Parkside Yeronga Master Plan

Acoustic Report

Noise Impact Assessment

Prepared for: Economic Development Queensland

Attention: John Marshall

Date: 16 September 2021

Prepared by: Carl Edser

Ref: 301048272

Stantec Australia Pty Ltd
Level 3, 52 Merivale Street, South Brisbane QLD 4101
Tel: +61 7 3029 5000 Web: www.stantec.com

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Revision

Revision	Date	Comment	Prepared By	Approved By
001	16/09/2021	Final	CE/MLL	MLL
002	16/09/2021	Final (minor typos)	MLL	MLL
003	16/09/2021	Final (Figure update)	MLL	MLL
004	16/09/2021	Final (additional assessment figure)	MLL	MLL

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1. Introduction

Stantec Australia Pty Ltd (Stantec) have been engaged by Economic Development Queensland (EDQ) to undertake a noise impact assessment from rail transportation networks for the Parkside Yeronga Master Plan Development Application (Parkside Yeronga project). The project site is located at 70 Park Rd (Lot 3 on SP300888), Yeronga QLD 4104 and is within the Brisbane City Council (BCC).

The purpose of conducting the noise impact assessment is to demonstrate that the completed project can be developed such that all future planned activities and usage remains compliant with the acoustic requirements set by:

- Local council policies and relevant development schemes;
- State-based legislation and regulatory requirements;
- Relevant and current Australian Standards.

This acoustic report forms a part of the development application for consideration by EDQ and relevant State authorities and provides the following:

- Details the site setting in context with surrounding environment;
- Outlines the results of noise measurements conducted at the project site;
- Establishes environmental noise limits applicable at the nearest external noise sensitive land uses, as well as noise limits from external sources impacting the proposed development; and
- Provides details of acoustic assessments undertaken for the project.

The purpose of this report is to assist in determining which lots within the subdivision will be subject to acoustic requirements. Since the actual noise level on the building facades will depend on the location of each sensitive space within dwellings relative to the adjoining railway, the acoustic categories specified in this report are subject to change. The actual noise categories must be defined for the individual dwelling designs during the Development Application (DA) stage.

Noise monitoring was conducted on site as part of the study. Results from the survey were used to inform the acoustic modelling conducted to predict future rail noise levels on site using a computer noise model developed of the site. Each individual lot was given a noise category based on the noise predictions of rail noise.

A glossary of acoustic terms used in this report a glossary is included in **Appendix A.**

2. Referenced Documentation

2.1 Regulations, Policies, Standards and Guidelines

The following documents detailed in **Table 1** are relevant to the project and are referred to throughout this report.

Table 1: Applicable Regulations, Policies, Standards and Guidelines referenced in this report

Title	Abbreviation
State Development Assessment Provisions Version 2.6 (effective 7 February 2020 from Department of Infrastructure, Local Government and Planning)	SDAP
Queensland Development Code Mandatory Part 4.4 – *Buildings in a Transport Noise Corridor* Version 1.1 (published 17 August 2015 from Department of Housing and Public Works)	QDC MP4.4
Australian Standard AS 1055.1-1997 Acoustics – Description and measurement of environmental noise	AS 1055
International Standards Organization 9613-2:1996 Attenuation of sound during propagation outdoors – Part 2: General method of calculation	ISO 9613
Yeronga Priority Development Area - Development Scheme published by the Department of State Development, Manufacturing, Infrastructure and Planning August 2019	YDS

2.2 Study Inputs

Acoustic assessment and the preparation of this report have been conducted based on the following received documentation detail in **Table 2**.

Table 2: Received documentation

Date Received	Details	Revision / Date Prepared	Prepared by	Format
8th Sept 2021	210908 Existing Terrain.dxf Existing terrain supplied by civil designers	8th Sept 2021	Stantec	3D DXF
	210908 Proposed ROL Boundaries.dxf Proposed Reconfiguration of Lot Boundaries			
	210908 Proposed Terrain.dxf Proposed finished terrain levels designed by Civil designers			
-	Nearmap Aerial Photography Used to determine and location of existing buildings nearby to the site.	Photography date: 26th August 2021	Nearmap.com	-

3. Project Details

3.1 Site Description

The project site is located at 70 Park Rd (Lot 3 on SP300888), Yeronga QLD 4104 and is within the Brisbane City Council (BCC). The site is exposed to noise emissions from passenger and freight rail transportation lines situated to the north of the site. The railway line is a primary passenger connection route between Gold Coast, Logan and Brisbane council regions.

The project site has been shown in context with the rail line existing surrounding developments and noise monitoring locations (conducted by Stantec and discussed in **Section 3.3**) in **Figure 1**.

Figure 1: Project site and noise monitoring location

Source: Nearmap (image dated 26/08/2021, accessed 15/09/2021)

3.2 Proposed Development

The proposal seeks a PDA Preliminary Approval for a material change of use and a PDA Development Permit for a reconfiguring a lot (1 into 14 lot subdivision, road and park). The proposed staging is:

- Stage 1: 3 lot subdivision to establish lots 1, 11 easements and balance lot (lot 500).
- Stage 2a: 8 lot subdivision of balance lot (lot 500) to establish lots 3, 4, 5, 6, 789, 10, 21, 22 and easements.
- Stage 2b: volumetric easements (Public Plaza).
- Stage 3: 5 lot subdivision of Lot 789 to establish lots 7, 8, 9, 12 and 13 and easements.

The proposal seeks a PDA preliminary approval for a material change of use in accordance with a masterplan for the development of four precincts for a range of residential, commercial and community uses, including multiple dwelling, retirement living, office, shop and community facilities.

The proposed arrangement of the precincts is shown below in **Figure 2** with the Site masterplan shown in **Figure 3**.

Figure 2 Proposed Precincts (Source: UD and Landscape Report prepared by Archipelago)

Figure 3 Illustrative Master Plan (Source: UD and Landscape Report prepared by Archipelago)

3.3 Site Noise Measurements

3.3.1 Unattended Noise Measurement Method

To quantify the existing noise environment on site and degree of exposure to noise associated with rail transport, unattended noise monitoring (noise logging) was conducted from Friday 23rd April 2021 to Friday 30th April 2021 (inclusive).

The location of the noise monitoring location has been shown in **Figure 1**.

Noise measurements were conducted following guidance from Australian Standard AS 1055:2018 – *Acoustics – Description and measurement of environmental noise*, and the instruments were configured as follows:

- A-weighting frequency response;
- FAST time response; and
- 15-minute, 1 minute and 1 second intervals.

The sound level meter was calibrated before and after the measurement period. The instrument showed a drift less than ±1 dB during the course of monitoring; therefore, measurements are considered valid according to AS 1055:2018. Complete details and full measured results, refer to the details presented in **Appendix B**.

3.3.2 Site Averaged Noise Levels

A summary of relevant of the average unattended noise levels recorded at each measurement location from Friday 23rd April 2021 to Friday 30th April 2021 (inclusive) presented in **Table 3**. For further details and full measured results, refer to **Appendix B**.

Table 3: Summary of relevant noise descriptors used to determine noise limits and inform acoustic assessment

Equivalent Continuous Noise Level, L_{eq} dB(A)			Rating Background Level, RBL dB(A)			Background Noise Level, $L_{90,T}$ dB(A)			$L_{10,18hr}$ dB(A)
Day [1)]	**Evening** [1)]	**Night** [1)]	**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**	
62	61	58	45	45	35	45	49	38	61
NOTES: 1) Day – 7am-6pm | Evening – 6pm-10am | Night – 10pm-7am									

3.3.3 Existing Railway Noise Levels

In addition to establishing the general acoustic profile at the project site, the purpose of unattended noise monitoring was to quantify noise levels associated with rail transport service. According to the Queensland Rail Code of Practice – Railway Noise Management;

> *"The Single Event Maximum Level provides a way to account for the potential disturbance based on peak maximum levels. Typically, on rail lines through urban areas, the Single Event Maximum Level is determined from highest 15 peak maximum levels over a 24-hour period."*

The measured data and captured audio files (described by **Appendix B**) was processed and analysed for each 24-hour period. A summary of the worst-case 15 peak maximum levels over a 24-hour period, which were measured on the Saturday 24th April 2021, as well as the calculated single event maximum noise level have been provided in **Table 4**.

Table 4: Calculation of Single event maximum noise level (SEM) 24-hour period (measured Saturday 24th April 2021)

Time	Train Type	Measurement Distance (m)	Measured Level L_{max} dB(A)
12:03:58	Passenger Train 1	24	85
18:35:13	Passenger Train 2		84.8
20:51:10	Passenger Train 3		83.9
11:51:43	Passenger Train 4		83.8
16:21:32	Passenger Train 5		83.2
21:04:10	Passenger Train 6		83.1
9:43:50	Passenger Train 7		82
9:44:45	Freight Train 1		81.9
14:21:03	Passenger Train 8		81.9
18:45:36	Passenger Train 9		81.8
16:35:05	Passenger Train 10		81.7
15:41:40	Passenger Train 11		81.3
14:21:04	Passenger Train 8		81.1
18:39:23	Freight Train 2		80.2
21:09:02	Freight Train 3		80
Single event maximum noise level (SEM)			**82.4**
Leq,24hour dB(A)			**59.8**

4. Noise Criteria

4.1 Yeronga Priority Development Area - Development Scheme

This document has a single requirement regarding noise intrusion on the site within ***Section 2.5.6 Community safety and development constraints***:

The siting, design, construction and operation of development supports community safety and gives appropriate consideration to development constraints by:…..

…… 3. avoiding, to the greatest extent practicable, then managing or mitigating significant adverse impacts:

a. *from air pollution and light nuisance*
b. *from noise emissions on sensitive uses41, including those from transport noise corridors, and c. on the environment,*

4.2 State Development Assessment Provisions V2.6

The ***State Development Assessment Provisions v2.6*** (SDAP) defines the state's interest in development assessment in the proximity to infrastructure. Within SDAP, ***State code 2: Development in a railway environment*** details the specific requirements for the assessment of railway noise in **Table 2.2.2: Environmental emissions**.

The relevant Performance Outcome (PO) and Acceptable Outcomes (AO) are reproduced from the Code in **Table 5**.

Table 5: Performance Outcomes and Acceptable Outcomes (reproduced from Table 2.2.2 of State Code 2)

Performance outcomes	Acceptable outcomes
Noise	
Accommodation activities	
PO25 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.	**AO25.1** 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) L_{eq} (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.* *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:
	AO25.2 Buildings which include a habitable room are setback the maximum distance possible from a railway or type 2 multi-modal corridor. AND
	AO25.3 Buildings are designed and oriented so that habitable rooms are located furthest from a railway or type 2 multi-modal corridor. AND
	AO25.4 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. *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.* *To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report be provided.* *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.*
PO26 Development involving an accommodation activity minimises noise intrusion from a railway or type 2 multi-modal corridor in outdoor spaces for passive recreation.	**AO26.1** 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) L_{eq} (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
	AO26.2 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
	AO26.3 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).
Childcare centres and educational establishments	
PO27 Development involving a: 1. childcare centre; or 2. educational establishment minimises noise intrusion from a	**AO27.1** 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) L_{eq} (1 hour) façade corrected (maximum hour during opening hours) 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 that a RPEQ certified noise assessment report be provided.*

Performance outcomes	Acceptable outcomes
railway or type 2 multi-modal corridor in indoor education areas and indoor play areas.	*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.* OR all of the following apply:
	AO27.2 Buildings which include an indoor education area, indoor play area or sleeping room are setback furthest from a railway or type 2 multi-modal corridor as possible. AND
	AO27.3 Buildings are designed and oriented so that indoor education areas, indoor play areas or sleeping rooms are located furthest from a railway or type 2 multi-modal corridor. AND
	AO27.4 Buildings are designed and constructed using materials which ensure indoor education areas and indoor play areas meet the following internal noise criteria: 1. ≤50 dB(A) single event maximum sound pressure level. AND
	AO27.5 Buildings are designed and constructed using material which ensure sleeping rooms in a childcare centre meet the following internal noise criteria: 1. ≤45 dB(A) single event maximum sound pressure level. *Note: Noise levels from railways or type 2 multi-modal corridors are measured in accordance with AS1055.1–1997 Acoustics – Description and measurement of environmental noise.* *To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report be provided.*
PO28 Development involving a: 1. childcare centre; or 2. educational establishment minimises noise intrusion from a railway or type 2 multi-modal corridor in outdoor education areas and outdoor play areas.	**AO28.1** A noise barrier or earth mound is provided which is designed, sited and constructed: 1. to meet the following external noise criteria in each outdoor education area or outdoor play area: a. ≤62 dB(A) L_{eq} (24 hour) free field (between 6am and 6pm) 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. *Note: To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report be provided.* OR
	AO28.2 Each outdoor education area and outdoor play area is shielded from noise generated from a railway or type 2 multi-modal corridor by a building, a solid gap-free fence, or other solid gap-free structure.

4.3 Queensland Development Code Mandatory Part 4.4

The Queensland Development Code Part MP 4.4 - *'Buildings in a Transport Noise Corridor'* August 2015 (QDC MP4.4) specifies Noise Categories to ensure that habitable rooms of residential buildings are adequately protected from transport noise with allowance for 10 years growth.

The purpose of the QDC MP4.4 is to ensure any habitable rooms of Class 1, 2, 3 and 4 buildings located in a transport noise corridor are designed and constructed to reduce transport noise and protect the occupants inside dwellings. The Code requires that each external facade of a habitable room be assigned a noise category, which is dependent upon the future noise exposure at the façade.

The Code applies at the time of Building Approval for buildings on the subject site. It is responsibility of the building certifier to assess the building design against the provisions of the Code or an assessment undertake by a noise assessment which is specific to the building and its noise with surrounding buildings and screening. It must be prepared by a suitably qualified person.

The objective of the noise assessment is to clearly demonstrate that the noise category that is applicable to a particular part of or entire building, or site. The applicable criteria for determining the relevant noise category are reproduced in **Table 6** below.

Table 6 MP 4.4 Noise category levels

Noise Category	Single event maximum noise* (L_{Amax}) for railway land
Category 4	≥ 85 dB(A)
Category 3	80 – 84 dB(A)
Category 2	75 – 79 dB(A)
Category 1	70 - 74 dB(A)
Category 0	≤ 69 dB(A)

* measured at 1 m from the façade of the proposed building.

Acceptable solutions for the external envelope of each habitable room in a relevant residential building must comply with the nominated minimum acoustic rating for each building component specified in Schedule 1 of the Code to achieve a minimum transport noise reduction level for the relevant noise category by either using :

(a) using materials specified in Schedule 2 of the Code; or

(b) using materials with manufacturer's specifications that, in combination, achieve the minimum Rw value for the relevant building component and applicable noise category.

5. Predicted Levels of Railway Noise

5.1 Rail noise modelling

A rail noise model was created to predict the noise intrusion onto the development site from the adjoining rail line. Rail noise calculations were conducted with the SoundPLAN implementation of the Nordic Rail Prediction Method (Kilde Rep.130) used for both passenger and freight rail noise, which is recommended in TMR document *Attachment A - Railway Noise Assessment Report Structure and Specific Issues*.

To predict the noise impacts onto and from the Project, a three-dimensional computer model of the site was built using SoundPLAN 8.2 acoustic software. The computer model was created as a representation of the existing and future site, which incorporates the following inputs:

- Calculation algorithms – SoundPLAN implementation of the accepted noise prediction standards;
- Terrain elevation – A 3D representation of the existing terrain;
- Ground surface corrections – Areas of soft (absorptive) and hard (reflective) ground;
- Rail lines – The placement of each rail line as a source line and the input of traffic flow parameter; and
- Shielding effects – As provided by buildings and noise barriers;
- Sensitive receptors – Locations where the noise limits are to be assessed;
- Propagation effects – The attenuation of sounds as it travels through the atmosphere and attenuates over distance.

Noise predictions were conducted in the form of noise contour maps across the site, in the absence of detailed building designs at this stage.

Specific detail of the rail modelling inputs and assumptions is provided in **Appendix C**.

5.2 Rail traffic model verification

The rail model is to be considered verified when the difference between the measured and predicted noise levels at the monitoring location is less than ±2 dB(A). The SEM is calculated using the TMR guideline, the values in **Table 7** result.

Table 7: Rail traffic noise model verification

Location	Noise descriptor	Monitor Location predicted noise level	Measured noise level	Difference
Monitoring Location	SEM[1]	**82.5**	**82.4**	-0.1
	$L_{Aeq,24hr}$[2]	**59.6**	**59.8**	+0.2

The model has therefore been validated and has been used without correction

5.3 Predicted Railway Noise Levels

This section presents the results of noise intrusion predictions that were conducted to estimate the extent of rail noise noise impacts onto the individual lots. A discussion of results and recommendations to mitigate the noise impacts is presented in **Section 6**.

5.3.1 Predicted Noise Levels - LAmax

Predicted rail noise contours across the site are included in **Appendix D** as follows in **Table 8**:

Table 8 Predicted rail noise contours

Figure	Assessment
Figure 6	Predicted Future Rail Noise Levels 2031 at 1.5m AGL (Façade Corrected)
Figure 7	Predicted Future Rail Noise Levels 2031 at 1.5m AGL (Free-field)
Figure 8	Rail Noise MP 4.4 Categories at 1.5m AGL
Figure 9	Rail Noise MP 4.4 Categories at 7.5m AGL
Figure 10	Rail Noise MP 4.4 Categories at 13.5m AGL

5.3.2 Predicted Noise Levels - – LAeq (24hr)

The predicted $L_{Aeq\ (24\ hour)}$ rail noise level at the measurement location which is closer to the rail line and more affected than any other point on the site is less than 59.8 dB(A) (free-field) based on current number of trains per day. This complies with the SDAP criteria for both external façade and private open space with allowance for future rail traffic growth.

As compliance is achieved at the most affected point on the site to the rail line and all other receptors are further removed than this point, compliance is will be achieved across the site. No further assessment is warranted.

6. Assessment of Railway Noise

6.1 Assessment - State Development Assessment Provisions V2.6

The ***State Development Assessment Provisions v2.6*** (SDAP) defines the state's interest in development assessment. It contains the matters the State Assessment Referral Agency (SARA) considers where there is a matter of interest to the State. Within SDAP, ***State code 2: Development in a railway environment*** details the specific requirements for the assessment of railway noise in **Table 2.2.2: Environmental emissions**.

The relevant Performance Outcome (PO) and Acceptable Outcomes (AO) are reproduced from the Code in **Table 5**. Note that the criteria for childcare centre does not apply.

Table 9: Performance Outcomes and Acceptable Outcomes (reproduced from Table 2.2.2 of State Code 2)

Performance outcomes	Acceptable outcomes	Response
Noise		
Accommodation activities		
PO25 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.	**AO25.1** 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: c. ≤65 dB(A) L_{eq} (24 hour) façade corrected d. ≤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. 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:	A noise barrier provides a reduction in noise levels by the obstruction of line-of-sight between the noise sources and receptor. At this site, the railway corridor is elevated above the site ground levels by up to 4 metres. The proposed development is also likely to consist of multiple storeys building which have receptors well elevated above the finish levels on the site. Furthermore, the main noise source on diesel trains is the exhaust which is located 3.5m above the track level. To provide any reduction the barrier would need to be more than 6 to 7.5 metres tall above the site. This is not an effective and practical method to provide a noise reduction. It would also potentially obstruct views to the north, and unlikely to be acceptable as it would result in maintenance difficulties where it adjoined the railway embankment. Acceptable outcome **AO25.2, 3 and 4** present below are the preferred solution to the management of rail noise across the site and have been considered further following.

Performance outcomes	Acceptable outcomes	Response
	AO25.2 Buildings which include a habitable room are setback the maximum distance possible from a railway or type 2 multi-modal corridor. AND	This requirement forms part of building design which are part of future applications on the site.
	AO25.3 Buildings are designed and oriented so that habitable rooms are located furthest from a railway or type 2 multi-modal corridor. AND	This requirement forms part of building design which are part of future applications on the site.
	AO25.4 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. 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. To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report be provided. 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.	This requirement forms part of building design which are part of future applications on the site. However, the relevant information for assessment of rail noise across the site against **PO25.4** is provided on **Figure 8,9 and 10.** These figures show noise contours for each of the MP4.4 categories across the entire site at various height above the finished ground levels.
PO26 Development involving an accommodation activity minimises noise intrusion from a railway or type 2 multi-modal corridor in outdoor spaces for passive recreation.	**AO26.1** 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: c. ≤62 dB(A) L_{eq} (24 hour) free field d. ≤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	The relevant information for assessment of rail noise across the site against **PO26** is provided on **Figure 7** which shows noise contours across the entire site at 1.5m above the finished ground levels. While the noise criteria is exceeded across most of the Public open space precinct against the rail corridor, compliance would be achieved on the Green Spine Area and in the areas of the Community Precinct Areas at the southern end of the site.
	AO26.2 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.	Where the outdoor space criteria are exceeded on Multiple Dwelling lots at the northern end of the site, passive recreation within each lot will need to be assessed as part of individual development applications after following the PDA Preliminary Approval. On these lots, use can

Performance outcomes	Acceptable outcomes	Response
	AND	be made of shielding provided by building forms and noise barriers within each lot.
	AO26.3 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).	This requirement forms part of building design which are part of future applications on the site.
Childcare centres and educational establishments		
PO27 Development involving a: 1. childcare centre; or 2. educational establishment minimises noise intrusion from a railway or type 2 multi-modal corridor in indoor education areas and indoor play areas.	**AO27.1** 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: c. ≤65 dB(A) L_{eq} (1 hour) façade corrected (maximum hour during opening hours) d. ≤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 that a RPEQ certified noise assessment report be provided. 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. OR all of the following apply:	It is possible that a Childcare use is included in the Community Precinct and/or Commercial Precinct which are located at the Southern end of the site. The relevant information for assessment of rail noise across the site against **PO27** is provided on **Figure 8,9 and 10** which show noise contours across the entire site at various height above the finished ground levels. At the southern end of the site where these potential uses occur, predicted noise levels are well below the permissible SEM noise level of 87 dB(A).
	AO27.2 Buildings which include an indoor education area, indoor play area or sleeping room are setback furthest from a railway or type 2 multi-modal corridor as possible. AND	This requirement forms part of building design which are part of future applications on the site.
	AO27.3 Buildings are designed and oriented so that indoor education areas, indoor play areas or sleeping rooms are located furthest from a railway or type 2 multi-modal corridor. AND	This requirement forms part of building design which are part of future applications on the site.

Performance outcomes	Acceptable outcomes	Response
	AO27.4 Buildings are designed and constructed using materials which ensure indoor education areas and indoor play areas meet the following internal noise criteria: 2. ≤50 dB(A) single event maximum sound pressure level. AND	This requirement forms part of building design which are part of future applications on the site.
	AO27.5 Buildings are designed and constructed using material which ensure sleeping rooms in a childcare centre meet the following internal noise criteria: 2. ≤45 dB(A) single event maximum sound pressure level. Note: Noise levels from railways or type 2 multi-modal corridors are measured in accordance with AS1055.1–1997 Acoustics – Description and measurement of environmental noise. To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report be provided.	This requirement forms part of building design which are part of future applications on the site.
PO28 Development involving a: 1. childcare centre; or 2. educational establishment minimises noise intrusion from a railway or type 2 multi-modal corridor in outdoor education areas and outdoor play areas.	**AO28.1** A noise barrier or earth mound is provided which is designed, sited and constructed: 1. to meet the following external noise criteria in each outdoor education area or outdoor play area: c. ≤62 dB(A) L_{eq} (24 hour) free field (between 6am and 6pm) d. ≤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. Note: To demonstrate compliance with the acceptable outcome, it is recommended that a RPEQ certified noise assessment report be provided. OR	It is possible that an outdoor childcare areas is included in the Community Precinct and/or Commercial Precinct which are located at the Southern end of the site. The relevant information for assessment of rail noise across the site against **PO28** is provided on **Figure 7** which shows noise contours across the entire site at various height above the finished ground levels. At the southern end of the site, where these potential uses occur, it can be seen that predicted noise levels are well below the permissible SEM noise level of 84 dB(A) Free Field.
	AO28.2 Each outdoor education area and outdoor play area is shielded from noise generated from a railway or type 2 multi-modal corridor by a building, a solid gap-free fence, or other solid gap-free structure.	This requirement forms part of building design which are part of future applications on the site.

6.2 Assessment - Queensland Development Code Mandatory Part 4.4

The relevant information for assessment of rail noise across the site against QDC MP4.4 is included in **Appendix D** and are described in **Table 8**. These figures show noise contours for each of the MP4.4 categories across the entire site at various height above the finished ground levels.

Table 10 Predicted rail noise contours

Figure	Assessment
Figure 8	Rail Noise MP 4.4 Categories at 1.5m AGL
Figure 9	Rail Noise MP 4.4 Categories at 7.5m AGL
Figure 10	Rail Noise MP 4.4 Categories at 13.5m AGL

6.3 Assessment – Summary of Acoustic Requirements

Figure 4 shows a summary assessment against the various requirements of SDAP and MP4.4.

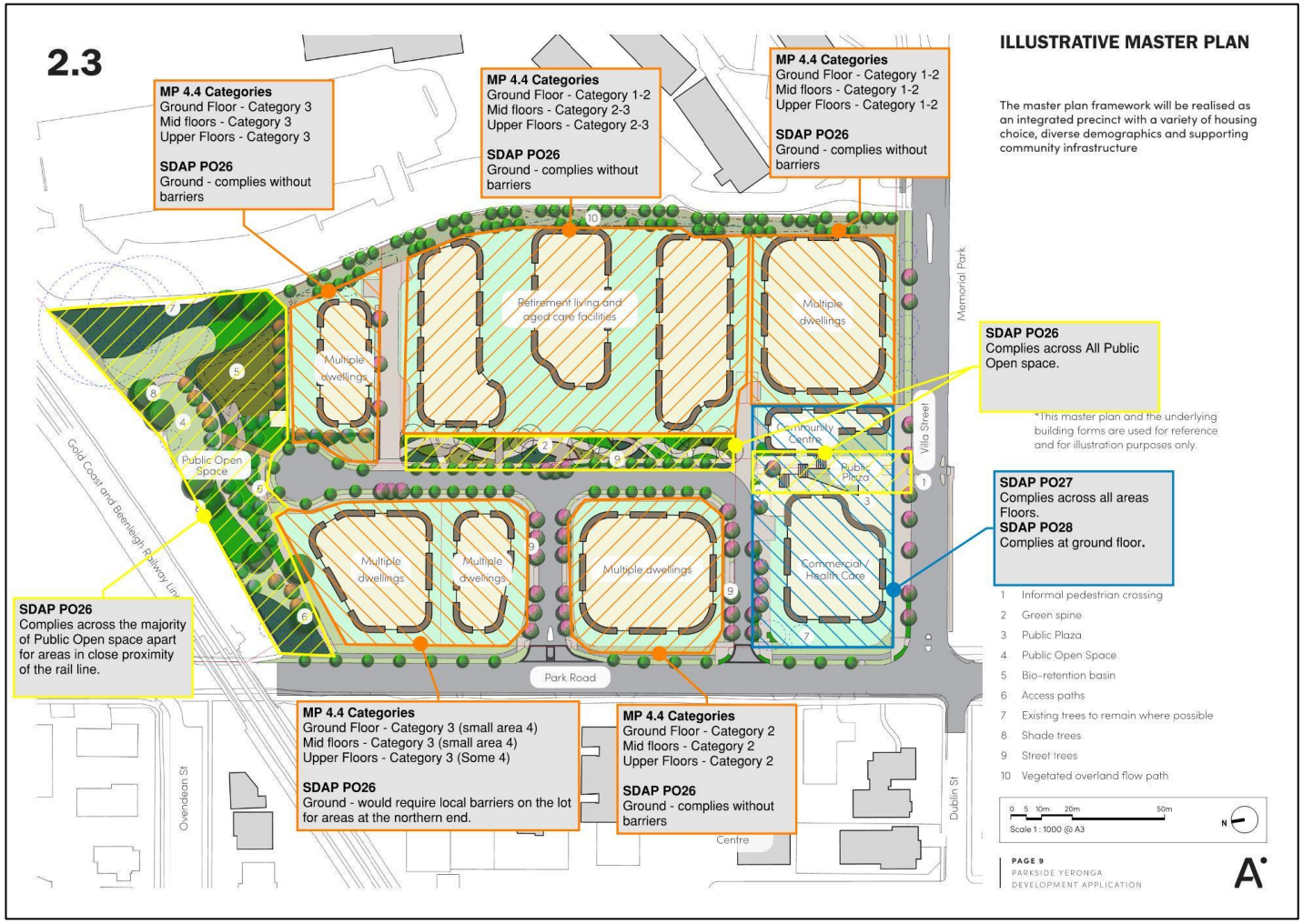

Figure 4 - Illustrative Master Plan and Summary of predicted MP4.4 Categories

7. Conclusion

A noise impact assessment has been conducted for the proposed Parkside Yeronga Development and the following conclusions have been reached:

- Noise monitoring was conducted to determine the existing noise levels on site and computational modelling was used to forecast railway noise levels on site to determine suitable mitigation treatments to reduce future noise impacts.
- Assessment against the various requirements of SDAP are provided in **Table 5**. A summary of the outcomes is provided in **Figure 4**.
- The relevant QDC MP 4.4 categories have been determined from noise contours as shown in **Appendix D** and a summary of the Categories is provided in **Figure 4** for each area of the site.
- It is proposed to manage noise affected buildings on the site through the use of QDB MP4.4 and the use of approval conditions of the preliminary approval.

It is noted that the actual noise level on the building facades of the individual rooms will depend on:

a) the location of each sensitive space within the affected dwellings relative to the rail corridor; and
b) the screening provided by the intervening buildings between the room and the railway.

Currently the study does not take these elements into account as the building forms are unknown. Therefore, the acoustic categories specified in this report are subject to change. The actual noise categories may be defined for the individual dwelling designs during the Development Application stage and/or Building Approval Stage.

Based on the noise assessment conducted, the future dwellings can be designed to achieve compliant noise levels by implementing adequate acoustic measures into the architectural design.

8. Recommendations

The recommended acoustic treatments to achieve compliance with the requirements of SDAP are as follows:

- Condition a noise impact assessment for any application on each lot within the site when an application is made.
- Condition all development on the site, which is a Class 1, 2 or 4 building as defined by the National Code for Construction to comply with the minimum requirements of QDC MP4.4.
- Condition all development on the site, which includes a childcare centre; or educational establishment to comply with the minimum requirements of SDAP for the nominated uses.

Should you have any queries regarding this report, please do not hesitate to contact the undersigned.

Thanks,

Stantec Australia Pty Ltd

Michael Lanchester
**Associate, Acoustics Section Manager **

Appendix A Glossary of Acoustic Terms

TERM	DEFINITION
Acceptable Noise Level:	The acceptable L_{Aeq} noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receptor location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level.
Decibel [dB]:	The units of sound pressure level.
dBA:	A-weighted decibels. Noise measured using the A filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
L_{Amax}	The maximum A-weighted sound pressure level measured over a period.
L_{Amin}	The minimum A-weighted sound pressure level measured over a period.
L_{A1}	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
L_{A10}	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
L_{A90}	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dBA.

L_{Aeq}	The A-weighted “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
L_{AeqT}	The constant A-weighted sound which has the same energy as the fluctuating sound of the traffic, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R_w:	The Sound Insulation Rating R_w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

Appendix B Noise Monitoring Details

Unattended noise logging was conducted from Friday 23rd April 2021 to 30th April 2021 (inclusive) at the location shown in **Figure 1** (coordinates in **Table 11**). This location was selected due to a high degree of exposure to the railway line.

Table 11: Noise monitoring coordinates

Monitor	Latitude	Longitude
001	-27.515506	153.020467

The following instrumentation was used:

- An NTi XL2 Class 1 sound level meter (S/N A2A-12892-E0), and Pulsar 105 Class 1 acoustic calibrator (S/N 72913). The instrument had a current calibration certificate by a certified National Association of Testing Authorities (NATA) acoustics laboratory at the time of measurements.

Noise measurements were conducted in accordance with Australian Standard AS 1055.1-1997 – *Acoustics – Description and measurement of environmental noise*, and the instruments were configured as follows:

- A-weighting frequency response;
- FAST time response;
- 15-minute, 1 minute and 1 second intervals.

The sound level meter was calibrated before and checked at the end of the measurement period. The instrument showed a drift less than ±1 dB during the course of monitoring; therefore, measurements are considered valid according to AS1055.1-1997.

Audio was recorded during the measurements period and used for the purpose of identifying contributing noise sources.

Noise monitoring results

The raw sound level meter files were post-processed to determine relevant long-tern noise descriptors, some of which were used to determine the applicable noise limits.

Results and time trace plots of relevant noise descriptors are provided below (see **Table 12** and **Figure 5**). Where data was not measured for a full period (i.e. at the start and end of measurement), the cells are shown dashed in the table. In addition, the noise descriptor averages are presented.

A summary of weather observations by the Bureau of Meteorology (BoM) during the monitoring period is presented in **Table 13**. Where adverse weather (e.g. rain, excessive wind) occurred within the monitoring period, the measured data has been excluded.

Table 12: Summary of measured noise levels (rounded)

Noise descriptor	Average	23-Apr-21	24-Apr-21	25-Apr-21	26-Apr-21	27-Apr-21	28-Apr-21	29-Apr-21
$L_{A10(18hr),6am-12am}$	61	—	61	60	60	62	62	62
$L_{Aeq,7am-6pm}$	62	—	61	60	60	63	64	63
$L_{Aeq,6pm-10pm}$	61	61	60	60	60	60	62	61
$L_{Aeq,10pm-7am}$	58	58	58	57	59	59	59	—
$RBL_{,7am-6pm}$	45	—	41	38	40	44	45	46
$RBL_{,6pm-10pm}$	45	43	43	42	47	43	44	43
$RBL_{,10pm-7am}$	35	33	33	32	35	35	34	—
$L_{A90,7am-6pm}$	45	—	43	41	43	47	48	49
$L_{A90,6pm-10pm}$	49	45	46	47	48	47	47	47
$L_{A90,10pm-7am}$	38	38	37	36	39	39	38	—

Figure 5: Time trace of relevant noise descriptors

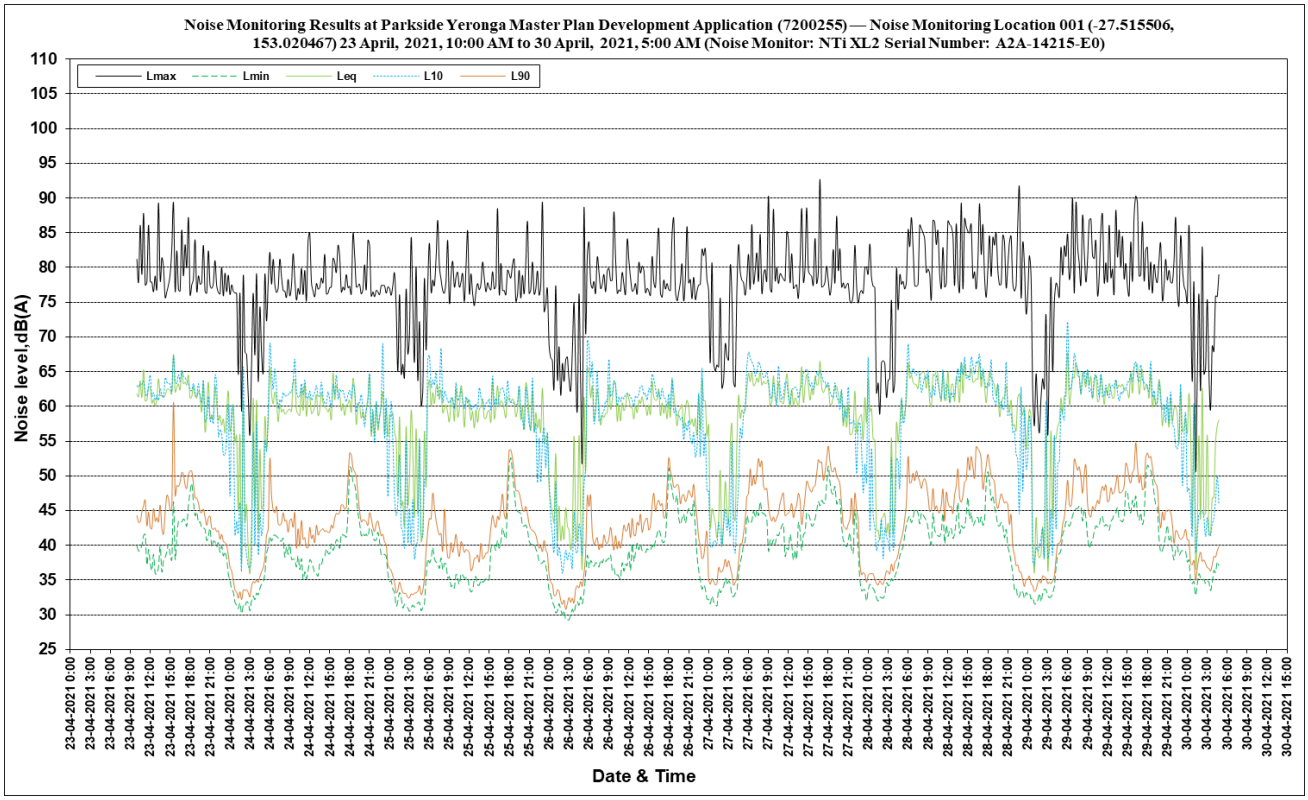

Table 13: Summary of BoM weather observations during unattended monitoring (monitored days highlighted)

Brisbane, Queensland
April 2021 Daily Weather Observations

Most observations from Brisbane City, but some from Brisbane Airport.

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Th	18.0	26.2	0		5.7	SSE	31	15:09	23.6	57	6	SSW	7	1020.9	23.4	68	7	SSW	4	1018.8
2	Fr	17.9	26.6	2.8		8.8	E	41	14:46	23.7	59	2	SSE	11	1022.5	24.1	53	7	ESE	17	1021.0
3	Sa	20.5	25.4	0		1.2	ESE	33	14:10	22.6	70	7	SSE	7	1021.6	22.5	80	7	ESE	9	1019.0
4	Su	19.6	22.5	8.4		0.0	ENE	20	13:58	20.7	92	8	WSW	2	1019.6	21.4	91	8	ESE	4	1016.4
5	Mo	20.1	23.3	9.4		0.0	SE	30	15:31	21.6	87	8	SSE	11	1016.4	23.0	87	8	SE	13	1013.3
6	Tu	20.9	24.3	45.4		0.9	E	37	05:21	22.1	94	8	S	6	1015.7	22.9	85	7	SSE	11	1013.1
7	We	19.6	27.5	20.6		6.5	SSE	30	11:07	22.4	86	7	SSW	9	1013.0	27.4	57	6	SE	13	1008.8
8	Th	19.2	28.1	0		10.2	S	26	09:51	24.7	63	7	S	11	1008.8	26.7	59	1	S	6	1005.7
9	Fr	18.3	30.6	0		10.6	WNW	19	14:24	23.9	63	0	WSW	4	1009.3	30.3	45	2	W	6	1004.6
10	Sa	17.7	33.0	0		10.9	W	28	13:41	24.2	61	1	WSW	4	1008.7	32.7	30	1	WSW	7	1004.7
11	Su	18.3	29.2	0		7.4	W	30	15:40	22.5	57	7	SW	4	1010.7	29.0	30	1	W	11	1008.3
12	Mo	13.2	24.6	0.2		10.0	SE	26	13:52	18.9	39	1	WSW	9	1018.0	23.6	49	1	ENE	9	1016.1
13	Tu	14.7	24.9	0		10.7	SE	20	10:55	21.4	52	1	SSW	6	1021.9	23.2	42	2	ESE	9	1018.9
14	We	13.6	26.3	0		10.8	NE	19	15:05	19.5	64	1	WSW	6	1020.7	25.4	47	1	NE	6	1016.7
15	Th	15.0	28.4	0		10.9	NE	19	14:25	20.6	69	0	WSW	6	1017.6	26.6	49	1	NNE	7	1014.0
16	Fr	17.1	30.5	0		10.0	E	28	16:05	22.5	63	1	SW	2	1017.6	27.5	52	3	ENE	9	1015.2
17	Sa	19.5	24.7	0		0.7	SE	26	00:32	21.2	67	8	SW	6	1019.6	23.6	68	7	E	6	1016.3
18	Su	15.0	24.9	24.6		8.5	ENE	19	16:40	19.5	63	2	SW	7	1018.6	23.8	49	2	SSE	7	1015.4
19	Mo	14.4	26.5	0.2		10.9	SSE	19	09:24	20.3	61	1	SW	6	1019.1	25.2	44	1	NNE	6	1015.7
20	Tu	14.6	27.6	0		10.7	NNE	19	16:43	20.3	69	0	WSW	6	1019.1	27.4	35	1	WNW	4	1014.4
21	We	14.5	30.1	0		10.9	W	31	15:59	22.4	62	0	WSW	6	1015.1	29.8	26	1	WSW	13	1010.3
22	Th	12.0	22.0	0		1.0	W	24	22:08	16.7	62	7	SSW	6	1016.6	21.1	40	7	W	6	1012.5
23	Fr	11.6	25.0	0		10.9	WSW	17	11:33	18.7	35	1	SSW	7	1018.8	24.6	29	1	N	2	1016.1
24	Sa	12.2	25.1	0		10.7	NE	17	14:27	18.3	60	1	SSW	6	1022.5	23.8	49	1	ENE	7	1019.3
25	Su	13.7	26.6	0		10.5	NE	17	14:59	19.8	70	1	SSW	4	1022.6	25.1	47	1	ENE	7	1019.2
26	Mo	15.0	24.8	0		9.7	ESE	20	20:55	20.2	70	1	SSW	6	1023.7	24.1	48	2	E	9	1020.8
27	Tu	16.0	25.8	0		7.8	ESE	24	15:45	20.7	66	3	SW	6	1025.6	23.6	52	1	E	9	1021.7
28	We	15.7	24.6	0		5.5	E	22	17:54	21.2	63	1	SSW	7	1024.2	22.6	58	7	SE	7	1021.3
29	Th	15.7	25.1	0.6		8.5	E	28	14:56	19.6	69	6	SSW	4	1023.4	22.3	60	6	ESE	15	1020.8
30	Fr	17.1	24.2	0		1.7	ESE	33	13:31	21.5	70	7	SE	9	1025.0	19.8	85	8	ESE	7	1023.8
Statistics for April 2021																					
	Mean	16.4	26.3			7.4				21.2	65	3		6	1018.6	24.9	53	3		8	1015.4
	Lowest	11.6	22.0			0.0				16.7	35	0	#	2	1008.7	19.8	26	1	N	2	1004.6
	Highest	20.9	33.0	45.4		10.9	E	41		24.7	94	8	#	11	1025.6	32.7	91	8	ESE	17	1023.8
	Total			112.2		222.6															

Temperature, humidity, wind, pressure and rainfall observations are from Brisbane {station 040913}. Cloud, evaporation and sunshine observations are from Brisbane Aero {station 040842}

Brisbane Airport is located about 12 kilometres north east of the Brisbane City site, and closer to the coast. The evaporation, sunshine and cloud values should be used as a guide only.

IDCJDW4019.202104 Prepared at 13:01 UTC on 5 Sep 2021

Appendix C Noise Model Details

A three-dimensional computer model of the study area was created within SoundPLAN 8.2 software. The following inputs were utilised in building the model:

- **Topography:** refer to **Table 14** below

Table 14 Geofiles used to create the SoundPLAN 8.2

File	Description	Date received
210908 Existing Terrain.dxf	Existing terrain used by Civil designers	8th Sept 2021
210908 Proposed ROL Boundaries.dxf	Proposed Reconfiguration of Lot Boundaries	
210908 Proposed Terrain.dxf	Proposed finished terrain levels designed by Civil designers	
Nearmap Aerial Photography	Used to determine and location of existing buildings nearby to the site.	Photography date: 26th August 2021

- **Noise map Calculations** – Noise contour maps were calculated as free-field noise levels at the following heights:
    - Ground: 1.5 m above finished ground level (AGL);
    - Level 3: 7.5 m AGL; and
    - Level 5: 13.5 m AGL.
- **Calculation algorithms** Rail noise emissions were calculated using the SoundPLAN implementation of the Nordic Rail Prediction Method (Kilde Rep.130) used for both passenger and freight rail noise.
- **Ground surface corrections –** 20% ground absorption factor accounting for predominately compacted soil and concrete / asphalt surface types between source and receptor.
- **Rail traffic parameters** – Rail traffic parameters used are reproduced in **Table 15** and
- **Table** 16, respectively.

Table 15: Rail model input assumptions

<table>
<tr><th>Modelling element</th><th>Input / Assumption</th></tr>
<tr><td>Ground Elevation Geometry</td><td>From input files provided by Stantec Civil Designers</td></tr>
<tr><td>SoundPLAN Assessment Methodology</td><td>Rail Noise Impact: Kilde report 67/130</td></tr>
<tr><td>Rail Alignment</td><td>From aerial photography (aggregated to one line equidistant between all lines.)</td></tr>
<tr><td>Existing Rail Traffic Flow Data</td><td>Supplied by Queensland Rail for the lines
Email from Tony.Bennett@qr.com.au Fri 2021/05/14 6:03 AM</td></tr>
<tr><td>Proposed (2026) Rail Traffic Flow Data</td><td>Sourced from: https://crossriverrail.qld.gov.au/resources/rfpc4/136_Technical-reports.pdf
Table 9.2. Train volumes for the CRR Project
<table>
<tr><th rowspan="2">Segment</th><th colspan="2">Year 2026</th><th colspan="2">Year 2036</th></tr>
<tr><th>Freight Train Movements</th><th>Passenger Train Movements</th><th>Freight Train Movements</th><th>Passenger Train Movements</th></tr>
<tr><td>Yeerongpilly - Park Road</td><td>34</td><td>488</td><td>42</td><td>577</td></tr>
<tr><td>Up</td><td></td><td>244</td><td></td><td>278</td></tr>
<tr><td>Down</td><td></td><td>165</td><td></td><td>195</td></tr>
<tr><td>Dual Gauge</td><td>34</td><td>79</td><td>42</td><td>104</td></tr>
</table></td></tr>
<tr><td>Train Types and Parameters Used</td><td>See
Table 16 below.</td></tr>
</table>

Table 16: Train types and parameters used in modelling

Train type	Number of trains (provided by QR)	Length per train, m	Speed (km/h)	Rail track height above the ground, m	ΔLeq, dB	ΔLtype Engine, dB	ΔLtype Wagons,
Citytrain	255	150	60 est.	0.6	-9.2	-2.0	-2.0
Freight	16	540	30 est.	0.6	-8.0	-3.0	-3.0
Diesel Loco	16	37	30 est.	3.6	-8.0	1.0	1.0

Δ**Leq:** is the correction factor applied to the standard Kilde report $L_{Aeq,24hr}$ predicted noise level to correct for train length and expected noise levels adjusted / calibrated to unattended noise logging conducted by Stantec.

Δ**Ltype:** engine is the correction factor applied to the standard Kilde report predicted L_{Amax} at 10 metres (engine = moving point source) adjusted / calibrated to unattended noise logging conducted by Stantec.

Δ**Ltype:** wagons is the correction factor applied to the standard Kilde report predicted L_{Amax} at 10 metres (wagons = line source) adjusted / calibrated to unattended noise logging conducted by Stantec.

- **Sound reflections -** The number of reflections from barriers, buildings and the ground has been set to 3. Reflections from buildings to rail noise producing an increase in rail noise at the façade prediction point carry a +2.5 dB correction as required by TMR for rail noise predictions.
- **Search radius** - The noise source search radius was setup at 5000m.

Appendix D – Noise Contour Maps

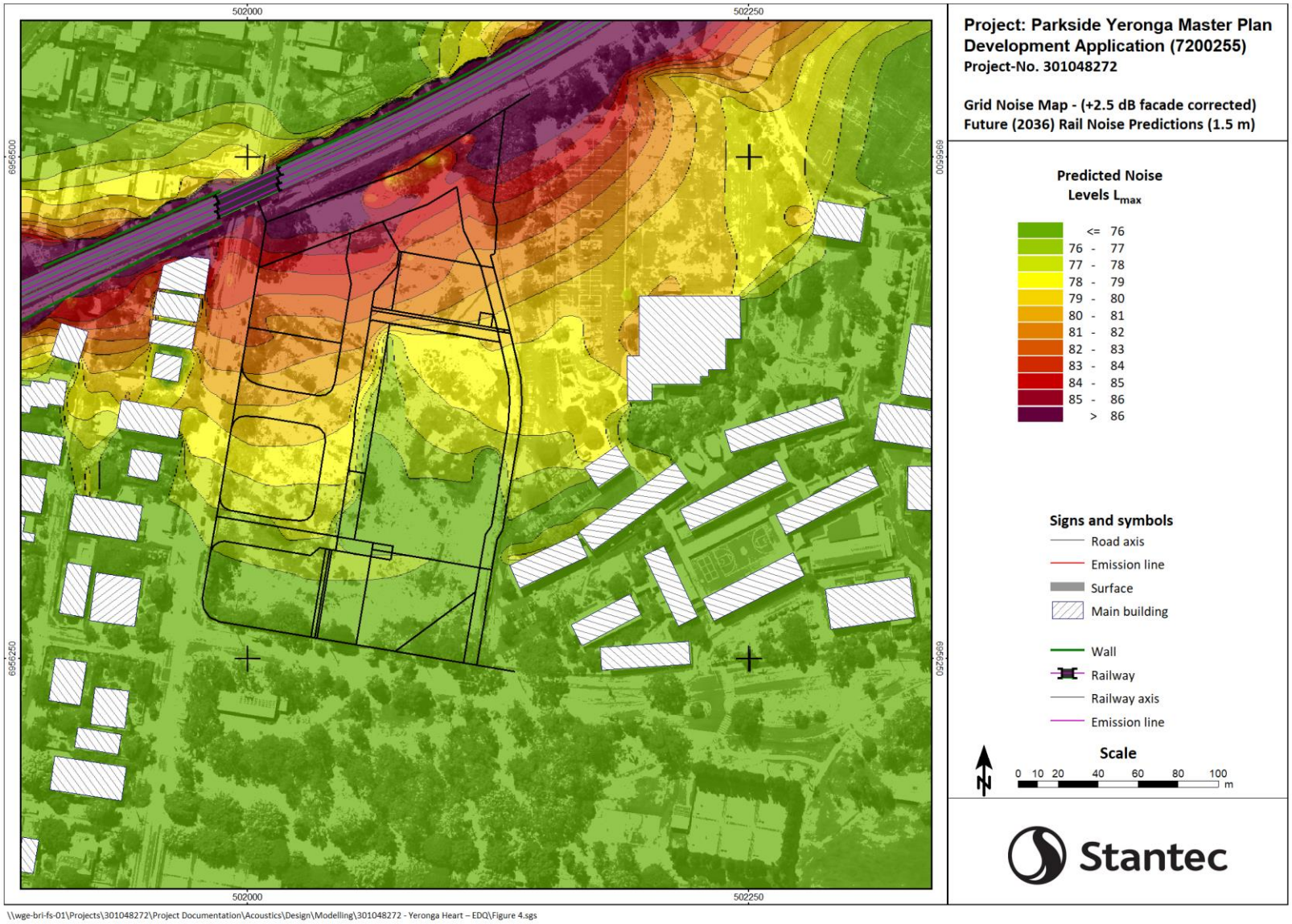

Figure 6 – Predicted Future Rail Noise Levels 2031 at 1.5m AGL (Façade Corrected)

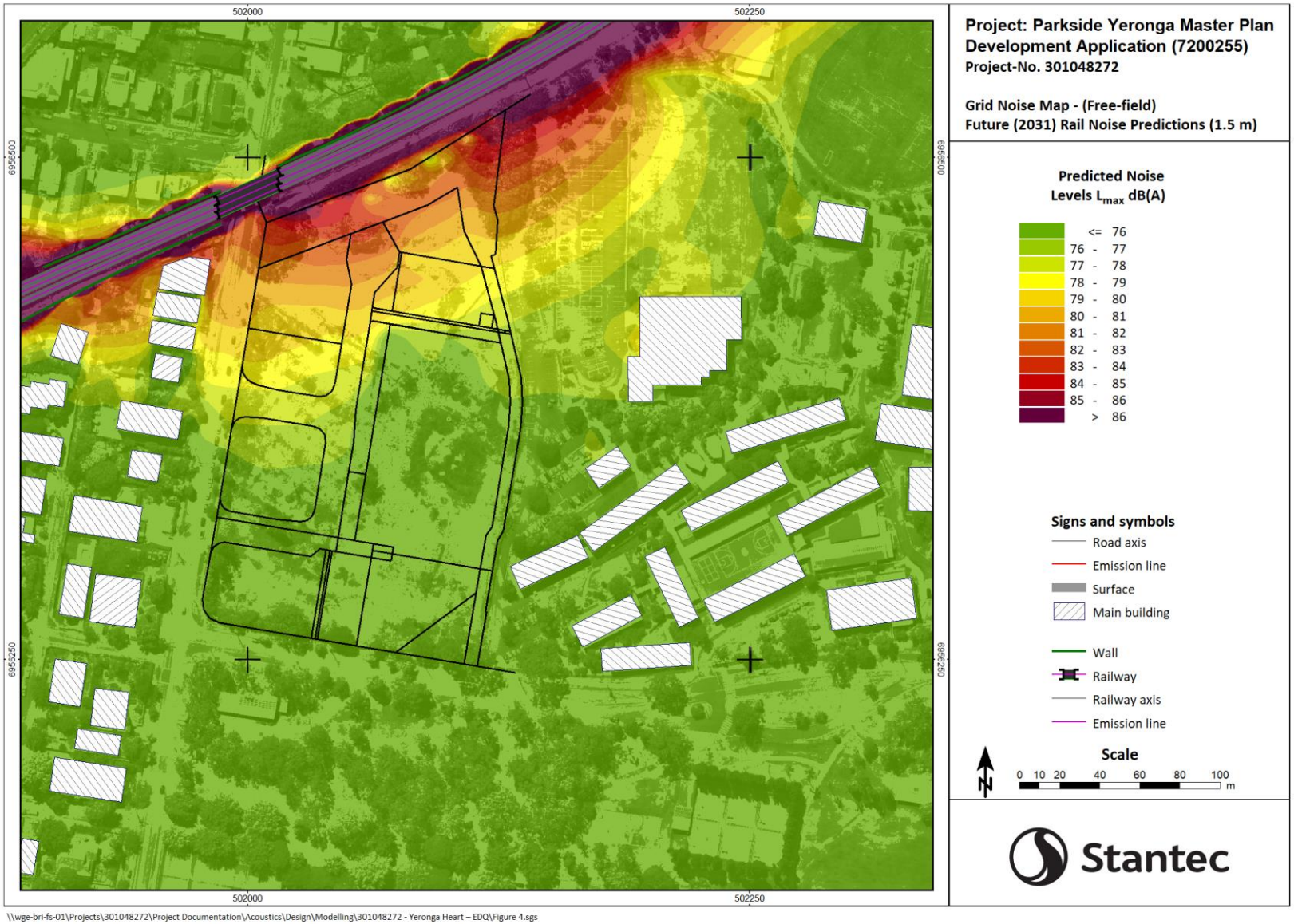

Figure 7 – Predicted Future Rail Noise Levels 2031 at 1.5m AGL (Free-field)

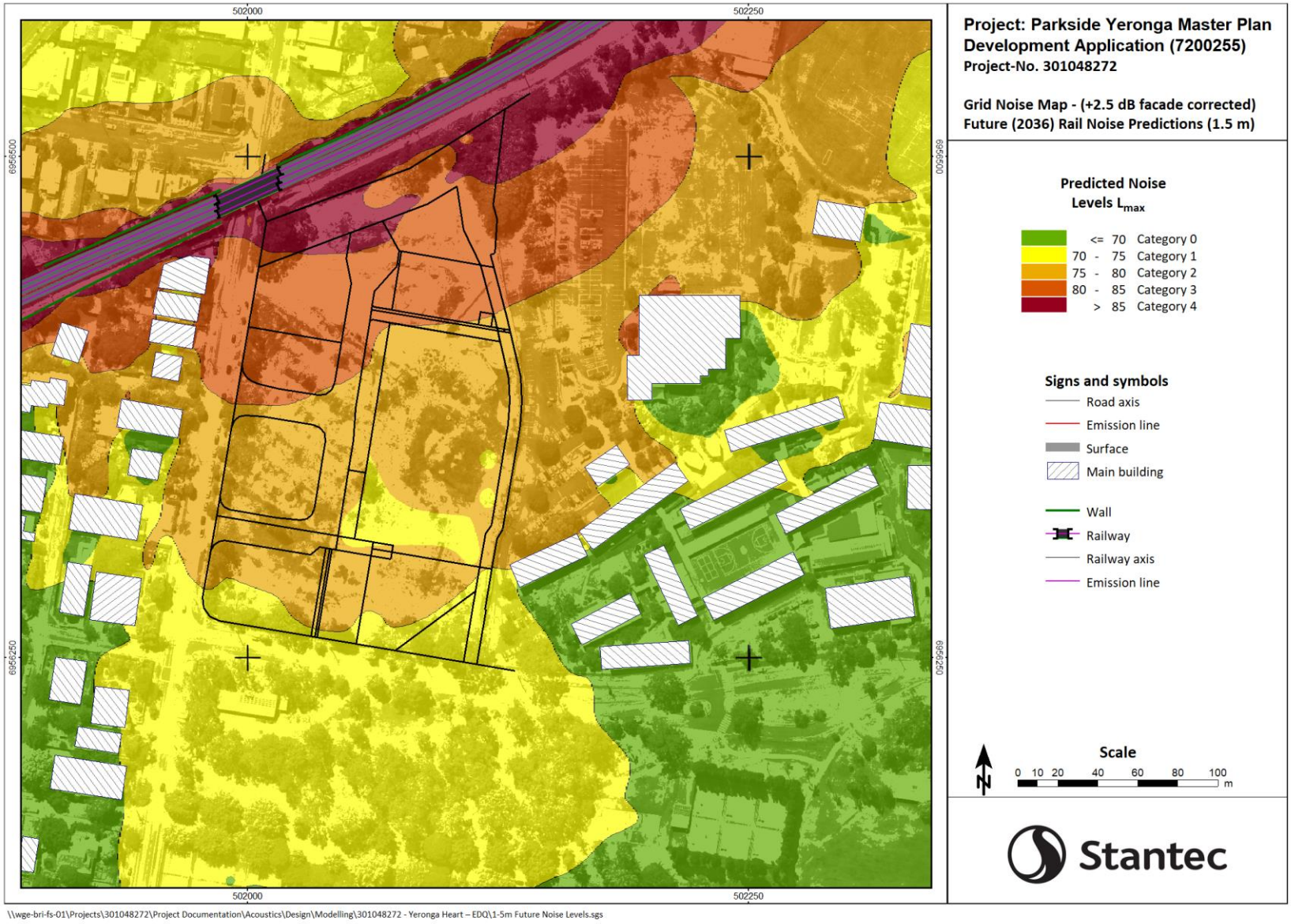

Figure 8 –Rail Noise MP 4.4 Categories at 1.5m AGL

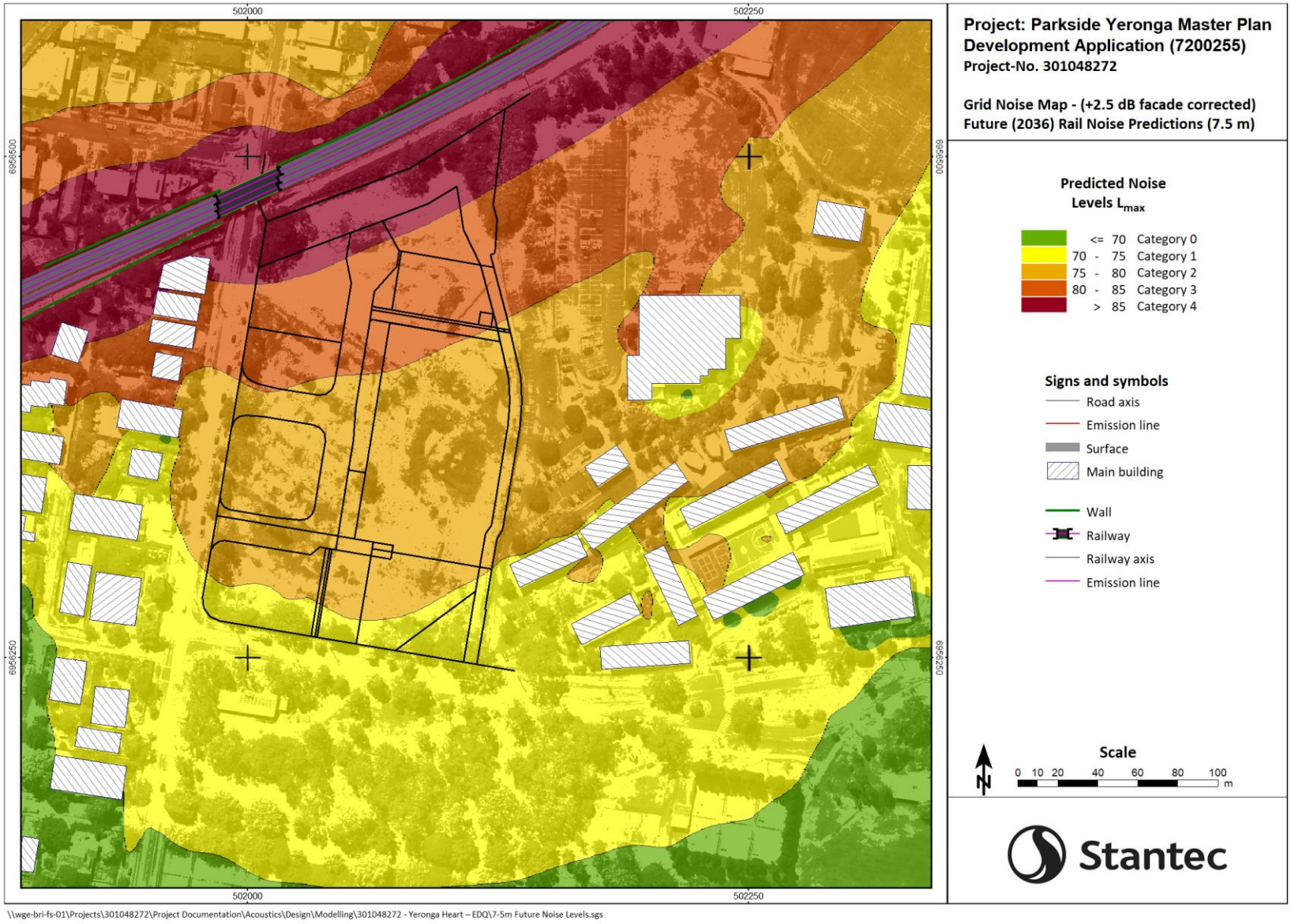

Figure 9 – Rail Noise MP 4.4 Categories at 7.5m AGL

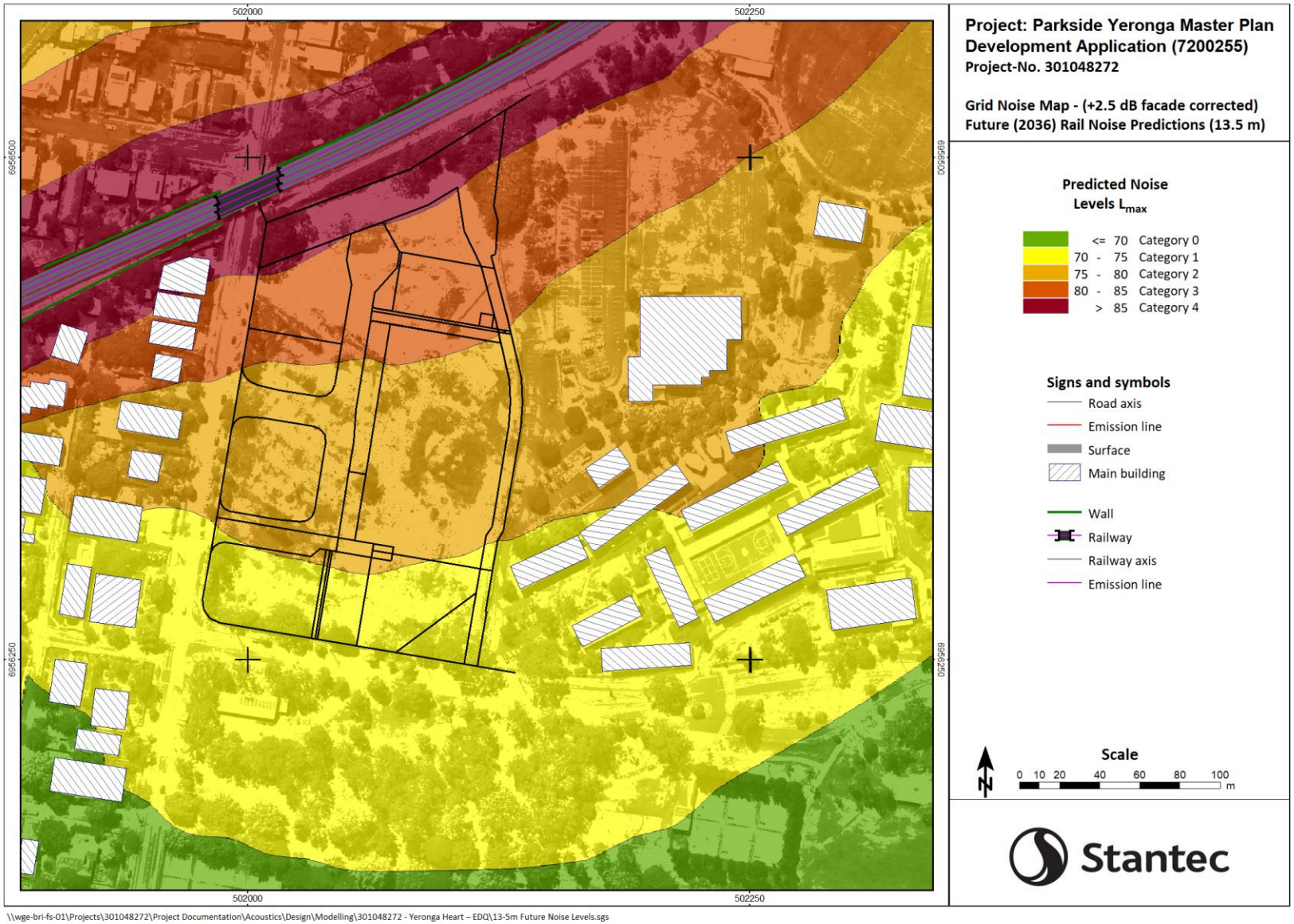

Figure 10 – Rail Noise MP 4.4 Categories at 13.5m AGL

Design with
community in mind

Level 3
52 Merivale Street
South Brisbane QLD 4101
Tel +61 7 3811 4500

For more information please visit
www.stantec.com

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