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ACOUSTICAL REPORT

PROPOSED MIXED-USE DEVELOPMENT

2 MANDALA PARADE, CASTLE HILL NSW 2154

(DORAN DRIVE PRECINCT)

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ACOUSTICAL REPORT
PROPOSED MIXED-USE DEVELOPMENT
2 MANDALA PARADE, CASTLE HILL NSW 2154
(DORAN DRIVE PRECINCT)

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1.0 INTRODUCTION

Koikas Acoustics Pty Ltd was engaged to prepare an acoustical report for the proposed mixed-use development at 2 Mandala Parade, Castle Hill NSW 2154 seeking approval for the construction of four buildings up to twenty storeys with associated basement level parking.

For the DA proposal, the acoustic adequacy of the proposed design must be assessed in terms of standard planning guidelines issued by Council in their Local Environment Plan (LEP) and Development Control Plan (DCP), and also in terms of other standard planning guidelines related to common sources of noise.

As per Council guidelines and other standard planning instruments, Koikas Acoustics has determined the following acoustical components require an assessment at the current DA stage:

1. Road traffic along Carrington Road and surrounding local road, as well as Hills Showground Station, and its impact on future occupants of the development.
2. Rail vibration assessment from the Hills Showground Station, and the impact on future occupants of the development.
3. Mechanical plant noise emission from the proposed development to neighbouring dwellings (determine criteria only at DA stage).
4. Inter-tenancy sound insulation requirements for shared partitions within the building.
5. Construction noise and vibration plan of management.
6. Noise impact assessment arising from increased road traffic due to the development.
7. Noise impact assessment from the existing car park across Doran Drive.

This report presents the results and findings of an acoustic assessment for the subject proposal. In-principle acoustic treatments and noise control recommendations are included (where required) so that the premises may operate in compliance with the nominated acoustic planning levels.

2.0 THE PROPOSAL

The development known as Doran Drive Precinct is proposed to occupy the following site at 2 Mandala Parade, Castle Hill NSW 2154.

The application is for a mixed-use development consisting of approximately 431 residential units and 10,935 m^2 commercial/retail/community uses over 4 buildings with a maximum of 20 storeys with associated basement parking levels.

The current development design can be seen in architectural drawings as prepared by Turner Studio, detailed in Table 1. All calculations and noise modelled scenarios conducted for this assessment are based on the architectural drawings detailed in the drawing list. Where design changes are made without the prior knowledge of Koikas Acoustics, the assessment results and conclusions published within this report may be incorrect.

The development location is situated in a primarily urban area with the following zoning:

- R4 high-density residential zoning to the distant south;
- Currently B2 local centre zoning west, south and subject site;
- R1 general residential to the east, and
- RE1 public recreation to the north.

The development is surrounded by the following:

- Hills Showground Station to the south;
- Castle Hill Showground to the North;
- Public car park and mixed-use premises to the west (across Doran Drive);
- Proposed mixed-use building to the west (Hills Showground Precinct West) and east (Hills Showground Precinct East) and,
- Existing residential premises to the south.

Prevailing ambient noise conditions on-site and in the local area are generally the result of typical environmental noise such as traffic and localised commercial/domestic noise sources.

Table 1. Design drawings used in the assessment					
Drawing Title	**Drawing No.**	**Revision**	**Scale**	**Date**	**Job No.**
Basement 06	DA-110-002	-	1:200	25/06/2021	19068
Basement 05	DA-110-003	-	1:200	25/06/2021	19068
Basement 04	DA-110-004	-	1:200	25/06/2021	19068
Basement 03	DA-110-005	-	1:200	25/06/2021	19068
Basement 02	DA-110-006	-	1:200	25/06/2021	19068
Basement 01	DA-110-007	-	1:200	25/06/2021	19068
Ground Level	DA-110-008	-	1:200	25/06/2021	19068
Upper Level	DA-110-009	-	1:200	25/06/2021	19068
Level 01	DA-110-010	-	1:200	25/06/2021	19068
Level 02	DA-110-020	-	1:200	25/06/2021	19068
Level 03	DA-110-030	-	1:200	25/06/2021	19068
Level 04	DA-110-040	-	1:200	25/06/2021	19068
Level 05	DA-110-050	-	1:200	25/06/2021	19068
Level 06	DA-110-060	-	1:200	25/06/2021	19068
Level 07	DA-110-070	-	1:200	25/06/2021	19068
Level 08	DA-110-080	-	1:200	25/06/2021	19068
Level 09	DA-110-090	-	1:200	25/06/2021	19068
Level 10	DA-110-100	-	1:200	25/06/2021	19068
Level 11	DA-110-110	-	1:200	25/06/2021	19068
Level 12	DA-110-120	-	1:200	25/06/2021	19068
Level 13	DA-110-130	-	1:200	25/06/2021	19068
Level 14	DA-110-140	-	1:200	25/06/2021	19068
Level 15	DA-110-150	-	1:200	25/06/2021	19068
Level 16	DA-110-160	-	1:200	25/06/2021	19068
Level 17	DA-110-170	-	1:200	25/06/2021	19068
Level 18	DA-110-180	-	1:200	25/06/2021	19068
Level 19	DA-110-190	-	1:200	25/06/2021	19068
Level 20	DA-110-200	-	1:200	25/06/2021	19068
Level 21	DA-110-210	-	1:200	25/06/2021	19068
Roof	DA-110-220	-	1:200	12/05/2021	19068
North Elevation	DA-210-101	-	1:200	28/04/2021	19068
East Elevation	DA-210-201	-	1:200	28/04/2021	19068
South Elevation	DA-210-301	-	1:200	28/04/2021	19068
West Elevation	DA-210-401	-	1:200	28/04/2021	19068
Internal Elevation A&B	DA-310-101	-	1:200	-	19068
Internal Elevation C&D	DA-310-201	-	1:200	-	19068
Internal Elevation A&C	DA-310-301	-	1:200	-	19068
Internal Elevation B&D	DA-310-401	-	1:200	-	19068

The subject site and surrounding properties are identified on the aerial photograph included as Figure 1.

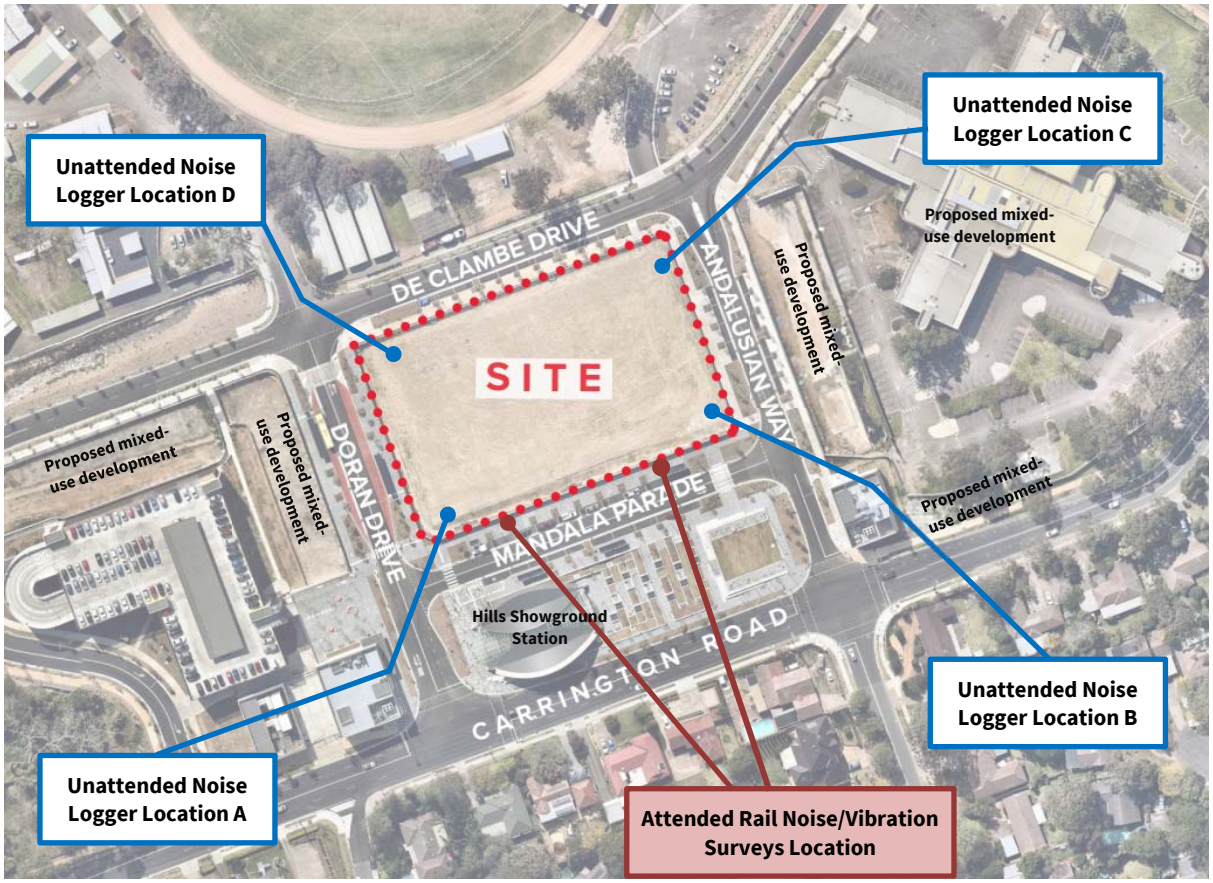


Figure 1. Aerial photo of the subject site, surrounding area and logger locations (image source – Turner Studio)

3.0 UNATTENDED AMBIENT NOISE SURVEY

Existing external ambient noise levels were measured by installing a sound level meter data logger in the following locations (see Figure 1):

- Monitoring Location A – Corner Mandala Parade and Doran Drive;
- Monitoring Location B – Corner Andalusian Way and Mandala Parade;
- Monitoring Location C – Corner De Clamb Drive and Andalusian Way, and
- Monitoring Location D – Corner Doran Drive and De Clamb Drive.

Two Type 1 precision Svantek 977, one Type 1 precision Svantek 949 and one Type 1 precision BSWA 801 noise loggers were used for the survey. The installed locations meant that the microphones were approximately 1.5 metres above the ground level in free field conditions. These meters were placed to measure existing ambient and traffic noise levels pertaining to the surrounding area.

The instrument was set-up to measure A-frequency and 'Fast' time-weighted noise levels. Noise level data was stored within the logger memory at 15-minutes intervals for about one week between Friday 10th and Thursday 16th July 2020.

Calibration readings were taken before and after each survey with a NATA calibrated and certified Larson Davis CAL200 precision acoustic calibrator. No system drift was observed for this meter.

BOM weather records for the nearest available weather station indicate that inclement weather conditions did not adversely impact on the noise survey.

Noise logging surveys were conducted during 2020 covid lockdowns, as such, measured ambient noise levels may not be representative of typical traffic/ambient noise levels. Koikas Acoustics recommends that ambient noise logging surveys be reconducted at the CC stage to confirm ambient noise levels.

Table 2. Summary of noise logger results [dB]				
Location	**Period, T [1]**	**Ambient noise level** LAeq	**Rating background level** LA90	**Traffic noise level** LAeq,Period
Monitoring Location A (Cnr Mandala Parade & Doran Drive)	Day	55	49	54
	Evening	51	42	
	Night	47	32	47
Monitoring Location B (Cnr Andalusian Way & Mandala Pde)	Day	57	49	56
	Evening	52	44	
	Night	47	34	47
Monitoring Location C (Cnr DeClamb Drive & Andalusian Wy)	Day	60	52	59
	Evening	57	46	
	Night	52	35	52
Monitoring Location D (Cnr Doran Drive & De Clamb Drive)	Day	60	50	59
	Evening	57	44	
	Night	52	33	52
Notes	1. The NSW EPA NPI refers to Night as 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays. 2. Refer to **Appendix A** for unattended noise logger graphs.			

4.0 ATTENDED RAIL NOISE AND VIBRATION SURVEYS

Rail noise and vibration surveys were conducted by Koikas Acoustics Pty Ltd on the 17th July 2020 around the subject premises. The location of the surveys can be seen in Figure 1.

The assessment procedure of AS 2377-2002 considers that a minimum of 10 rail pass-by events should be recorded to acquire reliable noise and vibration data.

Noise measurements were taken with a Type 1 NTi XL2-TA spectrum analyser sound level meter. The instrument was field calibrated with a Larson Davis CAL200 Precision Acoustic Calibrator before and after the survey. No system drift was recorded.

Rail noise was not audible above the road traffic noise levels, as such, was not measurable.

Rail vibration levels were measured with a Vibrock V901. The survey data was subsequently analysed as per ISO 2631-2:2003 to appropriate a Vibration Dose Value (VDV) in $m/s^{1.75}$ for each measured train pass-by event.

No vibrations were measurable from the metro train pass-bys at the nearest most-vibration sensitive location (refer to Figure 1). Non-measurable vibration levels are significantly below the human comfort thresholds recommended in the DEC guideline, as such, Koikas Acoustics expects a low probability of adverse comment and no further mitigation measures are required to mitigate rail vibrations.

5.0 EXTERNAL NOISE AND VIBRATION INTRUSION ASSESSMENT

Calculating the level of traffic noise that is transmitted through a façade and into a room is dependent upon the external façade noise level, the sound insulation performance of the building façade (inclusive of all building components), and the level of acoustic absorption that is present within the subject room.

As per *AS3671-1989 Acoustics – Road traffic noise intrusion*, the prediction of façade traffic noise levels considers a forecast increase in traffic volumes over a 10-year planning period. In the absence of RMS traffic volume data for the specific road corridor, Koikas Acoustics has adopted a forecast 2% p.a. increase in traffic volumes over 10-years.

5.1 ACOUSTICAL REQUIREMENTS

5.1.1 ISEPP/DOP

As per Clause 102 of the State Environmental Planning Policy (Infrastructure) 2007, hereafter referred to as ISEPP, development for residential, place of public worship, hospital, educational facility or child care centre use must be designed to consider the indoor noise amenity of future occupants.

Where the development is for residential use, and the site is adjacent to a classified road that carries an annual daily traffic volume of more than 20,000 vehicles, and that the consent authority considers is likely to be impacted by road noise or vibration, maximum allowable indoor traffic noise levels are defined as:

For closed windows and doors

- for bedrooms $L_{Aeq,\ Nighttime}$ 35 dB (10 pm – 7 am);
- for bedrooms $L_{Aeq\ Day\ time}$ 45 dB (7 am – 10 pm), and
- for living spaces $L_{Aeq,\ Day\ \&\ Night}$ 45 dB (24 hours).

ISEPP requires that before any application is determined under which this clause applies, consideration must be given to guidelines that are issued by the Director-General. It is the understanding of Koikas Acoustics that the Director-General has issued guidelines relating to the determination of suitable indoor noise levels for development with open windows allowing natural ventilation of indoor areas. The Director-General has recommended under this condition (open windows) that indoor noise levels should not exceed:

For open windows and doors

- for bedrooms $L_{Aeq,\ Nighttime}$ 45 dB (10 pm – 7 am);
- for bedrooms $L_{Aeq\ Daytime}$ 55 dB (7 am – 10 pm, and
- for living areas $L_{Aeq,\ Day\ \&\ Night}$ 55 dB (24 hours).

The NSW Department of Planning (DoP) supports the design targets of ISEPP and the Director-General

guidelines within their road/rail noise guidelines (*Development near rail corridors and busy roads, Interim Guideline 2008*). The DoP guideline further defines the duration under which noise levels are assessed, being $L_{Aeq\ 9\ hours\ (10\ pm\ to\ 7\ am)}$ for bedrooms and $L_{Aeq\ 15\ hours\ (7\ am\ to\ 10\ pm)}$ elsewhere.

A summary of the applied traffic noise planning levels is included in Table 3.

Table 3. Indoor design noise level [dB]

Description	Noise metric	Windows/Doors Open-Closed	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Infrastructure SEPP	$L_{Aeq\ Day/Night\ Period}$	Closed Closed Open Open	Bedroom 40 Living Space 40 Bedroom 50 Living Space 50	Bedroom 35 Living Space 40 Bedroom 40 Living Space 50

5.1.2 Urban Design Guidelines – Doran Drive

The relevant noise criteria adopted in the Showground Station Precinct Site Urban Design Guidelines have been extracted below.

Table 2: Projected Internal Traffic Noise Levels

Period	Internal Space	Project Internal Noise Goals Windows Closed	Windows Open
Between 10pm and 7am	In any bedroom	35 dB(A) LAeq (9hour)	45 dB(A) LAeq (9hour)
At any time	Any habitable space (other than a garage, kitchen, bathroom or hallway)	40 dB(A) LAeq (9hour /15hour)	50 dB(A) LAeq (9hour /15hour)

b. Appropriate measures shall be taken to ensure that the following internal noise levels from "normal use" of the active street fronts and Castle Hill Showground (i.e. combined patron and music noise) are not exceeded:

Table 3: Internal Noise Levels from "Normal Use" of Active Street Fronts

Period	Internal Space	Measured with Internal Windows Closed
Daytime/Evening (7am to 10pm)	In bedrooms	38dB(A) Leq(15min)
	Living rooms	43dB(A) Leq(15min)
Late Evening (10pm - midnight)	In bedrooms	35dB(A) Leq(15min)
From 7am up to midnight	Living rooms	40dB(A) Leq(15min)
Overnight (midnight to 7am)	Each tenancy inaudible at any residential receptor	-

c. Appropriate measures shall be taken to ensure that the following cumulative impacts of simultaneous road traffic noise and patron and music noise (provided they are individually compliant with Controls 7a and 7b) are not exceeded:

Table 4: Cumulative Impacts of Simultaneous Road Traffic, Patron and Music Noise

Internal Space	Recommended Noise Criteria	Maximum Noise Criteria
Living areas / Working areas	40 dBA LAeq(9hour /15hour)	45 dBA LAeq(9hour /15hour)
Sleeping areas	35 dBA LAeq(9hour /15hour)	40 dBA LAeq(9hour /15hour)

5.1.3 Green Star – Acoustic Comfort

The compliance requirements for the internal noise levels from Green Star – Design & As Built v1.3 have been extracted below.

10.1 INTERNAL NOISE LEVELS

|| **One (1) point** is awarded where project teams demonstrate that internal ambient noise levels in the *nominated area* are no more than 5dB(A) above the lower figure in the range recommended in Table 1 of AS/NZS2107:2016. || R2.10.01

The noise measurement and documentation must be provided by a qualified acoustic consultant and in accordance with AS/NZS 2107:2016. Noise measurement must account for all internal and external noise including noise arising from building services equipment, noise emission from outdoor sources such as traffic, and (where known) noise from industrial process. Occupancy noise is excluded.

|| Compliance shall be demonstrated through measurement, and the measurements shall be conducted in at least 10% of the spaces in the *nominated area*. The selection of representative spaces must be justified within the Submission Template and must consider how the spaces are considered to be the most conservative with respect to both internal, and external noise sources.

The range of measurement locations shall be representative of all spaces available within the *nominated area*. All relevant building systems must be in operation at the time of measurement. Projects less than 500m^2 Gross Floor Area (GFA) must account for measurements conducted in at least 95% of spaces within the nominated area. || R1.10.01

5.1.4 AS2107:2016

The design sound levels of AS2107:2016 have been extracted below.

TABLE 1 (*continued*)

Item	Type of occupancy/activity	Design sound level ($L_{Aeq,t}$) range	Design reverberation time (T) range, s
7	RESIDENTIAL BUILDINGS (see Note 5 and Clause 5.2)		
	Houses and apartments in inner city areas or entertainment districts or near major roads—		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	—
	Living areas	35 to 45	—
	Sleeping areas (night time)	35 to 40	—
	Work areas	35 to 45	—
	Houses and apartments in suburban areas or near minor roads—		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	—
	Living areas	30 to 40	
	Sleeping areas (night time)	30 to 35	
	Work areas	35 to 40	—

Item	Type of occupancy/activity	Design sound level ($L_{Aeq,t}$) range	Design reverberation time (T) range, s
8	SHOP BUILDINGS		
	Department Stores—		
	Main floor	< 55	See Note 1
	Upper floor	< 50	See Note 1
	Enclosed carparks	< 65	—
	Small retail stores (general)	< 50	See Note 1
	Shopping malls	< 55	See Note 1
	Show rooms	< 50	See Note 1
	Speciality shops (where detailed discussion is necessary in transactions)	< 45	See Note 1
	Supermarkets	< 55	See Note 1

5.1.5 DECC 2006

The rail vibration criteria as stated in the NSW Government Department of Planning Development Near Rail Corridors and Busy Roads - Interim Guidelines December 2008 states:

Vibration levels such as the intermittent vibration emitted by trains should comply with the criteria in Assessing Vibration: a technical guideline (DECC 2006). Table 2.4 of Assessing Vibration: a technical guideline (DECC 2006) outlines the relevant rail noise vibration criterion.

Table 4. Acceptable vibration dose values for intermittent vibration

Location	Daytime ($m/s^{1.75}$)		Night-time ($m/s^{1.75}$)	
	Preferred-Value	Maximum Value	Preferred Value	Maximum Value
Critical Areas	0.10	0.20	0.10	0.20
Residential Areas	**0.20**	**0.40**	**0.13**	**0.26**
Offices, schools, educational institutions, places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

5.2 FAÇADE TRAFFIC NOISE LEVELS

The noise sources were modelled in a computer program called Cadna/A, which is a software package developed by DataKustik. Cadna/A incorporates a computer-aided drafting (CAD) program that utilises the height of the ground, the position of buildings and other structures to run through a set of algorithms and calculate at user-defined grid points and user input receiver locations the overall sound pressure level and frequency dependant noise level spectrum. It then interpolates the calculated noise levels at each of the grid points to produce noise level contours.

The noise level calculations take into account the propagation of sound from a sound source as a function of its distance, the shielding effects of barriers and buildings, the attenuation and reflection off the ground and buildings.

Receiver locations were assigned in the computer model at representative positions to determine the resultant noise levels at surrounding premises. The predicted noise levels at these locations were used to provide recommendations on appropriate building noise mitigation measures that would achieve the required noise reductions to comply with the nominated noise criterion.

A calibrated Cadna/A noise model was used to predict external façade traffic noise levels. Maximum levels are predicted to be $L_{Aeq\ 15\ hour}$ 62 dB / $L_{Aeq\ 9\ hour}$ 55 dB along the northern façade of the buildings fronting De Clamb Drive. Reduced noise exposure along the sides of the buildings will result from the limited field of view of traffic and partial noise shielding from adjacent buildings.

Refer to **Appendix B** for Cadna noise contour maps and **Appendix C** for noise intrusion calculations.

5.3 RECOMMENDED CONSTRUCTION MATERIALS

Indoor noise levels were calculated to determine the acoustic performance of the proposed building facade. The noise modelling and subsequent analysis conclude the following:

5.3.1 External walls

Table 5. External walls recommendations

Recommended construction	Area to which the recommendation applies
The brick veneer wall system consisting of: • 110mm brick; • 50mm gap; • 64mm steel stud with 75mm insulation (11 kg/m^3), and • 13mm plasterboard. Alternatively, the double-brick wall system consisting of: • 110mm brick;	All external walls

• 50mm gap with brick ties, and • 110mm brick. Alternatively, the concrete wall system consisting of: • AFS 162; • 64mm steel stud, and • 13mm plasterboard.	

5.3.2 Ceiling/roof

Table 6. Ceiling/roof recommendations

Recommended construction	Area to which the recommendation applies
150 mm concrete slab	All ceiling/roof areas

5.3.3 Glass windows and doors

Recommendations for glass windows and doors are as follows:

- Rw 34 for 10.38mm laminated glass - habitable spaces fronting the surrounding roads, and
- Rw 31 for 6.38mm laminated glass – all other spaces.

In addition to the minimum glass recommendation, the installed window/glazed door systems (inclusive or framing and seals) must achieve a minimum acoustic rating of:

- Rw 34 for 10.38mm laminated glass;
- Rw 31 for 6.38mm laminated glass, and
- comply with Notes 1 to 5 below.

Koikas Acoustics notes that the recommendations provided in this report are for the minimum required glazing predicted to achieve satisfactory acoustic performance. Design factors such as safety, thermal or energy efficiency are outside the scope of this report and should be assessed accordingly. It is the Client's responsibility to ensure all glazed windows and sliding doors installed on-site to meet all building design requirements.

Notes

1. Window frames should be tightly fitted to the external wall minimising any air gaps. Any air gaps present should be packed with timber and an appropriate acrylic sealant such as Knauf Bindex (or approved equivalent).
2. All open-able windows and glazed door systems should be airtight when closed.
3. Q-lon type seals or the equivalent should be fitted along the perimeter of all glazing systems to minimise air gaps. For sliding glass systems that cannot incorporate Q-lon seals, heavy-duty fin-type seals such as Schlegel SilentFin could be used. If the windows/doors are not designed to be air-tight when closed, the reduced performance of the windows/doors could compromise the acoustic integrity of the building facade.
4. Recommended glass systems have been calculated based on current architectural drawings as established within this report.
5. High performing glazed window and door systems, can be supplied by Eco Aluminium. Mob 0475 770 272. Web: www.ecoaluminium.com.au. Other reputable suppliers can also be considered.

5.3.4 Timber entry doors

Any timber entry doors to the residential units should be a minimum 35-40 mm thick solid-core timber with acoustic perimeter and door bottom seals. Suitable acoustic seals could be Raven type RP10/RP10si door frame/perimeter seals and RP8si door bottom seals, or an approved equivalent from another manufacturer.

5.3.5 Ventilation

As a general rule, where windows or doors opened sufficiently to provide natural ventilation to a room, the indoor noise level is 10dB below the outside noise level. Therefore, a window or sliding door to a room may be opened to provide natural ventilation where the outdoor noise level does not exceed 10dB above the "Windows open" criteria as detailed within this report. Habitable spaces not fronting the surrounding roads are suitable for natural ventilation through open windows/doors.

For rooms requiring an alternate source of ventilation other than open windows/doors, the following may be considered (subject to review by a ventilation expert):

- Borrowed air from elsewhere in the dwelling/unit
- Incorporating a component of fresh air into a ducted air conditioning system
- Installing a small air supply fan and acoustically treated duct into a ceiling bulkhead

Any penetrations in the walls or roof to accommodate ventilation system/s should not impact the acoustic integrity of the building façade. An acoustical engineer should review any proposed ventilation solution that proposes a penetration of the building façade.

6.0 MECHANICAL PLANT AND BUILDING USE NOISE IMPACTS

Mechanical plant and equipment on this project could include air conditioning condensers units where they are installed in the development and other ventilation plant required for basement levels and garbage rooms etc.

6.1 ACOUSTICAL REQUIREMENTS

6.1.1 EPA Noise Policy for Industry

Noise emission design targets have been referenced from the NSW Environmental Protection Authority Noise Policy (EPA) for Industry (NPfI). The NPfI replaces the former Industrial Noise Policy, also prepared by the EPA.

The NPfI is designed to assess environmental noise impacts associated with scheduled activities prescribed within the Protection of the Environment Operations Act 1997, Schedule 1. It is also commonly used as a reference tool for establishing suitable planning levels for noise generated by mechanical plant and equipment and noise emission from commercial operations.

The guideline applies limits on the short-term intrusive nature of a noise or noise-generating development (project intrusive noise level), as well as applying an upper limit on cumulative industrial noise emissions from all surrounding development/industry (project amenity noise level).

The most stringent of the project intrusive noise level and project amenity noise level is applied as the **project noise trigger level**. The project noise trigger level is the point, above which noise emission from a source or development site would trigger a management response.

To be able to define the more stringent of the intrusive and amenity noise levels, the underlying noise metrics must be the same. As the intrusive noise level is defined in terms of an $L_{Aeq\ 15\ minutes}$ and the amenity noise level is defined in terms of an $L_{Aeq\ Period}$, a correction +3dB correction is applied to the project amenity noise level to equate the $L_{Aeq\ Period}$ to $L_{Aeq\ 15\ minutes}$.

6.1.2 Offensive Noise (POEO Act 1997 definition)

In the definitions of the Protection of the Environment Operations Act 1997, 'offensive noise' means noise:

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

6.1.3 Protection of the Environment Operations (Noise Control) Regulation 2017

Clause 45 of the regulation requires that air conditioning units installed on residential premises must not emit noise that is audible within a habitable room in any other residential premises between the hours of 10 pm and 7 am (Monday to Friday) or 10 pm and 8 am (Saturday, Sunday and public holidays).

6.1.4 Green Star – Acoustic Comfort

The compliance requirements for the internal noise levels from Green Star – Design & As Built v1.3 have been extracted below.

10.1 INTERNAL NOISE LEVELS

|| **One (1) point** is awarded where project teams demonstrate that internal ambient noise levels in the *nominated area* are no more than 5dB(A) above the lower figure in the range recommended in Table 1 of AS/NZS2107:2016. || R2.10.01

The noise measurement and documentation must be provided by a qualified acoustic consultant and in accordance with AS/NZS 2107:2016. Noise measurement must account for all internal and external noise including noise arising from building services equipment, noise emission from outdoor sources such as traffic, and (where known) noise from industrial process. Occupancy noise is excluded.

|| Compliance shall be demonstrated through measurement, and the measurements shall be conducted in at least 10% of the spaces in the *nominated area*. The selection of representative spaces must be justified within the Submission Template and must consider how the spaces are considered to be the most conservative with respect to both internal, and external noise sources.

The range of measurement locations shall be representative of all spaces available within the *nominated area*. All relevant building systems must be in operation at the time of measurement. Projects less than 500m^2 Gross Floor Area (GFA) must account for measurements conducted in at least 95% of spaces within the nominated area. || R1.10.01

6.1.5 AS2107:2016

The design sound levels of AS2107:2016 have been extracted below.

TABLE 1 (*continued*)

Item	Type of occupancy/activity	Design sound level ($L_{Aeq,t}$) range	Design reverberation time (T) range, s
7	RESIDENTIAL BUILDINGS (see Note 5 and Clause 5.2)		
	Houses and apartments in inner city areas or entertainment districts or near major roads—		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	—
	Living areas	35 to 45	—
	Sleeping areas (night time)	35 to 40	—
	Work areas	35 to 45	—
	Houses and apartments in suburban areas or near minor roads—		
	Apartment common areas (e.g. foyer, lift lobby)	45 to 50	—
	Living areas	30 to 40	
	Sleeping areas (night time)	30 to 35	
	Work areas	35 to 40	—

6.2 PROJECT NOISE TARGETS

This noise is assessed in accordance with the planning levels contained within the NPfI. Acoustic planning levels are largely determined in relation to the existing environmental noise levels. Noise surveys conducted for this assessment show that environmental noise levels can differ based on the location of a particular receiver and its orientation to major contributors of noise in the area, such road corridors and commercial operations.

The following NPfI planning levels apply for this project:

Table 7. NPfI planning levels									
Period, T (Note 1)	**Monitoring Location A – Corner Mandala Parade and Doran Drive**								
	Intrusive		**Amenity**					**Project noise trigger level**	**AC Inaudibility Noise Level**
	RBL	**RBL + 5**	**Area classification**	**Recommended amenity noise level**	**High traffic area**	**Project amenity noise**	**+3dB correction**		
Day	49	54	Urban	60	No	55	58	54	-
Evening	42	47	Urban	50	No	45	48	47	-
Night	32	37	Urban	45	No	40	43	37	22-27
Period, T (Note 1)	**Monitoring Location B – Corner Andalusian Way and Mandala Parade**								
	Intrusive		**Amenity**					**Project noise trigger level**	**AC Inaudibility Noise Level**
	RBL	**RBL + 5**	**Area classification**	**Recommended amenity noise level**	**High traffic area**	**Project amenity noise**	**+3dB correction**		
Day	49	54	Urban	60	No	55	58	54	-
Evening	44	49	Urban	50	No	45	48	48	-
Night	34	39	Urban	45	No	40	43	39	24-29
Period, T (Note 1)	**Monitoring Location C – Corner De Clamb Drive and Andalusian Way**								
	Intrusive		**Amenity**					**Project noise trigger level**	**AC Inaudibility Noise Level**
	RBL	**RBL + 5**	**Area classification**	**Recommended amenity noise level**	**High traffic area**	**Project amenity noise**	**+3dB correction**		
Day	52	57	Urban	60	No	55	58	57	-
Evening	46	51	Urban	50	No	45	48	48	-
Night	35	40	Urban	45	No	40	43	40	27
Period, T (Note 1)	**Monitoring Location D – Corner Doran Drive and De Clamb Drive**								
	Intrusive		**Amenity**					**Project noise trigger level**	**AC Inaudibility Noise Level**
	RBL	**RBL + 5**	**Area classification**	**Recommended amenity noise level**	**High traffic area**	**Project amenity noise l**	**+3dB correction**		
Day	50	55	Urban	60	No	55	58	55	-
Evening	44	49	Urban	50	No	45	48	48	-
Night	33	38	Urban	45	No	40	43	38	26

Notes
1. The NSW EPA Industrial Noise Policy refers to the following time periods, Day – 7 am to 6 pm Monday to Saturday and 8 am to 6 pm Sunday and public holidays, Evening – 6 pm to 10 pm Monday to Sunday, Night – 10pm to 7 am Monday to Saturday and 10 pm to 8 am Sunday and public holidays.
2. The amenity criterion is based on the area classification of the site as being 'urban' and has been corrected for an assessment in areas of high traffic and for existing industrial noise where applicable.
3. Project noise amenity level = recommended noise amenity level – 5dB, except where specific circumstances are met, such as high traffic.
4. Inaudibility is generally achieved when the noise is 5-10 dB below the background noise level.

Surrounding commercial properties must also not be exposed to noise that exceeds $L_{Aeq\ Period\ (business\ hours)}$ 60 dB during business hours.

6.3 DESIGN SCENARIOS

Mechanical plant noise assessment is normally undertaken once final mechanical design and specification have been completed for CC Stage. A preliminary review of the Woolworths mechanical plant has been provided in Section 11.1.

7.0 INTER-TENANCY NOISE

The following recommendations are expected to satisfy the relevant provisions of the BCA sound insulation requirements between tenancies. Options have been provided in all cases that consider a range of standard constructions.

All wall systems should be installed in accordance with general installation guidelines included in the BCA and as per relevant manufacturer installation guidelines/requirements.

Alternate systems and design may be considered to those recommended within this report provided that they are approved by an appropriately qualified acoustical engineer/consultant.

7.1 ACOUSTICAL REQUIREMENTS

7.1.1 BCA

In Class 2 or 3 buildings, the BCA acoustical Performance Requirements state that separating walls and floors must provide insulation against the transmission of airborne or impact generated sound sufficient to prevent illness or loss of amenity for the occupants.

A wall/ floor partition is considered to satisfy BCA Performance Requirements where it is shown to:

- Have a laboratory tested acoustic rating that meets or exceeds the Deemed-to-Satisfy provisions of F5.4 to F5.7, or
- Complies with Specification F5.2, or
- Is tested on-site to achieve the minimum acoustic performance as defined within *Verification Methods* FV5.1 and FV5.2.

The Deemed-to-Satisfy provisions applying to this specific development are summarised below:

Table 8. BCA acoustic design requirements			
Partition	**Detail**	**Airborne sound**	**Impact sound**
Floor	Separating SOU's, or an SOU from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or part of a different classification	Rw + Ctr ≥ 50	Ln,w ≤ 62
Wall *See notes 1 and 2*	Separating SOU's	Rw + Ctr ≥ 50	Not applicable
	Separating a habitable room (other than a kitchen) in one SOU from a bathroom, sanitary compartment, laundry, kitchen in another SOU	Rw + Ctr ≥ 50	Discontinuous construction
	Separating an SOU from a plant room or lift shaft	Rw ≥ 50	Discontinuous construction
	Separating an SOU from a stairway, public corridor, public lobby or the like, or part of a different classification	Rw ≥ 50	Not applicable
Door	Located in a wall separating an SOU from a stairway, public corridor, public lobby or the like	Rw ≥ 30	Not applicable
Services	Duct, soil, waste or water supply pipes located in a wall or floor cavity and serves or passes through more than one SOU (including a stormwater pipe)	Rw + Ctr ≥ 40 (habitable) Rw + Ctr ≥ 25 (other)	Not applicable
Pumps	A flexible coupling must be used at the point of connection between the service's pipes in a building and any circulating or another pump.		
Notes 1. 2. 3.	Where a wall is to achieve a sound insulation rating and has a floor above, the wall must continue to either the underside of the floor or to the ceiling which has a comparable sound insulation rating to the wall. Where a wall is to achieve a sound insulation rating and has a roof above, the wall must continue to either the underside of the roof or to the ceiling which has a comparable sound insulation rating to the wall. As defined by the BCA, a 'habitable room' means a room used for normal domestic activities such as bedroom, living room, lounge room, music room, television room, kitchen dining room, study, playroom, family room, home theatre and sunroom.		

7.1.2 Green Star – Acoustic Comfort

The compliance requirements for the internal noise levels from Green Star – Design & As Built v1.3 have been extracted below.

10.3 ACOUSTIC SEPARATION

One (1) point is awarded where the project addresses noise transmission in enclosed spaces within the nominated area. Enclosed space is defined as meeting rooms, private offices, classrooms, residential apartments (bounding apartment construction), and any other similar space where it is expected that noise should not carry over from one space to the next. For this specific criterion, where the delivery method of the project is core and shell, then the criteria may be considered 'Not Applicable'.

There are three methods for demonstrating compliance with this criterion.

10.3A Sound Reduction	|| The partition between the spaces should be constructed to achieve a weighted sound reduction index (R_w) of: • At least 45; for all partitions which are: – Fixed without a door; and/or – Glazed partitions without a door*. • At least 35; for all partition types that contain a door. *The Acoustic Consultant can use their discretion to determine whether an Rw of 35 or 45 is more applicable when using glazed partitions. The selected Weighted Sound Reduction index must be justified in terms of adjoining space use, required levels of noise sensitivity between spaces and any other aspects which would help to achieve acoustic separation. || R2.10.04
10.3B Sound Insulation	The sound insulation between enclosed spaces complies with: $D_w + LA_{eq}T > 75$ Where: D_w = Weighted sound level difference measured between two spaces; and $LA_{eq}T$ = Indoor ambient noise level in the space adjacent to the enclosed space. The sounds tests from which D_w is derived must be measured in accordance with ISO 140-4:1998. Measurements must be based on finished rooms, accounting for any carpets and acoustically absorbent ceilings specified. The measurements can be conducted in either furnished or unfurnished spaces.

|| 10.3C Residential Projects	For residential projects: • The inter-tenancy apartment construction to habitable areas results in airborne noise isolation standard of Rw+Ctr > 55; and • All inter-tenancy walls should include Discontinuous Construction as defined by the Building Code of Australia • Walls between apartments and public corridors results in airborne noise isolation standard of Rw > 55; and • The floor construction above habitable rooms and wet areas of adjacent dwellings (i.e. floor cover) results in an impact isolation standard of Ln,w + CI < 55. • Apartment entry doors include acoustic seals and achieve laboratory acoustic rating of Rw 30. Where: $L_{n,w} + C_I$ is used to describe impact sound performance of floors. $L_{n,w}$ = Weighted Normalised Impact Sound Pressure Level and C_I = Spectrum Adaptation Term. The lower the $L_{n,w} + C_I$, the better the performance of the floor. $R_w + C_{tr}$ is used to describe the sound insulation performance. R_w = The Weighted Sound Reduction Index, and C_{tr} = A correction factor (and is a negative number). So if a building element has R_w of 60 and a C_{tr} of −10, its $R_w + C_{tr}$ will equal 50. The addition of C_{tr} and R_w helps to account for lower frequency sounds, such as those created by modern home theatre systems and music equipment. The higher the $R_w + C_{tr}$ number, the better the performance of the system. || R2.10.05

Compliance shall be demonstrated through measurement, and the measurements shall be conducted in at least 10% of the spaces in the *nominated area*. The selection of representative spaces must be justified within the Submission Template and must consider how the spaces are considered to be the most conservative with respect to both internal, and external noise sources.

The range of measurement locations shall be representative of all spaces available within the *nominated area*. All relevant building systems must be in operation at the time of measurement. Projects less than 500m^2 Gross Floor Area (GFA) must account for measurements conducted in at least 95% of spaces within the nominated area.

7.2 PROPOSED PARTITION WALLS

7.2.1 Inter-tenancy wall

Intertenancy walls that separate adjoining apartments are required to achieve an Rw + Ctr not less than 55, and be of discontinuous construction where a habitable room in one apartment adjoins a wet area (including a kitchen) in another apartment.

The following wall system has been acoustically tested to comply with the required BCA acoustic standard (ATF 1238):

- 13mm Fyrchek plasterboard;
- 28mm furring channel with 50mm S4 polyester insulation;
- 75mm Hebel Powerpanel;
- 35mm cavity;
- 64mm steel stud with 105mm R2 Bradford glasswool insulation, and
- 13mm Fyrchek plasterboard.

The above wall system (ATF 1238) is acceptable for inter-tenancy walls in the development. Where concrete support columns are built into the inter-tenancy walls, discontinuity of the wall must be maintained as required by the BCA where the wall separates a habitable room in one sole-occupancy unit from a wet area (bath/kitchen/laundry etc) in another sole-occupancy unit.

The following alternative wall system has been acoustically tested to comply with the required BCA acoustic standard (ATF 1235):

- 13mm Fyrchek plasterboard;
- 75mm Hebel Powerpanel;
- 35mm cavity;
- 64mm steel stud with 75mm R1.5 Bradford glasswool insulation, and
- 13mm Fyrchek plasterboard.

The above wall system (ATF 1235) is acceptable for inter-tenancy walls in the development. Where concrete support columns are built into the inter-tenancy walls, discontinuity of the wall must be maintained as required by the BCA where the wall separates a habitable room in one sole-occupancy unit from a wet area (bath/kitchen/laundry etc) in another sole-occupancy unit.

7.2.2 Corridor walls

Corridor walls are defined as walls that separate an apartment from a common area such as a Lobby or Corridor/Hallway. They are required to achieve an Rw not less than 55.

The following alternative wall system has been modelling on Insul V9.0.22 to comply with the required BCA acoustic standard and is recommended as an alternative to the proposed wall system:

- 13mm standard plasterboard;
- 75mm Hebel Powerpanel;
- 15mm cavity;
- 64mm steel stud with cavity insulation (75mm thick Bradford Acoustigard 11, CSR Martini Prime 75 or similar), and
- 13mm standard plasterboard.

This wall system is of discontinuous construction and can be used between a SOU and a stairway, public corridor, public lobby, plant room or lift shaft.

7.3 ALTERNATIVE PARTITION WALLS

Table 9 recommends several partition wall systems that are capable of achieving the required BCA acoustic performance.

Table 9. Alternative partition wall systems

Wall type	BCA design standard	Construction
Inter-tenancy wall	Rw + Ctr ≥ 50 Discontinuous	*Partition wall between sole-occupancy units – Separating a habitable room (other than a kitchen) in one unit from a bathroom, sanitary compartment, laundry or kitchen in an adjoining unit* **[AFS]** AFS 162 Logicwall, 20mm cavity, 64mm steel studs with 75mm thick Tontine TSB4 insulation within the stud cavity, 10mm Soundcheck. **[Masonry]** Two leaves of 110mm clay brick masonry, 50mm cavity between the leaves (where brick ties are used they are to be of the resilient type), 13mm cement render to each side. *BCA D.T.S.* **[Concrete]** 125mm concrete panel, 20mm cavity, 64mm steel studs, 70mm polyester insulation (9kg/m^3) between the studs, 13mm plasterboard fixed to studs. *BCA D.T.S.* **[Hebel]** 13mm Fyrchek, 75mm Hebel Powerpanel, 35mm cavity, 64mm steel studs with 100mm S6 polyester insulation, 13mm Fyrchek/Aquachek. **[Lightweight]** 2x64mm steel studs, 20mm cavity, 60mm polyester insulation (11kg/m3) positioned between one row of studs, 2x13mm fire resistant plasterboard each side.
	Rw + Ctr ≥ 50	*Partition wall between sole-occupancy units* **[AFS]** AFS 162 Logicwall panel, paint or render finish. **[AFS]** AFS 162 Logicwall panel, 28mm furring channel, Tontine TSB2 insulation within the framing cavity, 13mm plasterboard. **[Masonry / Hebel / Lightweight]** As above. **[Concrete]** 200mm concrete panel, 13mm cement render of each face. *BCA D.T.S.*
Common wall	Rw ≥ 50 Discontinuous	*Partition wall between sole-occupancy unit and plant room or lift shaft* As above for inter-tenancy wall partitions that satisfy discontinuous construction
	Rw ≥ 50	*Partition wall between sole-occupancy unit and stairway, public corridor, public lobby or the like or part of a different classification* **[AFS]** AFS 150 Logicwall panel, paint or render finish. **[AFS]** AFS 162 Logicwall panel, paint or render finish. **[Masonry]** Single leaf 150mm brick masonry with 13mm cement render on each face. **[Concrete]** 125mm thick concrete panel. **[Hebel]** 13mm Gyprock CD, 75mm Hebel Powerpanel, minimum 20mm cavity, 64mm steel framing with 50mm glasswool insulation, 13mm Gyprock CD. **[Lightweight]** 92mm steel studs, 60mm polyester insulation (11kg/m3) positioned between the studs, 2x13mm fire-resistant plasterboard each side.
Services shaft wall	Rw+Ctr ≥40	*Services shaft wall to habitable room within unit* **[Masonry]** 110mm brick masonry with 13mm cement render on each face. *BCA D.T.S.* **[Concrete]** 100mm thick concrete panel. *BCA D.T.S.* **[Lightweight]** 2x13mm plasterboard, pipe lagging (Soundlag 4525C, Acoustilag 45)
	Rw+Ctr ≥25	*Services shaft wall to non-habitable room within unit* **[Lightweight]** 2 layers of 13mm plasterboard

Notes:

1. Recommendations within the above table are based on published acoustic data obtained from the manufacturer's website. Laboratory tests of the AFS 162 Logicwall on its own showed non-compliance with the BCA requirement of Rw + Ctr 50.
2. However, an investigation by PKA Consulting concludes that the poor acoustic performance was due to factors not related to the wall system, but rather the test facility. It is expected that the acoustic performance will satisfy the BCA condition. This conclusion is supported by numerous field tests that indicate compliance with the BCA verification methods rating.
3. All installation of proprietary type wall systems must be in accordance with the relevant installation guidelines and manuals.
4. *BCA D.T.S.* = BCA Deemed-to-Satisfy construction. These wall systems are to be installed as per "Construction Deemed-to-Satisfy" notes included within Specification F5.2 of Volume One of the BCA. Where these systems are installed correctly in accordance with the BCA they do not require compliance testing to verify acoustic performance.

7.4 RECOMMENDED PARTITION FLOOR/CEILING

The following floor/ceiling assemblies are recommended to achieve the BCA minimum acoustic rating requirements.

Table 10. Recommended acoustic underlays to achieve or exceed the BCA nominated criterion of L'nTw 62

TYPE	Uniroll	Regupol	Damtec	A1 Rubber
Carpet	Carpet over carpet underlay over ≥ 150 mm concrete slab will typically achieve L'nTw ≤ 40			
Direct Stick Tiles	9 or 10 mm ceramic tiles over 5 mm adhesive over the underlay (specified below) + ≥150 mm concrete slab over 100 mm ceiling cavity and 13 mm plasterboard ceiling will typically achieve L'nTw ≤ 50			
	RFC750 (4.5 mm) RF700 (4- 5- 10 mm)	4515 (4.5 mm)	Standard (4-6mm) Damtec Multi (4 mm)	Acoustamat 600 (5 mm, 10 mm) Acoustamat 700 (5 mm) Acoustamat 850 (3, 4 , 5, 10 mm),
Under Screed Tiles	9 or 10 mm ceramic tiles over 5 mm glue over 30 mm screed over the underlay (specified below) + ≥150 mm concrete slab over 100 mm ceiling cavity and 13 mm plasterboard ceiling will typically achieve L'nTw ≤ 50			
	RFC750 (4.5mm) RF700 (5mm)	4515 (4.5 mm) 6010 (8/4 mm) 6010 (10 mm)	Standard (4 or 6mm) Damtec Multi (4 mm)	Acoustamat 600 (5, 10 mm) Acoustamat 700 (5 mm) Acoustamat 850 (3, 4, 5, 10 mm)
Direct Stick or Floating Timber Flooring	Timber flooring over the underlay (specified below) + ≥150 mm concrete slab over 100 mm ceiling cavity and 13 mm plasterboard ceiling will typically achieve L'nTw ≤ 50			
	19 mm strip timber + adhesive + 15 mm ply + RFC700 ((4, 5 or 10 mm) ***Engineered floating floor*** + 2 mm foam slip layer + RF700 (4, 5mm)	***Parquetry flooring*** + adhesive + K225 (5 mm) ***Engineered timber or laminate*** floorings + adhesive + 5515 (5 mm) ***Engineered timber*** + adhesive + 6010 (8/4 mm) ***Engineered timber*** + adhesive + 6010 (10 mm) ***Engineered timber*** + adhesive + 6010 (17/8 mm) + 18 mm plywood	***10 mm Engineered timber*** + adhesive + Standard (2, 3 mm) ***16 mm parquetry*** + adhesive + Standard (2, 3 or 5 mm) ***18 mm timber floor*** + adhesive + Standard (3 or 5 mm) ***18 mm timber floor*** + adhesive + plywood + Color (2 mm) ***16 mm parquetry*** + adhesive + Color (2 mm)	***Solid timber*** +adhesive+ plywood+ Acoustamat 600, 700, 850 (5, 10 mm) ***Engineered timber floating*** + Acoustamat 600, 700, 850 (5, 10 mm) ***Engineered timber*** + Acoustamat 600, 700, 850 (5, 10mm) ***Laminate floating*** + adhesive + Acoustamat 600, 700, 850 (5, 10 mm) ***Engineered*** + Acoustamat 600, 700, 850 (5, 10 mm)
Direct Stick Vinyl Flooring	Vinyl flooring over the underlay (specified below) + ≥150 mm concrete slab over 100 mm ceiling cavity and 13 mm plasterboard ceiling will typically achieve L'nTw ≤ 50			
			2.5 mm vinyl sheeting + adhesive + Color (2 mm) ***4.5 mm LVT Plank*** + adhesive + Color (2 mm)	***Vinly plank floating*** + Acoustamat 850 (3, 4, 5, 10 mm), ***Vinyl plank*** + Acoustamat 850 (3, 4, 5, 10mm) ***Vinyl plank*** +Acoustamat 960 (3 mm) ***Vinyl sheet*** direct stick + Acoustamat 850 (3 mm)

The above recommendations also apply to balconies/terraces situated above indoor areas of apartments below.

All flooring and acoustic underlays should be installed as per relevant manufacturers installation and design guides.

Hard floor coverings such as tiles must not make contact with any walls or joinery such as kitchen benches, cupboards etc. During the installation of hard floor coverings, temporary spacers of 5 - 10 mm should be used to isolate the floor covering from walls and/or joinery with the resulting gaps filled with a suitable mastic type sealant or off-cut of rubber underlay material. Most acoustic underlay manufacturers include a construction detail in this regard that involves an upturn of the rubber underlay material at the wall/floor junction.

Alternative floor/ceiling systems could be considered provided that the acoustic performance is tested or assessed by a consulting acoustical engineer to be compliant with the sound insulation performance requirements of the BCA.

Except for those flooring systems tested in a NATA certified laboratory and complying with the requirements of the BCA, in-situ verification of installed acoustic performance should be determined for all other flooring systems with or without the combination with underlays. It is therefore recommended that before any flooring system is installed, preliminary testing be undertaken at the subject site to ensure that the acoustic impact rating required is achieved. Impact noise test results can vary from site to site as many factors can influence the acoustic impact rating.

These include:

- the thickness of floor slabs,
- the air gap between the plasterboard ceiling and the concrete slab,
- the sealing between the plasterboard and the walls,
- the thickness and density of the plasterboard ceiling,
- the connections of the suspended ceiling grid to the concrete slab,
- the surface area of the floor,
- flanking paths,
- the wall types, and
- the junctions between the slab and the walls.

The above floor systems have been assessed to comply with the BCA airborne and impact sound insulation requirements. **The 'for construction' floor systems should be re-assessed at the detailed design stage.**

Verification of installed acoustic performance should also be determined in accordance with the recommendations of Section 7.8 of this report.

7.5 MAIN ENTRY DOORS

Any main entry doors to the residential units should be a minimum 40 mm thick solid-core timber with acoustic perimeter and door bottom seals. Suitable acoustic seals could be Raven type RP10/RP10si door frame/perimeter seals and RP8si door bottom seals, or an approved equivalent from another manufacturer.

7.6 SOIL, WASTE, WATER SUPPLY PIPES

Where a duct, soil, waste or water supply pipe is located within a wall or ceiling cavity and serves or passes through one or more SOU's, the following separation details may be used to comply with the required acoustic rating:

Table 11. Services in cavity wall or ceiling			
Option	**Rating**	**Documented source**	**System detail**
1	Rw + Ctr 25	CSR Red Book, Koikas Acoustics opinion	2 layers of 10mm plasterboard
2	Rw + Ctr 25	CSR Red Book	Acoustilag 45 and 13mm plasterboard wall/ceiling lining
3	Rw + Ctr 25	CSR Red Book	Unlagged pipes and 13mm Soundchek wall/ceiling lining. Alternatively, 2 layers of 16mm Fychek may be used as wall/ceiling lining
4	Rw + Ctr 40	CSR Red Book	Acoustilag 45 and 13mm Soundchek wall/ceiling lining. Alternatively, 2 layers of 16mm Fychek may be used as wall/ceiling lining
5	Rw + Ctr 40	Pyrotech Soundlag 4525C brochure	Soundlag 4525C and minimum 10mm plasterboard wall/ceiling lining
Notes: 1. 2. 3.	The acoustic lagging material may be excluded by using Rehau Raupiano Plus pipe system. All installations are to be in accordance with relevant manufacturers' specifications and requirements. Incorporating downlights into ceilings will impact on the acoustic rating of the partition system. Consultation should be made with an acoustic consultant in the event of downlights being proposed in the ceiling. The CSR Red Book provides some guidance on downlights being installed in a services partition system.		

The BCA further qualifies the acoustic requirements of services partitions with the following:

- Services must not be chased into concrete or masonry elements,
- An access door or panel must be firmly fixed so as to overlap the frame or rebate the frame by not less than 10mm and be fitted with proper sealing gasket along all edges and constructed of:
- Wood, particle board or block board not less than 38mm thick; or
- Compressed fibre reinforced cement sheeting not less than 9mm thick; or
- Other suitable material with a mass per unit area not less than 24kg/m2.
- A water supply pipe must only be installed in the cavity of discontinuous construction, and in the case of a pipe that serves only one SOU, must not be fixed to the wall leaf on the side adjoining any other SOU and have a clearance not less than 10mm to the other wall leaf.

7.7 SOUND ISOLATION OF PUMPS

A flexible coupling must be used at the point of connection between the service's pipes in a building and any circulation or another pump.

7.8 VERIFICATION OF ACOUSTIC PERFORMANCE

It is common for comparable floor/ceiling systems designs to achieve varying acoustic insulation and isolation ratings between buildings. This can be due to the quality of workmanship, attention to detail in sealing any penetrations, and the emergence of flanking sound transmission paths within a building. For this reason, one cannot categorically state that any partition will achieve a specific acoustic rating without conducting in-situ testing.

Koikas Acoustics recommends that in-situ testing is conducted on a representative, and fully installed floor/ceiling assembly (for all types of floor coverings – timber, tiles, carpet) to ensure adequate acoustic insulation and isolation is achieved, prior to installing all floors on all floor levels of the building.

8.0 CONSTRUCTION NOISE AND VIBRATION PLAN OF MANAGEMENT

8.1 ACOUSTICAL REQUIREMENTS

Noise and vibration generated during excavation and construction works are assessed at surrounding residential receivers in accordance with the Interim Construction Noise Guidelines (NSW DECCW, 2009).

8.1.1 ICNG - Construction noise

The guideline recognises that construction and excavation works will at times generate noise that is clearly audible at neighbouring sites. The primary focus is to provide a means of determining the severity of noise impacts at surrounding affected receiver locations and a framework for managing construction noise, generally through implementing best practice noise minimisation principles and facilitating communication between construction workers and the local community.

Small-scale construction projects/works generally do not require detailed calculations of noise emission.

For ongoing projects where surrounding receivers may be exposed to construction noise for periods exceeding three weeks, a more detailed assessment approach is adopted. In this case, a receiver is categorised by the likely community reaction to the level of noise, where some community reaction is expected at 10dB above the background level and strong community reaction is expected at levels exceeding 75 dB(A).

For this assessment, 10 dB above the existing EPA minimum measured daytime background level is 59 dB(A). This is defined as the Noise Affected Level under the ICNG. Above 75 dB(A) is defined as the Highly Noise Affected Level.

8.1.2 ICNG - Construction vibration

Section 4.4 of the ICNG states that "Human comfort vibration from construction works, including continuous, intermittent or impulsive vibration from construction, but excluding blasting, is to be assessed in accordance with Section 2.5 'Short-term works' in *Assessing Vibration – a technical guideline (DEC 2006)*".

The DEC vibration standard has been sourced from *British Standard 6472-1992 Evaluation of human exposure to vibration in buildings (1Hz to 80Hz).* The referenced table nominates preferred and maximum vibration dose values (VDV) that correlate with human annoyance at receiver sites of different classifications such as residential, education facilities etc.

Table 12. Acceptable vibration dose value for intermittent vibration (m/s$^{1.75}$), BS6472:1992				
Location	**Daytime**		**Night-time**	
	Preferred values	**Maximum values**	**Preferred values**	**Maximum values**
Critical areas	0.1	0.2	0.1	0.2
Residences	**0.2**	**0.4**	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

A more critical assessment of vibration impacts may be related to structural damage to surrounding buildings. It is expected that the geotechnical engineer will specify a peak particle velocity limit not to be exceeded at the site boundary. Where this is not available, a guide to applicable structural damage criteria can be taken from *British Standard 7385-2:1993* and/or *German Standard DIN4150-3.*

BS7385-2:1993 recommends a maximum peak component particle velocity when measured at the base of the building of:

- 50mm/s for reinforced or framed structures – Industrial and heavy commercial buildings.
- 15mm/s for unreinforced or light framed structures – Residential or light commercial type buildings.

German standard DIN4150-3 recommends a maximum peak particle velocity of:

Table 13. DIN4150-3 Guideline values for assessing short-term vibration effects					
Line	**Type of structure**	**Vibration velocity, v_i, in mm/s**			
		Foundation			**Plane of floor of uppermost full storey**
		At a frequency of			**Frequency mixture**
		Less than 10Hz	**10 to 50Hz**	**50 to 100Hz**	
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

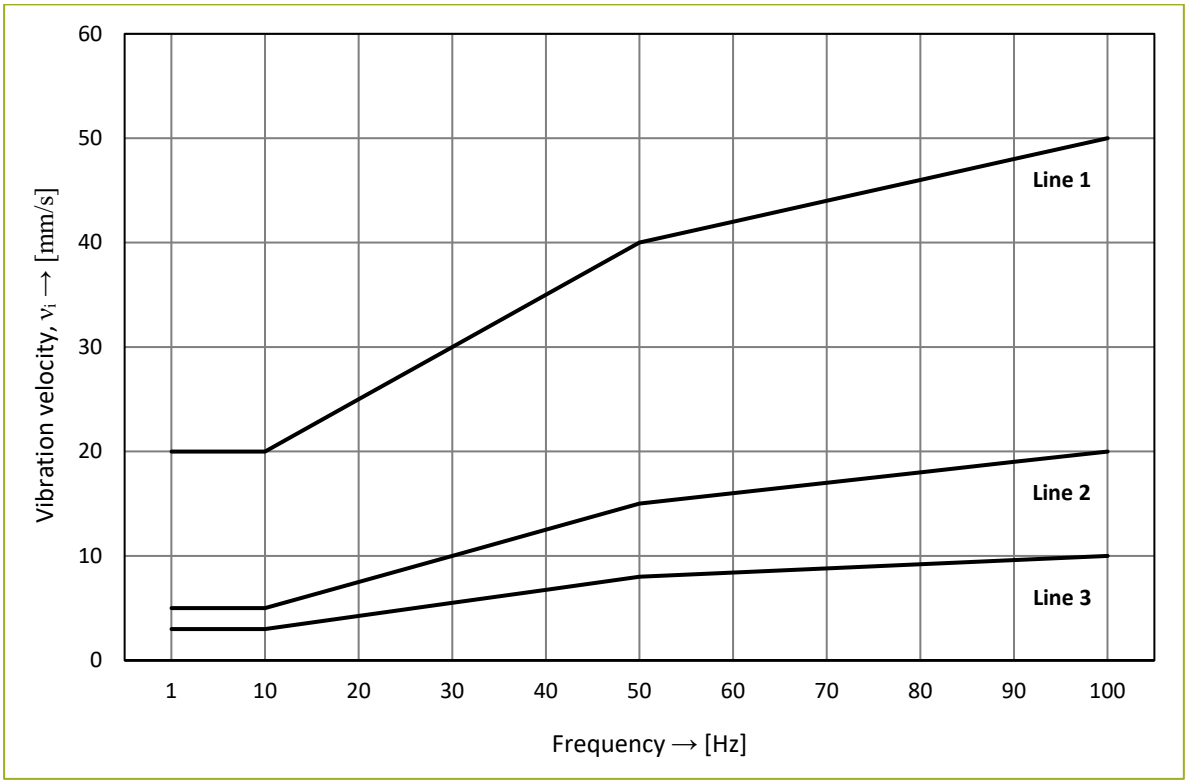


Figure 2. DIN4150-3 Curves representing guideline vibration velocity values at the building foundation

8.1.3 Sydney Metro – Technical Services

The requirements from Sydney Metro Underground Corridor Protection Technical Guidelines (Doc No.: iCentral SM-20-00081444, Dated: April 2021) have been extracted below.

Extract 1:

b) In the acoustic report for the proposed mixed-use development (Appendix 54), Section 1 states that Koikas Acoustics has determined that a rail vibration assessment from the Hills Showground Station is required at the DA stage. However, such an assessment is not found in the report. A rail vibration and ground borne noise assessment is required.

Response 1:

Section 4.0 of the DA Acoustical Report outline the rail noise and vibration assessment.

This concludes the following:

- Rail noise was not audible and measurable at the nearest boundary, as such, compliance with the rail noise requirements is expected to be achieved. The road traffic noise was found to be the dominant noise and the building has been sufficiently designed to comply with the noise requirements.
- Rail vibration were not measurable at the nearest boundary, as such, Koikas Acoustics expects a low probability of adverse comments with regards to rail vibration.

Extract 2:

c) In Section 5.1.1, no ISEPP/DOP ground borne noise or vibration requirements for the proposed development are stated. The requirements are provided in Section 3.6.3 and 3.6.4 of the ISEPP/DOP and should be included in the assessment.

Response 2:

Reference is made to the ground borne vibration criteria in Section 5.1.5, with respect to *Assessing Vibration: a technical guideline (DECC 2006)*.

The noise impact from the ground borne noise is expect to be negligible as it is not measurable. This requirement will be updated in the next issue of the CC acoustical report.

Extract 3:

d) Considerations for assessing operational noise and vibration impacts from rail operations on the development are available for the developer in Section 9.3.2 of the Sydney Metro Underground Corridor Protection Technical Guidelines.

Response 3:

As no noise or vibration were measurable above ground at the assessment site, the noise impact from the rail operation is expected to be negligible and increased volume is not expected to cause adverse effects on the development.

Section 8.0 of the DA Acoustical Report outlines the construction noise and vibration impacts on surrounding premises and a plan of management on how to address the noise and vibration concerns.

Anticipated construction noise levels are presented in Table 15 (Section 8.2) and noise and vibration controls are outline in Section 8.4.

Anticipated vibration levels can not accurately be determined as it is based on unknown variable such as geological structure of the construction site and area to the Sydney Infrastructure, location/depth of works, and the type, intensity and use of machinery.

Prior to the commencement of excavation and each machinery onsite, attended noise and vibration monitoring will be conducted by Koikas Acoustics to determine the expected noise and vibrations levels at surrounding premises and determine the appropriate mitigations measures to ensure noise and vibration levels within the adopted planning levels.

Continuous vibration monitoring will also be conducted at the Sydney Metro Infrastructure for the duration of the demolition/excavation/piling to ensure the vibrations are within acceptable limits and modify construction methodology should workers be notified that vibration levels exceed the acceptable limits. The vibration monitors included SMS and audible/visual alarms to notify workers when the vibration levels reach warning and threshold alerts. The location of the vibration monitoring will be constantly reviewed throughout various stages of the construction works to depend if vibration monitors should be relocated to ensure the Sydney Metro infrastructure is sufficiently protected.

Extract 4:

e) The basement and foundations of the proposed development and their relative locations to the underground rail corridor and the station should be considered in the ground borne noise and vibration assessment.

Response 4:

Anticipated vibration levels can not accurately be determined as it is based on unknown variable such as geological structure of the development site. As ground borne noise and vibration is not audible or measurable above ground, rail operation is not expected to cause adverse effects to the development site.

Once excavation has commenced onsite and Koikas Acoustics can have access to the sub-terrain area, additional rail noise and vibration measurement will be undertaken to ensure the ground borne noise and vibration levels at the basement/foundation level to confirm the rail operation is negligible and within the acoustical requirements.

8.1.4 The Hills Shire Council

The Hills Shire Council have requested the following additional information:

> ***Furthermore a real item of concern for this development is related to the need for all windows and doors (accessing or facing the showground directly) to be double glazed. It expected that events at the Showground will generate substantial sound that will impact on this and other nearby residential / apartment towers.***

At this stage of works, Koikas Acoustics does not see double glazing as a necessity.

These events generally do not occur during the night-time where a sleep disturbance assessment is required. During the daytime, the noise impact from the typical use of the Showground at the façade of the building is expected to be below the designed traffic levels. Furthermore, the towers are almost 100 m from the edge of the Showground and 200 m from the centre.

Koikas Acoustics is required to reconduct noise logging at the CC stage (as discussed in this report) and as such, this can be coordinated to be installed with future events to measure the noise impact from typical events at the Showground, and determine whether double-glazing or other building materials are required to achieved the recommended indoor design levels.

8.2 CONSTRUCTION NOISE

8.2.1 Construction noise sources and sound levels

In terms of noise emanating from typical construction activity, levels range depending on the process or sources involved. Typical construction noise levels are included in *Australian Standard 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites* and the *Department for Environment, Food and Rural Affairs (DEFRA – UK) Update of Noise Database for Prediction of Noise on Construction and Open Sites, December 2004.*

Table 14. Construction activity typical sound levels, [dB]

Equipment	Typical sound power level – Lw	Reference noise level – L_{Aeq} at 10m
Circular saw	112	84
Angle grinder	108	80
Hand tools (pneumatic)	116	88
Trucks (dump)	117	89
22-tonne excavator	99	71
Excavator loading truck	107	79
Concrete pump	103	75
Concrete truck and pump	95	67

8.2.2 Calculated construction noise levels

The level of noise predicted at a specific receiver location is governed by the source noise level, the distance between the source and receiver, and the presence of any screening objects along the propagation path. The location of plant and equipment on construction sites are not always at a fixed point and, therefore, the distance between a noise source and receiver location can vary.

Koikas Acoustics has assessed each of the identified construction noise sources at a central location on the development site. This results in the following distances to nearby residential properties:

- 20 metres to Hills Showground Station;
- 30 metres to the nearest boundary of Hills Showground Precinct East;
- 30 metres to the nearest boundary of Hills Showground Precinct West;
- 30 metres to the nearest boundary of Castle Hill Showground, and
- 75 metres to the residential premises along Carrington Road.

Construction noise levels were calculated at the residential boundary for each of the nearest residential receivers. Construction noise levels will vary at times from those predicted in this report on account of plant and equipment being located at varying locations within the development site.

Table 15. Estimated construction noise levels to surrounding receivers – $L_{Aeq\ 15\ min}$ [dB]			
Equipment	**Noise assessment receiver location**		
	Hills Showground Station	**Hills Showground Precinct East and West, and Castle Hill Showground**	**Residential premises along Carrington Road**
Circular saw	78	74	66
Angle grinder	74	70	62
Hand tools (pneumatic)	82	78	70
Trucks (dump)	83	79	71
22 tonne excavator	65	61	53
Excavator loading truck	73	69	61
Concrete pump	69	65	57
Concrete truck and pump	61	57	49
Notes 1.	Predicted construction noise levels are estimates only due to the large variance in noise level generated by comparable plant performing similar tasks on different construction sites. Should complaints arise it may be necessary to survey noise being generated on-site to determine the actual working noise levels.		

Estimated construction noise levels in Table 15 do not consider acoustic screening from any existing boundary fences. Receivers that are screened from construction equipment by a boundary fence of approximately 1.8 metres in height, noise levels may be up to 5 dB below those predicted.

Noise from construction is predicted to, at times, exceed the Noise Affected level of the ICNG at nearby premises. This is due to the proximity of the adjoining residences in relation to the assessment site and the typical nature of noise associated with construction equipment.

It should be noted that the predicted levels consider construction noise levels being constant over a 15 minutes assessment period with the equipment operating at maximum capacity. Therefore, calculated noise levels above should be considered as conservative. Given typical respite periods, we could reasonably expect construction noise levels to be up to 3 to 5dB lower than predicted.

8.3 VIBRATION ASSESSMENT

The highest anticipated vibration levels will result from rock breaking or other impulsive-type excavation works (depending on the local geology).

Rock sawing is an alternative to rock breaking that generates far less vibration and should be used for removal of the existing rock should hammering cause excessive vibrations.

A guide to safe work distances for typical vibration generating construction works is given in Table 2 of the *Construction Noise and Vibration Guideline (RMS, 2016)*.

Table 16. Reproduced in part from Table 2 of the RMS construction noise and vibration guide			
Plant item	**Rating / Description**	**Minimum working distance**	
		Cosmetic damage (BS7385)	**Human response (Assessing vibration: A technical guideline)**
Vibratory roller	< 50kN (Typically 1-2 tonnes)	5m	15m to 20m
	< 100kN (Typically 2-4 tonnes)	6m	20m
Small hydraulic hammer	300kg – 5 to 12t excavator	2m	7m
Medium Hydraulic Hammer	900kg – 12 to 18t excavator	7m	23m
Jackhammer	Handheld	1m (nominal)	2m

The vibration generated from an excavator removing site soil during earthworks for the basement is not expected to result in structural damage or human annoyance at nearby receivers.

8.4 NOISE & VIBRATION CONTROLS

The NSW Department of Environment, Climate Change and Water (DECCW) recognise that there is a need to balance the existing noise amenity of residents along with the necessity to continue growth within the region. The fundamental principle involved with the development and success of each noise policy is maintaining open and free channels of communications between developers and residents alike.

Construction noise policies are implemented to limit noise exposure for premises surrounding construction sites. Noise controls and mitigation strategies must be reasonable and feasible and applied on a case-by-case basis to ensure the best possible outcome for all parties involved.

Due to proximity, construction noise levels will generally exceed any adopted criterion. For this particular development, construction noise levels could potentially significantly exceed the Noise Affected Level of the ICNG at times.

Minimising the impact of noise from construction sites to surrounding land uses can be achieved through treatment of the noise sources themselves, treating noise along its propagation path. Consideration needs to be given to each source in identifying the most practical and efficient noise controls where treatment is necessary.

Table C3 in AS2436-2010 states the relevant effects of various types of noise control measures typically employed on construction sites.

Table 17. AS2436-2010 Table C3 – Relative effectiveness of various forms of noise control	
Control by	**Nominal noise reduction possible, in total A-weighted sound pressure level LpA [dB]**
Distance	Approximately 6 for each doubling of distance
Screening	Normally 5 to 10, maximum 15
Enclosure	Normally 15 to 25, maximum 50
Silencing	Normally 5 to 10, maximum 20

For this project, the following noise and vibration controls could be implemented to help maintain suitable noise and vibration amenity for surrounding land uses:

- The use of moveable screens for specific work practices could achieve noise reductions of Table 17. The screens would have to be moveable where noise sources are not stationary within the construction site.
- Providing an acoustic type hoarding along the site boundary will also lower noise levels to surrounding pedestrians and Sydney Metro Station.
- Exhaust silencers could be considered to motorised plant and equipment such as the excavators. Silenced plant and equipment could lower noise emission from the exhaust system by 5 to 10dB.
- Undertake construction works during standard hours as defined in the ICNG.
- Use appropriately sized plant and equipment.
- Identify when high noise-generating activities are likely to take place and conducting this work during times of least noise sensitivity. Having open lines of communication with residents and appropriate scheduling of works on construction sites are processes recommended in both the City's construction noise code and the NSW ICNG.
- To minimise vibration from rock breaking, it is recommended that a hydraulic hammer attachment with a pointed 'cone' type hammer is used in place of a flat 'block' type hammer.
- The minimum work distances as tabled within this report should be observed at all times, especially regarding structural damage guidelines.
- Continuous vibration monitoring surveys may be considered during excavation to ensure vibration levels do not reach a point where the structural integrity of Sydney Metro is compromised. Vibration monitors can be set to measure either the peak particle velocity or r.m.s. acceleration at the site boundary where a design vibration limit is specified by the Geotech engineer or as a Vibration Dose Value within Sydney Metro Station.
- Progress noise monitoring could also be conducted during construction works to provide feedback to site managers as to the level of noise being emitted from the site.
- Refer to Section 6 of the ICNG and Section 4 of AS2436-2010 for additional information regarding the design, selection, and implementation of suitable work practices for noise control on construction sites.

8.5 VIBRATION MONITORING

Sydney metro has provided the following comments regarding vibration monitoring:

> ***We are of the view the sensitivity of the Vibrock V901 used for measurements is not sufficient. Ground-borne noise will be dominant concern over VdV for which greater sensitivity than 0.1mm/s on V901 is needed. Consultant has stated measurements will be repeated following excavation therefore we recommend the use of a more sensitive accelerometer at this time.***

Koikas Acoustics will conduct vibration monitoring with a meter that has a greater sensitivity than 0.1mm/s during the excavation stage.

8.6 COMPLAINTS HANDLING

A site contact and phone number should be distributed to all surrounding premises and displayed on the site notice-board for any complaints arising due to noise and/or vibration generated during construction works. The site should have clear complaints handling procedure and staff who are well-versed in the complaints handling procedures.

A register of all complaints must be kept on-site and be readily available. Details within the complaints register should include, but not be limited to:

- Date and time of the complaint,
- The person receiving a complaint,
- Complainant phone number,
- Site contact who the complaint was referred to for action,
- Description of the complaint,
- Action to be taken,
- The time frame for action to be implemented.

All complaints should be given a fair hearing and adequately investigated. This may involve scheduling a relevant consultant to substantiate or refute any received complaint, and/or verifying any remedial action taken by the site manager by way of on-site testing.

9.0 TRAFFIC NOISE IMPACT ARISING FROM THE PROPOSED DEVELOPMENT

9.1 ACOUSTICAL REQUIREMENTS

According to the NSW Road Noise Policy, the following noise criteria apply:

Noise Mode Scenario	Space	Noise Criteria	Period
Scenario 2.1	Residential	$L_{Aeq,(1hr)}$ = **55 dB -** External	Daytime (0700-2200)
Scenario 2.2	Residential	$L_{Aeq,(1hr)}$ = **55 dB -** External	Daytime (0700-2200)

Furthermore, the relative increases in traffic noise levels arise from the proposed development are not to exceed 2 dB is also applicable for residential premises.

9.2 TRAFFIC VOLUMES

Koikas Acoustics has been advised the existing 2021 and proposed total peak traffic volumes are as seen in Figure 3 and Figure 4 respectively.

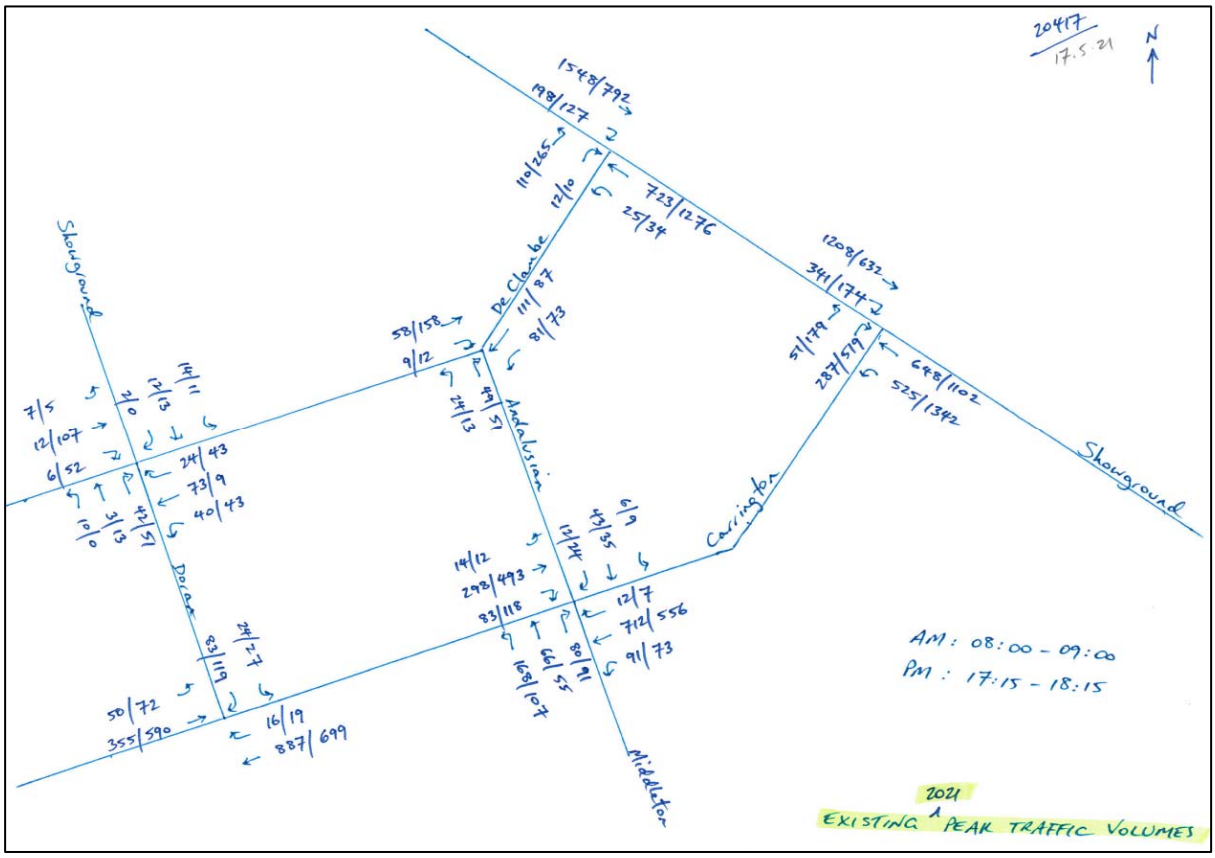


Figure 3. Existing 2021 Peak Traffic Volumes (image source – Deicorp)

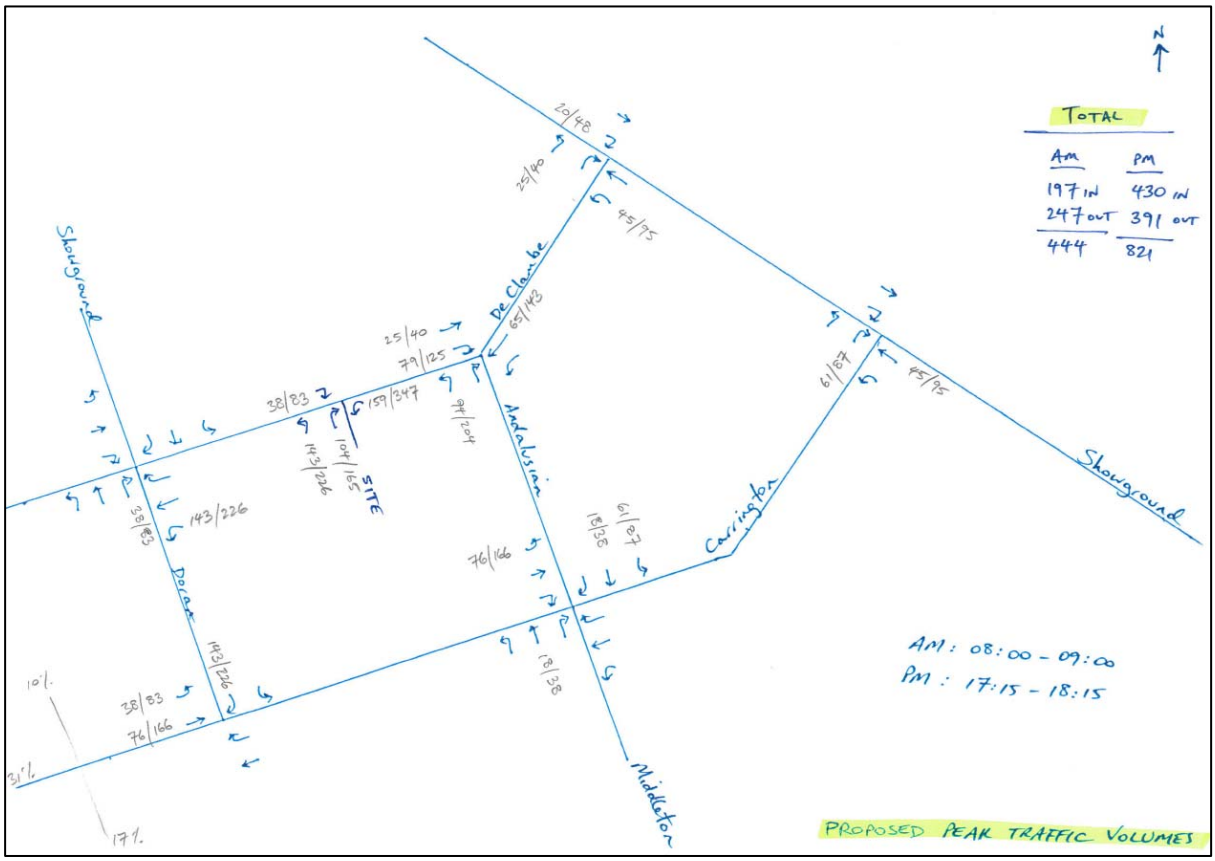


Figure 4. Proposed Peak Traffic Volumes (image source – Deicorp)

The existing PM peak traffic volumes is lower than the AM peak traffic volumes and the proposed PM peak traffic volumes is higher than the AM peak traffic volumes, as such, road traffic noise increase has been assessed in accordance with the existing and proposed PM peak traffic volumes.

9.3 CADNA (A) NOISE MODEL

A calibrated Cadna/A noise model was used to predict traffic noise levels, as described in Section 5.2. Refer to **Appendix B** for Cadna noise contour maps

Scenario 2.1 (Existing Traffic Noise Impact to Surrounding Premises)

External Noise Criterion: $L_{Aeq,\ 1\ hr}$ ≤ 55 dB or ≤ 2 dB Increase

As a worst-case scenario, the existing PM peak hour traffic volumes for local and future roads illustrated in Figure 3 have been included in this noise model scenario.

Scenario 2.2 (Proposed Traffic Noise Impact to Surrounding Premises)

External Noise Criterion: $L_{Aeq,\ 1\ hr}$ ≤ 55 dB or ≤ 2 dB Increase

As a worst-case scenario, the PM peak hour traffic volumes for local and future roads illustrated in Figure 4 have been included in this noise model scenario.

Table 18. Calculated receiver noise levels [dB] - $L_{Aeq\ 15\ minutes}$			
Receiver location	**Existing Traffic Noise Levels (Scenario 2.1)**	**Proposed Traffic Noise Levels (Scenario 2.2)**	**Relative Increase**
R1 – Level 2 Residential	66	67	**1**
R2 – Level 2 Residential	68	70	**2**
R3 – Level 2 Residential	72	74	**2**
R4 – Level 2 Residential	73	74	**1**
R5 – Level 2 Residential	69	70	**1**
R6 – Level 2 Residential	67	68	**1**
R7 – Level 2 Residential	67	68	**1**
R8 – Level 2 Residential	68	70	**2**
R9 – Level 2 Residential	69	70	**1**

The maximum calculated road traffic noise level based on the existing (no-build option) to the surrounding residential premise is found to be $L_{Aeq,1hour}$ 73 dB and exceeds the traffic noise criterion by 18 dB. As such, the limiting criterion is less than or equal to 2 dB increase for the proposed build option in Scenario 2.2. The additional road traffic noise due to the development is therefore expected to achieve the acoustic requirement of the NSW Road Noise Policy without further noise mitigation measures.

10.0 CAR PARK SERVICING THE HILL SHOWGROUND CAR PARK NOISE IMPACT ASSESSMENT

Noise impact assessment from the existing Hills Showground car park servicing opposite Doran Drive to the proposed development has been conducted.

10.1 ACOUSTICAL REQUIREMENTS

Any new car park constructed near residential premises would be expected to comply with the EPA's Noise Policy for Industry. Whilst there are no specific guidelines or recommended noise levels from the existing car park area, Koikas Acoustics has considered the EPA's Noise Policy for Industry. As per Section 6.2 (Table 7), the EPA's Noise Policy for Industry planning levels is summarised in Table 19.

Table 19. NPfI planning levels

Period, T (Note 1)	Project Noise Trigger Levels			
	Monitoring Location A – Corner Mandala Parade and Doran Drive	Monitoring Location B – Corner Andalusian Way and Mandala Parade	Monitoring Location C – Corner De Clamb Drive and Andalusian Way	Monitoring Location D – Corner Doran Drive and De Clamb Drive
Day	54	54	57	55
Evening	47	48	48	48
Night	37	39	40	38
Notes 1.	The NSW EPA NPfI refers to, **Daytime**: 7 am – 6 pm Monday to Saturday and 8 am to 6 pm Sunday and public holidays. **Evening**: 6 pm – 10 pm Monday to Sunday **Night**: 10 pm - 7 am Monday to Saturday and 10 pm to 8 am Sunday and public holidays.			

10.2 TRAFFIC VOLUMES

The traffic volumes and noise sources utilised for this assessment was the parking lot module in the calibrated Cadna/A noise model. This considers the size, capacity and type of car park to determine the relevant sound power level.

The car park is divided over three floor levels with approximately 100 parking spaces each floor level.

10.3 CADNA (A) NOISE MODEL

A calibrated Cadna/A noise model was used to predict car park noise levels, as described in Section 5.2. Refer to **Appendix B** for Cadna noise contour maps

Scenario 3 (The Hills Showground Car park impact to the subject site)

The predicted operational noise levels are presented in Table 20.

Table 20. Calculated receiver noise levels [dB] - $L_{Aeq\ 15\ minutes}$

Receiver location	Daytime Project noise criteria	Calculated Daytime Noise Levels	Night-time Project noise criteria	Calculated Night-time Noise Levels
R1 – Level 2 Residential	**54**	36	**37**	31
R2 – Level 2 Residential		40		35
R3 – Level 2 Residential		40		35
R4 – Level 2 Residential		38		34
R5 – Level 2 Residential		38		34
R6 – Level 2 Residential		37		33
R7 – Level 2 Residential		35		30

Predicted noise levels during the daytime and night-time period are expected to comply with the adopted project noise trigger levels. As the car park is expected to achieved compliance in accordance with the EPA's Noise Policy for Industry to the subject residential site, no further acoustic treatments are required.

11.0 CONCLUSION

Koikas Acoustics was requested to prepare an acoustical report for the proposed mixed-use development at 2 Mandala Parade, Castle Hill NSW 2154 seeking approval for the construction of four buildings up to twenty storeys with associated basement level parking.

The assessment considers potential noise impacts to future occupants of the development, and to surrounding residents such that acceptable acoustic amenity for the area is maintained.

Acoustic planning levels have been referenced from current ISEPP, NSW DoP, EPA, BCA, Interim Construction Noise Guidelines (NSW DECCW, 2009), Sydney Metro – Technical Services and other relevant acoustic planning guidelines and requirements. The included recommendations are based on designs prepared by Turner Studio.

The conclusions reached in this report should assist the Council in making their determination of the proposal in terms of compliance with the necessary acoustic design requirements. A further detailed acoustic report may be required for the CC submission should the building design be amended, or as required by Council. Of the assessed components of noise, the following conclusions have been reached:

1. The building can be sufficiently insulated against existing external sources of noise in the area such as road and rail traffic through the use of acoustic glazing. Recommended glazing systems are provided in this report. These recommendations should be verified before construction.
2. Rail vibration was not measurable at the nearest boundary, as such, Koikas Acoustics expects a low probability of adverse comment and no further mitigation measures are required.
3. A detailed assessment of mechanical plant noise is normally assessed at CC Stage.
4. Acoustic treatment options for the common floors and services partitions included within this report would be adequate for satisfying the sound insulation provisions of the BCA.
5. A quantitative construction noise impact assessment has been conducted and construction noise and vibration plan of management have been prepared to outline reasonable and feasible noise and vibration mitigation measures. Not all mitigation measures apply to this development.
6. Based on the results of the analysis in noise model Scenarios 2.1 and 2.2, the future project road traffic noise level is expected to achieve less than 2 dB increase in noise levels to surrounding residential premises. The additional road traffic noise due to the development is therefore expected to achieve the acoustic requirement of the NSW Road Noise Policy.
7. Predicted noise levels from the existing Hills Showground car park are expected to achieved compliance in accordance with the EPA's Noise Policy for Industry to the subject residential site. No further acoustic treatments are required.

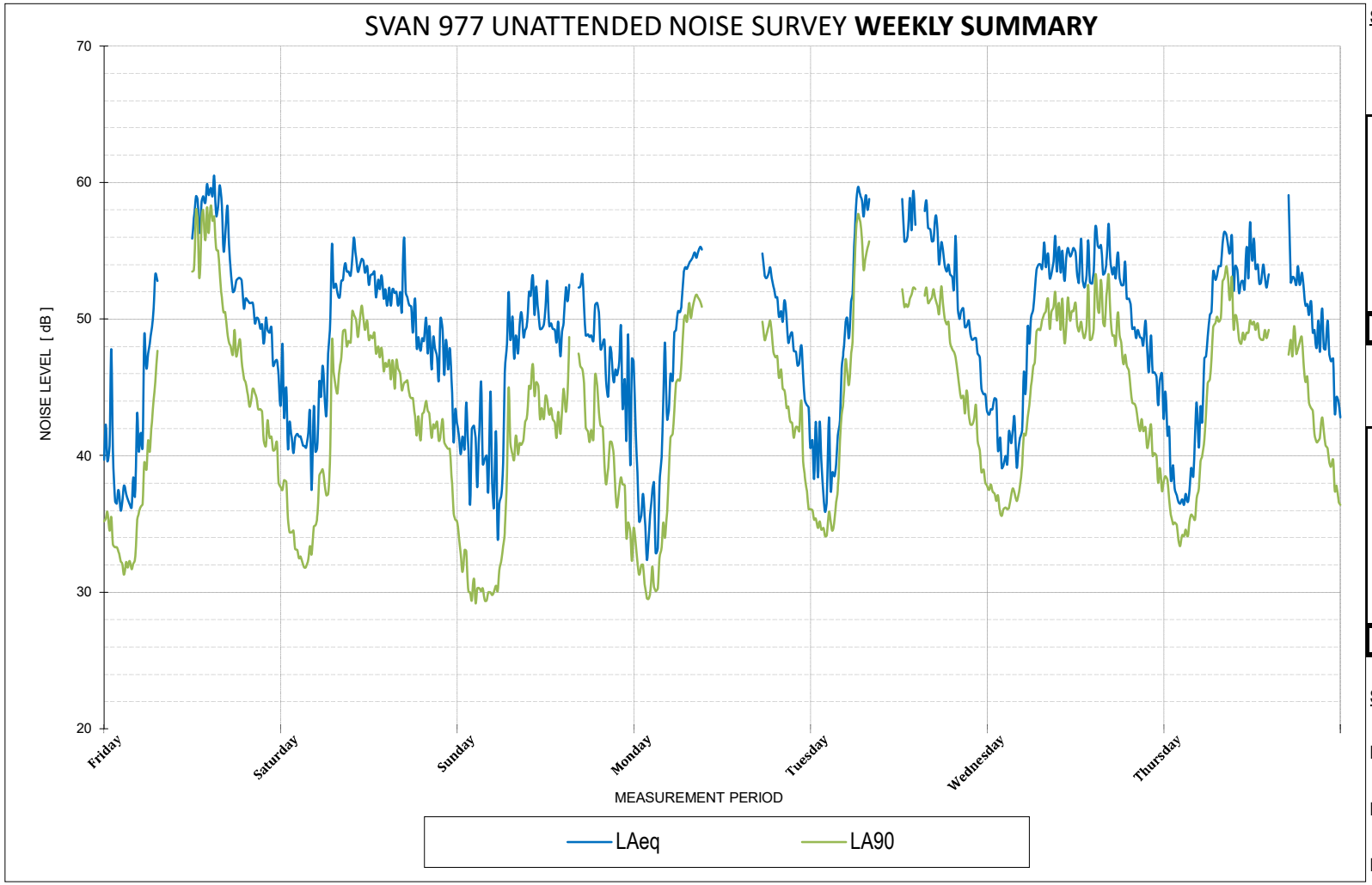
In our professional opinion, there is sufficient scope within the proposed building design to achieve the acoustical planning guidelines.

APPENDIX A

APPENDIX A

APPENDIX A

WEEKLY SUMMARY **LOGGER LOCATION:** Corner Mandala Parade & Dorian Drive **PERIOD:** 10th to the 16th July 2020



Sundays and Public Holidays the hours change to 0800

SUMMARY OF AMBIENT LEVELS

	LA90 Daytime	*LA90* Evening	*LA90* Night-time
Day 1	48	43	32
Day 2	45	41	32
Day 3	41	38	30
Day 4	50	42	30
Day 5	51	43	35
Day 6	49	42	36
Day 7	49	41	34
RBL	**49**	**42**	**32**

	LAeq Daytime	*LAeq* Evening	*LAeq* Night-time
Day 1	58	51	45
Day 2	53	49	45
Day 3	51	48	45
Day 4	54	51	46
Day 5	57	53	51
Day 6	54	51	46
Day 7	54	51	45
Average	**55**	**51**	**47**

SUMMARY OF TRAFFIC LEVELS

LAeq 15 hrs	0700-2200	54	dB
LAeq 9 hrs	2200-0700	47	dB
Max LAeq 1 hr	0700-2200	55	dB
Max LAeq 1 hr	2200-0700	48	dB

Maximum noise events as defined in the Environmental Noise Management Manual 7 day average - [LAmax - LAeq ≥ 15]	19

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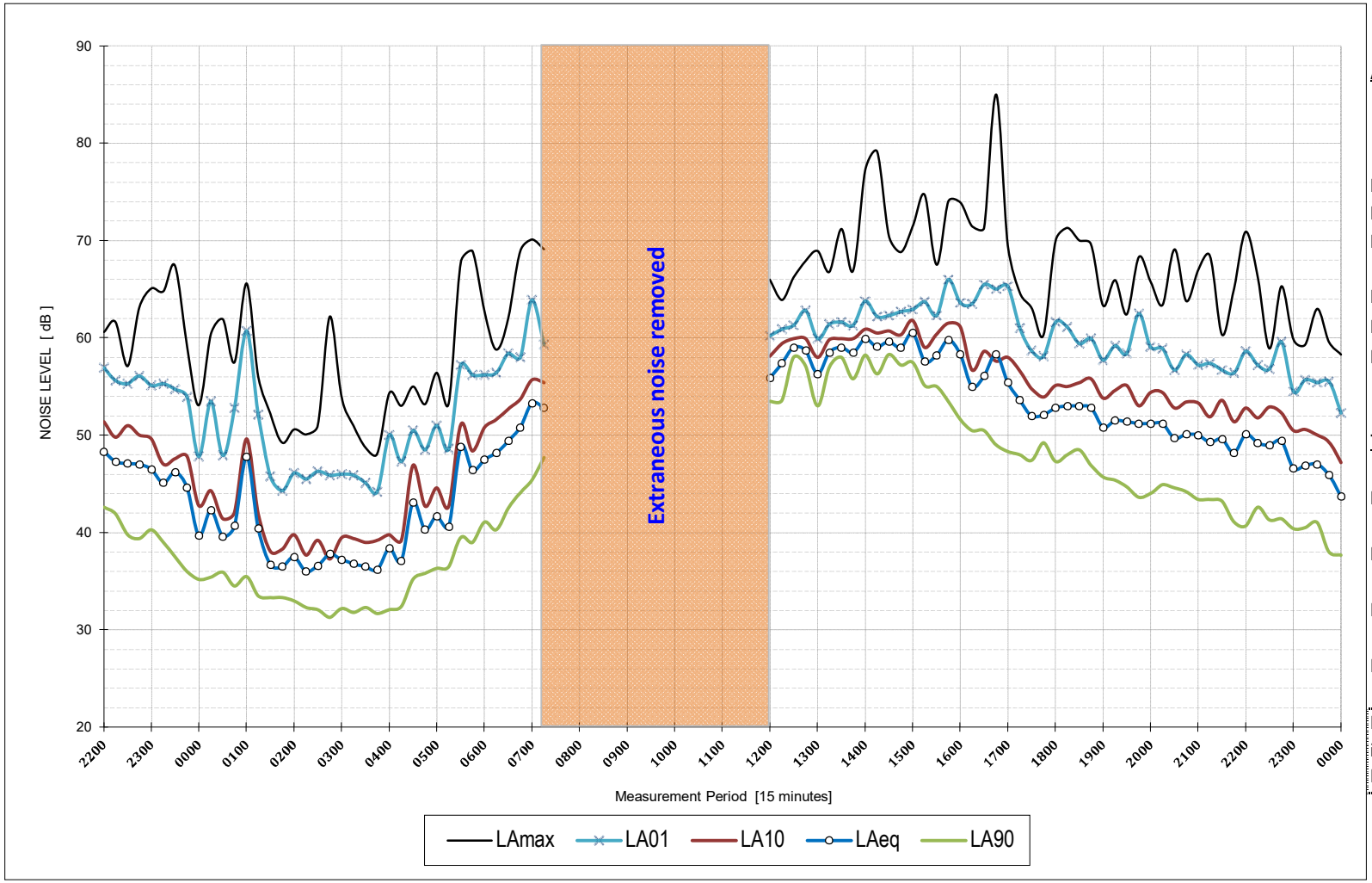
DAY 1 **LOGGER LOCATION:** Corner Mandala Parade & Dorian Drive **DATE:** Friday, 10 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	48	dB
LA90 Evening	1800-2200	43	dB
LA90 Night-time	2200-0700	32	dB
LAeq Daytime	0700-1800	58	dB
LAeq Evening	1800-2200	51	dB
LAeq Night-time	2200-0700	45	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	56	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	59	dB
Max LAeq 1 hour	2200-0700	47	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	18

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DAY 2 **LOGGER LOCATION:** Corner Mandala Parade & Dorian Drive **DATE:** Saturday, 11 July 2020

AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	45	dB
LA90 Evening	1800-2200	41	dB
LA90 Night-time	2200-0700	32	dB
LAeq Daytime	0700-1800	53	dB
LAeq Evening	1800-2200	49	dB
LAeq Night-time	2200-0700	45	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	52	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	54	dB
Max LAeq 1 hour	2200-0700	48	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	24

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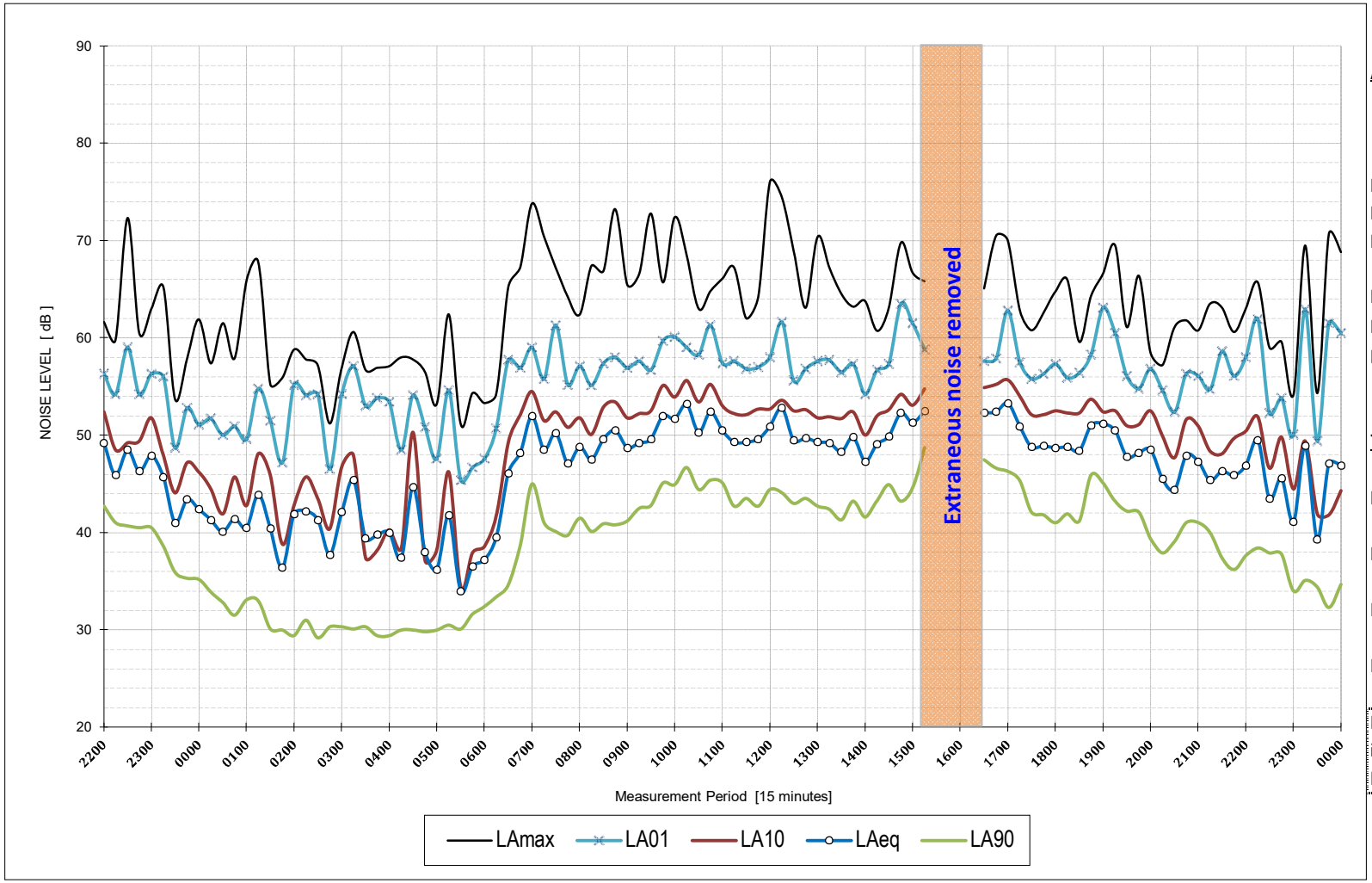
DAY 3 **LOGGER LOCATION:** Corner Mandala Parade & Dorian Drive **DATE:** Sunday, 12 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0800-1800	41	dB
LA90 Evening	1800-2200	38	dB
LA90 Night-time	2200-0800	30	dB
LAeq Daytime	0800-1800	51	dB
LAeq Evening	1800-2200	48	dB
LAeq Night-time	2200-0800	45	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	50	dB
LAeq 9 hours	2200-0700	43	dB
Max LAeq 1 hour	0700-2200	52	dB
Max LAeq 1 hour	2200-0700	46	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	26

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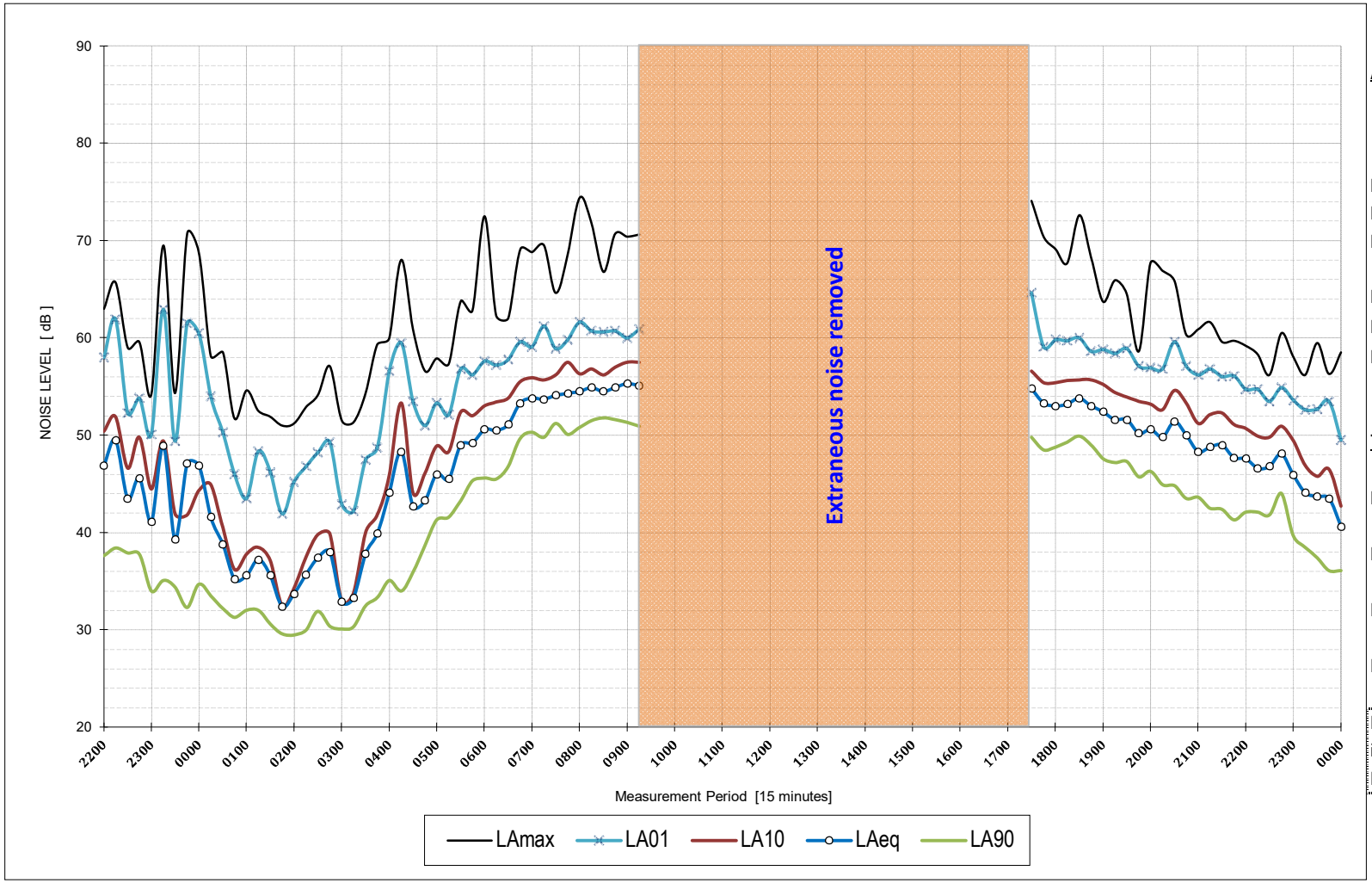
CONSULTANTS IN NOISE & VIBRATION

DAY 4 **LOGGER LOCATION:** Corner Mandala Parade & Dorian Drive **DATE:** Monday, 13 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	50	dB
LA90 Evening	1800-2200	42	dB
LA90 Night-time	2200-0700	30	dB
LAeq Daytime	0700-1800	54	dB
LAeq Evening	1800-2200	51	dB
LAeq Night-time	2200-0700	46	dB

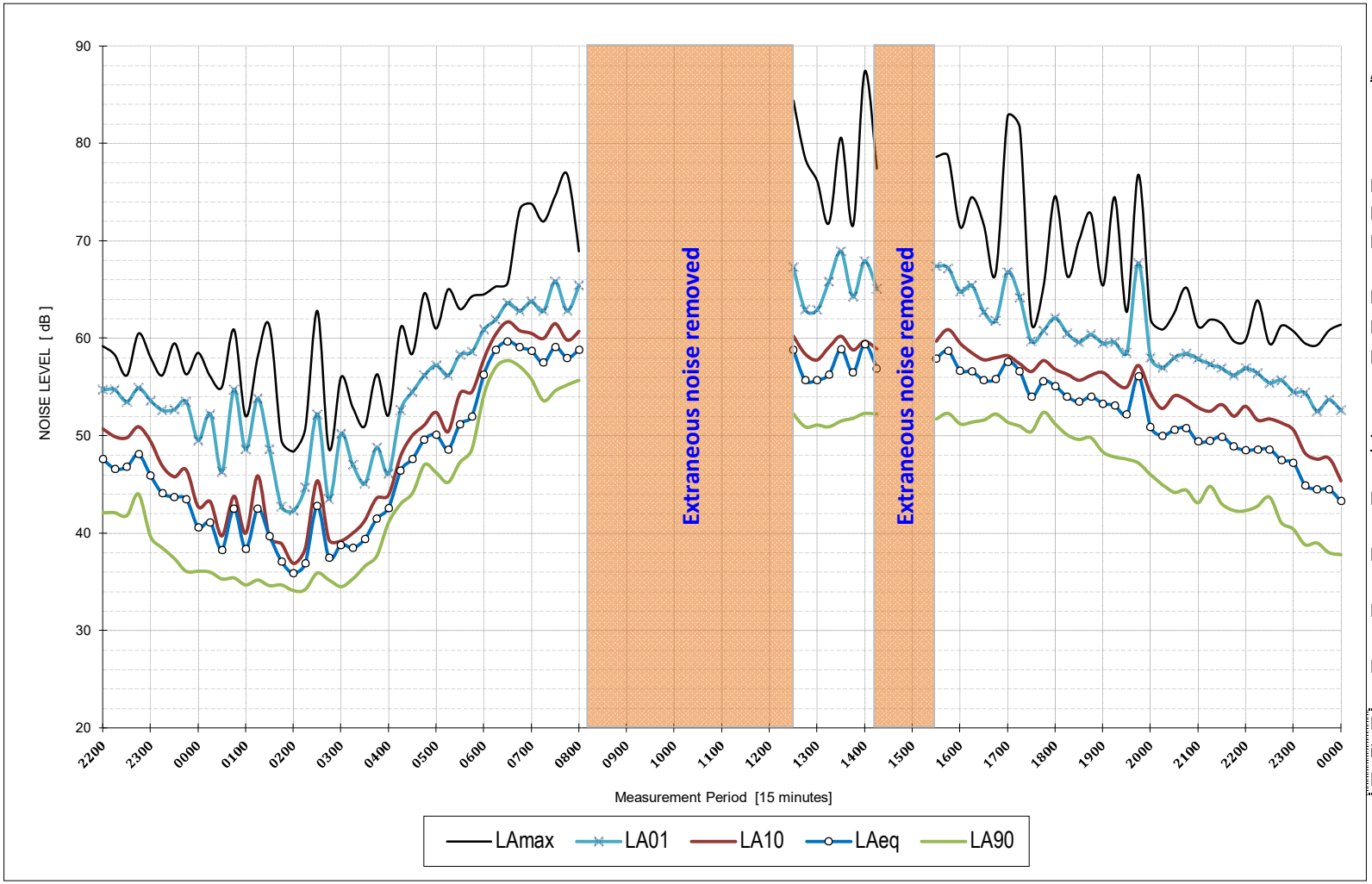
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	53	dB
LAeq 9 hours	2200-0700	46	dB
Max LAeq 1 hour	0700-2200	55	dB
Max LAeq 1 hour	2200-0700	49	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	27

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 5 **LOGGER LOCATION:** Corner Mandala Parade & Dorian Drive **DATE:** Tuesday, 14 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	51	dB
LA90 Evening	1800-2200	43	dB
LA90 Night-time	2200-0700	35	dB
LAeq Daytime	0700-1800	57	dB
LAeq Evening	1800-2200	53	dB
LAeq Night-time	2200-0700	51	dB

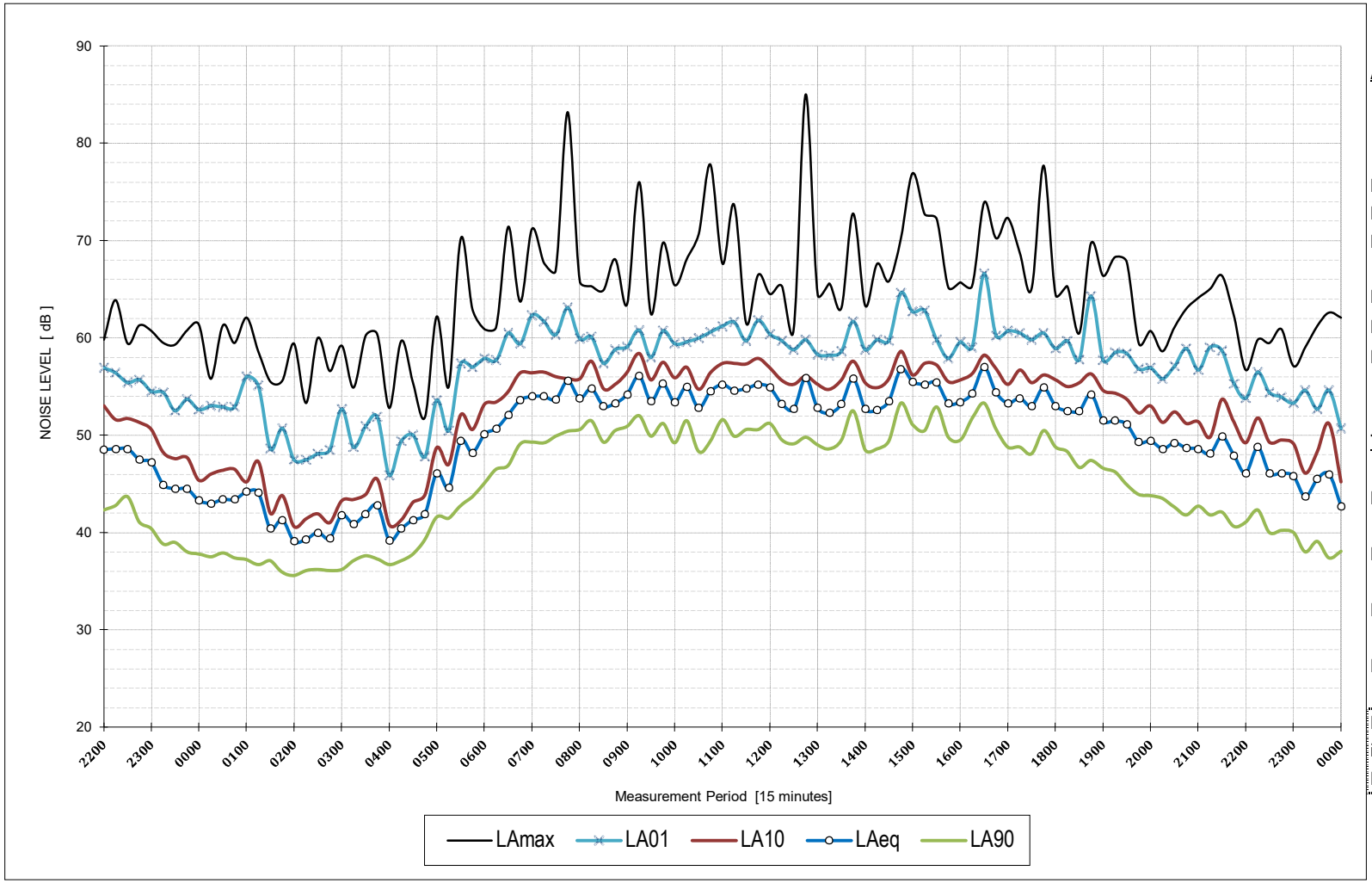
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	56	dB
LAeq 9 hours	2200-0700	51	dB
Max LAeq 1 hour	0700-2200	58	dB
Max LAeq 1 hour	2200-0700	52	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	11

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 6 **LOGGER LOCATION:** Corner Mandala Parade & Dorian Drive **DATE:** Wednesday, 15 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	49	dB
LA90 Evening	1800-2200	42	dB
LA90 Night-time	2200-0700	36	dB
LAeq Daytime	0700-1800	54	dB
LAeq Evening	1800-2200	51	dB
LAeq Night-time	2200-0700	46	dB

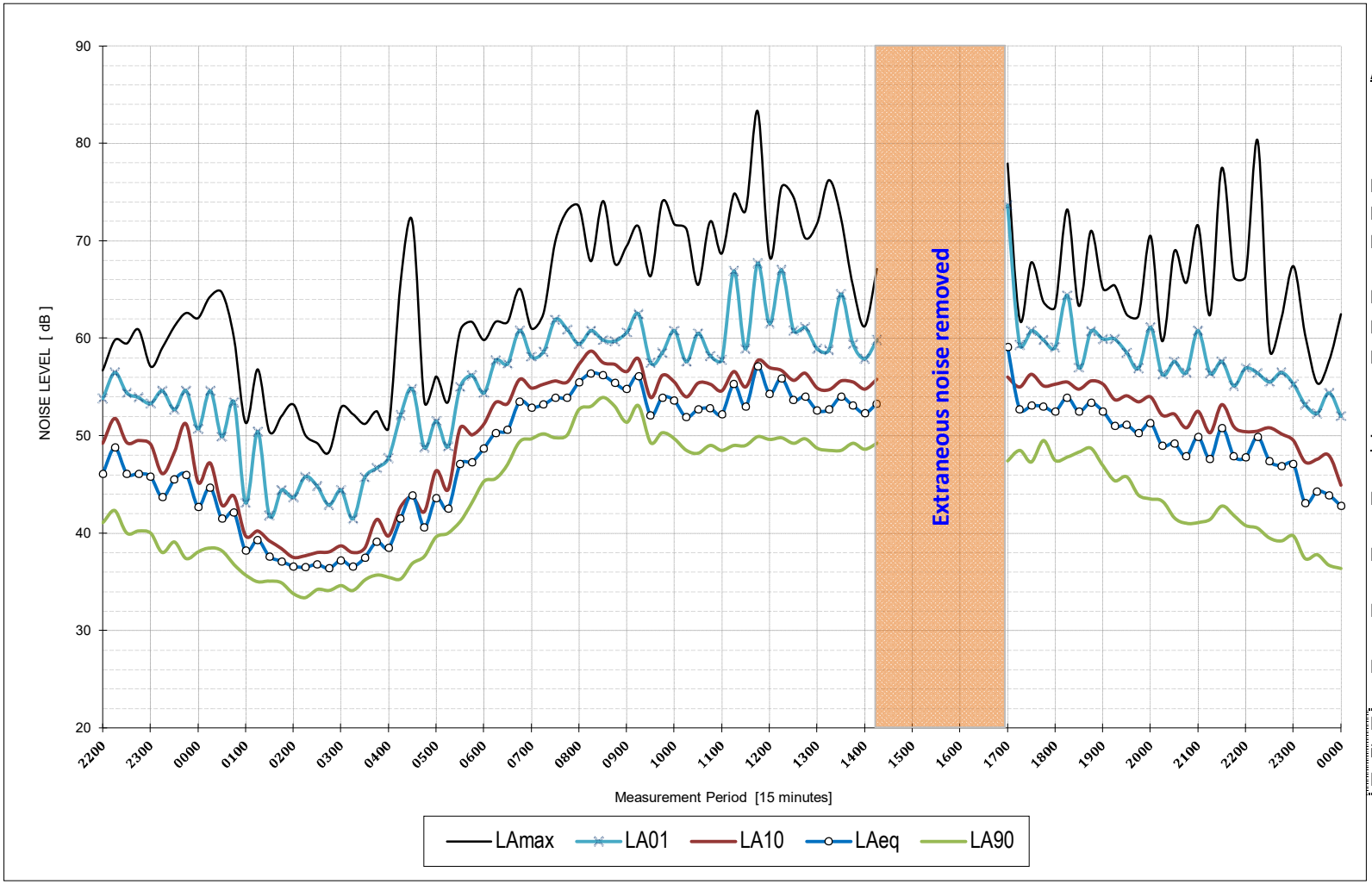
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	54	dB
LAeq 9 hours	2200-0700	46	dB
Max LAeq 1 hour	0700-2200	55	dB
Max LAeq 1 hour	2200-0700	48	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	17

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 7 **LOGGER LOCATION:** Corner Mandala Parade & Dorian Drive **DATE:** Thursday, 16 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	49	dB
LA90 Evening	1800-2200	41	dB
LA90 Night-time	2200-0700	34	dB
LAeq Daytime	0700-1800	54	dB
LAeq Evening	1800-2200	51	dB
LAeq Night-time	2200-0700	45	dB

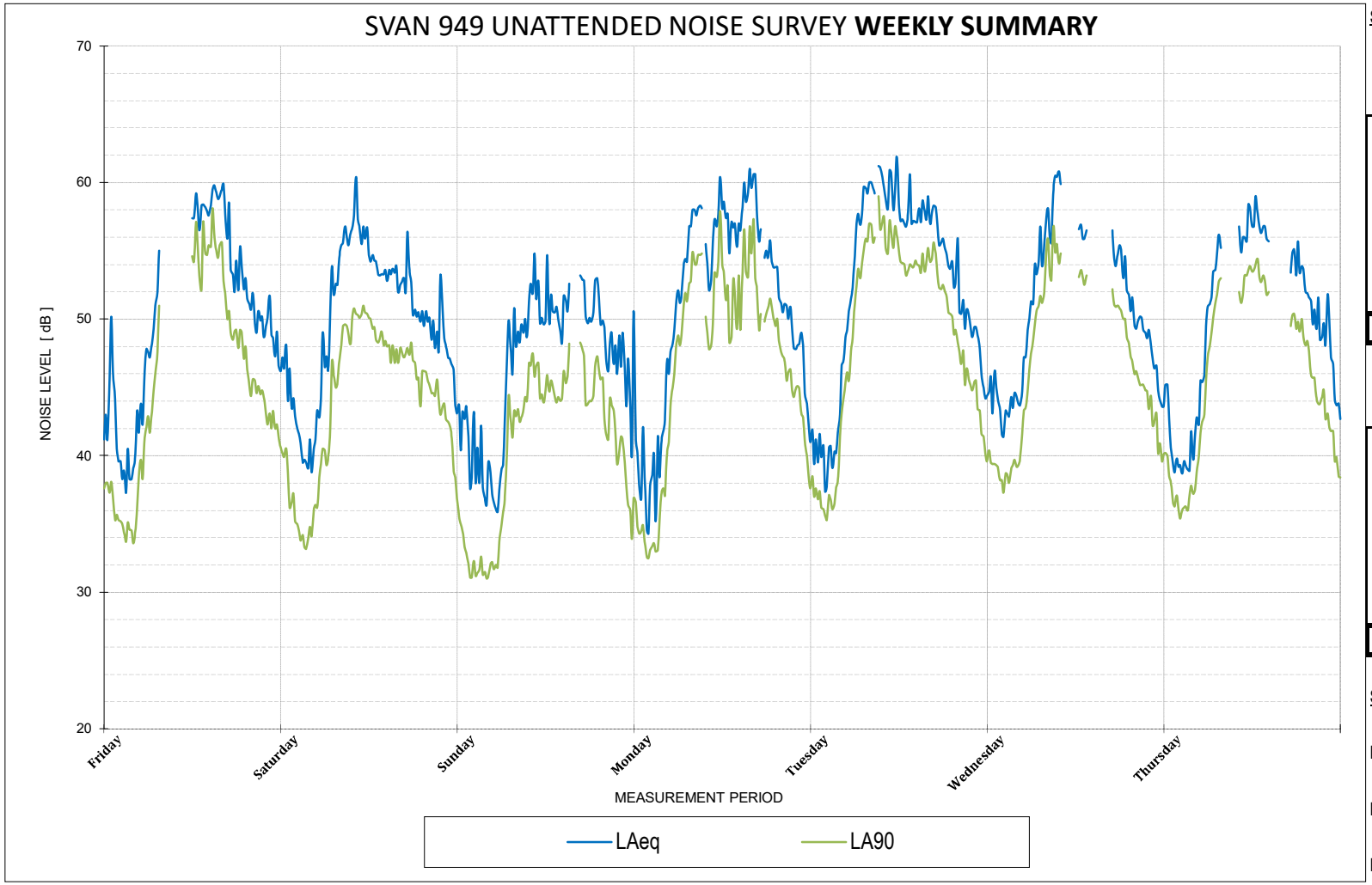
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	54	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	56	dB
Max LAeq 1 hour	2200-0700	47	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	13

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

WEEKLY SUMMARY **LOGGER LOCATION:** Corner Andalusian Way & Mandala Pde **PERIOD:** 10th to the 16th July 2020



Sundays and Public Holidays the hours change to 0800

SUMMARY OF AMBIENT LEVELS

	LA90 Daytime	*LA90* Evening	*LA90* Night-time
Day 1	49	44	34
Day 2	47	44	34
Day 3	43	41	31
Day 4	49	45	33
Day 5	53	45	36
Day 6	51	45	38
Day 7	51	44	36
RBL	**49**	**44**	**34**

	LAeq Daytime	*LAeq* Evening	*LAeq* Night-time
Day 1	58	52	45
Day 2	55	50	46
Day 3	51	50	45
Day 4	58	53	47
Day 5	59	53	50
Day 6	57	52	47
Day 7	56	52	46
Average	**57**	**52**	**47**

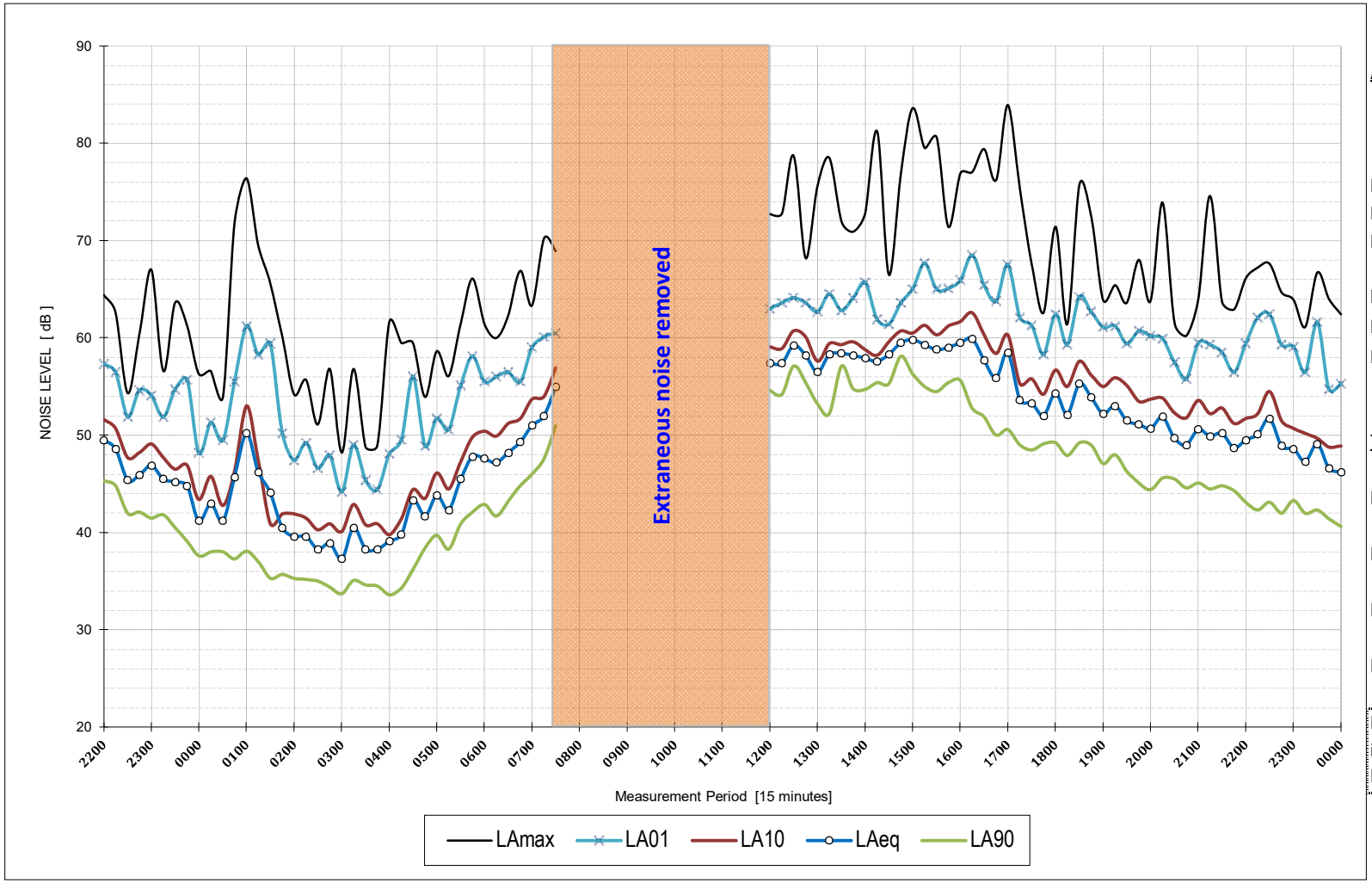
SUMMARY OF TRAFFIC LEVELS

LAeq 15 hrs	0700-2200	56	dB
LAeq 9 hrs	2200-0700	47	dB
Max LAeq 1 hr	0700-2200	58	dB
Max LAeq 1 hr	2200-0700	48	dB

Maximum noise events as defined in the Environmental Noise Management Manual 7 day average - [LAmax - LAeq ≥ 15]	19

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 1 **LOGGER LOCATION:** Corner Andalusian Way & Mandala Pde **DATE:** Friday, 10 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	49	dB
LA90 Evening	1800-2200	44	dB
LA90 Night-time	2200-0700	34	dB
LAeq Daytime	0700-1800	58	dB
LAeq Evening	1800-2200	52	dB
LAeq Night-time	2200-0700	45	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	56	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	59	dB
Max LAeq 1 hour	2200-0700	47	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	18

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 2 **LOGGER LOCATION:** Corner Andalusian Way & Mandala Pde **DATE:** Saturday, 11 July 2020

AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	47	dB
LA90 Evening	1800-2200	44	dB
LA90 Night-time	2200-0700	34	dB
LAeq Daytime	0700-1800	55	dB
LAeq Evening	1800-2200	50	dB
LAeq Night-time	2200-0700	46	dB

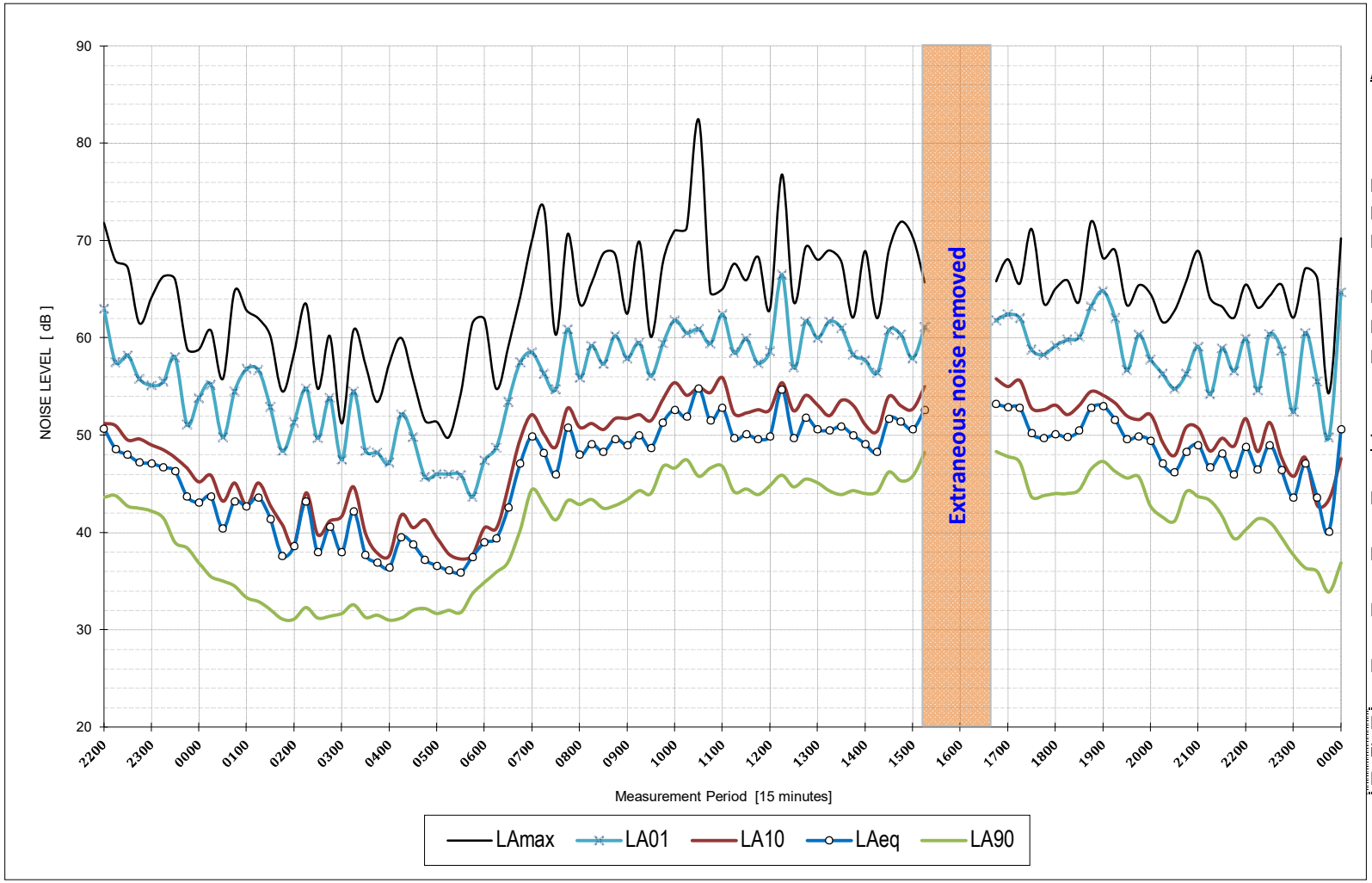
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	54	dB
LAeq 9 hours	2200-0700	46	dB
Max LAeq 1 hour	0700-2200	56	dB
Max LAeq 1 hour	2200-0700	48	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	30

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 3 **LOGGER LOCATION:** Corner Andalusian Way & Mandala Pde **DATE:** Sunday, 12 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0800-1800	43	dB
LA90 Evening	1800-2200	41	dB
LA90 Night-time	2200-0800	31	dB
LAeq Daytime	0800-1800	51	dB
LAeq Evening	1800-2200	50	dB
LAeq Night-time	2200-0800	45	dB

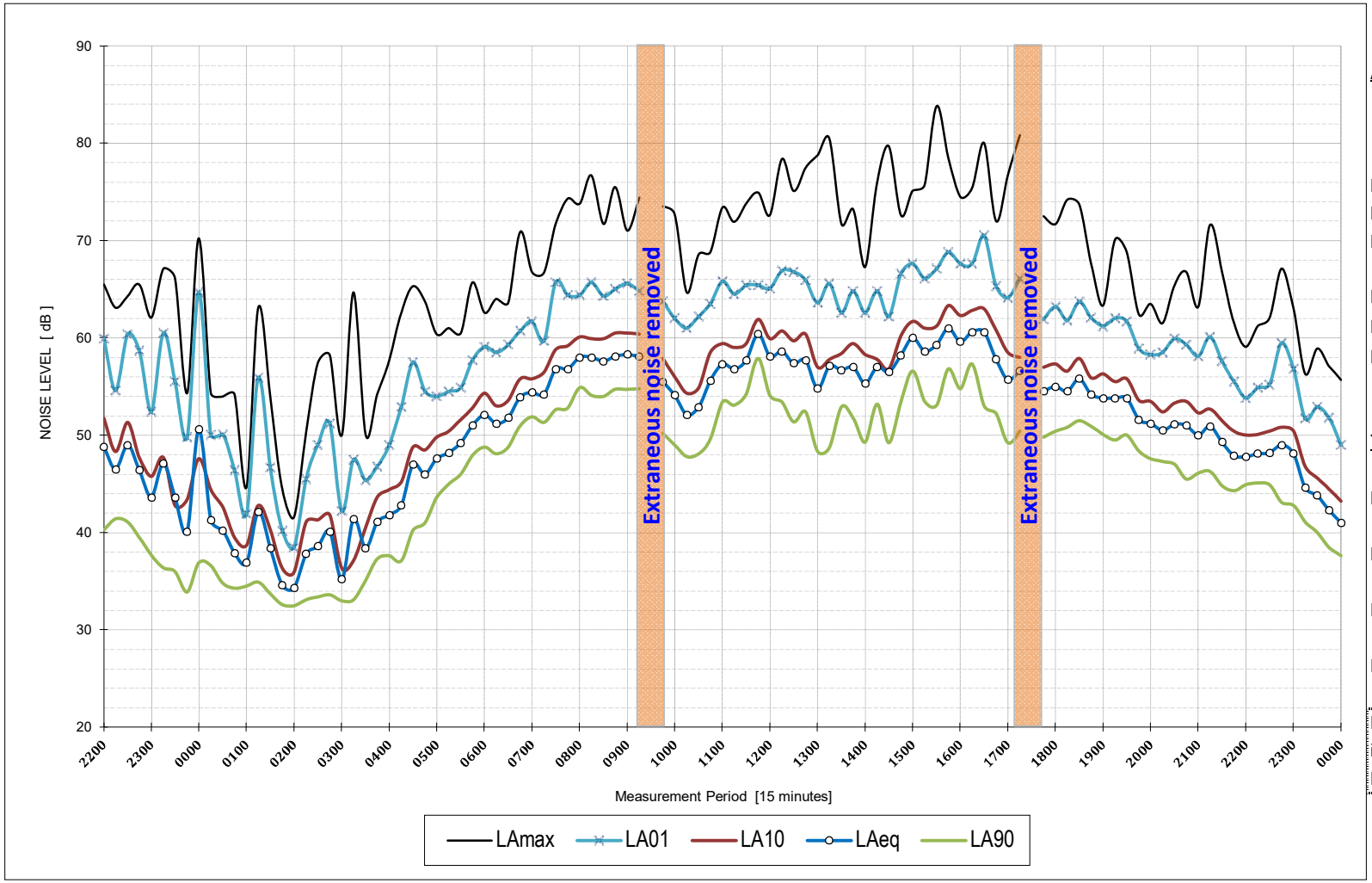
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	51	dB
LAeq 9 hours	2200-0700	44	dB
Max LAeq 1 hour	0700-2200	53	dB
Max LAeq 1 hour	2200-0700	47	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	31

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 4 **LOGGER LOCATION:** Corner Andalusian Way & Mandala Pde **DATE:** Monday, 13 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	49	dB
LA90 Evening	1800-2200	45	dB
LA90 Night-time	2200-0700	33	dB
LAeq Daytime	0700-1800	58	dB
LAeq Evening	1800-2200	53	dB
LAeq Night-time	2200-0700	47	dB

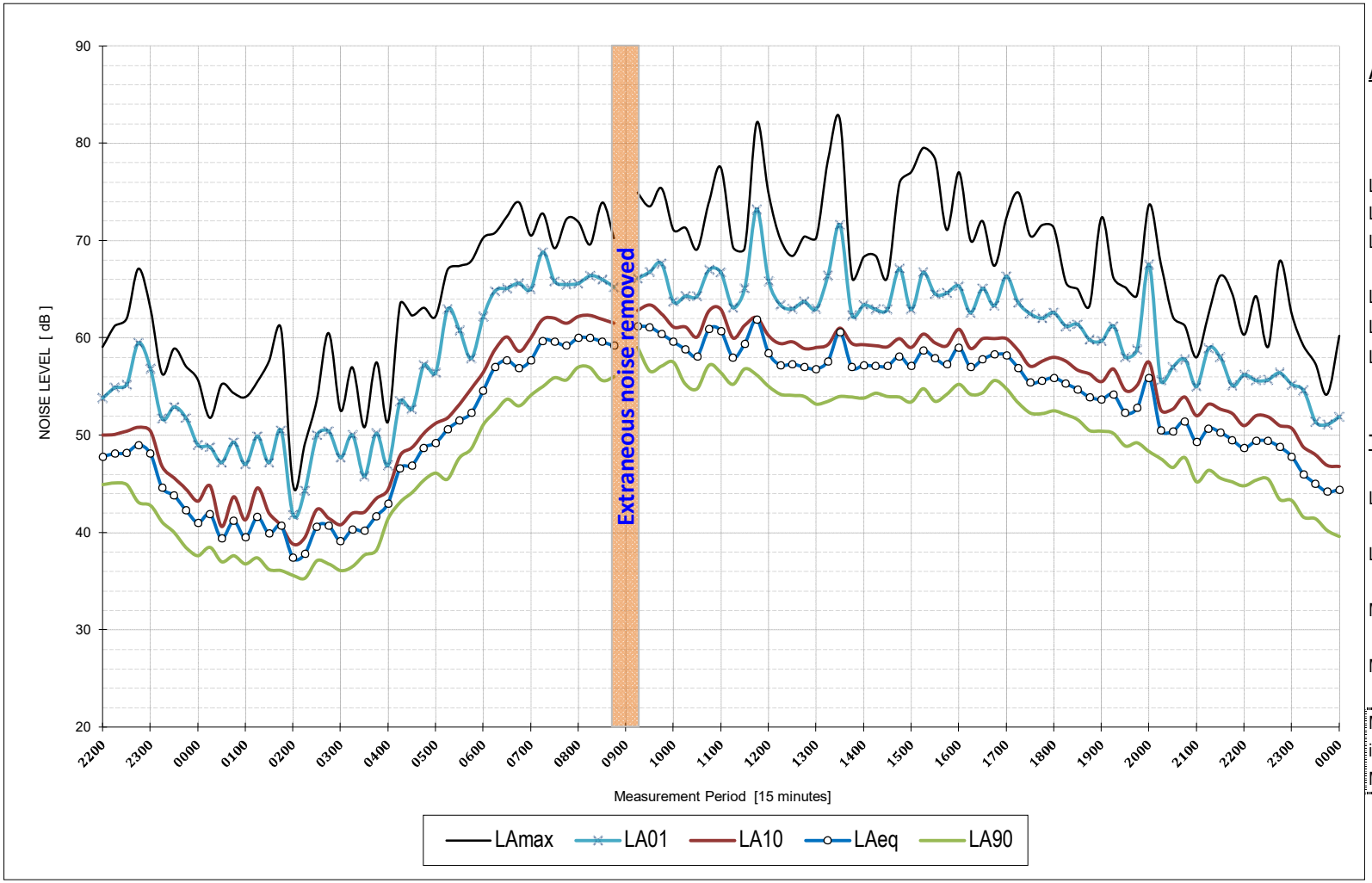
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	57	dB
LAeq 9 hours	2200-0700	47	dB
Max LAeq 1 hour	0700-2200	59	dB
Max LAeq 1 hour	2200-0700	50	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	19

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 5 **LOGGER LOCATION:** Corner Andalusian Way & Mandala Pde **DATE:** Tuesday, 14 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	53	dB
LA90 Evening	1800-2200	45	dB
LA90 Night-time	2200-0700	36	dB
LAeq Daytime	0700-1800	59	dB
LAeq Evening	1800-2200	53	dB
LAeq Night-time	2200-0700	50	dB

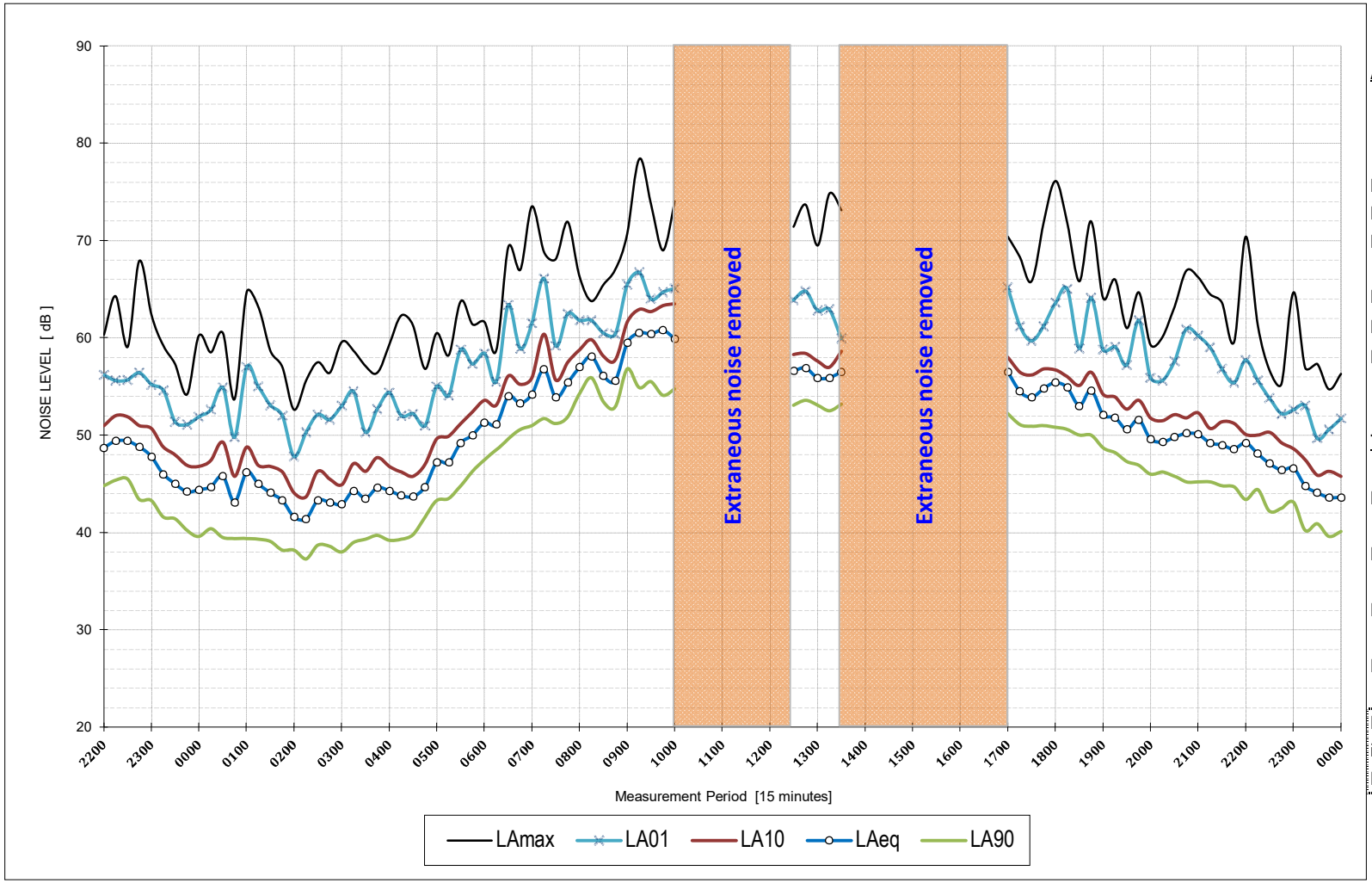
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	58	dB
LAeq 9 hours	2200-0700	50	dB
Max LAeq 1 hour	0700-2200	60	dB
Max LAeq 1 hour	2200-0700	52	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	15

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 6 **LOGGER LOCATION:** Corner Andalusian Way & Mandala Pde **DATE:** Wednesday, 15 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	51	dB
LA90 Evening	1800-2200	45	dB
LA90 Night-time	2200-0700	38	dB
LAeq Daytime	0700-1800	57	dB
LAeq Evening	1800-2200	52	dB
LAeq Night-time	2200-0700	47	dB

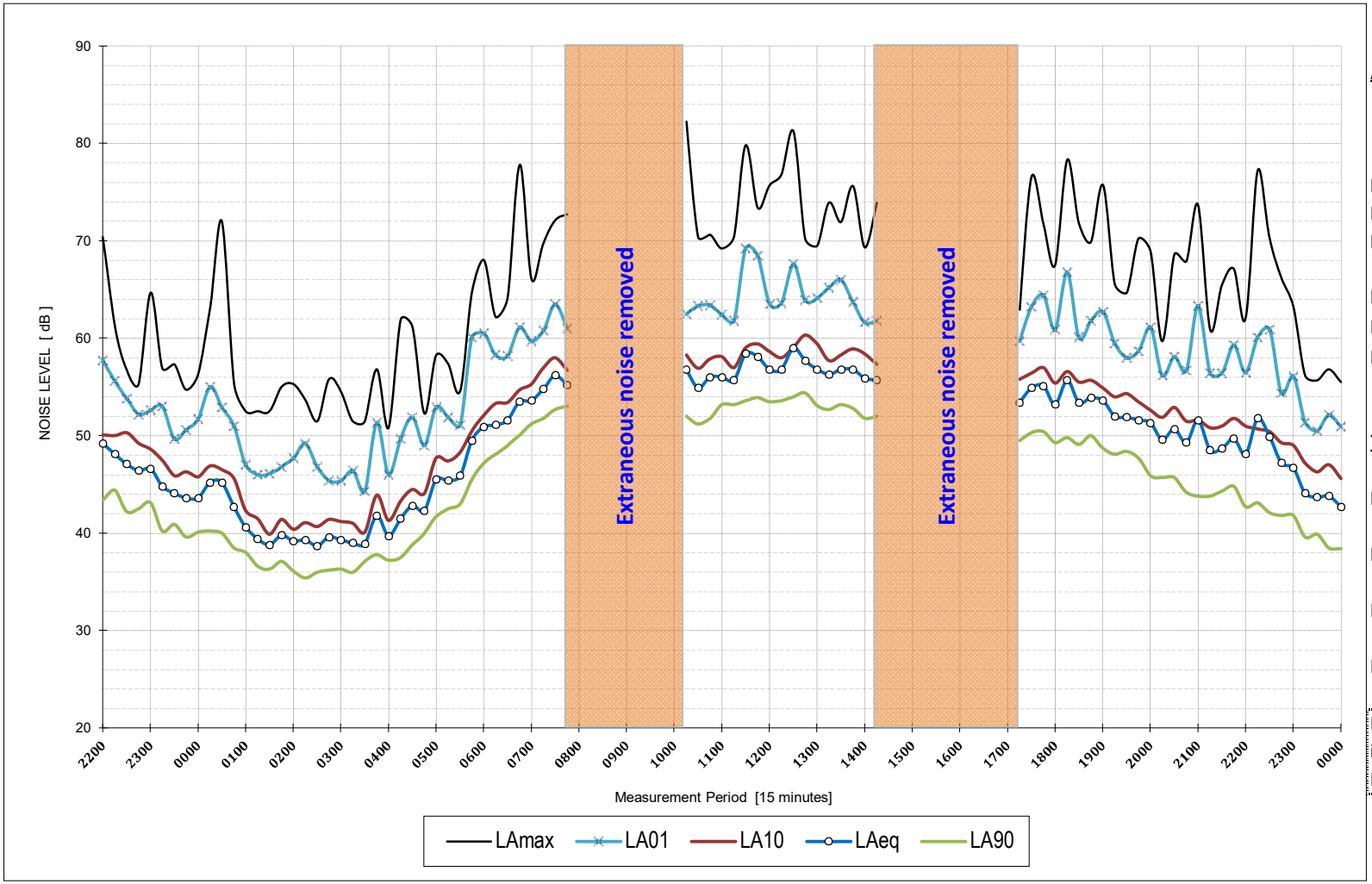
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	56	dB
LAeq 9 hours	2200-0700	47	dB
Max LAeq 1 hour	0700-2200	58	dB
Max LAeq 1 hour	2200-0700	50	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	9

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 7 **LOGGER LOCATION:** Corner Andalusian Way & Mandala Pde **DATE:** Thursday, 16 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	51	dB
LA90 Evening	1800-2200	44	dB
LA90 Night-time	2200-0700	36	dB
LAeq Daytime	0700-1800	56	dB
LAeq Evening	1800-2200	52	dB
LAeq Night-time	2200-0700	46	dB

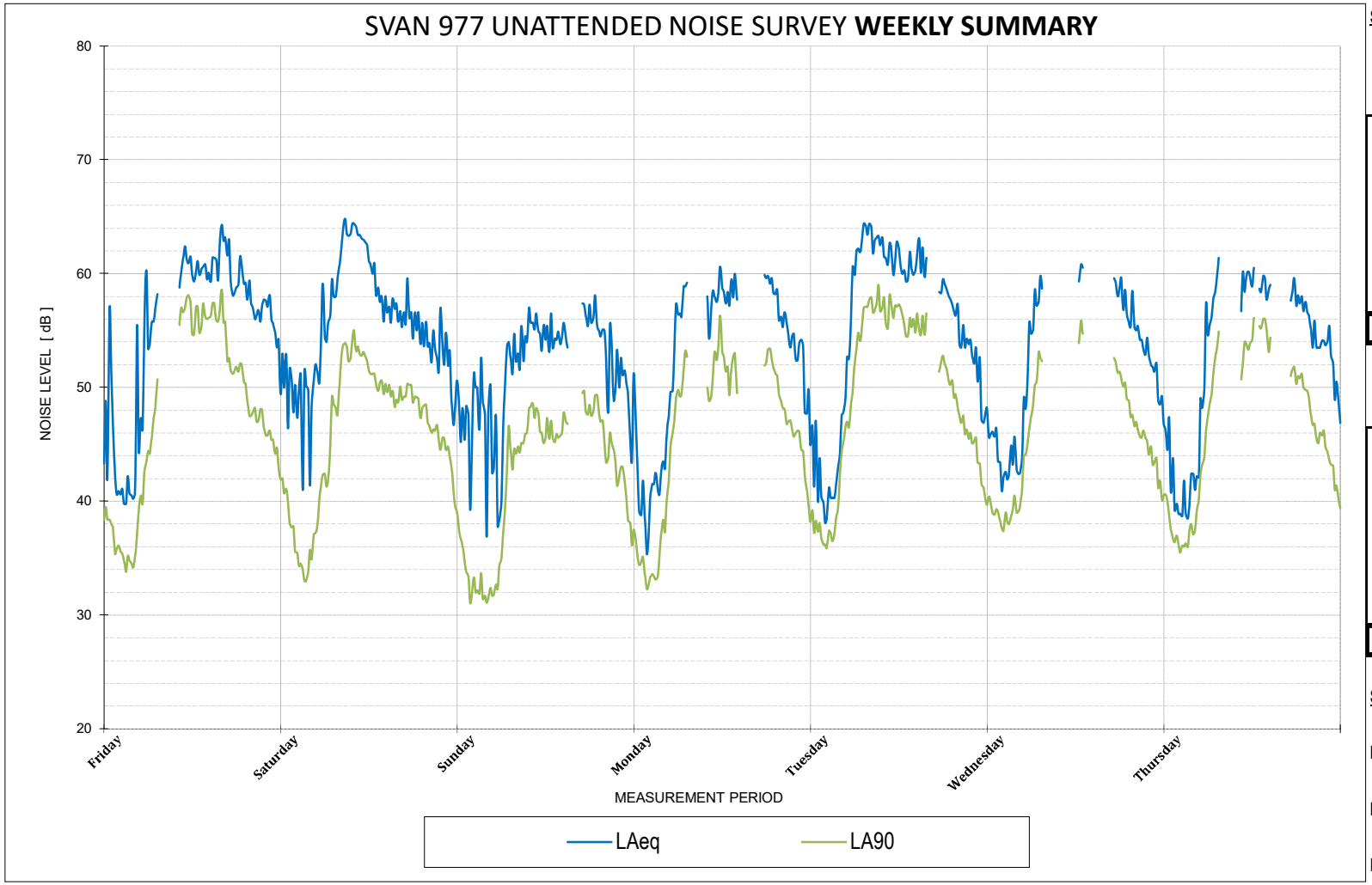
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	55	dB
LAeq 9 hours	2200-0700	46	dB
Max LAeq 1 hour	0700-2200	58	dB
Max LAeq 1 hour	2200-0700	48	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	14

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

WEEKLY SUMMARY **LOGGER LOCATION:** Corner De Clamb Drive & Andalusian Way **PERIOD:** 10th to the 16th July 2020



Sundays and Public Holidays the hours change to 0800

SUMMARY OF AMBIENT LEVELS

	LA90 Daytime	*LA90* Evening	*LA90* Night-time
Day 1	52	47	35
Day 2	49	46	34
Day 3	45	43	32
Day 4	49	47	33
Day 5	55	46	37
Day 6	52	46	38
Day 7	52	46	36
RBL	**52**	**46**	**35**

	LAeq Daytime	*LAeq* Evening	*LAeq* Night-time
Day 1	61	58	52
Day 2	61	55	53
Day 3	55	55	50
Day 4	58	57	51
Day 5	62	57	55
Day 6	59	56	51
Day 7	59	56	50
Average	**60**	**57**	**52**

SUMMARY OF TRAFFIC LEVELS

LAeq 15 hrs	0700-2200	59	dB
LAeq 9 hrs	2200-0700	52	dB
Max LAeq 1 hr	0700-2200	60	dB
Max LAeq 1 hr	2200-0700	55	dB

Maximum noise events as defined in the Environmental Noise Management Manual 7 day average - [LAmax - LAeq ≥ 15]	28

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 1 **LOGGER LOCATION:** Corner De Clamb Drive & Andalusian Way **DATE:** Friday, 10 July 2020

AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	52	dB
LA90 Evening	1800-2200	47	dB
LA90 Night-time	2200-0700	35	dB
LAeq Daytime	0700-1800	61	dB
LAeq Evening	1800-2200	58	dB
LAeq Night-time	2200-0700	52	dB

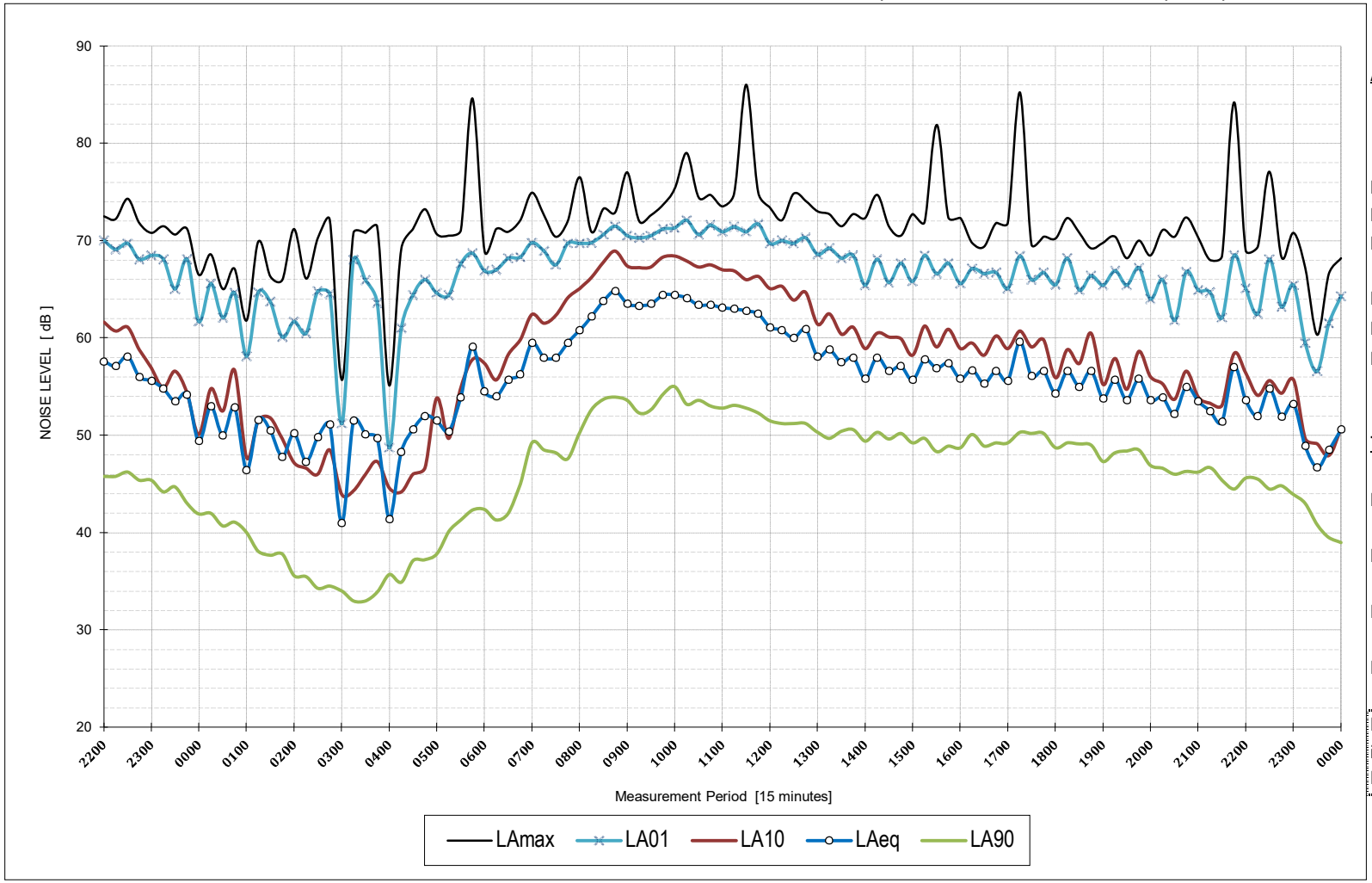
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	60	dB
LAeq 9 hours	2200-0700	52	dB
Max LAeq 1 hour	0700-2200	62	dB
Max LAeq 1 hour	2200-0700	56	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	29

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 2 **LOGGER LOCATION:** Corner De Clamb Drive & Andalusian Way **DATE:** Saturday, 11 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	49	dB
LA90 Evening	1800-2200	46	dB
LA90 Night-time	2200-0700	34	dB
LAeq Daytime	0700-1800	61	dB
LAeq Evening	1800-2200	55	dB
LAeq Night-time	2200-0700	53	dB

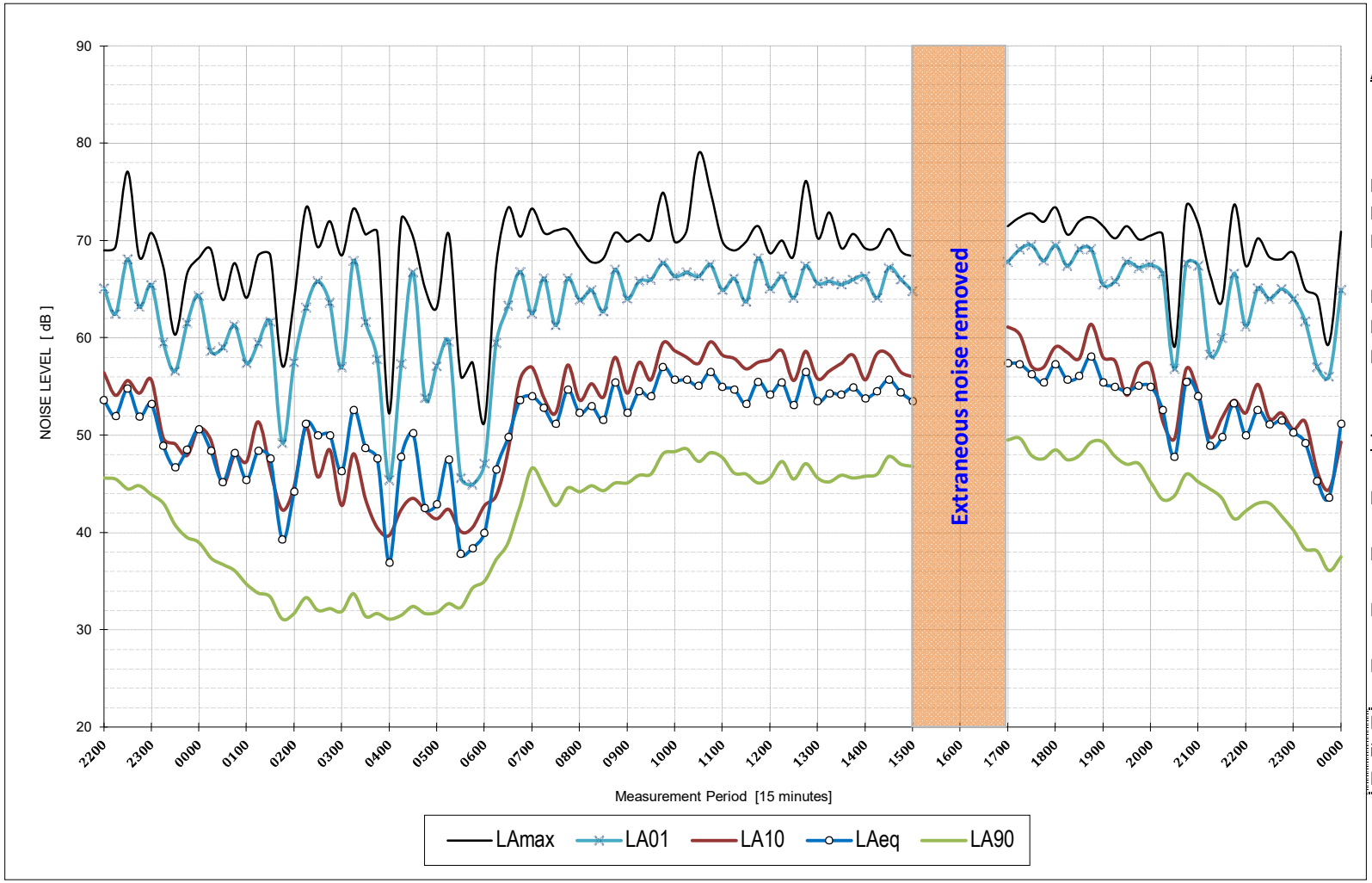
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	60	dB
LAeq 9 hours	2200-0700	53	dB
Max LAeq 1 hour	0700-2200	64	dB
Max LAeq 1 hour	2200-0700	56	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	31

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 3 **LOGGER LOCATION:** Corner De Clamb Drive & Andalusian Way **DATE:** Sunday, 12 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0800-1800	45	dB
LA90 Evening	1800-2200	43	dB
LA90 Night-time	2200-0800	32	dB
LAeq Daytime	0800-1800	55	dB
LAeq Evening	1800-2200	55	dB
LAeq Night-time	2200-0800	50	dB

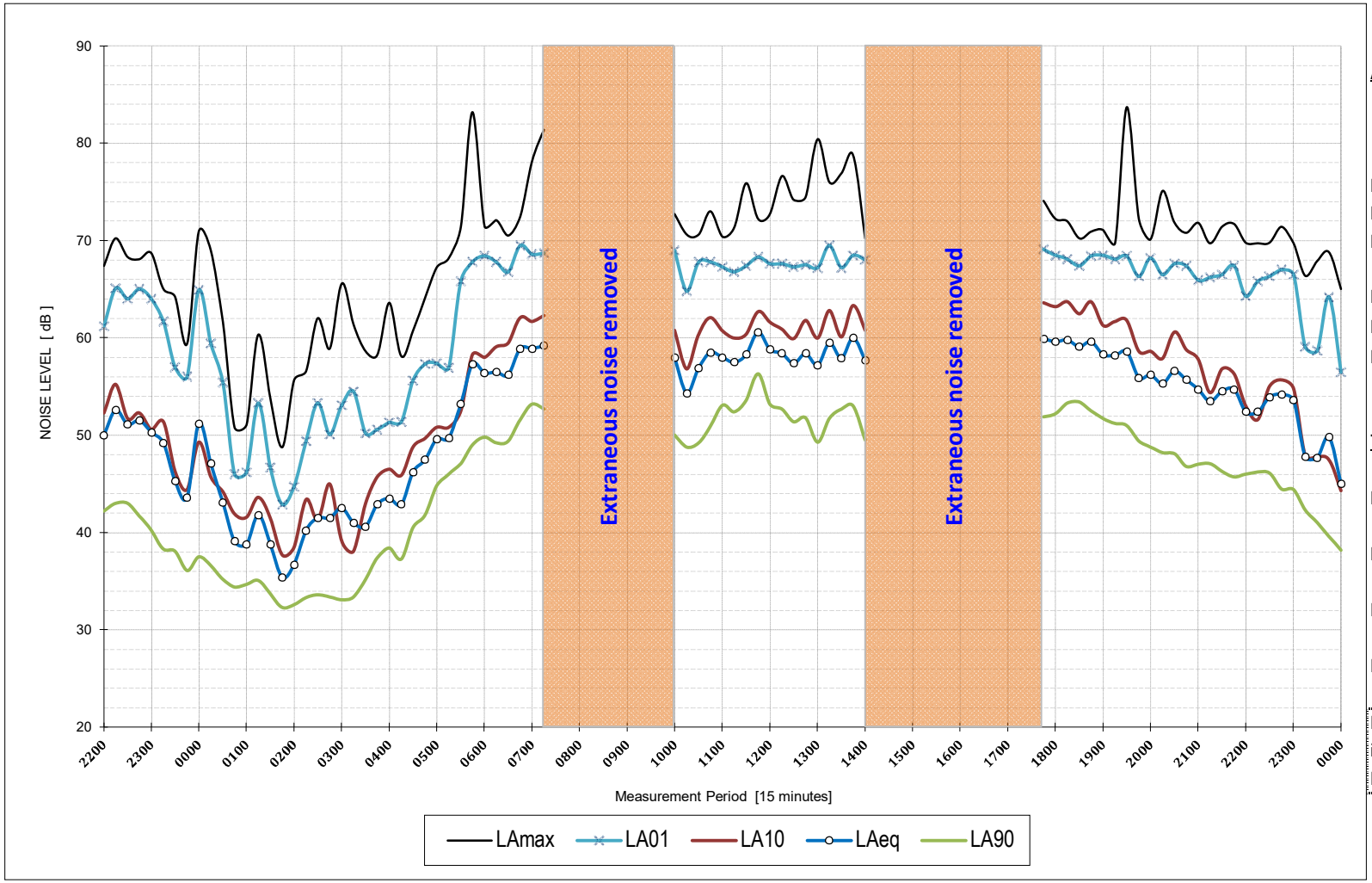
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	55	dB
LAeq 9 hours	2200-0700	49	dB
Max LAeq 1 hour	0700-2200	57	dB
Max LAeq 1 hour	2200-0700	51	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	34

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 4 **LOGGER LOCATION:** Corner De Clamb Drive & Andalusian Way **DATE:** Monday, 13 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	49	dB
LA90 Evening	1800-2200	47	dB
LA90 Night-time	2200-0700	33	dB
LAeq Daytime	0700-1800	58	dB
LAeq Evening	1800-2200	57	dB
LAeq Night-time	2200-0700	51	dB

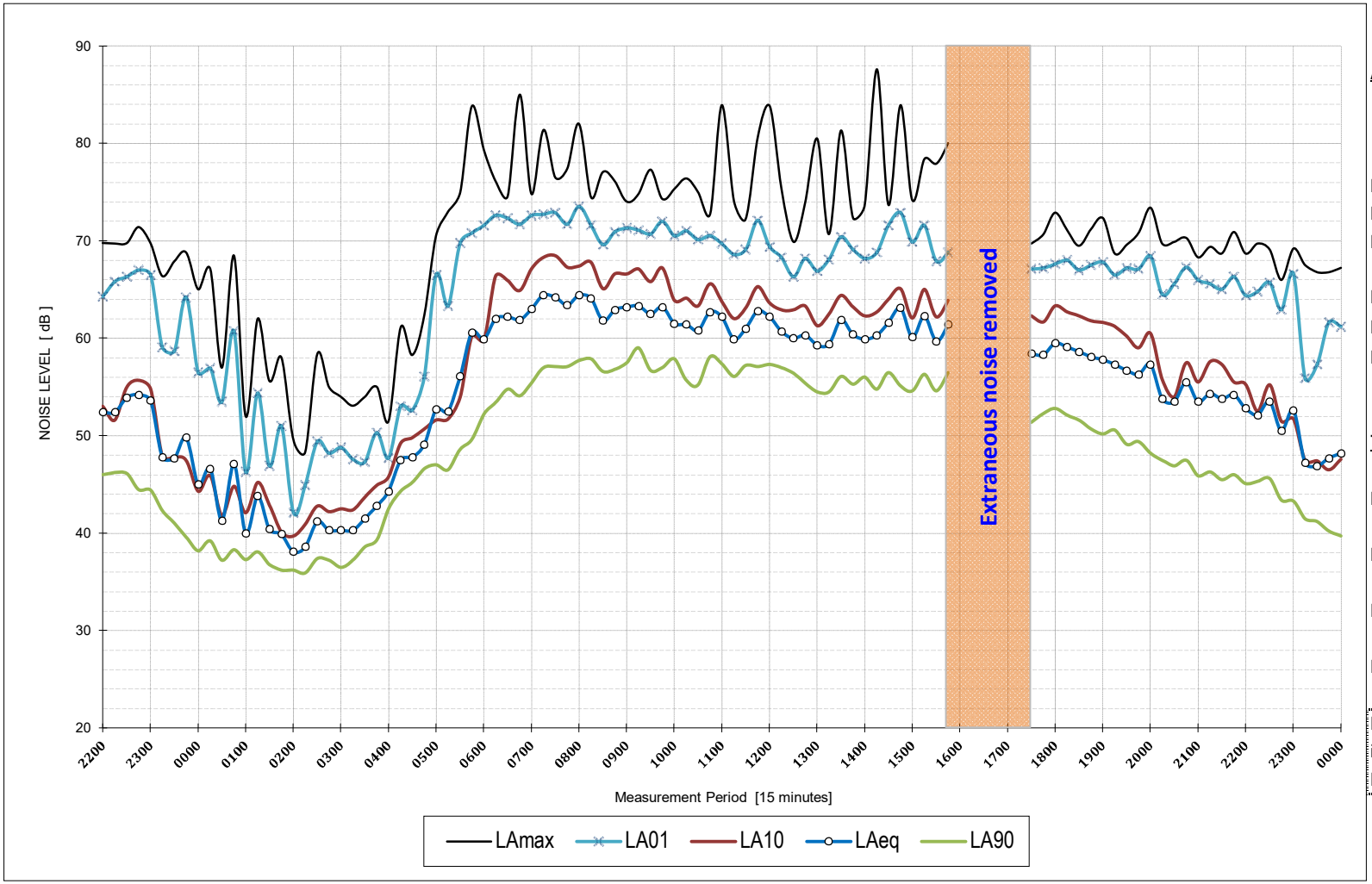
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	58	dB
LAeq 9 hours	2200-0700	51	dB
Max LAeq 1 hour	0700-2200	60	dB
Max LAeq 1 hour	2200-0700	55	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	30

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 5 **LOGGER LOCATION:** Corner De Clamb Drive & Andalusian Way **DATE:** Tuesday, 14 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	55	dB
LA90 Evening	1800-2200	46	dB
LA90 Night-time	2200-0700	37	dB
LAeq Daytime	0700-1800	62	dB
LAeq Evening	1800-2200	57	dB
LAeq Night-time	2200-0700	55	dB

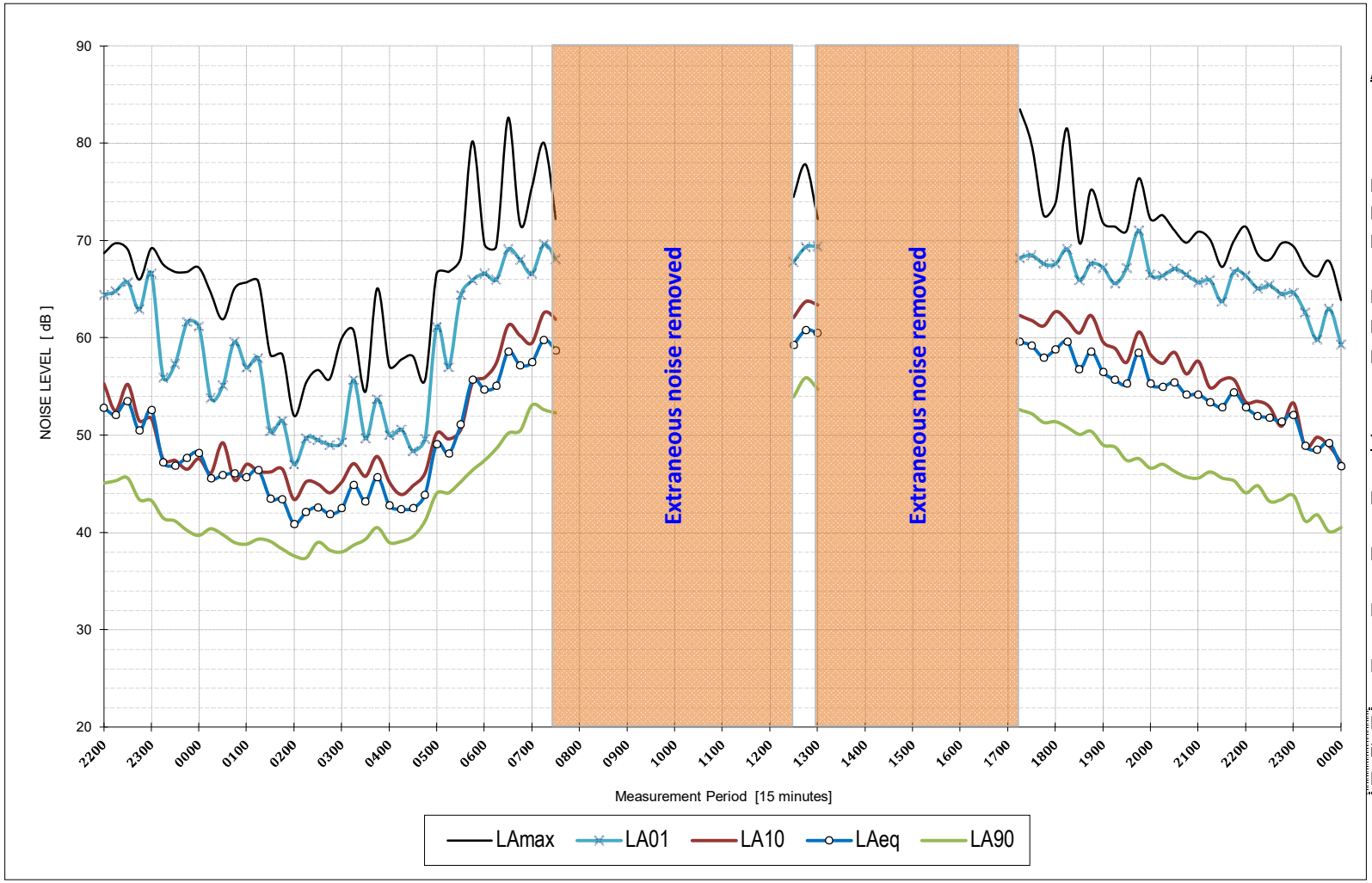
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	61	dB
LAeq 9 hours	2200-0700	55	dB
Max LAeq 1 hour	0700-2200	63	dB
Max LAeq 1 hour	2200-0700	58	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	22

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 6 **LOGGER LOCATION:** Corner De Clamb Drive & Andalusian Way **DATE:** Wednesday, 15 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	52	dB
LA90 Evening	1800-2200	46	dB
LA90 Night-time	2200-0700	38	dB
LAeq Daytime	0700-1800	59	dB
LAeq Evening	1800-2200	56	dB
LAeq Night-time	2200-0700	51	dB

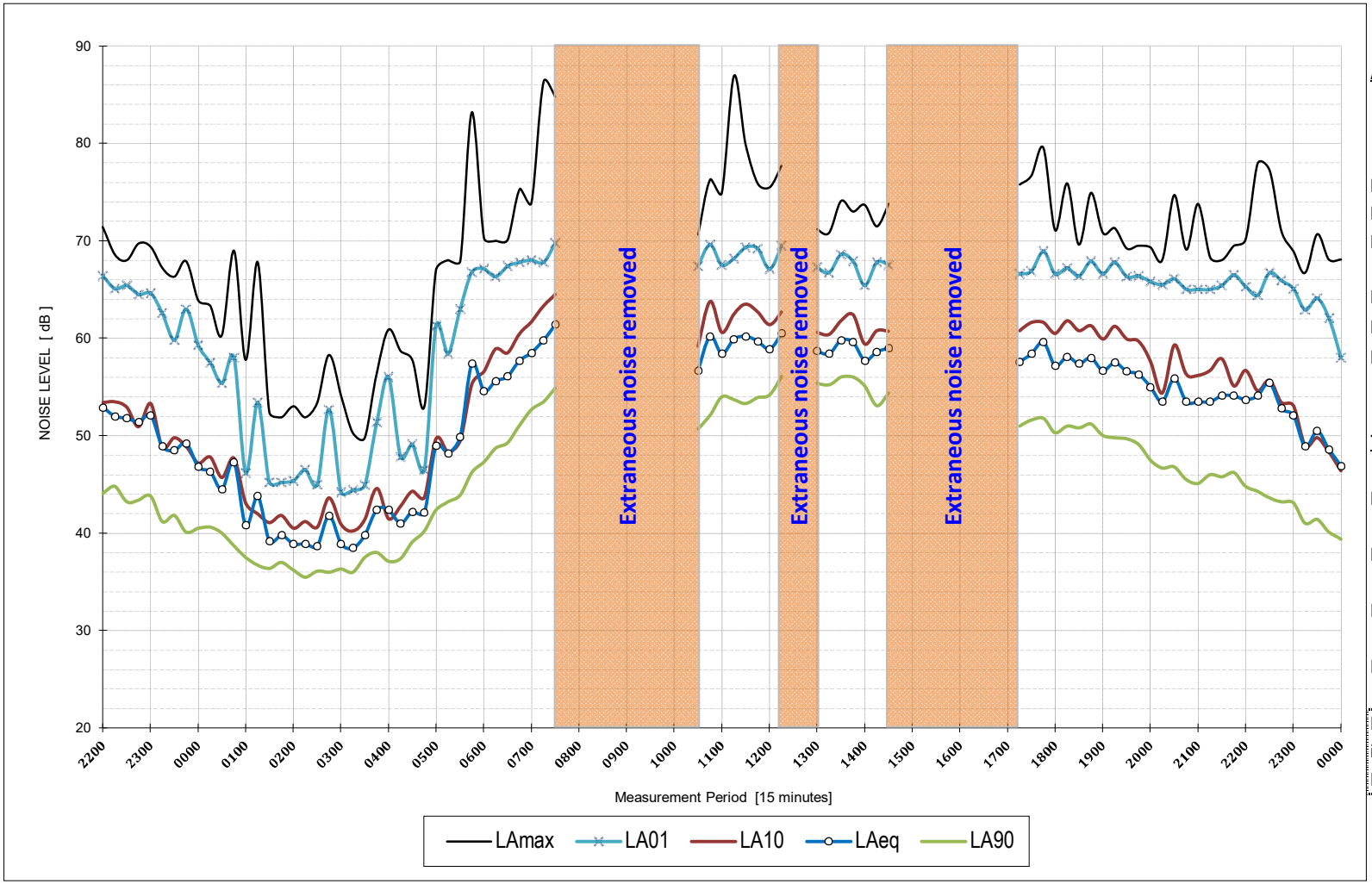
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	58	dB
LAeq 9 hours	2200-0700	51	dB
Max LAeq 1 hour	0700-2200	60	dB
Max LAeq 1 hour	2200-0700	53	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	24

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

DAY 7 **LOGGER LOCATION:** Corner De Clamb Drive & Andalusian Way **DATE:** Thursday, 16 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	52	dB
LA90 Evening	1800-2200	46	dB
LA90 Night-time	2200-0700	36	dB
LAeq Daytime	0700-1800	59	dB
LAeq Evening	1800-2200	56	dB
LAeq Night-time	2200-0700	50	dB

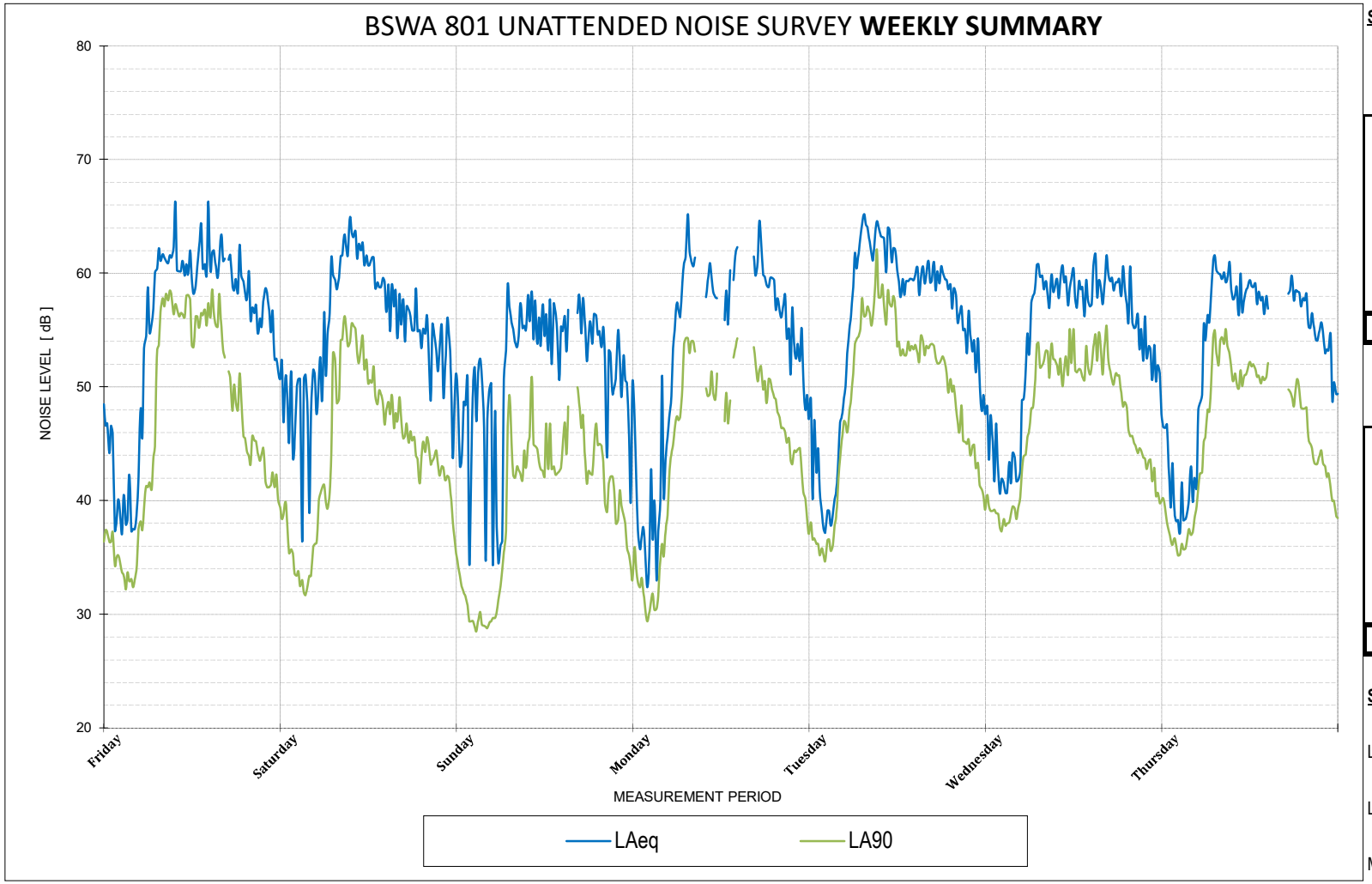
TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	58	dB
LAeq 9 hours	2200-0700	50	dB
Max LAeq 1 hour	0700-2200	60	dB
Max LAeq 1 hour	2200-0700	54	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	25

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

WEEKLY SUMMARY **LOGGER LOCATION:** Corner Dorian Drive & De Clamb Drive **PERIOD:** 10th to the 16th July 2020



Sundays and Public Holidays the hours change to 0800

SUMMARY OF AMBIENT LEVELS

	LA90 Daytime	***LA90*** Evening	***LA90*** Night-time
Day 1	51	44	33
Day 2	46	43	33
Day 3	42	39	29
Day 4	48	44	30
Day 5	53	45	36
Day 6	51	44	38
Day 7	50	43	36
RBL	**50**	**44**	**33**

	LAeq Daytime	***LAeq*** Evening	***LAeq*** Night-time
Day 1	61	58	51
Day 2	60	55	53
Day 3	56	54	51
Day 4	61	58	51
Day 5	62	58	54
Day 6	59	57	51
Day 7	59	57	50
Average	**60**	**57**	**52**

SUMMARY OF TRAFFIC LEVELS

LAeq 15 hrs	0700-2200	59	dB
LAeq 9 hrs	2200-0700	52	dB
Max LAeq 1 hr	0700-2200	62	dB
Max LAeq 1 hr	2200-0700	54	dB

Maximum noise events as defined in the Environmental Noise Management Manual 7 day average - [LAmax - LAeq ≥ 15]	31

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DAY 1 **LOGGER LOCATION:** Corner Dorian Drive & De Clamb Drive **DATE:** Friday, 10 July 2020

AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	51	dB
LA90 Evening	1800-2200	44	dB
LA90 Night-time	2200-0700	33	dB
LAeq Daytime	0700-1800	61	dB
LAeq Evening	1800-2200	58	dB
LAeq Night-time	2200-0700	51	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	61	dB
LAeq 9 hours	2200-0700	51	dB
Max LAeq 1 hour	0700-2200	63	dB
Max LAeq 1 hour	2200-0700	55	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	35

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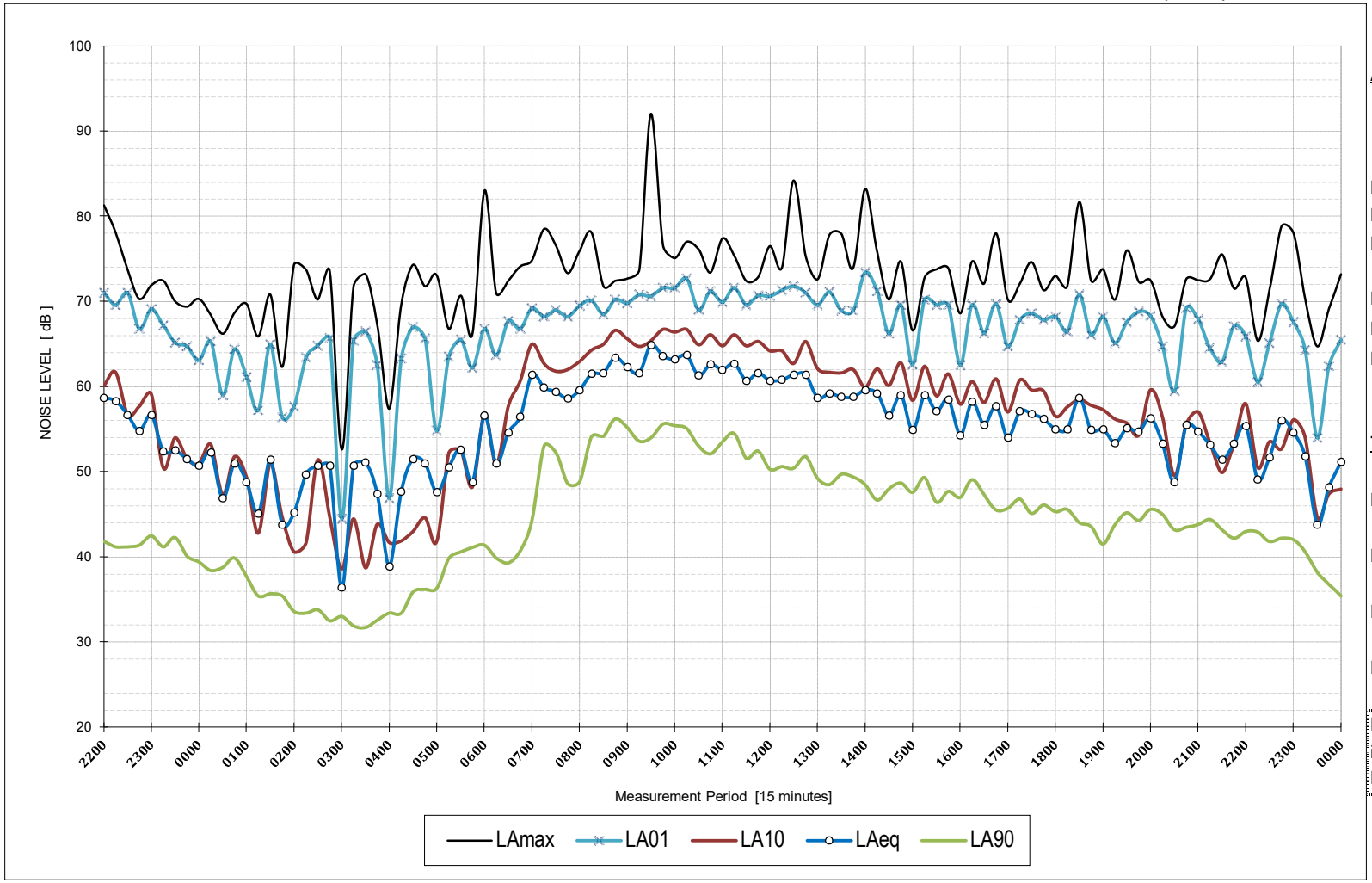
CONSULTANTS IN NOISE & VIBRATION

DAY 2 **LOGGER LOCATION:** Corner Dorian Drive & De Clamb Drive **DATE:** Saturday, 11 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	46	dB
LA90 Evening	1800-2200	43	dB
LA90 Night-time	2200-0700	33	dB
LAeq Daytime	0700-1800	60	dB
LAeq Evening	1800-2200	55	dB
LAeq Night-time	2200-0700	53	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	60	dB
LAeq 9 hours	2200-0700	53	dB
Max LAeq 1 hour	0700-2200	63	dB
Max LAeq 1 hour	2200-0700	55	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	36

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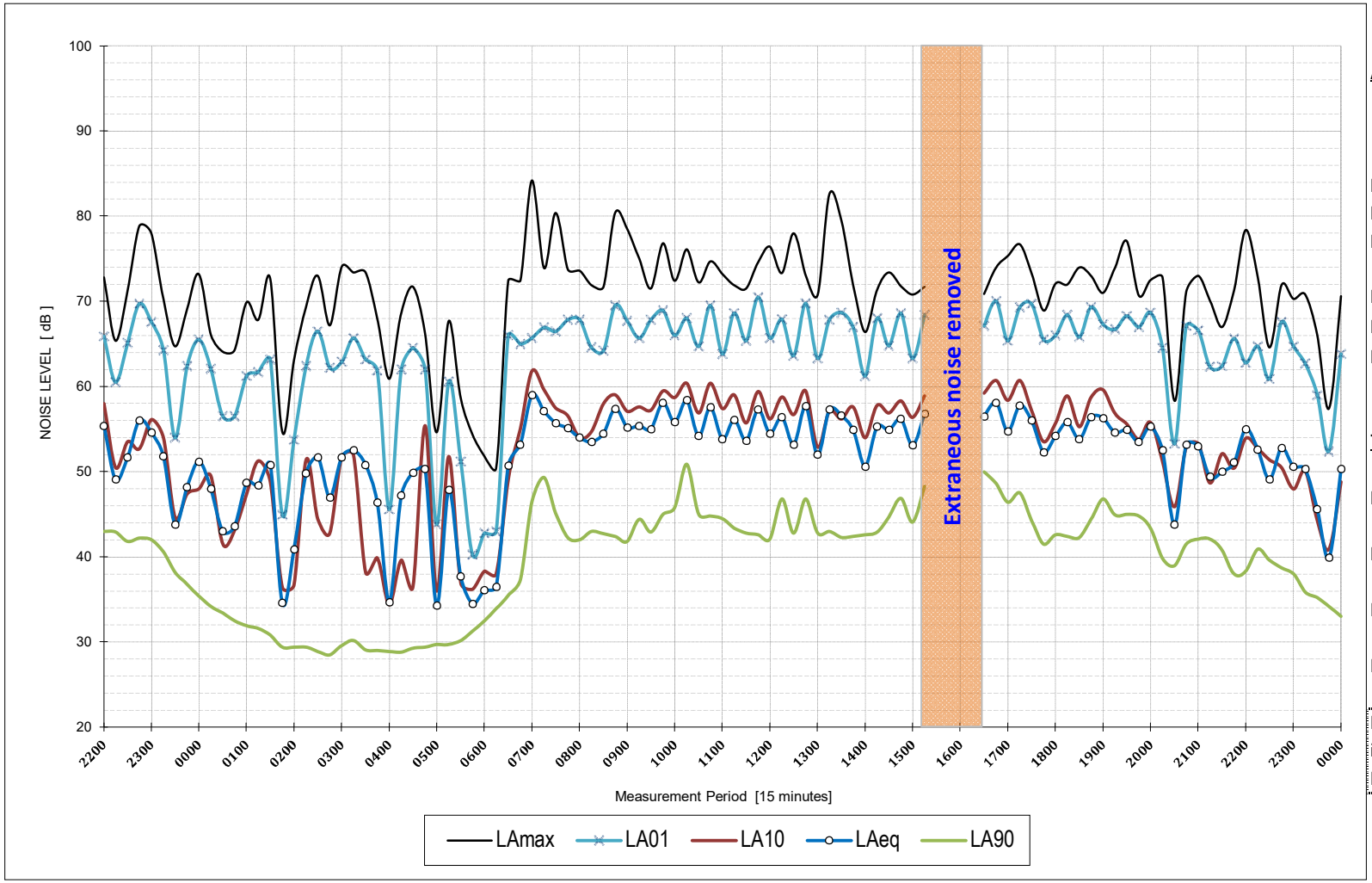
DAY 3 **LOGGER LOCATION:** Corner Dorian Drive & De Clamb Drive **DATE:** Sunday, 12 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0800-1800	42	dB
LA90 Evening	1800-2200	39	dB
LA90 Night-time	2200-0800	29	dB
LAeq Daytime	0800-1800	56	dB
LAeq Evening	1800-2200	54	dB
LAeq Night-time	2200-0800	51	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	55	dB
LAeq 9 hours	2200-0700	50	dB
Max LAeq 1 hour	0700-2200	57	dB
Max LAeq 1 hour	2200-0700	53	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	35

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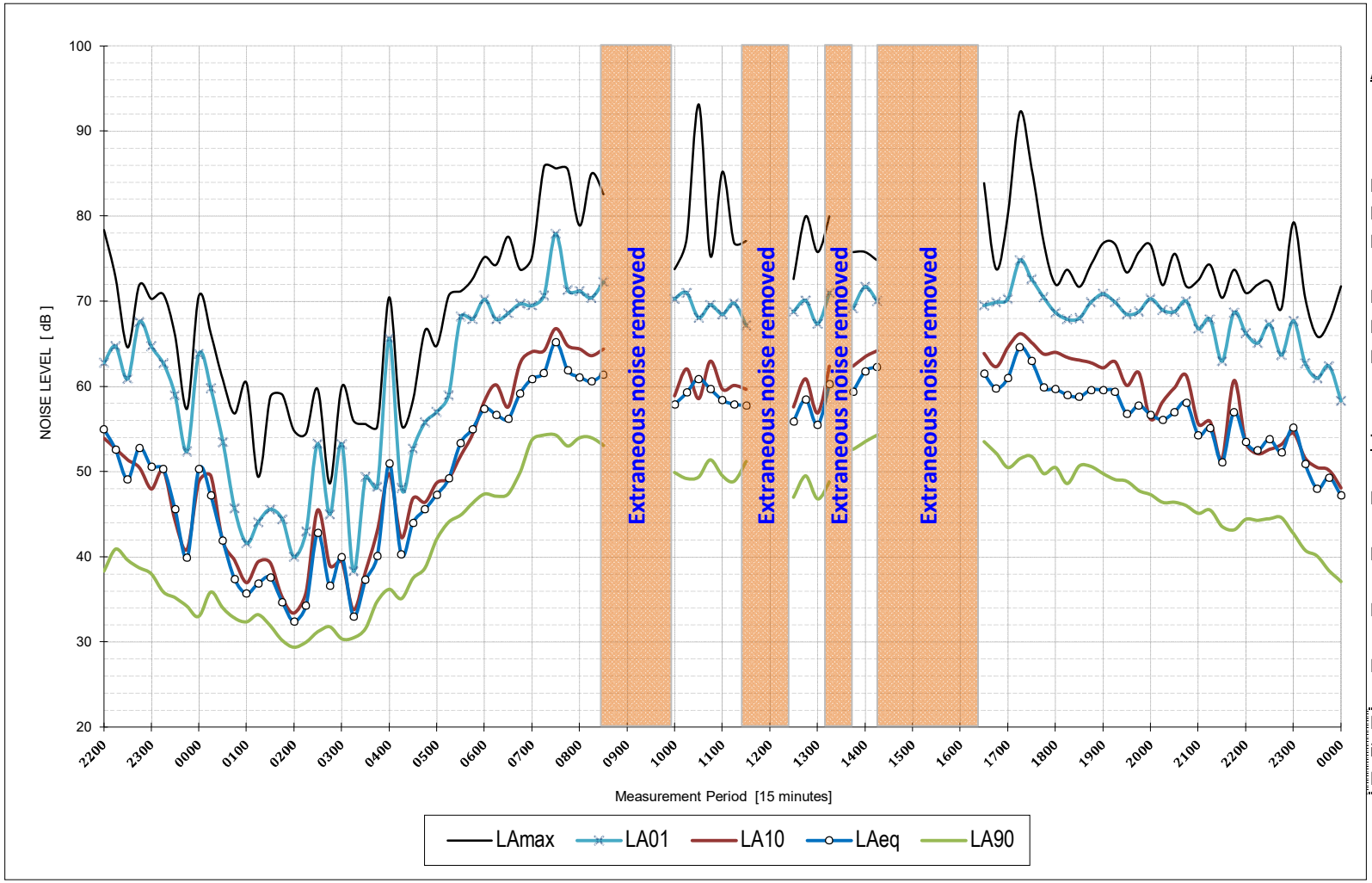
CONSULTANTS IN NOISE & VIBRATION

DAY 4 **LOGGER LOCATION:** Corner Dorian Drive & De Clamb Drive **DATE:** Monday, 13 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	48	dB
LA90 Evening	1800-2200	44	dB
LA90 Night-time	2200-0700	30	dB
LAeq Daytime	0700-1800	61	dB
LAeq Evening	1800-2200	58	dB
LAeq Night-time	2200-0700	51	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	60	dB
LAeq 9 hours	2200-0700	51	dB
Max LAeq 1 hour	0700-2200	62	dB
Max LAeq 1 hour	2200-0700	54	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	32

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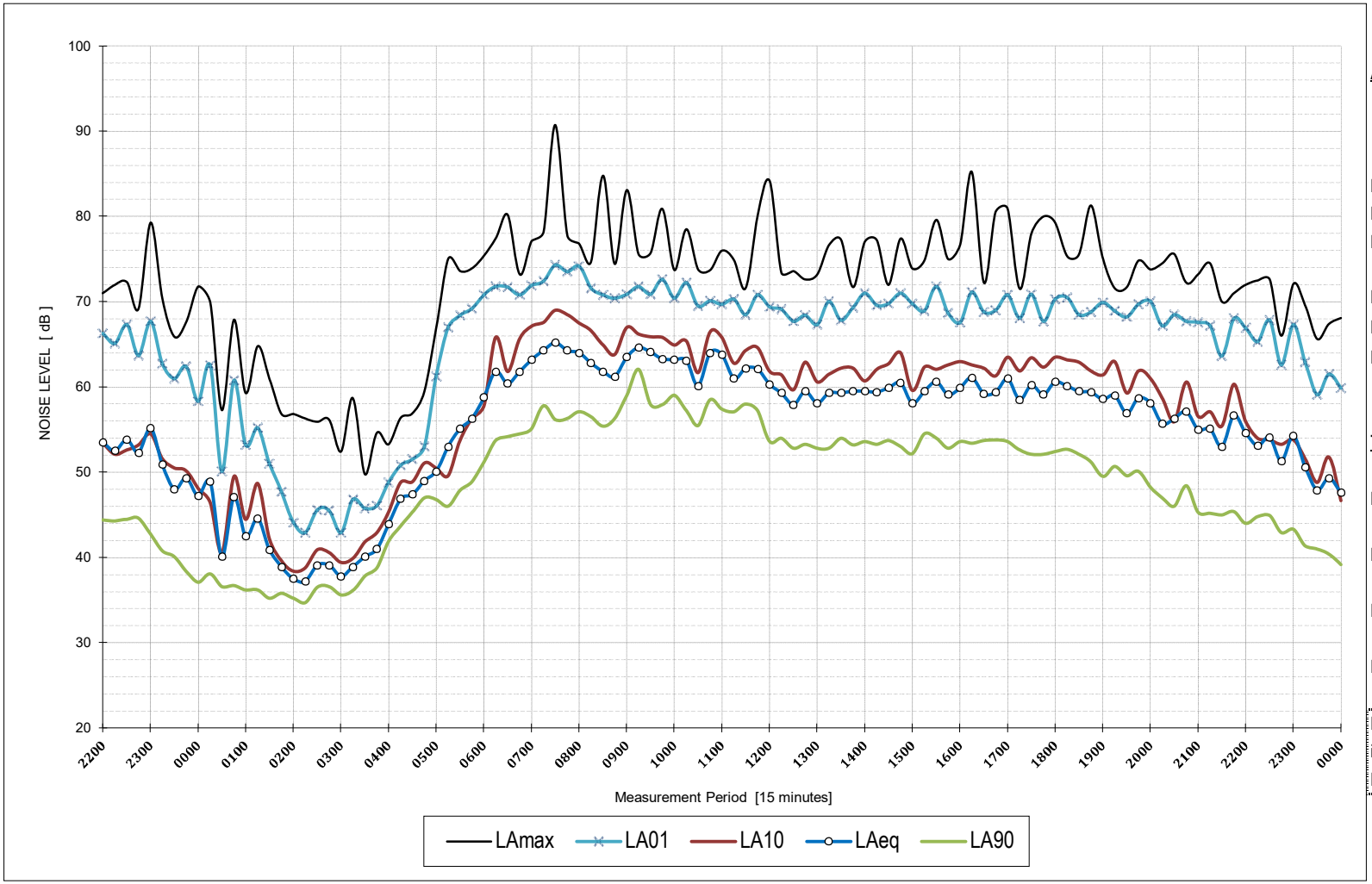
CONSULTANTS IN NOISE & VIBRATION

DAY 5 **LOGGER LOCATION:** Corner Dorian Drive & De Clamb Drive **DATE:** Tuesday, 14 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	53	dB
LA90 Evening	1800-2200	45	dB
LA90 Night-time	2200-0700	36	dB
LAeq Daytime	0700-1800	62	dB
LAeq Evening	1800-2200	58	dB
LAeq Night-time	2200-0700	54	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	61	dB
LAeq 9 hours	2200-0700	54	dB
Max LAeq 1 hour	0700-2200	63	dB
Max LAeq 1 hour	2200-0700	56	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	28

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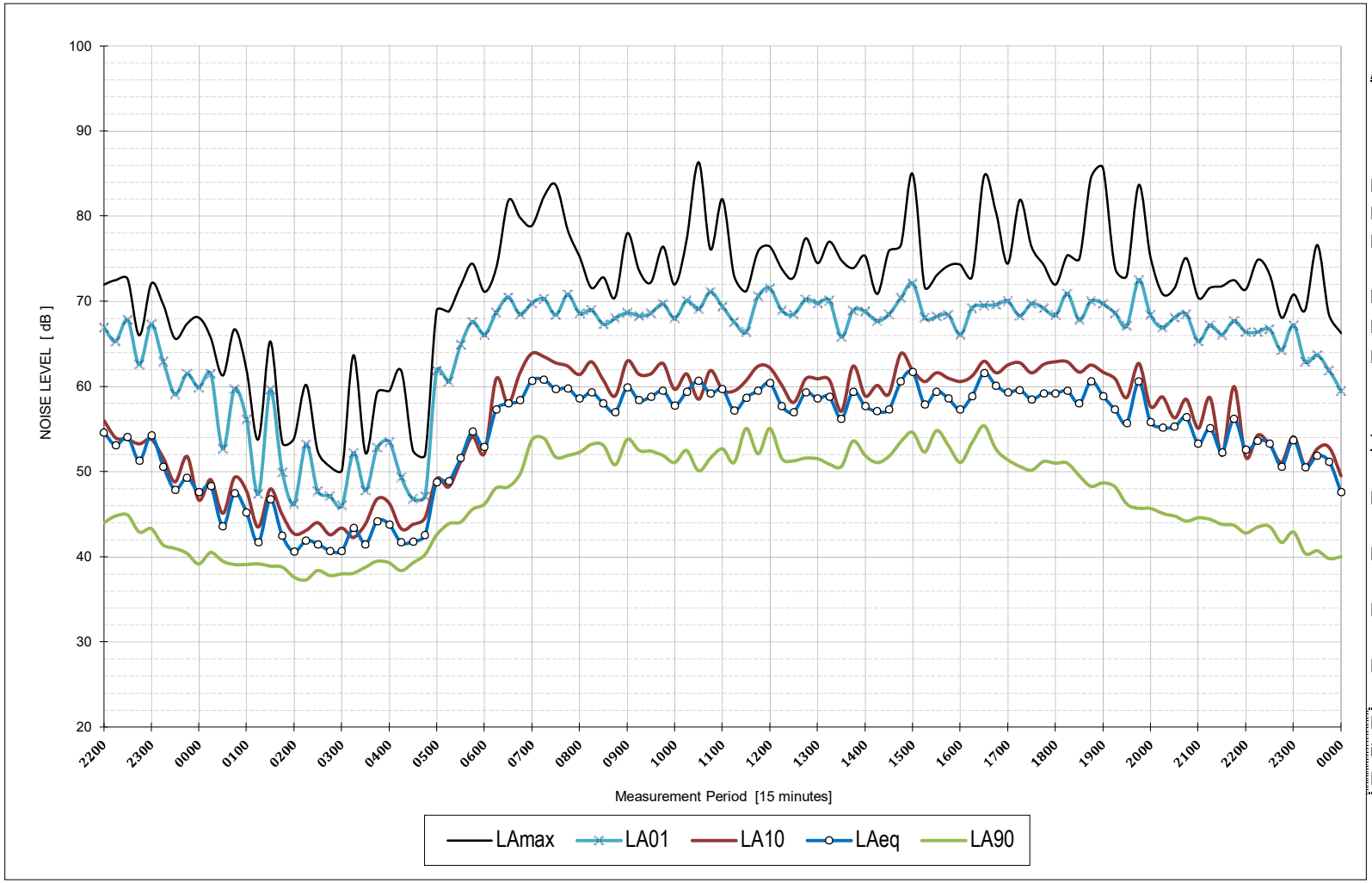
CONSULTANTS IN NOISE & VIBRATION

DAY 6 **LOGGER LOCATION:** Corner Dorian Drive & De Clamb Drive **DATE:** Wednesday, 15 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	51	dB
LA90 Evening	1800-2200	44	dB
LA90 Night-time	2200-0700	38	dB
LAeq Daytime	0700-1800	59	dB
LAeq Evening	1800-2200	57	dB
LAeq Night-time	2200-0700	51	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	59	dB
LAeq 9 hours	2200-0700	51	dB
Max LAeq 1 hour	0700-2200	60	dB
Max LAeq 1 hour	2200-0700	53	dB

Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	26

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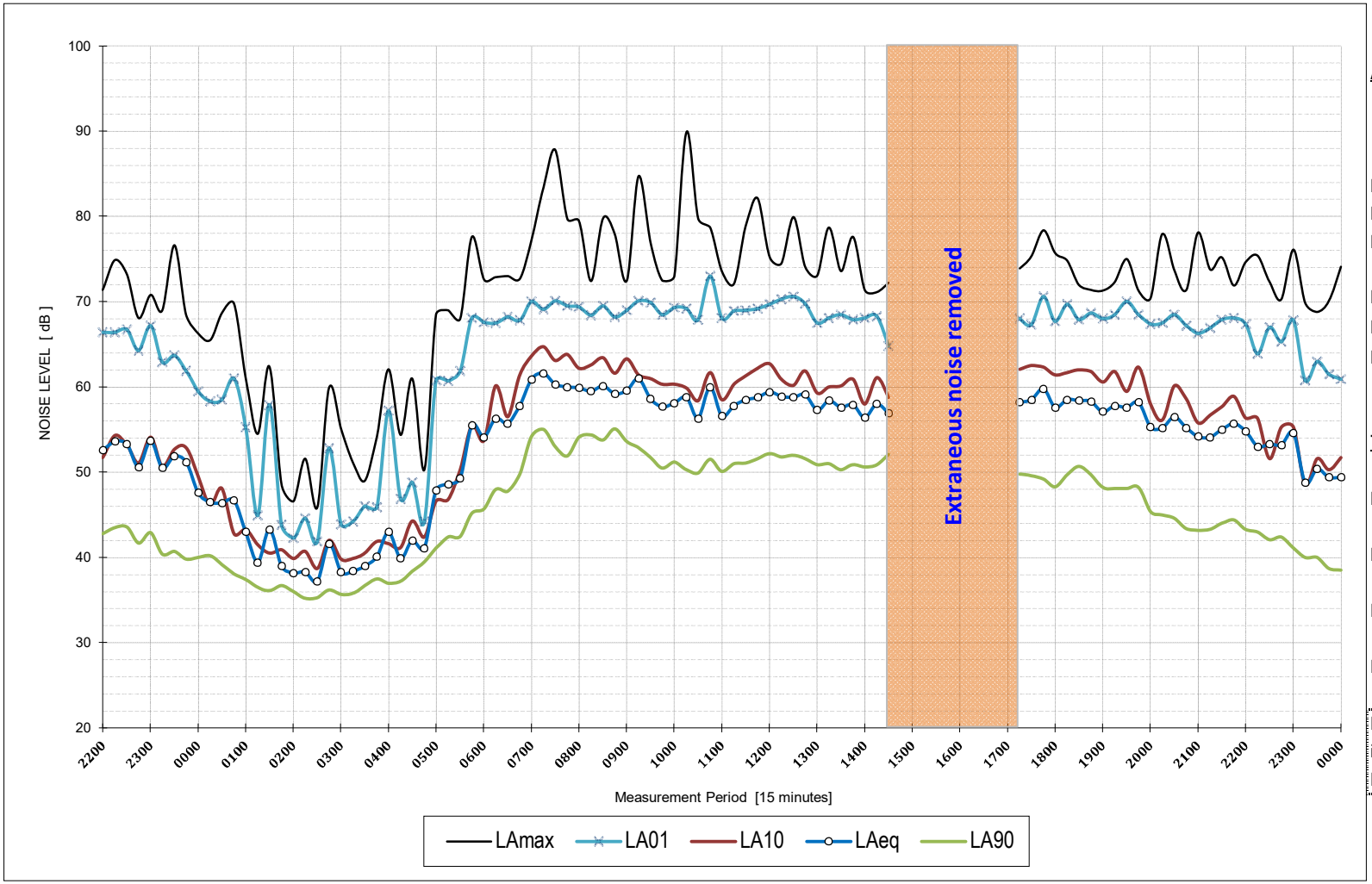
CONSULTANTS IN NOISE & VIBRATION

DAY 7 **LOGGER LOCATION:** Corner Dorian Drive & De Clamb Drive **DATE:** Thursday, 16 July 2020



AMBIENT NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	50	dB
LA90 Evening	1800-2200	43	dB
LA90 Night-time	2200-0700	36	dB
LAeq Daytime	0700-1800	59	dB
LAeq Evening	1800-2200	57	dB
LAeq Night-time	2200-0700	50	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	58	dB
LAeq 9 hours	2200-0700	50	dB
Max LAeq 1 hour	0700-2200	60	dB
Max LAeq 1 hour	2200-0700	53	dB

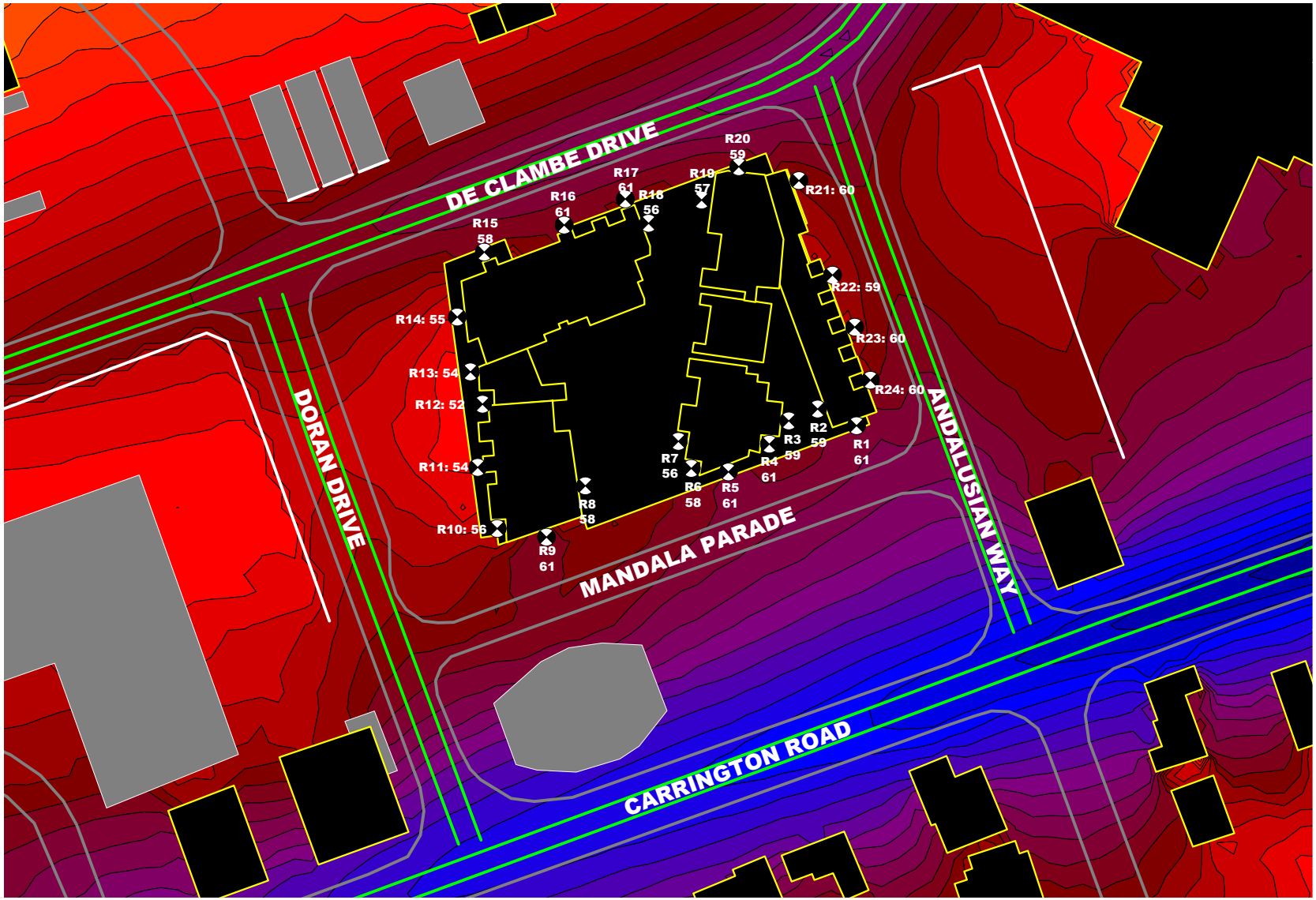
Maximum noise events as defined in the Environmental Noise Management Manual [LAmax - LAeq ≥ 15]	26

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

APPENDIX B

APPENDIX B

APPENDIX B



Scenario 1.1
(Level 2)
**** NOISE SOURCES ****

~ Carrington Road
~ Doran Drive
~ Andalusian Way
~ De Clambe Drive

Note:
- LAeq,15hrs noise level contours shown and receiver points are at a height of 1.5 m above the Level 2.
- The maximum reading at the nearest resident is 61 dB(A).

PRINT DATE: 26/05/21

Line Source
Building
Barrier
3D-Reflector
Ground Absorption
Contour Line
Receiver

> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

JOB NUMBER: 4214
CLIENT: Deicorp Pty Ltd
SITE ADDRESS: 2 Mandala Pde, Castle Hill
ASSESSED TO: ISEPP/DOP
LIMITING CRITERIA: 35 dB(A) - Bedrooms (2200-0700)
40 dB(A) - Other (0700-2200)

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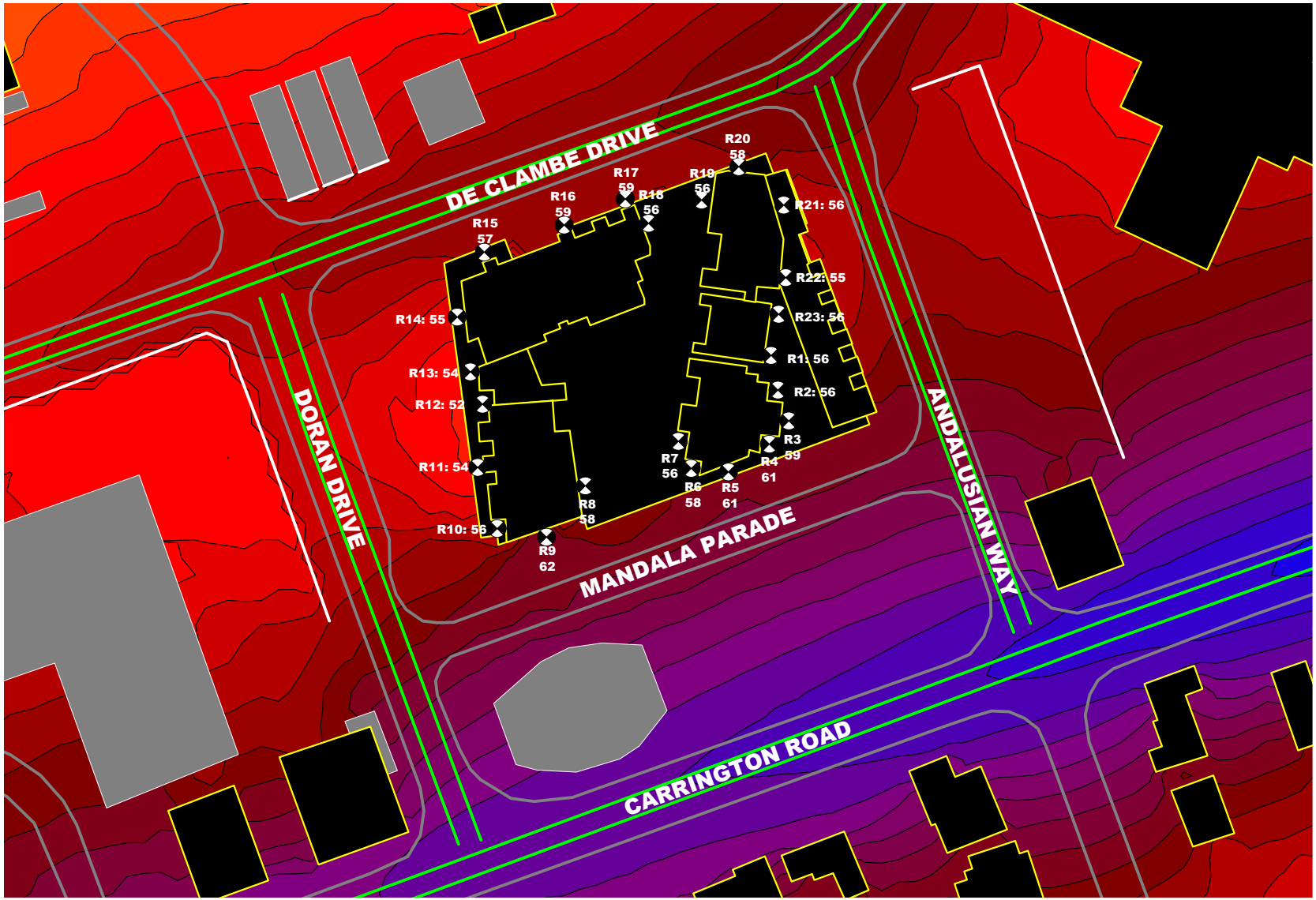

Scenario 1.2
(Level 6)
**** NOISE SOURCES ****

~ Carrington Road
~ Doran Drive
~ Andalusian Way
~ De Clambe Drive

Note:
- LAeq,15hrs noise level contours shown and receiver points are at a height of 1.5 m above the Level 6.
- The maximum reading at the nearest resident is 62 dB(A).

PRINT DATE: 26/05/21

Line Source
Building
Barrier
3D-Reflector
Ground Absorption
Contour Line
Receiver

> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

JOB NUMBER: 4214
CLIENT: Deicorp Pty Ltd
SITE ADDRESS: 2 Mandala Pde, Castle Hill
ASSESSED TO: ISEPP/DOP
LIMITING CRITERIA: 35 dB(A) - Bedrooms (2200-0700)
40 dB(A) - Other (0700-2200)

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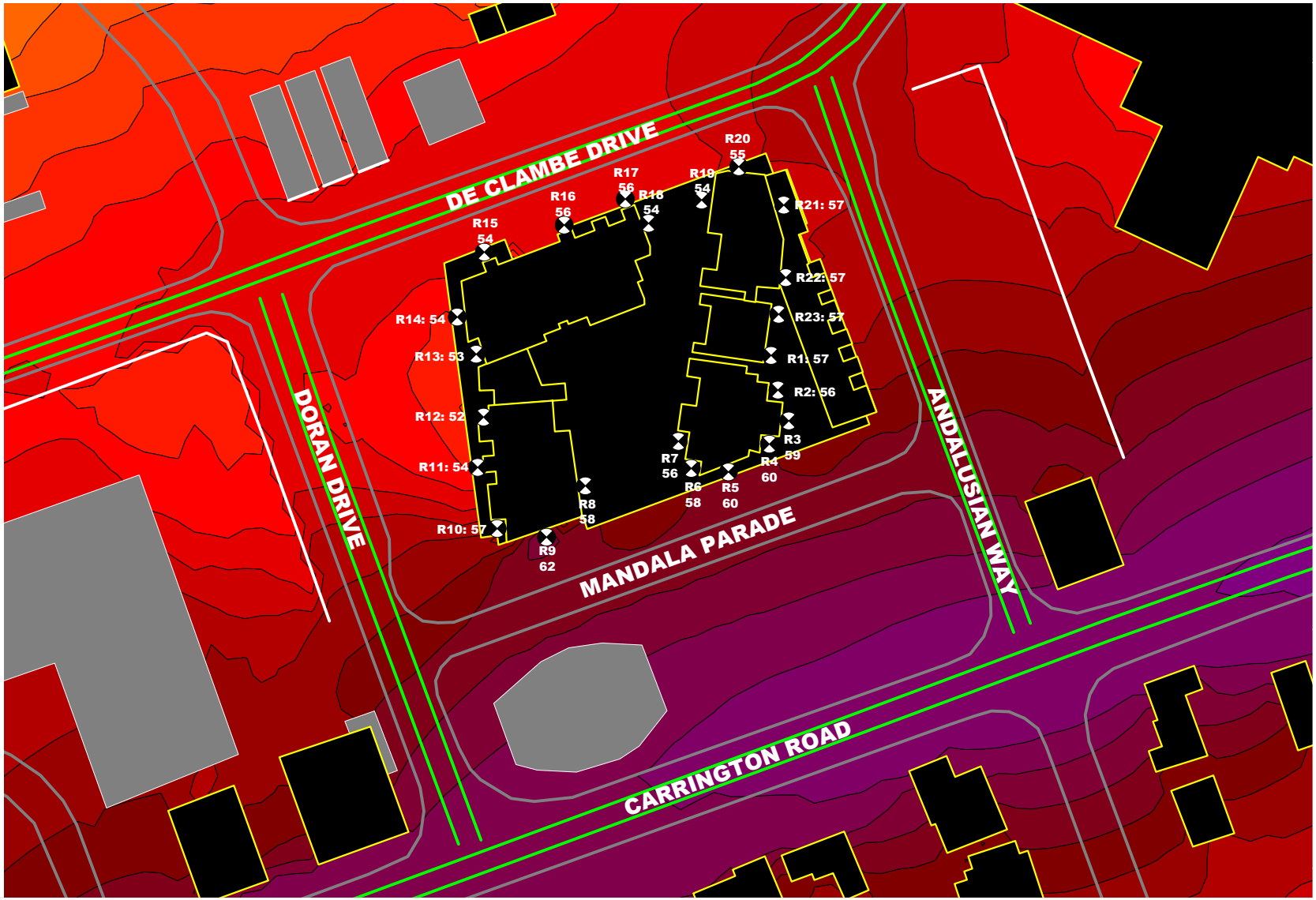

Scenario 1.3
(Level 12)
**** NOISE SOURCES ****

~ Carrington Road
~ Doran Drive
~ Andalusian Way
~ De Clambe Drive

Note:
- LAeq,15hrs noise level contours shown and receiver points are at a height of 1.5 m above the Level 12.
- The maximum reading at the nearest resident is 62 dB(A).

PRINT DATE: 26/05/21

Line Source
Building
Barrier
3D-Reflector
Ground Absorption
Contour Line
Receiver

> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

JOB NUMBER: 4214
CLIENT: Deicorp Pty Ltd
SITE ADDRESS: 2 Mandala Pde, Castle Hill
ASSESSED TO: ISEPP/DOP
LIMITING CRITERIA: 35 dB(A) - Bedrooms (2200-0700)
40 dB(A) - Other (0700-2200)

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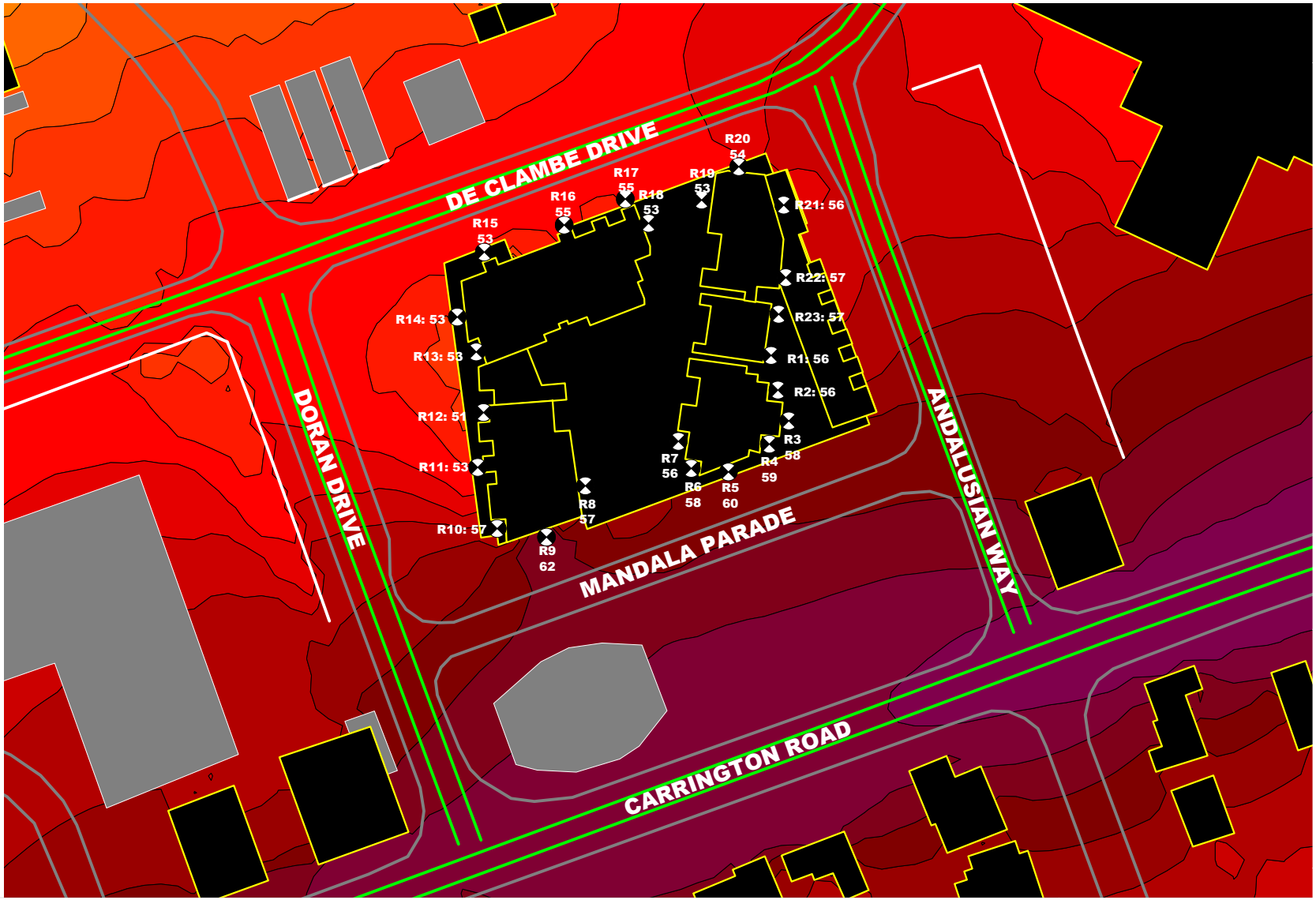

Scenario 1.4
(Level 18)
**** NOISE SOURCES ****

~ Carrington Road
~ Doran Drive
~ Andalusian Way
~ De Clambe Drive

Note:
- LAeq,15hrs noise level contours shown and receiver points are at a height of 1.5 m above the Level 18.
- The maximum reading at the nearest resident is 62 dB(A).

PRINT DATE: 26/05/21

Line Source
Building
Barrier
3D-Reflector
Ground Absorption
Contour Line
Receiver

> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

JOB NUMBER: 4214
CLIENT: Deicorp Pty Ltd
SITE ADDRESS: 2 Mandala Pde, Castle Hill
ASSESSED TO: ISEPP/DOP
LIMITING CRITERIA: 35 dB(A) - Bedrooms (2200-0700)
40 dB(A) - Other (0700-2200)

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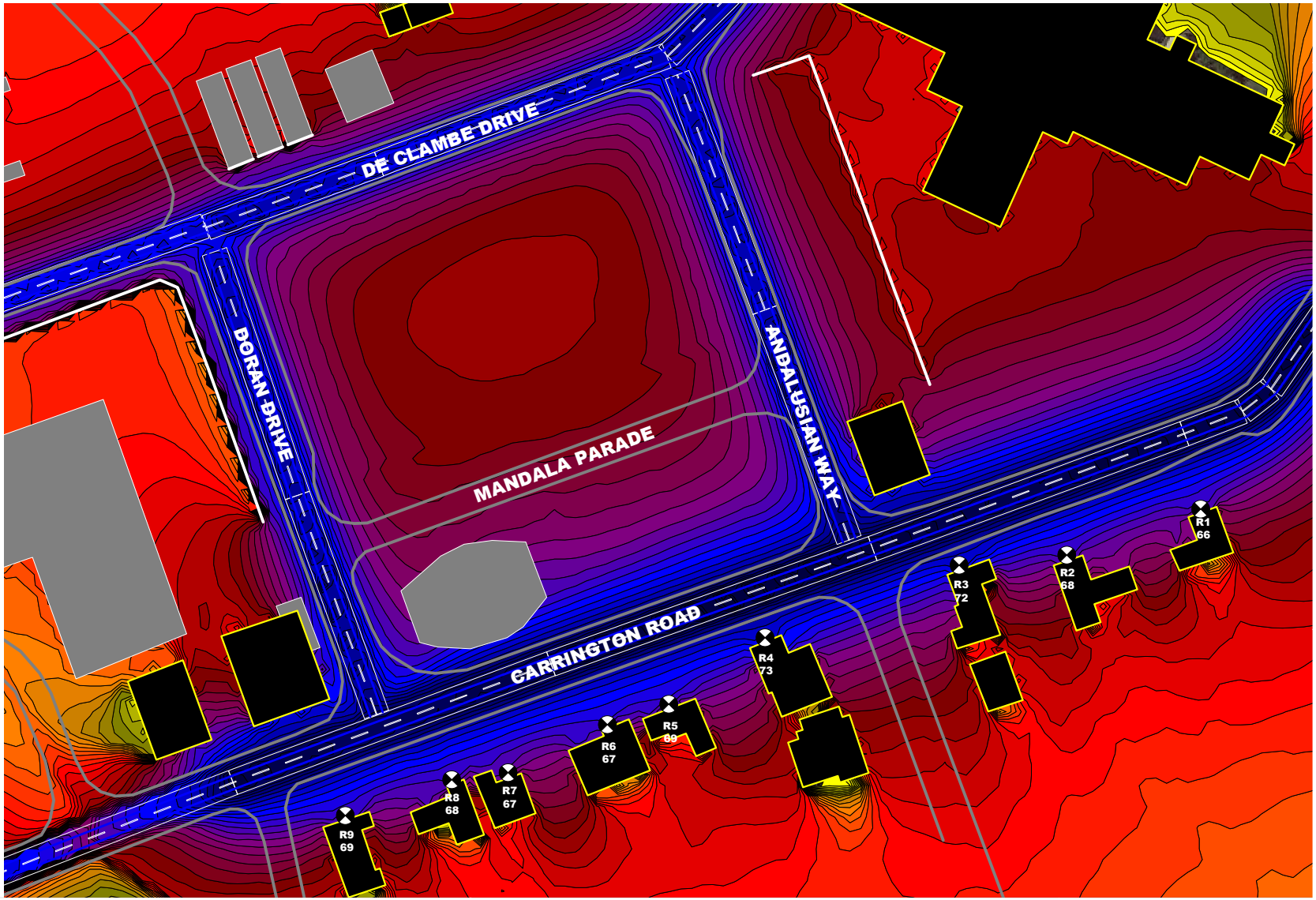

Scenario 2.1
(Existing)
**** NOISE SOURCES ****

~ Carrington Road
~ Doran Drive
~ Andalusian Way
~ De Clambe Drive

Note:
- Max LAeq,1hr noise level contours shown and receiver points are at a height of 1.5 m above the ground floor.
- The maximum reading at the nearest resident is 73 dB(A).

PRINT DATE: 26/05/21

Road
Building
Barrier
3D-Reflector
Ground Absorption
Contour Line
Receiver

> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

JOB NUMBER: 4214
CLIENT: Deicorp Pty Ltd
SITE ADDRESS: 2 Mandala Pde, Castle Hill
ASSESSED TO: NSW Road Noise Policy
LIMITING CRITERIA: 2 dB - relative increase

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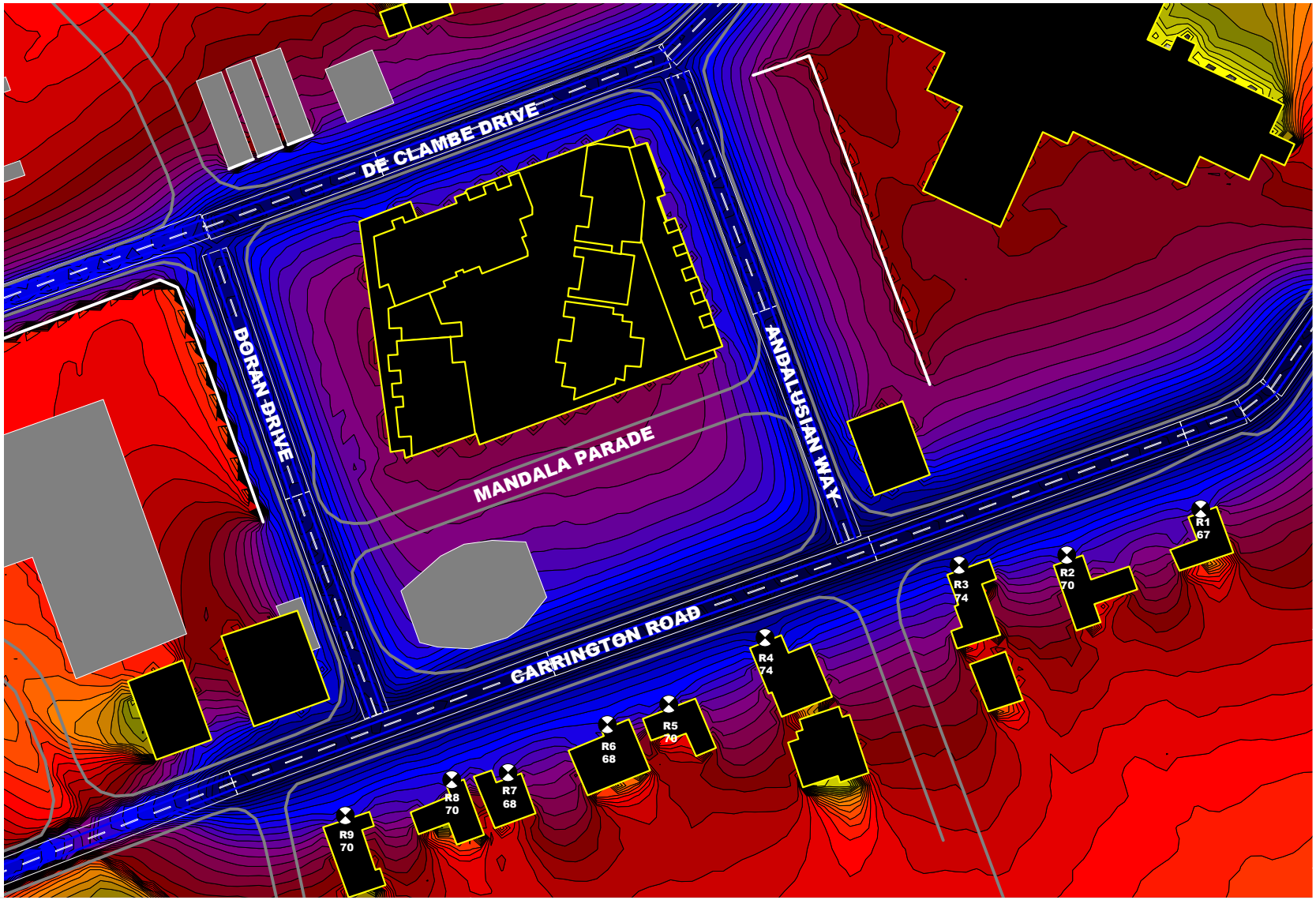

Scenario 2.2
(Proposed)
**** NOISE SOURCES ****

~ Carrington Road
~ Doran Drive
~ Andalusian Way
~ De Clambe Drive

Note:
- Max LAeq,1hr noise level contours shown and receiver points are at a height of 1.5 m above the ground floor.
- The maximum reading at the nearest resident is 74 dB(A).

PRINT DATE: 26/05/21

Road
Building
Barrier
3D-Reflector
Ground Absorption
Contour Line
Receiver

> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

JOB NUMBER: 4214
CLIENT: Deicorp Pty Ltd
SITE ADDRESS: 2 Mandala Pde, Castle Hill
ASSESSED TO: NSW Road Noise Policy
LIMITING CRITERIA: 2 dB - relative increase

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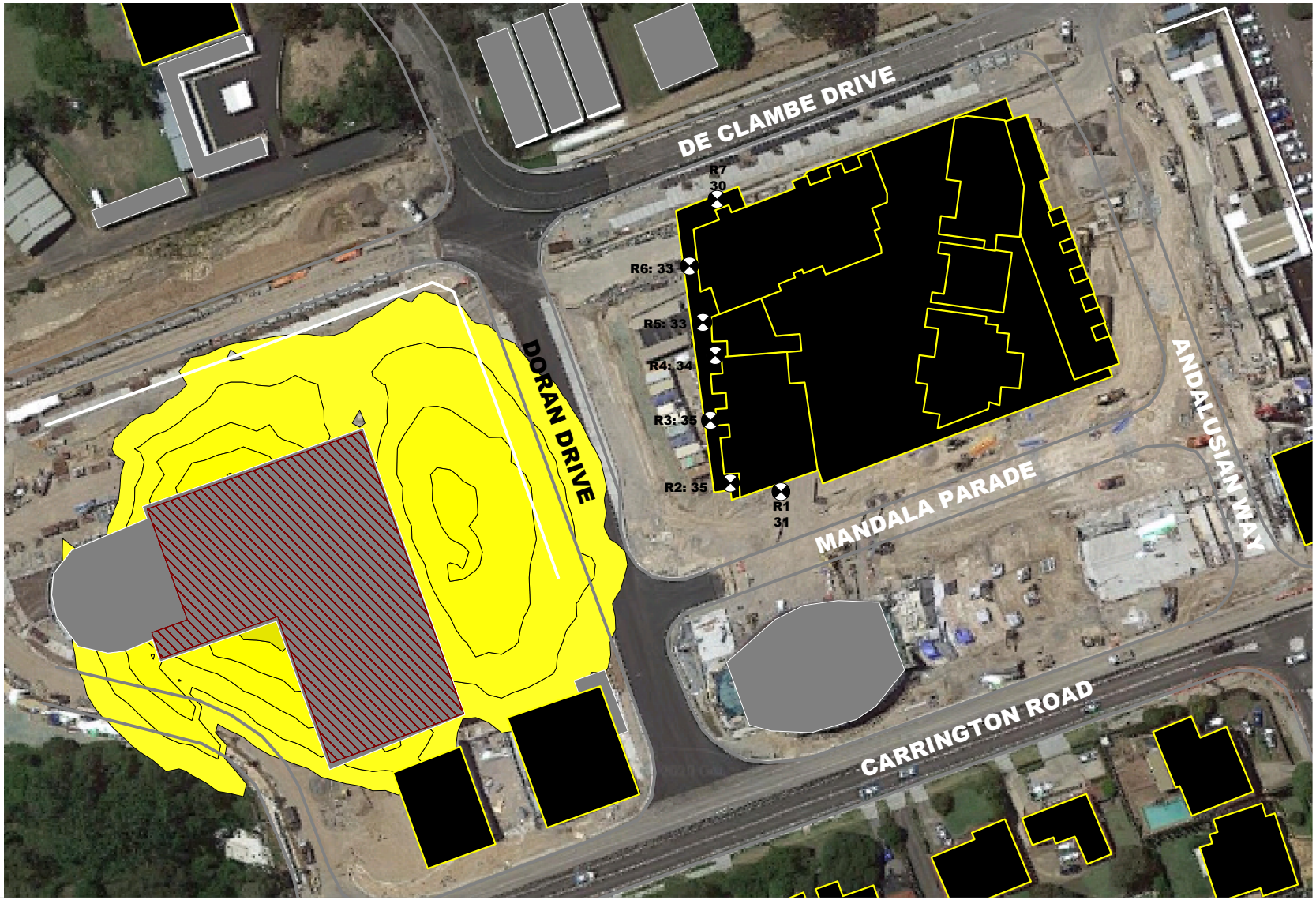

Scenario 3
(Level 2)
**** NOISE SOURCES ****

~Hills Showground Car Park

Note:
- LAeq,15min (night) noise level contours shown and receiver points are at a height of 1.5 m above the Level 2.

- Noise contour end at the limiting criteria of 37 dB(A).

- The maximum reading at the nearest resident is 35 dB(A).

PRINT DATE: 26/05/21

Parking Lot
Building
Barrier
3D-Reflector
Ground Absorption
Contour Line
Receiver

> 30.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB
> 75.0 dB
> 80.0 dB

koikas acoustics PTY LTD
CONSULTANTS IN NOISE & VIBRATION

JOB NUMBER: 4214
CLIENT: Deicorp Pty Ltd
SITE ADDRESS: 2 Mandala Pde, Castle Hill
ASSESSED TO: EPA's Noise Policy for Industry
LIMITING CRITERIA: 37 dB(A) - Night (2200-0700)
54 dB(A) - Day (0700-2200)

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APPENDIX C

APPENDIX C

APPENDIX C

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *A206 - Bed 1*

ROOM DATA

H 2.6 m D 4 m
W 3 m V 31.2 m3

		63	125	250	500	1k	2k	4k	8k	Area
	Bedroom, timber floor, furnished (RT60, sec)	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.38*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R17	47	51	52	58	57	56	52	48	63
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	0.8
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	7.0
STL 3										
STL 4										
	Noise through Component 1	11	0	0	-2	-11	-19	-28	-37	12
	Noise through Component 2	31	31	25	28	27	25	16	6	36
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**31**	**31**	**25**	**28**	**27**	**25**	**17**	**8**	**36**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R18	40	44	46	51	50	48	45	40	56
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.0
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	9.4
STL 3										
STL 4										
	Noise through Component 1	5	-6	-5	-7	-17	-26	-33	-44	6
	Noise through Component 2	25	25	21	23	21	18	11	-1	31
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**25**	**25**	**21**	**23**	**22**	**18**	**11**	**4**	**31**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	31	31	25	28	27	25	17	8	36
Façade 2	25	25	21	23	22	18	11	4	31
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**32**	**32**	**27**	**29**	**28**	**26**	**18**	**10**	**37**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *A202 - Kitchen/Dining/Living area*

ROOM DATA

H 2.6 m D 5 m
W 4 m V 52.0 m3

		63	125	250	500	1k	2k	4k	8k	Area
	KLD, timber and tile floor, furnished (RT60, sec)	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*0.7*	*0.6*	*0.6*	*0.64*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R15	42	46	47	53	53	51	48	43	59
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.3
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	11.7
STL 3										
STL 4										
	Noise through Component 1	6	-4	-3	-4	-11	-20	-29	-39	8
	Noise through Component 2	26	27	22	26	27	23	15	3	33
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**26**	**27**	**22**	**26**	**27**	**23**	**15**	**6**	**33**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R15	42	46	47	53	53	51	48	43	59
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.0
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	9.4
STL 3										
STL 4										
	Noise through Component 1	5	-5	-4	-5	-12	-21	-30	-40	7
	Noise through Component 2	25	26	21	25	26	22	14	2	32
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**25**	**26**	**21**	**25**	**26**	**22**	**14**	**6**	**32**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	26	27	22	26	27	23	15	6	33
Façade 2	25	26	21	25	26	22	14	6	32
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**29**	**29**	**25**	**29**	**29**	**26**	**18**	**10**	**36**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *B206 - Bed 2*

ROOM DATA

H 2.6 m D 4 m
W 3 m V 31.2 m3

	63	125	250	500	1k	2k	4k	8k	Area
Bedroom, timber floor, furnished (RT60, sec)	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.38*
EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R9	38	43	47	53	59	55	48	36	62
STL 1 *110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	0.8
STL 2 *10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	7.0
STL 3									
STL 4									
Noise through Component 1	2	-8	-5	-7	-9	-20	-32	-49	4
Noise through Component 2	22	23	20	23	29	24	12	-6	32
Noise through Component 3	0	0	0	0	0	0	0	0	0
Noise through Component 4	0	0	0	0	0	0	0	0	0
NOISE THROUGH FAÇADE 1	**22**	**23**	**21**	**23**	**29**	**24**	**13**	**3**	**32**
EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R9	40	45	49	55	61	57	50	38	64
STL 1 *110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.0
STL 2 *10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	9.4
STL 3									
STL 4									
Noise through Component 1	5	-5	-2	-3	-6	-17	-28	-46	7
Noise through Component 2	25	26	24	27	32	27	16	-3	36
Noise through Component 3	0	0	0	0	0	0	0	0	0
Noise through Component 4	0	0	0	0	0	0	0	0	0
NOISE THROUGH FAÇADE 2	**25**	**26**	**24**	**27**	**32**	**27**	**16**	**4**	**36**
EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1									
STL 2									
STL 3									
STL 4									
Noise through Component 1	0	0	0	0	0	0	0	0	0
Noise through Component 2	0	0	0	0	0	0	0	0	0
Noise through Component 3	0	0	0	0	0	0	0	0	0
Noise through Component 4	0	0	0	0	0	0	0	0	0
NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1									
STL 2									
STL 3									
STL 4									
Noise through Component 1	0	0	0	0	0	0	0	0	0
Noise through Component 2	0	0	0	0	0	0	0	0	0
Noise through Component 3	0	0	0	0	0	0	0	0	0
Noise through Component 4	0	0	0	0	0	0	0	0	0
NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	22	23	21	23	29	24	13	3	32
Façade 2	25	26	24	27	32	27	16	4	36
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**27**	**28**	**25**	**28**	**34**	**29**	**18**	**8**	**37**

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CONSULTANTS IN NOISE & VIBRATION

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *B205 - Kitchen/Dining/Living area*

ROOM DATA

H 2.6 m D 5 m
W 6 m V 78.0 m3

		63	125	250	500	1k	2k	4k	8k	Area
	KLD, timber and tile floor, furnished (RT60, sec)	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*0.7*	*0.6*	*0.6*	*0.64*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R9	38	43	47	53	59	55	48	36	62
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.3
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	11.7
STL 3										
STL 4										
	Noise through Component 1	1	-9	-5	-5	-7	-18	-31	-48	3
	Noise through Component 2	20	22	21	24	31	25	13	-5	34
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**21**	**22**	**21**	**25**	**31**	**25**	**13**	**4**	**34**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R9	40	45	49	55	61	57	50	38	64
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.6
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	14.0
STL 3										
STL 4										
	Noise through Component 1	3	-6	-2	-3	-4	-15	-28	-45	6
	Noise through Component 2	23	25	23	27	34	28	16	-3	36
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**23**	**25**	**23**	**27**	**34**	**28**	**16**	**4**	**36**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	21	22	21	25	31	25	13	4	34
Façade 2	23	25	23	27	34	28	16	4	36
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**25**	**27**	**25**	**29**	**36**	**30**	**18**	**8**	**38**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *D202 - Bed 1*

ROOM DATA
H 2.6 m D 4 m
W 3 m V 31.2 m3

	63	125	250	500	1k	2k	4k	8k	Area
Bedroom, timber floor, furnished (RT60, sec)	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.38*
EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R5	37	41	46	52	58	54	47	36	61
STL 1 *110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	0.8
STL 2 *10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	7.0
STL 3									
STL 4									
Noise through Component 1	1	-10	-6	-8	-10	-21	-33	-49	3
Noise through Component 2	21	21	19	22	28	23	11	-6	31
Noise through Component 3	0	0	0	0	0	0	0	0	0
Noise through Component 4	0	0	0	0	0	0	0	0	0
NOISE THROUGH FAÇADE 1	**21**	**21**	**20**	**22**	**28**	**23**	**12**	**3**	**31**
EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R5	37	41	46	52	58	54	47	36	61
STL 1 *110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.0
STL 2 *10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	9.4
STL 3									
STL 4									
Noise through Component 1	2	-9	-5	-6	-9	-20	-31	-48	4
Noise through Component 2	22	22	21	24	29	24	13	-5	33
Noise through Component 3	0	0	0	0	0	0	0	0	0
Noise through Component 4	0	0	0	0	0	0	0	0	0
NOISE THROUGH FAÇADE 2	**22**	**22**	**21**	**24**	**29**	**24**	**13**	**4**	**33**
EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1									
STL 2									
STL 3									
STL 4									
Noise through Component 1	0	0	0	0	0	0	0	0	0
Noise through Component 2	0	0	0	0	0	0	0	0	0
Noise through Component 3	0	0	0	0	0	0	0	0	0
Noise through Component 4	0	0	0	0	0	0	0	0	0
NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1									
STL 2									
STL 3									
STL 4									
Noise through Component 1	0	0	0	0	0	0	0	0	0
Noise through Component 2	0	0	0	0	0	0	0	0	0
Noise through Component 3	0	0	0	0	0	0	0	0	0
Noise through Component 4	0	0	0	0	0	0	0	0	0
NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	21	21	20	22	28	23	12	3	31
Façade 2	22	22	21	24	29	24	13	4	33
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**24**	**24**	**23**	**26**	**32**	**26**	**16**	**8**	**35**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *D202 - Kitchen/Dining/Living area*

ROOM DATA

H 2.6 m D 5 m
W 6 m V 78.0 m3

		63	125	250	500	1k	2k	4k	8k	Area
	KLD, timber and tile floor, furnished (RT60, sec)	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*0.7*	*0.6*	*0.6*	*0.64*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R5	37	41	46	52	58	54	47	36	61
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.3
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	11.7
STL 3										
STL 4										
	Noise through Component 1	0	-11	-6	-6	-8	-19	-32	-48	2
	Noise through Component 2	19	20	20	23	30	24	12	-5	33
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**20**	**20**	**20**	**24**	**30**	**24**	**12**	**4**	**33**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R6	36	41	46	51	57	54	46	35	60
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.6
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	14.0
STL 3										
STL 4										
	Noise through Component 1	-1	-10	-5	-7	-8	-18	-32	-48	2
	Noise through Component 2	19	21	20	23	30	25	12	-6	33
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**19**	**21**	**20**	**23**	**30**	**25**	**12**	**4**	**33**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	20	20	20	24	30	24	12	4	33
Façade 2	19	21	20	23	30	25	12	4	33
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**22**	**24**	**23**	**26**	**33**	**28**	**16**	**8**	**36**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *A606 - Bed 1*

ROOM DATA

H 2.6 m D 4 m
W 3 m V 31.2 m3

		63	125	250	500	1k	2k	4k	8k	Area
	Bedroom, timber floor, furnished (RT60, sec)	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.38*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R17	44	47	48	54	53	52	48	43	59
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	0.8
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	7.0
STL 3										
STL 4										
	Noise through Component 1	8	-4	-4	-6	-15	-23	-32	-42	9
	Noise through Component 2	28	27	21	24	23	21	12	1	33
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**28**	**27**	**22**	**24**	**23**	**21**	**13**	**5**	**33**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R18	40	44	45	51	51	48	44	38	56
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.0
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	9.4
STL 3										
STL 4										
	Noise through Component 1	5	-6	-6	-7	-16	-26	-34	-46	6
	Noise through Component 2	25	25	20	23	22	18	10	-3	31
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**25**	**25**	**20**	**23**	**22**	**18**	**10**	**4**	**31**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	28	27	22	24	23	21	13	5	33
Façade 2	25	25	20	23	22	18	10	4	31
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**30**	**29**	**24**	**27**	**26**	**23**	**15**	**9**	**35**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *A602 - Kitchen/Dining/Living area*

ROOM DATA

H 2.6 m D 5 m
W 4 m V 52.0 m3

		63	125	250	500	1k	2k	4k	8k	Area
	KLD, timber and tile floor, furnished (RT60, sec)	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*0.7*	*0.6*	*0.6*	*0.64*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R15	40	44	46	52	51	49	46	40	57
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.3
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	11.7
STL 3										
STL 4										
	Noise through Component 1	4	-6	-4	-5	-13	-22	-31	-42	6
	Noise through Component 2	24	25	21	25	25	21	13	0	32
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**24**	**25**	**21**	**25**	**25**	**21**	**13**	**5**	**32**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R15	40	44	46	52	51	49	46	40	57
STL 1	*Double brick with brick ties (no insulation)*	*37*	*45*	*43*	*49*	*59*	*69*	*78*	*80*	1.0
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	9.4
STL 3										
STL 4										
	Noise through Component 1	-3	-6	-2	-2	-12	-24	-37	-45	3
	Noise through Component 2	23	24	20	24	24	20	12	-1	31
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**23**	**24**	**20**	**24**	**24**	**20**	**12**	**5**	**31**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	24	25	21	25	25	21	13	5	32
Façade 2	23	24	20	24	24	20	12	5	31
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**27**	**27**	**24**	**28**	**28**	**24**	**16**	**9**	**34**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *B606 - Bed 2*

ROOM DATA

H 2.6 m D 4 m
W 3 m V 31.2 m3

		63	125	250	500	1k	2k	4k	8k	Area
	Bedroom, timber floor, furnished (RT60, sec)	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.38*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R9	38	43	47	53	59	55	48	36	62
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	0.8
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	7.0
STL 3										
STL 4										
	Noise through Component 1	2	-8	-5	-7	-9	-20	-32	-49	4
	Noise through Component 2	22	23	20	23	29	24	12	-6	32
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**22**	**23**	**21**	**23**	**29**	**24**	**13**	**3**	**32**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R9	40	45	49	55	61	57	50	38	64
STL 1	*Double brick with brick ties (no insulation)*	*37*	*45*	*43*	*49*	*59*	*69*	*78*	*80*	1.0
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	9.4
STL 3										
STL 4										
	Noise through Component 1	-1	-4	1	1	-4	-18	-33	-48	6
	Noise through Component 2	25	26	24	27	32	27	16	-3	36
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**25**	**26**	**24**	**27**	**32**	**27**	**16**	**4**	**36**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	22	23	21	23	29	24	13	3	32
Façade 2	25	26	24	27	32	27	16	4	36
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**27**	**28**	**25**	**28**	**34**	**29**	**18**	**8**	**37**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *B605 - Kitchen/Dining/Living area*

ROOM DATA

H 2.6 m D 5 m
W 6 m V 78.0 m3

		63	125	250	500	1k	2k	4k	8k	Area
	KLD, timber and tile floor, furnished (RT60, sec)	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*0.7*	*0.6*	*0.6*	*0.64*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R9	38	43	47	53	59	55	48	36	62
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.3
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	11.7
STL 3										
STL 4										
	Noise through Component 1	1	-9	-5	-5	-7	-18	-31	-48	3
	Noise through Component 2	20	22	21	24	31	25	13	-5	34
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**21**	**22**	**21**	**25**	**31**	**25**	**13**	**4**	**34**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R9	40	45	49	55	61	57	50	38	64
STL 1	*Double brick with brick ties (no insulation)*	*37*	*45*	*43*	*49*	*59*	*69*	*78*	*80*	1.6
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	14.0
STL 3										
STL 4										
	Noise through Component 1	-3	-5	1	1	-2	-16	-33	-47	6
	Noise through Component 2	23	25	23	27	34	28	16	-3	36
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**23**	**25**	**23**	**27**	**34**	**28**	**16**	**4**	**36**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	21	22	21	25	31	25	13	4	34
Façade 2	23	25	23	27	34	28	16	4	36
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**25**	**27**	**25**	**29**	**36**	**30**	**18**	**8**	**38**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *D602 - Bed 1*

ROOM DATA

H 2.6 m D 4 m
W 3 m V 31.2 m3

		63	125	250	500	1k	2k	4k	8k	Area
	Bedroom, timber floor, furnished (RT60, sec)	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.38*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R5	37	42	46	52	58	54	47	36	61
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	0.8
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	7.0
STL 3										
STL 4										
	Noise through Component 1	1	-9	-6	-8	-10	-21	-33	-49	3
	Noise through Component 2	21	22	19	22	28	23	11	-6	31
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**21**	**22**	**20**	**22**	**28**	**23**	**12**	**3**	**31**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R5	37	42	46	52	58	54	47	36	61
STL 1	*Double brick with brick ties (no insulation)*	*37*	*45*	*43*	*49*	*59*	*69*	*78*	*80*	1.0
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	9.4
STL 3										
STL 4										
	Noise through Component 1	-4	-7	-2	-2	-7	-21	-36	-50	3
	Noise through Component 2	22	23	21	24	29	24	13	-5	33
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**22**	**23**	**21**	**24**	**29**	**24**	**13**	**4**	**33**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	21	22	20	22	28	23	12	3	31
Façade 2	22	23	21	24	29	24	13	4	33
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**24**	**25**	**23**	**26**	**32**	**26**	**16**	**8**	**35**

TRAFFIC NOISE INTRUSION CALCULATIONS

Job *4214*
Client *Deicorp Pty Ltd*
Site *2 Mandala Parade, Castle Hill*
Room *D602 - Kitchen/Dining/Living area*

ROOM DATA

H 2.6 m D 5 m
W 6 m V 78.0 m3

		63	125	250	500	1k	2k	4k	8k	Area
	KLD, timber and tile floor, furnished (RT60, sec)	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*0.7*	*0.6*	*0.6*	*0.64*
	EXTERNAL FAÇADE 1 - NOISE LEVEL, LAeq, Period [dB] - R5	37	42	46	52	58	54	47	36	61
STL 1	*110mm brick + 50mm air gap + 64mm steel stud with insul + 13mm pb*	*31*	*46*	*46*	*53*	*61*	*68*	*73*	*78*	1.3
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	11.7
STL 3										
STL 4										
	Noise through Component 1	0	-10	-6	-6	-8	-19	-32	-48	2
	Noise through Component 2	19	21	20	23	30	24	12	-5	33
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 1	**20**	**21**	**20**	**24**	**30**	**24**	**12**	**4**	**33**
	EXTERNAL FAÇADE 2 - NOISE LEVEL, LAeq, Period [dB] - R6	36	42	46	51	57	54	46	35	60
STL 1	*Double brick with brick ties (no insulation)*	*37*	*45*	*43*	*49*	*59*	*69*	*78*	*80*	1.6
STL 2	*10.38mm laminated glass with qlon + fin/mohair seals*	*21*	*25*	*30*	*33*	*32*	*34*	*39*	*45*	14.0
STL 3										
STL 4										
	Noise through Component 1	-7	-8	-2	-3	-6	-19	-37	-50	2
	Noise through Component 2	19	22	20	23	30	25	12	-6	33
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 2	**19**	**22**	**20**	**23**	**30**	**25**	**12**	**4**	**33**
	EXTERNAL FAÇADE 3 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	EXTERNAL FAÇADE 4 - NOISE LEVEL, LAeq, Period [dB]									0
STL 1										
STL 2										
STL 3										
STL 4										
	Noise through Component 1	0	0	0	0	0	0	0	0	0
	Noise through Component 2	0	0	0	0	0	0	0	0	0
	Noise through Component 3	0	0	0	0	0	0	0	0	0
	Noise through Component 4	0	0	0	0	0	0	0	0	0
	NOISE THROUGH FAÇADE 4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

SUMMARY OF RESULTS

	Noise Transmission Through Each Façade LAeq,Period [dB]								
Frequency	63	125	250	500	1k	2k	4k	8k	Tot
Façade 1	20	21	20	24	30	24	12	4	33
Façade 2	19	22	20	23	30	25	12	4	33
Façade 3	0	0	0	0	0	0	0	0	0
Façade 4	0	0	0	0	0	0	0	0	0
CALCULATED INDOOR TRAFFIC NOISE LEVEL, LAeq, Period [dB]	**22**	**25**	**23**	**26**	**33**	**28**	**16**	**8**	**36**