RESIDENTIAL ESTATE, LOT 5 DP 1199045

Consideration of Transportation Noise

Prepared for:

PEET Limited
C/-SPACELAB Studio Pty Ltd
5/97 Northbourne Avenue
TURNER ACT 2612

SLR Ref: 670.11031-R01
Version No: -v3.0
March 2019

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
GPO Box 410
Canberra ACT 2600 Australia

T: +61 2 6287 0800
E: canberra@slrconsulting.com   www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with PEET Limited (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
670.11031-R01-v3.0	20 March 2019	Matthew Bryce	Antony Williams	Matthew Bryce
670.11031-R01-v2.0	25 January 2019	Matthew Bryce	Antony Williams	Matthew Bryce
670.11031-R01-v1.0	13 December 2018	Matthew Bryce	Antony Williams	Matthew Bryce

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

CONTENTS

APPENDICES

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has undertaken an assessment of transportation noise for a residential estate to be located on land known as Lot 5 DP 1199045 (“the Project”) at Greenleigh in New South Wales (NSW).

This assessment addresses noise from the nearby road network with regard to NSW acoustic amenity criteria for future occupants of yet-to-be designed dwellings, and forms part of the DA for the proposal.

In addition, consideration of the Project site relative to potential noise associated with the Canberra Airport has also been made.

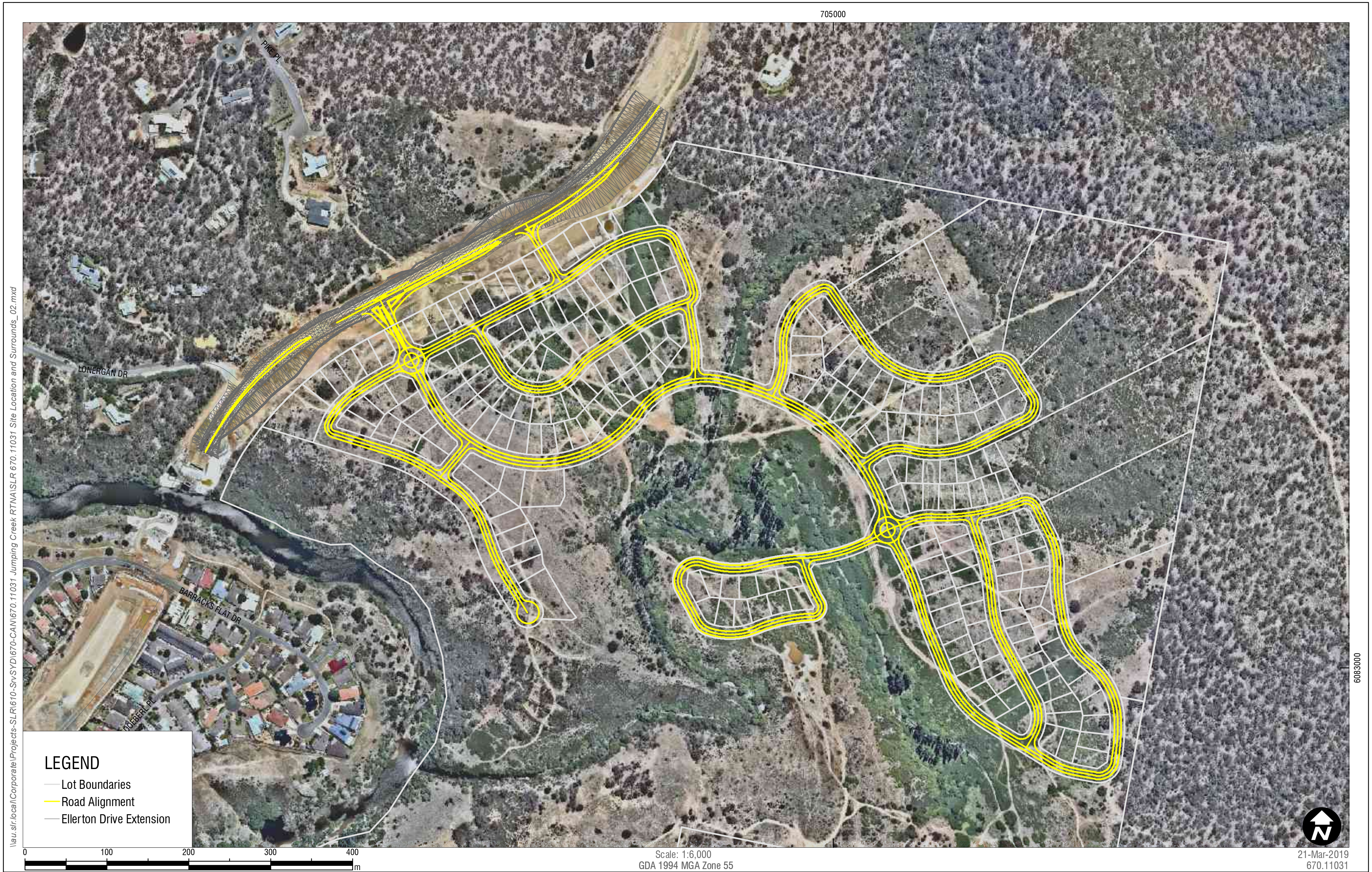
A glossary of the acoustical terminology used throughout this report is contained within **Appendix A**.

2 Project Site Description and Surrounds

The Project is to be located immediately adjacent to the Ellerton Drive Extension road alignment which is currently under construction.

An aerial view of the project site and surrounds, together with the proposed allotment layout is shown in **Figure 1**.

The Canberra Airport is located approximately 8 kms to the northwest of the Project.



Scale: 1:6,000
GDA 1994 MGA Zone 55

21-Mar-2019
670.11031

Sheet Size : A4

SLR
www.slrconsulting.com

Site Location and Surrounds

FIGURE 1

3 Road Traffic Noise Criteria

3.1 Internal Traffic Noise Criteria

The proximity of the site to the Ellerton Drive Extension, and the number and type of vehicles expected on that road, warrants consideration of the NSW Department of Planning (DoP) *Development near Rail Corridors and Busy Roads – Interim Guideline* ("the Guideline") document issued in 2008.

The Guideline relies upon internal noise criteria provided in Regulation Clause 102 of the *State Environment Planning Policy (Infrastructure) 2007* (SEPP 102), which stipulates:

> *(3) If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:*
>
> *(a) in any bedroom in the building – 35 dB(A) at any time between 10 pm and 7 am,*
>
> *(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway) – 40 dB(A) at any time.*

3.2 External Traffic Noise Thresholds

Conventional external wall and roof/ceiling constructions and standard proprietary window glazing (4 mm thick or greater) will commonly attenuate noise ingress by approximately 20 dBA when in the closed position and by approximately 10 dBA when opened (sufficient to allow for natural ventilation).

Therefore, based on the internal traffic noise criteria, the corresponding external noise thresholds are shown in **Table 1**.

Table 1 External Noise Thresholds

Position of Facade Openings	Noise Level Outside Occupancy Type, dBA L_{Aeq}			
	Sleeping Areas		Other "Living" Areas	
	Daytime – 15 hour (7:00 am – 10:00 pm)	Night-time – 9 hour (10:00 pm – 7:00 am)	Daytime – 15 hour (7:00 am – 10:00 pm)	Night-time – 9 hour (10:00 pm – 7:00 am)
Windows open	50	45	50	50
Windows closed	60	55	60	60

Where road traffic noise exceeds the "windows open" criteria, dwellings will require windows and doors to be closed and alternative ventilation arrangements must therefore be provided.

Where road traffic noise exceeds the "windows closed" criteria, an upgraded building construction may be required, along with the alternative ventilation. The weakest acoustic element of a residential facade is usually the weather sealed windows. It is generally necessary to upgrade only the glazing and/or door components of building facades.

4 Noise Assessment and Recommendations

4.1 Road Traffic Noise Modelling

SLR developed a SoundPLAN (version 8.0) noise model of the Project site to predict for the year 2031 (ie 10 year horizon) noise levels at the Project site.

The model includes a digitised ground map (containing 3D ground elevations and buildings), the location and acoustic power levels of significant noise sources, and sensitive receptor locations.

The *Calculation of Road Traffic Noise 1988* (CoRTN) methodology within SoundPLAN was utilised to predict future road traffic noise levels. CoRTN incorporates the road design, the topography between the subject road and receptors, significant structures (eg buildings and noise barriers/fences) and traffic characteristics for the subject road (ie volume, composition, speed, and road surface type).

Road and traffic information for the Ellerton Drive Extension was obtained from the road traffic noise assessment for the Ellerton Drive Extension project prepared by SLR for the Queanbeyan-Palerang Regional Council (QPRC) in February 2017[1].

Table 2 summarises the information incorporated into the noise prediction model.

Table 2 Traffic and Road Information

Direction	Traffic Volumes				Road Surface	Traffic Speed, km/h
	Daytime – 15 Hour (7:00 am – 10:00 pm)		Night-time – 9 Hour (10:00 pm – 7:00 am)			
	Light[1]	Heavy[2]	Light[1]	Heavy[2]		
Northbound	2017	106	132	7	Stone Mastic Asphalt[3]	80
Southbound	3059	161	263	14		

1. Light vehicles are Class 1 and 2 vehicles, ie motorcycles and cars
2. Heavy vehicles comprise Class 3 to 12 vehicles.
3. A -2 dB adjustment for this type of road surface is applicable due to the relative 'loudness' compared to the CoRTN default road surface of Dense Graded Asphalt (DGA).

Separate predictions for two building heights were undertaken (1.5 m and 4 m for single and two-storey dwellings respectively). The predicted results include a +2.5 dBA reflection facade adjustment.

Future single-storey dwellings have been incorporated into the noise model in order to account for the potential screening effects provided by intervening buildings to the allotments behind, ie those allotments not directly exposed to road traffic noise. Allotment boundary fencing between properties, which may provide some noise screening in some instances, has not been considered.

[1] Refer to SLR report "*Ellerton Drive Extension: Noise and Vibration Assessment – Operation and Construction*", 670.10568-R1R8, dated 13 February 2017

4.2 Road Traffic Noise Modelling Results

4.2.1 Without Noise Barriers

The predicted external road traffic noise levels in contour form across the site are shown in **Figure 2** to **Figure 5**, to allow easy identification of "affected allotments", ie where the external road traffic noise level would likely exceed the thresholds shown in **Table 1**.

The road traffic noise levels have been predicted for the daytime (habitable rooms) and night-time periods (sleeping rooms) for both single and two storey dwellings.

The two lines (green and red) on each of the figures identify which allotments would be considered "noise affected". There are three outcomes:

1. Dwellings built on allotments to the south and east of the green line (windows open threshold level) do not require acoustic considerations (ie internal criteria are predicted to be achieved even with windows open).
2. Dwellings built on allotments between the green and red lines do not require specific acoustic constructions (eg glazing thicker than 4 mm) **but** require windows closed to meet internal criteria. Such dwellings would require ventilation by means other than open windows.
3. Dwellings built on allotments between the red line (windows closed threshold level) and the Ellerton Drive alignment (ie to the north and west of the red line), would also require windows to be closed (and assisted ventilation) in order to meet the internal criteria, and **may** require specific acoustic constructions (eg thicker glazing).

It can be seen in **Figure 2** to **Figure 5** that the red line does not impact on any of the proposed allotments for any of the prediction scenarios.

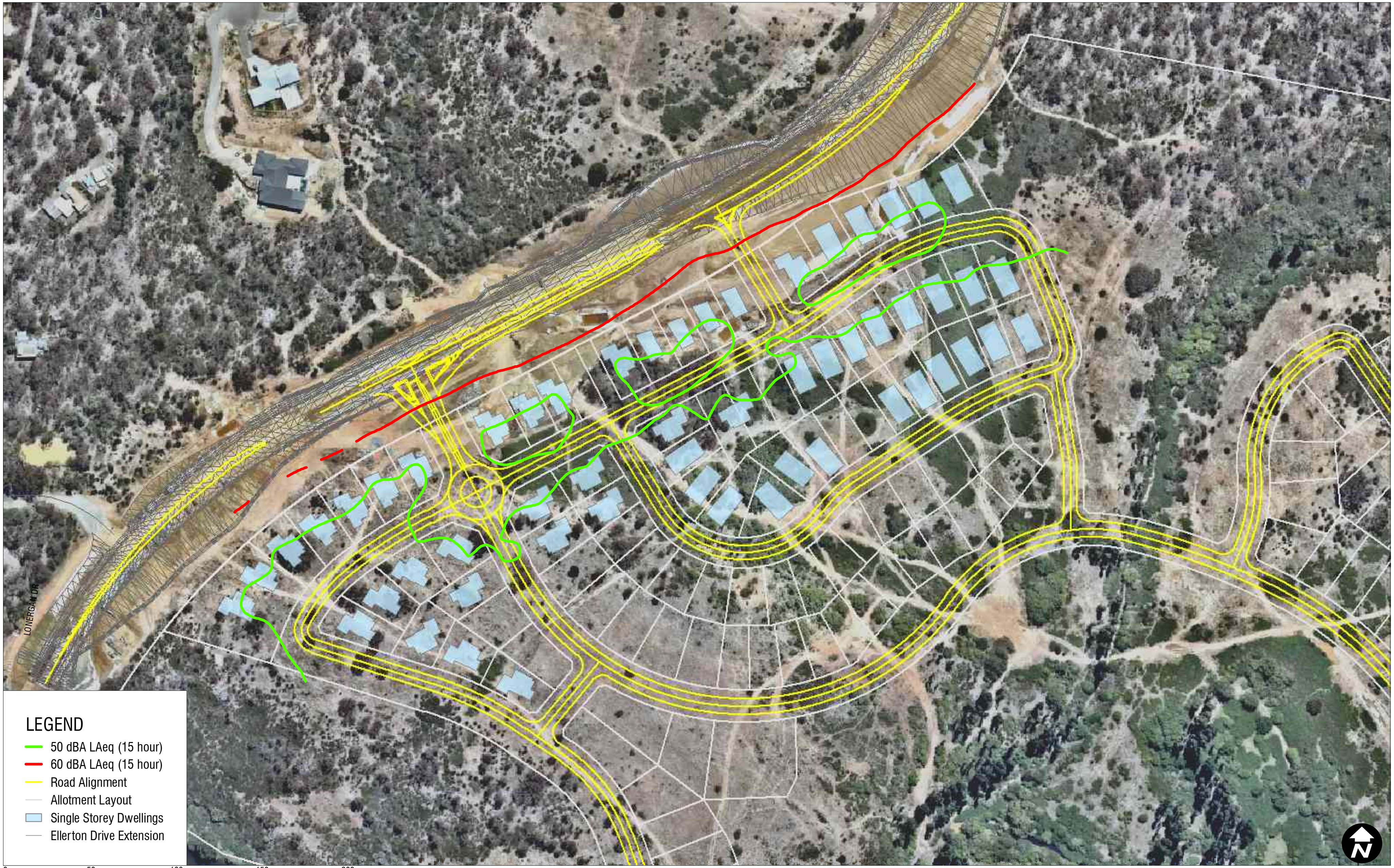
It can also be seen that it is the predicted daytime noise levels that will control the extent of the noise intrusion into the Project and therefore the number of "noise-affected allotments".

The affected allotments tend to be the first row of houses directly exposed to road traffic noise and will fall into the second outcome above, which would not be considered onerous given the propensity for the provision of mechanical ventilation in modern dwellings.

Information regarding "standard constructions" can be found in **Section 5** of this report.

It is expected that prospective purchasers of allotments in the estate would be provided with the noise contour maps of the affected allotments. This will enable informed decisions regarding building heights and construction requirements.

705000



\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\670-CAN\670.11031 Jumping Creek RTNA\SLR 670.11031 F02 Single Day No Barrier_02.mxd

0 50 100 150 200 m

Scale: 1:3,000
GDA 1994 MGA Zone 55

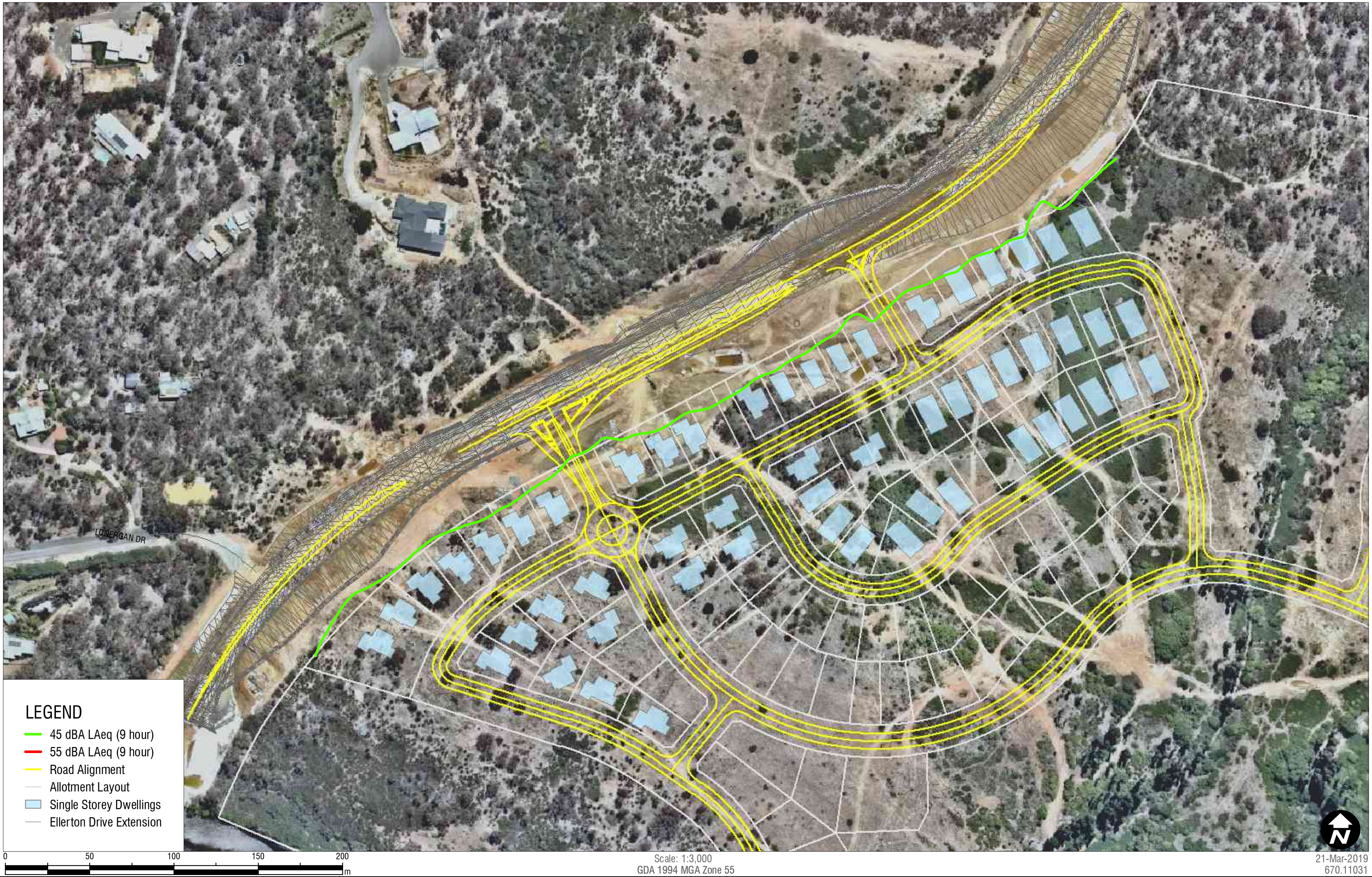
21-Mar-2019
670.11031

Sheet Size : A4

SLR
www.slrconsulting.com

Daytime Road Traffic Noise Levels
Single Storey Dwellings
No Noise Barrier

FIGURE 2



\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\670-CAN\670.11031 Jumping Creek RTNA\SLR 670.11031 F03 Single Night No Barrier_02.mxd

Scale: 1:3,000
GDA 1994 MGA Zone 55

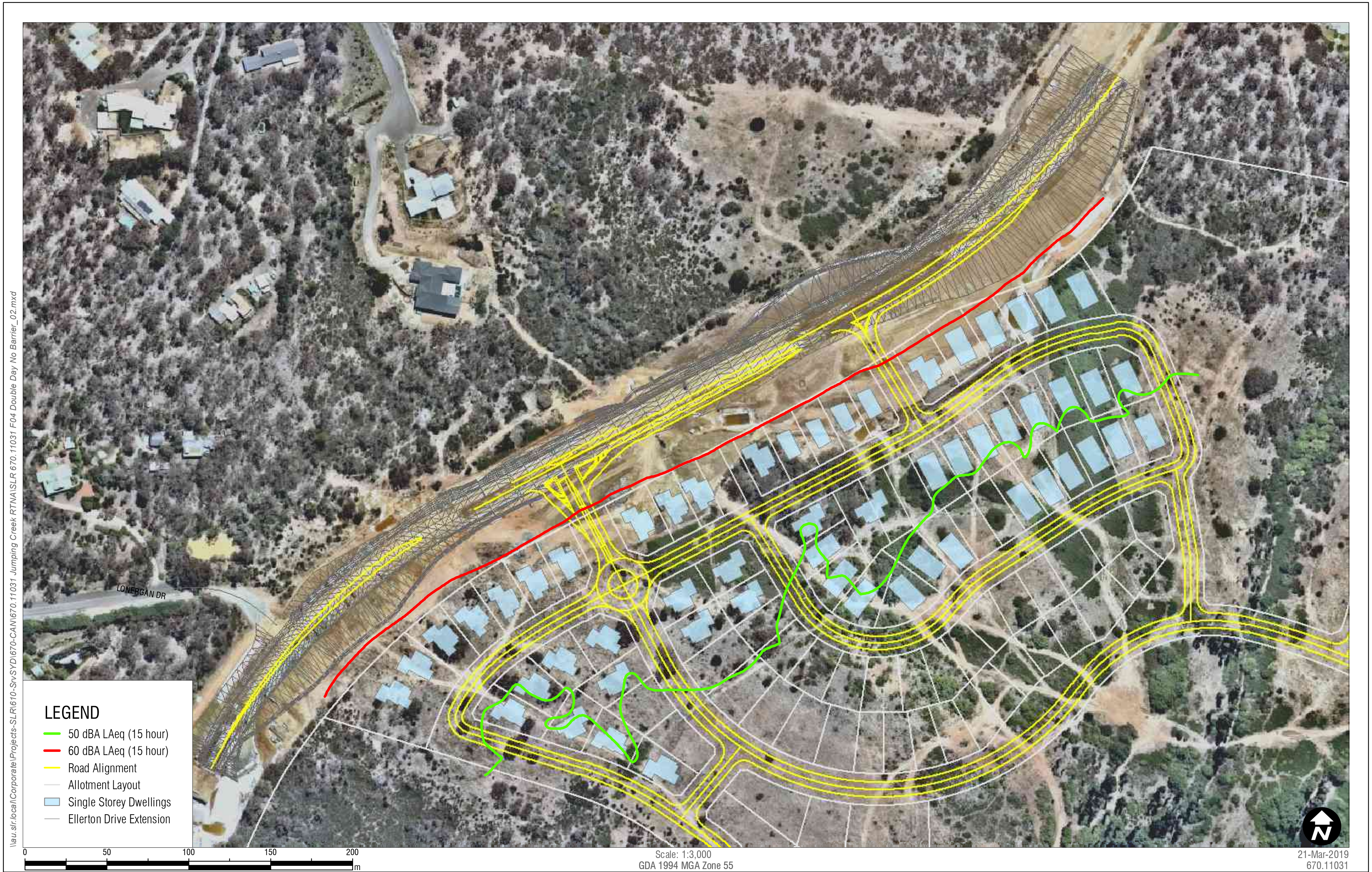
21-Mar-2019
670.11031

Sheet Size : A4

SLR
www.slrconsulting.com

Night-time Road Traffic Noise Levels
Single Storey Dwellings
No Noise Barrier

FIGURE 3

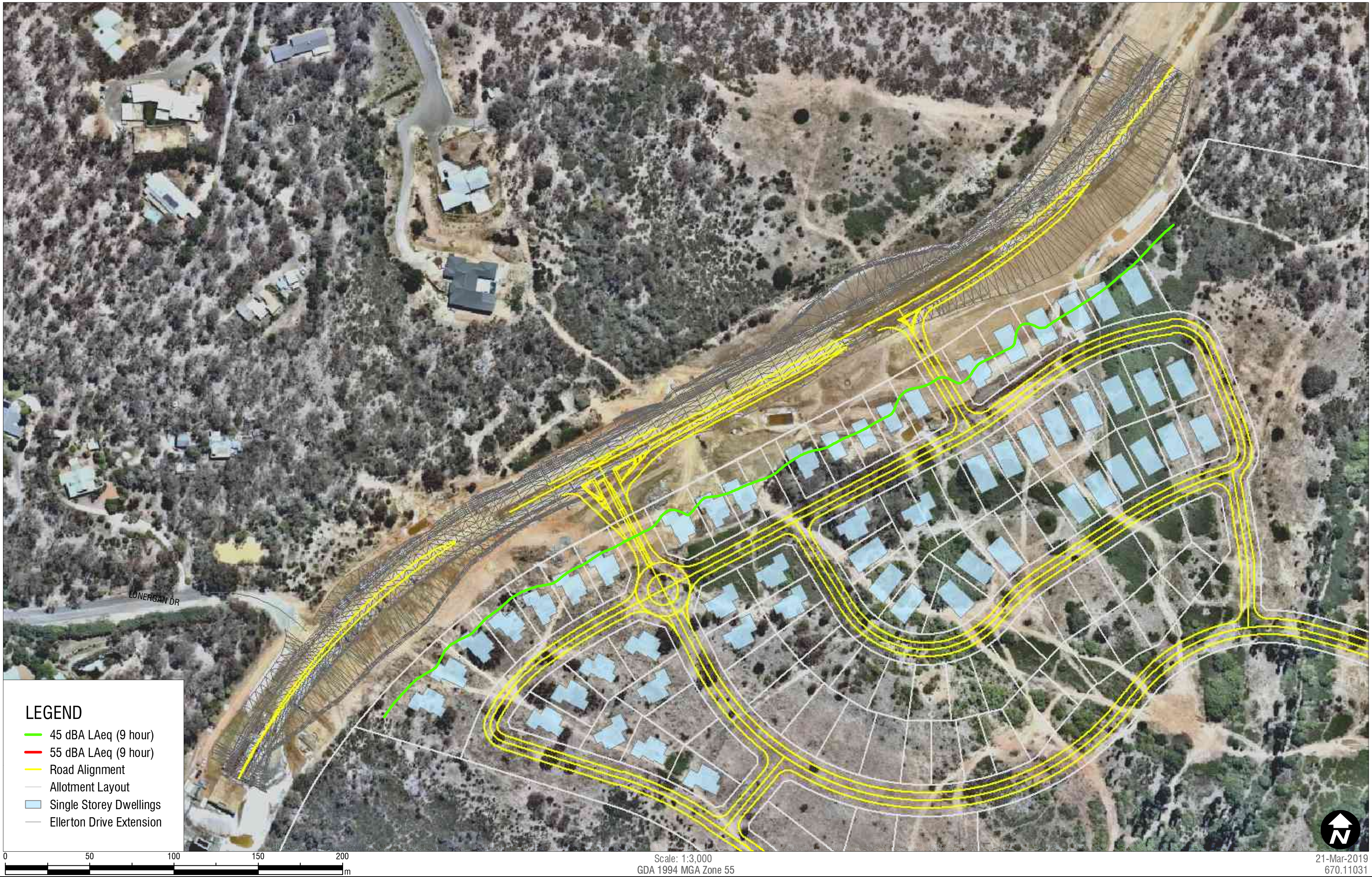


Sheet Size : A4

SLR
www.slrconsulting.com

Daytime Road Traffic Noise Levels
Double Storey Dwellings
No Noise Barrier

FIGURE 4



\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\670-CAN\670.11031 Jumping Creek RTNA\SLR 670.11031 F05 Double Night No Barrier_02.mxd

Scale: 1:3,000
GDA 1994 MGA Zone 55

21-Mar-2019
670.11031

Sheet Size : A4

SLR
www.slrconsulting.com

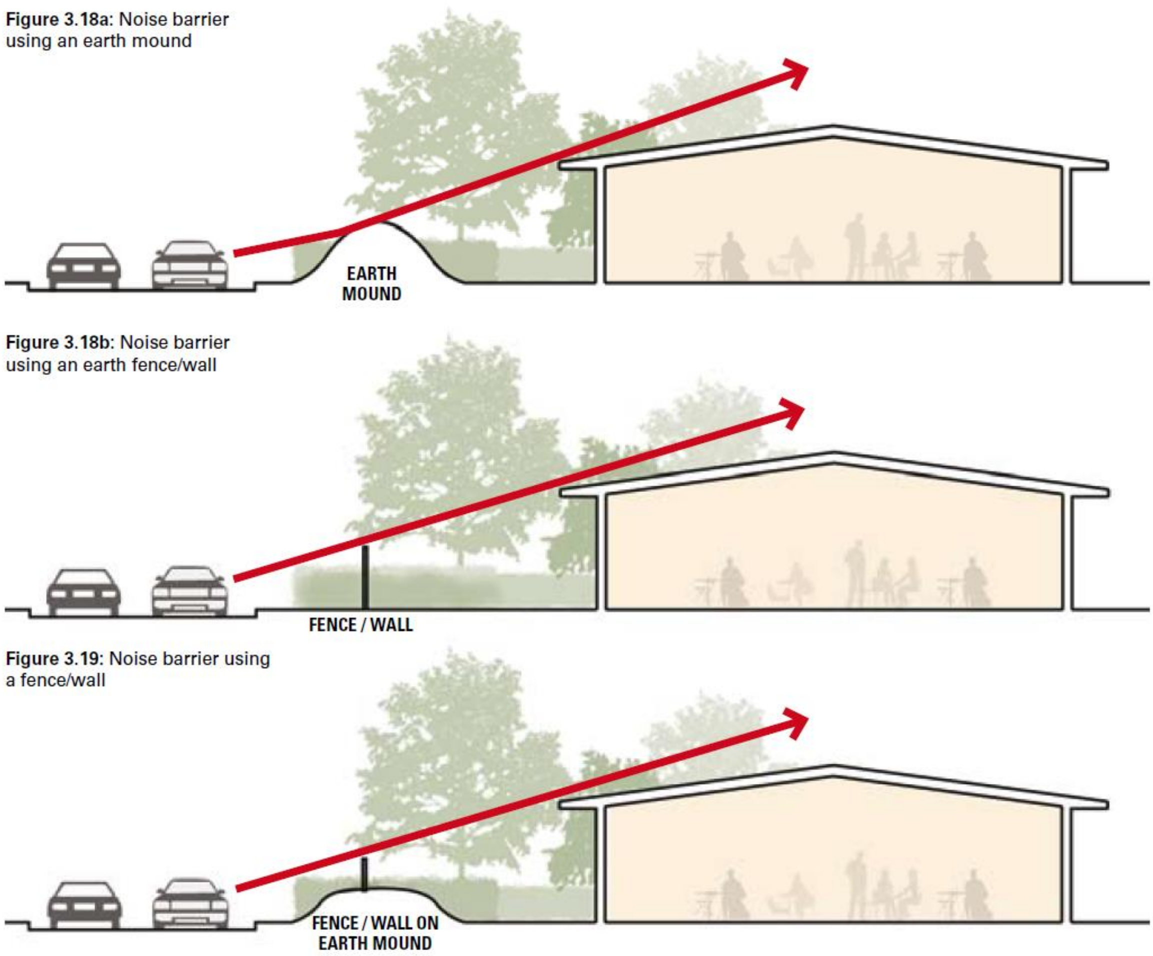
Night-time Road Traffic Noise Levels
Double Storey Dwellings
No Noise Barrier

FIGURE 5

4.3 Noise Barriers

Noise barriers or earth mounds can be an effective way to reduce road noise impacts. Where space allows, raised earth mounds can also be used as noise barriers and can be enhanced by placing a low wall on top. These methods are shown below **Figure 6**.

Figure 6 Noise Barrier and Mounds



Note: Taken from DP&I *Development near Rail Corridors and Busy Roads – Interim Guideline*.

Whilst noise barriers can provide significant noise benefit they can also introduce a number of negative aspects, including access to property, aesthetic impacts, daylight access, overshadowing, drainage, graffiti, restriction of line-of-sight, maintenance access and safety concerns.

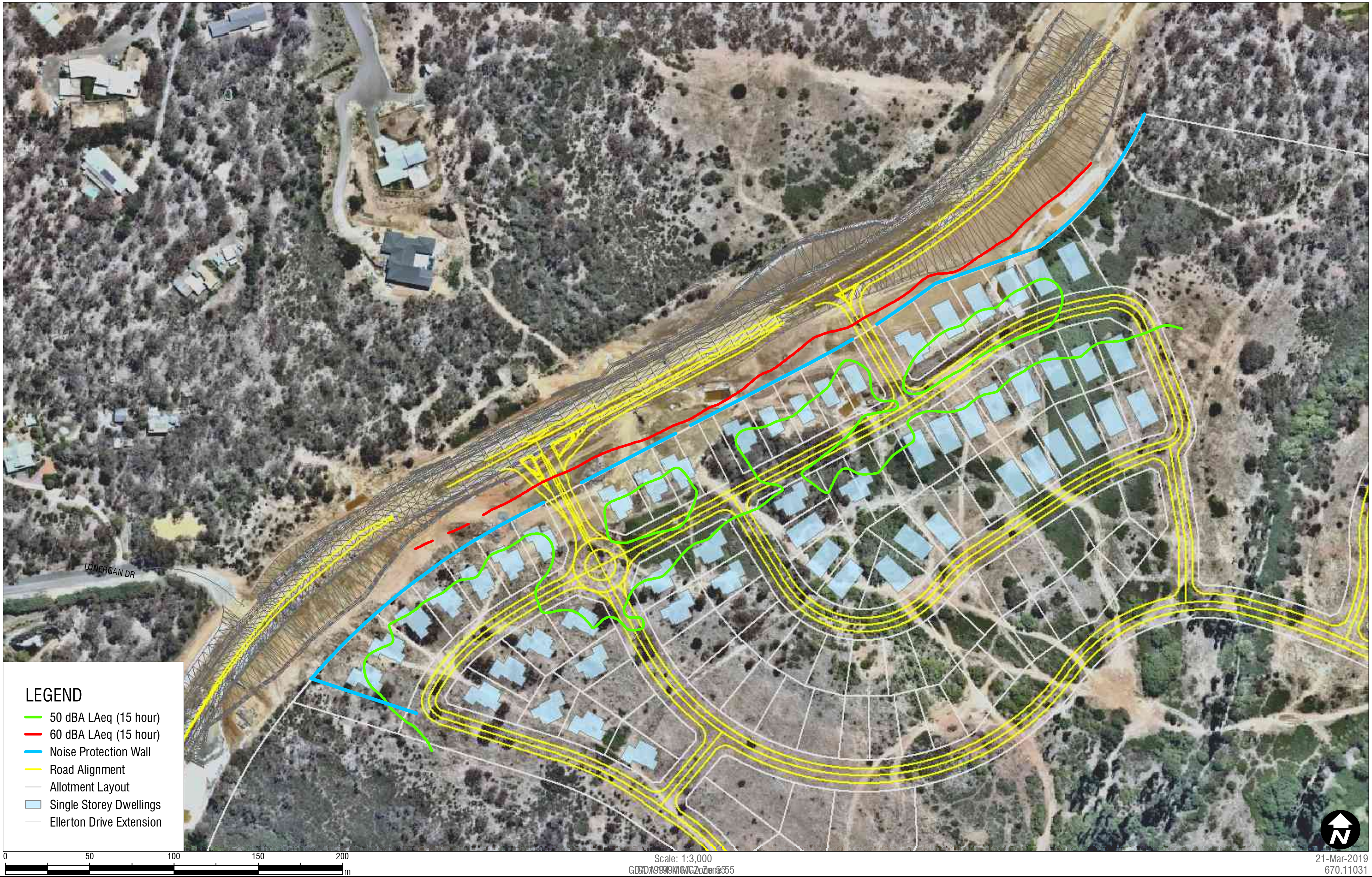
Noise barriers are most commonly used next to major motorways and are less common on arterial roads or on roads where access is required to be maintained.

4.3.1 Noise Barriers – Boundary Location

Noise barriers of 2.4 m in height located to the rear of the allotments have been incorporated into the model. The predicted daytime noise levels for single and two-storey dwellings have been shown in **Figure 7** and **Figure 8** respectively, together with the locations where noise barriers on property boundaries have been considered.

It can be seen by comparing the noise contours shown in the "no noise barrier" figures, that a 2.4 m high noise barrier would have negligible noise reduction effect. This is due to the topography of the project site which is generally much lower than the height of the Ellerton Drive Extension.

An investigation into higher noise barriers indicated that a barrier height of 4 m still had negligible noise reduction effect. Therefore, it is reasonable to conclude that the use of noise barriers on property boundaries would not be feasible.



\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\670-CAN\670.11031 Jumping Creek RTNA\SLR 670.11031 F06 Single Day 2400mm Boundary Barrier_02.mxd

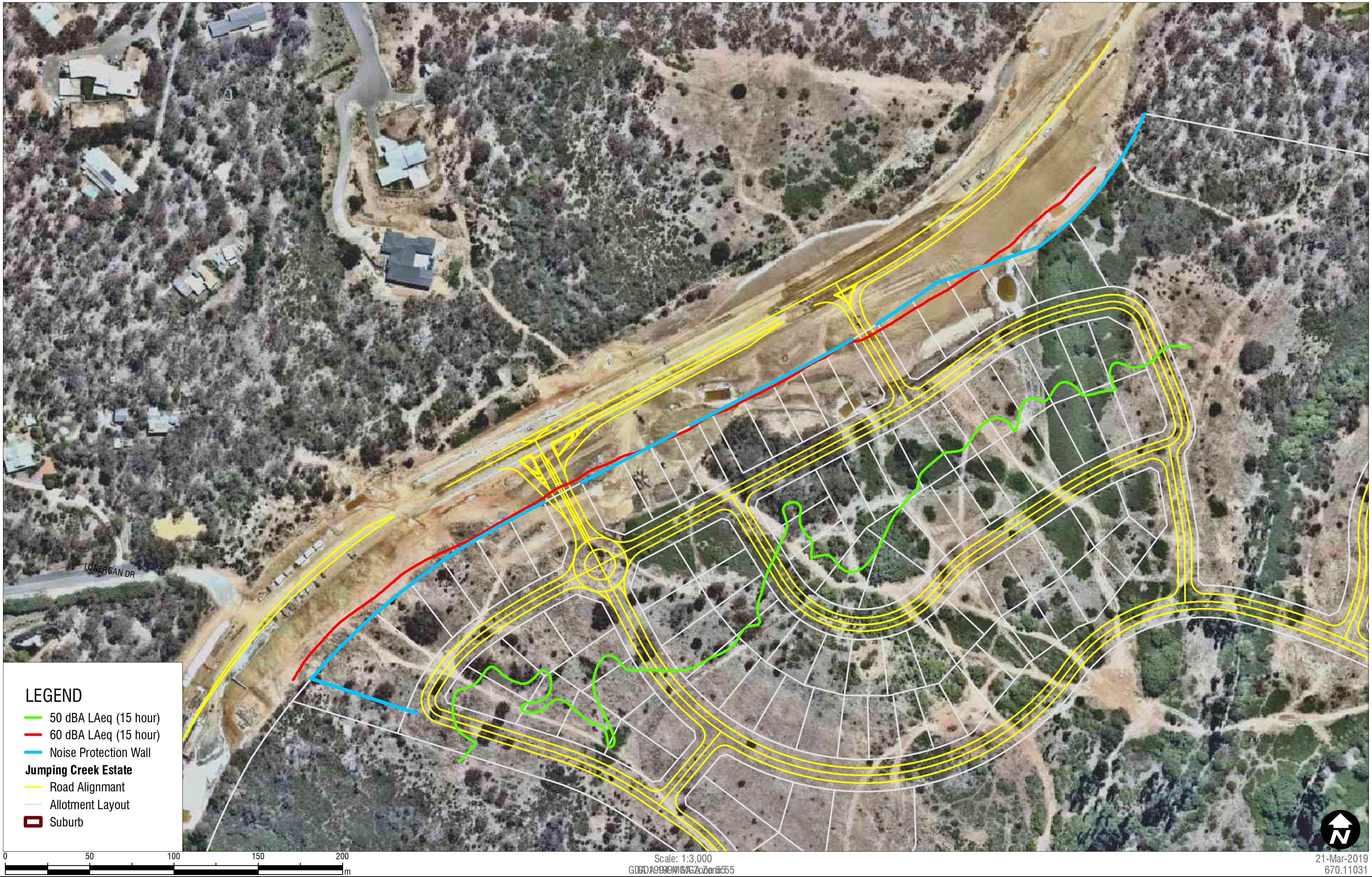
Sheet Size : A4

SLR

www.slrconsulting.com

Daytime Road Traffic Noise Levels
Single Storey Dwellings
2400mm Boundary Barrier

FIGURE 7



\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\670-CAN\670.11031 Jumping Creek RTNA\SLR 670.11031 F07 Double Day 2400mm Boundary Barrier_02.mxd

Sheet Size : A4

SLR

www.slrconsulting.com

Daytime Road Traffic Noise Levels
Double Storey Dwellings
2400mm Boundary Barrier

FIGURE 8

4.3.2 Noise Barriers within the Road Reservation

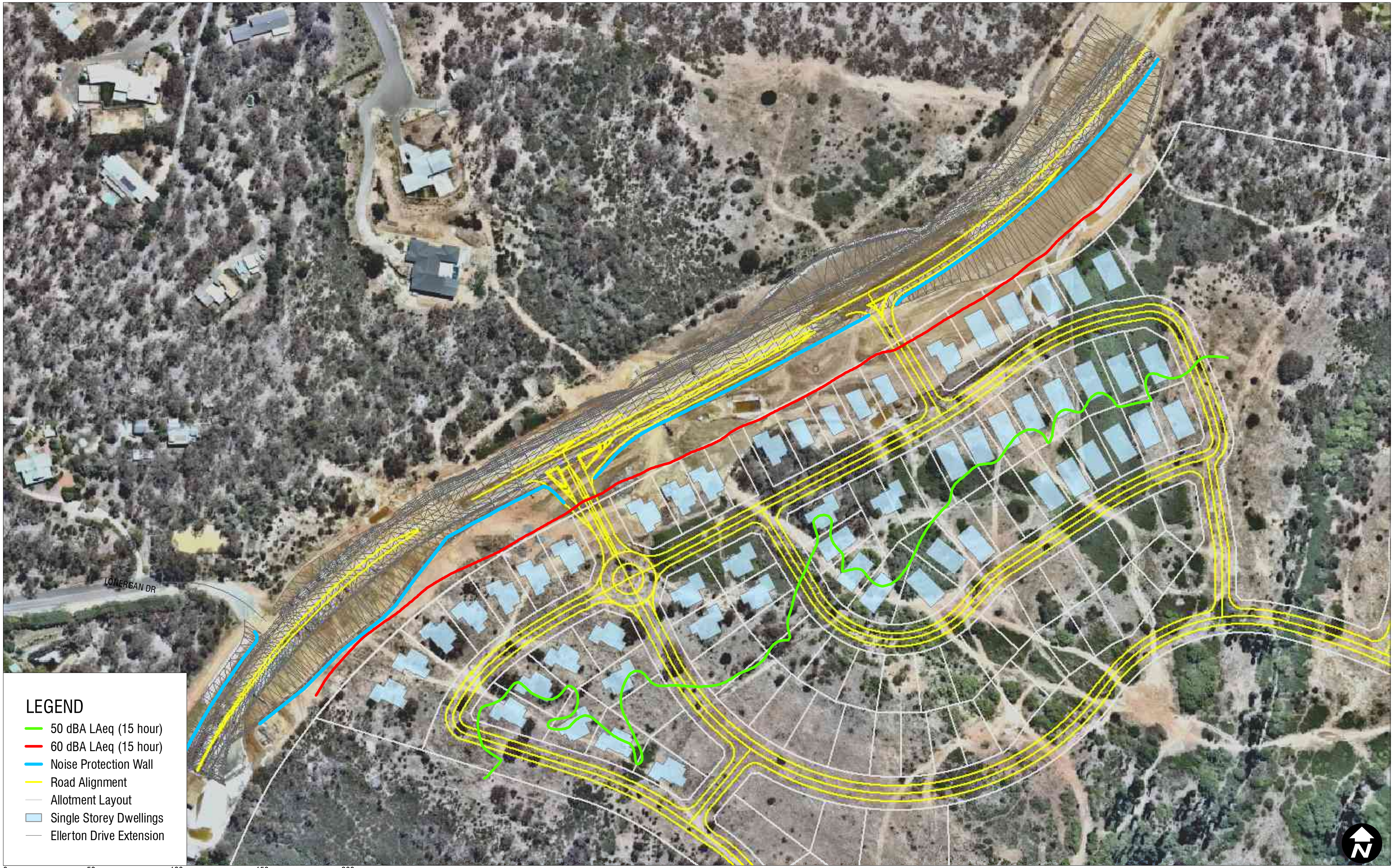
Noise barriers are generally more effective when located close to the noise source. Consequently, noise reduction effect of placing a noise barrier within the Ellerton Drive Extension road reservation has been investigated.

It is acknowledged that a location within the road reservation would require consultation with the QPRC.

The predicted daytime noise levels for single and two-storey dwellings have been shown in **Figure 9** and **Figure 10** respectively, together with the roadside locations of the noise barrier considered.

The figures show that a roadside barrier reduces road traffic noise intrusion onto the Project site significantly, relative to the no barrier and boundary barrier scenarios. The "noise-affected" allotments would be limited to those in the southwest corner of the site where the Ellerton Drive Extension passes through cutting.

Details of suitable the construction of a noise barrier has been shown in **Appendix B**.



0 50 100 150 200 m

Scale: 1:3,000
GDA1994 MGA Zone 55

21-Mar-2019
670.11031

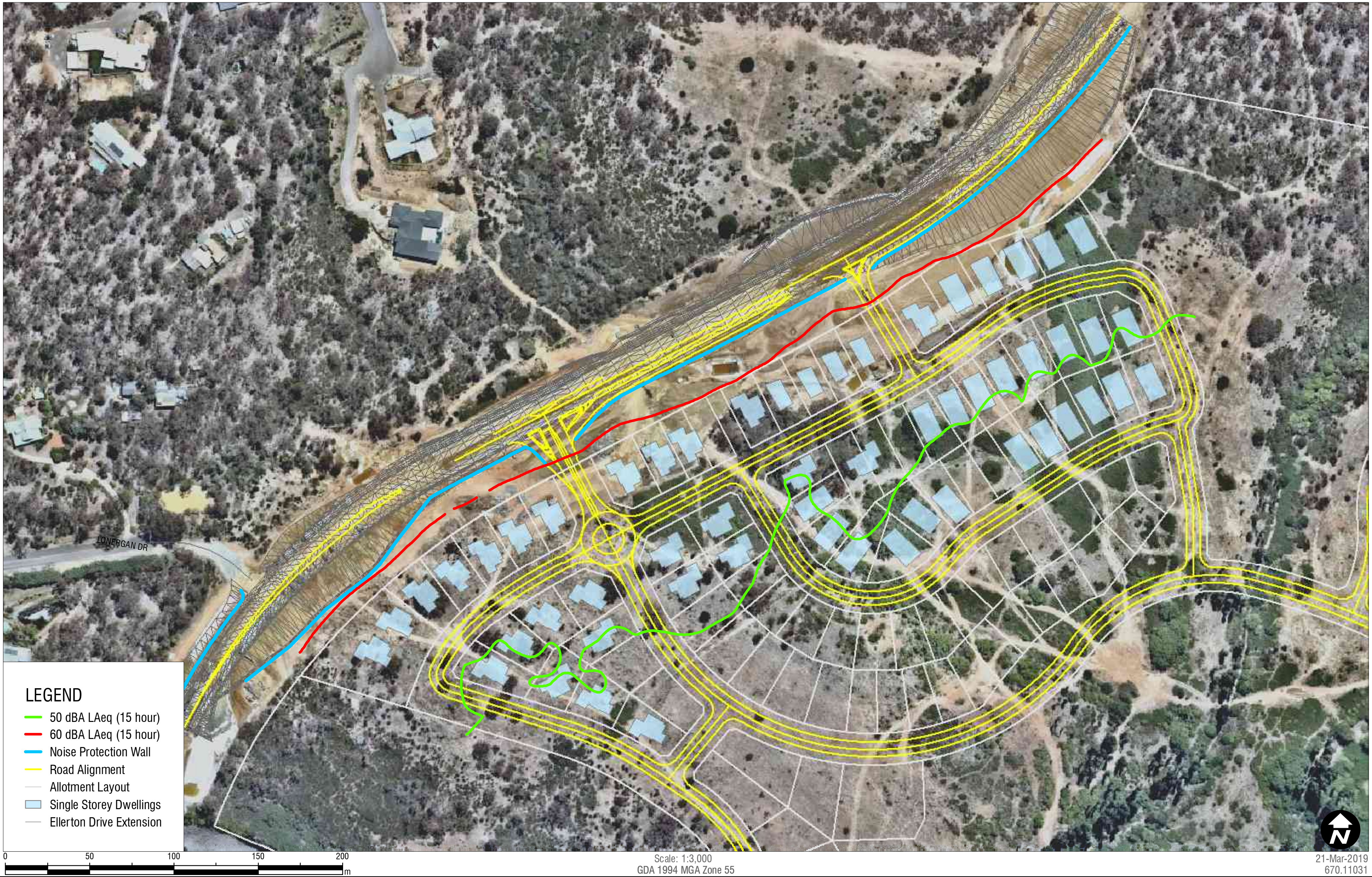
\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\610-CAN\670.11031 Jumping Creek RTNA\SLR 670.11031 F08 Single Day 2000mm Roadside Barrier_02.mxd

Daytime Road Traffic Noise Levels
Single Storey Dwellings
2000mm Roadside Barrier

FIGURE 9

Sheet Size : A4

SLR
www.slrconsulting.com



\\au.slr.local\Corporate\Projects-SLR\610-SrvSYD\670-CAN\670.11031 Jumping Creek RTNA\SLR 670.11031 F10 Double Day 2000mm Roadside Barrier_02.mxd

Sheet Size : A4

SLR
www.slrconsulting.com

Daytime Road Traffic Noise Levels
Double Storey Dwellings
2000mm Roadside Barrier

FIGURE 10

5 Building Constructions – Facade Insulation

The precise acoustic treatments required to achieve the internal SEPP criteria would be determined when the design of future dwellings become known. There are several factors that influence the extent of any acoustic treatments, including:

- The road traffic noise level adjacent to the facade. This may be affected by:
  - screening from other dwellings or other significant structures
  - the distance between the facade and the noise source
  - the orientation of the dwelling relative to the noise source.
- The internal layout of the dwelling, ie noise-sensitive occupancies may be located away from the side of the dwelling most exposed to the noise source.
- The construction materials of the dwelling.
- The size/area of glazed elements relative to the acoustically 'stronger' elements.

However, based on the predicted noise levels at the Project site – less than 60 dBA $L_{Aeq(15hour)}$ – a maximum noise reduction of up to 20 dBA would be required for any dwelling facade on any allotment.

That level of reduction would not be considered onerous and, assuming a typical residential dwelling design, would be achieved using standard constructions with proprietary glazing including those described as Category 1 "deemed-to-satisfy" constructions within the DoP Guideline.

The building constructions for those categories are described in **Table 3**.

Table 3 Category 1: 'Deemed-to-Comply' Constructions

Facade Element	Minimum Sound Insulation, R_w	Construction
Windows/Sliding Doors	24	Openable with minimum 4 mm monolithic glass and standard weather seals
External Walls	38	Timber frame or cladding: 6 mm fibre cement sheeting or weatherboards or plank cladding externally, 90 mm deep timber stud or 92 mm metal stud, 13 mm standard plasterboard internally. Brick veneer: 110 mm brick, 90 mm timber stud or 92 mm metal stud, minimum 50 mm clearance between masonry and stud frame, 10 mm standard plasterboard internally. Double brick cavity: 2 leaves of 110 mm brickwork separated by 50 mm gap.
Roof/Ceiling	40	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10 mm plasterboard ceiling fixed to ceiling joists, R1.5 insulation batts in roof cavity.
Entry Door[1]	28	35 mm solid core timber door fitted with full perimeter acoustic seals.
Floor	29	1 layer of 19 mm structural floor boards, timber joist on piers. OR Concrete slab floor on ground.

1. For dwellings at the Project site, acoustic seals would only be required where the entry door faces the Ellerton Drive Extension.

These constructions are a 'deemed to comply' design and no further assessment is required where they are used, however, confirmation of equivalent sound insulation performance of the alternative treatments must be obtained from the supplier/manufacturer or suitably qualified person.

The constructions apply to the entire building and not just the exposed facade/s. A detailed assessment, provided by a suitably qualified acoustic engineer, having consideration for the factors described above may result in less acoustic treatment than would the 'deemed-to-comply' constructions.

Mechanical ventilation that is compliant with Australian Standard 1668.2-2012 "*The use of ventilation and airconditioning in buildings - Mechanical ventilation in buildings*" (AS 1668) would be required to enable occupants to maintain closed windows/doors.

Although glazing must be closed to achieve the indoor noise objectives, this does not preclude the use of natural ventilation. Where natural ventilation is to be provided, the ventilation opening must however be selected such that the overall composite sound insulation of the facade is not compromised.

6 Aircraft Noise

In relation to Aircraft Noise, the *Queanbeyan Local Environmental Plan 2012* (Part 7 Clause 7.7) (LEP) states:

7.7 Development in areas subject to aircraft noise

(1) The objectives of this clause are as follows:

(a) to prevent certain noise sensitive developments from being located near the Canberra Airport and its flight paths,

(b) to assist in minimising the impact of aircraft noise from that airport and its flight paths by requiring appropriate noise attenuation measures in noise sensitive buildings,

(c) to ensure that land use and development in the vicinity of that airport do not hinder or have any other adverse impacts on the ongoing safe and efficient operation of that airport.

(2) This clause applies to development that:

(a) is on land that:

(i) is near the Canberra Airport, and

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

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

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

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

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

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

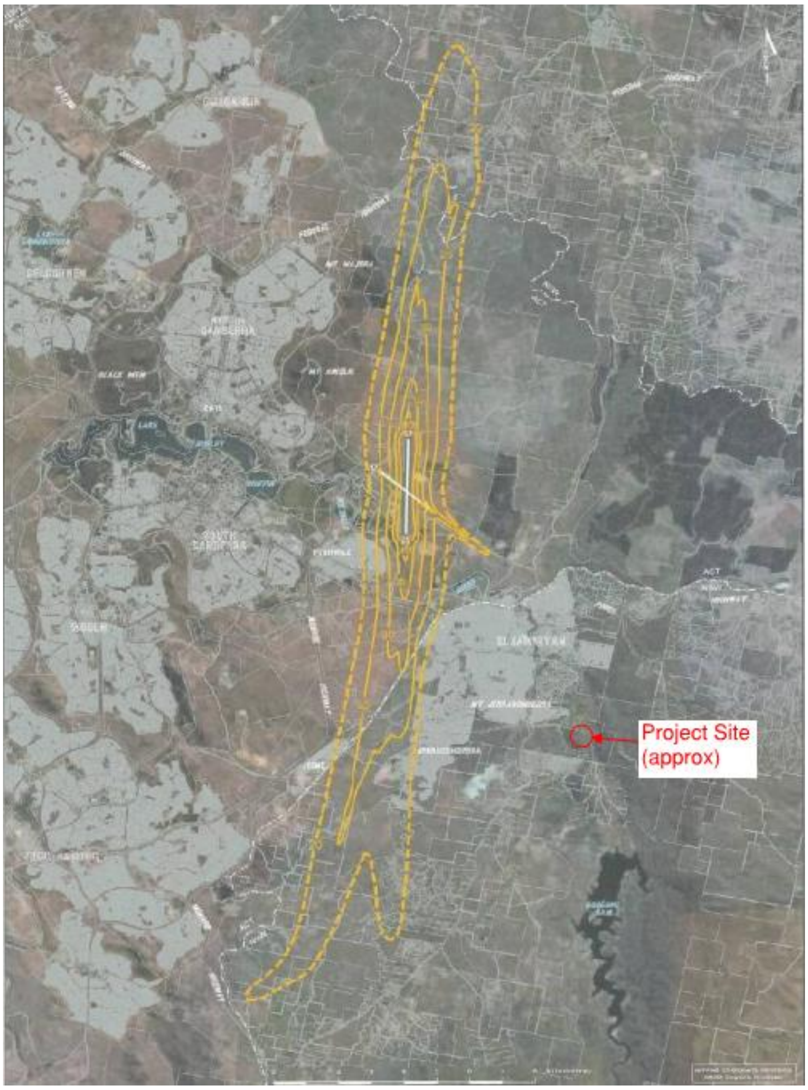
(4) In this clause:

ANEF contour means a noise exposure contour shown as an ANEF contour on the Noise Exposure Forecast Contour Map for the Canberra Airport prepared by the Department of the Commonwealth responsible for airports.

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

The location of the Project site relative to the Canberra Airport and its ultimate ANEF noise contours as endorsed by Airservices Australia is shown in **Figure 11**.

Figure 11 Canberra Airport Ultimate ANEF noise contours



Source: Canberra Airport 2014 Master Plan (p238)

It can be seen in **Figure 11** that the Project site will be well outside the lowest (20) ANEF contour. Consequently, Clause 7.7 of the LEP would not apply to the Project site and there will be no requirement for the Project or future occupants to further consider noise from the Canberra Airport.

7 Conclusion

SLR has undertaken a road traffic noise assessment for a proposed residential estate development at Lot 5 DP 1199045.

The assessment involved predicting noise from vehicles on the future Ellerton Drive Extension (currently under construction) and comparing the traffic noise levels with external noise threshold levels based on internal noise criteria described in the *Development near Rail Corridors and Busy Roads – Interim Guideline* and its referral policy, Regulation Clause 102 of the *State Environment Planning Policy (Infrastructure) 2007*.

Predictions of traffic noise were made using traffic volumes for the year 2031.

The assessment found that allotments which are next to Ellerton Drive are likely to be “noise affected” due to road traffic noise impacts

An investigation of the noise reduction effects of noise barriers indicated the following:

- Barriers located on the property boundaries would not reduce noise intrusion into the development site.
- A 2 m high noise barrier located adjacent to the Ellerton Drive Extension alignment within the road reservation would reduce noise intrusion into the development site and subsequently the number of noise-affected allotments.

In relation to achieving the internal traffic noise criteria, specific acoustic treatments would not be required for any conventionally-constructed dwelling on any allotment, other than closed windows to habitable rooms for a small number of allotments, which subsequently impacts on ventilation requirements to those rooms.

Precise building constructions can be determined by way of a specific road traffic noise intrusion assessment or it would be acceptable to use the Category 1 “deemed-to-satisfy” constructions based on the DoP Guideline are presented in **Table 3**.

A road traffic noise intrusion assessment, incorporating noise reduction due to screening from houses/fences etc, may result in less onerous building constructions relative to the “deemed-to-satisfy” constructions, but can only be undertaken when building construction details (location, orientation, layout and window sizes) are known.

The Project site will not be subject to aircraft noise as defined in the *Queanbeyan Local Environmental Plan 2012* (Part 7 Clause 7.7).

APPENDIX A

Acoustic Terminology

1 Sound Level or Noise Level

The terms "sound" and "noise" are almost interchangeable, except that in common usage "noise" often refers to unwanted sound.

Sound/noise consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio logarithmically to a more manageable size.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 "A" Weighted Sound Pressure Level

Sound pressure is not sensed equally by the human ear at all frequencies. The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter having a frequency response corresponding to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud, although the perceived loudness can also be affected by the character of the sound (eg the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level).

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels:

Sound Pressure Level (dBA)	Noise Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

3 Free Field and Facade Reflections

"Free field" describes a microphone position where there are no reflecting surfaces, other than the ground, close enough to influence the sound pressure level. A position at least 4 m from the closest vertical surface, eg a building facade, is considered free field.

A microphone position closer than 4 m to a reflective surface may be affected by reflected noise. It is common to consider reflected noise by adjusting a predicted noise level by +2.5 dBA to account for the facade that will be there in the future, particularly in the context of a road traffic noise assessment.

4 Steady State and Time-varying Noise

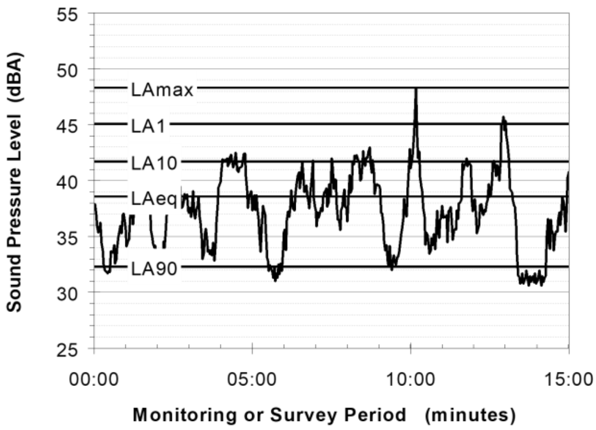
Noise whose average characteristics remain relatively constant or do not vary over time are referred to as steady-state noise, eg noise from an airconditioner.

Time-varying noise describes noise that fluctuates in level over time, eg road traffic noise.

5 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the period, L_{A10} the noise exceeded for 10% of the period, etc.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

- L_{A1} The noise level exceeded for 1% of the 15 minute interval, commonly used for the assessment of short-term noise events. It is often similar in value to the L_{Amax} level.
- L_{A10} The noise level exceeded for 10% of the 15 minute interval. This may be referred to as the average maximum noise level and is often used in the context of road traffic noise.
- L_{Aeq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.
- $L_{Aeq(T)}$ The L_{Aeq} evaluated over a time period, T.
- L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- L_{Amax} The "maximum noise level" for an event, commonly used in the assessment of potential sleep disturbance during night-time periods.
- $L_{Ax,adj,T}$ The average of the L_{Ax} noise levels (eg L_{A90}, L_{A1}) during time period T adjusted for tonality and impulsiveness.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the "repeatable minimum" L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or "average" levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

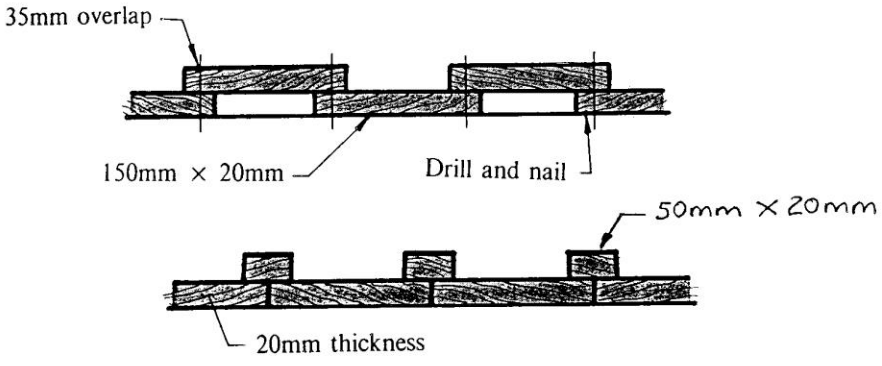
APPENDIX B

Acoustic Fence Construction

Acoustic fences can be made from any material (eg concrete, cement sheeting, timber, acrylic sheeting, glass, Colourbond metal sheeting) provided the panels have an overall surface weight of at least 15 kg/m^2.

Also, there must be no gaps between individual panels, and no gaps where the panels meet the ground.

The minimum construction requirements for a typical noise-reducing fence (timber paling) have been shown below.



Two methods of constructing a solid timber fence.

ASIA PACIFIC OFFICES

BRISBANE
Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CANBERRA
GPO Box 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
5 Foelsche Street
Darwin NT 0800
Australia
T: +61 8 8998 0100
F: +61 2 9427 8200

GOLD COAST
Ground Floor, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Suite 2, 2 Domville Avenue
Hawthorn VIC 3122
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

ROCKHAMPTON
rockhampton@slrconsulting.com
M: +61 407 810 417

SYDNEY
2 Lincoln Street
Lane Cove NSW 2066
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TAMWORTH
PO Box 11034
Tamworth NSW 2340
Australia
M: +61 408 474 248
F: +61 2 9427 8200

TOWNSVILLE
Level 1, 514 Sturt Street
Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

AUCKLAND
68 Beach Road
Auckland 1010
New Zealand
T: +64 27 441 7849

NELSON
5 Duncan Street
Port Nelson 7010
New Zealand
T: +64 274 898 628

NEW PLYMOUTH
Level 2, 10 Devon Street East
New Plymouth 4310
New Zealand
T: +64 0800 757 695