents a summary of the meteorological conditions considered for the operational noise computer modelling.

Table 5.2 – Summary of Meteorological Assessment Conditions

Period	Meteorological Assessment Condition
Day	Calm
Evening	Calm
	NE Wind
Evening and Night	Calm
	NE Wind
	E Wind
	F Class Inversion

6 Noise criteria

Noise impact is assessed in accordance with the NPfI. The assessment procedure has two components:

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

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level, which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

6.1 Project intrusive noise levels

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

$L_{Aeq,15minute}$ **Intrusiveness noise level = Rating Background Level ('RBL') plus 5dB(A)**

Based on the minimum RBLs and the proposed operating hours of the events, the intrusiveness noise levels for residential receivers are reproduced in Table 6.1 below.

Table 6.1 – Intrusiveness noise levels, dB(A)

Receiver	Intrusiveness Noise Level, $L_{Aeq,15min}$		
	Day	Evening	Night
Receivers R1 to R2	46 + 5 = **51**	46 + 5 = **51**	41 + 5 = **46**
Receivers R3 to R13	55 + 5 = **60**	52 + 5 = **57**	46 + 5 = **51**

6.2 Amenity noise levels

The project amenity noise levels for different time periods of the day are determined in accordance with Section 2.4 of the NPfI. The NPfI recommends amenity noise levels ($L_{Aq,period}$) for various receivers and represent the objective for total industrial noise experienced at receiver locations. However, when assessing a single development and its impact on an area, "project amenity noise levels" apply.

The recommended amenity noise levels applicable for the subject area are reproduced in Table 6.2 below.

Table 6.2 – Recommended amenity noise levels, dB(A)

Type of Receiver	Noise Amenity Area	Time of Day	Recommended Amenity Noise Level, L_{Aeq}
Residential	Suburban	Day	55
		Evening	45
		Night	40

Notes: 1. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period

2. The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration.

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the project amenity noise level that applies for each new noise source is determined as follows:

$L_{Aeq,period}$ Project amenity noise level = $L_{Aeq,period}$ Recommended amenity noise level – 5dB(A)

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$L_{Aeq,15minute} = L_{Aeq,period} + 3dB(A)$

The project amenity noise levels ($L_{Aeq,\ 15min}$) applied for this project are reproduced in Table 6.3 below, based on a 'suburban' noise amenity area.

Table 6.3 – Project amenity noise levels, dB(A)

Type of Receiver	Noise Amenity Area	Time of Day	Project Amenity Noise Level	
			$L_{Aeq,\ Period}$	$L_{Aeq,\ 15min}$
Residence	Suburban	Day	55 – 5 = 50	50 + 3 = **53**
		Evening	45 – 5 = 40	40 + 3 = **43**
		Night	40 – 5 = 35	35 + 3 = **38**

6.3 Project Noise Trigger Levels

In accordance with the NPfI the project noise trigger levels (PNTLs), which are the lower (i.e. more stringent) value of the project intrusiveness noise level and project amenity noise level, have been determined as shown in Table 6.4 below.

Table 6.4 – $L_{Aeq,\ 15min}$ project noise trigger levels, dB(A)

Receiver Location	Day	Evening	Night
Receivers R1 to R2	51	43	38
Receivers R3 to R13	53	43	38

6.4 Sleep disturbance noise levels

The potential for sleep disturbance from maximum noise level events from the proposed permanent events during the night-time period should be considered. In accordance with the NPfI, a detailed maximum noise level event assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

- **$L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or**
- **L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater.**

Where there are noise events found to exceed the initial screening level, further analysis is undertaken to identify:

- The likely number of events that might occur during the night assessment period,
- The extent to which the maximum noise level exceeds the rating background noise level.

Therefore, the sleep disturbance noise levels for the project are presented in Table 6.5.

Table 6.5 – Sleep disturbance assessment levels, dB(A)

Receiver	Assessment Level $L_{Aeq,15min}$	Assessment Level L_{AFmax}
Receiver R1 to R2	41 + 5 = **46**	41 + 15 = **56**
Receiver R3 to R13	46 + 5 = **51**	46 + 15 = **67**

There is unlikely to be significant variation between $L_{Aeq,15min}$ values and L_{AFmax} values for the specific sources of noise proposed for the permanent events. Hence, compliance with the more stringent project trigger noise level presented in Table 6.4 will result in compliance with the project's sleep disturbance criteria set out in Table 6.5.

7 Operational noise assessment

7.1 Operational noise modelling scenarios

Operational noise modelling scenarios will consider permanent events such as fun runs and festivals, which are considered representative of the noise impacts from the broad events at the centre. Within the modelled scenarios, fun runs would occur during the daytime period and would be held at the Hacking Arena or Main Arena 1. Festivals would typically occur during the day, evening and/or night time periods and would be held at the Main Arena 1 or Indoor Arena 5. Operational noise from these permanent events would include public announcement (PA) system noise, music noise and patron noise.

Based on the modelled operational events , there would potentially be up to nine (9) scenarios, described as follows:

1. Fun run – Hacking Arena during the daytime period
2. Fun run (No PA System) – Hacking Arena during the daytime period
3. Fun run – Main Arena 1 during the daytime period
4. Festival – Main Arena 1 during the daytime period
5. Festival – Main Arena 1 during the evening period
6. Festival – Main Arena 1 during the night period
7. Festival – Indoor Arena 5 during the daytime period
8. Festival – Indoor Arena 5 during the evening period
9. Festival – Indoor Arena 5 during the night period

7.2 Operational noise sources

The source noise levels used for the predictions and presented in Table 7.1, were obtained from previous noise measurements of similar types of activities and held in our database and library.

Table 7.1 – Source noise levels for operations

Area	Applicable noise source	Sound Power Level, dB(A)
Hacking Arena	PA system used for music	114
Hacking Arena	Amplified music utilising portable speaker (max 2m above ground level)	107
Hacking Arena	PA system used for announcements (reduced levels)	109
Main Arena 1	PA system used for music	117
Main Arena 1	Amplified music utilising portable speaker (max 2m above ground level)	107

Area	Applicable noise source	Sound Power Level, dB(A)
Main Arena 1	PA system used for announcements (reduced levels)	109
Indoor Arena 5	PA system used for music	118
Indoor Arena 5	Amplified music utilising portable speaker (max 2m above ground level)	107
Indoor Arena 5	PA system used for announcements (reduced levels)	109
All areas	Patrons with no music (per person - male loud voice)	83
All areas	Patrons with no music (per person – female loud voice	79

7.3 Noise modelling methodology

The noise predictions were carried out using the CadnaA noise modelling software, which takes into account sound radiation patterns, acoustic shielding and potential reflections from intervening building elements, and noise attenuation due to distance.

The operational scenario parameters presented in Table 7.2, as discussed with the client, have been adopted for acoustic modelling purposes.

7.4 Noise predictions and assessment

Table 7.3 summarises the results of the noise modelling and assessment, presenting the predicted noise emission levels at the identified assessment locations against the established noise goals.

Table 7.2 – Operational scenario parameters

Scenario	Type of event	Period	No. of Patrons (nominal maximum capacity)[1]	Patronaged area(s)	PA system zone/area used for music	PA system zone/area used for announcements (up to 1 min in any 15 min period)	Amplified music utilising portable speakers (max 2m above ground level)
1	Fun Run	Daytime	2,000	Hacking Arena	Hacking Arena	Hacking Arena (All zones)	N/A
2	Fun Run	Daytime	4,000	Hacking Arena	N/A	Hacking Arena (Reduced levels)	Hacking Arena
3	Fun Run	Daytime	4,000	Main Arena 1	Main Arena 1	Main Arena 1 (All zones)	N/A
4	Festivals	Daytime	8,000	Main Arena 1	N/A	Main Arena 1 (All zones)	Main Arena 1
5	Festivals	Evening	8,000	Main Arena 1	N/A	Main Arena 1 (Reduced levels)	Main Arena 1 (Reduced levels)
6	Festivals	Night	4,000	Main Arena 1	N/A	Main Arena 1 (Reduced levels)	Main Arena 1 (Reduced levels)
7	Festivals	Daytime	10,000	Indoor Arena 5	Indoor Arena 5	Indoor Arena 5 (All zones)	Centre of Indoor Arena 5
8	Festivals	Evening	10,000	Indoor Arena 5	Indoor Arena 5	Indoor Arena 5 (All zones)	Centre of Indoor Arena 5
9	Festivals	Night	8,000	Indoor Arena 5	N/A	Indoor Arena 5 (Reduced levels)	Centre of Indoor Arena 5 (Reduced levels)

Note: 1. Modelling accounts for 50% of patrons talking at any one time

Table 7.3 – Predicted noise levels at nominated receiver locations

Scen-ario	Type of event	Operational period	Met. Condition	Patronaged area	Description	Predicted noise level, $L_{Aeq,\,15min}$, dB(A)												
						R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
1	Fun run	Daytime	Calm	Hacking Arena	*Criteria*	*51*	*51*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*
					Predicted noise level	51	49	46	47	49	50	43	42	40	38	37	36	35
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	Fun run	Daytime	Calm	Hacking Arena	*Criteria*	*51*	*51*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*
					Predicted noise level	51	48	44	46	46	46	41	40	38	36	35	34	33
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	Fun run	Daytime	Calm	Main Arena 1	*Criteria*	*51*	*51*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*
					Predicted noise level	42	44	39	40	42	43	46	50	52	53	53	52	50
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	Festival	Daytime	Calm	Main Arena 1	*Criteria*	*51*	*51*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*
					Predicted noise level	42	45	42	42	44	45	48	51	52	53	53	52	50
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	Festival	Evening	Calm	Main Arena 1	*Criteria*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*
					Predicted noise level	32	35	32	32	35	35	38	41	41	42	43	42	40
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	Festival	Evening	NE Wind	Main Arena 1	*Criteria*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*
					Predicted noise level	5	35	38	35	36	38	39	42	43	42	41	41	39
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	Festival	Night	Calm	Main Arena 1	*Criteria*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
					Predicted noise level	26	29	26	27	29	30	33	36	36	37	38	36	34
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	Festival	Night	NE Wind	Main Arena 1	*Criteria*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
					Predicted noise level	30	33	30	31	33	33	36	38	37	36	36	34	32
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	Festival	Night	E Wind	Main Arena 1	*Criteria*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
					Predicted noise level	30	33	30	31	33	33	36	38	37	36	36	34	32
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	Festival	Night	E Wind	Temp. Inversion	*Criteria*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
					Predicted noise level	30	33	30	31	33	33	36	39	38	39	40	39	37

Scen-ario	Type of event	Operational period	Met. Condition	Patronaged area	Description	Predicted noise level, $L_{Aeq,\,15min}$, dB(A)												
						R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes
7	Festival	Daytime	Calm	Indoor Arena 5	*Criteria*	*51*	*51*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*	*53*
					Predicted noise level	43	45	40	42	44	45	47	51	48	49	48	47	45
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	Festival	Evening	Calm	Indoor Arena 5	*Criteria*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*
					Predicted noise level	35	37	32	34	36	37	39	43	40	41	40	39	37
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	Festival	Evening	NE Wind	Indoor Arena 5	*Criteria*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*	*43*
					Predicted noise level	35	37	32	34	36	37	39	43	40	41	40	39	37
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	Festival	Night	Calm	Indoor Arena 5	*Criteria*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
					Predicted noise level	30	32	27	28	30	31	34	38	35	36	35	33	31
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	Festival	Night	NE Wind	Indoor Arena 5	*Criteria*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
					Predicted noise level	30	32	27	28	30	31	34	38	35	36	35	33	31
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	Festival	Night	E Wind	Indoor Arena 5	*Criteria*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
					Predicted noise level	30	32	27	28	30	31	34	38	35	36	35	33	31
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	Festival	Night	Temp Inversion	Indoor Arena 5	*Criteria*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*	*38*
					Predicted noise level	30	32	27	28	30	31	34	38	35	36	35	33	31
					Complies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Provided that the operational scenario parameters in Table 7.2 are adhered to, noise levels are predicted to comply with the established noise goals at the identified receivers for all assessed operational scenarios except for Scenario 6 where minor exceedances of up to 2dB(A) occur at Receivers R8, R10 and R11 during night time temperature inversion occurrences. In accordance with the NPfI, an exceedance of up to 2dB(A) is considered to be negligible and the exceedance would not be discernible by the average listener and therefore would not warrant further noise treatments or controls. Furthermore, temperature inversion would occur only during the Winter periods on some nights and occurrences over the entire calendar year would be considered infrequent.

7.5 Recommendations

Noise monitoring of the first event or associated sound-check will be critical to validate and verify appropriate noise levels for the permanent events.

Noise monitoring at both the receiver locations and at the PA system and/or amplified music location(s) would be required to manage noise levels during the event. A coordinated communication procedure between off site monitoring location and on site management would be required to ensure any exceedances are promptly addressed. Benchmarks for internal noise levels should be established early in the event and communicated to the sound engineers for each performer, as relevant. It is recommended that a representative from the event be responsible for the overseeing of all music mixing duties to ensure noise is appropriately managed.

The external noise monitoring should ideally be undertaken at the assessment locations outlined above, for the first event at minimum, and otherwise representative locations would need to be determined.

8 Conclusion

An operational noise assessment has been undertaken as part of the DA submission to Fairfield City Council for proposed permanent events, other than equestrian related events, at the Sydney International Equestrian Centre located in Horsley Park. Specifically, this report has quantified operational noise emission from proposed permanent events, including fun runs and festivals, and has assessed noise at the nearest sensitive receivers. Noise emission levels from the proposed permanent events for different scenarios, which are broadly indicative of the range of worst case noise impacts associated with the expanded use of the centre, have been predicted and were assessed as generally complying with the established noise goals in accordance with the NPfI.

Furthermore, on the basis of the assessment, recommendations have been made in regard to noise management measures to be incorporated into the operation of the development in order to maintain compliance during the proposed permanent events.

APPENDIX A Glossary of terminology

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

Absorption Coefficient α	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.
Air-borne noise	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 source and receiver.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Amenity	A desirable or useful feature or facility of a building or place.
AS	Australian Standard
Assessment period	The time period in which an assessment is made. e.g. Day 7am-10pm & Night 10pm-7am.
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
Background noise	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. 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 LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.
Berm	Earth or overburden mound.
Buffer	An area of land between a source and a noise-sensitive receiver and may be an open space or a noise-tolerant land use.
Bund	A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound.
BS	British Standard
CoRTN	United Kingdom Department of Environment entitled “Calculation of Road Traffic Noise (1988)”

Decibel [dB]	The units of sound measurement. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear, defined as 20 micro Pascal 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 110dB Operating a chainsaw or jackhammer 120dB Deafening
dB(A)	A-weighted decibel. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in 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 is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.
Diffraction	The distortion of sound waves caused when passing tangentially around solid objects.
DIN	German Standard
ECRTN	Environmental Criteria for Road Traffic Noise, NSW, 1999
EPA	Environment Protection Authority
Field Test	A test of the sound insulation performance in-situ. See also 'Laboratory Test' The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion. A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.
Fluctuating Noise	Noise that varies continuously to an appreciable extent over the period of observation.
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	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.
Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
IGANRIP	Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects, NSW DEC 2007

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.
INP	NSW Industrial Noise Policy, EPA 1999
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.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L10(1hr)	The L10 level measured over a 1 hour period.
L10(18hr)	The arithmetic average of the L10(1hr) levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq or Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the LAeq.
LAeq(1hr)	The LAeq noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted Leq during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
LAeq(8hr)	The LAeq noise level for the period 10pm to 6am.
LAeq(9hr)	The LAeq noise level for the period 10pm to 7am.
LAeq(15hr)	The LAeq noise level for the period 7am to 10pm.
LAeq (24hr)	The LAeq noise level during a 24 hour period, usually from midnight to midnight.
Lmax	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the LAmax.
Lmin	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the LAmin.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
NCA	Noise Catchment Area. An area of study within which the noise environment is substantially constant.
Noise	Unwanted sound
Pre-construction	Work in respect of the proposed project that includes design, survey, acquisitions, fencing, investigative drilling or excavation, building/road dilapidation surveys, minor clearing (except where threatened species, populations or ecological communities would be affected), establishing ancillary facilities such as site compounds, or other relevant activities determined to have minimal environmental impact (e.g. minor access roads).
Reflection	Sound wave reflected from a solid object obscuring its path.
RING	Rail Infrastructure Noise Guideline, NSW, May 2013

RMS	Root Mean Square value representing the average value of a signal.
Rw	Weighted Sound Reduction Index A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory. The term supersedes the value STC which was used in older versions of the Building Code of Australa. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w. The higher the value the better the acoustic performance of the building element.
R'w	Weighted Apparent Sound Reduction Index. As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The higher the value the better the acoustic performance of the building element.
RNP	Road Noise Policy, NSW, March 2011
Sabine	A measure of the total acoustic absorption provided by a material. It is the product of the Absorption Coefficient (alpha) and the surface area of the material (m2). For example, a material with alpha = 0.65 and a surface area of 8.2m2 would have 0.65 x 8.2 = 5.33 Sabine. Sabine is usually calculated for each individual octave band (or third-octave).
SEL	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 Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the Rw and the sound insulation between two rooms can be described by the DnT,w.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Spoil	Soil or materials arising from excavation activities.
STC	Sound Transmission Class A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory. The term has been superseded by Rw.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.

Transmission Loss	The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also the vibration level difference between one point and another. For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the Rw or R'w or DnT,w.

APPENDIX B Long-term noise monitoring methodology

B.1 Noise monitoring equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the following instrumentation:

Description	Type	Octave band data	Logger location(s)
RTA06 (NTi Audio XL2, with low noise microphone)	Type 1	1/1	L1, L2

Notes: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table, and are suitable for field use.

The equipment was calibrated prior and subsequent to the measurement period 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 NSW NPfI. Determination of extraneous meteorological conditions was based on data provided by the Bureau of Meteorology (BOM), for a location considered representative of the noise monitoring location(s). However, the data was adjusted to account for the height difference between the BOM weather station, where wind speed and direction is recorded at a height of 10m above ground level, and the microphone location, which is typically 1.5m above ground level (and less than 3m). The correction factor applied to the data is based on Table C.1 of ISO 4354:2009 '*Wind actions on structures*'.

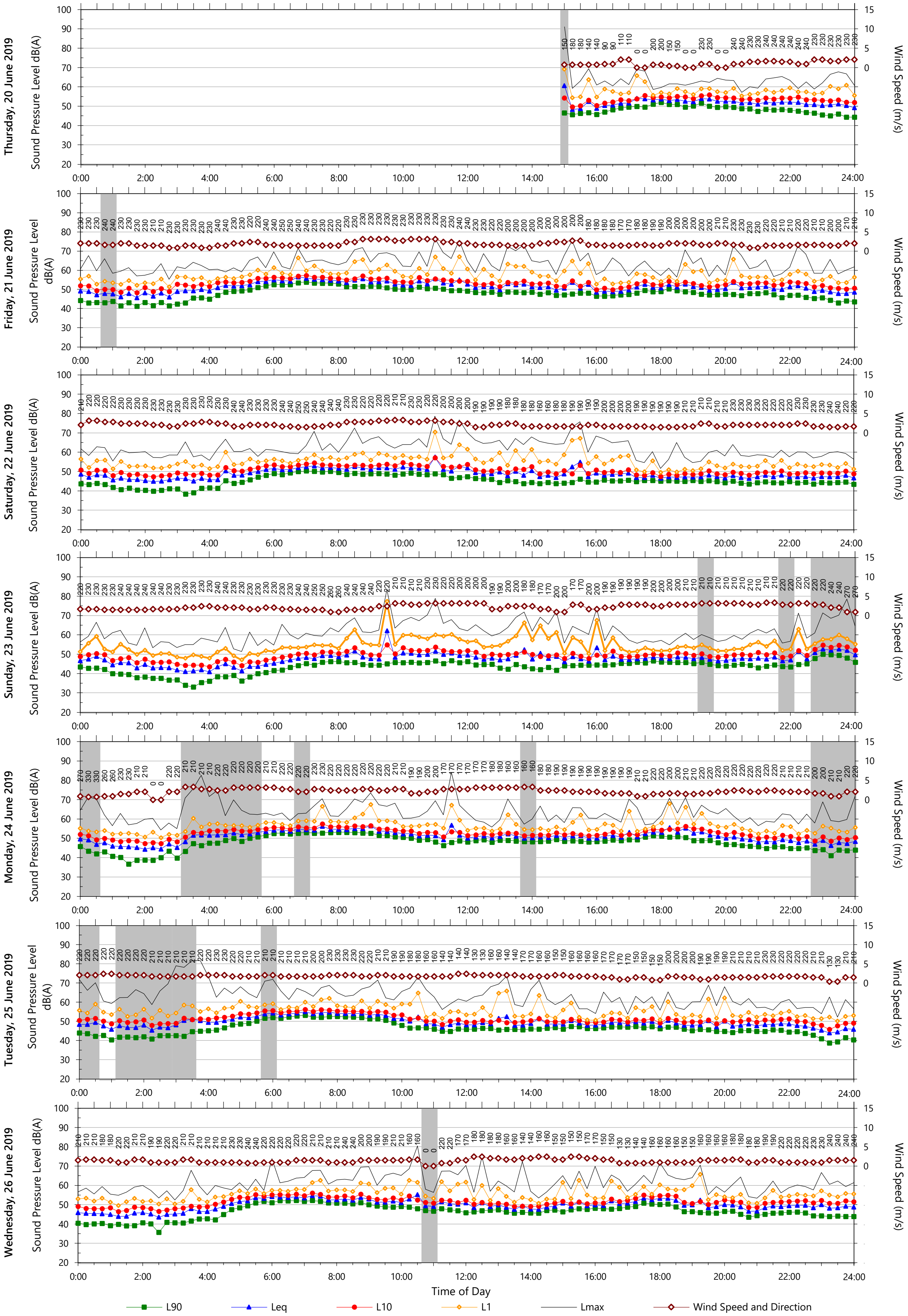
B.3 Noise vs time graphs

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, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C Long-term noise monitoring results

Unattended Monitoring Results

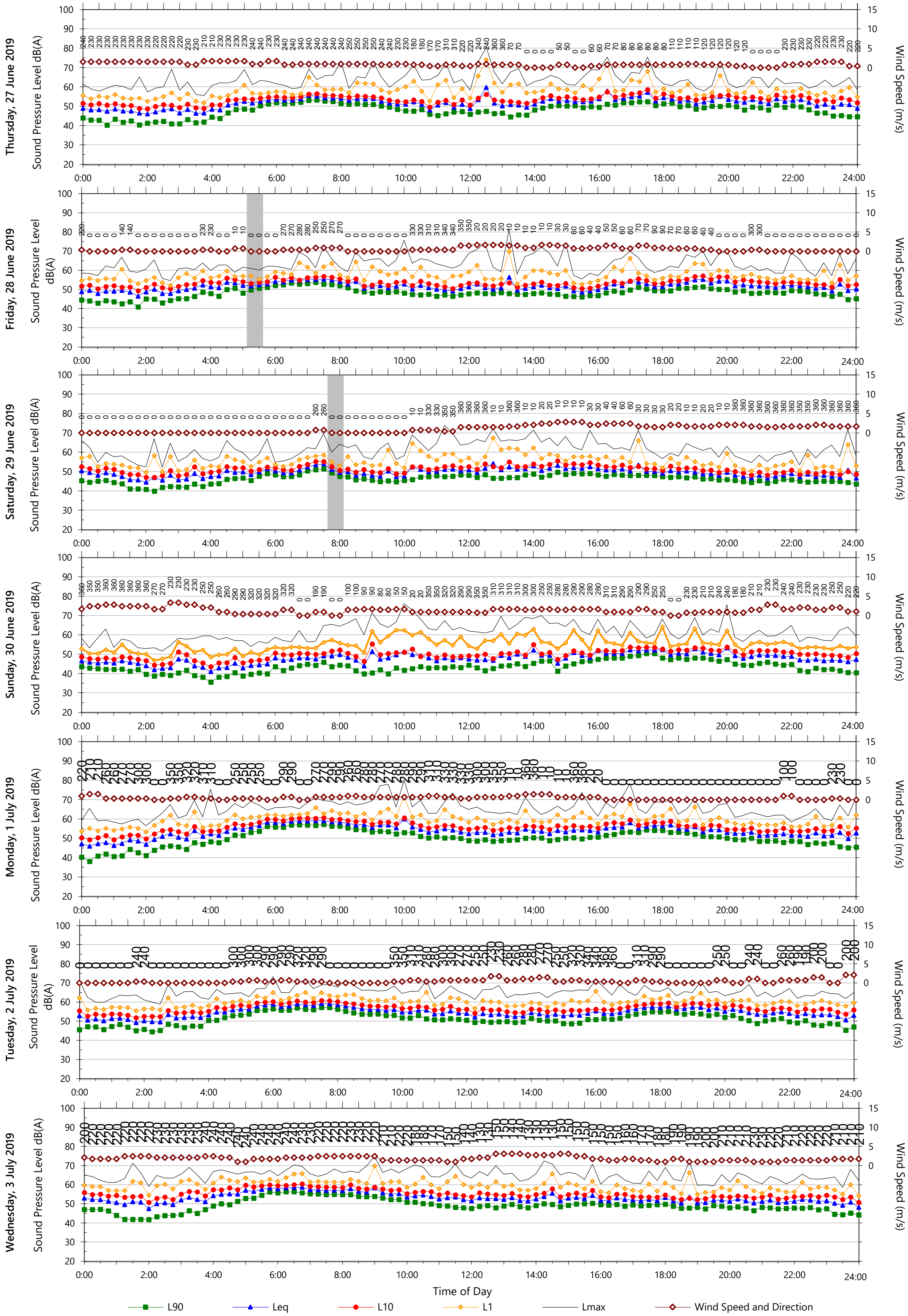
Location: 1662 THE HORSLEY DRIVE HORSLEY PARK



Data File: 2019-06-20_SLM_001_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r29)

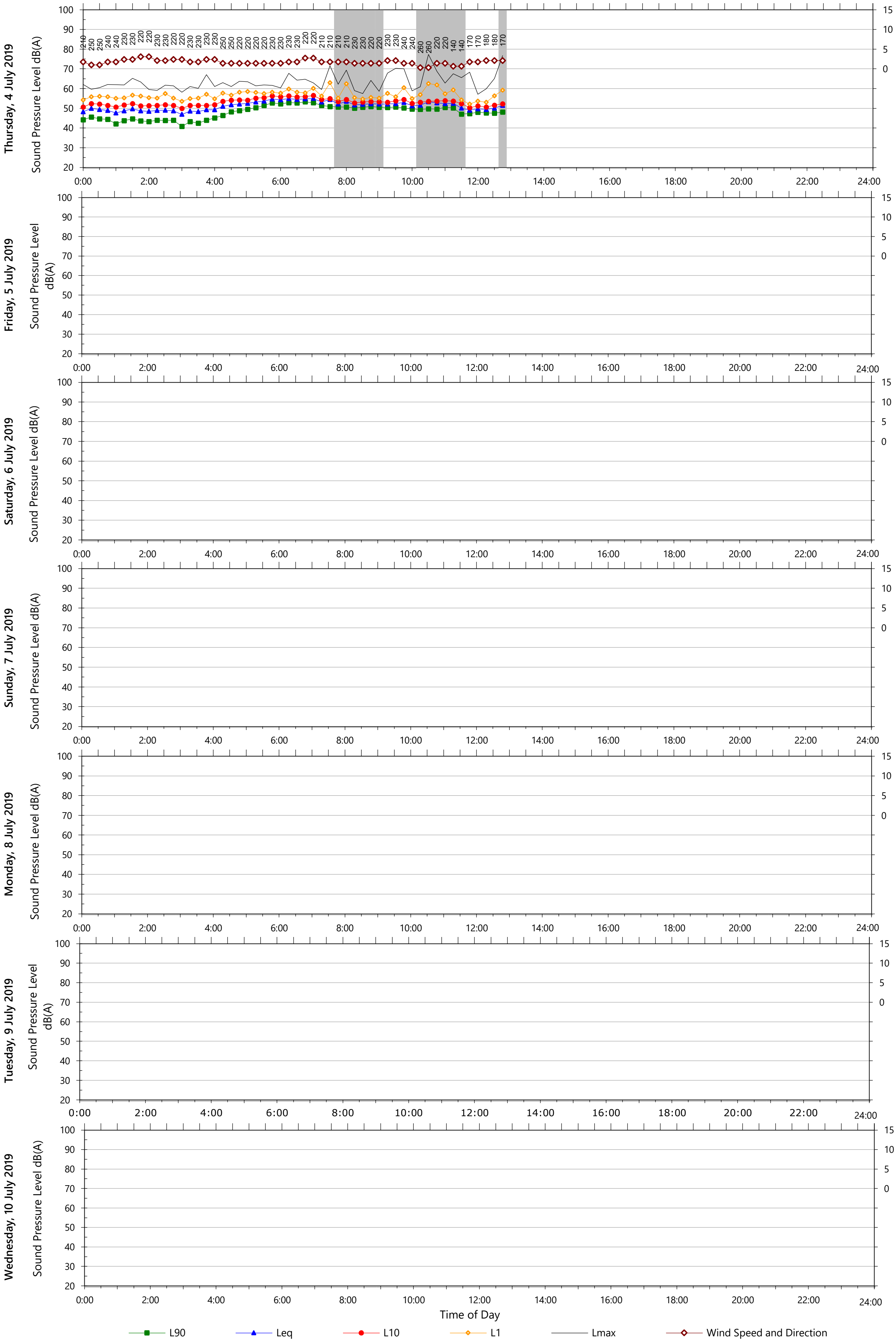
Unattended Monitoring Results **Location: 1662 THE HORSLEY DRIVE HORSLEY PARK**



Data File: 2019-06-20_SLM_001_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r29)

Unattended Monitoring Results **Location: 1662 THE HORSLEY DRIVE HORSLEY PARK**

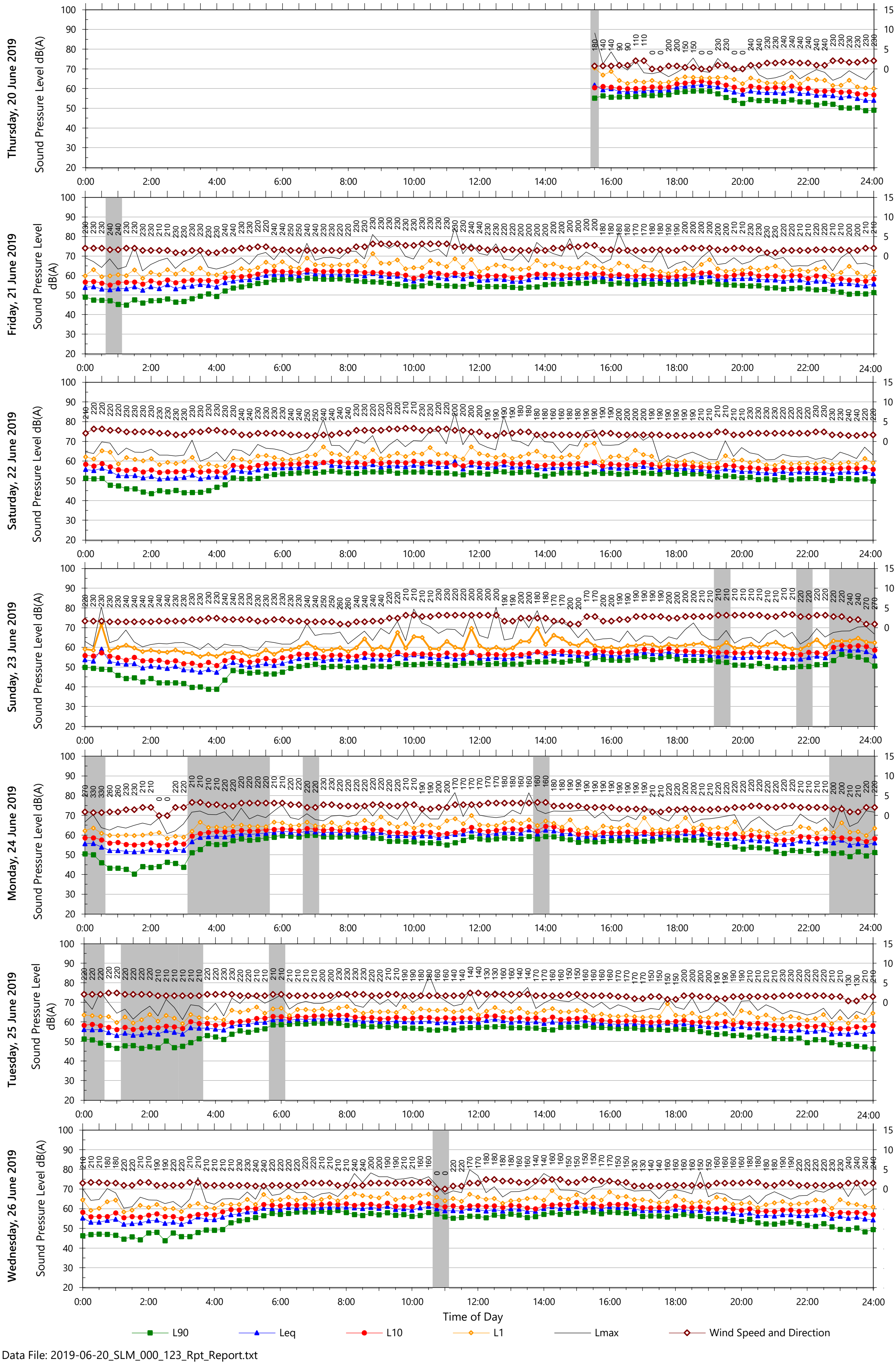


Data File: 2019-06-20_SLM_001_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r29)

Unattended Monitoring Results

Location: 501-511 WALLGROVE ROAD HORSLEY PARK



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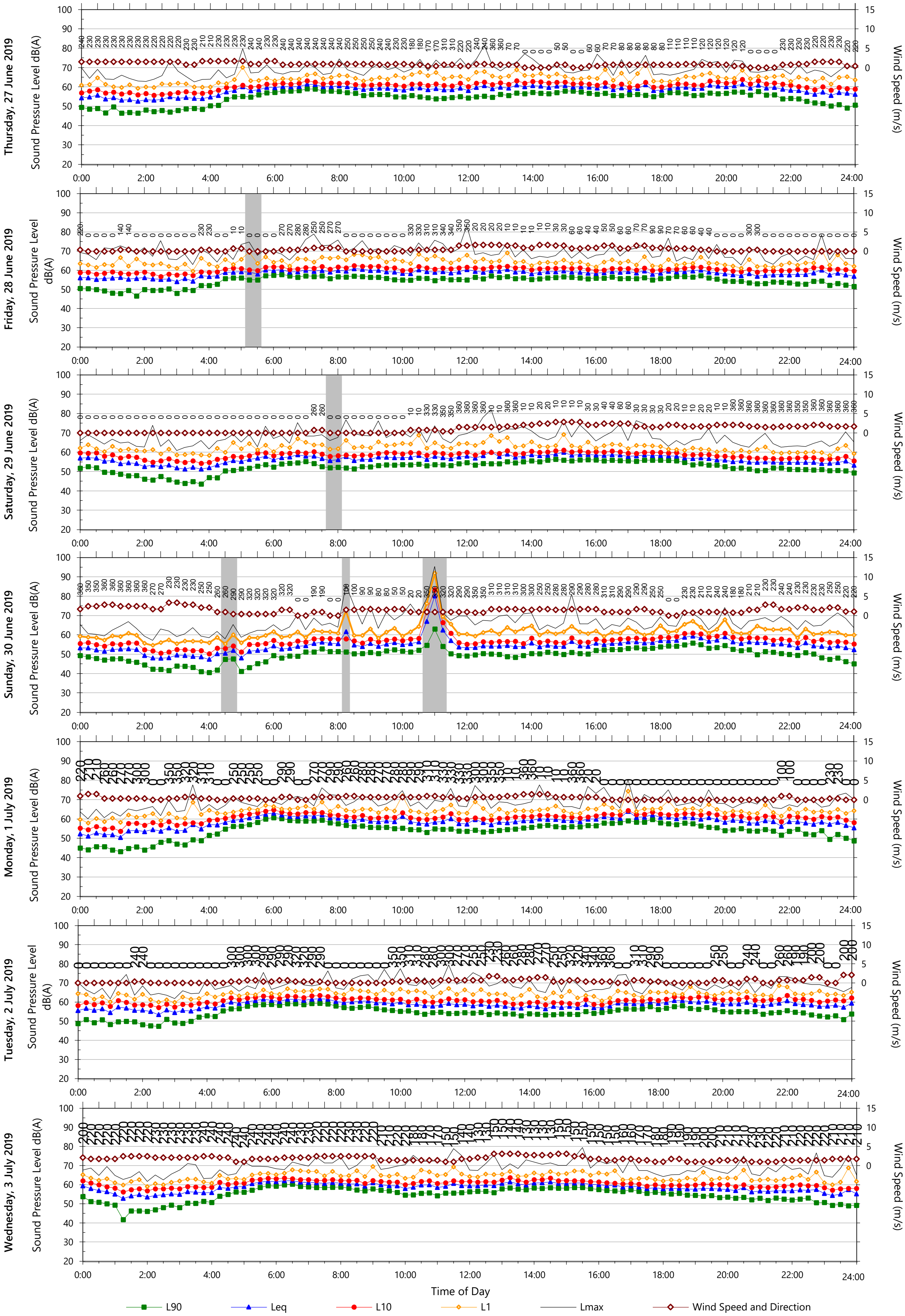
Template: QTE-26 Logger Graphs Program (r29)

Unattended Monitoring Results

Location: 501-511 WALLGROVE ROAD HORSLEY PARK

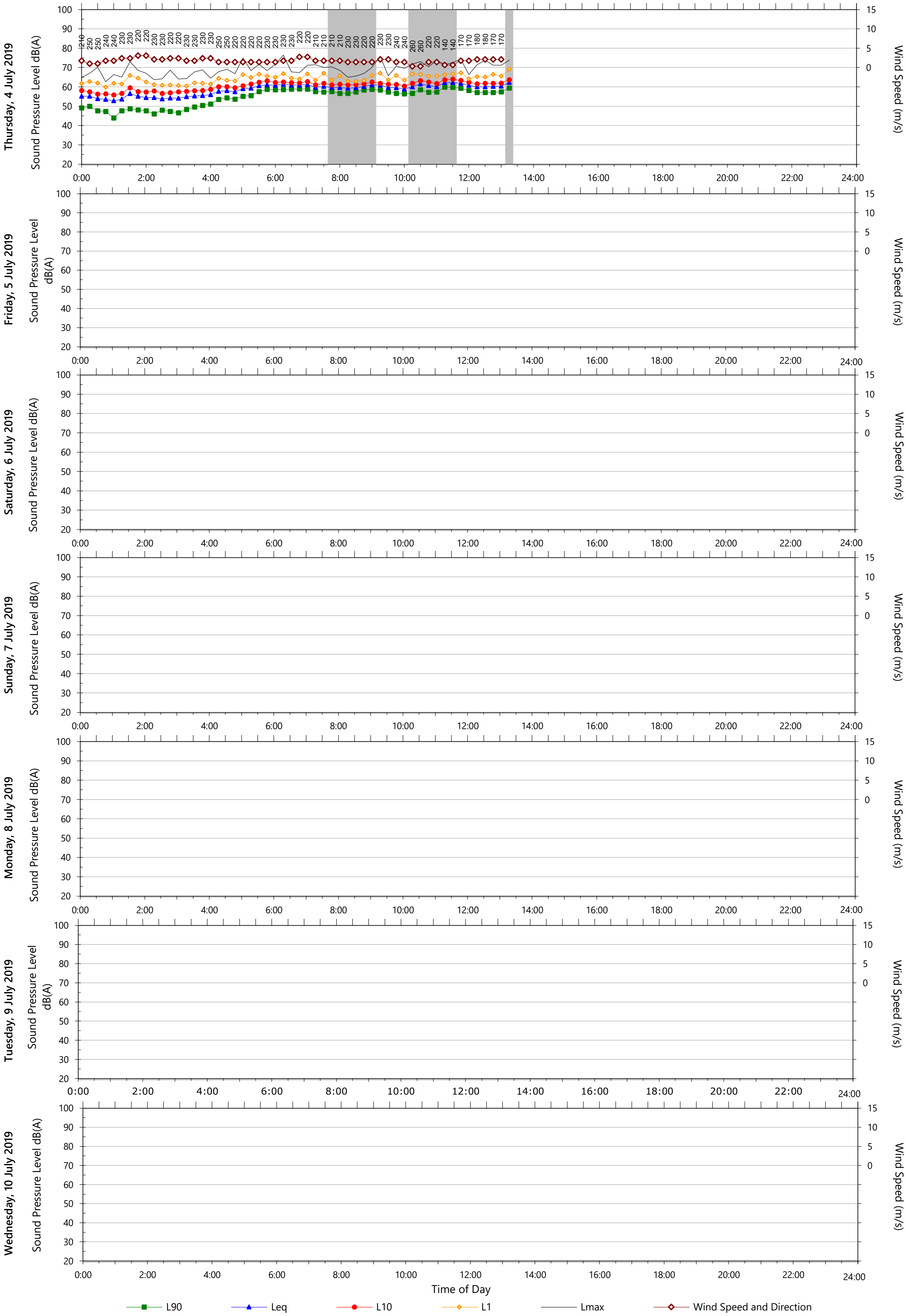


Data File: 2019-06-20_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r29)

Unattended Monitoring Results

Location: 501-511 WALLGROVE ROAD HORSLEY PARK



Data File: 2019-06-20_SLM_000_123_Rpt_Report.txt

Template: QTE-26 Logger Graphs Program (r29)