Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:
HERRING STORER ACOUSTICS
Suite 34, 11 Preston Street, Como, W.A. 6152
P.O. Box 219, Como, W.A. 6952
Telephone: (08) 9367 6200
Facsimile: (08) 9474 2579
Email: hsa@hsacoustics.com.au

ABN DEVELOPMENTS

PROPOSED SUBDIVISION
LOTS 1, 200 & 300 WANNEROO ROAD
WOODVALE

ACOUSTIC ASSESSMENT

OCTOBER 2010

OUR REFERENCE: 11896-9-10066

DOCUMENT CONTROL PAGE

ACOUSTIC ASSESSMENT
LOTS 1, 200 & 300 WANNEROO ROAD
WOODVALE

Job No: 10066

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FOR

ABN DEVELOPMENTS

DOCUMENT INFORMATION			
Author:	**George Watts**	**Checked By:**	**Tim Reynolds**
Date of Issue :	**5 July 2010**		

REVISION HISTORY

Revision	Description	Date	Author	Checked
1	Incorporating Internal Subdivision Design	16/6/2010	GW	TR
2	Incorporating ABN Comments	5/7/2010	GW	TR
3	Incorporating ABN Comments	12/8/2010	GW	TR
4	Incorporating ABN Comments	26/9/2010	GW	TR
5	Incorporating ABN Comments	13/10/2010	GW	TR
6	Incorporating ABN Comments	25/10/2010	PLD	TR
7	Wall Height Change	28/10/2010	PLD	TR
8	Finalisation of Report	10/01/2010	GW	GW

DOCUMENT DISTRIBUTION

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1	6	ABN Developments		✓
1	7	ABN Developments		✓
1	8	ABN Developments		✓
1	9	ABN Developments		✓

CONTENTS

APPENDICIES

1. INTRODUCTION

Herring Storer Acoustics was commissioned by ABN Developments to undertake an acoustical assessment of noise that would be received at the proposed residential sub division location at Lots 1, 200 and 300 Wanneroo Road, Woodvale. As part of the study, the following was carried out:

- Noise monitoring of existing noise levels associated with Wanneroo Road.
- Determination of noise levels associated with future traffic flows.
- Assess the predicted noise levels for compliance with the appropriate criteria.
- If exceedances are predicted, comment on possible noise amelioration options for compliance with the appropriate criteria.

For information, a locality plan is attached in Appendix A.

2. SUMMARY

The results of the acoustic assessment indicate that noise received at the ground floor level of residences located adjacent to Wanneroo Road exceed the “Limit” criteria.

Following discussions with both council and ABN developments, it is recommended that a 1.8 metre high wall be constructed in the locations shown in Appendix A.

With the implementation of the 1.8 metre high wall, noise received at the ground floor of the residences complies with the “Limit” level, with the exception of Lots 44, 45, 46, 47, 68, 69, 70 and 71. Therefore, to achieve compliance at these lots, in conjunction with the construction of the 1.8 metre wall, the following noise control advice is recommended;

- Outdoor areas for these lots be located on the opposite side of the residence to Wanneroo Road. This will ensure the outdoor area complies with the “Limit” level.
- The façade of the residences facing Wanneroo Road will require upgrading to ensure internal areas meet the requirements of AS2107:2000. Appendix G contains details to these specific internal areas, with Appendix F providing general advice as to “Quiet House Designs”.
- Notification on the title of these lots as per the WAPC requirements for residence constructed between the noise “limit” and “target” levels.
- An acoustic consultants report accompanies any variation to the measures listed in Appendix G. It is noted that the design requirements listed in Appendix G are applicable to the Lots listed above and any facades above ground level exposed to Wanneroo Road.

It is understood that it is impractical to relocate the outdoor area of the proposed development at Lots 71 such that they do not abut Wanneroo Road. Two of the four residences on these lots are understood to include a roof structure to the outdoor area. This structure will provide sufficient amelioration to reduce noise levels to comply with the “Limit” level. It is recommended that the balance of the residences on these lots be constructed in a similar manner. It is noted that only the facade fronting Wanneroo Road requires the upgraded construction.

Note: The noise amelioration as outlined in Appendix G is only required to the first row of residences, as these houses provide an adequate barrier between the road and the other residences.

3. CRITERIA

The Western Australian Planning Commission (WAPC) released on 22 September 2009 State Planning Policy 5.4 "Road and Rail Transport Noise and Freight Considerations In Land Use Planning". Section 5.3 – Noise Criteria, which outlines the acoustic criteria, states:

"5.3 - NOISE CRITERIA

Table 1 sets out the outdoor noise criteria that apply to proposals for new noise-sensitive development or new major roads and railways assessed under this policy.

These criteria do not apply to—

- *proposals for redevelopment of existing major roads or railways, which are dealt with by a separate approach as described in section 5.4.1; and*
- *proposals for new freight handling facilities, for which a separate approach is described in section 5.4.2.*

The outdoor noise criteria set out in Table 1 apply to the emission of road and rail transport noise as received at a noise-sensitive land use. These noise levels apply at the following locations—

- *for new road or rail infrastructure proposals, at 1 m from the most exposed, habitable façade of the building receiving the noise, at ground floor level only; and*
- *for new noise-sensitive development proposals, at 1 m from the most exposed, habitable façade of the proposed building, at each floor level, and within at least one outdoor living area on each residential lot.*

Further information is provided in the guidelines.

Table 1: Outdoor Noise Criteria

Time of day	***Noise Target***	***Noise Limit***
Day (6 am–10 pm)	$L_{Aeq(Day)}$ *= 55 dB(A)*	$L_{Aeq(Day)}$ *= 60 dB(A)*
Night (10 pm–6 am)	$L_{Aeq(Night)}$ *= 50 dB(A)*	$L_{Aeq(Night)}$ *= 55 dB(A)*

The 5 dB difference between the outdoor noise target and the outdoor noise limit, as prescribed in Table 1, represents an acceptable margin for compliance. In most situations in which either the noise-sensitive land use or the major road or railway already exists, it should be practicable to achieve outdoor noise levels within this acceptable margin. In relation to greenfield sites, however, there is an expectation that the design of the proposal will be consistent with the target ultimately being achieved.

Because the range of noise amelioration measures available for implementation is dependent upon the type of proposal being considered, the application of the noise criteria will vary slightly for each different type. Policy interpretation of the criteria for each type of proposal is outlined in sections 5.3.1 and 5.3.2.

The noise criteria were developed after consideration of road and rail transport noise criteria in Australia and overseas, and after a series of case studies to assess whether the levels were practicable. The noise criteria take into account the considerable body of research into the effects of noise on humans, particularly community annoyance, sleep disturbance, long-term effects on cardiovascular health, effects on children's learning performance, and impacts on vulnerable groups such as children and the elderly. Reference is made to the World Health Organization (WHO) recommendations for noise policies in their publications on community noise and the Night Noise Guidelines for Europe. See the policy guidelines for suggested further reading.

5.3.1 Interpretation and application for noise-sensitive development proposals

In the application of these outdoor noise criteria to new noise-sensitive developments, the objective of this policy is to achieve –

- *acceptable indoor noise levels in noise-sensitive areas (for example, bedrooms and living rooms of houses, and school classrooms); and*
- *a reasonable degree of acoustic amenity in at least one outdoor living area on each residential lot[1].*

If a noise-sensitive development takes place in an area where outdoor noise levels will meet the noise target, no further measures are required under this policy.

In areas where the noise target is likely to be exceeded, but noise levels are likely to be within the 5dB margin, mitigation measures should be implemented by the developer with a view to achieving the target levels in a least one outdoor living area on each residential lot[1]. Where indoor spaces are planned to be facing any outdoor area in the margin, noise mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces. In this case, compliance with this policy can be achieved for residential buildings through implementation of the deemed-to-comply measures detailed in the guidelines.

In areas where the outdoor noise limit is likely to be exceeded (i.e. above $L_{Aeq(Day)}$ of 60 dB(A) or $L_{Aeq(Night)}$ of 55 dB(A)), a detailed noise assessment in accordance with the guidelines should be undertaken by the developer. Customised noise mitigation measures should be implemented with a view to achieving the noise target in at least one outdoor living or recreation area on each noise-sensitive lot or, if this is not practicable, within the margin. Where indoor spaces will face outdoor areas that are above the noise limit, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces, as specified in the following paragraphs.

1 For non residential noise-sensitive developments, (e.g. schools and child care centres) consideration should be given to providing a suitable outdoor area that achieves the noise target, where this is appropriate to the type of use.

For residential buildings, acceptable indoor noise levels are $L_{Aeq(Day)}$ of 40 dB(A) in living and work areas and $L_{Aeq(Night)}$ of 35 dB(A) in bedrooms[2]. For all other noise-sensitive buildings, acceptable indoor noise levels under this policy comprise noise levels that meet the recommended design sound levels in Table 1 of Australian Standard AS 2107:2000 Acoustics—Recommended design sound levels and reverberation times for building interiors.

These requirements also apply in the case of new noise-sensitive developments in the vicinity of a major transport corridor where there is no existing railway or major road (bearing in mind the policy's 15-20 year planning horizon). In these instances, the developer should engage in dialogue with the relevant infrastructure provider to develop a noise management plan to ascertain individual responsibilities, cost sharing arrangements and construction time frame.

If the policy objectives for noise-sensitive developments are not achievable, best practicable measures should be implemented, having regard to section 5.8 and the guidelines."

The Policy, under Section 5.7, also provides the following information regarding "Notifications on Titles":

"5.7 - NOTIFICATION ON TITLE

If the measures outlined previously cannot practicably achieve the target noise levels for new noise-sensitive developments, this should be notified on the certificate of title.

Notifications on certificates of title and/or advice to prospective purchasers advising of the potential for noise impacts from major road and rail corridors can be effective in warning people who are sensitive to the potential impacts of transport noise. Such advice can also bring to the attention of prospective developers the need to reduce the impact of noise through sensitive design and construction of buildings and the location of outdoor living areas.

The notification is to ensure that prospective purchasers are advised of –

- *the potential for transport noise impacts; and*
- *the potential for quiet house design requirements to minimise noise intrusion through house layout and noise insulation (see the guidelines).*

Notification should be provided to prospective purchasers and be required as a condition of subdivision (including strata subdivision) for the purposes of noise-sensitive development as well as planning approval involving noise-sensitive development, where noise levels are forecast or estimated to exceed the target outdoor noise criteria, regardless of proposed noise attenuation measures. The requirement for notification as a condition of subdivision and the land area over which the notification requirement applies, should be identified in the noise management plan in accordance with the guidelines.

An example of a standard form of wording for notifications is presented in the guidelines."

2 For residential buildings, indoor noise levels are not set for utility spaces such as bathrooms. This policy encourages effective "quiet house" design, which positions these non-sensitive spaces to shield the more sensitive spaces from transport noise (see guidelines for further information).

4. NOISE MONITORING

To determine the existing noise received with the development associated with Wanneroo Road, an automatic noise data logger was located within the development. The results of the adjusted noise data logging are shown in Table 4.1. The data used was adjusted in accordance with the Main Roads Traffic Noise Measurement Specification Revision 5. Weather conditions stipulated in the specification have generally been met for the monitoring period. Weather conditions were provided by the Bureau of Meteorology.

TABLE 4.1 – MEASURED $L_{10,18\ hour}$, $L_{Aeq,16\ hour\ (DAY)}$ and $L_{Aeq,8\ hour\ (NIGHT)}$

Date	Parameter / Noise Level (dB(A))		
	$L_{10,18\ hour}$	$L_{Aeq,16\ hour}$ Day	$L_{Aeq,8\ hour}$ Night
20/4/2010	62.6	60.9	54.2
21/4/2010	62.2	60.3	54.3
22/4/2010	62.7	60.6	53.5
23/4/2010	62.9	60.6	55.0
24/4/2010	62.2	59.8	53.3
Average	**62.5**	**60.4**	**54.1**

The difference between the $L_{10,18\ hour}$ and the $L_{Aeq,\ 16\ hour}$ and the $L_{10,18\ hour}$ and the $L_{Aeq,8\ hour}$ are approximately 2 and 8 dB(A) respectively.

The monitored noise levels are shown graphically in Appendix B.

The automatic noise data logger records statistical A weighted sound pressure levels, of which the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} values are reported. These parameters are defined as:

L_{A1} The noise level exceeded for 1% of the time (in this instance, the noise level exceeded for 36 seconds in each 1-hour period).

L_{A10} The noise level exceeded for 10% of the time (in this instance, the noise level exceeded for 6 minutes in each 1-hour period.

L_{Aeq} The equivalent continuous noise level for the 1-hour period (sometimes referred to as the average noise level).

L_{A90} The noise level exceeded for 90% of the time (in this instance, the noise level exceeded for 54 minutes in each 1-hour period).

5. MODELLING

To determine the noise received within the subdivision from Wanneroo Road, acoustic modelling was carried out using SoundPlan, using the Calculation of Road Traffic Noise (CoRTN) algorithms. Noise modelling was undertaken in accordance with the "Implementation Guidelines" for the State Planning Policy 5.4.

The input data for the model included:

- Ground contours as provided.
- Other traffic data as listed in Table 4.1.
- A +2.5 dB adjustment to allow for façade reflection.

Table 5.1 - Noise Modelling Input Data

Parameter	Value
Traffic flows as of 2007	35,000 vpd
Estimated Traffic flows for 2031	48,000 vpd
Heavy Vehicles (%)	7%
Other	
Speed (km/hr)	70
Receiver Level (m)	+1.5 above ground
Façade Correction	+ 2.5 dB(A)
Road Surface	Dense Graded Asphalt

We note that with the measured difference between the $L_{Aeq,8hr}$ and the $L_{Aeq,16hr}$ being 6 dB(A), achieving compliance with the day period criteria will also achieve compliance with the night period criteria.

Both single point and noise contour calculations were undertaken for the following scenarios:

A Acoustic input data as outlined above.
B As for scenario A, but with a 1.8 metre high noise wall and internal fencing design (assumed to be 1.8m high).

The results of the single point calculations are listed in Appendix C, with the noise contour plots for scenario A and B listed in Appendices D and E respectively.

It is noted that only the residential lots facing Wanneroo Road have been considered in our analysis. Noise levels at lots further from Wanneroo Road will be attenuated by the housing closer.

6. DISCUSSION / RECOMMENDATION

Under the WAPC State Planning Policy 5.4, the "Noise Limits" as listed in Table 1 are to be an $L_{Aeq(night)}$ of 55 dB(A) and an $L_{Aeq\ (day)}$ of 60 dB(A) are the appropriate criteria for this development.

Based on the noise monitoring on site, the difference between the $L_{Aeq(16hr)}$ and the $L_{Aeq(8hr)}$ is greater than 5 dB(A). Therefore, if compliance with the day period noise limit is achieved, then compliance with the night period noise limits would also be achieved.

The policy states that the outdoor criteria apply to the ground floor level only. The policy also states that noise mitigation measures should be implemented with a view to achieving the target levels in least one outdoor living area.

The results of the acoustic assessment indicate that noise received at the ground floor level of residences located adjacent to Wanneroo Road exceed the "Noise Limits" for both current and future traffic flows.

With the introduction of the noise walls indicated in Appendix A, noise levels are calculated to comply with the "Limit" criteria for outdoor areas with the exception of Lots 44, 45, 46, 47, 68, 69, 70 and 71.

It is recommended that the outdoor area for these affected lots be located such that the residence is between the area and Wanneroo Road. This will provide an outdoor area meeting the “Limit” level due to the barrier effect of the residence itself.

It is understood that it is impractical to relocate the outdoor area of the proposed development at Lots 71 such that they do not abut Wanneroo Road. Two of the four residences on these lots are understood to include a roof structure to the outdoor area. This structure will provide sufficient amelioration to reduce noise levels to comply with the “Limit” level. It is recommended that the balance of the residences of these lots be constructed similarly.

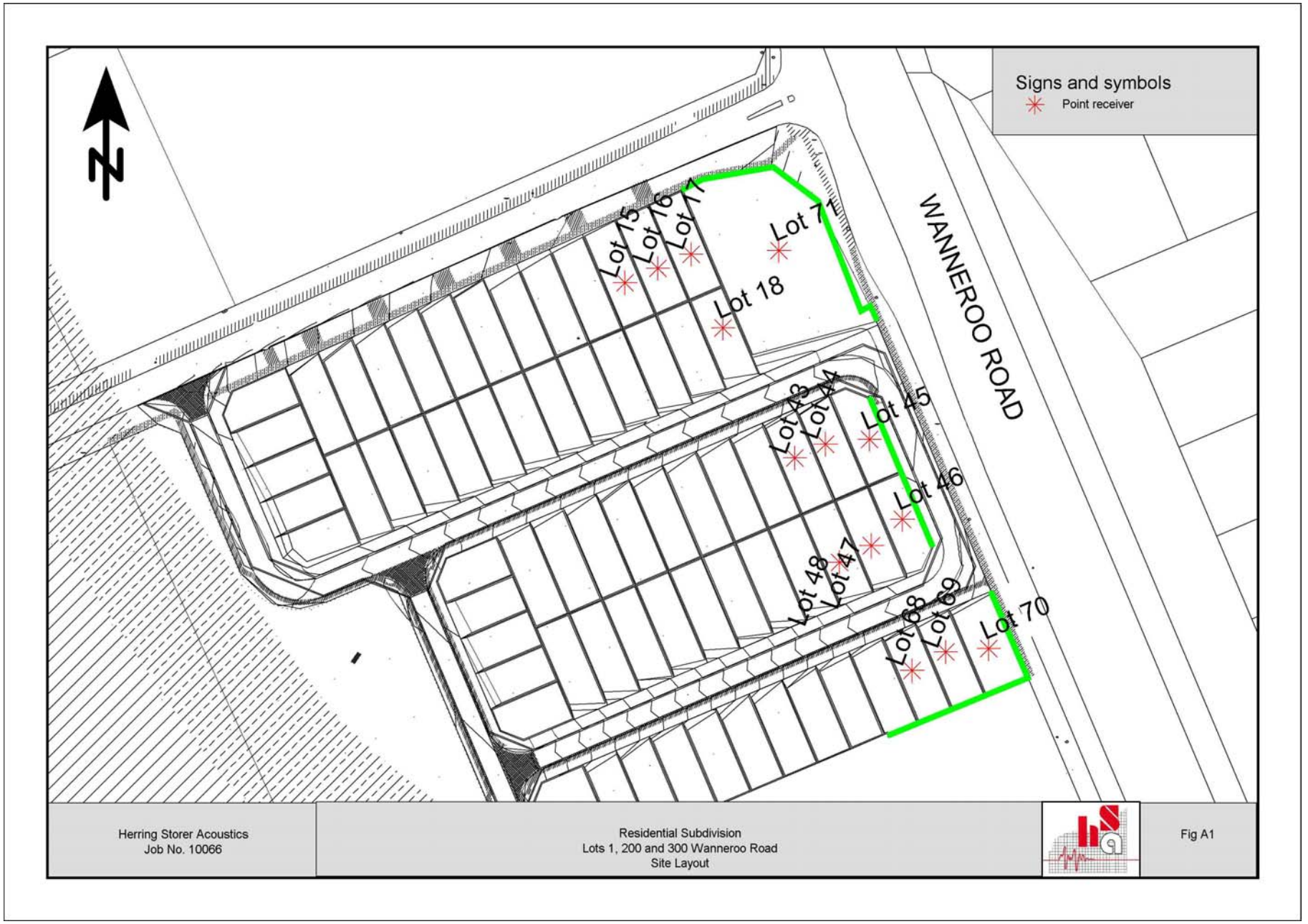
Quiet house design principles will need to be implemented for all affected lots for the façade facing Wanneroo Road and any facade exposed to Wanneroo Road above ground level. This would include locating bedrooms away from this façade and upgrading the construction. See Appendix F for general information on quiet house design and G for specific “deemed to satisfy” conditions. With the requirements of Appendix G implemented the quiet house design is considered to comply with the requirements, it is recommended that any variance to the measures listed be accompanied with an acoustic consultants report detailing the alternative measures.

We note that under the Planning Policy, as noise received within the proposed development would exceed the “Noise Target”, notification on the affected Titles is required. An example of an appropriate notice is given below:

> *“This property is situated in the vicinity of a transport corridor, and is currently affected, or may in the future be affected, by transport noise. Further information about transport noise, including development restrictions and noise insulation requirements for noise-affected property, are available on request from the relevant local government offices.”*

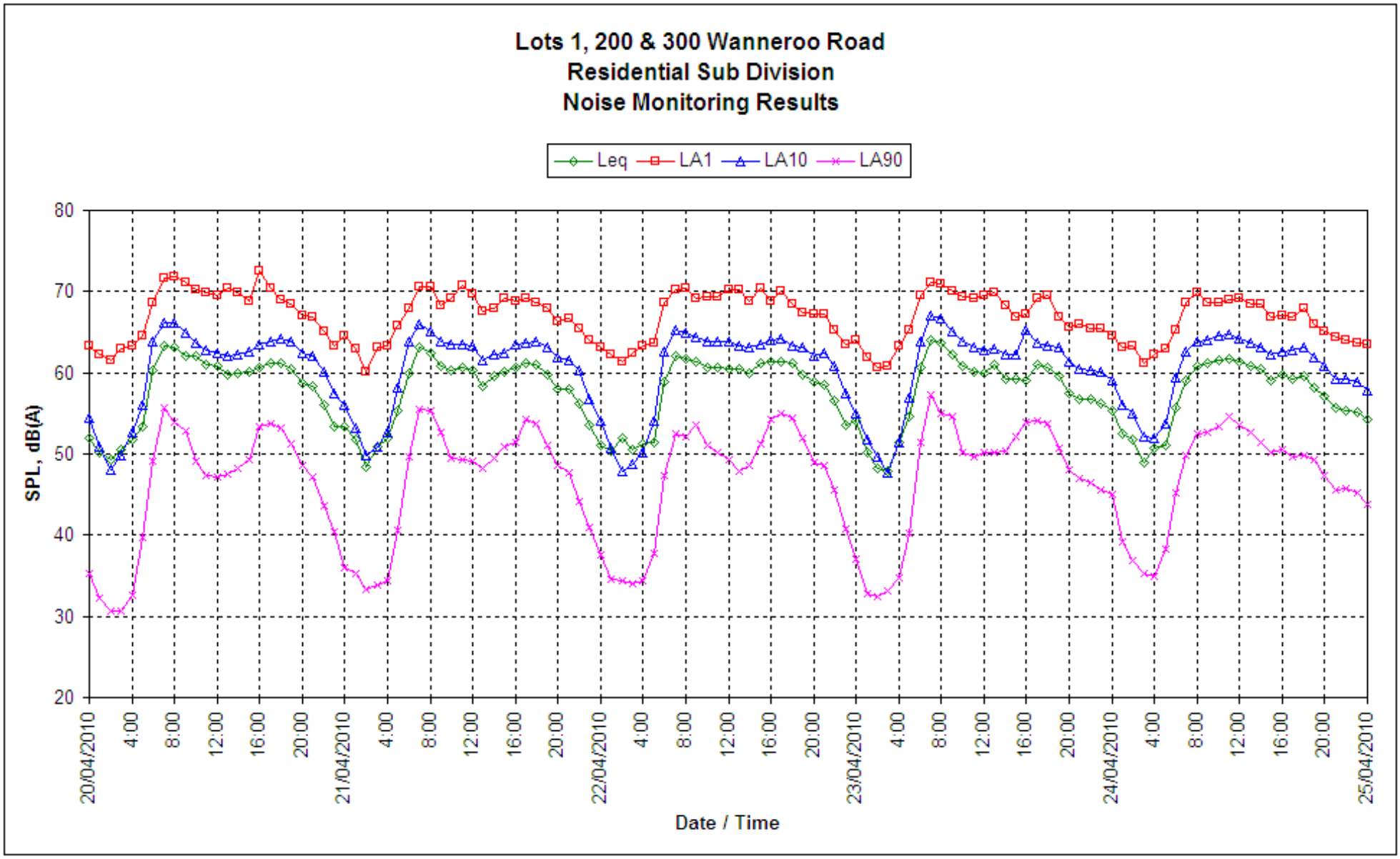
APPENDIX A

FIGURE A1 – SITE LAYOUT


N
Signs and symbols
Point receiver
WANNEROO ROAD
Lot 75
Lot 76
Lot 77
Lot 7
Lot 18
Lot 43
Lot 44
Lot 45
Lot 46
Lot 47
Lot 48
Lot 68
Lot 69
Lot 70
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Site Layout
Fig A1

APPENDIX B

NOISE MONITORING RESULTS


Lots 1, 200 & 300 Wanneroo Road
Residential Sub Division
Noise Monitoring Results
Leq
LA1
LA10
LA90
SPL, dB(A)
80
70
60
50
40
30
20
20/04/2010
4:00
8:00
12:00
16:00
20:00
21/04/2010
4:00
8:00
12:00
16:00
20:00
22/04/2010
4:00
8:00
12:00
16:00
20:00
23/04/2010
4:00
8:00
12:00
16:00
20:00
24/04/2010
4:00
8:00
12:00
16:00
20:00
25/04/2010
Date / Time

APPENDIX C

NOISE MODELLING RESULTS
SINGLE POINT CALCULATIONS

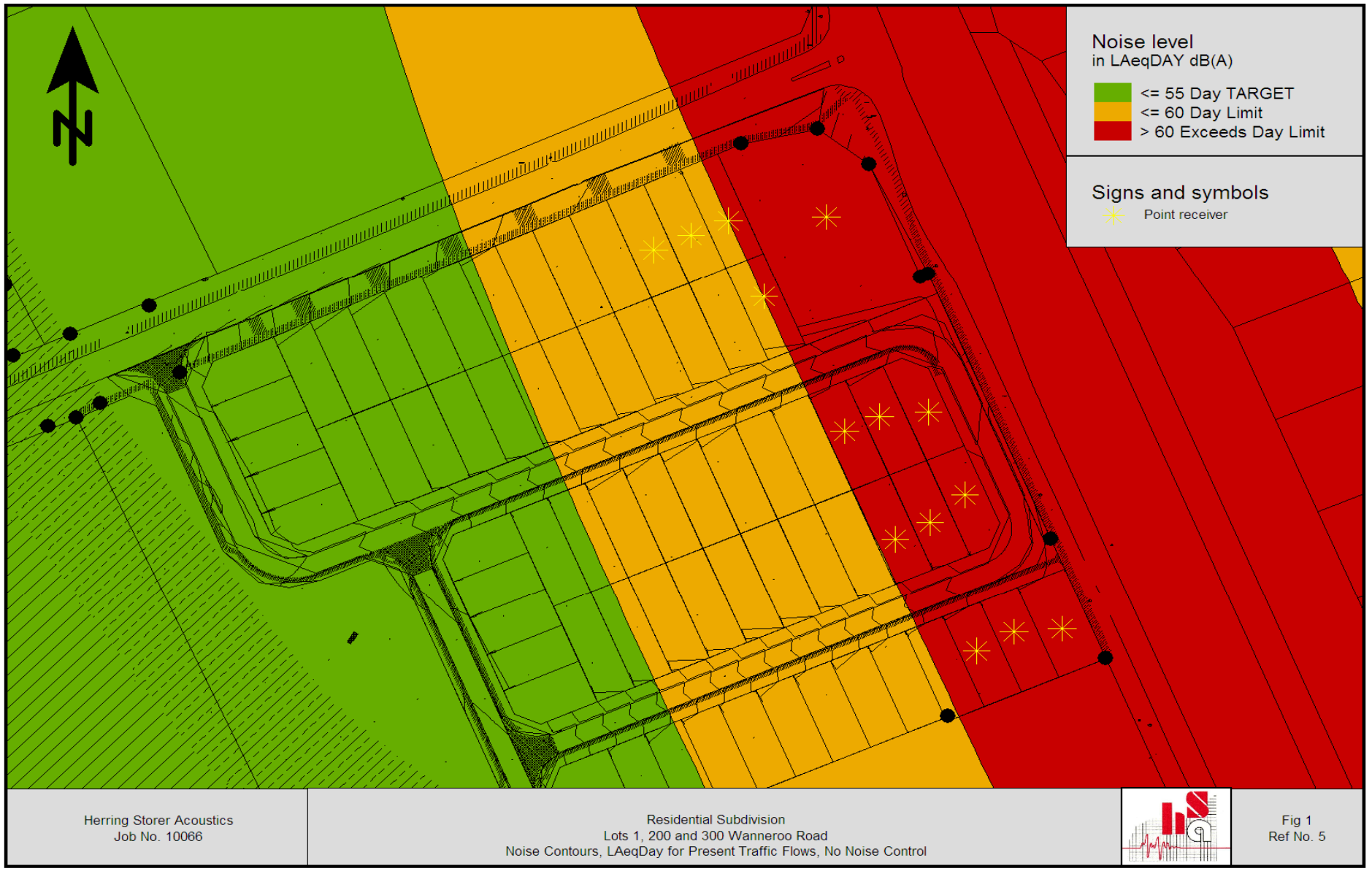
Current Traffic Flows					
Lot No.	$L_{Aeq(day)}$, dB(A)		Lot No.	$L_{Aeq(night)}$, dB(A)	
	Without Noise Control	With 1.8m Wall and internal fencing		Without Noise Control	With 1.8m Wall and internal fencing
Lot 15	58.1	56.5	Lot 15	52.1	50.5
Lot 16	59	57	Lot 16	53	51
Lot 17	60	57.1	Lot 17	54	51.1
Lot 71	63	59.1	Lot 71	57	53.1
Lot 18	60	57.6	Lot 18	54	51.6
Lot 45	63.4	59.1	Lot 45	57.4	53.1
Lot 46	63.4	59.2	Lot 46	57.4	53.2
Lot 70	64.8	61.2	Lot 70	58.8	55.2
Lot 44	61.7	59	Lot 44	55.7	53
Lot 43	60.5	58.2	Lot 43	54.5	52.2
Lot 47	61.7	59.1	Lot 47	55.7	53.1
Lot 48	60.5	58.3	Lot 48	54.5	52.3
Lot 69	62.8	60.4	Lot 69	56.8	54.4
Lot 68	61.3	59.1	Lot 68	55.3	53.1

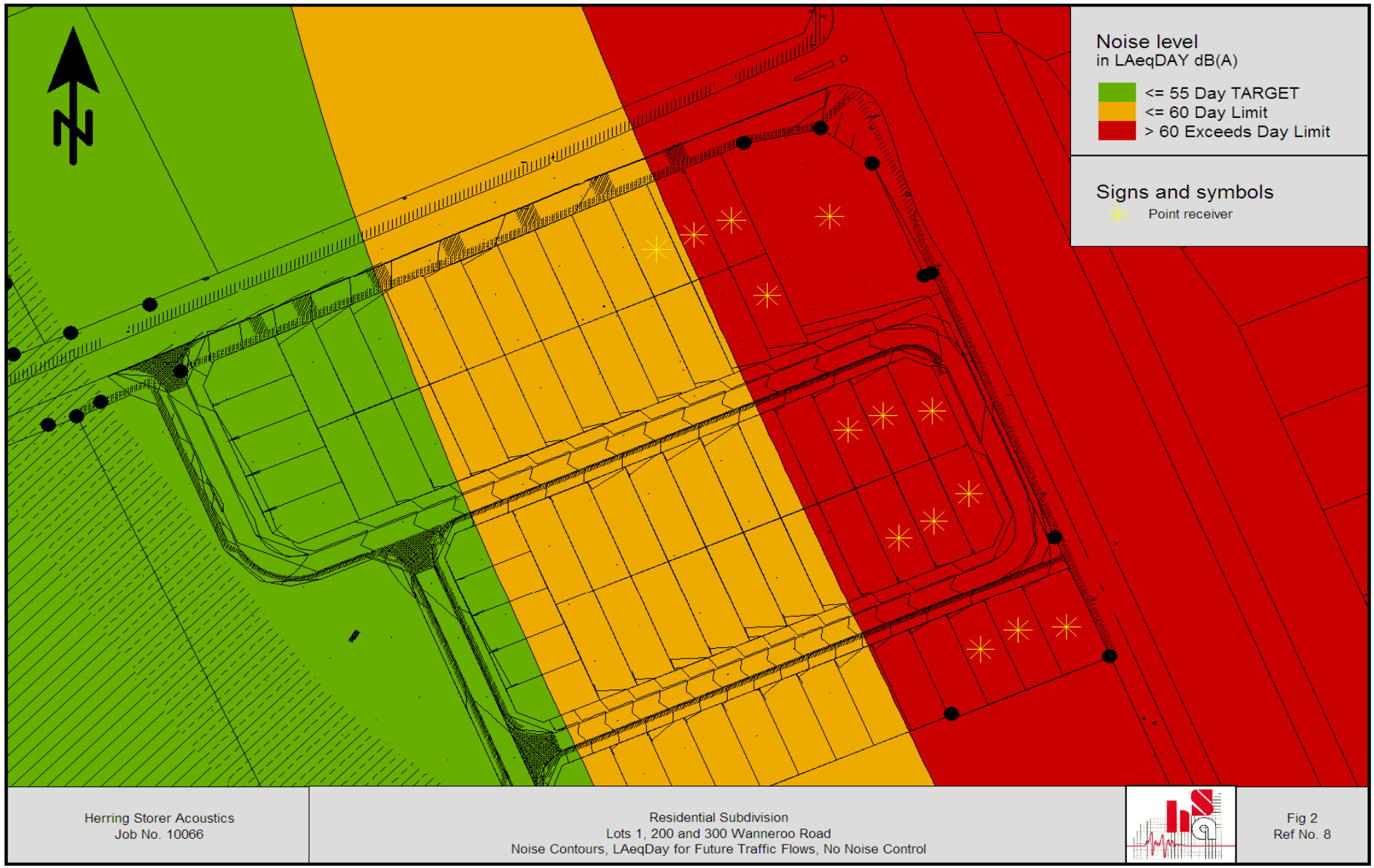
Future Traffic Flows					
Lot No.	$L_{Aeq(day)}$, dB(A)		Lot No.	$L_{Aeq(night)}$, dB(A)	
	Without Noise Control	With 1.8m Wall and internal fencing		Without Noise Control	With 1.8m Wall and internal fencing
Lot 15	59.4	57.9	Lot 15	53.4	51.9
Lot 16	60.3	58.3	Lot 16	54.3	52.3
Lot 17	61.4	58.5	Lot 17	55.4	52.5
Lot 71	64.4	60.5	Lot 71	58.4	54.5
Lot 18	61.4	58.9	Lot 18	55.4	52.9
Lot 45	64.8	60.4	Lot 45	58.8	54.4
Lot 46	64.7	60.5	Lot 46	58.7	54.5
Lot 70	66.2	62.5	Lot 70	60.2	56.5
Lot 44	63	60.4	Lot 44	57	54.4
Lot 43	61.9	59.5	Lot 43	55.9	53.5
Lot 47	63.1	60.5	Lot 47	57.1	54.5
Lot 48	61.8	59.6	Lot 48	55.8	53.6
Lot 69	64.1	61.8	Lot 69	58.1	55.8
Lot 68	62.6	60.5	Lot 68	56.6	54.5

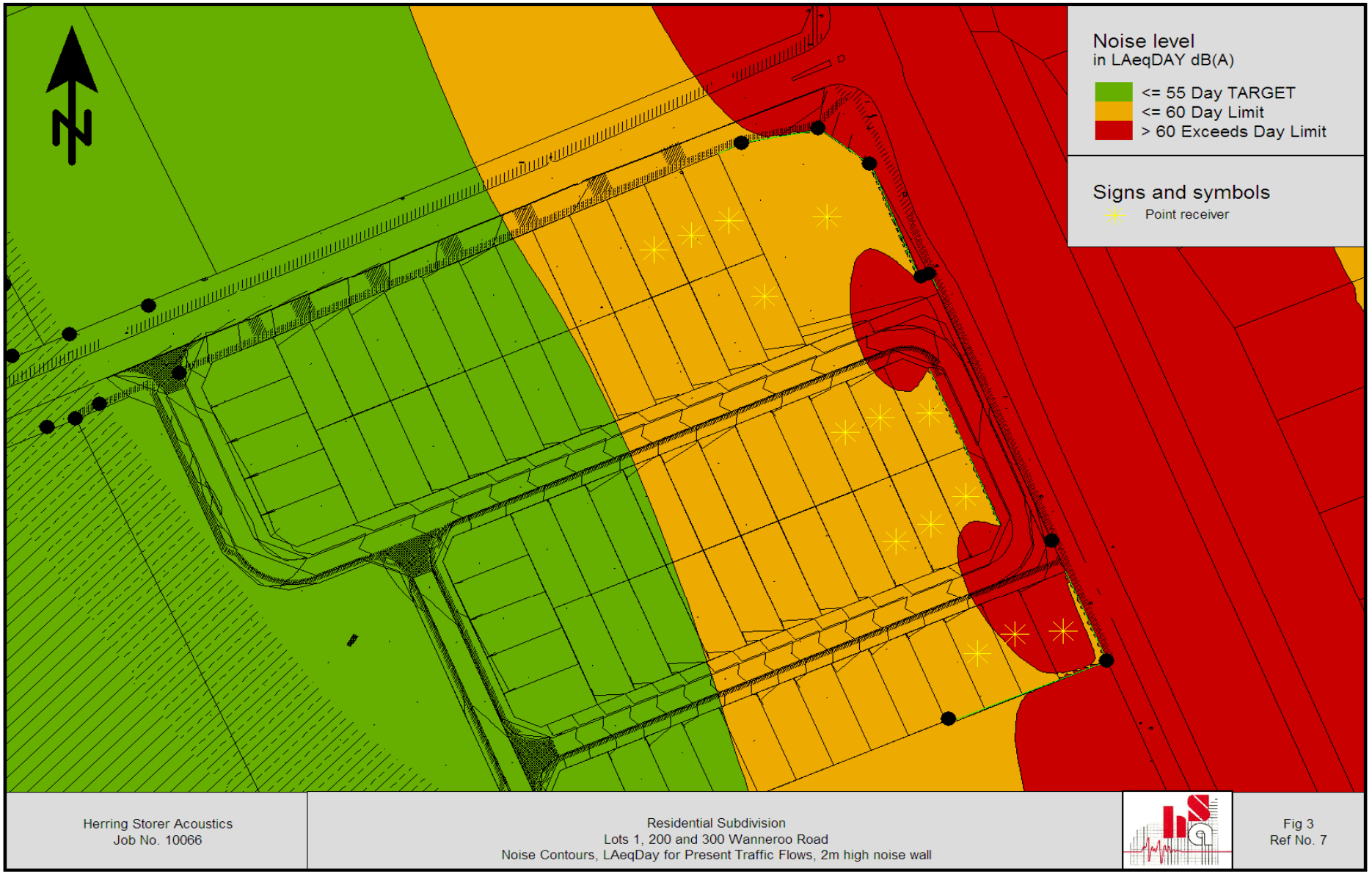
Note: Results include +2.5 dB(A) façade correction.

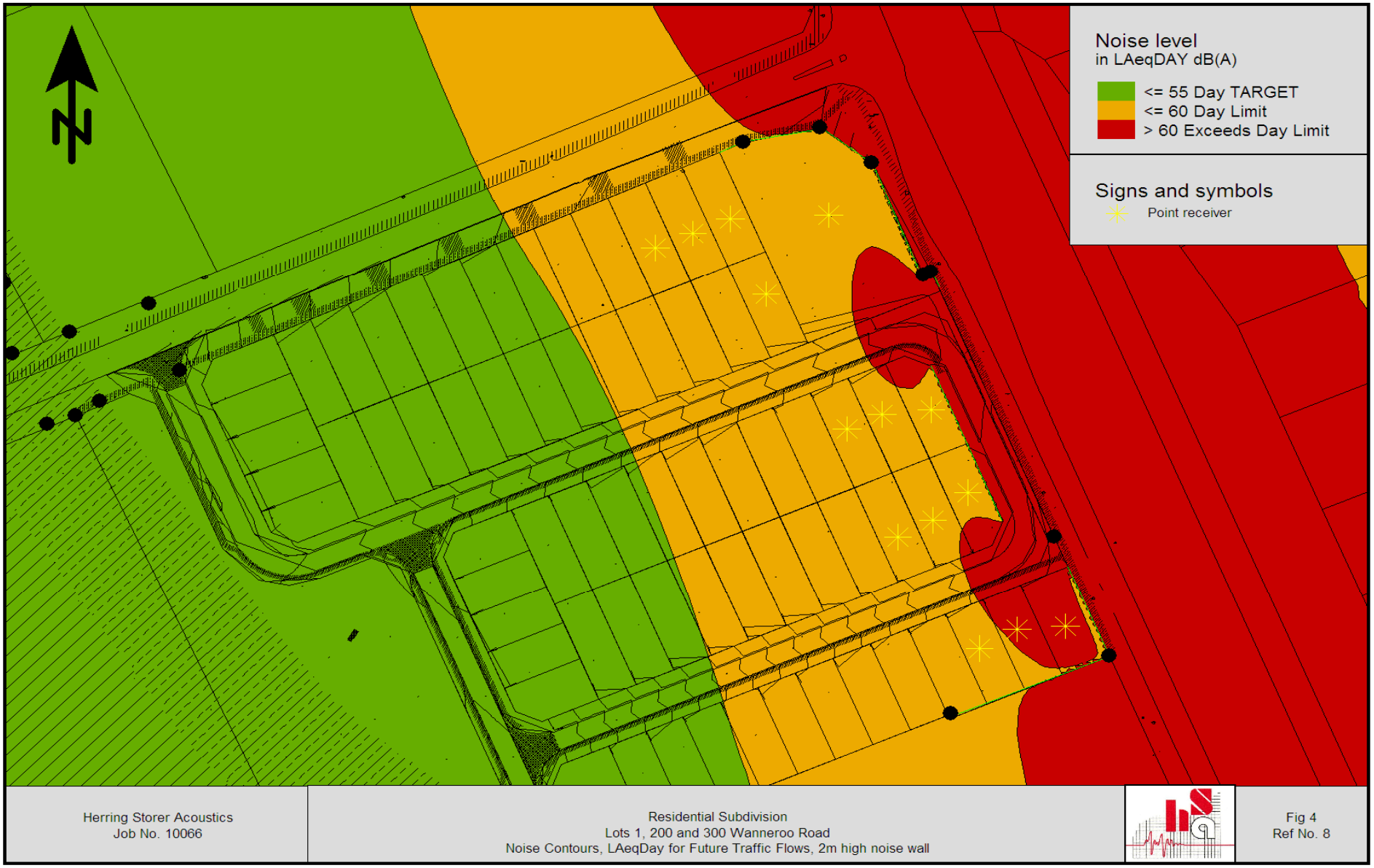
APPENDIX D

$L_{Aeq(DAY)}$ NOISE CONTOURS


N
Noise level
in LAeqDAY dB(A)
<= 55 Day TARGET
<= 60 Day Limit
> 60 Exceeds Day Limit
Signs and symbols
Point receiver
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Noise Contours, LAeqDay for Present Traffic Flows, No Noise Control
Fig 1
Ref No. 5

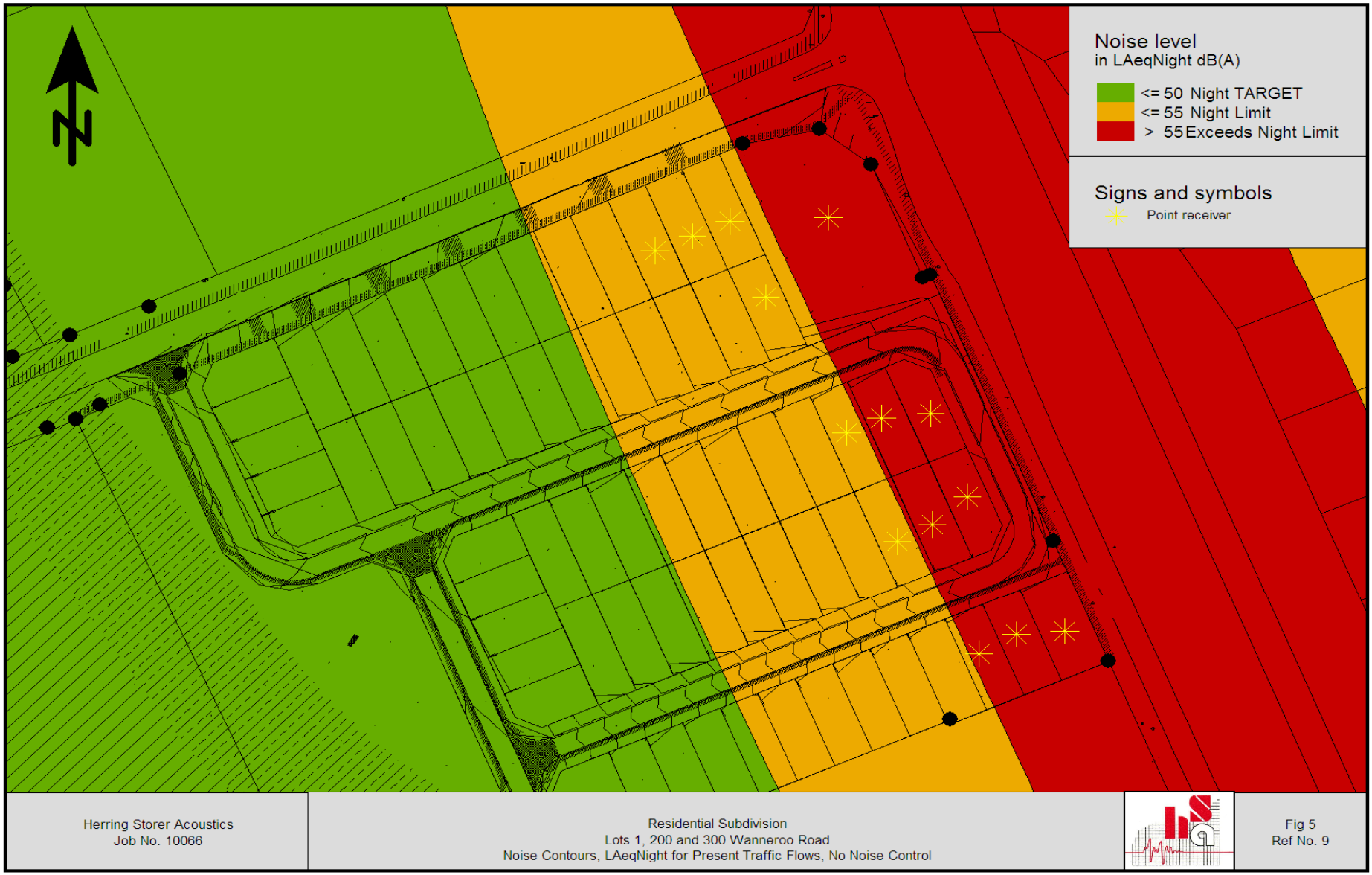

N
Noise level
in LAeqDAY dB(A)
<= 55 Day TARGET
<= 60 Day Limit
> 60 Exceeds Day Limit
Signs and symbols
Point receiver
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Noise Contours, LAeqDay for Future Traffic Flows, No Noise Control
Fig 2
Ref No. 8

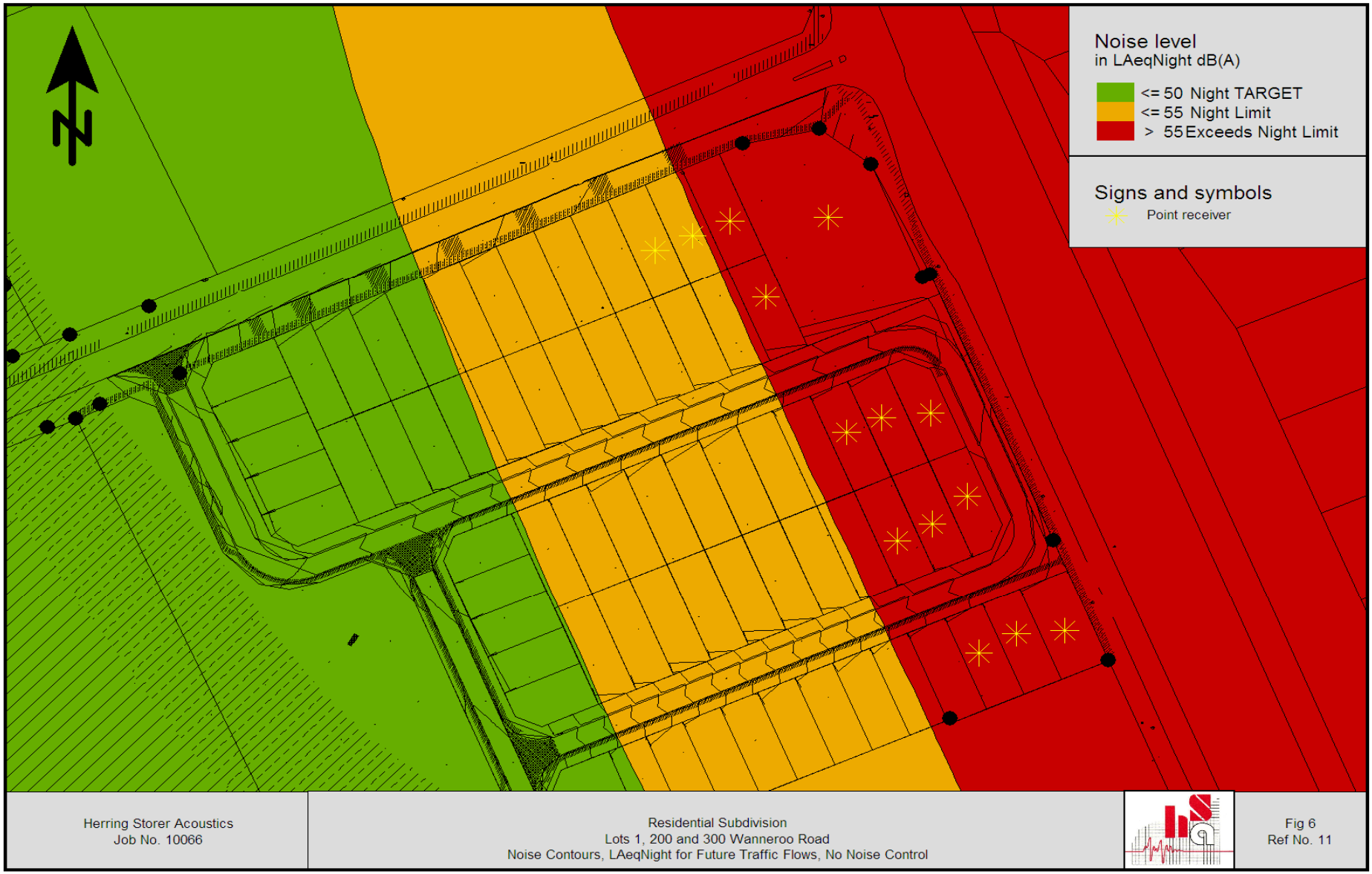

N
Noise level
in LAeqDAY dB(A)
<= 55 Day TARGET
<= 60 Day Limit
> 60 Exceeds Day Limit
Signs and symbols
Point receiver
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Noise Contours, LAeqDay for Present Traffic Flows, 2m high noise wall
Fig 3
Ref No. 7

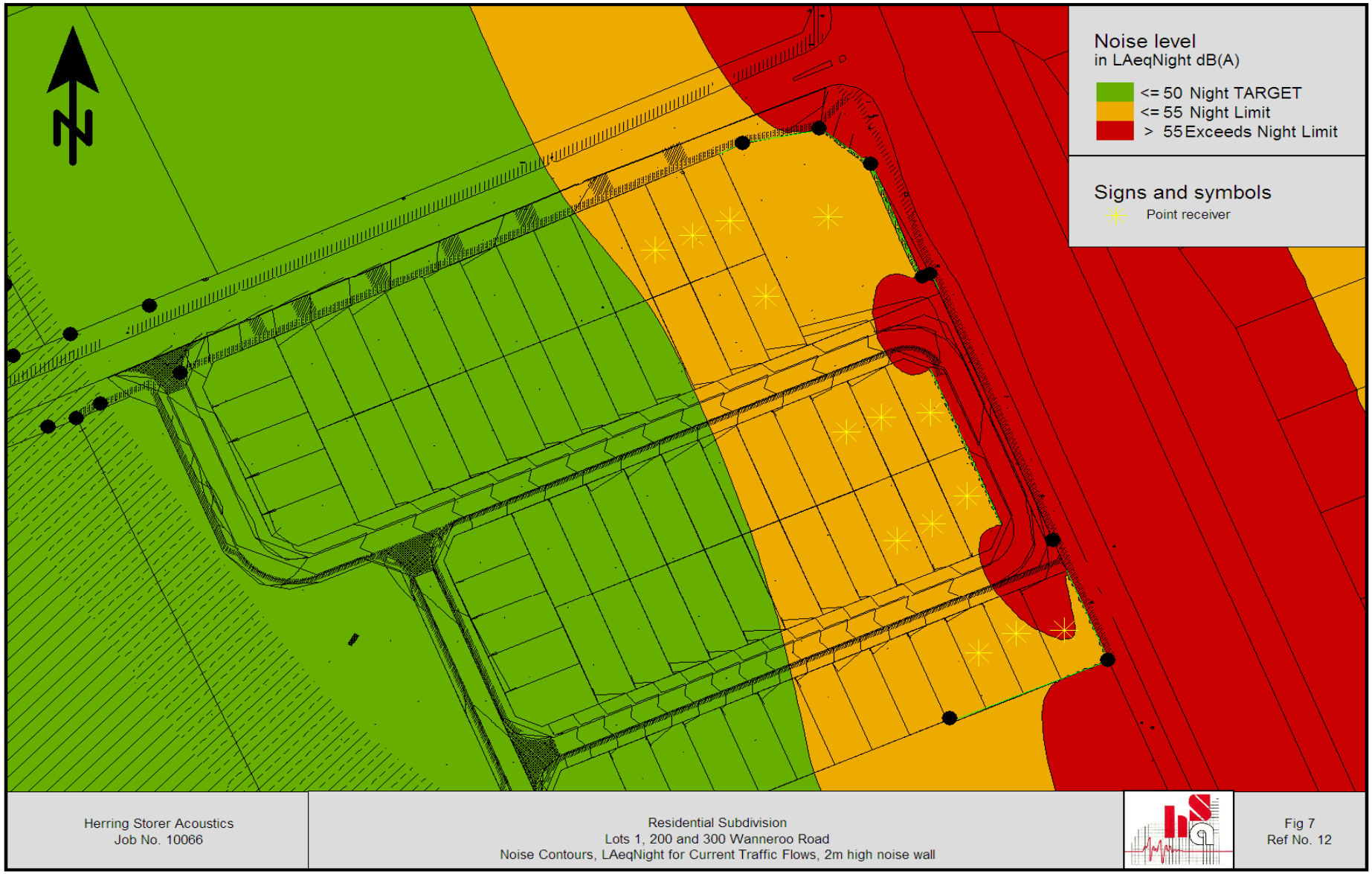

N
Noise level
in LAeqDAY dB(A)
<= 55 Day TARGET
<= 60 Day Limit
> 60 Exceeds Day Limit
Signs and symbols
Point receiver
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Noise Contours, LAeqDay for Future Traffic Flows, 2m high noise wall
Fig 4
Ref No. 8

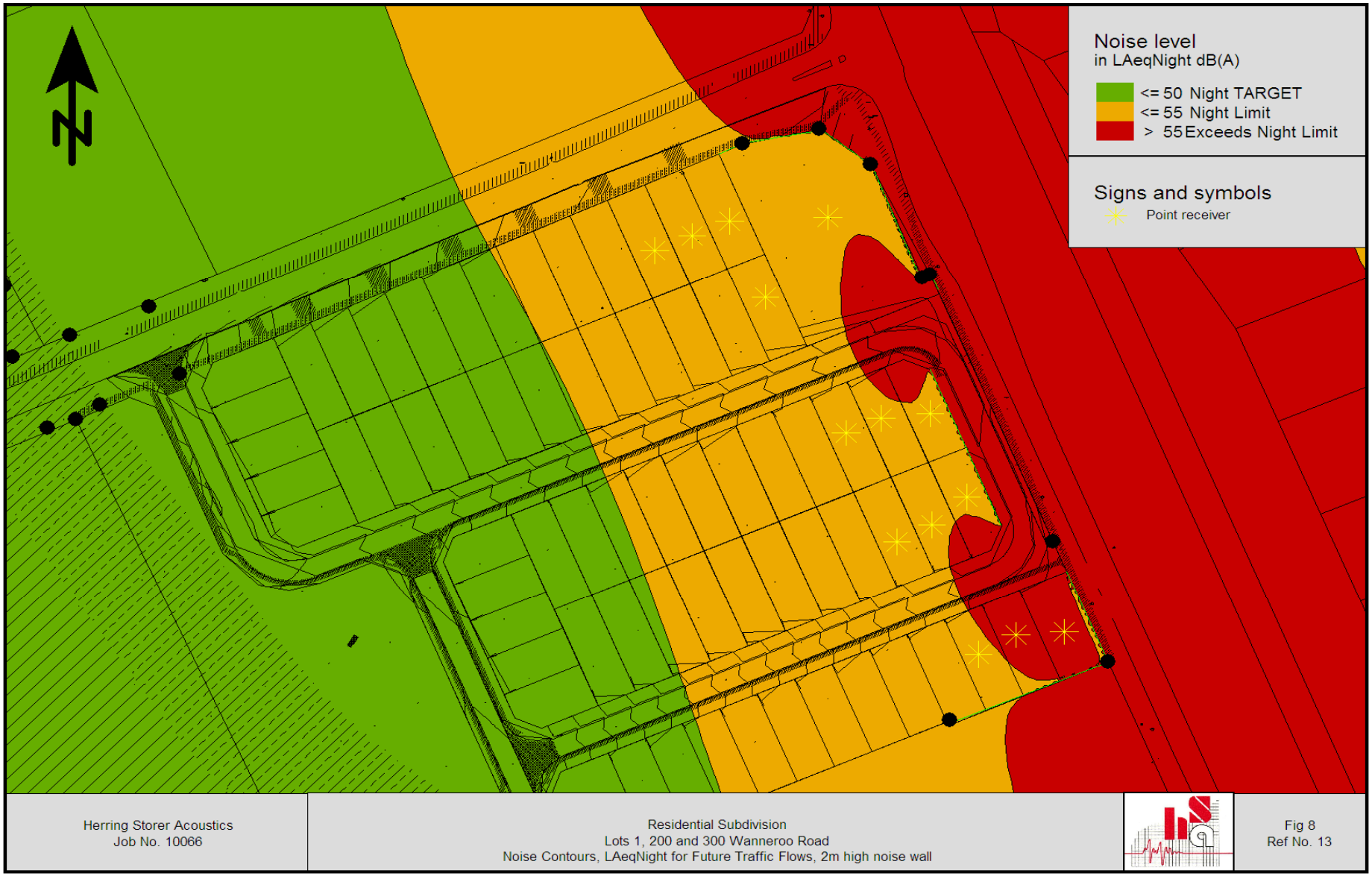
APPENDIX E

$L_{Aeq(NIGHT)}$ NOISE CONTOURS


N
Noise level
in LAeqNight dB(A)
<= 50 Night TARGET
<= 55 Night Limit
> 55 Exceeds Night Limit
Signs and symbols
Point receiver
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Noise Contours, LAeqNight for Present Traffic Flows, No Noise Control
Fig 5
Ref No. 9


N
Noise level
in LAeqNight dB(A)
<= 50 Night TARGET
<= 55 Night Limit
> 55 Exceeds Night Limit
Signs and symbols
Point receiver
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Noise Contours, LAeqNight for Future Traffic Flows, No Noise Control
Fig 6
Ref No. 11


N
Noise level
in LAeqNight dB(A)
<= 50 Night TARGET
<= 55 Night Limit
> 55 Exceeds Night Limit
Signs and symbols
Point receiver
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Noise Contours, LAeqNight for Current Traffic Flows, 2m high noise wall
Fig 7
Ref No. 12


N
Noise level
in LAeqNight dB(A)
<= 50 Night TARGET
<= 55 Night Limit
> 55 Exceeds Night Limit
Signs and symbols
Point receiver
Herring Storer Acoustics
Job No. 10066
Residential Subdivision
Lots 1, 200 and 300 Wanneroo Road
Noise Contours, LAeqNight for Future Traffic Flows, 2m high noise wall
Fig 8
Ref No. 13

APPENDIX F

“QUIET HOUSE” DESIGN – GENERAL INFORMATION

Treatment to houses in the form of thick glazing, door seals and roof / ceiling treatment can give reductions of up to 10 dB(A) over and above that of closed windows. However, this requires that one is inside with the windows shut and often necessitates the use of mechanical ventilation or air conditioning. Also, such reductions tend to reduce mid to high frequency noise leaving the sometimes more annoying low frequency noise.

The following provides some techniques that can be incorporated in “Quiet House” designs:-

- Locating bedrooms on opposite side of residence from road.
- Locating of laundries / bathrooms on same side of road.
- Protecting main entrance from road noise.
- Enclosing eaves.
- Roof insulation.
- Use of thicker glazing, with casement windows using winders.
- Double brick construction.

Australian Standard AS 2021-1994 “Acoustics - Aircraft noise intrusion - Building siting and construction” can also provide guidance on construction requirements for various maximum noise levels.

The barriers should be solid in nature, with no gaps. However, their construction can range from Colourbond, closed timber or compressed cement sheet fence to a masonry wall.

Some specific building guidelines that can be included in the quiet house design guidelines, include:

- Double brick or brick / weatherboard construction.

- Casement windows in timber or commercial steel frames and compressible seals (windows visible from Wanneroo Road only).

- First floor glazing to bedrooms with exposure to Wanneroo Road to be 6.38mm thick laminated glass. Other living spaces on side(s) of residence visible from Wanneroo Road to be minimum of 6mm glass.

- Eaves to be enclosed using 6mm thick compressed cement sheeting or equivalent.

- Sliding doors with seals and overlapping meeting stiles are acceptable on the side of the residence facing Wanneroo Road for living rooms, sliding doors to bedrooms are not acceptable.

- Roofs to be colourbond (or equivalent) with 50mm anticon, with ceilings on top floor to be one layer of 13mm plasterboard and 50mm thick (minimum 32 kg/m^3) insulation laid over the top.

- No recessed light fittings allowed in bedroom ceilings (on top storey).

Additionally, residences are to be designed to achieve an L_{Aeq} of 50 dB(A) at outdoor living areas, by either the layout / orientation of the residence and / or construction of fencing.

Note: An acceptable solution to the top storey is to allow lofts. These spaces can have higher noise levels, and so long as the floor is concrete and there is a door to the loft then noise would be acceptable.

Notifications of vehicle traffic noise and the above requirements are to be placed on titles.

For these residences, designs are to be checked by an acoustical consultant with a report stating that the construction adequately attenuates vehicle traffic noise to achieve the following noise levels:

Living and Work Areas	$L_{Aeq(Day)}$ of 40 dB(A)
Bedrooms	$L_{Aeq(Night)}$ of 35 dB(A)
Outdoor living Area	$L_{Aeq(night)}$ of 50 dB(A)

The above building criteria are for the first row of residences, as these residences will provide the barrier to the residences behind.

APPENDIX G

DEEMED-TO-SATISFY CONSTRUCTION STANDARDS

With the following noise control measures implemented, the lots within the development that are calculated to exceed the noise target (i.e Lots 44, 45, 46, 47, 68, 69, 70 and 71) have been calculated to meet the internal noise standards; and the outdoor living area standards as per the requirements of *AS2107:2000.*

Area Type	**Orientation**	**Noise Control Measures**
Bedroom	Facing Wanneroo Road	• 6mm (minimum) laminated glazing • Fixed, casement or awning windows with compressible seals • No external doors • Enclosed eaves • No vents to outside walls/eaves • Mechanical ventilation/air conditioning
	Side-on to Wanneroo Road	• 6mm (minimum) laminated glazing • Enclosed eaves • Mechanical ventilation/air conditioning
	Away from Wanneroo Road	No requirements
Living and work areas	Facing Wanneroo Road	• 6mm (minimum) laminated glazing • Fixed, casement or awning windows with compressible seals • 35mm (minimum) solid core external doors with acoustic seals • Sliding doors must be fitted with acoustic seals • Enclosed eaves • No vents to outside walls/eaves • Mechanical ventilation/air conditioning
	Side-on to Wanneroo Road	• 6mm (minimum) laminated glazing • Enclosed eaves • Mechanical ventilation/air conditioning
	Away from Wanneroo Road	No requirements
Other Indoor Areas	Any	No requirements
Outdoor Living Area	Facing Wanneroo Road	• Minimum 1.8m high solid fence (e.g. Hardifence, pinelap or colourbond) • Picket fences are not acceptable
	Side-on to Wanneroo Road	
	Away from Wanneroo Road	No requirements