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AMENDED IN RED
By: Vivian Lun
Date: 31 October 2024
Queensland Government

Rockpool Northshore Hamilton

DA Acoustic Assessment Report

McNab

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Executive summary

An acoustic assessment for the proposed residential aged care facility at the 330 MacArthur Avenue, Hamilton, has been undertaken with respect to the provisions of:

- Brisbane City Plan 2014
- Northshore Hamilton Urban Development Area Development Scheme
- Queensland Environment Protection Act 1994,
- Queensland Environmental Protection (Noise) Policy 2019, and
- relevant Australian standards and guidelines.

This acoustic assessment considered impacts and control of external noise upon occupants within the development as well as environmental noise emissions associated with the development on surrounding sensitive receivers.

Assessment of external noise ingress has been carried out based on site noise surveys and proposed design taking into consideration general ambient noise, aircraft noise as well as prevention and management of sleep disturbance to the occupants. Appropriate building envelop acoustic performance requirements are established to achieve relevant internal noise amenity for various uses within the development.

The potential noise emission sources associated with the development were assessed including mechanical plant noise, car park activity noise, as well as services delivery and waste management.

Noise emissions from each of the identified noise sources were assessed with appropriate noise control measures recommended to meet the relevant project assessment noise criteria.

Noise and vibration impact from the construction of the project were also considered with management measures recommended to assist with control of impacts during project construction.

Based on the assessment undertaken in this report, it is concluded that potential noise ingress and egress impacts upon and from the proposed development can be adequately controlled to achieve compliance with relevant noise criteria and provisions subject to incorporation of acoustic recommendations provided in this report.

Contents

Not approved as part of this document.
A detail Construction Noise Management Plan to be submitted in accordance with Condition 13 of this approval.

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1.0

Introduction

1.0 Introduction

Cundall has been engaged to undertake an acoustic assessment of the proposed residential aged care facility at the 330 MacArthur Avenue, Hamilton. The proposed development is a six storey and 153-bed residential aged care with 44 on-grade sleeved car parking spaces. The ground floor will include a mix of administrative spaces, amenities and back of the house spaces, communal as well as accommodation units. Upper levels predominantly include accommodation and communal spaces.

The proposed development is located within the Brisbane City Council for which the provisions of the *Brisbane City Plan 2014* (City Plan) are applicable. The proposed development is also subject to the provisions of the *Northshore Hamilton Urban Development Area Development Scheme* (Northshore Hamilton UDA Development Scheme).

This acoustic assessment and report consider the following aspects with respect to the provisions of the Brisbane City Plan as well as the Northshore Hamilton UDA Development Scheme:

- External noise impacts on occupants of development,
- Environmental noise emission impact on surrounding sensitive receivers.

Acoustic assessment in this report has been prepared with reference to relevant requirements of the following:

- Brisbane City Plan 2014
- Northshore Hamilton Urban Development Area Development Scheme
- Queensland Environment Protection Act 1994,
- Queensland Environmental Protection (Noise) Policy 2019, and
- relevant Australian standards and guidelines.

1.1 Purpose of report

This report outlines an acoustic assessment of the proposed residential aged care facility at 330 MacArthur Avenue, Hamilton, QLD. The report has been requested as part of the project submission for Development Application approval.

1.2 Key assumptions

The acoustic assessment in this report is based on the following key assumptions:

- Proposed development plan and drawings prepared by GJG Architects dated 11 June 2024.
- Site inspection and observations made by Cundall acoustic engineer outlined throughout the report.
- Assumptions and information in relation to the operation of the facility presented throughout the report.

2.0

Proposed development

2.0 Proposed development

2.1 Site context

The development is situated on a portion of the land at 330 MacArthur Avenue, Hamilton QLD 4007 at the corner of the MacArthur Avenue and Angora Road. The development is located within Emerging Community (EC) zone of the Brisbane City Plan surrounded by a mix of residential, commercial and industrial as well as community and entertainment uses within the Northshore Hamilton Urban Development Area. The location of the development and surrounding locality is shown in Figure 2-1.

To the north and east, the proposed development immediately adjoins residential townhouses and apartments along MacArthur Avenue and Angola Road. To the south and west, proposed development adjoins a vacant block of land which is likely to be developed as future residential and/or mixed-use developments. A number of commercial developments are also located to the north west of the site further away along MacArthur Avenue.

Further to the north across Curtain Avenue W, a variety of industrial development are located within the Industry Investigation Zone. Additional industrial uses are also located further to the west of the site within the EC Emerging Community Zone including the Vaxxas Biomedical facility along Barcham Road as well as the electro plating facility along Cedar Road. The proposed development is also in relative proximity to the recreational and entertainment uses along the MacArthur Avenue including Riverfront Event spaces namely the Collective, East Street Northshore and Maritime Green Northshore, as well as the Northshore Tennis Park located to the southwest of the proposed development. The location of the surrounding uses identified are shown in Figure 2-2 below.

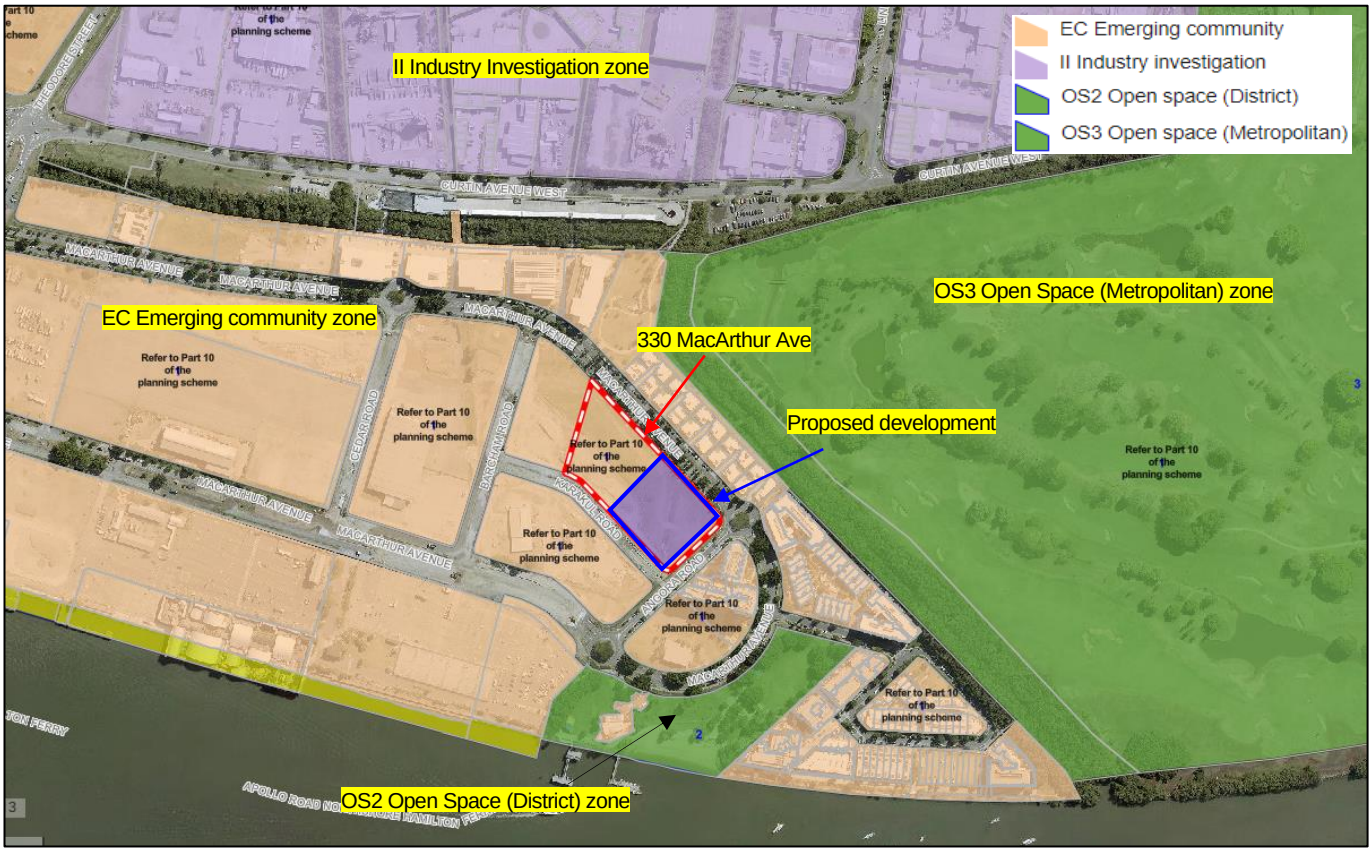

Figure 2-1 Project site and surrounds[1]

[1] Aerial imagery courtesy of Brisbane City Council City Plan Online Tool, © Department of Resources, Brisbane City Council & State of Queensland

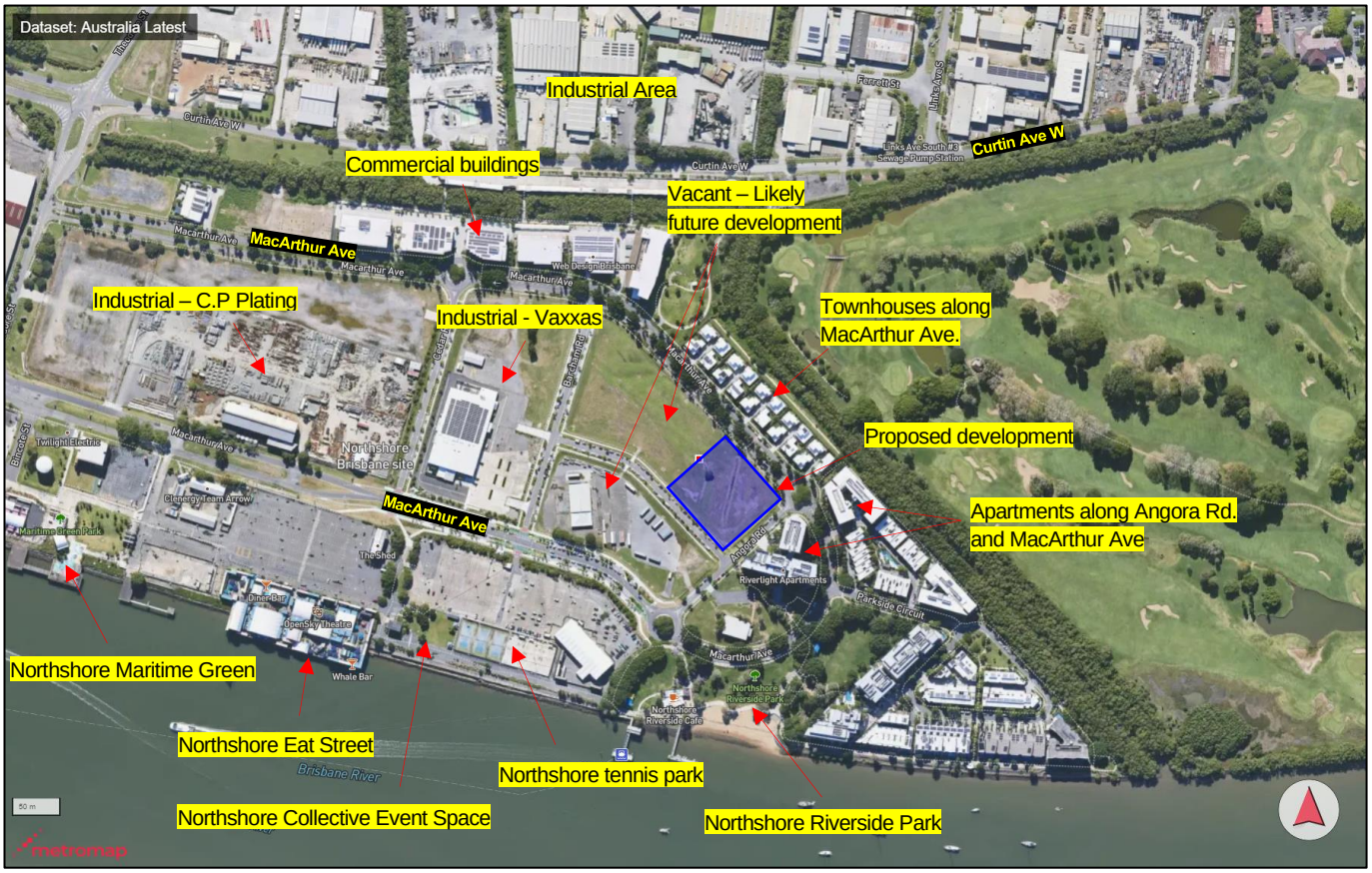

Figure 2-2 Surrounding developments[2]

2.2 Development

The proposed development is a six-storey residential aged care facility with 153-beds and 44 on-grade sleeved car parking spaces. The development is comprised of a mix of administrative offices, back of the house and amenities spaces as well as accommodation and communal spaces. The upper floors typically consist of accommodation units with central communal spaces such as lounge, dining, servery and amenities.

A loading and servicing area is provisioned on the north western portion of the site with the mechanical plant expected to be located on the rooftop deck above the back of house area. The proposed building is an L shaped design wrapping around the central Resident Garden and the sleeved carpark space with entry on Karakul Road. The proposed development layout is presented in Figure 2-3 along with the expected 3D view of the development shown in Figure 2-4.

[2] Imagery courtesy of MetroMap, ©2024, imagery date 02/06/2024

Figure 2-3 Proposed development (excerpt from Architectural drawing 2391-DA-2.1 to 2.4)

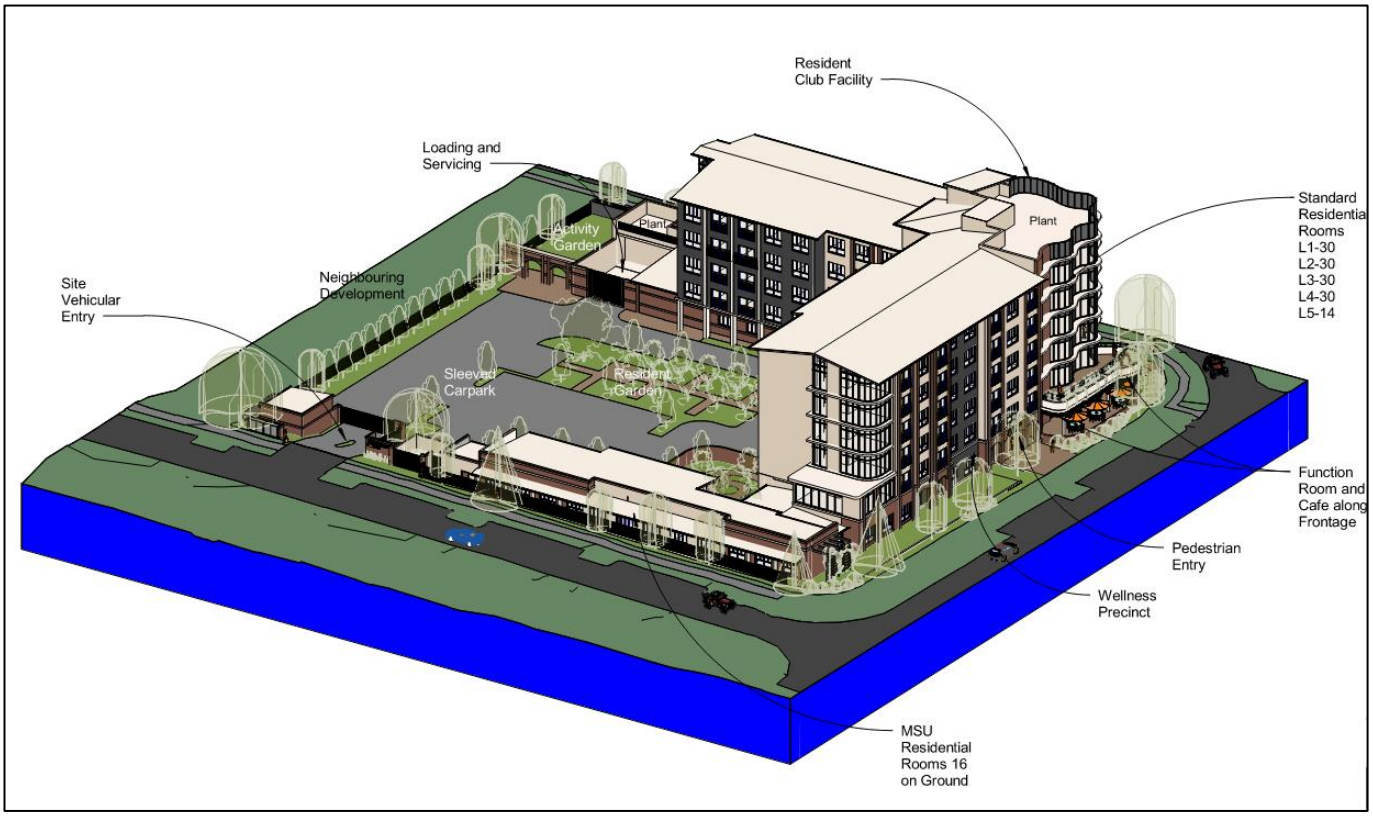

Figure 2-4 3D view of the proposed development (excerpt from Architectural drawing 2391-DA-6.1)

2.3 Noise sensitive receivers

The nearest noise sensitive receivers to the site are identified as the existing residential dwellings and apartments along MacArthur Avenue as well as the adjoining potential future residential and mixed-use developments to the west and south. Other residential receivers are also located along the river front further south east of the site along Parkside Circuit. The nearest identified noise sensitive receivers are listed in Table 2-1 and shown in Figure 2-5 below.

Table 2-1 Identified noise sensitive receivers

Receiver ID	Address/Receptor	Type/ use	Orientation
R1	341 MacArthur Avenue dwellings	Existing Residential	North
R2	Atria North Apartments – 331 MacArthur Ave.	Existing Residential	East
R3	Riverlight Apartments – 320 MacArthur Ave.	Existing Residential	East/South-east
R4	Western future development	Likely residential/mixed use	West
R5	Southern future development	Likely residential/mixed use	South

Figure 2-5 Identified nearest noise sensitive receivers[3]

[3] Imagery courtesy of MetroMap, ©2024, imagery date 02/06/2024

3.0

Acoustic environment

3.0 Acoustic environment

3.1 Ambient noise character

The proposed development is located within the heart of Northshore, Brisbane, a waterfront urban renewal project that is transforming the existing port and industrial area into a vibrant mixed use riverside precinct. Located six kilometres from the Brisbane CBD, the Northshore Hamilton Urban Development Area covers 304 hectares of land, with a 3.8 kilometre river frontage. The Northshore Hamilton UDA includes land between Kingsford Smith Drive and the Brisbane River, extending from Bretts Wharf to the west and the Gateway Motorway to the east.

The proposed development is located at 330 MacArthur Avenue and surrounded by a mix of residential, commercial and industrial as well as community and entertainment uses within the Northshore Hamilton UDA. A number of site visits and acoustic surveys were carried out at and surrounding the proposed development area to understand the existing acoustic environment and sources within the area.

Daytime acoustic environment was characterised by a combination of aircraft flyovers, traffic noise from distant major roads as well as intermittent traffic on local roads (i.e., MacArthur Ave), community and natural environment soundscape and some contribution from surrounding industrial developments and precinct. Other noise sources contributing to the ambient acoustic environment include the river cruise and vessel activities, surrounding recreational and entertainment noise (such as live events along Riverfront noted during weekend).

Evening acoustic environment was similar in nature but different in level to the daytime with a mix of neighbourhood noise sources contributing to the ambient acoustic environment. The recreational and entertainment noise sources were more dominant during evening hours on weekend due to events and activation of river front spaces such as the Eat Street and Maritime Green.

Night-time soundscape was generally controlled by distant traffic noise from Gateway Motorway and Kingsford Smith Drive, surrounding industrial uses and natural environment noise such as inspects and occasional birds callings. The aircraft noise was not present during night-time hours.

3.2 Noise surveys

Attended environmental noise surveys were carried out by Cundall at the proposed development site and during various hours of the day between Thursday 20 June to Monday 24 June 2024. The purpose of the noise surveys was primarily to:

- identify sources of noise that are likely to affect the development and assess their expected noise levels.
- identify potential noise sensitive receivers in the vicinity.
- Understand existing background environment at nearby noise sensitive receivers.

Short-term attended ambient and background noise measurements were carried out in the vicinity of the proposed development site to assist with understanding the existing acoustic environment and the external noise sources likely to affect the proposed development. Note continuous noise monitoring was not possible at the time due to site access restrictions. Accordingly, short term attended measurements were carried out during various times of day, evening and night-time hours during the monitoring campaign to enable representative samples of the existing acoustic environment. The location of the attended noise monitoring is shown in Figure 2-5.

3.3 Instrumentation

A SVAN 977D Class 1 sound level meter was used for the noise measurements. The sound level meter was field calibrated both before and after the measurement period using a 01dB-Stell Cal 21 Acoustic Calibrator. No drift of more than 0.5 dB was observed for reference level before and after measurements. Both the sound level meter and calibrator held current NATA certified calibration certificate at the time of testing which can be provided upon request. Summary of instrumentation used is provided in Table 3-1 below:

Table 3-1 Noise measurement instrumentation

Item	Model	Class	Serial Number	Calibration date
Sound level metre	SVAN 977D	Class 1	98463	20 February 2023
Acoustic calibrator	01dB-Stell Cal 21	Class 1	34254627	06 March 2024

3.4 Noise measurement results

A summary of the established ambient sound pressure levels relevant to this assessment based on the noise measurement surveys carried out is presented in Table 3-2. The individual noise measurement survey results are presented in Appendix B. Note the measured ambient sound pressure levels are considered representative of that expected at the proposed development site as well as the nearest identified noise sensitive receivers due to proximity.

Table 3-2 Summary of measured ambient sound pressure levels

Acoustic parameter	Measured sound pressure levels		
	Daytime	Evening	Night time
Rating Background Level (RBL)	37 dBA (1)	43 dBA	34 dBA
Average ambient noise, L_{eq}	55 dBA	51 dBA	45 dBA
Highest ambient noise, L_{eq}	57 dBA	52 dBA	47 dBA
Maximum event (slow response), L_{Smax}	73 dBA	68 dBA	69 dBA
Maximum event (fast response), L_{Fmax}	N/A	N/A	77 dBA

Note:

1. Typical background noise levels (L_{90}) ranging between 41 – 44 dBA were measured during daytime period with exception of one instance on Saturday 22 June at 15:40 where 37 dBA was measured. Higher RBL may be expected following continuous background noise monitoring.

Establishment of relevant ambient sound pressure levels have been made with consideration to guidance provided in

- Brisbane City Council SC6.21 Noise impact assessment planning scheme policy, and
- Department of Environment and Science (DES) Noise Measurement Manual 2020

The Rating Background Noise Levels (RBL) have been established based on the lowest measured background noise levels (L_{90}) during attended monitoring campaign for each day, evening and nighttime periods. Both the average and highest ambient L_{eq} sound pressure levels are reported. The average ambient L_{eq} sound pressure level is the energy average logarithmic sound pressure level representing the time-average noise levels within the assessment period. The maximum event noise levels have also been establishing with slow and fast time response relevant to the assessment of aircraft noise flyovers as well as general transient noise sources and sleep disturbance respectively. For maximum event (L_{max}), consideration is given to the highest measured levels during the relevant period.

4.0

Acoustic criteria

4.0 Acoustic criteria

4.1 Brisbane City Plan 2014

Brisbane City Plan 2014 (City Plan) is Brisbane City Council's plan for the future development of Brisbane. It outlines the applicable development requirements for different zones, overlays, development types and the like enabling the implementation of the cities Strategic Vision. The following provisions are considered relevant for this acoustic assessment with respect to the proposed development, applicable zones and overlays:

Applicable provision	Item	City Plan Reference	Comment
Zone	EC Emerging Community Zone	Part 6.2.6.2 Emerging Community zone code	No specific acoustic requirements.
Neighbourhood Plans	Australia TradeCoast neighbourhood plan	Part 7.2 Neighbourhood plan codes	No specific acoustic requirements.
Development type	Retirements and residential care facility code	Part 9.3.18	Acoustic performance requirements and acceptable outcomes.
Overlays	Airport environs overlay	8.2.2 Airport environs overlay code	Aircraft noise control requirements
Planning Scheme Policies	Noise impact assessment planning scheme policy	SC6.21	Relevant procedures and guidance to address City Plan acoustic related provisions.
	Refuse planning scheme policy	SC6.26	General acoustic requirements for management of refuse collection noise impacts
	Transport, access, parking and servicing planning scheme policy	SC6.31	General acoustic requirements for management of servicing area noise impacts
Other	Northshore Hamilton Priority Development Area	Sections 3.7 & 3.9	General noise and acoustic requirements.

4.1.1 Airport environs overlay code

Part 8.2.2 airport environs overlay code of the City Plan provides provisions for developments designated within the Airport environs overlay. The following relevant acoustic performance and acceptable outcomes relevant to this assessment are noted:

Table 4-1 Airport environs overlay code performance and acceptable outcomes (Table 8.2.2.3.A of the City Plan)

Performance outcomes	Acceptable outcomes
Section F—If in the Australian Noise Exposure Forecast (ANEF) contour sub-categories	

Performance outcomes	Acceptable outcomes
PO8 Development adequately attenuates for aircraft noise in buildings to protect the health and wellbeing of occupants by complying with the internal noise criteria in Table 8.2.2.3.B. Note—A noise impact assessment report prepared in accordance with the Noise impact assessment planning scheme policy can assist in demonstrating achievement of this performance outcome.	**AO8.1** Development for a caretaker's accommodation, childcare centre, community care centre, community residence, dual occupancy, dwelling house, dwelling unit, educational establishment, health care service, hospital, multiple dwelling, relocatable home park, residential care facility, retirement facility or rooming accommodation located in the ANEF 20-25 sub-category: a. provides external windows and doors which are acoustically rated to a minimum of Rw 30: b. ensures that the roof, ceiling and insulation combination is acoustically rated to a minimum of Rw 45; c. ensures that external walls are acoustically rated to a minimum of Rw 50. **AO8.2** Development for a resort complex, rural workers' accommodation, short-term accommodation or tourist park located in the ANEF 25-30 sub-category: a. provides external windows and doors which are acoustically rated to a minimum of Rw 30; b. ensures that the roof, ceiling and insulation combination is acoustically rated to a minimum of Rw 45; c. ensures that external walls are acoustically rated to a minimum of Rw 50. **AO8.3** Development for an office is not located in the ANEF 25-30 sub-category, ANEF 30-35 sub-category, ANEF 35-40 sub-category, or ANEF 40-45 sub-category. **AO8.4** No acceptable outcome is prescribed where development for a community use, detention facility, funeral parlour, place of worship, theatre or veterinary service. **AO8.5** Development for a use not identified in AO8.1, AO8.2, AO8.3 or AO8.4 is not located in the ANEF 40-45 sub-category.
PO9 Development for a sensitive use is appropriately located to prevent inappropriate exposure to very high levels of aircraft noise.	**AO9.1** Development for a caretaker's accommodation, childcare centre, community care centre, community residence, dual occupancy, dwelling house, dwelling unit, educational establishment, health care service, hospital, multiple dwelling, relocatable home park, residential care facility, retirement facility or rooming accommodation is not located within the ANEF 25-30 sub-category, ANEF 30-35 sub-category, ANEF 35-40 sub-category, or ANEF 40-45 sub-category. **AO9.2** Development for a resort complex, rural workers' accommodation, short-term accommodation or tourist park is not located within the ANEF 30-35 sub-category, ANEF 35-40 sub-category, or ANEF 40-45 sub-category.

Table 4-2 Aircraft noise internal noise criteria (Table 8.2.2.3.B)

Use		L_{ASMax}
Residential care facility	Sleeping areas	50 dBA
	Other habitable rooms	55 dBA

4.1.2 Retirements and residential care facility code

Part 9.3.18 Retirement and Residential care facility code of the City Plan outlines the following relevant acoustic performance and acceptable outcomes relevant to this assessment:

Table 4-3 Retirements and residential care facility code performance and acceptable outcomes (Table 9.3.18.3.A of the City Plan)

Performance outcomes	Acceptable outcomes
PO2 Development, including a car park, is of a nature, scale, layout, design and construction that does not result in noise emissions that exceed the following criteria: ▪ $L_{Aeq,adj,T}$ emitted from the residential care facility is not greater than the rating background level plus 3 at a sensitive use. Where T is: ▪ Day (7am to 6pm): 11hr ▪ Evening (6pm to 10pm): 4hr ▪ Night (10pm to 7am): 9hr. Where $L_{Aeq,adj,T}$ is the A-weighted equivalent continuous sound pressure level during measurement time T, adjusted for tonal and impulsive noise characteristics, determined in accordance with the methodology described in the Noise impact assessment planning scheme policy. Note—Rating background level is to be determined in accordance with the methodology described in the Noise impact assessment planning scheme policy. Note—A noise impact assessment report prepared in accordance with the Noise impact assessment planning scheme policy can assist in demonstrating achievement of this performance outcome.	**AO2** Development: a. ensures mechanical plant or equipment is acoustically screened from adjoining sensitive uses; b. for a residential care facility or care co-located use provides a 2m high acoustic fence along any boundary with adjoining sensitive uses; c. ensures car parking and vehicle movement areas are acoustically screened from adjoining residential dwellings. Note—Mechanical plant includes, but is not limited to, generators, motors, compressors and pumps such as air-conditioning, refrigeration or coldroom motors.

Performance outcomes	Acceptable outcomes
PO4 (1) Development for services and related structures, including electricity transformers and fire hydrant and booster assemblies, air conditioning and other mechanical plant, vents, exhausts and refuse and recycling storage areas: a. are integrated into the development; b. do not dominate the site frontage; c. are compatible with the intended streetscape character; d. ensure adverse amenity impacts to the streetscape and habitable spaces are ameliorated; e. provide for refuse and recycling including source separation; f. are of a design that allows low-frequency service collection; g. minimise ongoing building management cost for occupants.	**AO4.1** Development ensures that services and related structures, including electricity transformers and fire hydrant and booster assemblies, air conditioning and other mechanical plant, vents, exhausts and refuse and recycling storage areas: a. comprise no more than 5m or 10% of the street frontage, whichever is the lesser; b. are orientated towards the internal driveways or footpaths on site; c. are located, screened or landscaped so that they are not visually obtrusive when viewed. Note—Development of greater than 10 dwelling units indicates locations for all transformers, fire hydrant and booster assemblies and meter boxes. **AO4.2** Development provides refuse and recycling collection and storage facilities, including source separation, in accordance with the Refuse planning scheme policy.
PO8 (1) Development height, bulk and scale, siting and layout ensures: d. sufficient visual and acoustic privacy between dwellings without reliance on screening; Editor's note—This is demonstrated through the provision of streetscape elevations, site sections and plans showing adjoining and street context, shadow diagrams and landscape plans.	**AO8** Development is contained within the building envelope for the site created by applying: a. the maximum building height specified in: i. a neighbourhood plan; or ii. if no neighbourhood plan applies or no requirements are specified in the neighbourhood plan, the requirements set out in Table 9.3.18.3.B; b. acceptable outcomes for building height transitions specified in Table 9.3.18.3.C and in a neighbourhood plan, where applicable; c. front, rear and side boundary setback requirements specified in Table 9.3.18.3.D and in a neighbourhood plan, whichever is the greatest; d. car parking boundary setback requirements specified in Table 9.3.18.3.E and in a neighbourhood plan, whichever is the greatest; e. building separation requirements in Table 9.3.18.3.F; f. deep planting and landscaping requirements in Table 9.3.18.3.G. Refer to Figures a and b. Note—This acceptable outcome can be demonstrated by the preparation of a building envelope plan, elevations and sections. Note—Roofing of terrace areas on car parking structures are to comply with boundary setback requirements for balconies.

Performance outcomes	Acceptable outcomes
PO14 Development for rooftops and building caps contributes to the architectural distinction of the building and: a. is contextually and climatically appropriate in form; b. is responsive to orientation and solar access; c. is not marred by plant and equipment; d. may incorporate a rooftop garden where integrated as part of the overall building design and enhancing the presentation and visual amenity of the rooftop and skyline when viewed from external public vantage points. Note—External public vantage points means from at least two mostly unobstructed views of the development from a public area.	**O14.1** Development provides building caps and rooftops which: a. include interesting forms created through pitches, gables, skillions or other features; b. designs rooftop service structures, lift motor rooms and mechanical plant and equipment as an architectural feature of the building that is incorporated into the roof form and visually and acoustically screened from any communal open space on the rooftop; c. enables future inclusion of plant and equipment such as telecommunications facilities in an unobtrusive manner. Refer to Figure e. **AO14.2** Development for a rooftop garden: a. incorporates a combination of built form and soft landscape elements integrated with the overall building design; b. enhances the presentation and visual amenity of the rooftop and skyline when viewed from external public vantage points. Note—External public vantage points means from at least two mostly unobstructed views of the development from a public area.
PO17 (1) The orientation of buildings and separation between buildings on site and to buildings on an adjoining site: c. provides visual and acoustic privacy without reliance on screening by facing and offsetting balconies and spaces to avoid direct outlook to existing or approved habitable rooms or outdoor spaces.	**AO17.1 (1)** Development positions the primary balcony, window, or private open space to face the street frontage, rear boundary, communal open space or adjoining public open space, and limits solid balustrading of any such balconies facing the street or adjoining public space to a maximum values outlined in A017.1 (refer to Table 9.3.18.3.A of the City Plan for further details) **AO17.2** Development provides building placement and design that complies with the separation distances in Table 9.3.18.3.F. **AO17.3 (1)** Where development does not meet the minimum separation distance for habitable rooms or balconies facing habitable rooms or balconies in Table 9.3.18.3.F to an existing dwelling house, or where a direct view is available from balconies, terraces, decks, roof decks, communal spaces or private open spaces into windows of habitable rooms, balconies, terraces or decks of an existing dwelling house, development ensures such elements of the retirement facility or residential care facility has reference to requirement of the AO17.3 (refer to Table 9.3.18.3.A of the City Plan for further details) **AO17.4 (1)** Where development meets the minimum separation distance for habitable rooms or balconies facing habitable rooms or balconies in Table 9.3.18.3.F and where no direct view (as described in AO17.3 above) is present, development should limit a number of elements as per requirements of the AO17.4 (refer to Table 9.3.18.3.A of the City Plan for further details).

Performance outcomes	Acceptable outcomes
PO23 Development in a zone in the centre zones category or the Mixed use zone must: a. be located, designed and constructed to protect bedrooms and other habitable rooms from exposure to noise arising from non-residential activities outside the building; b. be designed and constructed to achieve a minimum reduction in sound pressure level between the exterior of the building and the bedrooms or indoor primary living areas of 30dBA. c. Note—A noise impact assessment report prepared in accordance with the Noise impact assessment planning scheme policy can assist in demonstrating achievement of this performance outcome. Note—Site-specific criteria will be identified in a neighbourhood plan for sites within a Special Entertainment Precinct Area or within the Transport noise corridor overlay.	**AO23** Development in a zone in the centre zones category or the Mixed use zone has a minimum acoustic performance of: ▪ R_W 35 for glazing (windows and doors) where total area of glazing is greater than 1.8m^2; ▪ R_W 32 for glazing (windows and doors) where total area of glazing is less than or equal to 1.8m^2.
PO36 Development provides fencing and retaining walls that must: a. facilitate casual surveillance of the street and public space; b. enable use of private open space; c. assist in highlighting entrances to the property; d. provide an articulated and non-dominating interface to the streetscape and pedestrian environment.	**AO36.1** Development ensures that, where fencing is provided, the height of any new fence is a maximum of: a. 1.2m, where fence construction is solid or less than 50% transparent; b. 1.5m, where fence construction is at least 50% transparent; c. 1.8m and solid, only where the site is on an arterial road; d. 2m, where an acoustic fence is required for a residential care facility or care co-located use along any boundary with adjoining sensitive uses. Note—Higher solid fences are acceptable where privacy and security is required for communal open space areas in a residential care facility. **AO36.2** Development incorporating solid front fences or walls that front the street or other public spaces of longer than 10m, provide indentations, material variation and landscaping. **AO36.3** Development for a retaining wall is: a. stepped; b. a maximum 0.6m height if directly abutting the edge of the adjoining road reserve verge. **AO36.4** The combined height of any structure (except for a built to boundary wall) on the side or rear boundary is no greater than 2m in height and finished with low-maintenance and pre finished materials. Note—Structures include car parking walls, retaining walls, fences, planters and roofing to terraces, balconies or patios.
Notes 1. Full requirements and text as per provisions of the City Plan is omitted for brevity. Refer to Table 9.3.18.3.A of the City Plan for further details and full requirements.	

4.1.3 Noise impact assessment planning scheme policy

Schedule SC6.21 *Noise impact assessment planning scheme policy* of the City Plan outlines procedures and assessment benchmarks for assessment of acoustic impacts relevant to provisions setout in the City Plan. The provisions of the SC6.21 are not reproduced in this section for brevity. However, consideration has been given to the procedures and guidance provided in SC6.21 for each of the relevant assessed acoustic aspect in this report.

4.1.4 Refuse planning scheme policy

The following acoustic related provisions are applicable with respect to provisions of the SC6.26 Refuse planning scheme policy of the City Plan:

Table 4-4 SC6.26 Refuse planning scheme policy relevant acoustic requirements

Provision	Description
2. General Requirements	The waste collection system is to achieve the following outcomes: ▪ both the customer and service provider can access the bin storage area and collection point conveniently; ▪ the location, design and operation of the bin storage and collection system do not have unreasonable adverse acoustic, odour or visual impacts on the development, surrounding properties or the streetscape; ▪ the supply and servicing of either mobile garbage bins or bulk bins or refuse compactors complies with the requirements of this planning scheme policy. Note— Where alternative waste servicing solutions are proposed, advice may be sought directly from Council's waste service area prior to lodgement of the development application.
5. Non-residential reduce collection	1. Non-residential development is to provide sufficient capacity to achieve low-frequency servicing in line with Table 2. 2. Refuse generation rates for specific uses are provided in Table 4. These figures are to be used to calculate the refuse and recycling capacity required. Note—Where a refuse generation rate is not defined in Table 4, the applicant is responsible for providing evidence in support of the refuse generation proposed. 3. Sufficient information is provided to demonstrate that refuse collection can occur in an efficient and safe manner on site without adverse impact on amenity (acoustic, odour or visual impacts) and pedestrian and vehicular traffic. 4. This information may include evidence from a refuse collection contractor to demonstrate that collection will occur outside normal service/delivery or business times, where seeking permission to allow a refuse collection vehicle to use service bays or parking spaces on the site for access. 7. The storage area for refuse bins are: c. screened from neighbouring properties to mitigate impacts from odour, amenity and noise;

Table 4-5 SC6.26 Non-residential service frequency requirements (Table 2 of the SC6.26)

Zone	Maximum service frequency
Emerging community (1)	Twice per week
Note— 1. Where the development site is located within a zone that directly adjoins any of the nominated zones the development must either locate servicing areas away from the adjoining zone or minimise service frequency to be compatible with the adjoining zone type (e.g. Mixed use zone adjoining Low density residential zone).	

4.1.5 Transport, access, parking and servicing planning scheme policy

The following acoustic related provisions are applicable with respect to the SC6.31 Transport, access, parking and servicing planning scheme policy of the City Plan:

Table 4-6 SC6.31 Transport, access, parking and servicing planning scheme policy relevant acoustic requirements

Provision	Description
5. Service area design standards	**5.2 Location** 3. If a service area is located adjacent to a residential use, it is acoustically screened to minimise visibility and noise intrusion.

4.1.6 Northshore Hamilton Urban Development Area Development Scheme

Northshore Hamilton UDA Development Scheme outlines principles and provisions to achieve the vision of a vibrant waterfront community with diverse commercial opportunities and transit hub oriented as well as promoting a subtropical Brisbane City living environment with healthy and diverse community.

The following outlines the acoustic related provisions of the Northshore Hamilton UDA relevant to this development:

3.0 Land Use Plan: UDA Wide Development Criteria

3.7 Urban design and sustainability

Building form – (a) General provisions

Residential building design is to ensure visual and noise privacy, adequate balcony size, adequate storage space, adequate room sizes, functional room relationship, and the provision of useable and well connected common outdoor spaces.

3.9 Sustainability and the environment

General noise requirements

The design, siting and layout of development must address noise impacts and where necessary incorporate appropriate noise mitigation measures.
Development achieves acceptable noise levels for noise sensitive uses in affected areas.
An acoustic report will be required to evaluate and address potential noise impacts and recommend appropriate noise mitigation measures.

Note reference is made to *Environmental Protection (Noise) Policy 2008* in relation to acceptable noise levels for noise sensitive uses in affected area which is now superseded. Assessment in this report has reference to the Environmental Protection (Noise) Policy 2019.

4.2 AS2107:2016

Additional reference is made to the recommended internal noise level targets outlined in Australian Standard AS2107-2016 *Acoustics – Recommended design sound levels and reverberation times for building interiors* summarised in Table 4-7. The recommended internal design noise levels for residential buildings are consistent with that adopted by Brisbane City Plan. For other spaces such as office, administrative and therapy areas where no guidance is provided by the Brisbane City Council, consideration is given to AS2107.

Table 4-7 Recommended internal noise level design criteria

Space	Internal design noise level, $L_{eq,1hr}$ dBA
Retirement Homes & Villages – Houses and apartments in suburban areas or near minor roads	
Common areas (e.g. foyer, lift lobby etc)	45 – 50

Space	Internal design noise level, $L_{eq,1hr}$ dBA
Living areas	30 – 40
Sleeping areas (night time)	30 – 35
Work areas	35 – 45
Administrative areas	
General office areas (offices, meeting, staff, reception)	40 – 45
Wellness/beauty/consult	40 – 45
Function	40 – 45
Amenities	≤ 55

4.3 Sleep disturbance

Potential for sleep disturbance and awakening for night time and sleeping areas from external ambient noise sources should be considered and appropriately mitigated. Noise impact assessment planning scheme policy of the Brisbane City Plan notes that where the development involves a proposed sensitive use in an existing noisy environment, sleep awakenings should be considered and provides a method of estimating the worst case awakenings based on the night time noise levels ($L_{eq,night}$). However specific guidance on the recommended target is not provided.

Reference is made to the WHO Guidelines for Community Noise 1999 recommended sleep disturbance level, which has been referenced within other sections of the Brisbane City Plan. Similarly, DES *Noise Measurement Manual* when investigation sleep disturbance issues, recommends assessment with reference to sleep disturbance and awakening criteria as per WHO, 1999 and 2009. Guidance with respect to sleep disturbance targets are also provided in other documents such as NSW Road Noise Policy (NSW RNP). The following Table 4-8 below summarises the recommended sleep disturbance targets:

Table 4-8 Recommended sleep disturbance assessment targets

Reference	Maximum events, L_{Fmax}	Transient noise, $L_{eq,night}$
WHO 1999, enHealth Council 2004	L_{Fmax} 45 dBA, 10 – 15 times for a good night sleep	$L_{eq,night}$ 30 dBA, negative effects on sleep avoided
NSW RNP, WHO 2009	L_{Fmax} 50 – 55 unlikely to awaken people	$L_{eq,night\ outside}$ 40 dBA a number of effects are observed, but their impact is modest
	One or two events with L_{Fmax} 65 – 70 not likely to affect health and wellbeing significantly	

4.4 Environmental Protection Act 1994

The Environmental Protection Act 1994 (EP Act) protects Queensland's environment while allowing for development that improves the quality of life and maintains ecological processes. Chapter 8 Part 3B Division 3 of the EP Act provides default noise standards that apply for a number of specific noise sources and activities. Default noise standards under the provisions of the EP Act apply to local government areas where no other specific local law in relation to these are in force. The relevant noise standards under the provisions of the EP Act are presented in Table 4-9.

Table 4-9 Allowable noise limits under provisions of EP Act

EP Act Ch.8 Part 3B Div. 3 Clause	Equipment or Activity	Description	Time	Allowable Noise Limits
440R	Building and Construction	Construction work such as drilling, cutting etc.	Monday to Saturday, 6.30am – 6.30pm	Noise permitted
			Monday to Saturday, 6.30pm – 6.30am Sundays and Public Holidays	No audible noise permitted
440S	Machinery and power tools (Regulated Devices)	Includes compressors and generators, ducted vacuuming systems, grass cutters (such as lawn mowers and edge cutters), impacting tools (such as hammers and nail guns), leaf blowers and mulchers, oxyacetylene burners and electrical, mechanical or pneumatic power tools (such as chainsaws, drills and sanders).	Monday to Saturday, 7 am – 7 pm Sundays and Public Holidays, 8 am – 7pm	Regulated device can be used.
			Monday to Saturday, 7 pm – 7 am Sundays and Public Holidays, 7 pm – 8am	No audible noise permitted
440T	Pumps (includes swimming pool pumps & spa blowers)	Includes an electrical, mechanical or pneumatic pump (liquid pump, air pump or heat pump).	Any day, 7am – 7pm	5 dB above background level
			Any day, 7pm – 10pm	3 dB above background level
			Any day, 10pm – 7am	No audible noise permitted
440U	Air conditioning Unit Equipment	Noise from air-conditioning equipment.	Any day, 7am – 10pm	5 dB above background level
			Any day, 10pm – 7am	3 dB above background level
440V	Refrigeration Equipment	Includes refrigeration equipment on properties such as cold rooms and truck-mounted units.	Any day, 7am – 10pm	5 dB above background level
			Any day, 10pm – 7am	3 dB above background level
440W	Indoor venues	Indoor venues for commercial purposes	Any day, 7am – 10pm	5 dB above background level
			Any day, 10pm – midnight	3 dB above background level
			Any day, midnight – 7am	No audible noise permitted

4.5 Environmental Protection (Noise) Policy 2019

Queensland Environmental Protection (Noise) Policy 2019 sets out the state-wide development principals and requirements under the provisions of the Environmental Protection Act 1994. The environmental values specified in section 6 of the Environmental Protection (Noise) Policy 2021 are as follows:

6 Environmental values

The environmental values to be enhanced or protected under this policy are--

(b) the qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following—
- *(i) sleep;*
- *(ii) study or learn;*
- *(iii) be involved in recreation, including relaxation and conversation;*

The Environmental Protection (Noise) Policy 2021 specifies the acoustic quality objectives for different types of sensitive receivers. The noise criteria for relevant receivers within proposed development premises are shown in Table 4-10.

Table 4-10 Acoustic quality objectives

Sensitive receptor	Time of day	Acoustic quality objectives (measured at the receptor) dBA		
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$
Residence (for outdoors)	Daytime and evening	50	55	65
Residence (for indoors)	Daytime and evening	35	40	45
	Night-time	30	35	40
Childcare centre or kindergarten (for indoors)	When open for business, other than when the children usually sleep	35	--	--
	When the children usually sleep	30	--	--
School or playground (for outdoors)	When the children usually play outside	55	--	--
commercial and retail activity (for indoors)	when the activity is open for business	45	--	--

4.6 Summary of external noise intrusion criteria

With reference to relevant provisions discussed above including Brisbane City Council, aircraft noise as well as sleep disturbance considerations, the following Table 4-11, summarises the project adopted internal noise amenity targets for external control of noise.

Table 4-11 Summary of internal noise targets

Spaces	$L_{eq,T}$	L_{Fmax}	L_{smax}
Units (sleeping and living)	$L_{eq,1hr}$ 35 dBA $L_{eq,night}$ 30 dBA	45 dBA	50 dBA
Communal Living (lounge, dining etc)	$L_{eq,1hr}$ 40 dBA	---	55 dBA
Administrative areas (offices, staff, meeting, function, therapy, consult and beauty, etc)	$L_{eq,1hr}$ 40 – 45 dBA	---	55 dBA

4.7 Summary of environmental noise criteria

With reference to the identified noise sensitive receivers, requirements of the EP Act, EPP (Noise) and Brisbane City Council, adopted environmental noise limits for the project are summarised in Table 4-12 below. Note the established environmental noise criteria are based on the minimum measured background noise levels during short term background noise monitoring campaign. Higher noise criteria may be applicable subject to results of long term continuous background noise monitoring.

Table 4-12 Summary of environmental noise criteria

Receivers	Noise criteria, $L_{eq,\ 1hr}$ dBA [1]								
	Day			Evening			Night		
	Noise EPP	EP Act [2]	Brisbane City Plan	Noise EPP	EP Act [2]	Brisbane City Plan	Noise EPP	EP Act [2]	Brisbane City Plan
All identified receivers (R1 – R5)	50	42	40	50	42	40	45 [3]	37	37

Notes:

1. Assessment time period of 1 hr is adopted as per requirement of Noise EPP. Note assessment period relevant to Brisbane City Plan requirements are $L_{eq,11hr}$, $L_{eq,4hr}$, $L_{eq,9hr}$ for day, evening and night periods.
2. Requirement based on default noise standards of the EP Act. Requirements only apply to Air conditioning and refrigeration units as per Section 440U & 440V of the EP Act.
3. Equivalent external noise criteria based on a 15 dB outdoor to indoor correction in line with the adopted approach by EPP (Noise) 2019.

5.0

External noise control

5.0 External noise control

Building envelop should consider adequate sound attenuation measures such that the relevant internal noise amenity targets are achieved within the proposed development as outlined in Section 4.6.

5.1 Incident noise levels

Based on the measured ambient noise levels, the following incident external noise levels are adopted for assessment of external noise intrusion and control.

Table 5-1 Established incident noise levels

Acoustic parameter	Ambient L_{eq}, Day/Evening	Ambient L_{eq}, Night	Maximum event, L_{Fmax}	Aircraft, L_{Smax}
Relevance	**(Living and communal)**	**Sleeping areas**	**Sleep disturbance**	**Aircraft noise**
External incident noise	L_{eq} 57 dBA	L_{eq} 47 dBA	L_{Fmax} 77 dBA	L_{Smax} 69 dBA

The corresponding octave band sound pressure spectra for each of the relevant incident noise levels are presented in Table 5-2 below.

Table 5-2 Established incident noise levels spectra

Incident noise	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Ambient $L_{eq, day/evening}$	68	64	59	55	51	45	37	30	57
Ambient $L_{eq, night}$	61	55	49	42	41	36	36	32	47
Maximum (fast), L_{Fmax}	76	68	60	59	65	69	73	71	77

5.2 Aircraft noise

Provisions of Part 8.2.2 Airport environs overlay code of the Brisbane City Plan requires assessment of aircraft noise where proposed development fall within ANEF categories of 20 and above. Assessment of aircraft noise intrusion against the specific internal aircraft noise amenity levels as summarised in Section 4.6 would be required plus consideration to minimum acoustic performance requirements for building envelop as outlined in Section 4.1.1.

The proposed development is located in relative proximity to Brisbane International Airport with nearest runway located about 5.4 km north east of the development site. The location of the proposed development site with respect to Brisbane City Plan Airport Environ Overlay - ANEFs are shown in Figure 5-1 below.

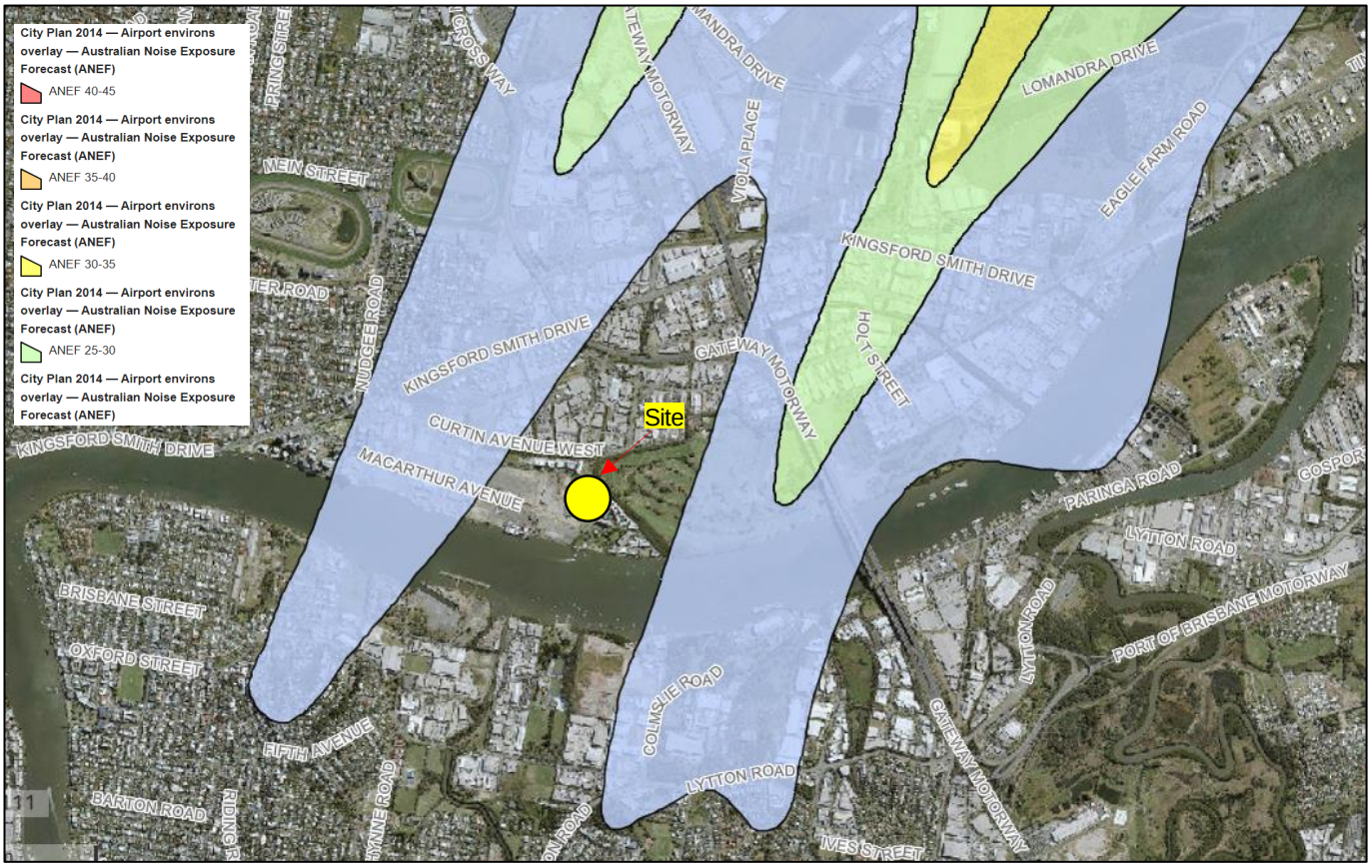

Figure 5-1 Site location with respect to Airport environs overlay – Brisbane Airport ANEFs

The proposed development is located just outside the ANEF 20 – 25 contours for which provisions of the Airport environments overlay code apply. Accordingly, the acoustic related performance requirements and outcomes of the Brisbane City Plan Airport Environs Overlay code would not apply.

However, based on site inspection and ambient noise measurements carried out (refer to Section 3.0), aircraft flyover noise was a notable ambient noise feature of the area. Accordingly, nonetheless consideration has been given to assessment of likely aircraft noise intrusion based on the measured L_{Smax} incident noise levels outlined in Section 5.1 and the recommended aircraft internal noise targets as outlined in Section 4.6.

5.3 Recommendations

External ambient noise sources that may potentially be impacting on the sensitive uses within the development are identified as:

- traffic noise from surrounding roads,
- aircraft flyovers,
- noise from surrounding industrial and commercial uses, and
- entertainment and recreational activities.

Contributions of each of above noise sources have been reflected within the measured ambient and maximum noise levels outlined in Section 5.1. An assessment of likely external noise intrusion has been undertaken based on the measured ambient and maximum noise levels presented in Section 5.1 having specific regards to control of external general ambient noise, prevention of sleep disturbance as well as control of aircraft noise.

Building envelop should incorporate adequate noise attenuation measures to achieve the internal noise levels outlined in Section 4.6 with doors and windows closed.

With reference to established external noise levels and expected acoustic environment, adequate control of external noise is predicted to be met the recommended acoustic performance requirements presented in Table 5-3. Examples of suitable constructions achieving each of the relevant acoustic performance is also provided. Alternative constructions can be achieved subject to the nominated acoustic performance being met and review by acoustic consultant.

Table 5-3 External noise control requirements

Envelop element	Acoustic performance requirement	Example constructions

Facade	R_W 48 & $R_W + C_{tr}$ 35 dB	▪ Brick masonry or precast walls with cavity and insulation and internal lining
		▪ Lightweight metal cladding element:
		  ▪ Metal cladding with 9 mm compressed fibre cement (CFC) backing
		  ▪ Minimum 92 mm wall cavity with steel stud and framing
		  ▪ Minimum 75 mm thick acoustic insulation, density of 14 kg/m^3 cavity
		  ▪ 13 mm plasterboard internal lining
		▪ Lightweight FC cladding:
		  ▪ 9 mm CFC cladding
		  ▪ Minimum 92 mm wall cavity with steel stud and framing
		  ▪ Minimum 75 mm thick acoustic insulation, density of 14 kg/m^3 cavity
		  ▪ 13 mm fire rated plasterboard internal (10.5 kg/m^2) lining

Roof	$R_W + C_{tr}$ 40 dB	▪ Minimum 0.48 mm thick metal deck roof ▪ 75 mm thick, minimum 14 kg/m^3 acoustic cavity insulation sandwiched between roof metal and purlins ▪ Minimum 500 mm airgap (purling/joist depth and suspended ceiling) ▪ Suspended light grid ceiling with 13 mm thick plasterboard or mineral fibre tile with minimum CAC of 35
External glazing	R_W 35 dB	▪ Single 10.38 laminated glass or ▪ DGU system 10 mm glass /12 air gap/ 6 mm glass
External doors (e.g. balcony)	R_W 30 dB	▪ 40 mm solid core door (minimum surface density of 28 kg/m^2) or 10 mm glazed doors with acoustic perimeter and bottom seals. ▪ Sliding glazed door with minimum 10 mm glass in aluminium door frame. Sliding door should have rubber fin or sweeping seals on both sides of the head, bottom, leading edge and the trailing edge. Door should have bottom and head track as well as mullion for the sliding door to fully lock when closed and sealed airtight.
Ventilation system	R_W 35 dB	▪ Ventilation system provided in addition to operable windows should achieve minimum R_W 35 dB

6.0

Noise emissions

6.0 Noise emissions

Proposed development should consider adequate noise mitigation strategies to ensure that it does not unreasonably diminish the amenity of nearby noise sensitive uses. The noise sources associated with the proposed development operations potentially impacting on the surrounding noise sensitive receivers include:

- mechanical plant noise,
- car park noise emissions, and
- delivery and waste management.

6.1 Mechanical noise

Noise emissions from the external mechanical plant should meet the established project environmental noise limits presented in Section 4.7 in accordance with provisions of the *Noise EPP* 2019 and the Brisbane City Council *Noise assessment planning scheme policy*.

The mechanical plant are expected to be located on the rooftop deck above the back of house area on the north western corner of the site within a dedicated plant deck area. The mechanical plant is expected to be well acoustically shielded from the eastern and south eastern residential receivers by the facility building itself.

Acoustic screening is however expected to be required from the plant deck area to the northern, western and southern receivers. Mechanical design strategy and selections are not available at this stage to enable a detailed assessment of likely noise emissions.

Appropriate acoustic mitigation measures and screening will be designed at later stage of the project when mechanical design and selections are available to enable the project environmental noise targets to be met at relevant identified noise sensitive receivers. Expected noise attenuation strategies include (subject to assessment at later stage):

- Selection of low noise equipment and those with nigh time operation mode enabling reduced emissions at night
- Orientation and layout of mechanical plant to optimise acoustic attenuation and shielding from the facility structure.
- Acoustic screening/barrier for the mechanical plant deck in the form of solid acoustic barrier or acoustic louvres
- Local treatment to individual units or equipment such as acoustic barrier, attenuators or enclosures.

Additionally, to comply with the Acceptable Outcomes AO2 of the Brisbane City Plan *Retirements and residential care facility* code, the following is required with reference to mechanical plant:

> *Development:*
>
> *a. ensures mechanical plant or equipment is acoustically screened from adjoining sensitive uses;*
>
> *Note—Mechanical plant includes, but is not limited to, generators, motors, compressors and pumps such as air-conditioning, refrigeration or coldroom motors.*

The mechanical plant acoustic screen should comply with the following definition of the Table SC1.2.3.B of Schedule 1 of the Brisbane City Plan:

> *The source of noise is completely screened from view of habitable rooms (including balconies, patios, decks and verandas) of an adjoining sensitive use by solid, gap free material and construction e.g. acoustic fence, building, or enclosure.*
>
> *Acoustic fence is defined as Solid, gap free fence with minimum panel surface density of 12.5kg/m^2 .*

Note equivalent acoustic performance may also be achieved with consideration of acoustically louvred screening with adequate insertion loss and height subject to further acoustic review and design. An acoustic assessment of proposed

mechanical plant should be carried out at later project design stages to ensure above requirements and project noise limits as outlined in Section 4.7 are met.

6.2 Carpark noise emissions

The facility accommodates 44 on grade sleeved parking spaces located on the south western portion of the site with entry from Karakul Road. An assessment of proposed development car parking noise emissions is undertaken and considers the following:

- Peak hour car park activity noise emissions
- Maximum noise events associated with likely early arrival of staff just before 7 am (sleep disturbance)

Based on the preliminary project traffic estimates, the following trip generations are assumed:

- Up to 30 trips in peak hour for the development during shift changes

Potential noise emissions from the car park have been predicted using a developed computational noise model for the facility with the following inputs:

- Engine start and idling sound power of L_{eq} 80 dBA
- Slow moving car sound power level of L_{eq} 82 dBA
- Maximum sound power of L_{max} 92 dBA for cars short term events including door closing, engine star and movements.
- Car park and driveway maximum speed of 10 km/h.
- 30 cars movements in/out during peak hours and shift changes
- Maximum of 4 – 5 staff arriving prior to 7 am in any hour.
- Cars engine start/idling for maximum of 20 seconds.
- Maximum L_{max} events (door slamming, engine start etc) duration of 5 seconds.

Additionally, to comply with the Acceptable Outcomes AO2 of the Brisbane City Plan *Retirements and residential care facility* code, the following is required with reference to car parking and boundary fences:

> *Development:*
>
> *b. for a residential care facility or care co-located use provides a 2m high acoustic fence along any boundary with adjoining sensitive uses;*
> *c. ensures car parking and vehicle movement areas are acoustically screened from adjoining residential dwellings*

The boundary and car parking acoustic screen should comply with the following definition of the Table SC1.2.3.B of Schedule 1 of the Brisbane City Plan:

> *The source of noise is completely screened from view of habitable rooms (including balconies, patios, decks and verandas) of an adjoining sensitive use by solid, gap free material and construction e.g. acoustic fence, building, or enclosure.*
>
> *Acoustic fence is defined as Solid, gap free fence with minimum panel surface density of 12.5kg/m^2 .*

Based on above, to comply with the relevant Brisbane City Plan provisions and project environmental noise emissions, an acoustic fence is recommended along the western site boundary with a minimum height of 2 m and extent shown in Figure 5-1.

The acoustic fence should be solid with no gaps on the face or bottom and constructed with a material achieving a minimum surface density of 12.5 kg/m^2. Note adequate acoustic screening is achieved via the building structure on the

eastern, southern and northern boundaries and therefore no additional physical acoustic fencing is recommended for the purpose of noise control.

Figure 6-1 Minimum extent of acoustic fence/barrier

Based on the above recommended acoustic screening, the following car parking noise levels as presented in Table 6-1 below are predicted at the nearest noise sensitive receivers.

Table 6-1 Predicted car parking noise levels

ID	Receiver	Predicted noise levels, dBA			Noise criteria	Comply?
		Daytime/ evening, L_{eq}	Night, L_{eq}	Maximum events, L_{night}		
R1	341 MacArthur Avenue dwellings	33 dBA	< 25 dBA	<15 dBA	Day, 40 dBA Eve., 40 dBA Night, 37 dBA L_{night} 40 dBA	Yes
R2	Atria North Apartments 331 MacArthur Ave.	< 25 dBA	< 20 dBA	<15 dBA		Yes
R3	Riverlight Apartments 320 MacArthur Ave.	< 25 dBA	< 20 dBA	20 dBA		Yes
R4	Western future development	GF 39 dBA Upper, 45 dBA	37 dBA	30 dBA		Yes, at ground level and likely exceedance at upper levels if multi-storey.
R5	Southern future development	40 dBA	32 dBA	20 dBA		Yes

As demonstrated in Table 6-1, the predicted noise emissions from the likely car parking including the car movements during peak morning and evening hours are predicted to meet the noise limits at all identified sensitive receivers except at the likely future western development if a multi-storey sensitive development is considered. The predicted noise levels at ground level of the likely future development meet the relevant noise limit with recommended acoustic fencing implemented. However, for a multi-storey sensitive use, the effectiveness of the acoustic fencing diminishes for upper floors due to direct line of sight resulting in predicted noise levels of up to 45 dBA.

Despite the likely exceedance of the predicted car parking noise levels for upper floors of potential future development above the project daytime noise target of 40 dBA, no adverse noise impact is expected due to the following reasons:

- The Brisbane City Plan recommended daytime noise target for carparking is an average noise limit over the daytime period (11 hours), while the assessment and predicted noise level presented in Table 6-1 is a 1 hour average ($L_{eq,1hour}$). The equivalent 11 hour average noise from carparking equates to $L_{eq,11hour}$ 35 dBA which meets the relevant PO2 of the Retirements and residential care facility code.
- The predicted noise level of $L_{eq,1hour}$ 45 dBA still meets the recommended acoustic quality objective level of 50 dBA for identified noise sensitive receivers.
- The noise level and character of carparking noise would be similar to that already experienced by the likely development due to existing ambient and local traffic. The predicted noise level of 45 dBA is well below the existing measured average ambient noise levels of 51 – 55 dBA in the area as presented in Section 3.4.

Furthermore, as shown in Table 6-1, the predicted night time car parking activity noise levels are also found to comply with relevant targets for each of average noise (L_{eq}) and maximum event (L_{night}) for risk of sleep disturbance.

Accordingly, operation of the car parking within the proposed development is not expected to result in any adverse noise impacts on adjoining noise sensitive receivers satisfying provisions of Brisbane City Plan, and Noise EPP with implementation of the recommended acoustic fencing on western boundary.

6.3 Delivery and waste management

Noise generated by waste collection, services or delivery vehicles should be controlled by management of the collection/delivery times to minimise disturbance to nearby residents. Out of hours (evening and night-time period) should be avoided where practical. Incorporation of Best Management Practices as recommended in Section 6.4 will enable noise impacts to the adjacent receivers, if any, to be reduced during operation.

Additionally, the relevant acoustic provisions of the Refuse planning scheme policy of the Brisbane City Plan as outlined in Section 4.1.4 should be incorporated including;

- Limiting the servicing frequency to maximum of two per week, and
- Screened storage area of the refuse bins from neighbouring properties.

Similarly, for the servicing area, the provision Section 5.2 of the SC6.31 Transport, access, parking and servicing planning scheme policy as outlined in Section 4.1.5 should also be considered requiring acoustically screened service area from neighbouring residential use.

6.4 Operational noise management

On the basis of the acoustic assessment undertaken in this report, the following operational and good practice noise management measures are recommended to minimise the noise impact on surrounding uses where practical and safe to do so:

Mechanical services

- Ensure the services are operating between 7 am – 10 pm with appropriate automatic control using BMS system to enable reduced load for evening/night time hours as necessary.
- External mechanical plant should be regularly maintained.

Parking

- Appropriate signage is recommended to be incorporated in parking space to require all visitors and staff to be considerate to surrounding neighbours with respect to noise, minimise and avoid slamming doors and the like.
- Training should be provided to staff with consideration to operational noise measures to minimise emissions to the surrounding receivers when using parking and prevent noisy events before 7 am such as slamming doors when arriving, talking in parking space, excessive idling or revving the engine and the like. These measures should also generally be incorporated during facility hours.

Waste Management

- Schedule collection/delivery times after 9 am to minimise disturbance to nearby residents.
- Bin bays are to be adjacent to a street frontage, or if not possible then at a designated point adjacent to the common access driveway.
- The bin bay should be positioned so as to minimise noise impacts on residents from the usage of bins and waste or recycling collection.

Not approved as part of this document. A detail Construction Noise Management Plan to be submitted in accordance with Condition 13 of this approval.

AMENDED IN RED
By: Vivian Lun
Date: 31 October 2024
Queensland Government

7.0

Construction noise and vibration

AMENDED IN RED
By: Vivian Lun
Date: 31 October 2024

Queensland Government

CUNDALL

Not approved as part of this document.
A detail Construction Noise Management Plan to be submitted in accordance with Condition 13 of this approval.

7.0 Construction noise and vibration

Project construction noise and vibration impact will be addressed at a later stage via implementation of a construction noise and vibration management plan for the works.

7.1 Construction noise and vibration criteria

7.1.1 Construction noise criteria

The application of the noise standard for building work (Section 440R of the Environmental Protection Act 1994) as well as Brisbane City Council provisions, requires construction activities to be limited to the hours between 6.30am – 6.30pm - Monday to Saturday as outlined in Section 4.4. Use of regulated devices as defined in EP Act and described in Section 4.4 should also be limited to hours between 7 am – 7 pm, Monday to Saturday and 8 am – 7pm Sundays and Public Holidays.

Construction works outside these hours will need to be inaudible at the noise sensitive receivers unless otherwise exemptions and relevant approvals are sought from Council. These include:

- 6.30pm to 6.30am Monday to Saturday
- any time on Sunday or public holidays (normal Saturday restrictions apply for Saturday public holidays).

Generally, the proposed works is expected to be undertaken during standard construction hours as required by the Brisbane City Council. Noise from all construction activities is expected to be managed and minimised as far as reasonably practicable.

In the absence of specific guidance, reference can be made to the guidance provided by NSW *Interim Construction Noise Guidelines* 2009 (ICNG 2009) with the following requirements outlined in Table 7-1.

Table 7-1 NSW ICNG 2009 guidance for standard working hours

Indicative impact	Managed impact	Noise affected	Highly affected
Construction noise level	< background + 10 dBA	Above background + 10 dBA but below 75 dBA	Above 75 dBA
Reaction to noise	Generally acceptable with prior notification although would be clearly noticeable	Point above which maybe some community reaction to noise	Point above which maybe strong community reaction to noise

Based on above guidance and typical background noise levels of 41 – 44 dBA expected in the area during standard construction hours, the following construction noise management targets as presented in Table 7-2 are recommended. It is noted that below construction noise targets are not mandatory and are provided as guidance only for the management of construction noise.

Table 7-2 Construction noise level guidance

Indicative impact	Managed impact	Noise affected	Highly affected
Construction noise level	50 dBA	50 – 75 dBA	Above 75 dBA
Reaction to noise	Generally acceptable with prior notification although would be clearly noticeable	Point above which maybe some community reaction to noise	Point above which maybe strong community reaction to noise

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Date: 31 October 2024

Queensland Government

CUNDALL

Not approved as part of this document.
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7.1.2 Structural damage vibration criteria

Most commonly specified "safe" structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks and are set well below the levels that have potential to cause damage to the main structure. Example of these vibration level limits are nominated within the BBS7385: Part 2.

The vibration criteria specified within the DIN 4150: Part 3 have been recommended for structures surrounding the project site. The criteria specified within DIN 4150 are designed for controls of continuous long-term vibration or repetitive vibration with the potential to cause fatigue effects to structure.

The following Peak Particle Velocity (PPV) values are specified within DIN 4150 as safe limits, below which even superficial cosmetic damage is not to be expected:

- 10 mm/s for commercial buildings and buildings of similar design.
- 5 mm/s for dwellings and buildings or similar design.
- 2.5 mm/s for buildings of great intrinsic value (e.g. heritage listed buildings).

For short-term vibration events (i.e. those unlikely to cause resonance or fatigue), DIN 4150 offers the criteria shown in Table 7-3. These are maximum levels measured in any direction at the foundation or in the horizontal axes in the plane of the uppermost floor.

Table 7-3 DIN 4150 Structural Damage - Safe Limits for Short-term Building Vibration

Group	Type of Structure	Peak Particle Velocity, (mm/s)[1]		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[2]
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 at 10 Hz increasing to 40 at 50 Hz	40 at 50 Hz increasing to 50 at 100 Hz
2	Dwellings and buildings of similar design and/or use	5	5 at 10 Hz increasing to 15 at 50 Hz	15 at 50 Hz increasing to 20 at 100 Hz
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order	3	3 at 10 Hz increasing to 8 at 50 Hz	8 at 50 Hz increasing to 10 at 100 Hz

Note 1: Unless specified, vibration levels are measured at foundation of the structure

Note 2: For frequencies above 100 Hz the upper value in this column should be used

7.1.3 Human comfort vibration criteria

For most construction activities that generate perceptible vibration by occupants in nearby buildings (e.g. earth works and excavation works), the character of the vibration emissions is considered to be intermittent in nature. As a guide, the BS5228-2:2009 provide effects of perceived vibration level in terms of peak particle velocity (PPV, mm/s).

Table 7-4 Guidance on effects of vibration levels (BS 5228-2: 2009)

Vibration level (mm/s)	Effect
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with demolition. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environment will cause complaint, but can be tolerated if prior warning and explaining has been given to residents.
10.0	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

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Table 7-4 suggests that people will be able to detect vibration at levels of about 0.15 mm/s and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

The EPA *Assessing Vibration: a technical guideline* nominates preferred and maximum vibration goals for critical areas, residences and other sensitive receivers (related to the Project) are shown in Table 7-5 for intermittent vibration and Table 7-6 for continuous vibration. The guideline advises a low probability of adverse comment or disturbance to building occupants would be expected at or below the preferred values.

The applicable human comfort vibration goal for intermittent vibration source is defined in terms of Vibration Dose Values (VDVs) where the permissible vibration level corresponding to the VDV varies according to the duration of exposure.

Table 7-5 Preferred and Maximum Vibration Dose Values for Intermittent Vibration (EPA, 2006)

Building Type	Preferred Vibration Dose Value ($m/s^{1.75}$)	Maximum Vibration Dose Value ($m/s^{1.75}$)
Residential Daytime	0.20	0.40
Residential Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80

Note: Daytime is 7:00 am to 10:00 pm and Night-time is 10:00 pm to 7:00 am

Table 7-6 Preferred and Maximum Vibration Dose Values for Continuous Vibration (EPA, 2006)

Building Type	Preferred Vibration Dose Value ($m/s^{1.75}$)	Maximum Vibration Dose Value ($m/s^{1.75}$)
Residential Daytime	0.20	0.40
Residential Night-time	0.14	0.28
Offices, schools, educational institutions and places of worship	0.40	0.80

Note: Daytime is 7:00 am to 10:00 pm and Night-time is 10:00 pm to 7:00 am

In applying the preferred and maximum VDV the guidelines states that:

> *'Situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short term duration. An example is a demolition or excavation Project.'*

The guideline also advises that:

> *'Where all feasible and reasonable measures have been applied to control potential ground vibration levels the maximum values may be used. For values above the maximum value the proponent should negotiate directly with the affected community.'*

When short-term works such as piling, demolition or compaction give rise to impulsive vibrations, it should be noted that undue restriction on vibration levels can significantly prolong the demolition process and may result in greater annoyance overall.

7.1.4 Nominated site control vibration targets

Based on the vibration criteria detailed above, the site-specific controls to reduce risk of cosmetic damage as per DIN 4150 are outlined below in Table 7-7.

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Table 7-7 Nominated site control vibration targets (warning and stop levels)

Structure	Site Control vibration Criteria[1] (Peak Particle Velocity, PPV) in any Orthogonal Direction	
	Warning Level	Stop Level
Residential buildings	4 mm/s	5 mm/s
Commercial buildings	10 mm/s	20 mm/s

Note 1: Vibration levels measured at the base of the building

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7.2 Construction noise and vibration impacts

7.2.1 Construction noise

Construction noise should be minimised as reasonably practical during standard hours outlined in Section 7.1. Guidance is provided for recommended construction noise action levels in Section 7.1. This can be incorporated into the project construction noise and vibration management plan. Where these levels cannot be achieved, the contractor will use all reasonable and feasible noise mitigation and management measures to reduce noise generation and impacts. Preliminary construction noise mitigation measures are provided in Section 7.3.

7.2.2 Typical construction equipment sound power levels

The recommended maximum allowable noise levels for construction plant expected to be used are provided in Table 7-8 All plant and equipment used for construction must have operating Sound power level or Sound pressure levels below or equal to the allowable noise levels listed in Table 7-8. For other equipment where not listed in Table 7-8 reference should be made to the recommended maximum sound power and pressure levels listed in the following documents:

- Transport for NSW *Demolition Noise and Vibration Strategy* (CNVS, 2018)*;*
- Australian Standard AS 2436-2010 *Guide to noise and vibration control on demolition, demolition and maintenance sites*;
- UK's Department of Environment, Food and Rural Affairs *Noise Database for Prediction of Noise on Demolition and Open Sites* (DEFRA, 2006);
- British Standard BS 5228-1 *Code of practice for noise and vibration control on demolition and open sites.*

Table 7-8 Recommended maximum allowable noise levels for construction equipment

Plant item	Sound power levels, dBA	Sound pressure level at 10 m
Dump truck	110	82
Front end loaders	112	84
Excavator 35t + hydraulic hammer [1]	122	94
Hand tools/ Power tools	102	74
Scissor Lift	98	70
Bobcat [1]	110	82
Jackhammer	121	93
Concrete truck	109	81
Angle Grinder	109	81
Concrete pump	112	84
Concrete saw	116	88
Mobile crane	98	70

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Plant Item	Sound power levels, dBA	Sound pressure level at 10 m
Tower crane	104	76
Compressor	100	72

Note 1: Equipment with special audible characteristics.

7.2.3 Vibration compliance

The construction contractor will be required to comply with the nominated site control vibration targets outlined in Table 7-7. Disturbance to building occupants can potentially occur at much lower vibration levels than the safe limits relating to cosmetic or structural damage of the building. The risk of exceeding the recommended building damage criteria should be managed by carrying out vibration measurements during piling, excavation, demolition and compaction works in order to establish satisfactory buffer zones where relevant.

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7.3 Recommended mitigation measures and work practices

7.3.1 General noise and vibration mitigation measures

The following general mitigation measures are provided to assist with management of construction noise and vibration during project construction. Typical noise management procedures are as follows:

General

- Where feasible and reasonable, construction should be carried out during the approved standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
- Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers (both noise and vibration generating activity).
- The contractor will take all reasonable and feasible measures to mitigate noise effects;
- The contractor will take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers;
- Minimise plant and vehicles idling when not in use;
- All plant and equipment should be maintained in a proper and efficient manner to minimise noise emissions, including the replacement of engine covers, repair of defective silencing equipment, tightening of rattling components and the repair of leakages in air lines;
- Notification of occupant's adjacent to the site of when these activities occur; and
- Implementing an effective community consultation and complaints management.

Noise

- Provision of localised treatment such as temporary barriers, shrouds and the like around fixed plant such as pumps, generators and groundwater extraction plant during use and by "stepping down" the plant settings out of demolition hours or turned off completely where able. The detailed design of acoustic treatments will be undertaken during the detailed design phase; and
- Maximising the offset distance between noisy plant items and nearby noise sensitive receivers;
- Where practicable, provision of additional respite from noise producing activities during extended hours operations;
- Use of broadband alarm in place of tonal alarm where practicable;
- Selection and maintenance of "quiet" type equipment where practicable;
- Minimise consecutive works in the same locality (if applicable);
- Minimising consecutive works in the same locality;
- Silenced air compressors, fitted with noise labels indicating a maximum (L_{Amax}) sound pressure level of not more than 75 dBA at 7 m is to be used on site. The sound pressure level of noise emitted from a compressor used is to comply with noise label requirements;

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- Orienting equipment away from noise sensitive areas; and
- Carrying out loading and unloading away from noise sensitive areas.

Vibration

- Selection and maintenance of low vibration equipment where practicable;
- Use only dampened rockbreakers and/or “city” rockbreakers to minimise the impacts associated with rockbreaking works.
- Trial testing of vibration levels is to be conducted where equipment identified as having the potential to exceed the human comfort criteria or where the vibration intensive plant or equipment is required to operate in close proximity to sensitive structure exceeding the nominated minimum working distances.
- Trial vibration monitoring to determine appropriate work distances of proposed demolition activities; and
- Utilise the smallest practicable size of plant equipment when in close proximity to the sensitive structure (e.g., small vibratory roller).

Construction traffic

- Where practicable, site should be arranged to provide one-way traffic movement minimise reversing of vehicles onsite.
- Utilising main road networks to access site and where practicable, heavy vehicles should enter site roads furthest from residential receivers.
- Provide instructions for heavy vehicles operators regarding minimising noise when entering and leaving the demolition sites.
- If required, planned truck queues to be located away from residences and operating school buildings in order to reduce noise impacts due to trucks idling; and
- Where practicable, heavy vehicles should be switched off while or during loading of debris queuing.

7.3.2 Monitoring of construction noise and vibration

Where required in response to complaints, noise and vibration monitoring should be conducted at the nearest residential receiver to the works being undertaken, once differentiation between site related noise sources and other sources has been established.

Vibration audits should be conducted at the nearest affected receiver or relevant structure for:

- Prevention of structural damage; and
- In response to complaints (human comfort).

7.3.3 Community consultation

Community consultation will, if required, be undertaken via the contractor, including:

- Advising the community of work to be undertaken.
- Recording and managing any complaints.

These and other elements of the community consultation will be addressed under the relevant procedures for the subject works.

7.3.4 Complaints handling

This protocol is intended to provide framework relating to complaint as a result of the proposed work, and application of appropriate corrective action is identified and implemented as necessary:

- All complaints (verbal, telephone or in writing) are to be recorded and forwarded to the Project Manager, together with details of the circumstance leading to the complaint, work activity at relating to the complaint and all subsequent actions taken.

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- The Project Manager shall investigate the complaint in order to determine whether work practices have been carried out with reasonable and feasible to minimise noise.
- Where excessive noise has been caused and identified as related to the work corrective action will be planned and implemented by the demolition contractor
- Project Manager shall inform the complainants regarding their complaints including:
  – Outcome of the investigation; and
  – Corrective action taken (if applicable).
- Follow up monitoring or other investigations will be carried out by the Project Manager and the demolition contractor to confirm the effectiveness of the corrective action.
- All stakeholders must be provided with a complaint response form, with the following details:
- Name and mobile phone number of a nominated contact for the Contractor, available during all demolition operations.
- Details of the relevant Council Authority for noise complaint.
- Facility to record time, source, and duration of disturbance.
- A postal address for issuing written complaint.

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8.0

Conclusion

8.0 Conclusion

An acoustic assessment for the proposed residential aged care facility at the 330 MacArthur Avenue, Hamilton, has been undertaken with respect to the provisions of:

- Brisbane City Plan 2014
- Northshore Hamilton Urban Development Area Development Scheme
- Queensland Environment Protection Act 1994,
- Queensland Environmental Protection (Noise) Policy 2019, and
- relevant Australian standards and guidelines.

This acoustic assessment considered impacts and control of external noise upon occupants within the development as well as environmental noise emissions associated with the development on surrounding sensitive receivers.

External ambient noise sources that may potentially be impacting on the sensitive uses within the development were identified as:

- traffic noise from surrounding roads,
- aircraft flyovers,
- noise from surrounding industrial and commercial uses, and
- entertainment and recreational activities in the precinct

Ambient noise measurements were carried out on site to assess and quantify the external noise levels associated with each of the above sources. Assessment of external noise ingress has been carried out taking into consideration general ambient noise, aircraft noise as well as prevention and management of sleep disturbance to the occupants. Appropriate building envelop acoustic performance requirements are established and outlined in Section 5.0 of this report enabling relevant internal noise amenity to be achieved.

The potential noise emission sources associated with the development assessed include:

- Mechanical plant noise.
- Car park activity noise.
- Services delivery and waste management.

Noise emissions from each of the identified noise sources were assessed with appropriate noise control measures recommended to meet the relevant project assessment noise criteria. Noise and vibration impact from the construction of the project were also considered with management measures recommended to assist with control of impacts during project construction.

Based on the assessment undertaken in this report, it is concluded that potential noise impacts from the development as well as external noise impacts upon the proposed development can be adequately controlled to achieve compliance with relevant noise criteria and Brisbane City Council requirements subject to incorporation of acoustic recommendations in this report summarised below:

- Building envelops acoustic performance requirements outlined in Section 5.0.
- Acoustically screen mechanical plant deck designed and assessed to comply with established project noise limits as outlined in Section 4.7.
- A minimum 2m high acoustic fence along the western boundary of the development as per the acoustic requirements and specifications provided in Section 6.2.
- Limiting the refuse servicing frequency to maximum of two per week as required by SC6.26 Refuse planning scheme policy of the City Plan.
- Acoustically screened storage area of the refuse bins from neighbouring properties as per the requirements of SC6.26 Refuse planning scheme policy of the City Plan.

- Acoustically screened servicing area from neighbouring residential use as per the provisions of SC6.31 Transport, access, parking and servicing planning scheme policy.
- Incorporation of operational noise management measures as outlined in Section 6.4 where practical and safe to do so to assist with minimising noise emissions as far as reasonably practical.

Appendices

Appendix A Acoustic terminology

ASSESSMENT BACKGROUND LEVEL (ABL)

A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background L_{A90} noise levels – i.e., the measured background noise is above the ABL 90% of the time.

'A'-WEIGHTED SOUND LEVEL dBA

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dBA. An A-weighting network can be built into a sound level measuring instrument such that sound levels in dBA can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. An increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise. A change of 2 to 3 dB is subjectively barely perceptible.

DECIBEL

The ratio of sound pressures which we can hear is a ratio of one million to one. For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound level' (L) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

EQUIVALENT CONTINUOUS SOUND LEVEL (L_{Aeq})

Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level, which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kilohertz (kHz), e.g., 2 kHz = 2000 Hz. Human hearing ranges from approximately 20 Hz to 20 kHz. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used.

For more detailed analysis, each octave band may be split into three one-third octave bands or, in some cases, narrower frequency bands.

RATING BACKGROUND LEVEL (RBL)

A single-number figure used to characterise the background noise levels from a complete noise survey.

The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey.

SOUND POWER AND SOUND PRESSURE

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source.

The sound pressure level (L_p) varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located.

STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index that allows for this variation. 'A'-weighted statistical noise levels are denoted L_{A10}, dB L_{A90} etc. The reference time period (T) is normally included, e.g., dB $L_{A10, 5min}$ or dB $L_{A90,8hr}$.

$L_{A90\ (T)}$

Refers to the sound pressure level measured in dBA, exceeded for 90% of the time interval (T) – i.e., measured noise levels were greater than this value for 90% of the time interval. This is also often referred to the background noise level.

$L_{A10\ (T)}$

Refers to the sound pressure level measured in dBA, exceeded for 10% of the time interval (T). This is often referred to as the average maximum noise level and is frequently used to describe traffic noise.

$L_{A1\ (T)}$

Refers to the sound pressure level measured in dBA, exceeded for 1% of the time interval (T). This is often used to represent the maximum noise level from a period of measurement.

WEIGHTED STANDARDISED SOUND PRESSURE LEVEL ($L_{nT,w}$)

The in-situ impact sound insulation performance of a floor/ceiling when impacted by a standardised, calibrated tapping-machine. Lower values indicate higher performance.

WEIGHTED SOUND REDUCTION INDEX (R_w)

The laboratory sound insulation performance usually provided by manufacturers and suppliers is the **weighted sound reduction index**, R_w. The higher the rating, the better the sound reduction between spaces.

Appendix B Noise measurement results

Summary of the attended ambient noise measurement results are provided in the following Tables Table B-1 & Table B-2.

Table B-1 Ambient noise measurements at L1 – Karakul Road

Date	Time	Sound pressure level, dBA			
		L_{90}	L_{eq}	L_{Smax}	L_{Fmax}
20 June	19:30	43	51	60	65
20 June	19:47	44	53	67	70
21 June	00:30	44	46	58	61
21 June	09:40	48	57	68	71
21 June	18:58	45	52	67	70
22 June	10:42	44	56	68	70
22 June	15:40	37	49	64	67
22 June	21:44	44	49	68	75
22 June	22:16	42	45	54	60
23 June	10:36	41	52	69	72
23 June	17:00	42	51	73	80
23 June	23:50	38	40	53	62
24 June	4:48	43	47	69	77
24 June	10:18	44	56	72	75
24 June	10:25	48	55	69	72

Table B-2 Ambient noise measurements at L2 – MacArthur Avenue

Date	Time	Sound pressure level, dBA			
		L_{90}	L_{eq}	L_{Smax}	L_{Fmax}
20 June	20:03	43	51	69	72
20 June	20:18	44	52	63	65
21 June	05:24	47	55	71	73

Date	Time	Sound pressure level, dBA			
		L_{90}	L_{eq}	L_{Smax}	L_{Fmax}
21 June	09:23	48	56	71	72
21 June	18:42	45	52	66	68
22 June	04:44	34	40	60	62
22 June	22:00	43	48	54	60

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