ADP Consulting : Engineering

Greenbank Shopping Centre – Stage 2 Redevelopment

Acoustic Report

Prepared for: DMA Partners

Project No: BNE0627
Date: 24 August 2023
Revision: 05

Creating great environments with great people

Project:	Greenbank Shopping Centre – Stage 2 Redevelopment
Location:	251 Teviot Road Greenbank QLD 4124
Prepared by:	ADP Consulting Pty Ltd Level 16, 15 Adelaide Street Brisbane QLD 4000
Project No:	BNE0627
Revision:	05
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Rev	Date	Comment	Author	Signature	Technical Review	Signature	Authorisa-tion & QA	Signature
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01	17/04/23	Stage 2 revision	SJ	-	WG	-	WG	-
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03	27/04/23	Stage 2 drawing update	SJ	-	-	-	-	-
04	22/08/2023	Stage 2 loading dock operations update	SJ	-	DZ	-	DZ	-
05	24/08/2023	Stage 2 childcare revision	SJ	-	DZ	-	DZ	-

Project Team	
Client / Principal	Region Group Ltd C/- DMA Partners
Project Manager	DMA Partners
Architect	Cottee Parker
Planning Consultant	Place Design Group

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1. Introduction

1.1 Document purpose

ADP Consulting Pty Ltd has been engaged by Region Group Ltd (RGN) C/- DMA Partners to undertake acoustics engineering services for the proposed Stage 2 redevelopment to the existing Greenbank Shopping Centre located at 251 Teviot Road, Greenbank (the proposed development).

This report is prepared to provide acoustic design advice and addresses the impact on nearby sensitive receivers from the operation of the proposed development, including:

- Noise emission from vehicular movements and activities (i.e. the dropping off and picking up of goods and materials) associated with carpark and loading areas
- Noise emission from associated plant and equipment

This report is to be used as a briefing document for the development and may be issued to Economic Development Queensland (EDQ) as part of the planning submission. It is noted that the development is located in the Logan City Council but is not required to respond to the Logan Planning Scheme 2015 as part of this submission.

The design criteria and acoustic treatment concepts in this report demonstrate the pathways by which these shall be addressed by ADP Consulting and the project team through further analysis, recommendations and coordination as the design progresses.

It is the responsibility of the relevant contractor to ensure the implementation of the acoustic design intent of this document; including compliance with criteria, codes, standards, specifications etc.

1.2 Referenced drawings, codes and standards

The followings drawings, conditions and other project-specific information has been referenced in preparing this report:

- Cottee Parker's "For Information" issue architectural drawings, dated 22 March 2023 (architectural drawings)

The following guidelines, standards and regulatory requirements have been used to define the site-specific acoustic criteria and construction for the development:

- AS/NZS 1668.1:2015 The Use of Ventilation and Air Conditioning in Buildings Part 1: Fire and Smoke Control in Buildings (AS/NZS 1668.1)
- AS/NZS 2107:2016 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors (AS/NZS 2107)
- ASHRAE Handbook 2011, Chapter 48 Sound and Vibration Control - prepared by The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- Environmental Protection Act 1994 (EP Act)
- Environmental Protection Regulation 2019 (EP Regulation)
- Environmental Protection (Noise) Policy 2019 (EPP Noise)

1.3 Project summary

The Stage 2 redevelopment comprises an extension of the Greenbank Shopping Centre with the following new components:

- Major supermarket tenancy with:
  - Associated loading area to the north
  - Associated Click & Collect service bays to the north
- Two (2) mini-major retail tenancies and other smaller retail and food & beverage tenancies adjoining the shopping centre buildings, with associated loading area to the north
- Internal mall, centre management offices, BOH storage, services, compactor and amenities areas
- On-grade outdoor carparking areas (up to 568 new parking spaces)

It is noted that the existing Greenbank Shopping Centre (Stage 1) comprises the following components:

- Existing Woolworths's supermarket, with associated loading area to the north
- Existing smaller retail tenancies adjoining the Woolworths's supermarket
- Existing Caltex Woolworths service station, fronting Teviot Road to the north-east
- Existing 7-Eleven service station, fronting Pub Lane to the south-east
- Existing BWS liquor store with drive-thru facility
- Existing "Pub Lane Tavern" venue
- Existing "Little Heroes" child care centre
- Existing on-grade outdoor carparking areas

We have been advised that:

- The existing Woolworths's supermarket loading area operates from 4am to 11pm, and therefore operates in the most sensitive "Night" period of 10pm-7am.
- The existing Woolworths's supermarket loading area serves a mix of vehicles including large trucks (articulated) and smaller delivery vans, with a typical usage frequency of:
  - Daily: 10-12 trucks
  - Weekly: 60-72 trucks
- It is anticipated that the operations of the new major supermarket tenancy and its associated loading area would be similar to those of the existing Woolworths's supermarket.
- There are no known conditions imposed on the Greenbank Shopping Centre that would limit the time, frequency or nature of operation of the above outlined components and uses – as such, operation is to be considered and assessed into most sensitive "Night" period of 10pm-7am.

2. Site investigations and noise measurements

2.1 Site investigations and site plan

The proposed development is located in the Logan City Council and specifically in "Priority Development Area" zoning.

The areas surrounding the proposed development are generally also comprised of "Priority Development Area" zoning, with some surrounding areas to the south of the proposed development on the opposite side of Pub Lane classified as "Rural Residential" zoning.

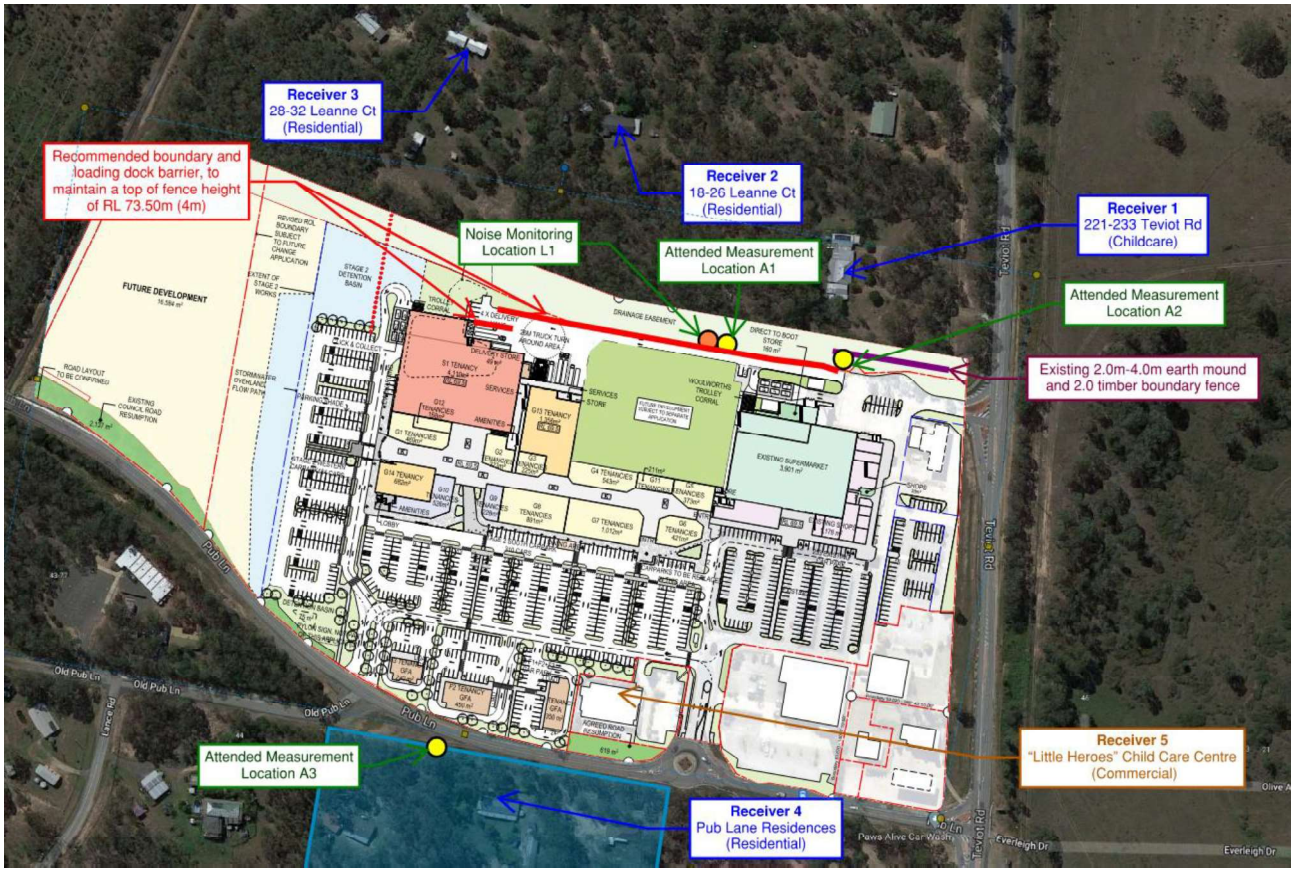
Based on our site survey and investigations we have identified the following sensitive receivers as being the nearest noise sensitive premises to the Stage 2 redevelopment:

- Residential receivers:
  - **Receiver 1:** 221-233 Teviot Road – Childcare Centre, located north-east of the Stage 2 redevelopment area at a minimum distance of approximately 75 metres
  - **Receiver 2:** 18-26 Leanne Court – Existing single-storey residential dwelling, located north of the Stage 2 redevelopment area at a minimum distance of approximately 125 metres
  - **Receiver 3:** 28-32 Leanne Court – Existing single-storey residential dwelling, located north-west of the Stage 2 redevelopment area at a minimum distance of approximately 150 metres
  - **Receiver 4:** Pub Lane Residences – Several existing single-storey residential dwellings, comprising the addresses 22-42 Pub Lane, and located south of the Stage 2 redevelopment area on the opposite side of Pub Lane at a minimum distance of approximately 85 metres
- Commercial receivers:
  - **Receiver 5:** "Little Heroes" Child Care Centre – Existing commercial childcare centre, located adjacent to / south of the Stage 2 redevelopment area and located east of the future food pad-sites
- The development itself that includes:
  - Services requiring noise attenuation and vibration isolation to ensure low indoor noise levels in occupied areas and compliance with noise emission regulations
  - An expected standard of amenity compliant with all applicable codes, regulatory requirements, client brief and other standards

The buildings in the immediate surrounds are predominantly residential uses (offsite) and commercial uses (onsite), and there were no significant noise sources (e.g. commercial plant, condenser units, air handling units, fans etc.) identified from other surrounding or nearby buildings which would impact on the amenity of the proposed development.

Figure 1 provides a site plan of the proposed development and its surrounds.

Figure 1 Site plan, including the location of sensitive receivers and noise measurements



2.2 Instrumentation

The following instrumentation was used for noise measurements and analysis:

- Noise Sentry NSRT Mk3 Class 1 sound level meter data logger (S/N: CHj2r12Q2XU9CLHgz6B5ND), utilised as an unattended noise logger
- NTi XL2 Class 1 sound level meter (S/N: A2A-14846-E0), with M2230 microphone comprising:
  - MA220 preamplifier (S/N: 7632)
  - MC230A transducer (S/N: A16344)
- Larson David CAL200 Class 1 acoustic calibrator (S/N: 15635)

All instrument systems has been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 0.2dB during attended measurements. No adjustments for instrument drift during the measurement period were warranted.

2.3 Unattended noise measurements

2.3.1 Background noise levels

Unattended noise measurements were conducted for a period of 9 days between Monday 15 November 2021 and Tuesday 23 November 2021 at Location L1 (as shown in Figure 1).

The long-term monitoring device was located in free field conditions, with the microphone approximately 1.5 metres above the natural ground level and located at the northern site boundary to be as close as practicable to the nearest residential receivers being Receiver 1 and Receiver 2 as identified in Section 2.1.

The long-term monitoring device was selected to collect background noise in the area to set noise emission criteria for the development. It was observed that the background noise levels at the measurement location were predominantly influenced by noise from wildlife and the rustling of foliage/vegetation in the forested areas indicative of those present at the nearest residential receivers to the north, with some from other local traffic and activities associated with the existing shopping centre.

Background noise levels measured at Location L1 are summarised in Table 1.

Table 1 Unattended background noise measurements, dB(A)

Location / Descriptor	Daytime (07:00-18:00)	Evening (18:00-22:00)	Night-time (22:00-07:00)
Location L1			
Repeatable – L_{Aeq}	55	50	53
Rating Background Level (RBL) – L_{A90}	46	44	39

The long-term monitoring device was configured to report noise level descriptors every 15 minutes and periods with inclement weather (i.e. rainfall present or wind speeds greater than 5m/s) were excluded from the reported results and assessment.

The Location L1 RBLs have been used for the determination of noise emission criteria. These criteria have been presented in Section 3.2 of this report.

Further detail of the unattended noise monitoring including hourly/daily noise levels are included in the noise logger graphs in Appendix B.

2.4 Attended noise measurements

2.4.1 Background noise levels

ADP Consulting conducted attended noise measurements on Monday 15 November 2021 at Location A1 and Location A2 during logger installation (as shown in Figure 1).

Additional attended noise measurements were conducted on Tuesday 23 November 2021 at Location A3 during the noise logger collection.

These noise measurements were taken during business hours to qualify and quantify the typical background/ambient noise levels at the attended measurement locations and supplement the long-term unattended noise measurements. The measured background/ambient noise levels at the attended measurement locations are noted to be higher than those measured at long-term monitoring Location L1, further supporting the conservative adoption of the Location L1 RBLs for the determination of noise emission criteria.

Table 2 presents the noise levels measured at the attended measurement locations as shown in Figure 1.

Table 2 Attended background noise measurements, dB(A)

Date and time	Location and comments	Noise level, dB(A)		
		L_{eq}	L_{10}	L_{90}
	Location A1			
Monday 15 November 2021, 2.15pm to 2.30pm	Measuring background/ambient noise levels at the northern site boundary adjacent to the logger Location L1.	54	56	48
	Location A2			
Monday 15 November 2021, 2.30pm to 2.45pm	Measuring background/ambient noise levels at the northern site boundary adjacent to the existing earth mound and boundary fence.	55	57	51
	Location A3			
Tuesday 23 November 2021, 2.30pm to 2.45pm	Measuring background/ambient noise levels at the Receiver 4: Pub Lane Residences located to the south on the opposite side of Pub Lane, with main contribution from road traffic on Pub Lane.	66	70	55

3. Noise criteria

3.1 Noise emissions – EP Act, Regulations and Noise Policy

This section defines the state regulatory requirements for this development and a criteria summary is provided in Section 3.2.

It is noted that the development is located in the Logan City Council but is not required to respond to the Logan Planning Scheme 2015 and any included acoustic criteria as part of this submission.

Instead, noise emissions requirements from the proposed development under the Environmental Protection Act 1994 (EP Act), Environmental Protection Regulation 2019 (EP Regulation) and Environmental Protection (Noise) Policy 2019 (EPP Noise) are as follows:

3.1.1 Acoustic quality objectives – EPP Noise

The acoustic quality objectives applicable at sensitive receptors are identified in Table 3 below.

Table 3 Acoustic quality objectives (Adapted from Schedule 1 to the EPP Noise)

Sensitive receptor	**Time of day**	**Acoustic quality objectives, dB(A) (measured at the receptor)**		
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$
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	-	-
Childcare centre or kindergarten (for outdoors)	When the children usually play outside	55	-	-
Commercial and retail activity (for indoors)	When the activity is open for business	45	-	-
Park or garden that is open to the public (whether or not on payment of an amount) for use other than for sport or organised entertainment	Anytime	The level of noise that preserves the amenity of the existing park or garden		

Part 7 of the EPP Noise states:

7. Acoustic quality objectives for sensitive receptors

5) If it is reasonable in the circumstances, an acoustic quality objective may be progressively achieved and maintained as part of achieving the object of this policy over the long term.

6) This section does not apply to a noise—

a) mentioned in schedule 1, part 1, section 1 of the Act; or

b) experienced within a residence or a workplace if the noise is made within the residence or workplace.

3.1.2 Background creep – EPP Noise

The EPP Noise 2019 states that

2) To the extent it is reasonable to do so, noise must be dealt with in a way that ensures—

a) The noise does not have any adverse effect, or potential adverse effect, on an environmental value under this policy; and

b) Background creep in an area or place is prevented or minimised.

c) Despite subsection (2)(b), if the acoustic quality objectives for an area or place are not being achieved or maintained, the noise experienced in the area or place must, to the extent it is reasonable to do so, be dealt with in a way that progressively improves the acoustic environment of the area or place.

ADP Consulting note that the EPP Noise 2019 policy document does not prescribe noise criteria for the prevention of minimisation of background creep.

In lieu, ADP Consulting have adopted the criteria from the earlier EPP Noise 2008 policy document, which states:

10 Controlling background creep

(2) To the extent that it is reasonable to do so, noise from an activity must not be—

(a) for noise that is continuous noise measured by $L_{A90,T}$—more than nil dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$; or

(b) for noise that varies over time measured by $L_{Aeq,adj,T}$—more than 5dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$.

3.1.3 Default noise standards – EP Act

Part 3B of the EP Act prescribes default "noise standards" to specific activities and noise sources. The following default noise standards may be relevant to the proposed development:

Part 3B Offences relating to noise standards
Division 3 Default noise standards
440T Pumps

(1) This section applies to premises at or for which there is a pump.

(2) An occupier of the premises must not use, or permit the use of, the pump on any day—

(a) before 7a.m, if it makes an audible noise; or

(b) from 7a.m. to 7p.m, if it makes a noise of more than 5dB(A) above the background level; or

(c) from 7p.m. to 10p.m, if it makes a noise of more than 3dB(A) above the background level; or

(d) after 10p.m, if it makes an audible noise.

(3) Subsection (2)(a), (c) and (d) do not apply to a noise made at an educational institution, that is not more than 5dB(A) above the background level.

(4) In this section—

pump—

(a) means an electrical, mechanical or pneumatic pump; and

Examples— liquid pump, air pump, heat pump

(b) includes a swimming pool pump and a spa blower.

440U Air-conditioning equipment

(1) This section applies to premises at or for which there is air-conditioning equipment.

(2) An occupier of the premises must not use, or permit the use of, the equipment on any day—

(a) before 7a.m, if it makes a noise of more than 3dB(A) above the background level; or

(b) from 7a.m. to 10p.m, if it makes a noise of more than 5dB(A) above the background level; or

(c) after 10p.m, if it makes a noise of more than 3dB(A) above the background level.

440V Refrigeration equipment

(1) This section applies to a person who is—

(a) an occupier of premises at or for which there is plant or equipment for refrigeration (refrigeration equipment); or

(b) an owner of refrigeration equipment that is on or in a vehicle, other than a vehicle used or to be used on a railway.

(2) The person must not use, or permit the use of, the refrigeration equipment on any day—

(a) before 7a.m, if it makes a noise of more than 3dB(A) above the background level; or

(b) from 7a.m. to 10p.m, if it makes a noise of more than 5dB(A) above the background level; or

(c) after 10p.m, if it makes a noise of more than 3dB(A) above the background level.

(3) In this section—

vehicle includes a trailer

3.2 Noise emissions – Summary

This section summarises site-specific noise emission requirements applicable to the proposed development per the EP Act / Regulations / Noise Policy as presented in Section 3.1.

The noise emission criteria have been determined based on long-term site background noise measurements as presented in Section 2.3.1.

Table 4 Noise emission criteria summary

Criteria item	Requirement per	Measurement descriptor	Criteria, dB(A)		
			Day (07:00-18:00)	Evening (18:00-22:00)	Night (22:00-07:00)
Acoustic quality objectives – External to residences	EPP Noise	$L_{Aeq,adj,1hr}$	50	50	-
Acoustic quality objectives – Internal to residences	EPP Noise	$L_{Aeq,adj,1hr}$	35	35	30
Acoustic quality objectives – External to childcare centres or kindergartens	EPP Noise	$L_{Aeq,adj,1hr}$	55	-	-
Acoustic quality objectives – Internal to childcare centres or kindergartens	EPP Noise	$L_{Aeq,adj,1hr}$	30-35	-	-
Acoustic quality objectives – Internal to commercial and retail activity	EPP Noise	$L_{Aeq,adj,1hr}$	45	45	-
Background creep – Continuous noise	EPP Noise	$L_{A90,T}$	46	44	39
Background creep – Varying noise	EPP Noise	$L_{Aeq,adj,T}$	51	49	44
Default noise standards – Pumps	EP Act	$L_{A90,T}$	51	47	Inaudible
Default noise standards – AC and refrigeration equipment	EP Act	$L_{A90,T}$	51	49	42

3.3 Internal noise levels

We propose the use of Australian Standards to recommend design criteria for the following:

> AS/NZS 2107 for internal noise levels and reverberation times

> AS/NZS 1668.1 for fire mode conditions

3.3.1 Internal noise levels and reverberation times - AS/NZS 2107

Indoor design noise levels deemed acceptable to the majority of reasonable occupants are published in AS/NZS 2107.

The following noise limits apply to continuous sources of outdoor noise (e.g. road traffic , rooftop plant) as well as sources internal to the proposed development such as plant and equipment, but not noise associated with occupants. When selecting and designing the internal noise levels for mechanical plant and equipment, we recommend that the range of levels presented in Table 5 for each space be used.

Furthermore, AS/NZS 2107 refers to ideal reverberation times for various spaces. Low reverberation times are critical for speech intelligibility and perception of a space as having high acoustic quality. Table 5 schedules the recommended reverberation times for different relevant spaces.

Table 5 Internal noise level and reverberation time criteria, AS/NZS 2107

Type of occupancy*	**Design sound level, $L_{eq,T}$, dB(A)**	**Reverberation time, seconds**
General / open plan office areas	40 to 45	0.4 to 0.6
Cafes, Restaurants, F&B	40 to 50	Minimise[1]
Small retail stores (general)	< 50	Minimise[1]
Toilet / change / showers	45 to 55	-
Supermarkets, large retail stores	50 to 55	Minimise[1]
Shopping malls, Circulation / Other occupied ventilated spaces	< 55	Minimise[1]

* As the commercial and retail tenancies are anticipated to be delivered as shells, the eventual fitout of the spaces by the tenants shall be their own responsibility – tenants may or may not choose to include acoustic treatments in their fitouts (e.g. absorptive surface finishes to control reverberation time) to achieve the above criteria.

[1] AS/NZS 2107 recommends that reverberation times be minimised as far as practical for noise control.

3.3.2 Fire mode conditions - AS/NZS 1668.1

Some building systems only operate in fire mode and during periodic testing, so they do not add to background noise under typical conditions. According to AS/NZS 1668.1, these systems are subject to noise limits, presented in Table 6, relating not to occupant comfort but rather to occupant distress and the intelligibility of emergency commands. Here, the 65 dB(A) limit supports the audibility of fire alarms.

Table 6 Fire mode maximum internal sound pressure levels

Area type	Internal noise criterion, L_{Aeq}, dB(A)
Occupied Area	65
Fire-isolated exit (e.g. fire stair)	80

3.4 Acoustic separation

Acoustic separation, or sound insulation, is important where there is a need control noise transmission between spaces such as between separate tenancies (e.g. for privacy) or between tenancies and common or BOH/plant areas (e.g. for noise level control).

It is recommended that the internal partition acoustic performances and constructions are developed in future during detailed design through further analysis, recommendations and coordination with the project team.

We note that the acoustic performance of internal partitions within a given tenancy shall be the responsibility of the eventual tenants.

4. Noise assessment

The proposed Stage 2 redevelopment is bounded by the following areas as defined in Section 2.1:

- The existing Greenbank Shopping Centre (Stage 1) to the east, out to Teviot Road
- The existing "Little Heroes" childcare centre and the future food pad-sites to the south, out to Pub Lane
- Residential land and dwellings to the north
- Residual land for future development (unspecified) to the west, with a rail corridor beyond

4.1 Operational noise levels

4.1.1 Loading area noise levels

It is understood that loading areas will accompany the proposed development and are located along the service road at the northern boundary of the Stage 2 redevelopment area, with the closest sensitive residential receivers located at a minimum distance of approximately 75 metres to the north.

The loading areas would constitute:

- Major supermarket e.g. main loading area, Click & Collect / Home delivery loading area, including with customer vehicle waiting bays
- Major supermarket e.g. Woolworths main loading area, Click & Collect / Home delivery loading area, including with customer vehicle waiting bays
- Loading area for mini-major retail tenancies, and other smaller retail and food & beverage tenancies

It is understood that access to these new loading areas would be from the service road with delivery and waste collection vehicles accessing the Greenbank Shopping Centre site from the same driveway to Teviot Road at the north-eastern corner that currently services the existing Woolworths loading areas.

It is anticipated that the delivery and waste collection vehicles will pass their designated loading area docks and reverse into the loading bays. Once loaded/unloaded, it is anticipated that they will exit via the same path via the service road heading east out to Teviot Road.

We understand that the noise generated from the loading areas will originate from the following activities:

- Delivery and waste collection truck/van movements along the service road and within the loading areas – it is also anticipated that trucks/vans will not travel faster than 15km/h
- Reverse beepers of trucks/vans
- Loading/unloading of goods, including with vehicle refrigeration units running and engines idling
- Forklift movements within loading areas
- Waste collection truck emptying garbage into compactor and the compacting of garbage

Based on noise measured on other similar projects, typical sound power levels, durations and source heights for each noisy activity have been scheduled in Table 7.

Table 7 Loading area activity sound power levels

Loading Area Activity	Sound Power Level, dB(A)	Typical duration in a single 30 minute period (L_{Aeq})	Source height, m
	L_{Aeq}		
Compactor, including truck emptying garbage	103	2 minutes	1.8
Forklift	106	3 minutes	1.5
Large articulated trucks (Supermarkets, Big box retailers, Waste collection)			
Truck arrival or departure (per movement)	102	20 to 45 seconds	3.5
Truck reversing with beeper	105	10 to 20 seconds	3.5
Typical refrigeration unit on top of idling truck	94	30 minutes	3.0
Truck being loaded/unloaded	90	20 minutes	1.5
Vans and small trucks (Click & Collect / Home delivery, Smaller retailers)			
Van (or small truck) arrival or departure (per movement)	94	15 to 30 seconds	2.0
Van (or small truck) reversing with beeper	97	5 to 15 seconds	2.0
Typical refrigeration unit on idling van (or small truck)	88	15 minutes	2.0
Van (or small truck) being loaded/unloaded	85	10 minutes	1.5

4.1.2 Shopping centre carpark, building and mechanical plant noise levels

It is understood that external at-grade carparking areas will accompany the proposed development and are located along southern side of the Greenbank Shopping Centre building, continuing out to the south to Pub Lane. The closest sensitive residential receivers located at a minimum distance of approximately 85 metres to the south. The existing "Little Heroes" child care centre adjoins these external carparking areas. There are some carparking areas at the north-eastern corner of the site comprising existing carparks and the new Click & Collect customer vehicle waiting bays.

It is understood that access to these new carparking areas for customers/patrons would primarily be from the intersections and roundabouts on Pub Lane.

We understand that the noise generated from the carparking and shopping centre building areas will originate from the following activities:

- Carpark vehicle usage (including car doors/boots slamming)
- Shopping trolley usage
- Mechanical plant and equipment operation

Based on noise measured on other similar projects, typical sound power levels, durations and source heights for each noisy activity have been scheduled in Table 8.

Table 8 Shopping centre carpark, building and mechanical plant sound power levels

Operational noisy activity	Sound Power Level, dB(A)	Typical duration in a single 30 minute period (L_{Aeq})	Source height, m
	L_{Aeq}		
Carpark vehicle usage (inc. door/boot slams) (per 50 vehicles)	85	30 minutes	1.0
Shopping trolleys	93	2 to 10 minutes	1.0
Mechanical plant and equipment	To be determined – will be controlled by careful equipment selection and acoustic measures, such as silencers, barriers, etc.	30 minutes	Varies

4.2 Noise assessment

4.2.1 Loading area and carpark noise impacts

Based on the operational assumptions presented in Section 4.1, the loading area recommendations in Section 5.1 and the acoustic barrier/fence recommendations presented in Section 5.2, we have calculated the noise emission levels at the nearest sensitive receivers for each assessment period and presented a summaries in Table 9 and Table 10 for comparison against the EPP Noise acoustic quality objectives and background creep noise criteria respectively.
We note that compliance at these nearest sensitive receivers implies compliance at other more distant locations.

The assessment has considered 24 hour operation of the Stage 2 redevelopment areas, consistent with the operation of the existing Woolworths's supermarket loading area which operates from 4am to 11pm, and therefore operates in the most sensitive "Night" period of 10pm-7am.

Where internal noise levels at the sensitive receivers are calculated, these consider a typical noise reduction of 10dB through open or partially closed windows/doors. We note that fully closed windows/doors would provide a higher typical noise reduction of 15-25dB and result in a lower internal noise level.

The calculations have considered the existing earth mound and timber fences as shown in Figure 1. Consideration has also been given to the ground level of the loading area, the natural ground level at the sensitive receivers, and the presence of elevation changes between them such as at raised sections of ground which would provide shielding noise attenuation.

A sensitive receiver height of 1.8 metres above the ground level has been assumed as no assessment to double storey sensitive receivers was required.

It is noted from the results in Table 9 that some exceedance of EPP Noise Acoustic Quality Objectives criteria is calculated. We offer the following reasoning and supporting arguments for the exceedance of this acoustic quality objectives criteria:

- Exceedance is in the order of 2-4dB and is only present for noise impacts internal to sensitive receivers with conservatively assumed opened windows/doors – we note that fully closed windows/doors would provide a higher typical noise reduction and result in lower, compliant internal noise levels.
  - For Receiver 1, the more stringent internal criteria is driven by the sleep patterns of the children. Where the windows and doors are closed, this is not likely to be an exceedance. Section 5 outlines additional measures to ensure compliance.
- Compliance is achieved for noise impacts external to the sensitive receivers, against both the EPP Noise acoustic quality objectives and the EPP Noise background creep noise criteria (which are specifically determined from the existing background noise levels at the sensitive receivers).
- As presented in Section 3.1.1, it is noted that Part 7 of the EPP Noise states:

  "If it is reasonable in the circumstances, an acoustic quality objective may be progressively achieved and maintained as part of achieving the object of this policy over the long term."

  It is reasonable to expect that noise emissions from the site, which are largely led by loading area and carpark vehicle engine/exhaust noise, and mechanical plant such as refrigeration units, would decrease over the long term with progressions in technological development and uptake such as the increasing prevalence of electric vehicles or the continuing noise reduction of mechanical plant.

Table 9 Noise emission assessment – EPP Noise – Acoustic quality objectives

Sensitive receivers / Time of day	Noise levels, dB(A)		Criteria, dB(A)		Compliance	
	L_{Aeq}		L_{Aeq}		L_{Aeq}	
	External	Internal	External	Internal	External	Internal
Receiver 1: 221-233 Teviot Road Childcare Centre						
Day: 7am to 6pm	48	38	55	30-35	Y	N (+8 to+3)
Evening/Night: 10pm to 7am	–	–	–	–	–	–
Receiver 2: 18-26 Leanne Court						
Day/Evening: 7am to 10pm	49	39	50	35	Y	N (+4)
Night: 10pm to 7am	44	34	–	30	Y	N (+4)
Receiver 3: 28-32 Leanne Court						
Day/Evening: 7am to 10pm	46	36	50	35	Y	N (+1)
Night: 10pm to 7am	41	31	–	30	Y	N (+1)
Receiver 4: Pub Lane Residences						
Day/Evening: 7am to 10pm	44	34	50	35	Y	Y
Night: 10pm to 7am	39	29	–	30	Y	Y

Sensitive receivers / Time of day	Noise levels, dB(A)		Criteria, dB(A)		Compliance	
	L_{Aeq}		L_{Aeq}		L_{Aeq}	
	External	Internal	External	Internal	External	Internal
Receiver 5: "Little Heroes" Child Care Centre						
Day: 7am to 6pm	39	29	55	30-35	Y	Y
Evening/Night: 10pm to 7am	–	–	–	–	–	–

Table 10 Noise emission assessment – EPP Noise – Background creep

Sensitive receivers / Time of day	Noise levels, dB(A)	Criteria, dB(A)	Compliance
	L_{Aeq}	L_{Aeq}	L_{Aeq}
	External	External	External
Receiver 1: 221-233 Teviot Road Childcare Centre			
Day: 7am to 6pm	48	51	Y
Evening: 6pm to 10pm	-	-	Y
Night: 10pm to 7am	-	-	Y
Receiver 2: 18-26 Leanne Court			
Day: 7am to 6pm	49	51	Y
Evening: 6pm to 10pm	49	49	Y
Night: 10pm to 7am	44	44	Y
Receiver 3: 28-32 Leanne Court			
Day: 7am to 6pm	46	51	Y
Evening: 6pm to 10pm	46	49	Y
Night: 10pm to 7am	41	44	Y
Receiver 4: Pub Lane Residences			
Day: 7am to 6pm	44	51	Y
Evening: 6pm to 10pm	44	49	Y
Night: 10pm to 7am	39	44	Y
Receiver 5: "Little Heroes" Child Care Centre			
Day: 7am to 6pm	39	51	Y
Evening: 6pm to 10pm	-	-	Y
Night: 10pm to 7am	-	-	Y

4.2.2 Mechanical plant and equipment noise impacts

At time of writing plant and equipment selection is yet to be finalised. It is anticipated that provision has been included in the current scheme to incorporate standard acoustic treatment, such as silencers, barriers, acoustically lined ductwork, acoustic louvres, etc as described in Section 5.1.

It is anticipated that internal noise levels and external noise emissions associated with the proposed development mechanical design will comply with the nominated criteria as listed in Section 3.2 and Section 3.3 above.

As the design progresses through the detailed design phase, acoustic measures will be incorporated in the design so that the noise criteria will be complied with. We note that compliance for commercial/retail tenancy plant (e.g. the major supermarket tenancy) shall ultimately be the responsibility of the mechanical contractor for the tenancy.

5. Recommendations

5.1 Loading area operations

To ensure that the noise emission limits presented in Section 3.2 and the noise levels our assessment scheduled in Section 4.1 are complied with, we recommend the following loading area operational restrictions scheduled in Table 11.

Table 11 Recommended loading area operational restrictions for noise emission compliance

Time of day	Operating conditions/restrictions for compliance – In any 30 minute period
Day/Evening (7am to 10pm)	> Up to 4 large truck movements (arriving or departing) > Up to 8 large trucks reversing with beepers > Up to 6 large trucks loading/unloading, including with refrigeration units running on top of idling trucks > Up to 8 van (or small truck) movements (arriving or departing) > Up to 4 vans (or small trucks) reversing with beepers > Up to 10 vans (or small trucks) loading/unloading, including with refrigeration units running on top of idling vehicles > Up to 2 waste collections and compactor usages (for 2 minutes each) > Up to 6 forklift usages (for 3 minutes each)
Night (10pm to 7am)	> Up to 2 large truck movements (arriving or departing) > Only 1 large truck reversing with beepers > Only 1 large truck loading/unloading, with refrigeration units and engines switched off whilst stationary. > Up to 4 van (or small truck) movements (arriving or departing) > Up to 2 vans (or small trucks) reversing with beepers > Up to 2 van (or small truck) loading/unloading, including with refrigeration units running on top of idling vehicles in the van loading area. > Up to 2 vans (or small trucks) loading/unloading, including with refrigeration units running on top of idling vehicles in the S1 Tenancy loading dock area > No waste collection > Only one S1 Tenancy compactor usage > No forklift usage > No bulk trolley movements > Up to 2 dock leveller uses, where the noise level does not exceed 65dBA at 2m > Up to 6 car collections at the S1 Tenancy Click and Collect

The R1 Childcare centre assumptions are as follows:

> The childcare centre only operates only during the day period.

- The sleep areas are enclosed and air-condition to allow for the sleep areas to be acoustically comfortable in relation to noise from other childcare areas.
- The transmission loss of the facade to the sleeping areas is greater than standard construction - R_w 25.

The general external criteria is 55dBA and the criteria for Childcare centre or kindergarten (for indoors) when the children usually sleep (1hr period) is 30dBA. Combined the with the façade performance, adjustment for 1hr and the external (internal sleep) criteria is 52dBA. The external noise based on the activities in the Table 11 meet the maximum 52dBA external criteria.

The general night period conditions were developed to allow for the scenario where the S1 Tenancy can perform the above actions in the night period and the movements and operations only relate to the operations of S1 Tenancy. It is likely that other loading dock operations could occur in a 30minute window in the night period where activity at S1 Tenancy is limited or inactive. Further acoustic analysis will be required to determine the conditions like what is shown in Table 11 relating to the other loading dock operations.

5.2 Acoustic barriers/fences

It is recommended that acoustic barriers/fences are constructed (or maintained where existing) to provide a noise reduction to onsite noise emissions, particularly where noisy activities are located in proximity to sensitive receivers with limited distance separation.

The requirements for the acoustic barriers/fences are summarised as follows:

- Constructed to the vertical heights and horizontal extents as indicated in Figure 1.
  - The new barriers are recommended to achieve a height of 4m (between RL 72.30 to 73.50 depending on the location) from the slab RL.
  - It is recommended to extend the new barrier an additional 35m toward Tivoli Road as the easement fence is unlikely to be retained.
- Constructed using materials that achieve a minimum surface density of at least 12.5kg/m^2. Acceptable materials include:
  - 19mm pine palings with a 40% overlap
  - 6mm glazing or 10mm Perspex
  - 9mm fibre cement sheet
  - Other alternatives such as masonry or concrete could be considered provided they meet the minimum surface density requirement, or earth mounding as is present at the north-east corner of the site.
- Constructed to be free of gaps and holes along the entire length and height. Where this cannot be achieved due to drainage, a 250mm gap at the base with a 250mm high curb in front of the barrier is recommended.

5.3 Mechanical plant and equipment

As discussed in Section 4.2.2, at time of writing plant and equipment selection is yet to be finalised. It is anticipated that provision has been included in the current scheme to incorporate standard acoustic treatment, such as silencers, barriers, acoustically lined ductwork, acoustic louvres, etc. to comply the nominated criteria as listed in Section 3 above.

Generally, the following allowances should be made for in the design:

- Support points for major plant items should be structurally rigid. Mid-span areas of floor slab should be avoided where practical. Ideally columns, thick structural slabs or very strong should be provided in such cases.
- Plant and associated motor and drive assemblies should be mounted on steel chassis or concrete inertia bases (in accordance with ASHRAE)
- For all major equipment such as chillers, diesel generators and cooling towers, local stiffening of plant room floors should be allowed
- 200mm concrete slabs and precast/in-situ concrete walls surrounding plant rooms
- Vibration isolators for equipment rotating plant and machinery located in plant rooms with >90% isolation efficiency
- All penetrations to plant rooms should be properly dimensioned, packed and sealed
- Main services ducts and pipes to have their own individual penetrations, with suitable spacing to allow good sealing
- Allowance for acoustic attenuation treatments e.g. internal lining to air inlets and discharges to meet external noise emission criteria
- For major equipment such as chillers and cooling towers, allow for local stiffening of the plant room floor
- Speed controllers, if used, should be of good quality and compatible with the motor model. Poor quality controllers can result in significant increase in motor noise, as much as 10dB(A), with an offensive characteristic such as high frequency tone
- Selection of low noise fans, allowance for smooth airflow conditions in ductwork, use of attenuators and lined duct work while minimising regenerated noise at bends, take-offs and transitions

It is understood that major base building rooftop plant items will accompany the proposed development and may require attenuation measures. Future comparison between the L_{eq} external noise emission levels at the nearby sensitive receivers and the noise emission limits presented in Section 3.2 would be required to ensure compliance.

5.4 Internal partition construction

It is recommended that the internal partition acoustic performances/constructions are developed in future during detailed design through further analysis, recommendations and coordination with the project team. We note that the internal partitions within a given tenancy shall be the responsibility of the eventual tenants.

Specific consideration may also be given to the future gym / commercial tenancy space proposed on the upper Level 1 area, to ensure activities in gyms, particularly the dropping of weights, can be addressed to reduce the transfer of noise or vibration to adjacent occupied areas in the development such as the future library / commercial tenancy space and other commercial/retail tenancies. We understand a gym operator is yet to be determined at the time of writing.

6. Conclusion

Current regulations and standards associated with the development have been reviewed and assessed in accordance with existing site constraints. The construction standards have been provided to satisfy the state government requirements and other relevant standards.

ADP Consulting believe there are no site conditions, statutory or other requirements that would preclude this development from complying with the criteria defined in this report.

The design criteria and acoustic treatment concepts in this report demonstrate the pathways by which these shall be addressed by ADP Consulting and the project team through further analysis, recommendations and coordination as the design progresses.

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Appendix A
Glossary of acoustic terms

Air-borne sound

The sound emitted directly from a source into the surrounding air, such as speech, television or music.

Ambient sound

Of an environment: the all-encompassing sound associated with that environment, being a composite of sounds from many sources, near and far. This is normally taken to be the L_{Aeq} value.

Background noise level

The average of the lowest levels of the noise levels measured in an affected area in the absence of noise from occupants and from unwanted external ambient noise sources. Usually the L_{A90} value represents the background noise level.

dB(A)

Unit of acoustic measurement weighted to approximate the sensitivity of human hearing to sound frequency.

Decibel scale

The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. Therefore, a 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. It is generally accepted that a 10 dB increase in the sound pressure level corresponds to a perceived doubling in loudness.

Examples of decibel levels of common sounds are as follows:

- 0 dB(A) Threshold of human hearing
- 30 dB(A) A quiet country park
- 40 dB(A) Whisper in a library
- 50 dB(A) Open office space
- 70 dB(A) Inside a car on a freeway
- 80 dB(A) Outboard motor
- 90 dB(A) Heavy truck pass-by
- 100 dB(A) Jackhammer / Subway train
- 110 dB(A) Rock Concert
- 115 dB(A) Limit of sound permitted in industry
- 120 dB(A) 747 take off at 250 metres

Frequency

The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high-pitched sound and a low frequency to a low-pitched sound.

L_{90}, L_{10}, etc

A statistical measurement giving the sound pressure level which is exceeded for the given percentile of a measurement period (i.e. L_{90} is the level which is exceeded for 90 percent of a measurement period). L_{90} is commonly referred to as a basis for measuring the background sound level.

$L_{Aeq,T}$

The equivalent continuous A-weighted sound pressure level. The value of the A-weighted sound pressure level of a continuous steady sound that, within a measurement time interval T, has the same A-weighted sound energy as the actual time-varying sound.

L_{Amax}

The maximum sound pressure level measured over the measurement period.

L_{Amin}

The minimum sound pressure level measured over the measurement period.

Day

Referred to as the period between 7am and 6pm for Monday to Saturday and 8am to 6pm for Sundays and Public Holidays.

Evening

Referred to as the period between 6pm and 10pm for Monday to Sunday and Public Holidays.

Night

Referred to as the period between 10pm and 7am for Monday to Saturday and 10pm to 8am for Sundays and Public Holidays.

Assessment background level (ABL)

The overall background noise level on each day, evening and night periods for each day of the noise monitoring.

Rating background level (RBL)

The overall background level on each day, evening and night periods for the entire length of noise monitoring.

Reverberation

The persistence, after emission by the source has stopped, of a sound field in an enclosure.

Sound isolation

A reference to the degree of acoustical separation between two spaces. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term 'sound isolation' does not specify any grade or performance quality and requires the units to be specified for any contractual condition.

Sound pressure level, L_p, dB of a sound

A measurement obtained directly obtained using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the R.M.S. sound pressure to the reference sound pressure of 20 micro Pascals.

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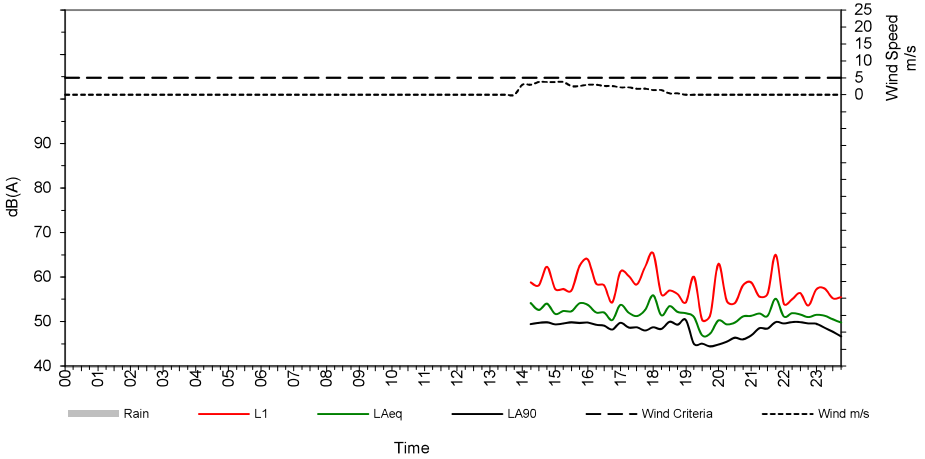
Appendix B
Noise logger graphs

Greenbank Shopping Centre

Noise Logger

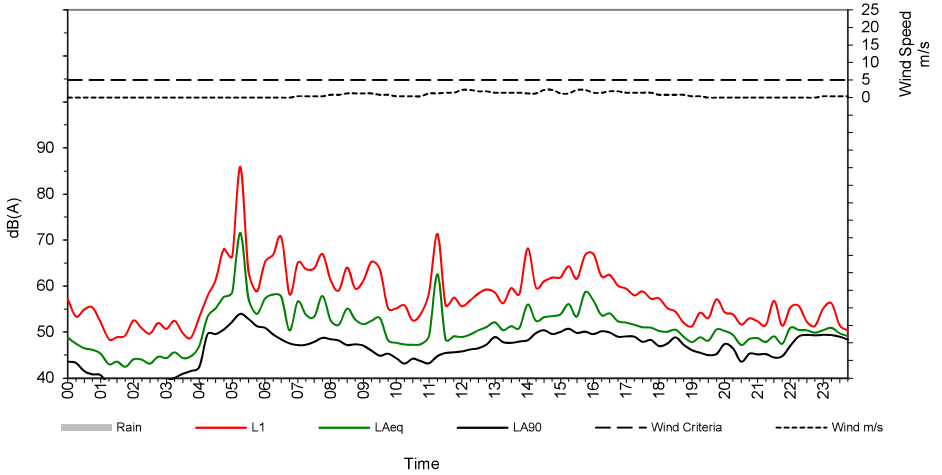
Monday 15 November 2021



Greenbank Shopping Centre

Noise Logger

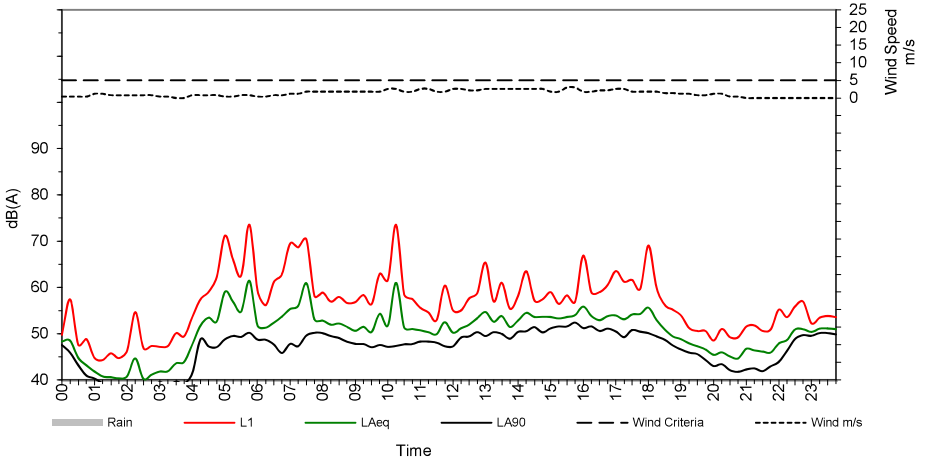
Tuesday 16 November 2021



Greenbank Shopping Centre

Noise Logger

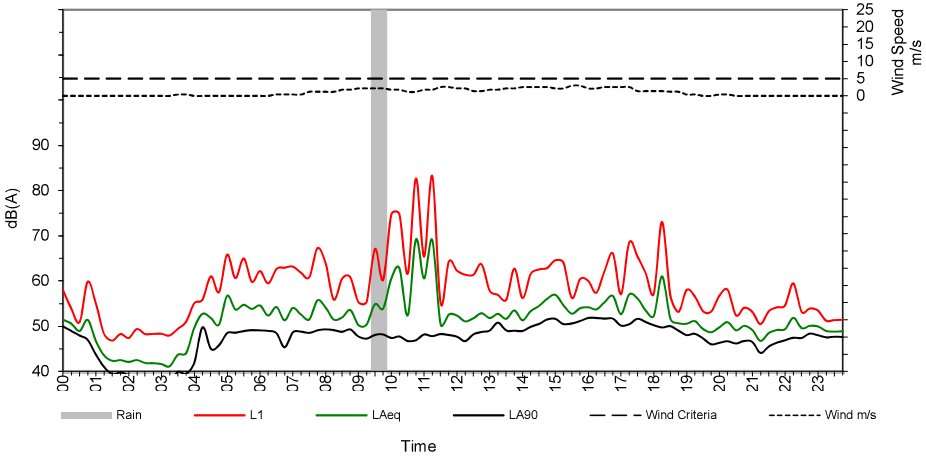
Wednesday 17 November 2021



Greenbank Shopping Centre

Noise Logger

Thursday 18 November 2021



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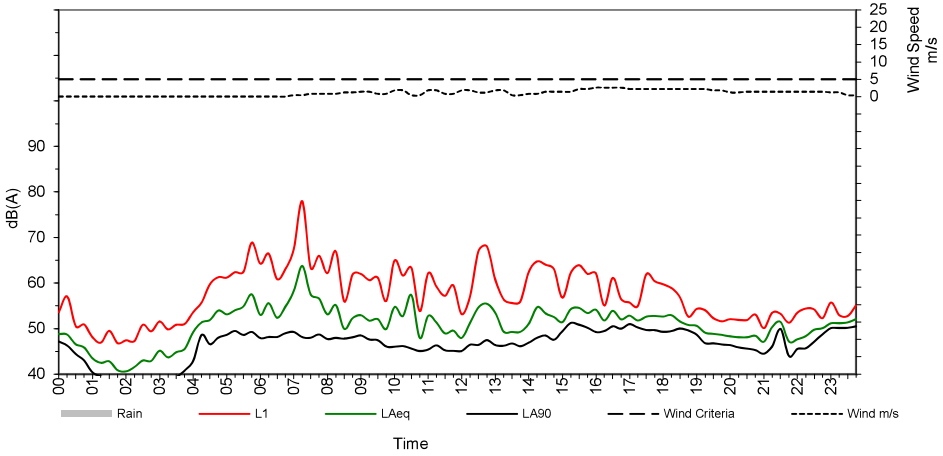
Noise Logger

Friday 19 November 2021



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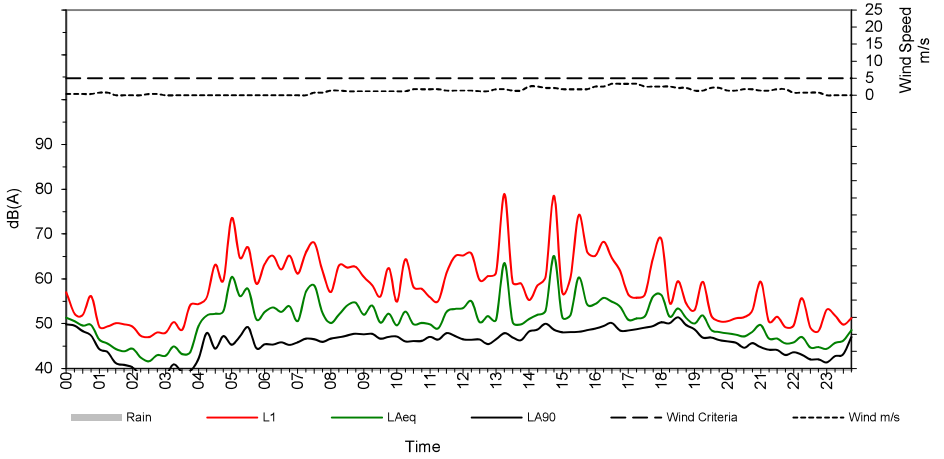
Noise Logger

Saturday 20 November 2021



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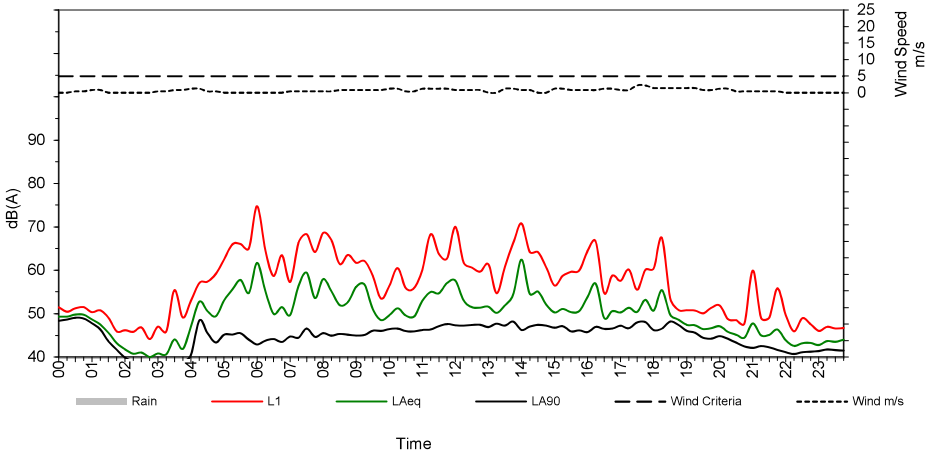
Noise Logger

Sunday 21 November 2021



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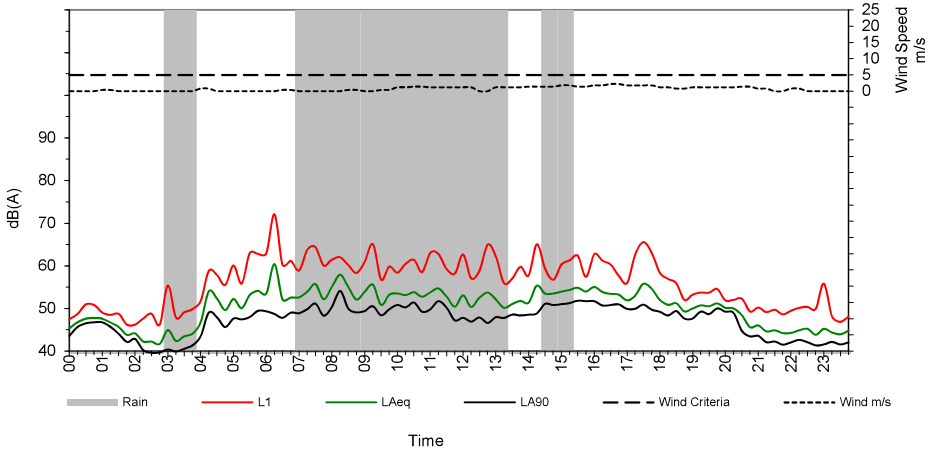
Noise Logger

Monday 22 November 2021



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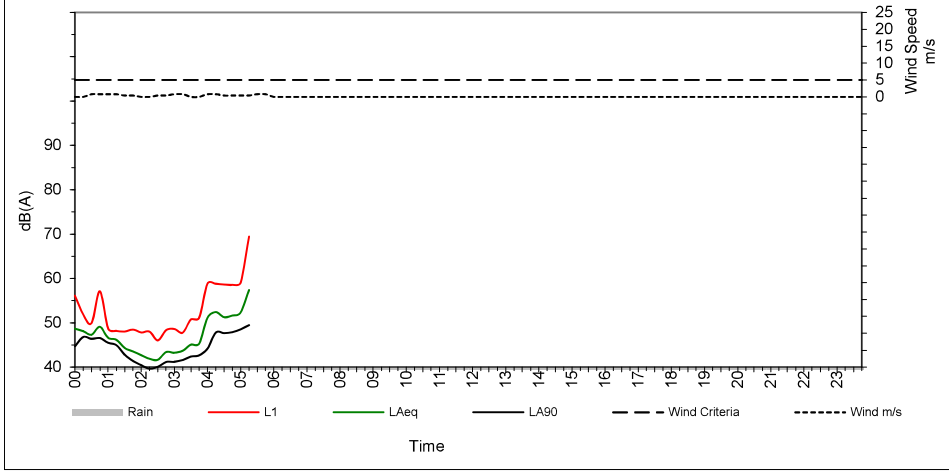
Tuesday 23 November 2021

Noise Logger



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