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ask ACOUSTICS & AIR QUALITY

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Land Lease Community Retirement Village

Aura Precinct 10

Noise Impact Assessment

Report: 197401.0244.R01V01.docx

Prepared for:

Stockland Residential Communities

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Contents

Appendices

1. Introduction

ASK Consulting Engineers (ASK) was commissioned by Stockland Residential Communities to provide a rail and road traffic noise assessment for the proposed Land Lease Community (LLC) retirement village development proposed within Aura Precinct 10. This acoustic report is to accompany on Application for Compliance Assessment Endorsement for consideration by EDQ.

The purpose of this report is as follows:

- Outline the relevant project noise criteria.
- Predict and assess the road/future rail traffic noise impact onto the development.
- Predict and assess the noise impacts onto the development.
- Describe noise mitigation requirements, if any.

To aid in the understanding of the terms in this report a glossary is included in **Appendix A**.

2. Study Area Description

The site is located within the Caloundra South Priority Development Area (Aura). More specifically the site is within Precinct 10 is shown in **Figure 2.1**. The North-South Sub-Arterial Road (Aura Boulevard) is to the east of the site, while the future CAMCOS rail line is located to the south.

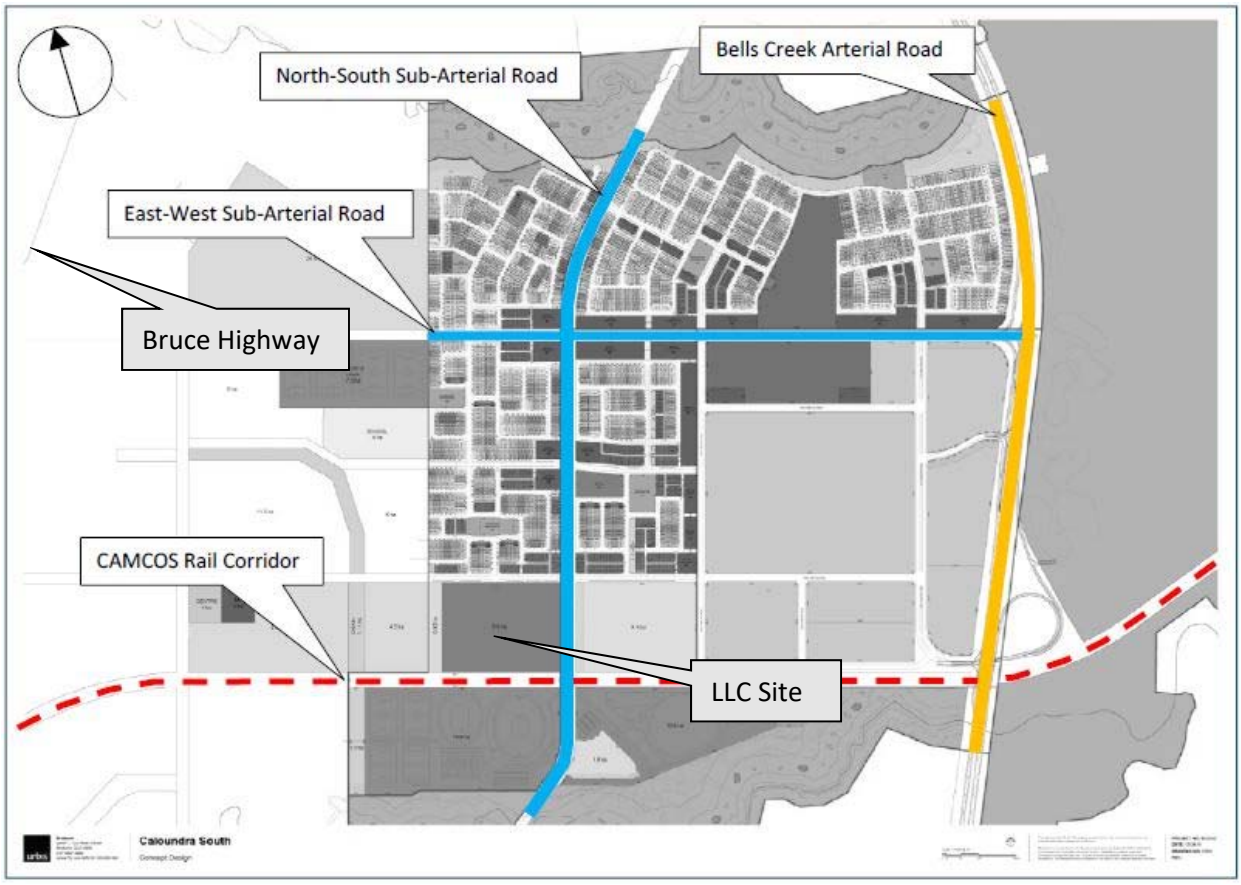


Figure 2.1 Site Location of the Proposed LLC Relative to Nearby Transport Corridors

The proposed development is potentially impacted upon in the future by rail traffic noise from the adjoining CAMCOS Rail Corridor to the south, and road traffic noise from North-South Sub-Arterial Road to the east. These noise issues are to be considered in the project design.

3. Proposed Development

The proposed development includes the following components:

- 230 residential dwellings
- 26 Caravan parking spaces
- A club house and community facilities at the centre of the development site.

The precinct including this site was previously assessed by ASK in the report ASK 8342R01V01 (dated 26/05/2016).

The proposed project drawings are included in **Appendix B**.

4. Acoustic Criteria

4.1 Overview

Acoustic criteria for the project are required to assess the road traffic and future rail noise impacts onto the various lots of the proposed development.

The acoustic assessment will be undertaken in accordance with the following relevant criteria:

- Criteria provided by Economic Development Queensland (EDQ)
- Department of State Development Infrastructure and Planning (DSDIP) State Assessment and Referral Agency (SARA) – State Development Assessment Provisions (SDAP).

4.2 Economic Development Queensland (EDQ)

The approved Plan of Development (PoD) applicable to the proposal (EDQ Ref DEV20131469) requires the following design standards to be met:

> DS15.20: All dwellings are to be designed and constructed using materials which ensure that any habitable rooms meet the following noise criteria based on the predicted Transport Noise Category for the railway being operational, being Queensland Development Code QDC MP4.4, or ≤45 dBA single event maximum sound pressure level. An Acoustic Report, prepared by a suitably qualified person, is to be lodged with any application for compliance assessment, demonstrating how this will be achieved.
>
> DS15.21: Each dwelling is to have an area of 10m² with a minimum diameter of 2m which meets the following external noise criteria in outdoor spaces for passive recreation based on the predicted Transport Noise Category for the railway being operational, being ≤84 dBA L_{max} (single event maximum sounds pressure level) free field. An Acoustic Report, prepared by a suitably qualified person, is to be lodged with any application for compliance assessment, demonstrating how this will be achieved.

The above criteria from the PoD have been taken form the State Assessment and Referral Agency (SARA) State Development Assessment Provisions (SDAP) regarding rail noise.

4.3 State Assessment and Referral Agency (SARA) – State Development Assessment Provisions (SDAP)

4.3.1 Overview

Acoustic criteria for the project will address noise intrusion into the development in accordance with the current version of the SDAP, being v2.5, effective 1 July 2019.

The following glossary of terms is provided in SDAP for accommodation activities:

- Accommodation activity means any of the following: caretaker's accommodation, community residence, dual occupancy, dwelling house, dwelling unit, multiple dwelling, relocatable home park, residential care facility, resort complex, retirement facility, rooming accommodation, short-term accommodation, tourist park, or a development with a combination of these uses.
- Private open space means an outdoor space for the exclusive use of occupants of a building.
- Passive recreation area means an area used for passive recreation such as a park, playground or walking track. This term does not include drainage reserves or channels, landscape buffer strips, environmental areas or corridors, or conservation areas or corridors.

- Residential building means a class 1, class 2, class 3 or class 4 building as defined in the Building Code of Australia.

4.3.2 State Code 1: Development in a State-Controlled Road Environment

The relevant performance outcomes and acceptable outcomes for developments in a state-controlled road or type 1 multi modal corridor environment are presented in **Table 4.1**.

Table 4.1 SDAP State Code 1 Performance and Acceptable Outcomes (Partial Copy Table 1.2.2: Environmental Emissions)

Performance Outcomes	Acceptable Outcomes
Accommodation Activities	
PO23 Development involving an accommodation activity or land for a future accommodation activity minimises noise intrusion from a state-controlled road or type 1 multimodal corridor in habitable rooms.	AO23.1 A noise barrier or earth mound is provided which is designed, sited and constructed: 1. to meet the following external noise criteria at all facades of the building envelope: a. ≤60 dB(A) L_{10} (18 hour) façade corrected (measured L_{90} (8 hour) free field between 10pm and 6am ≤40 dB(A)) b. ≤63 dB(A) L_{10} (18 hour) façade corrected (measured L_{90} (8 hour) free field between 10pm and 6am >40 dB(A)) 2. in accordance with chapter 7 integrated noise barrier design of the Transport Noise Management Code of Practice: Volume 1 (Road Traffic Noise), Department of Transport and Main Roads, 2013. Note: To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report is provided, prepared in accordance with the State Development Assessment Provisions Supporting Information – Community Amenity (Noise), Department of Transport and Main Roads, 2013. If the building envelope is unknown, the deemed-to-comply setback distances for buildings stipulated by the local planning instrument or relevant building regulations should be used. In some instances, the design of noise barriers and mounds to achieve the noise criteria above the ground floor may not be reasonable or practicable. In these instances, any relaxation of the criteria is at the discretion of the Department of Transport and Main Roads. OR all of the following acceptable outcomes apply: AO23.2 Buildings which include a habitable room are setback the maximum distance possible from a state controlled road or type 1 multi-modal corridor. AND AO23.3

	Buildings are designed and oriented so that habitable rooms are located furthest from a state controlled road or type 1 multi-modal corridor. AND AO23.4 Buildings (other than a relevant residential building or relocated building) are designed and constructed using materials which ensure that habitable rooms meet the following internal noise criteria: 1. ≤35 dB(A) L_{eq} (1 hour) (maximum hour over 24 hours). Statutory note: Noise levels from a state-controlled road or type 1 multi-modal corridor are to be measured in accordance with AS1055.1–1997 Acoustics – Description and measurement of environmental noise. Note: To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report is provided, prepared in accordance with the State Development Assessment Provisions Supporting Information – Community Amenity (Noise), Department of Transport and Main Roads, 2013. Habitable rooms of relevant residential buildings located within a transport noise corridor must comply with the Queensland Development Code MP4.4 Buildings in a transport noise corridor, Queensland Government, 2015. Transport noise corridors are mapped on the State Planning Policy interactive mapping system.
PO24 Development involving an accommodation activity or land for a future accommodation activity minimises noise intrusion from a state-controlled road or type 1 multimodal corridor in outdoor spaces for passive recreation.	AO24.1 A noise barrier or earth mound is provided which is designed, sited and constructed: 1. to meet the following external noise criteria in outdoor spaces for passive recreation: a. ≤57 dB(A) L_{10} (18 hour) free field (measured L_{90} (18 hour) free field between 6am and 12 midnight ≤45 dB(A)) b. ≤60 dB(A) L_{10} (18 hour) free field (measured L_{90} (18 hour) free field between 6am and 12 midnight >45 dB(A)) 2. in accordance with chapter 7 integrated noise barrier design of the Transport Noise Management Code of Practice – Volume 1 Road Traffic Noise, Department of Transport and Main Roads, 2013. Note: To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report is provided, prepared in accordance with the State Development Assessment Provisions Supporting Information – Community Amenity (Noise), Department of Transport and Main Roads, 2013. OR AO24.2 Each dwelling has access to an outdoor space for passive recreation which is shielded from a state controlled road or

	type 1 multi-modal corridor by a building, solid gap-free fence, or other solid gap-free structure. AND AO24.3 Each dwelling with a balcony directly exposed to noise from a state-controlled road or type 1 multi-modal corridor has a continuous solid gap-free balustrade (other than gaps required for drainage purposes to comply with the Building Code of Australia).

4.3.3 State Code 2: Development in a Railway Environment

Table 4.2 SDAP State Code 2 Performance and Acceptable Outcomes (Partial Copy Table 2.2.2: Environmental Emissions)

Performance Outcomes	Acceptable Outcomes
Accommodation Activities	
PO24 Development involving: 1. An accommodation activity; or 2. Land for a future accommodation activity Minimises noise intrusion from a railway or type 2 multi-modal corridor in habitable rooms.	AO24.1 A noise barrier or earth mound is provided which is designed, sited and constructed: 1. To meet the following external noise criteria at all facades of the building envelope: a. ≤65 dB(A) Leq (24 hour) façade corrected b. ≤87 dB(A) (single event maximum sound pressure level) façade corrected 2. In accordance with the Civil Engineering Technical Requirement – CIVIL-SR-014 Design of noise barriers adjacent to railways, Queensland Rail, 2011. Note: To demonstrate compliance with the acceptable outcome, it is recommended a RPEQ certified noise assessment report be provided. The noise assessment report should be prepared in accordance with the State Development Assessment Provisions Supporting Information – Community Amenity (Noise), Department of Transport and Main Roads, 2013. If the building envelope is unknown, the deemed-to-comply setback distances for buildings stipulated by the local planning instrument or relevant building regulations should be used. In some instances, the design of noise barriers and mounds to achieve the noise criteria above the ground floor may not be reasonable or practicable. In these instances, any relaxation of the criteria is at the discretion of the Department of Transport and Main Roads. OR all of the following acceptable outcomes apply: AO24.2 Buildings which include a habitable room are setback the maximum distance possible from a railway or type 2 multi-modal corridor. AND AO24.3

	Buildings are designed and oriented so that habitable rooms are located furthest from a railway or type 2 multi-modal corridor. AND AO24.4 Buildings (other than a relevant residential building or relocated building) are designed and constructed using materials which ensure that habitable rooms meet the following internal noise criteria: 1. ≤45 dB(A) single event maximum sound pressure level. Statutory note: Noise levels from railways or type 2 multi-modal corridors are to be measured in accordance with AS1055.1–1997 Acoustics – Description and measurement of environmental noise. Note: To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report be provided. The noise assessment report should be prepared in accordance with the State Development Assessment Provisions Supporting Information – Community Amenity (Noise), Department of Transport and Main Roads, 2013. Habitable rooms of relevant residential buildings located within a transport noise corridor must comply with the Queensland Development Code MP4.4 Buildings in a transport noise corridor, Queensland Government, 2015. Transport noise corridors are mapped on the State Planning Policy Interactive Mapping System.
PO25 Development involving an accommodation activity minimises noise intrusion from a railway or type 2 multimodal corridor in outdoor spaces for passive recreation.	AO25.1 A noise barrier or earth mound is provided which is designed, sited and constructed: 1. To meet the following external noise criteria in outdoor spaces for passive recreation: a. ≤62 dB(A) Leq (24 hour) free field b. ≤84 dB(A) (single event maximum sound pressure level) free field 2. In accordance with the Civil Engineering Technical Requirement – CIVIL-SR-014 Design of noise barriers adjacent to railways, Queensland Rail, 2011. OR AO25.2 Each dwelling has access to an outdoor space for passive recreation which is shielded from a railway or type 2 multi-modal corridor by a building, a solid gap-free fence, or other solid gap-free structure. AND AO25.3 Each dwelling with a balcony directly exposed to noise from a railway or type 2 multi-modal corridor has a continuous solid gap-free balustrade (other than gaps required for drainage purposes to comply with the Building Code of Australia).

4.4 Summary of Criteria

The summary of noise criteria nominated for the development is as follows:

- EDQ Rail Noise Criteria (from future CAMCOS corridor):
  - In outdoor spaces for passive recreation (e.g. back yard)
    - ≤84 dBA single event maximum sound pressure level free field
  - Habitable rooms are designed and constructed as per rail noise requirements of QDC MP4.4, or designed to achieve an internal noise level of ≤45 dBA single event maximum sound pressure level.
- SDAP Rail Noise Criteria (from future CAMCOS corridor):
  - At 1m from the building façades:
    - ≤65 dBA L_{eq} (24 hour) façade corrected.
    - ≤87 dBA single event maximum sound pressure level façade corrected.
  - In outdoor spaces for passive recreation (e.g. back yard)
    - ≤62 dBA L_{eq} (24 hour) free field
    - ≤84 dBA single event maximum sound pressure level free field
  - Habitable rooms are designed and constructed as per rail noise requirements of QDC MP4.4, or designed to achieve an internal noise level of ≤45 dBA single event maximum sound pressure level
  - Habitable rooms are designed and constructed as per road noise requirements of QDC MP4.4.
- SDAP Road Noise Criteria (from North-South Sub Arterial, a future State controlled road):
  - ≤60 dBA L_{10} (18 hour) façade corrected. Note: It is expected that the night time background noise level (L_{90} (8 hour) free field between 10pm and 6am) will be ≤40 dBA.
  - ≤57 dBA L_{10} (18 hour) free field. Note: It is expected that the day/evening background noise level (L_{90} (18 hour) free field between 6am and 12 midnight) will be ≤45 dBA)
  - Habitable rooms are designed and constructed as per QDC MP4.4.

From the above dot points it can be seen that the EDQ criteria match parts of the requirements of SDAP.

5. Rail Noise Assessment

5.1 Overview

Rail noise from the future CAMCOS corridor has been assessed onto the proposed development. The relevant assessment criteria are presented in **Section 4**.

At present, there is limited information available in relation to the future CAMCOS corridor, and there is some doubt about the ultimate timing of the service.

To assess the potential noise levels from rail traffic, indicative information has been drawn from the following documents:

- ARUP, Caboolture to Maroochydore Corridor Study Stage 3 Caloundra Options Assessment Report, date: March 1999.
- ARUP, Caboolture to Maroochydore Corridor Study Final Impact Assessment and Land Use Transport Strategy, Chapter 5 Environmental Setting, date: February 2001.

Future rail traffic noise levels across the site have been predicted using the SoundPlan computer model, based on the Kilde rail noise prediction method, which is approved by Queensland Rail.

5.2 Data

The following data has been used in the noise calculations:

- Due to the location of the corridor, it is assumed that only electric passenger trains will utilise the CAMCOS rail line. A noise source height of 0.5m has been applied for electric passenger trains.
- Ground contours for the site and the area of the CAMCOS corridor were provided by Calibre Consulting. The ground contours for the CAMCOS corridor do not included detailed consideration of the rail lines or required civil works.
- Receiver heights for the allotments were placed 1.8m above ground contour height.
- A +2.5 dBA facade reflection allowance is included in the rail noise level predictions.
- ASK has been advised by Stockland that the corridor has been design to support train travel speeds up to 100 km/h. Modelling of rail noise has applied this speed.
- ASK has been advised by Stockland that frequency of train travel for the corridor is unknown, however rail traffic is forecast to be running at a 30 minute headway by 2050. It is therefore assumed that there will be at least 15 train movements per day.
- Based on ASK's experience with similar rail noise assessments, L_{max} noise predictions typically determine the required mitigation measures (i.e. not set by L_{eq} noise predictions), and therefore due to absence of information regarding train frequencies, the assessment has been undertaken using L_{max} noise predictions only.
- Noise predictions have been undertaken using the eastbound rail line only, which is closest to the development. The setback distance from eastbound rail line to the boundary of LLC retirement village (closest boundary) is approximately 14 metres. The height of the rail line is based on the finished earthworks level of the corridor (between the rail lines) as it is the only data available. The application of this height is considered acceptable for the purposes of this assessment.
- A 3m high acoustic barrier is included along the railway line boundary to the west and east of the subject site (beyond the subject site). This barrier information was provided to ASK.

5.3 Limitations & Assumptions

The assessment of future rail noise impacts has been undertaken with the most up-to-date design information available for the project. Although detailed design for the CAMCOS corridor has not yet been undertaken, the level of design information is considered appropriate for the current stage of assessment. Further assessment of rail noise impacts could be undertaken following progression of the design of the development and the CAMCOS corridor.

5.4 Verification

As the CAMCOS rail corridor has not been constructed, noise measurements of rail pass-bys are not able to be undertaken.

Verification of the rail noise model has been undertaken using the generic passenger train sound exposure level (SEL) data provided by QR, and the corrections included in the SoundPlan model under the Kilde method, as required by QR. This method is considered suitable for the assessment and therefore the resulting noise predictions are considered accurate.

5.5 Calculations and Assessment

5.5.1 In Outdoor Spaces

The predicted noise levels in external outdoor recreational areas for each lot adjacent the southern boundary are presented in **Table 5.1**. The centre of the outdoor recreation area was modelled as approximately 3 to 4 metres from the southern (rear) boundary fence. This includes results with no barriers along the southern property boundary and with a 1.8m, 2.4m and 3.0m barrier.

table to be amended to reflect current layout

Table 5.1 Predicted Noise Levels in Outdoor Spaces for Passive Recreation

Lot	Rail Noise Level L_{max} (single event maximum sound pressure level) dBA (free-field)			
	No Barrier	1.8m Barrier	2.4m Barrier	3.0m Barrier
107	90	86	81	78
108	90	86	81	78
109	90	86	81	78
110	90	86	81	78
111	90	86	82	78
112	90	87	82	79
113	90	87	82	79
114	90	87	82	79
115	90	87	82	79
116	90	88	82	79
117	90	88	82	79
118	90	88	83	79
119	90	88	83	79
120	90	88	83	79
121	90	88	83	79

Lot	Rail Noise Level L_{max} (single event maximum sound pressure level) dBA (free-field)			
	No Barrier	1.8m Barrier	2.4m Barrier	3.0m Barrier
122	90	88	83	80
123	90	89	83	80
124	90	89	84	80
125	90	89	84	80
126	90	90	84	80
127	90	90	84	80
128	90	90	84	80
129	90	90	84	80
130	90	90	84	80
131	90	90	84	80
132	90	90	84	80
133	90	89	84	80
134	90	89	83	80
135	90	88	83	79
136	90	88	83	79
137	90	88	82	79
138	90	87	82	79
139	90	87	82	79
140	90	86	82	79
141	90	86	81	78
142	90	86	81	78
143	90	85	81	79

Note: All noise predictions in **Table 5.1** are free-field and do not include façade reflection.

From **Table 5.1** it can also be seen that the EDQ and SDAP criterion of '≤84 dBA single event maximum sound pressure level free field' is achieved at all lots with a minimum 2.4m barrier.

Currently the centre of the outdoor recreation area at Lot 130 was modelled as approximately 3 to 4 metres from the southern (rear) boundary fence with no shielding from the buildings. However, the actual layout of the buildings will provide substantial shielding at outdoor areas and thus the 84 dBA limit would be achieved with a lower barrier of 1.8m in height.

5.5.2 At Façade of Residences

Façade corrected noise levels are not required to be assessed using the EDQ criteria but are assessed under SDAP criteria.

The predicted noise levels at the façades for each lot adjacent the southern boundary are presented in **Table 5.2** and **Appendix C** contours.

table to be amended to reflect current layout

Table 5.2 Predicted Noise Levels at Facades

Lot	Rail Noise Level L_{max} (single event maximum sound pressure level) dBA (including façade reflection)			
	No Barrier	1.8m Barrier	2.4m Barrier	3.0m Barrier
107	92	88	83	81
108	92	89	84	81
109	92	89	84	81
110	92	89	84	81
111	92	89	84	81
112	92	89	84	81
113	92	89	84	81
114	92	90	85	81
115	92	90	85	81
116	92	90	85	81
117	92	90	85	82
118	92	91	85	82
119	92	91	85	82
120	92	91	85	82
121	92	91	85	82
122	92	91	86	82
123	92	91	86	82
124	92	91	86	82
125	92	91	86	82
126	92	92	87	82
127	92	92	87	83
128	92	92	87	83
129	92	92	87	83
130	92	92	87	83
131	92	92	87	83
132	92	92	87	83
133	92	92	86	82
134	92	91	86	82
135	92	91	86	82
136	92	91	85	82
137	92	90	85	82
138	92	90	85	81
139	92	89	84	81

Lot	Rail Noise Level L_{max} (single event maximum sound pressure level) dBA (including façade reflection)			
	No Barrier	1.8m Barrier	2.4m Barrier	3.0m Barrier
140	92	89	84	81
141	92	89	84	81
142	92	89	84	81
143	92	88	84	81

Note: All noise predictions in **Table 5.2** are include façade reflection.

From **Table 5.2** it can also be seen that the SDAP criterion of '≤87 dBA single event maximum sound pressure level façade corrected' is achieved at all lots with a 2.4m high noise barrier.

5.5.3 Inside Residences

Future residences should be designed to either (a) MP4.4, or (b) an internal noise level of 45 dBA L_{max} (Single event) as per EDQ requirements.

Rail traffic noise levels have been predicted across the LLC retirement village which is located adjacent to the CAMCOS corridor. Noise predictions have been carried out with the different acoustic fence heights at the south east boundary of the property. The façade corrected noise levels are presented in terms of noise contours in **Appendix C**.

Based on the rail noise levels in **Table 5.2** and **Figures C.3**, which include a 2.4m high noise barrier, some of the likely MP4.4 Categories are as follows:

- 1st row of houses (Lots 107 to 143):
  - Rear (southern side) of dwellings: Category 3 or 4
  - Side of dwellings: Category 3 or 4
  - Front of dwellings: Category 2
- 2nd row of houses (Lots 94 to 106, 144-153, 164)
  - Front (southern side) of dwellings: Category 2
  - Side of dwellings: Category 1 or 2
  - Rear of dwellings: Category 1 or 2

Specific acoustic ratings for each building façade have not been determined at this stage, but should be done so by calculating at points corresponding to each façade of each room in the future dwellings.

6. Road Traffic Noise Assessment

6.1 Overview

Road traffic noise from the North-South Sub-Arterial Road (Aura Boulevard) has been assessed onto the site.

There are no EDQ criteria for road traffic noise, but assessment would be required under SDAP.

TMR recommends that the prediction of road traffic noise is to be conducted according to the United Kingdom Department of Transport (1988) procedure published as ”Calculation of Road Traffic Noise” (CoRTN88). The road traffic noise levels have been predicted using the SoundPLAN computer model, based on the CoRTN88 traffic noise prediction method and is approved by TMR.

6.2 Data

The following data has been used in the noise calculations:

- Noise source height of 0.5 m.
- Ground contours for the site and North-South Sub-Arterial Road corridor were provided by Calibre Consulting.
- Receiver heights for the allotments were placed 1.8m above ground contour height.
- A +2.5 dBA facade reflection allowance is included in the road traffic noise level predictions.
- Road width as per design drawings provided by Calibre Consulting, and traffic lane advice provided by MWH Global.
- Forecast traffic volumes for the year 2031 for the north-south sub-arterial roads shown in **Table 6.1** have been provided by MWH Global. Traffic volumes for the sub-arterial roads were provided in the form of AM and PM pear hour traffic volumes. These volumes were converted to a 24 hour Annual Average Weekday Traffic (AAWT) volume (sum of the AM/PM peaks, multiplied by 5), and then converted to a Annual Average Daily Traffic (AADT) volume (multiplied by conversion factor of 0.945), based on advice provided by MWH Global.
- The road segments indicated in **Table 6.1** are presented graphically in **Figure 6.1**.
- The 18-hour traffic flow is taken to be 94% of the ultimate daily traffic flow.
- The road surface for all the roads used in the noise model is dense graded asphalt (DGA).
- The CoRTN road traffic noise model predicts the L_{10}(18 hour).
- Road traffic noise level predictions include the CoRTN calibration factors for Queensland conditions as detailed in Section 4.3.2.1 in TMR’s Transport Noise Management Code of Practice (2013). The corrections are -1.7dBA for facade corrected predictions, and -0.7dBA for free field predictions.

Table 6.1 Traffic Data for the North-South Sub-Arterial Road

Road	Segment	Direction	AADT	18 Hour Traffic Volume	Heavy Vehicle % (CV%)	Speed
North-South Sub-Arterial Road	B1	Southbound	14132	13285	3	60
		Northbound	11132	10464		
	B2	Southbound	2679	2518		
		Northbound	3662	3442		
	B3	Southbound	2396	2252		

Road	Segment	Direction	AADT	18 Hour Traffic Volume	Heavy Vehicle % (CV%)	Speed
		Northbound	3175	2985		
	B4	Southbound	3270	3074		
		Northbound	3341	3140		

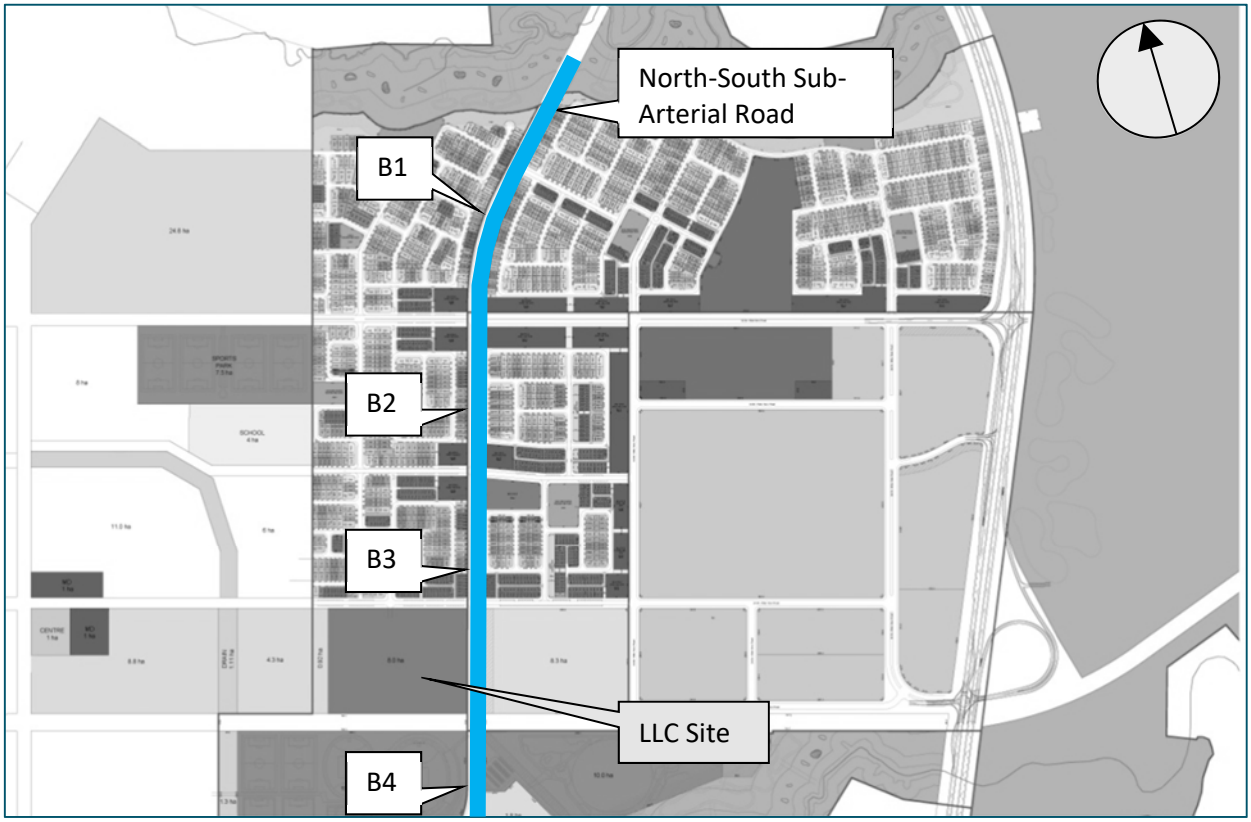


Figure 6.1 Road Segments

6.3 Verification

As Precincts 7, 8, 9 and 10, Bells Creek Arterial and the internal road network have not been developed completely, road traffic noise measurements are unable to be undertaken, and therefore the road traffic noise model for the site is unable to be validated. The accuracy of the noise modelling undertaken is considered acceptable for the purposes of the assessment.

6.4 Calculations and Assessment

The road traffic noise levels for 2031 have been predicted at the proposed retirement village. The predicted façade corrected L_{10}(18 hour) noise levels are presented in terms of noise contours in **Figure D.1** in **Appendix D**.

From **Figure D.1** it can seen that the north-eastern Lot 22 is within MP4.4 Noise Category 1 and is exposed to a road traffic noise level of up to approximately 60 dBA L_{10}(18hour) façade corrected, or approximately 58 dBA L_{10}(18hour) free field. These external noise levels at Lot 22 are acceptable at the façade, albeit marginal, but exceed the open space SDAP criterion by 1 dB. Road traffic noise levels at all other lots are acceptable.

The noise impact on Lot 122 could be reduced to MP4.4 Noise Category 0 with a 1.8m high barrier to the northern and eastern sides of Lot 122 as per **Figure D.2**. Noise contours with the 1.8m acoustic fence are included in **Figure D.2**.

7. Recommendations & Conclusion

Future rail and road noise impacts onto the proposed LLC retirement village have been considered. Rail noise impacts relate to the adjoining CAMCOS corridor which may be constructed at some point in the future and this has been assessed as per EDQ and SDAP criteria. The outcomes of the rail noise assessment are as follows:

- Rail noise levels in open spaces (i.e. back yards) of residences along the southern site boundary are compliant with EDQ and SDAP criteria with the following options for a barrier:
  - A 2.4m high noise barrier to the southern site boundary; or
  - A 1.8m high noise barrier when considering the protected nature of courtyards in the future building designs.
- Rail noise levels at the facade of residences along the southern site boundary are compliant with SDAP criteria with a 2.4m high noise barrier to the southern site boundary.
- Given the requirements noted above for compliance at open spaces and at façades, a 2.4m high barrier along the southern site boundary may be the preferred overall barrier solution.
- Future LLC dwellings are to be designed and constructed as per rail noise requirements of QDC MP4.4, or designed to achieve an internal noise level of ≤45 dBA single event maximum sound pressure level. Based on the rail noise levels in **Table 5.2** and **Figures C.3**, which include a 2.4m high noise barrier, some of the likely MP4.4 Categories are as follows:
  - 1st row of houses (Lots 107 to 143):
    - Rear (southern side) of dwellings: Category 3 or 4
    - Side of dwellings: Category 3 or 4
    - Front of dwellings: Category 2
  - 2nd row of houses (Lots 94 to 106, 144-153, 164)
    - Front (southern side) of dwellings: Category 2
    - Side of dwellings: Category 1 or 2
    - Rear of dwellings: Category 1 or 2

  Specific acoustic ratings for each building façade have not been determined at this stage, but should be done so by calculating at points corresponding to each façade of each room in the future dwellings.
- Road noise impacts relate to the future adjoining North-South Sub Arterial road and this has been assessed as per SDAP criteria. The outcomes of the road noise assessment are as follows:
  - Road noise levels are compliant with SDAP criteria at all lots except Lot 122.
  - With the construction of a 1.8m barrier to Lot 122, the noise levels are compliant with SDAP criteria at all lots including Lot 122. With this barrier, no construction upgrades are required to dwellings under MP4.4.

Appendix A Glossary

Parameter or Term	Description
dB	The decibel (dB) is the unit measure of sound. Most noises occur in a range of 20 dB (quiet rural area at night) to 120 dB (nightclub dance floor or concert).
dBA	Noise levels are most commonly expressed in terms of the 'A' weighted decibel scale, dBA. This scale closely approximates the response of the human ear, thus providing a measure of the subjective loudness of noise and enabling the intensity of noises with different frequency characteristics (e.g. pitch and tone) to be compared.
Day	The period between 7am and 6pm.
Evening	The period between 6pm and 10pm.
Night	The period between 10pm and 7am.
Free-field	The description of a noise receiver or source location which is away from any significantly reflective objects (e.g. buildings, walls).
L_1	The noise level exceeded for 1% of the measurement period.
L_{10}	The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level.
L_{90}	The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
L_{eq}	The equivalent continuous sound level, which is the constant sound level over a given time period, which is equivalent in total sound energy to the time-varying sound level, measured over the same time period.
$L_{eq,1hour}$	As for L_{eq} except the measurement intervals are defined as 1 hour duration.
L_{max}	Maximum A-weighted sound pressure level.
L_{eq}(24 hour)	The average L_{eq} noise level over the 24-hour period from midnight to midnight.
L_{10}(18 hour)	The arithmetic average of the one-hour L_{10} values between 6am and midnight. This parameter is used in the assessment of road traffic noise.
R_w	Weighted Sound Reduction Index – is a single number evaluation of the property of a partition to attenuate sounds. For the majority of partitions, the value of Rw will be similar to the value for STC. Partitions with particularly poor performance at 100 Hz may have lower values for Rw than for STC. Conversely, partitions with poor performance at 4000 Hz may have higher Rw than for STC. (As per AS1276.1-1999).
Habitable Rooms	According to the "Building Code of Australia" a Habitable Room is: " a room used for normal domestic activities and **Includes** a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre, and sunroom, but **Excludes** a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods."

Appendix B Project Drawings

DC8 STUDIO

MASTERPLAN & HOUSE TYPES

10.5M SITE
252m² SITE

2 BED
2 BATH
1 CAR
196m2

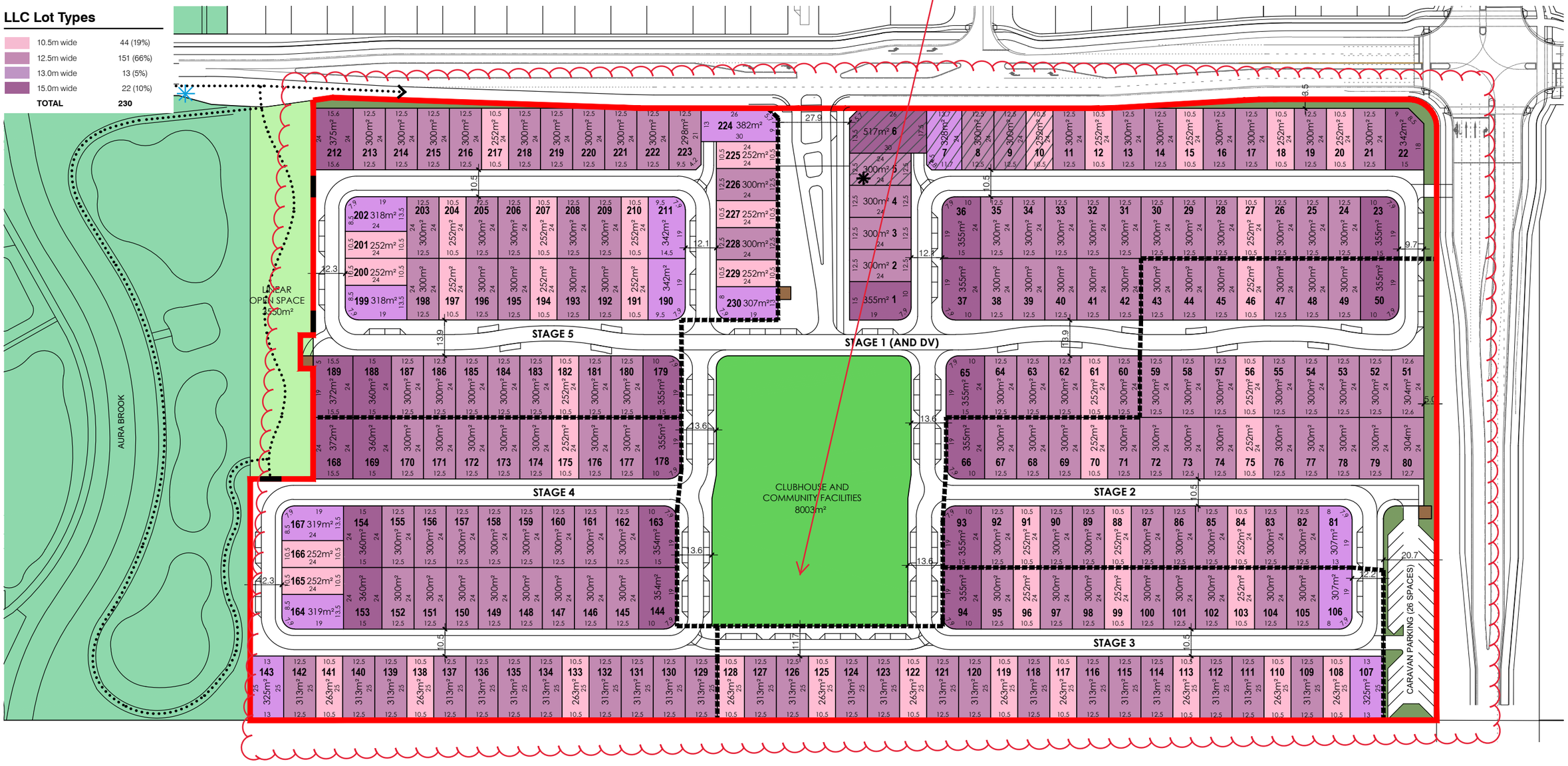
12.5M SITE
300m² SITE

3 BED
2 BATH
3 CAR
198-203m2

15M SITE
360m² SITE

3 BED
2.5 BATH
2 CAR
236m2

Plan to be amended to reflect the current layout



URBIS

AURA LLC
MASTER PLAN - SITE LAYOUT PLAN

1:1500 @ A3

DATE: 17.09.2019
JOB NO: P0013604
DWG NO: ROL01
REV: 5

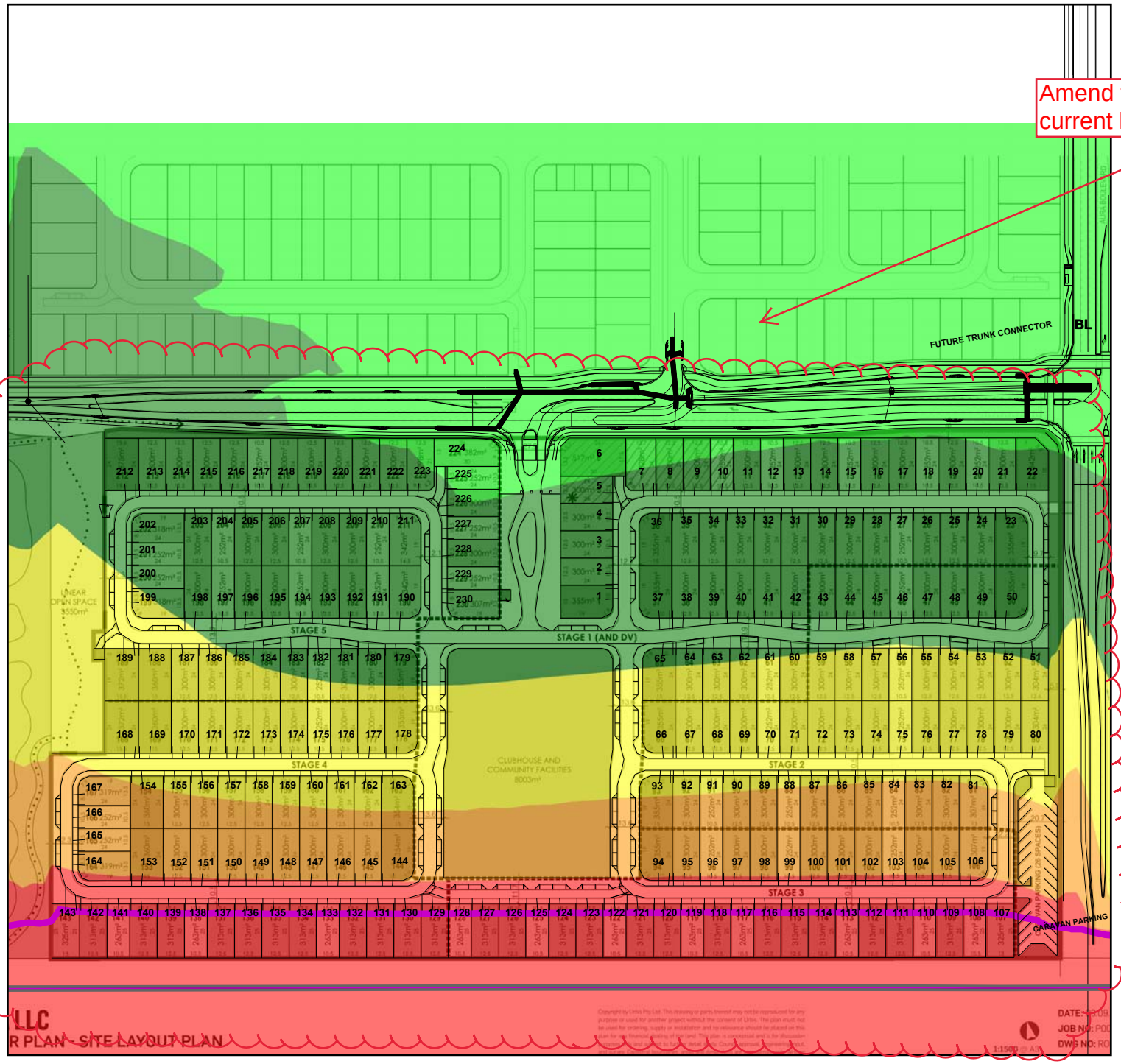
Appendix C Rail Traffic Noise Contours

Land Lease Community Retirement
Project Number: 0244

Amend to reflect current layout

Figure

C.1



Rail Road Noise Contours

No Barriers

Ground Floor, Calculation Height = 1.8m

Date: 29/10/2019
Drawn By: PJ
Prepared For: Stockland Development Pty Ltd

Rail Noise Levels L_{max}

(Facade Corrected) dBA

	<	69.5	MP4.4 Category 0
69.5 <=	<	74.5	MP4.4 Category 1
74.5 <=	<	79.5	MP4.4 Category 2
79.5 <=	<	84.5	MP4.4 Category 3
84.5 <=			MP4.4 Category 4

Signs and symbols

Railway

87 dBA Lmax (Facade Corrected)

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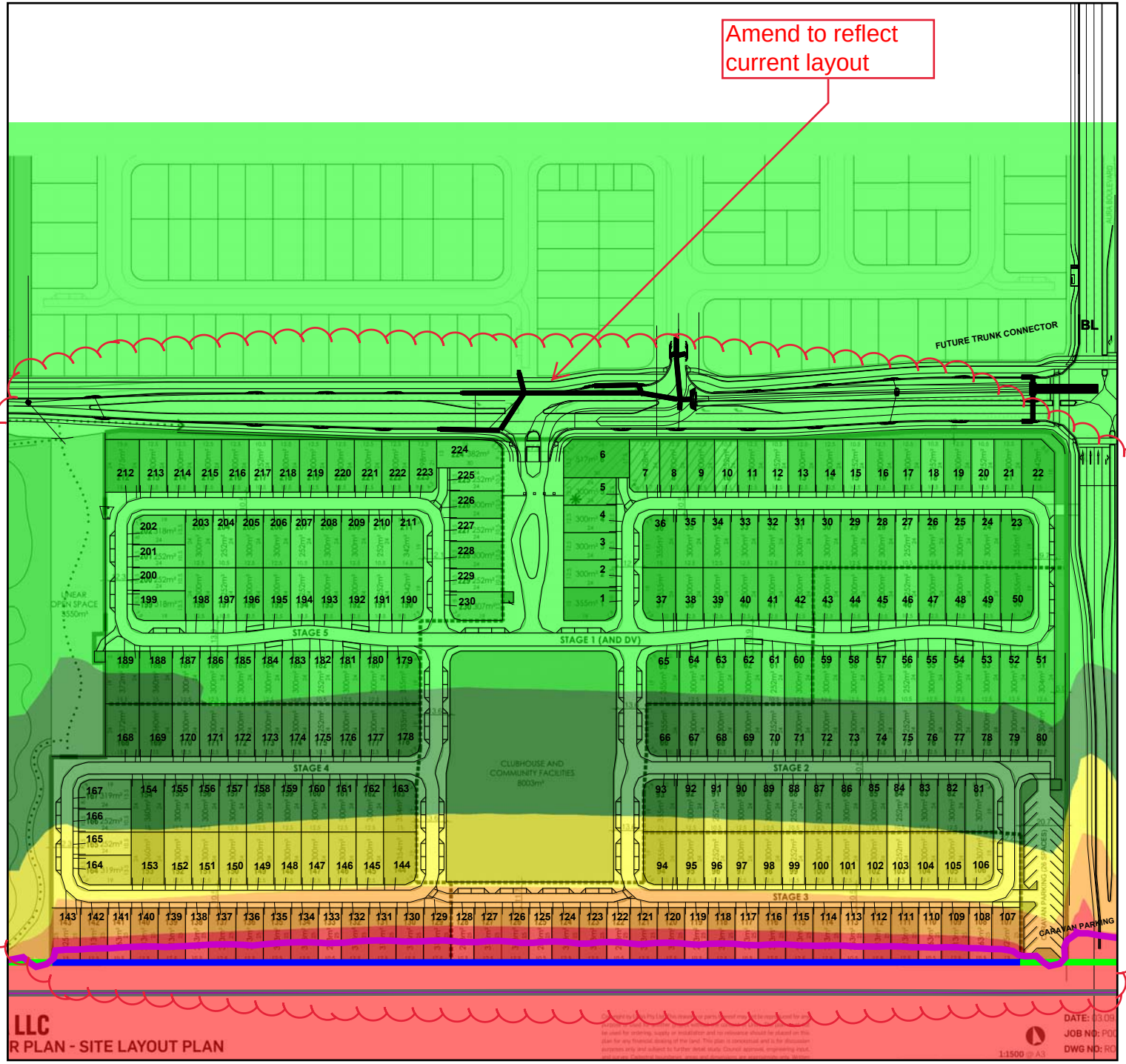
W:\197401\0244 - Land Lease Community Retirement\model\0244R01V01\Figure C.1.sgs



Land Lease Community Retirement
Project Number: 0244

Figure

C.2

Rail Road Noise Contours

1.8m Barrier Shielding the LLC Subject Site.
3.0m Barrier Extended Beyond the LLC Subject Site.
Ground Floor, Calculation Height = 1.8m

Date: 29/10/2019
Drawn By: PJ
Prepared For: Stockland Development Pty Ltd

Rail Noise Levels L_{max}

(Facade Corrected) dBA

	<	69.5	MP4.4 Category 0
69.5 <=	<	74.5	MP4.4 Category 1
74.5 <=	<	79.5	MP4.4 Category 2
79.5 <=	<	84.5	MP4.4 Category 3
84.5 <=			MP4.4 Category 4

Signs and symbols

- Railway
- 1.8m Acoustic Barrier
- 3.0m Acoustic Barrier
- 87 dBA Lmax (Facade Corrected)

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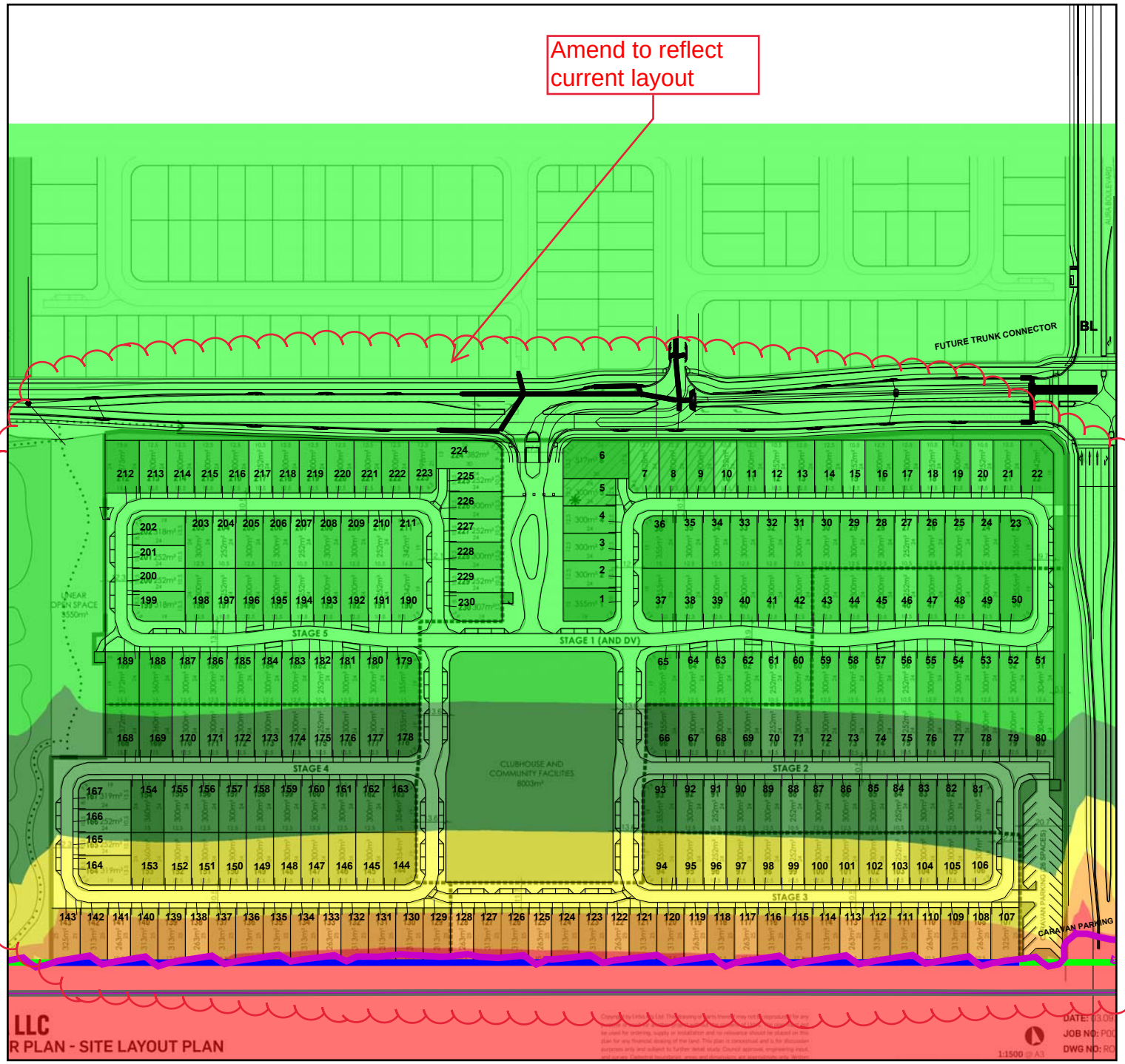
W:\197401\0244 - Land Lease Community Retirement\model\0244R01V01\Figure C.2.sgs



Land Lease Community Retirement
Project Number: 0244

Figure

C.3

Rail Road Noise Contours

2.4m Barrier Shielding the LLC Subject Site.
3.0m Barrier Extended Beyond the LLC Subject Site.
Ground Floor, Calculation Height = 1.8m

Date: 29/10/2019
Drawn By: PJ
Prepared For: Stockland Development Pty Ltd

Rail Noise Levels L_{max}

(Facade Corrected) dBA

	<	69.5	MP4.4 Category 0
69.5 <=	<	74.5	MP4.4 Category 1
74.5 <=	<	79.5	MP4.4 Category 2
79.5 <=	<	84.5	MP4.4 Category 3
84.5 <=			MP4.4 Category 4

Signs and symbols

- Railway
- 2.4m Acoustic Barrier
- 3.0m Acoustic Barrier
- 87 dBA Lmax (Facade Corrected)

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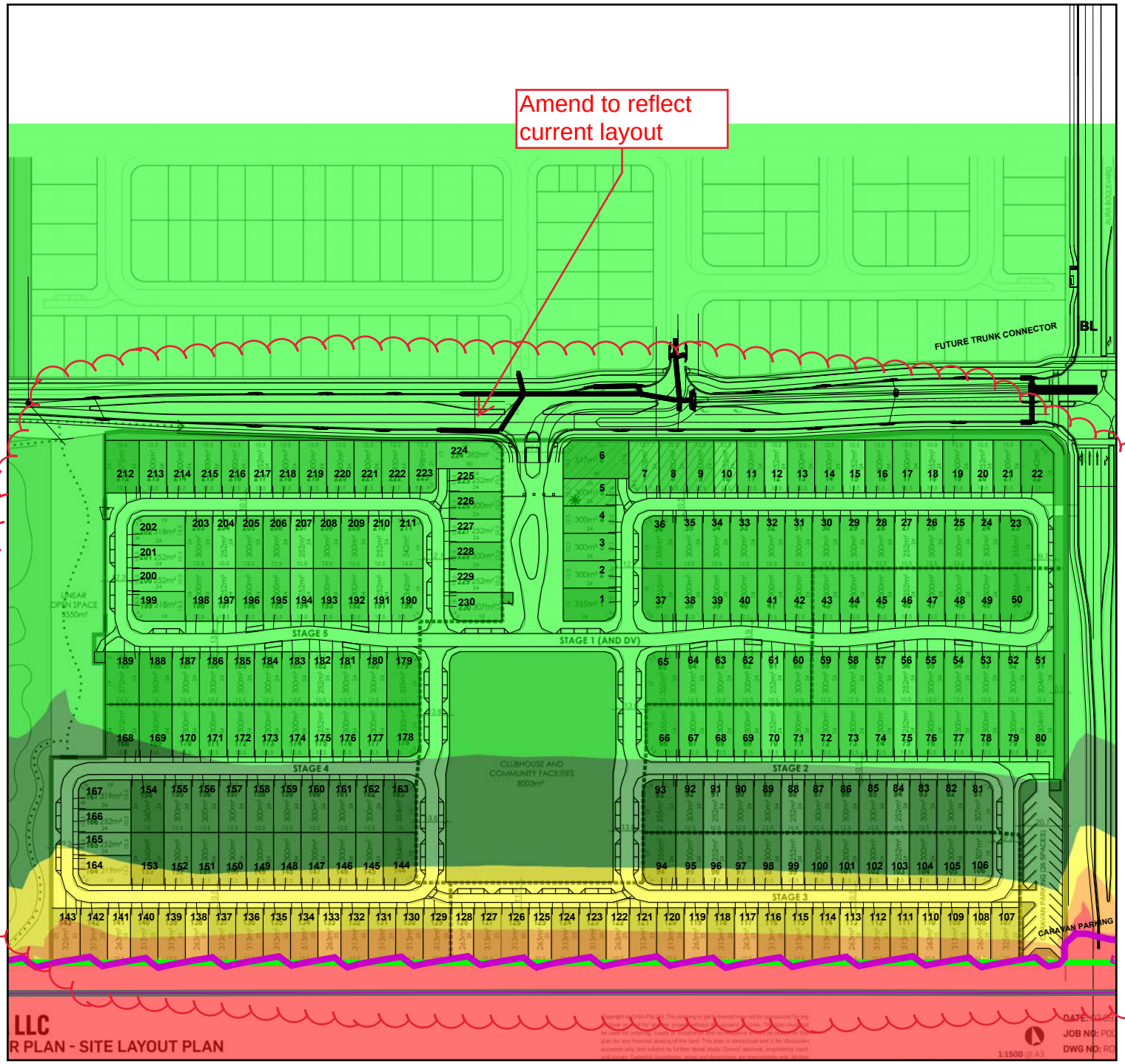
W:\197401\0244 - Land Lease Community Retirement\model\0244R01V01\Figure C.3.sgs



Land Lease Community Retirement
Project Number: 0244

Figure

C.4

Rail Road Noise Contours

3.0m Barrier Shielding the LLC Subject Site.
3.0m Barrier Extended Beyond the LLC Subject Site.
Ground Floor, Calculation Height = 1.8m

Date: 29/10/2019
Drawn By: PJ
Prepared For: Stockland Development Pty Ltd

Rail Noise Levels L_{max}
(Facade Corrected) dBA

	<	69.5	MP4.4 Category 0
69.5 <=	<	74.5	MP4.4 Category 1
74.5 <=	<	79.5	MP4.4 Category 2
79.5 <=	<	84.5	MP4.4 Category 3
84.5 <=			MP4.4 Category 4

Signs and symbols

- Railway
- 3.0m Acoustic Barrier
- 87 dBA Lmax (Facade Corrected)

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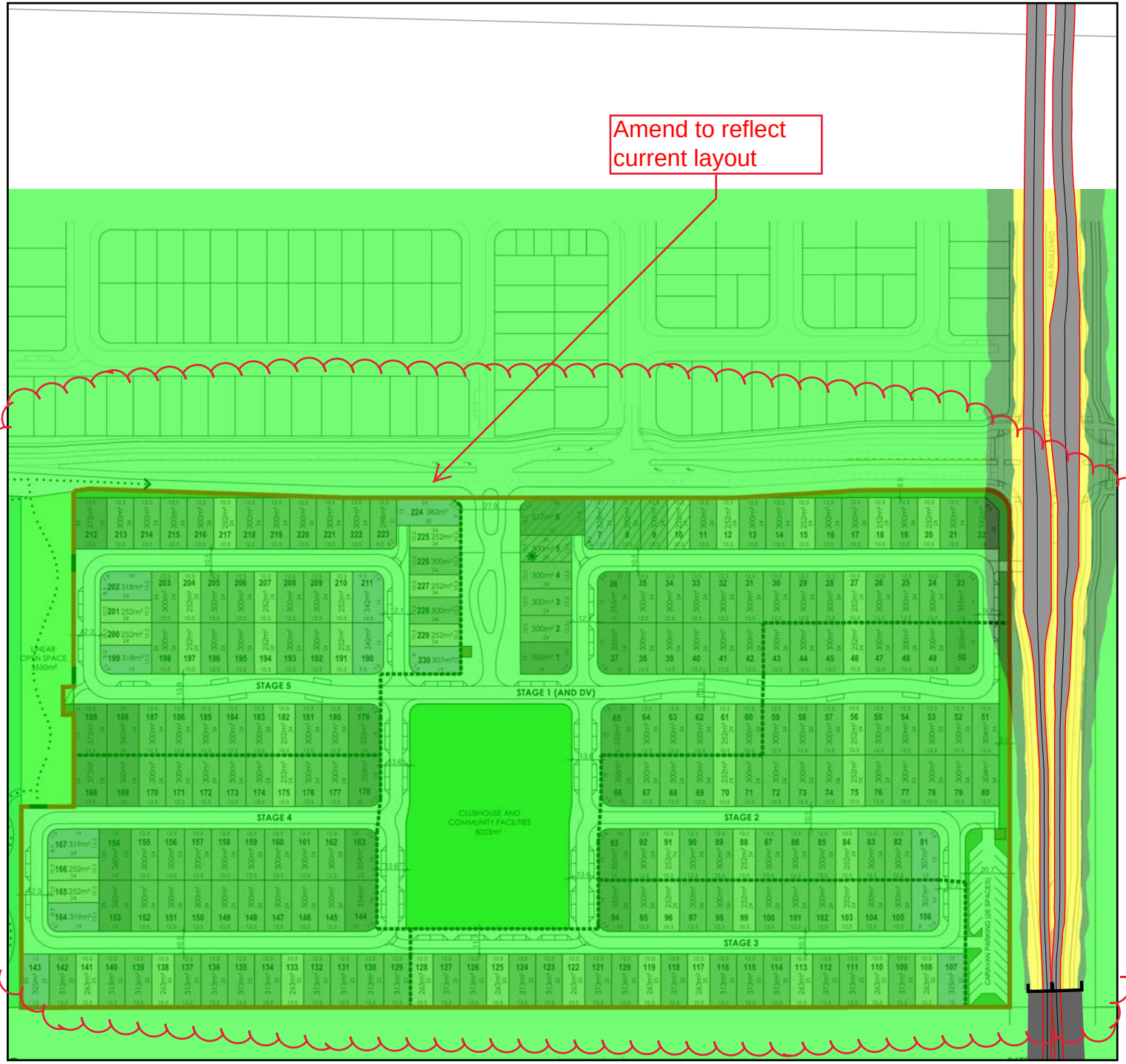
W:\197401\0244 - Land Lease Community Retirement\model\0244R01V01\Figure C.4.sgs

Appendix D Road Traffic Noise Contours

Land Lease Community Retirement
Project Number: 0244

Figure

D.1



North - South Sub-Arterial Road Noise Contours

No Barriers
Ground Floor, Calculation Height = 1.8m

Date: 30/10/2019
Drawn By: PJ
Prepared For: Stockland Development Pty Ltd

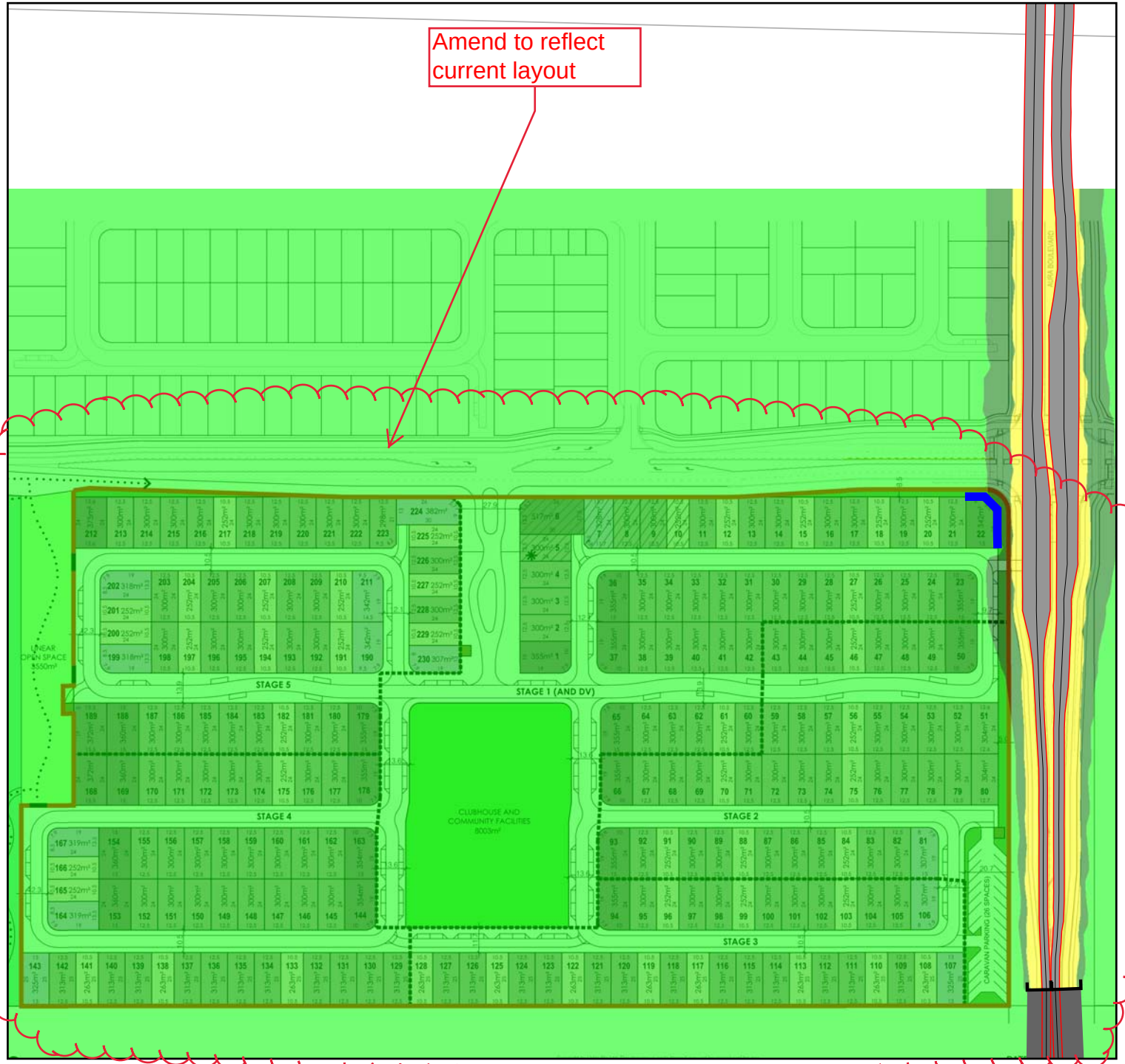
Levels L_{10}(18 hour)
(Facade Corrected) dBA

	<	57.5	MP4.4 Category 0
57.5 <=	<	62.5	MP4.4 Category 1
62.5 <=	<	67.5	MP4.4 Category 2
67.5 <=	<	72.5	MP4.4 Category 3
72.5 <=			MP4.4 Category 4

Signs and symbols
Road
Bridge abutment

ask ACOUSTICS & AIR QUALITY

W:\197401\0244 - Land Lease Community Retirement\model\0244R01V01\Figure E.1.sgs



Land Lease Community Retirement
Project Number: 0244

Figure

D.2

North - South Sub-Arterial Road Noise Contours

1.8m Barrier
Ground Floor, Calculation Height = 1.8m

Date: 30/10/2019
Drawn By: PJ
Prepared For: Stockland Development Pty Ltd

Levels L_{10}(18 hour)
(Facade Corrected) dBA

	<	57.5	MP4.4 Category 0
57.5 <=	<	62.5	MP4.4 Category 1
62.5 <=	<	67.5	MP4.4 Category 2
67.5 <=	<	72.5	MP4.4 Category 3
72.5 <=			MP4.4 Category 4

Signs and symbols
- Road
- Bridge abutment
- 1.8m Acoustic Barrier

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W:\197401\0244 - Land Lease Community Retirement\model\0244R01V01\Figure E.2.sgs