Urban Property Group

614-632 High Street, Penrith

Noise Impact Assessment

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Document Control

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1 Introduction

White Noise Acoustics has been engaged to undertake the Noise Impact Assessment of the proposed mixed use (residential and commercial) development located at 614-632 High Street, Penrith ("**Site**").

An initial report was provided in conjunction with the original development application. The DA has proceeded on appeal to the Land and Environment Court (Proceedings No. 355201 of 2021) and an amended proposal has now been prepared which, for acoustic assessment purposes, is reflected in plans numbered:

1. Architectural Drawings, including the DKO Architecture drawings with job number 00012012 and numbered DA200 to DA222 and dated May 2022.
2. Landscape drawings, including the Turf Design Studio drawing dated April 2022.

I understand that the client will be seeking leave from the Court to rely upon the amended development.

This assessment reviews acoustic issues associated with the amended proposal and includes the acoustic investigation into the potential for noise impacts from the operation of the completed project as well as potential noise impacts from existing noise sources within the vicinity of the Site which predominantly includes traffic noise from High Street to the north of the Site and Mulgoa Road which is location approximately 130m to the west of the Site.

1.1 Development Description

The Site is located on the southern side of High Street. The surrounding receivers to the Site include residential receivers to the south and commercial/retail receivers to the east and west.

The Site location is detailed in Figure 1 below.

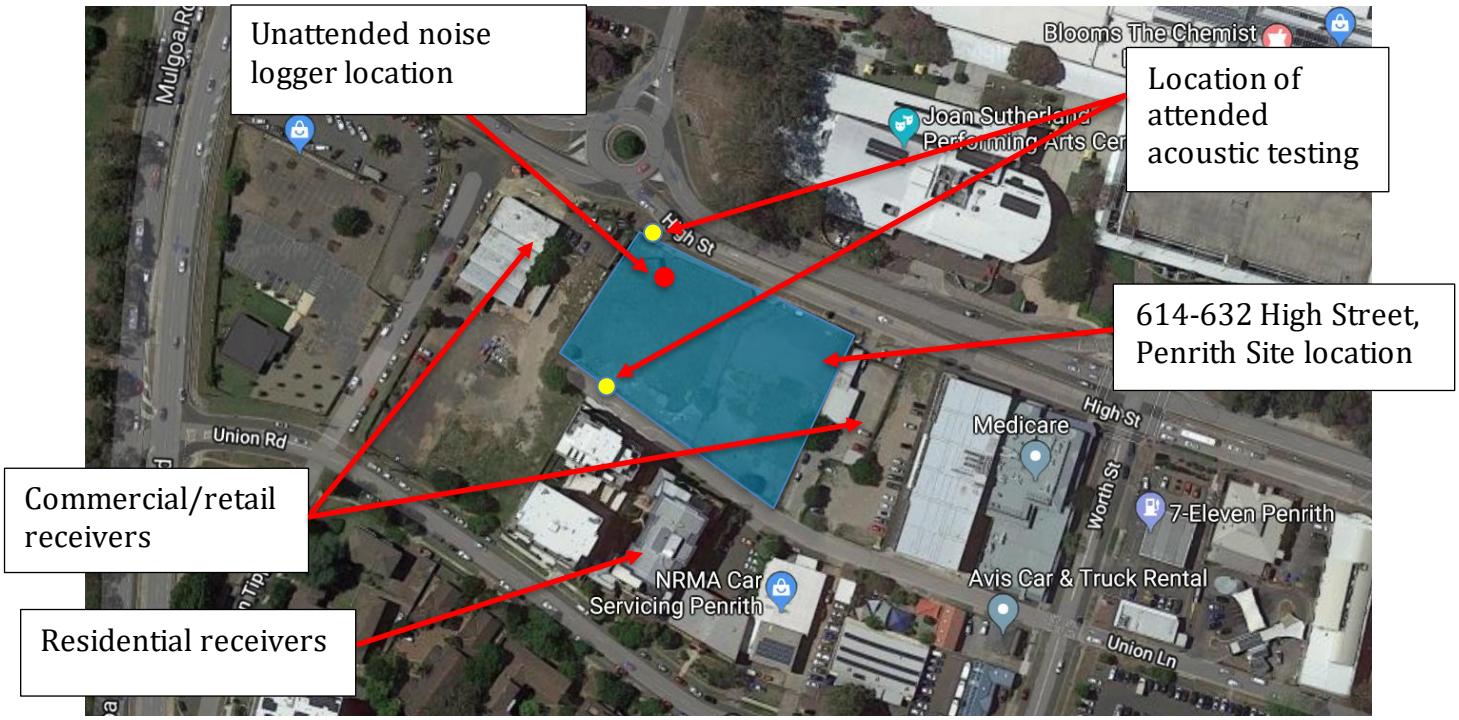


Figure 1 – 614-632 High Street, Penrith Site Location

2 Proposed Development

The Site is located within the Penrith City Council local government area. The amended development remains a mixed-use development of 45 storeys in height which, more particularly, incorporatesthe following:

1. A basement level with parking, storage and services;
2. ground floor retail uses;
3. a four-storey podium which incorporates:
    a. above-ground carparking that is sleeved on 3 sides but unsleeved towards Union Lane to the south;
    b. 3 levels of commercial uses;
4. a 41-storey tower above the podium which includes serviced apartments and residential units; and
5. communal spaces throughout the building including:
    a. a substantial open space on the top of the podium;
    b. terraces within the podium servicing the commercial and serviced apartment uses, and
    c. a large residential communal area within a double height void on level 38.

The Site is located on High Street which is not defined as a busy road carrying over 40,000 Annual Average Daily Traffic (AADT) number, nor carries over 20,000 AADT as defined in Map 16 of the RTA's *Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads*.

See the Figure below which includes the Site location included on Map 6 as detailed above.

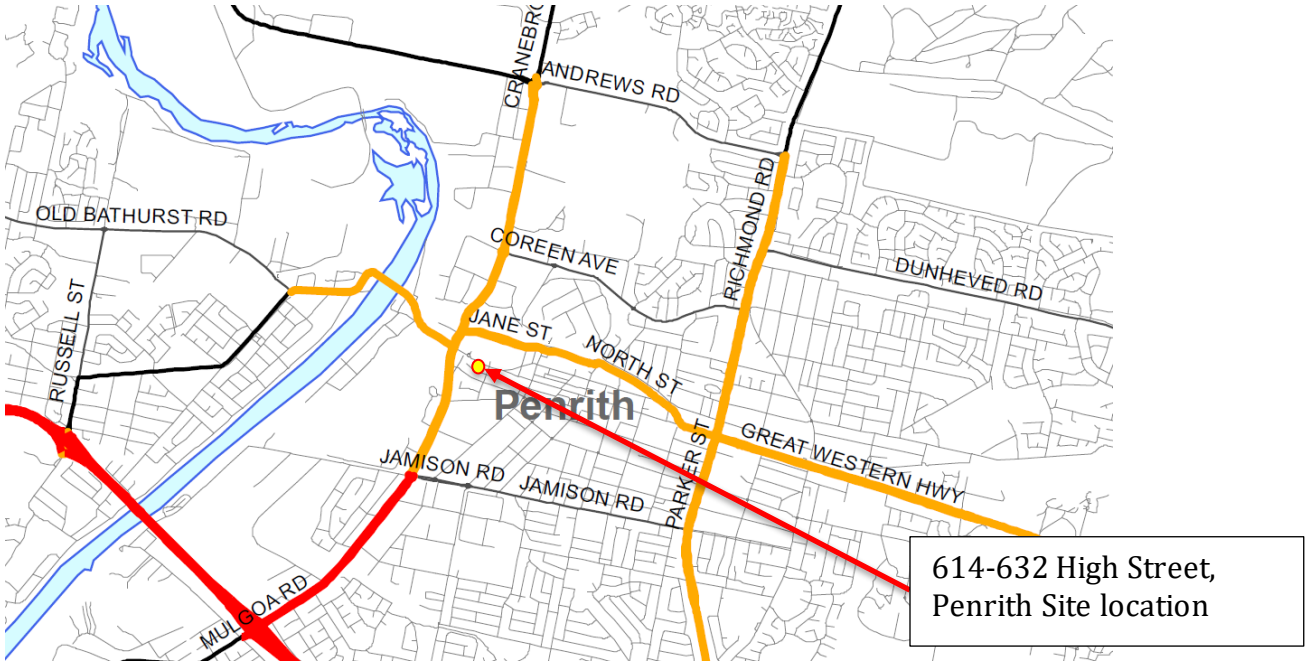


Figure 2 – Site Location of Map 6 of the RTA's *Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads*

3 Existing Acoustic Environment

The SSite is located to the southern side of High Street which is best classified as an *Urban* area. The existing noise levels at the Site are predominantly as a result of traffic noise within the vicinity of the SSite including High Street and Mulgoa Road (which includes high traffic flow volumes including use by heavy vehicles) within proximity to the SSite to the west. Existing receivers within the vicinity of the SSite include residential receivers to the south and commercial/retail to the east and west.

As part of this assessment an acoustic survey of the existing acoustic environment at the SSite was undertaken. The survey included attended noise level measurements at the SSite, during various times of the day on the 24th September, 2019 as well as long term unattended noise logging which was undertaken between the 24th of September and 1st of October, 2019. During the testing periods there was no inclement weather periods. It is not considered that there has been any change in the surrounding noise profile of the area that would warrant further surveys being undertaken. In other words, the surveys conducted in 2019 are considered to remain accurate as at the date of this amended report.

Noise logging was undertaken using a RION NL-42EX type noise monitor with serial number 00396932 and calibration with calibration number C19465. The noise logger was located to the rear of the SSite in a representative location to obtain background noise levels as detailed in Figure 1 above. The logger was positioned such that it was in a free field location and façade corrects were not required to be applied. Periods of inclement weather including precipitation and high wind have been excluded from the assessment of background levels.

Attended noise testing was conducted using a Bruel and Kjaer 2236C type meter. The meter was calibrated before and after testing and no significant drift was recorded.

3.1 Noise Survey Results

The attended and unattended noise locations were selected to obtain suitable noise levels for the assessment of background noise levels ($L_{90\,(t)}$) as well as the impact from traffic movements ($Leq_{(t)}$). The results of the acoustic survey are detailed in the tables below which have been used as the basis of this assessment.

Table 1 – Results of the Attended Noise Survey at the Site

Measurement Location	Time of Measurement	$L_{Aeq,\ 15min}$ dB(A)	$L_{A90,\ 15min}$ dB(A)	Comments
Attended noise measurement location, High Street	9.45am to 10.10am	68	54	Noise level at the Site dominated by vehicle movements on High Street and surrounding roadways.
Attended noise measurement location, Rear of the Site	10.15am to 10.30am	55	49	

Table 2 – Results of the Noise Logging at the Site

Measurement Location	Time of Measurement	Maximum Repeatable $L_{Aeq,\ 15min}$ dB(A)	Representable Background noise Level (RBL) $L_{A90,\ 15min}$ dB(A)
Noise logger location, see figure 1 above	Day	57	52
	Evening	52	47
	Night	50	45

4 Internal Noise Level Criteria

Internal noise levels within the future commercial and residential occupancies have been based on the relevant noise levels as detailed within the Australian Standard AS2107:2016 *Acoustics - Recommended design sound levels*

The recommended levels for various areas of the project are detailed in the following table. The recommended noise levels for residential dwellings near major roadways detailed within AS2107:2016 have been used as the basis of this assessment.

Table 3 - design Recommended design sound levels and reverberation times

Type of Occupancy/Activity	Design sound level maximum
Apartment common areas (e.g. foyer, lift lobby)	55 $L_{Aeq\ 15\ min}$
Residential - Living areas	40 $L_{Aeq\ 24\ hour}$
Residential - Sleeping areas (night time)	35 $L_{Aeq\ 9\ hour}$[1]
Toilets	55 $L_{Aeq\ 15\ min}$
Retail Areas	50 $L_{Aeq\ 15\ min}$
Commercial Areas	45 $L_{Aeq\ 15\ min}$
Note 1: The relevant time period for bedrooms include the period of 10pm to 7am	

5 Environmental Noise Intrusion Assessment

This section of the report details the assessment of environmental noise intrusion into the proposed development and the recommended acoustic treatments to ensure the recommended internal noise levels detailed in the Sections above (including traffic noise intrusion) are achieved.

Internal noise levels within the future areas of the development will result from the noise intrusion into the building through the external façade including glass, masonry and other façade elements. Typically, the acoustic performance of building elements including the relatively light weight elements of the building façade, including glass and/or plasterboard constructions, will be the determining factors in the resulting internal noise levels.

Calculations of internal noise levels have been undertaken based on the measured traffic and calculated aircraft environmental noise levels at the Site and the characteristics of the building, including window openings, buildings constructions and the like.

5.1 External Glass Elements

The recommended acoustic constructions to the buildings external façade glass elements are detailed in the table below to ensure the recommended internal noise levels detailed above are achieved, with the façade building openings closed.

Table 4 – External Glass Acoustic Requirements

Façade Orientation	Room Type	Recommended Glass Construction	Minimum Façade Acoustic Performance[1]
Retail Areas			
All Orientations	Retail Areas	6.38mm Laminated	Rw 30
Commercial Areas			
Facing High Street	Commercial Areas	10.38mm Laminated	Rw 35
Other Orientations	Commercial Areas	6.38mm Laminated	Rw 30
Residential Areas			
Facing High Street	Bedrooms	10.38mm Laminated	Rw 35
	Living Rooms	10.38mm Laminated	Rw 30
	Wet areas	6.38mm Laminated	Rw 30
Western Façade	Bedrooms	10.38mm Laminated	Rw 35
	Living Rooms	10.38mm Laminated	Rw 30
	Wet areas	6.38mm Laminated	Rw 30
All other façade orientations	Bedrooms	10.38mm Laminated	Rw 35
	Living Rooms	6.38mm Laminated	Rw 30
	Wet areas	6.38mm Laminated	Rw 30

Note 1: *The acoustic performance of the external façade includes the installed glazing and frame including (but not limited to) the façade systems seals and frame. All external glazing systems are required to be installed using acoustic bulb seals.*

The recommended glass constructions detailed in the table above include those required to ensure the acoustic requirements of the project are achieved. Thicker glazing may be required to achieve other project requirements such as structural, thermal, safety or other requirements and is to be advised by others.

5.2 External Building Elements

The proposed external building elements [BEN – PLEASE REVIEW IN LIGHT OF AMENDED MATERIALS SCHEDULE] including masonry, light weight or concrete external walls and roof are acoustically acceptable without additional acoustic treatment.

Any lightweight external pasteboard walls should be constructed from a construction with a minimum acoustic performance of Rw 5 5.

5.3 External Roof

The required external roof and ceiling constructions for the project are required to include the following:

1. Concrete external roof construction – no additional treatments required.
2. Metal deck roof construction – internal plasterboard to include:
    i. Living areas – 1x13mm standard plasterboard, with a 75mm thick 14kg/m3 insulation above the ceiling.
    ii. Bedrooms – 2x13mm standard plasterboard, with a 75mm thick 14kg/m3 insulation above the ceiling, with a 75mm thick 14kg/m3 insulation above the ceiling.
    iii. Wet areas – 1x13mm plasterboard or wet area board.

5.4 External Opening and Penetrations

All openings and penetrations are required to be acoustically treated such that the performance of the building construction is not compromised. This may require lining of duct work behind mechanical service openings/grills, treatments to ventilation opening and the like.

5.5 Surrounding Noise Sources

As the proposed development includes a multistorey development the upper levels of the project will have a possible line of sight to other surrounding noise sources including Mulgoa Road and the Western Railway Line.

The proposed acoustic treatments detailed in this report include suitable building constructions to ensure internal noise levels from all surrounding noise sources (including those detailed above) will be suitably acoustically treated to ensure the internal noise levels detailed in Section 4 of this report will be achieved within all units of the project (on all levels).

6 External Noise Emission Assessment

This section of the report details the relevant noise level criteria for noise emissions generated on the Site once completed.

The relevant authority which provides the required noise level criteria for noise levels generated on the Site includes the NSW Environmental Protection Authority's (EPA) Noise Policy for Industry (NPI).

6.1 NSW Environmental Protection Authority, Noise Policy for Industry

The NSW Environmental Protection Authority (EPA) Noise Policy for Industry (NPfI), previously Industrial Noise Policy, details noise criteria for the control of noise generated from the operation of developments and the potential for impact on surrounding receivers.

The NPI includes both intrusive and amenity criteria which are summarised below.

1. Intrusive noise level criteria, The NPfI states the following:

   'The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the LAeq descriptor), measured over a 15minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment.'

2. Amenity noise level criteria, The NPfI states the following:

   'To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance.'

   Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A)

   Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

The LAeq is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods. To standardise the time periods for the intrusiveness and amenity noise levels, this policy assumes that the LAeq,15min will be taken to be equal to the LAeq, period + 3 decibels (dB), unless robust evidence is provided for an alternative approach for the particular project being considered.

Project amenity noise level (ANL) is urban ANL (Table 2.1) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level (dB = decibel; dB[A] = decibel [A-weighted]; RBL = rating background noise level).

Noise levels used in the assessment of noise emission from the Site have been based on the noise level survey conducted at the Site and detailed in this section of the report.

Consequently, the resulting noise level criteria are summarised in the table below. The criteria are nominated for the purpose of determining the operational noise limits for the operation of the Site including mechanical plant associated with the development which can potentially affect noise sensitive receivers and operational noise levels from the future tenancies. For each assessment period, the lower (i.e. the more stringent) of the amenity or intrusive criteria are adopted. The calculated *Project Amenity Noise Level* includes either the Recommended Amenity Noise Level minus 5 dB(A) plus 3 dB(A) (for a 15minum period) or the measured existing Leq noise level – 10 dB if this is greater as determined by the NPfI.

Noise levels used in the assessment of noise emission from the SSite have been based on the noise level survey conducted at the SSite and detailed in this section of the report.

Consequently, the resulting noise level criteria are summarised in the table below. The criteria are nominated for the purpose of determining the operational noise limits for the operation of the SSite including mechanical plant associated with the development which can potentially affect noise sensitive receivers and operational noise levels from the future tenancies. For each assessment period, the lower (i.e. the more stringent) of the amenity or intrusive criteria are adopted. These are shown in bold text in the table below.

Table 5 – External Noise Level Criteria in Accordance with the NSW NPfI

Location	Time of Day	Project Amenity Noise Level, $L_{Aeq,\ period}$ [1] (dBA)	Measured $L_{A90,\ 15\ min}$ (RBL) [2] (dBA)	Measured $L_{Aeq,\ period}$ Noise Level (dBA)	Intrusive $L_{Aeq,\ 15\ min}$ Criterion for New Sources (dBA)
Urban residences	Day	58	51	57	**56**
	Evening	**48**	47	52	52
	Night[4]	**43**	45	50	48
Commercial	When in use	**65**	N/A	N/A	N/A

Note 1: Project Amenity Noise Levels corresponding to "Sub Urban" areas, recommended noise levels.

Note 2: L_{A90} Background Noise or Rating Background Level

Note 3: Project Noise Trigger Levels are shown in bold

Note 4: Noise from the operation of residential condensers are to be inaudible within a neighbouring residential premises

6.2 Noise Impact Assessment

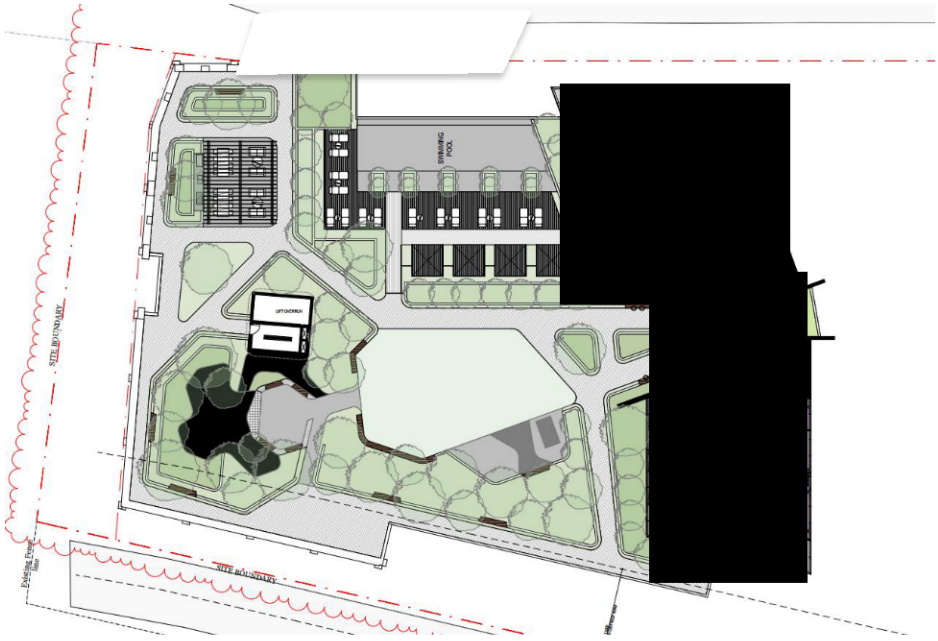
An assessment of noise generated on the SSite is provided in this section of the report. The assessment of noise levels generated on the SSite are summarised below:

1. Mechanical Services Equipment –Detailed selections of the proposed mechanical plant and equipment to be used on the Site are not available at this time. All future plant and equipment are to be acoustically treated to ensure the noise levels at all surrounding receivers comply with noise emission criteria detailed within this report. Experience with similar projects indicated that it is both possible and practical to treat all mechanical equipment such that the relevant noise levels are achieved. Examples of the possible acoustic treatments to mechanical equipment includes the following:
    a. Supply and Exhaust Fans – location of fans within the building and treated using internally lined ductwork or acoustic silencers.
    b. Condensers – Condensers may be located on balconies of individual apartments, within the podium level carparking or on the roof of the building. The location of condensers will be reviewed once details can be provided and acoustic screening design to ensure noise emission criteria are achieved.

Details of the required mechanical services equipment and acoustic treatments to ensure the relevant noise level criteria is achieved will be provided as part of the CC submission of the project.

6.3 Communal Areas

The proposed development includes a number of internal and external communal areas including a pool, BBQ and dining and recreation area. The propose external communal area is included in the figure below.



To mitigate noise levels from the communal areas area to both the future residential dwellings within the development as well as surrounding receivers the following acoustic mitigations are recommended:

1) External common areas is only to be used during the daytime and evening time including the following:
   a) (For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm.
   b) On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm)

2) The external communal areas are not to be used for high noise generating activities such as large gatherings, playing of loud music, parties or the like.

   a) Amplified music is not permitted to be played on the external communal areas at any time.
   b) Signs must be installed within the pavilion area outlining the recommendations above.

Providing the recommended acoustic mitigations detailed in the points above are included in the design and operation of the proposed communal areas the resulting noise emissions will be acoustically acceptable to the receives to the Site including future residential dwelling in the building and neighbouring receivers.

6.4 Future Retail and Commercial Tenancies

As part of the proposed development a number of retail and commercial tenancies are included on the ground floor of the project.

At this stage of the project the type of occupancies and possible operations are not known. As part of the future approvals process for each tenancy a detailed *Noise Impact Assessment* for each potentially high noise generating tenancy will be required to be conducted.

As part of the proposed development the tenancies should include a minimum design of the building such that the future acoustic requirements of possible tenancies to mitigate noise are included in the construction of the building, including:

a) A minimum of a 200mm thick concrete slab between retail and commercial tenancies to residential dwellings above.
b) A minimum 10.38mm Laminated facade to the proposed retail and commercial tenancies.

6.5 Garbage Removal and Service Deliveries

The removal of rubbish from the Site will be undertaken in accordance with the requirements of council's waste removal requirements.

Noise generated from the movement of garbage trucks and the like will be limited to small number of movements on any given week.

The proposed constructions to the building façade, and included in Section 5.1 above, include constructions which will mitigate noise levels from the intermittent noise resulting from the removal of waste.

The future operational requirements for the delivery to the retail and commercial areas are not know at this time. The proposed development includes a small loading area on the ground floor of the project which is contained within the building structure. The use of this proposed loading area by small trucks and vans servicing the retail and commercial areas will be acoustically mitigated as it is located within the building envelope.

The proposed development does not include a large Coles or Woolworths supermarket which will result in large reticulated trucks entering and exiting the Site during night time hours.

6.6 Additional Traffic Noise

The *NSW Road Noise Policy* includes acoustic criteria for noise resulting from additional traffic generated from the development (Section 3.4 *Applying the assessment and relative increase criteria; Step 4)*, which includes the following:

> **Step 4**
>
> For each assessment location in the study area, if the controlling criteria identified in Step 2 are not achievable in Step 3, justification should be provided that all feasible and reasonable mitigation has been applied.
>
> For existing residences and other sensitive land uses affected by **additional traffic on existing roads generated by land use developments**, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

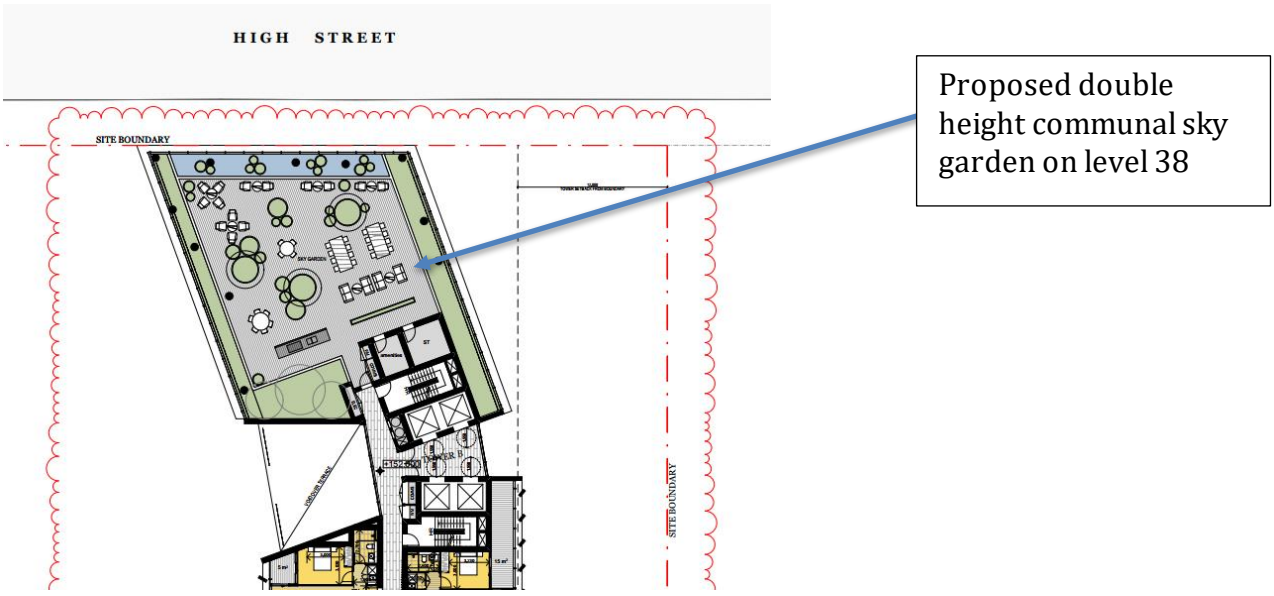
Based on the criteria detailed above, it is noted that vehicle numbers on surrounding roads would need to increase by around 60% from existing traffic flows, for a 2 dB increase in road traffic noise to occur. A 2 dB increase in road traffic noise is considered to be acceptable based on the requirements of the *NSW Road Noise Policy*.

Based on the number of additional vehicles movements resulting from the proposed development an increase in noise levels on surrounding roadways will be less than 2 dB and will be acoustically acceptable.

6.7 Communal Spaces

The proposed development includes a number of communal spaces including the following:

1. Level 38, double height void communal space – This area includes a double height sky garden as detailed in the figure below.



The proposed communal area includes an outdoor area for the use of residents. The communal open space includes an open area which will include exposure of noise from surrounding roadways including High Street.

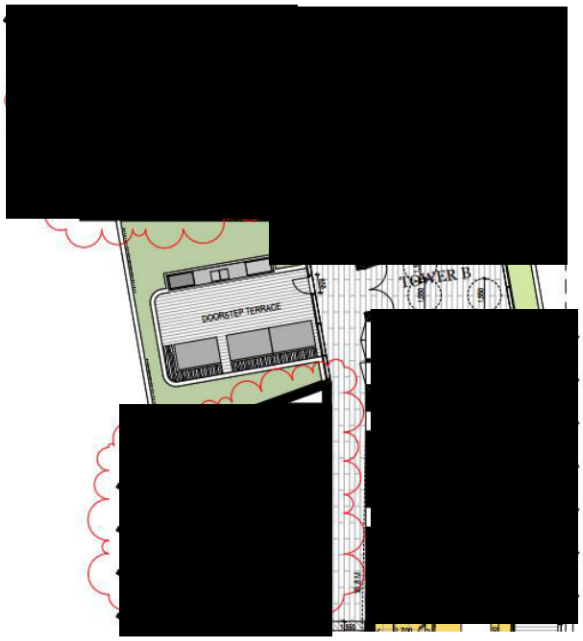
For the purpose of this assessment, we have assumed the following noise levels:

- Single person talking – 69dB(A) and an assumption of up to 30 people using the external terrace with 1 in 3 talking at any one time.
- Background music (for internal areas only) – 65dBA

To mitigate noise levels from the proposed common area to within the required noise emission criteria detailed in this report the following acoustic mitigations are recommended:

a. External common areas is only to be used during the daytime and evening time including the following:
    - (For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm.
    - On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm).
b. Use of the common area is permitted for communal activities. The area is not to be used for high noise generating activities such as large gatherings, playing of loud music or parties.
c. Amplified music is not permitted in the communal area or in the common room at any-time. No fixed speakers should be installed as part of the common area.
d. Signs must be installed within the area outlining the recommendations above.

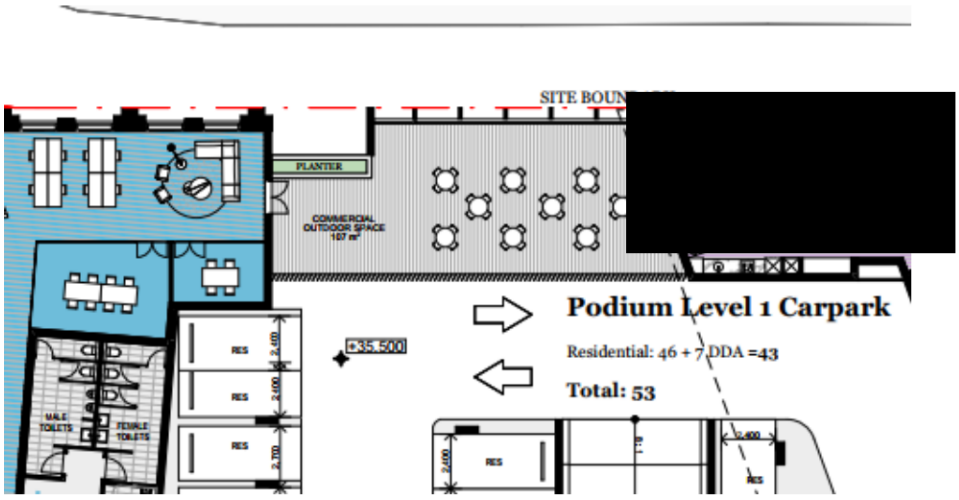
2. Door step terraces – There are door step terraces located on the typical levels of the project, as detailed in the figure below.



To mitigate noise levels from the proposed terraces the following acoustic mitigations are recommended:

a. Door stop terrace areas only to be used during the daytime and evening time including the following:
    - (For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm.
    - On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm).
b. The area is not to be used for high noise generating activities such as large gatherings, playing of loud music or parties.
c. Amplified music is not permitted in the terrace area at any-time. No fixed speakers should be installed as part of the area.
d. Signs must be installed within the area outlining the recommendations above and the requirement for the use of the areas to include good neighbourly behaviour.

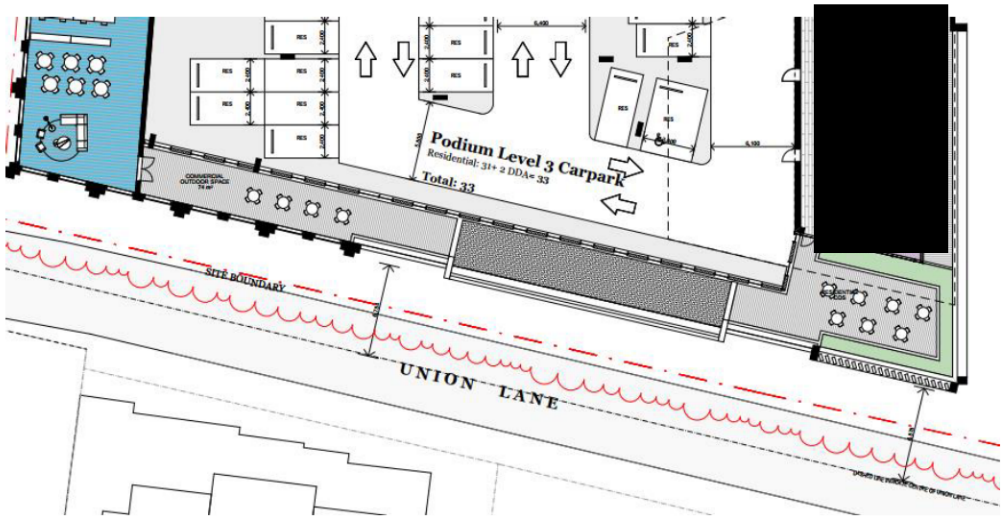
3. Level 1 and 2 commercial outdoor space – includes an external area which faces High Street and will include noise from traffic noise generated from vehicle movements on High Street. The proposed external area is detailed in the figure below.



To mitigate noise levels from the space the following acoustic mitigations are recommended:

a. The commercial outdoor space is only to be used during the daytime and evening time including the following:
    - (For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm.
    - On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm).
b. The area is not to be used for high noise generating activities such as large gatherings, playing of loud music or parties.
c. Amplified music is not permitted in the communal area or in the common room at any-time. No fixed speakers should be installed as part of the common area.
d. Signs must be installed within the area outlining the recommendations above and the requirement for the use of the areas to include good neighbourly behaviour.

4. Level 3 commercial outdoor space – includes an external area which faces Union Lane. The proposed external area is detailed in the figure below.



To mitigate noise levels from the proposed outdoor space the following acoustic mitigations are recommended:

e. The commercial outdoor space is only to be used during the daytime and evening time including the following:
   - (For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm.
   - On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm).

f. The area is not to be used for high noise generating activities such as large gatherings, playing of loud music or parties.

g. Amplified music is not permitted in the communal area or in the common room at any-time. No fixed speakers should be installed as part of the common area.

h. Signs must be installed within the area outlining the recommendations above and the requirement for the use of the areas to include good neighbourly behaviour.

Based on the assessment of the proposed external areas proposed within the development providing the recommended acoustic mitigations detailed in the points above are included in the design and operation of the proposed communal areas the resulting noise emissions will be acoustically acceptable at the surrounding receivers including to future residents within the development as well as existing receivers surrounding the project.

6.8 Noise From the use of the Carpark Areas

As part of the proposed development there is carparking located on the mezzanine levels to level 3 of the project. The car parking includes open façade elements to the south of the Site facing towards Union Lane with existing residential receivers opposite, a typical floor with parking is included in the figure below.

Open façade elements to carparking facing Union Lane

This section of the report details the assessment of potential noise impacts from the use of the carparking to the existing residences opposite on Union Lane.

The assessment of noise impacts from the use of the carpark has included the potential for sleep disturbance events during night-time hours. Details of the assessment are included in the following sections.

6.8.1 Sleep Disturbance Criteria

This section of the report details the relevant sleep disturbance noise level criteria for the assessment of noise emissions from the Site during night-time hours. The assessment of sleep disturbance includes intermittent noise levels from the use of the carpark areas including starting of car engines, closing of car doors and the like.

The most recent NSW guidance in relation to sleep disturbance is contained in the NSW EPA's online *Application notes – NSW industrial noise policy*. For the purposes of this assessment a night-time sleep disturbance 'screening criterion' noise goal of RBL +15 dB(A) is applied.

The term 'screening criterion' indicates a noise level that is intended as a guide to identify the likelihood of sleep disturbance. While it is not a firm criterion to be met, where the criterion is met, sleep disturbance is not likely. When the screening criterion is not met, a more detailed analysis is required.

With regard to reaction to potential sleep awakening events, the RNP gives the following guidance:

> From *the research on sleep disturbance to date it can be concluded that:*
>
> - *maximum internal noise levels below 50–55 dBA are unlikely to awaken people from sleep*
> - one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly

The EPA's *Industrial Noise Policy for Industry* (NPfI) and the *NSW Road Noise Policy (RNP)* includes suitable criteria for the assessment of potential sleep awakening events, which have been used as the basis of this report.

The NPfI includes the following commentary regarding possible sleep awakening events:

> ***2.5 Maximum noise level event assessment***
>
> *The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.*
> *Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - $L_{Aeq,15min}$ *40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
> - L_{AFmax} *52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*
>
> *A detailed maximum noise level event assessment should be undertaken. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance*

on possible impact is contained in the review of research results in the NSW Road Noise Policy.

The RNP includes the following comments regarding sleep disturbance:

From the research on sleep disturbance to date it can be concluded that:

- *maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
- *one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are*

not likely to affect health and wellbeing significantly.

Based on the relevant standards detailed above, a summary of the sleep disturbance noise level criteria is detailed in the following table.

Table 6 – Sleep Disturbance Criteria

Type of Receiver	Location	Policy	Description	Background Noise, Nightime	Resulting Maximum Noise Level
Residential Receiver	External Noise levels	Noise Policy for Industry	The potential for sleep disturbance from maximum noise level events	45 dB(A) L $L_{90,15min}$	$L_{Aeq,15min}$ 50 dB(A) Externally
					L_{AFmax} 60 dB(A) Externally
	Within the residential dwelling	Road Noise Policy	1 or 2 events unlikely to awaken people from sleep		65-70 dB(A) Lmax Internally
			Maximum internal noise unlikely to awaken people from sleep		50-55 dB(A) Lmax Internally

Based on the details included within the NPfI and the RNP, in the event a noise level of 60 dB(A) L_{max} or 50 $L_{Aeq\ 15\ min}$ does not occur externally at the residential receiver as a result of the use of the operation of the property (internally within the residential receiver) then noise levels are *unlikely to awaken people from sleep,* and compliance with the requirements of the NPfI and the RNP regarding sleep disturbance would be achieved.

6.8.2 Maximum Noise Level Assessment

Based on the proposed use of the proposed carparking areas on the mezzanine level to level 3, an assessment of the potential for maximum noise level events has been undertaken. The assessment includes the potential for maximum noise level events on the Site within the closest proximity to neighbours opposite the Site to the south opposite on Union Lane.

The assessment of maximum noise levels occurring on the proposed development included noise generated from the use of cars within the development including engines starting and the closing of doors, which include the activities with the potential to generate the greatest noise levels.

The assessment of the screening criteria has been undertaken for external noise levels, which is included in the sample calculation below.

Table 7 – Maximum Noise level events Screening Criteria to Residential Receiver (externally)

	Descriptor	
Noise Source	Car Engine Starting	Closing of a car door
Noise Source level (SWL)	100 dB(A) Lmax	95 dB(A) Lmax
Correction the carparking area	-6 dB	-6 dB
Barrier Effect for the façade of the proposed building (including open areas)	-4 dB	-4 dB
Distance Correction (15m)	-31 dB	-31 dB
Resulting External Noise Level	59 dB(A) Lmax	54 dB(A) Lmax
Screening Noise Level –	60 dB(A) L_{AFmax}	60 dB(A) L_{AFmax}

Based on the predicted noise levels above, the expected maximum noise levels from the use of the proposed carpark will comply with the '*screening test*' and will therefore be acoustically acceptable.

7 Construction Noise and Vibration Management

This section of the report details the assessment of noise associated with the proposed construction activities associated with the development. The assessment has been undertaken to assess the potential noise impacts from construction and demolition on surrounding receivers to the Site.

The proposed construction and demolition activities to be undertaken on the Site include the strip out of the existing areas of the existing building and limited external demolition of the existing building on the Site. The development will then be constructed using normal construction processes.

7.1 Construction Noise

The assessment of construction noise impacts generated from the Site has been undertaken in accordance with the requirements of the EAP Interim Construction Noise Guideline.

The EPA's Interim Construction Noise Guideline defines normal day time hours as the following:

2.2 Recommended standard hours

The recommended standard hours for construction work are shown in Table 1; however, they are not mandatory. There are some situations, as described below, where construction work may need to be undertaken outside of these hours. The likely noise impacts and the ability to undertake works during the recommended standard hours should be considered when scheduling work.

Table 1: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

7.2 Proposed Appliances

The proposed appliances which will be used as part of the demolition and construction of the project are detailed in the table below.

Table 8 – Noise Level from Expected Demotion Appliances

Tasks	Equipment	Sound Power Levels per task dB(A) L_{10}	Aggregate Sound Power Level per Task dB(A) L_{10}
Site Excavations	Jack hammer mounted on excavator	118	122
	Saw cutting	119	
	Excavators and bulldozers	115	
	Materials Movements	105	
	Bulldozers	115	
	Trucks	109	
Construction Works	Piling	115	120
	Welder	101	
	Saw cutter	109	
	Dump truck	109	
	Concrete saw	119	
	Power hand tools	109	
	Cranes	110	
Notes: Noise levels of proposed equipment to be used on the Site based on the Australian Standard AS2436-2010 and noise level measurements previously undertaken of similar equipment on construction Sites.			

7.3 Construction Noise Criteria

This section of the report details the relevant construction noise criteria which is applicable to the Site including the EPA's *Interim Construction Noise Guideline* (ICNG).

7.3.1 Interim Construction Noise Guideline

Noise criteria for construction and demolition activities are discussed in the *Interim Construction Noise Guideline* (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all "feasible" and "reasonable" work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting Site-specific feasible and reasonable work practices in order to minimise noise impacts.

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for receivers have been reproduced from the guideline and are listed in the table below.

Table 9 – Noise Management Levels from Construction – Quantitative Assessment

Receiver Type	Time of Day	Noise Management Level LAeq(15minute)1,2	How to Apply
Residential	Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
		Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
	Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Table 7 – Continued

Receiver Type	Time of Day	Noise Management Level LAeq(15minute)1,2	How to Apply
offices, retail outlets: external	When is use	LAeq (15 min) 70 dB(A)	During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.

Note 1 *Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

Note 2 *The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).*

Based on the table above the suitable construction noise management levels for works undertaken on the Site is detailed in Table 6 below.

Table 10 – Site Construction Noise Management Levels

Noise Source	Time Period	Receiver Type	Construction Noise Management Level	'High Noise Affected' Level
Construction Noise	Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Residential Receivers	62 dB(A) LAeq (15min)	75 dB(A) LAeq (15min)

Note 1: Construction noise management levels based on the Interim Construction Noise Guideline

7.4 Construction Vibration Assessment

This section of the report details the assessment of construction vibration impacts on surrounding receivers.

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 4.4.1.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 4.4.2.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 4.4.2.

7.4.1 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"*. (AVTG) This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources (refer to Table 11).
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 10).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 13).

Table 11 Continuous vibration acceleration criteria (m/s2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 12 Impulsive vibration acceleration criteria (m/s2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 13 Intermittent vibration impacts criteria (m/s1.75) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

7.4.2 Vibration Criteria – Building Contents and Structure

The vibration effects on the building itself are assessed against international standards as follows:

- For transient vibration: British Standard BS 7385: Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration" (BSI 1993); and
- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 "Effects of Vibration on Structure" (DIN 1999).

7.4.2.1 Standard BS 7385 Part 2 - 1993

For transient vibration, as discussed in standard BS 7385 Part 2-1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised in Table 14 and illustrated in the Figure below.

Table 14 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure below	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Standard BS 7385 Part 2 – 1993 states that the values in Table 14 relate to transient vibration which does not cause resonant responses in buildings. Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 14 may need to be reduced by up to 50% (refer to Line 3 in the Figure below).

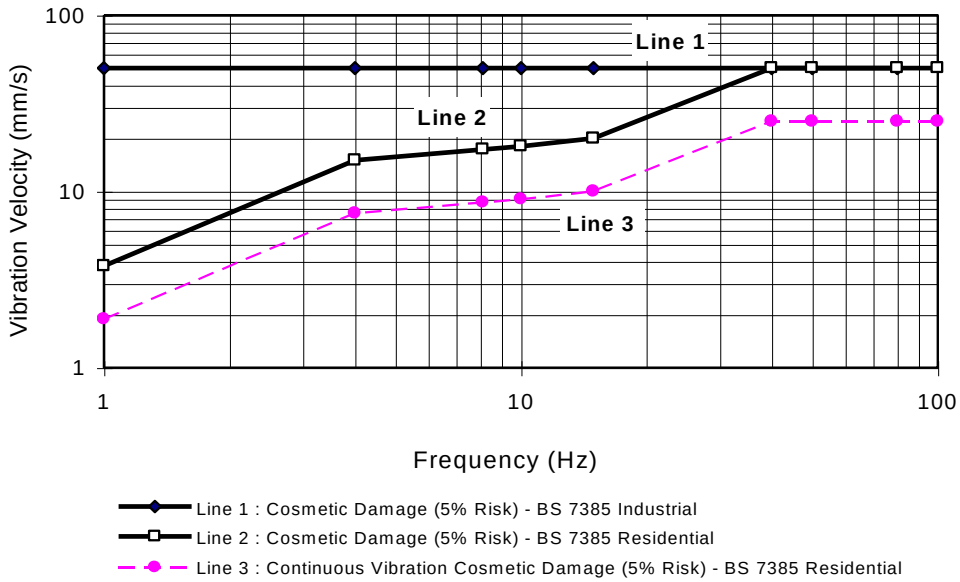


Figure 3 - BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 14, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 14 should not be reduced for fatigue considerations.

7.4.2.2 Standard DIN 4150 Part 3 - 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 15. The criteria are frequency dependent and specific to particular categories of structures.

Table 15 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
Note 1: For frequencies above 100Hz, at least the values specified in this column shall be applied.				

7.4.3 Project Vibration Criteria

Based on the details included in the sections above the project specific vibration criteria to protect the surrounding residential receivers from structural or architectural damage includes the following:

1. Project construction vibration criteria – 10 mm/s

7.5 Construction Noise Management

Based on the assessment conducted of the expected construction noise levels generated from the Site, levels are generally expected to require the building contractor to engage in management of activities on the Site and engagement with the local community.

Notwithstanding, the following management controls are recommended to mitigate construction noise levels on the Site:

1. Construction to be undertaken within the approved hours detailed within the projects *Conditions of Consent.*
2. All plant and equipment are to be maintained such that they are in good working order.
3. A register of complaints is to be recorded in the event of complaints being received, including location, time of complaint, nature of the complaint and actions resulting from the complaint.
4. If required a noise level measurement of the offending plant item generating complaints is to be conducted and noise mitigations undertaken to reduce noise levels to within Noise Management levels in the event magnitude of noise levels is found to be above suitable levels.
5. The use of percussive and concrete sawing should be undertaken behind a closed façade when possible.
6. The use of percussive equipment including hydraulic hammering should be limited such that they are not undertaken prior to 7.30am on weekdays and prior to 8.30am on Saturdays.
7. Where possible any excavation to be undertaken on the Site is to include ripping of material where possible.

In addition to the recommended mitigations above details of the proposed construction (including demolition) works to be conducted on the Site, including type of activities to be conducted as well as the expected duration of activities should be provided to the neighbouring receivers.

In the event noise levels are found to required additional noise reduction then all possible and practical mitigations are required to be included in the construction of the project. Possible acoustic treatments and controls may include the following:

1. Use of alternative appliances to complete the required works which result in reduced noise impacts on surrounding neighbours.
2. Period when noisy appliances are undertaken, such as undertaking noisy works on locations with the greatest distance to residential receivers during morning periods if possible.
3. Construction of acoustic screening to permanently located high noise generating equipment such as pumps and generators.
4. Scheduling of high noise generating works outside of noise sensitive periods if possible.
5. Other Site specific treatments and controls which may become possible once works commence.

7.6 Construction Vibration Impacts

An assessment of the potential for vibration generated as part of the required construction activities on the project (including excavation, demolition and construction) has been undertaken.

As the proposed building to be demolished on the Site are not attached to neighbouring structures and the proximity of neighbouring structures to the development Site (which include residential receives) vibration levels generated from the proposed demolition and construction on the Site are expected to comply with all vibration criteria detailed in this report.

In the event excavation is required on the Site including removal of stone, the following management technique should be included in the excavation methodology:

- A saw cut at the perimeter of any excavation within rock on the Site to boundaries adjacent neighbouring residential properties are required to include a saw cut to the rock prior to use of any excavation or ripping.

Based on the location of the Site which includes Beach Street as a separation to the potentially worst affected residential receivers magnitudes of vibration with the potential to exceed suitable limits for structural and architectural damage are not expected to be generated.

7.7 Noise and Vibration Monitoring

As part of the management of noise from the proposed demolition, excavation and construction activities to be undertaken on the Site the following noise and vibration measurements are recommended to be undertaken:

1. Noise – Attended noise level measurements of typical demolition, excavation and construction activities should be undertaken at Site. A

   Attended construction noise surveys of the Site and surrounding impacts on neighbours should be undertaken during the following as a minimum:
   a. Start of Demolition
   b. Commencement of any rock breaking or sawing on the Site.
   c. Periodically during the construction period if required.
   d. In response to any ongoing complaints received from neighbours.

2. Vibration – Based on the proximity of the surrounding receivers to the works required to be conducted on the Site vibration magnitudes with the potential to exceed the vibration criteria detailed in this report are not expected, therefore vibration monitoring is not recommended for the construction phases of the project.

7.8 Community Engagement

During the proposed construction of the project (including demolition, excavation and construction) the building contractor is required to engage in community interaction. The community interaction and notification is required to include the following:

1. Notification of the proposed works to be undertaken on the Site and the periods when works will be conducted, including information regarding the programme of works such as demolition and excavation.
2. Details of the relevant Site representative where complaints can be registered.
3. Details of the methodology to respond to complaints raised from the surrounding receivers.
4. A register of complaints, to be kept on Site including record of time and nature of the complaint as well as the outcomes and comments regarding investigations resulting from the complaint.

8 Conclusion

This report details the Noise Impact Assessment of the proposed amended development at 614-632 High Street, Penrith.

This report details the required acoustic constructions of the building's façade, including external windows, to ensure that the future internal noise levels comply with the relevant noise levels of the Australian Standard AS2107:2016. Providing the recommended constructions detailed in this report are included in the construction of the project the required internal noise levels will be achieved.

External noise emissions from the Site have been assessed and detailed in accordance with the NSW Environmental Protection Authorities Noise Policy for Industry (previously the Industrial Noise Policy). The future design and treatment of all building services associated with the project can be acoustically treated to ensure all noise emissions from the Site comply with the EPA NPfI criteria. Details of the equipment and associated acoustic treatments will be provided as part of the CC submission of the project.

For any additional information please do not hesitate to contact the person below.

Regards

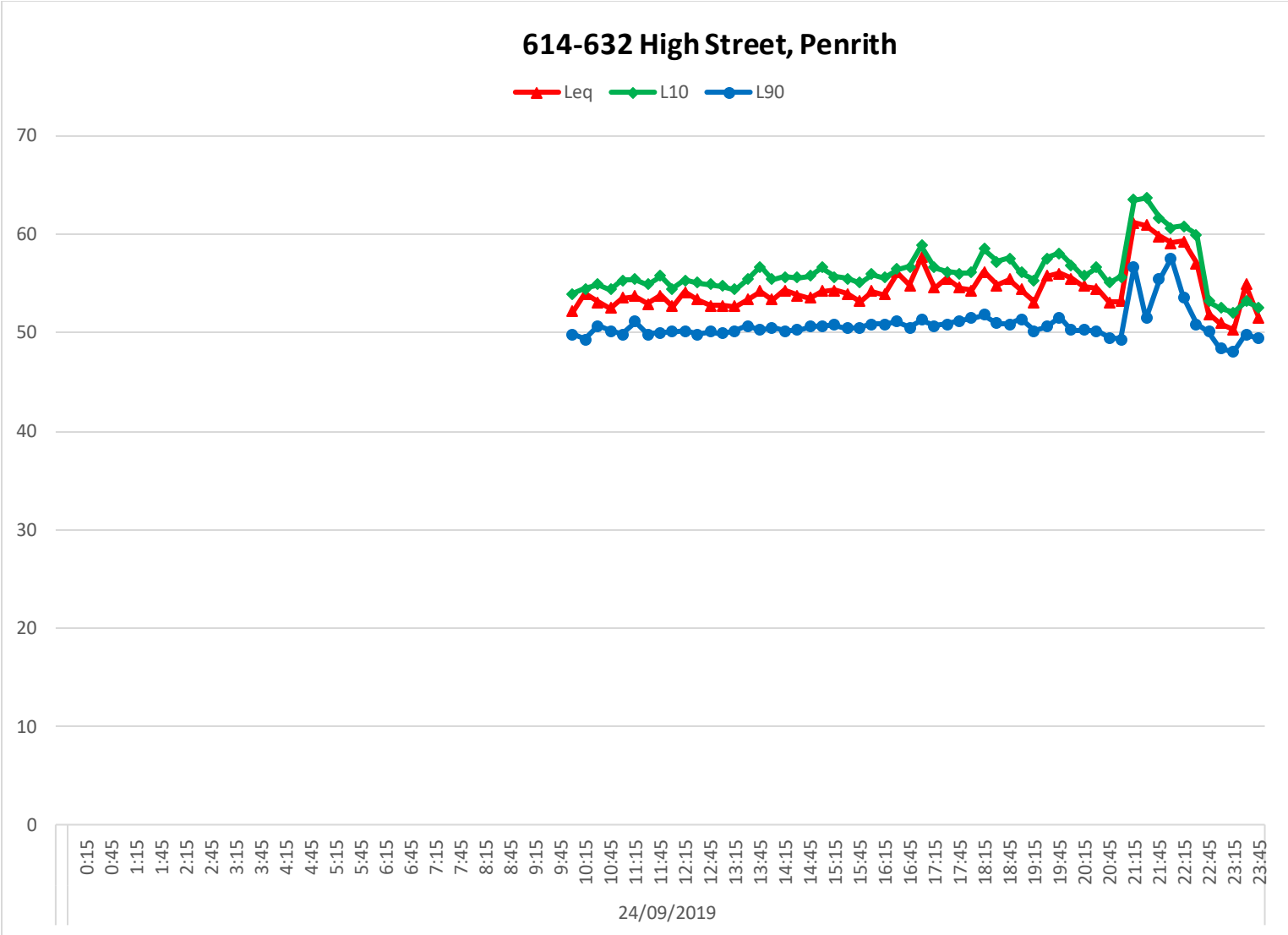
Ben White
Director
White Noise Acoustics

9 Appendix A – Glossary of Terms

Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0dB the faintest sound we can hear 30dB a quiet library or in a quiet location in the country 45dB typical office space. Ambience in the city at night 60dB Martin Place at lunch time 70dB the sound of a car passing on the street 80dB loud music played at home 90dB the sound of a truck passing on the street 100dB the sound of a rock band 115dB limit of sound permitted in industry 120dB deafening
dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Background Sound Low	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the L_{A90} value
Ctr	A frequency adaptation term applied in accordance with the procedures described in ISO 717.
dB (A)	'A' Weighted overall sound pressure level

Noise Reduction	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
NR Noise Rating	Single number evaluation of the background noise level. The NR level is normally around 5 to 6 dB below the "A" weighted noise level. The NR curve describes a spectrum of noise levels and is categorised by the level at 1000 Hz ie the NR 50 curve has a value of 50 dB at 1000 Hz. The NR rating is a tangential system where a noise spectrum is classified by the NR curve that just encompasses the entire noise spectrum consideration.
R_w	Weighted Sound Reduction Index - Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single element. Calculation procedures for Rw are defined in ISO 140-2:1991 "Measurement of Sound Insulation in Buildings and of Building Elements Part 2: Determination, verification and application of precision data".
R'_w	Field obtained Weighted Sound Reduction Index - this figure is generally up to 3-5 lower than the laboratory test determined level data due to flanked sound transmission and imperfect Site construction.
Sound Isolation	A reference to the degree of acoustical separation between any two areas. 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	A measurement obtained directly 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 rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, L_W dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are oppoSites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
Transmission Loss	Equivalent to Sound Transmission Loss and to Sound Reduction Index in terminology used in countries other than Australia. A formal test rating of sound transmission properties of any construction, by usually a wall, floor, roof etc. The transmission loss of all materials varies with frequency and may be determined by either laboratory or field tests. Australian Standards apply to test methods for both situations.

10 Appendix B – Noise Logging Results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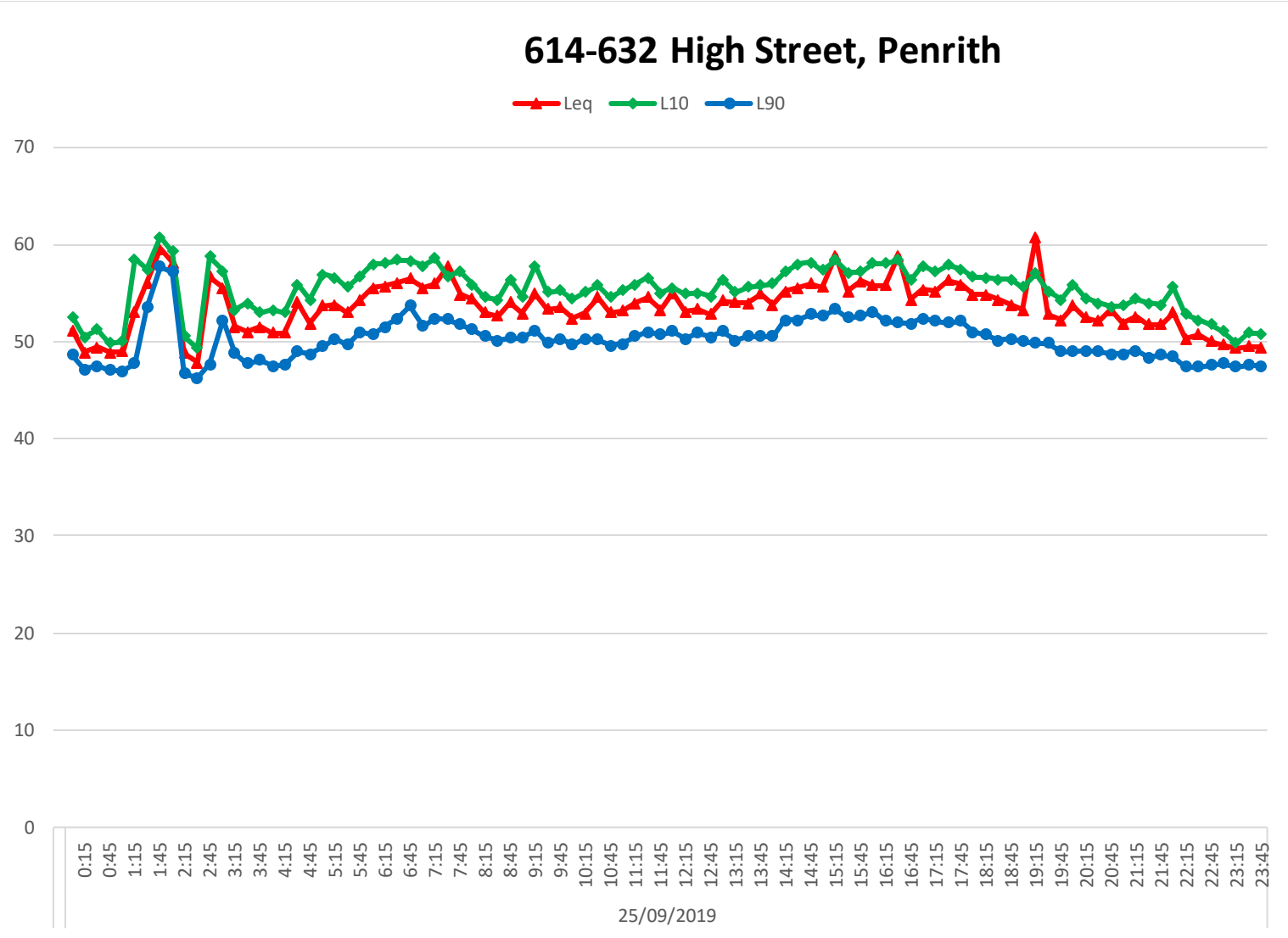
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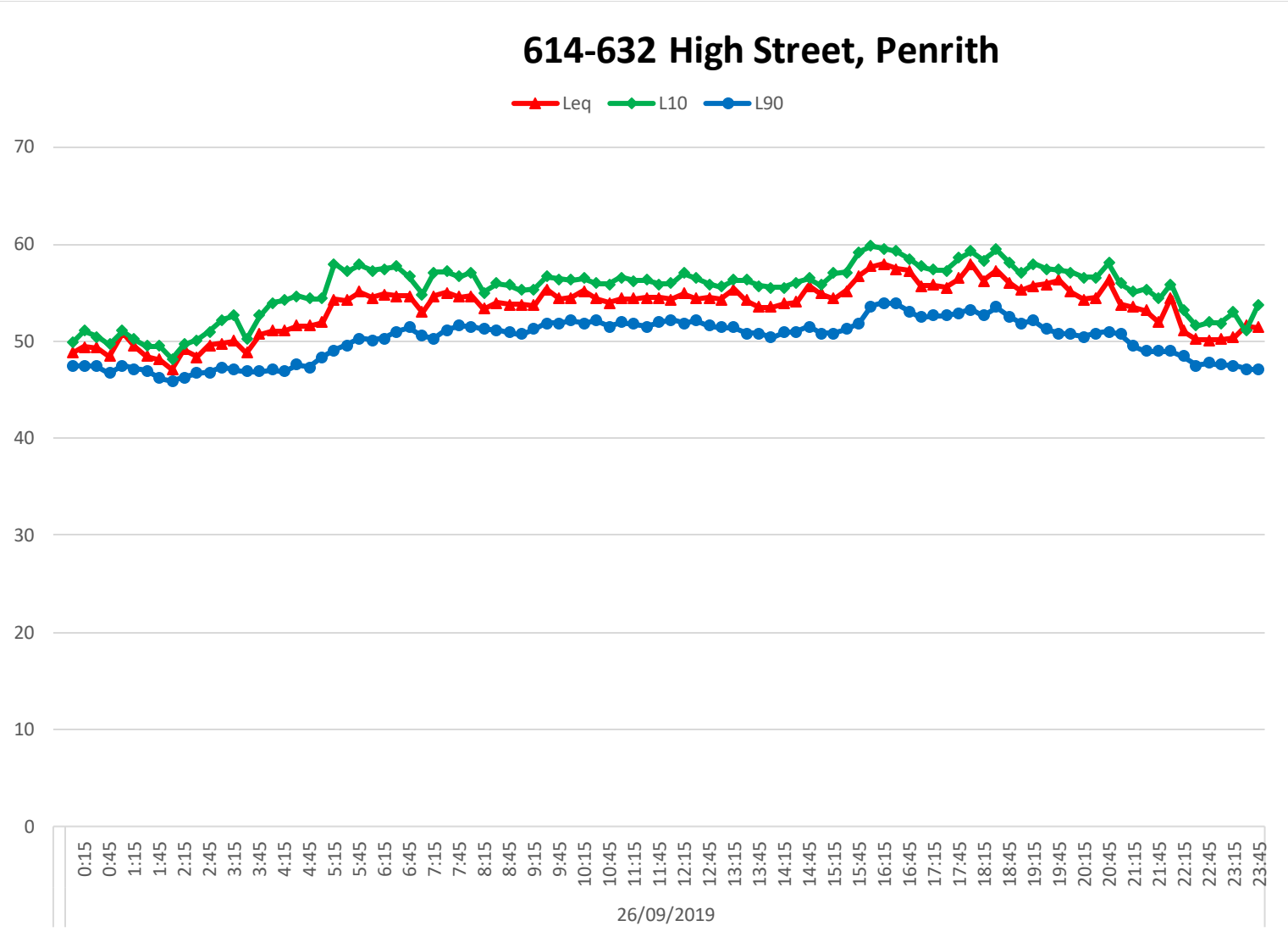
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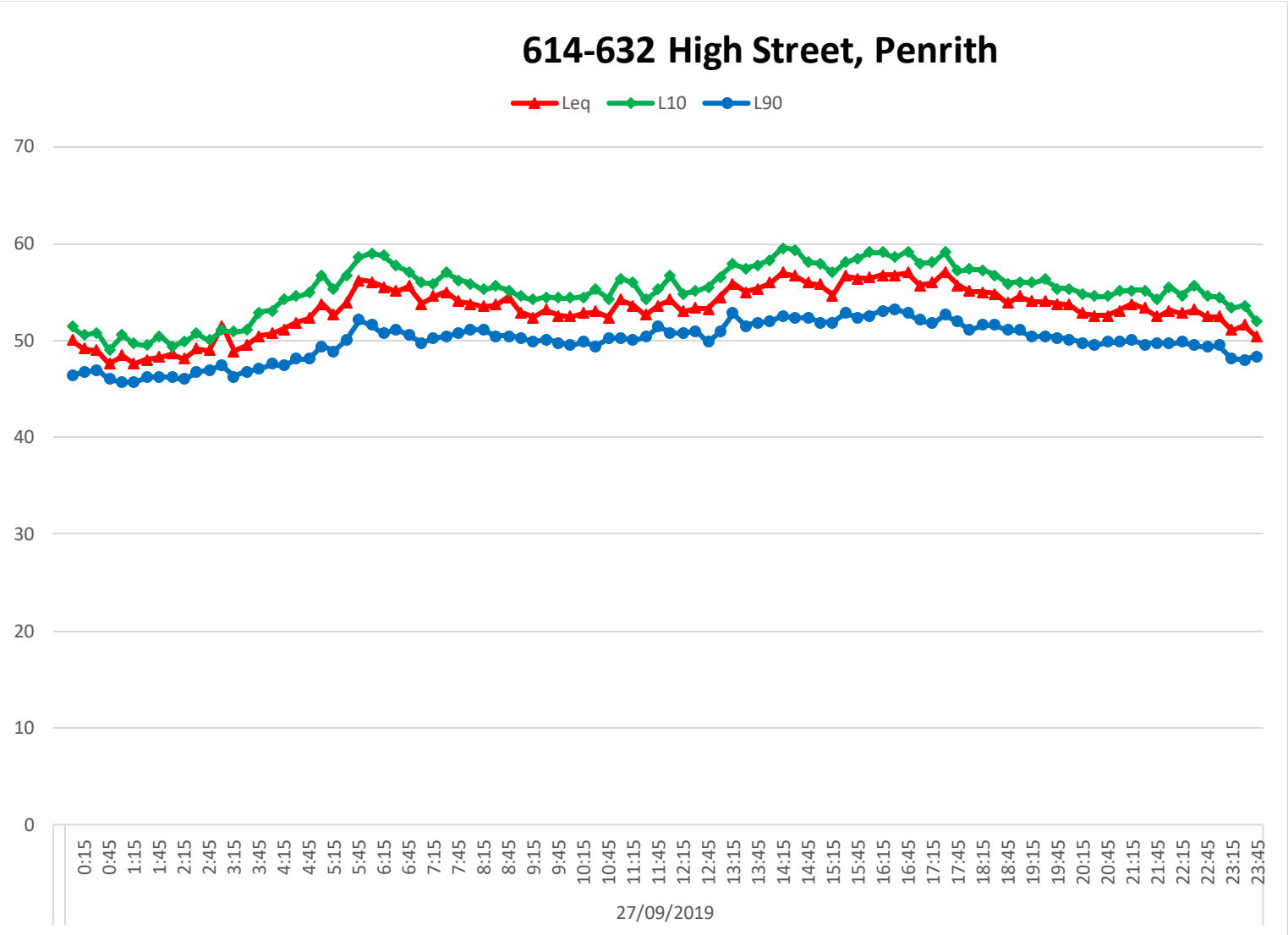
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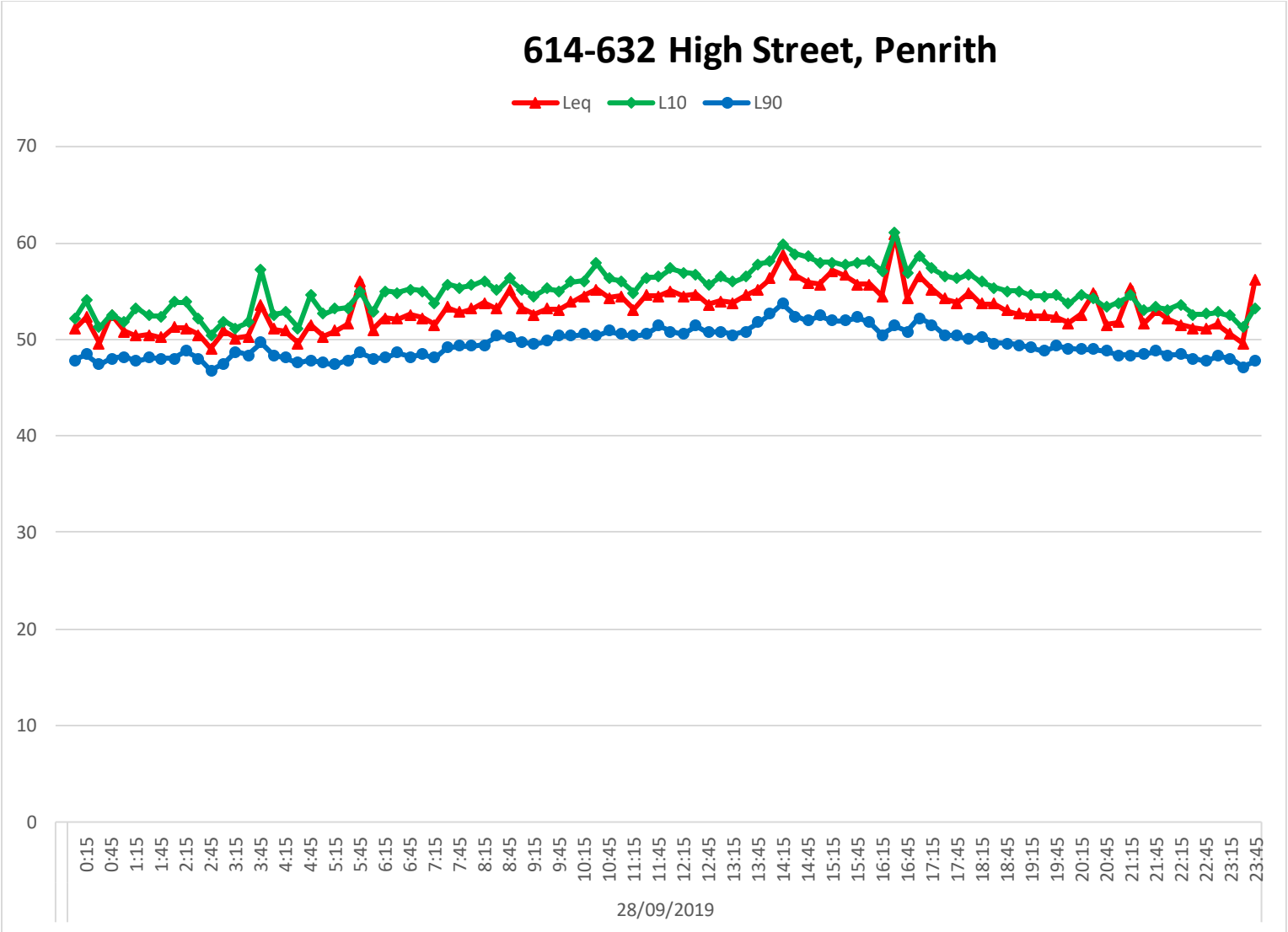
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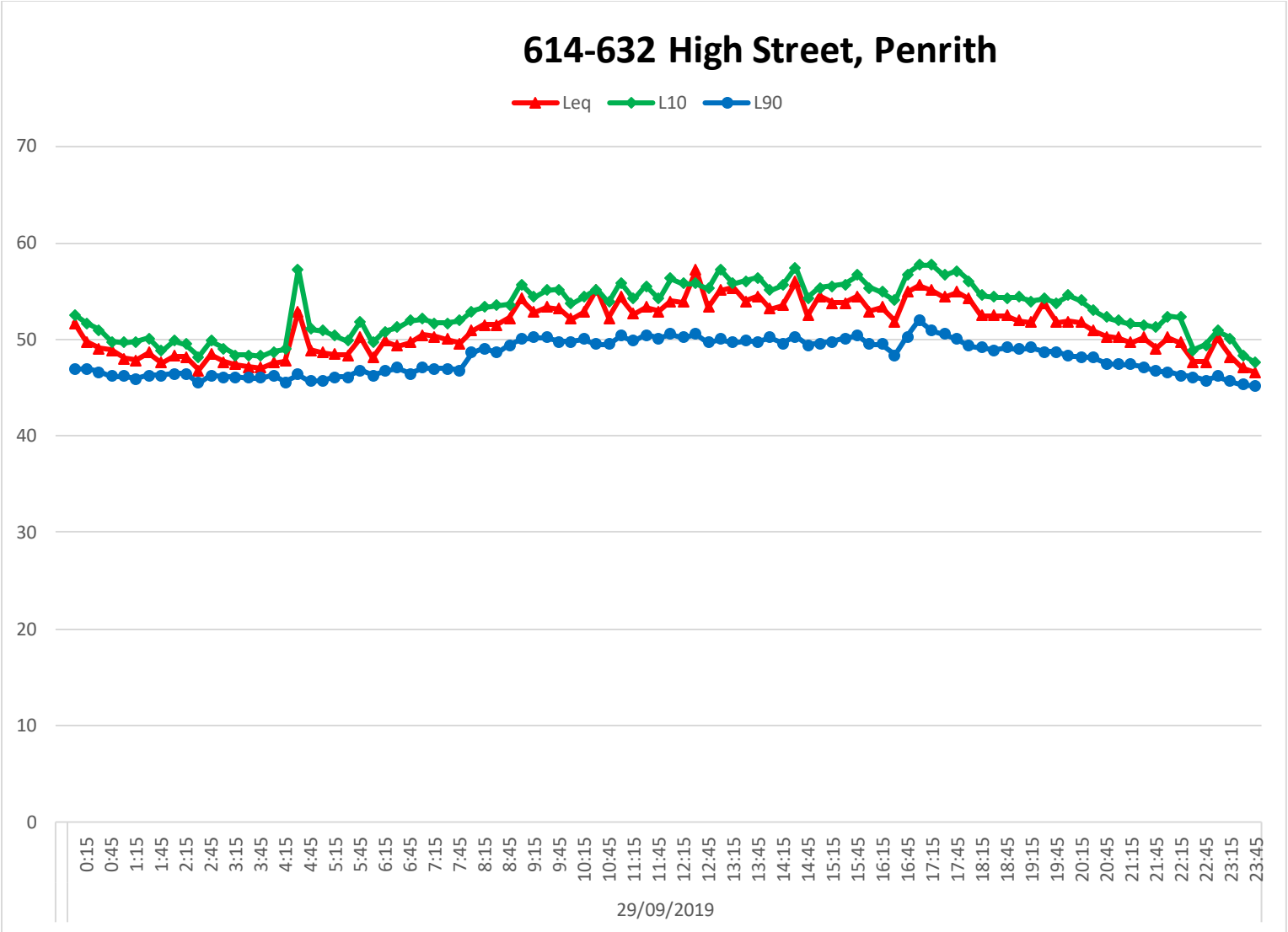
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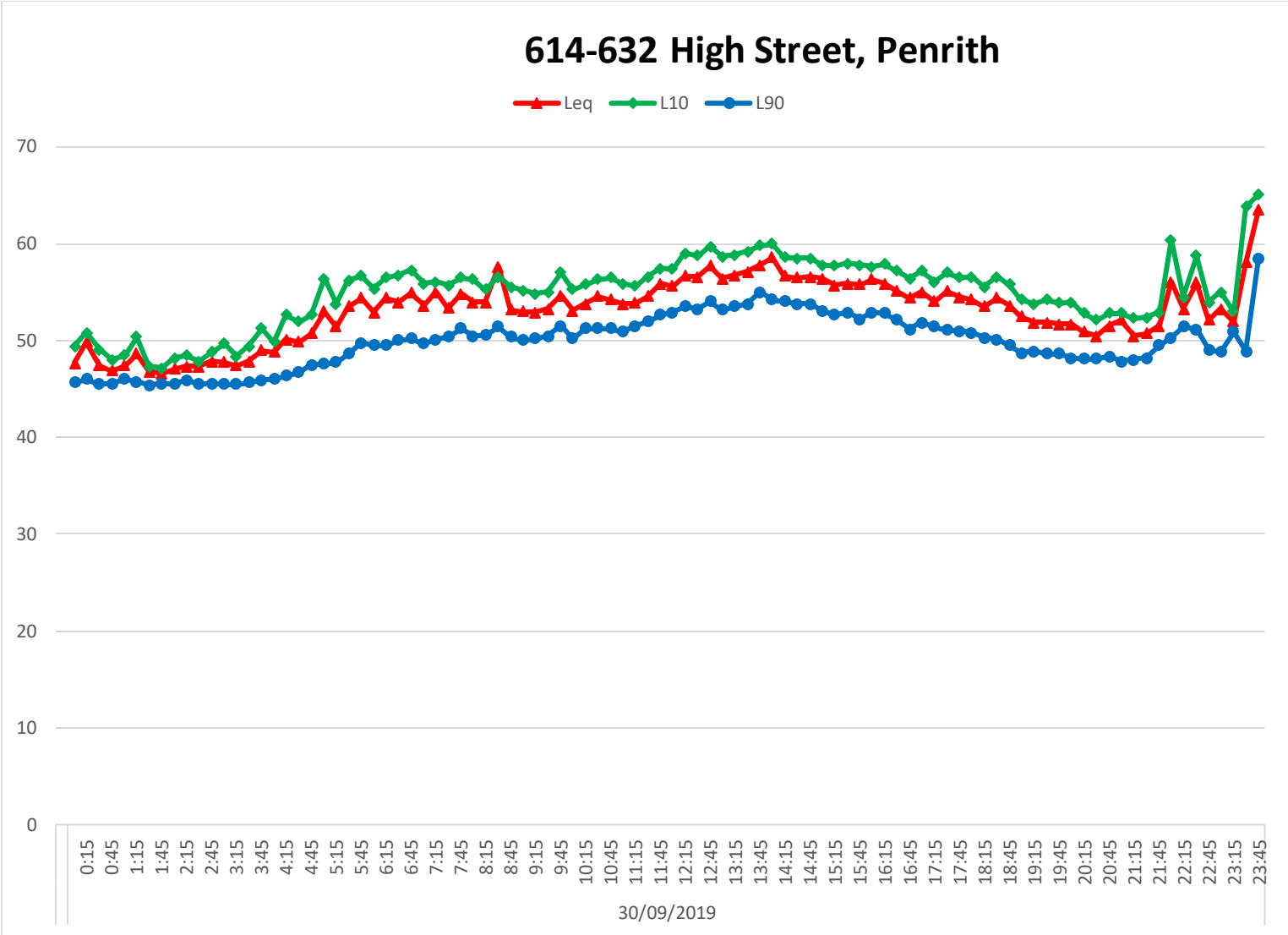
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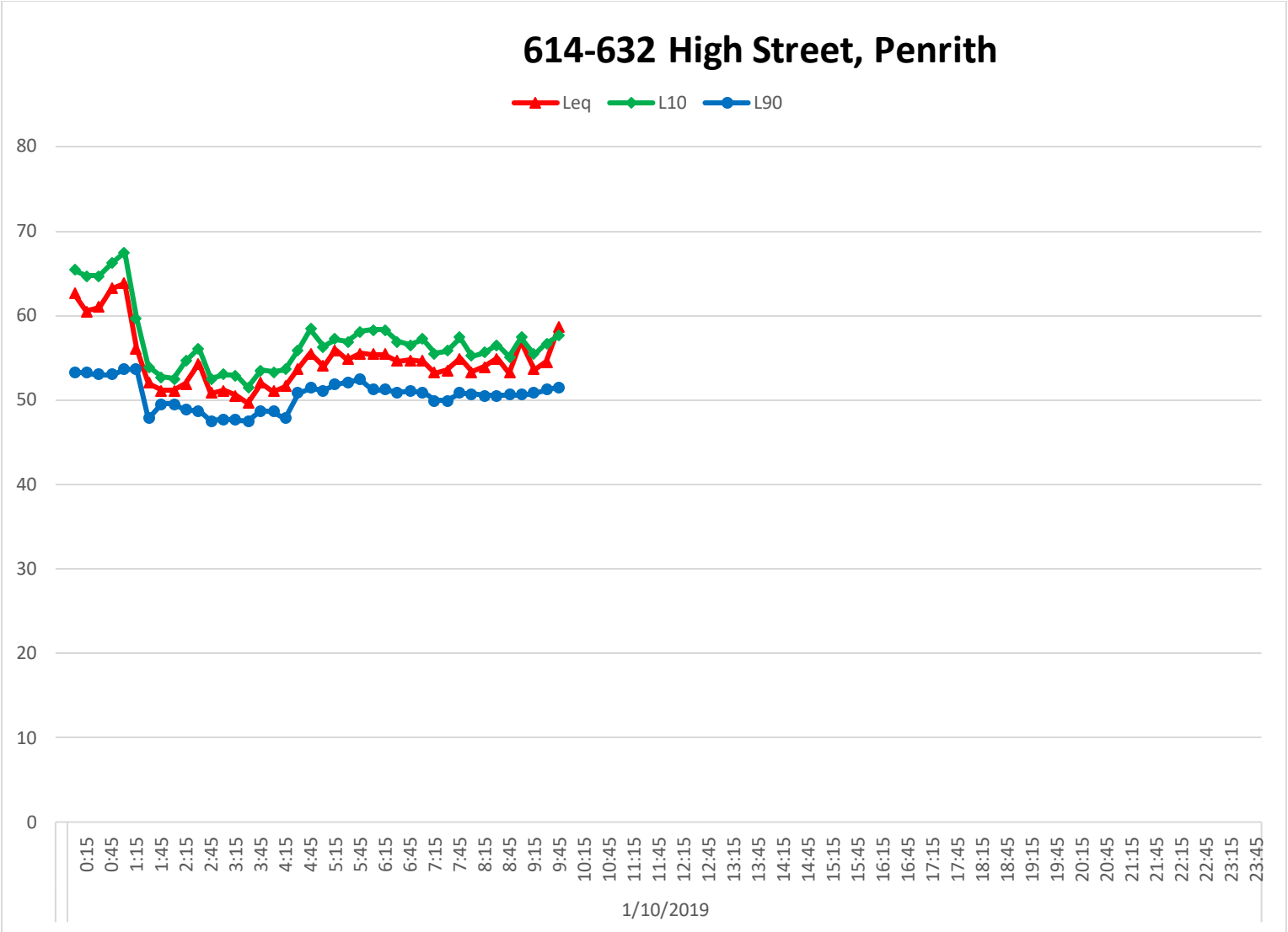
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