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SSDA Acoustic Assessment

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1 INTRODUCTION

Acoustic Logic (AL) has been engaged to conduct an acoustic assessment of potential noise and vibration impacts associated with the proposed development at 11-13 Percy Street, Auburn.

In accordance with the SEARs issued for SSD 10470, this document addresses noise impacts associated with the following:

- Noise intrusion to project site from adjacent roadways; and
- Noise emissions from mechanical plant to service the project site (in principle).

A separate Preliminary Construction Noise and Vibration Management Plan has been prepared to address the following in accordance with the SEARs:

- All potential noise and vibration sources during the construction and operational phases of the development, including on and off-site traffic noise, and
- Details of noise mitigation, management and monitoring measures.

AL have utilised the following documents and regulations in the noise assessment of the development:

- Cumberland City Council Advice Letter dated 25th June 2020
- Cumberland City Council – '*Auburn Development Control Plan 2010*'
- NSW Planning SEARs document (Ref: SSD-10470) dated 30th June 2020
- Australian Standard AS2107:2016 – '*Recommended Design Sound Levels and Reverberation Times for Building Interiors*' and
- NSW Department of Environment and Heritage, Environmental Protection Agency document – '*Noise Policy for Industry*' (NPI) 2017
- German Standard DIN 4150-3 (1999-02), and
- NSW Environmental Protection Authority (EPA) document – '*Assessing Vibration – A Technical Guideline.*'

This assessment has been conducted using the Nettleton Tribe architectural drawings (project no. 11250) dated 27/05/2020 for D.A Submission.

2 SITE DESCRIPTION

The proposed development comprises of two floors of industrial warehouse, small associated offices, two storeys of car/ van parking, a loading dock area for outbound vans on the western façade and a loading dock for inbound articulated trucks on the eastern façade.

Investigation has been carried out by this office in regards to the existing properties and noise impacts surrounding the proposed development, which is detailed below:

- Existing residential blocks to the west along St Hillers Road, and
- Existing industrial receivers bound the site on all sides.

The nearest noise receivers around the site include:

- **R1**: Residential Receiver 1 – Multi storey residential dwellings to the west and south west at 30-80 St Hillers Road, Auburn.
- **I1:** Industrial Receiver 1 – Multi storey industrial development to the west at 75-81 St Hillers Road, Auburn
- **I2:** Industrial Receiver 2 – Multi storey industrial development to the north at 15 Percy Street, Auburn
- **I3:** Industrial Receiver 3 – Multi storey industrial development to the east at 42 Boorea Street, Lidcombe
- **I4:** Industrial Receiver 4 – Multi storey industrial development to the south at 7-9 Percy Street, Auburn, and
- **I5:** Industrial Receiver 5 – Multi storey industrial development to the south-west at 57-73 St Hillers Road, Auburn and 42-58 Percy Street, Auburn.

It is noted that the worst affected residents in **R1** are located at 48-52 St Hilliers Road and 62 St Hilliers Road. Both addresses share line of sight to different portions of the proposed CFC frontage on Percy Street. In this regard, noise emissions predictions have been modelled to the façade or balcony of the worst affected residents at the respective addresses.

It is also noted that the worst affected façades of **I2** and **I4** are the façades facing Percy Street and the rear of the site (facing **I3**). The walls bounding the development site of the neighbouring industrial buildings are of concrete/ masonry construction with no glazed elements. As such, calculations have been made to the front and rear façades. Description of the industrial receiver definition can be found in Section 6.4.2.

A site map, measurement description and surrounding receivers are presented in Figure 1 below.

Figure 1 – Project Site
Source: NSW Six Maps

Project Site

Residential Receivers

Industrial Receivers

Commercial Receivers

Unattended Noise Monitor

Attended Measurements

3 NOISE DESCRIPTORS

Environmental noise constantly varies. Accordingly, it is not possible to accurately determine prevailing environmental noise conditions by measuring a single, instantaneous noise level.

To accurately determine the environmental noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In analysing environmental noise, three-principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}. The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the 15 minute period. L_{eq} is important in the assessment of environmental noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

The L_{max} parameter represents the loudest sound pressure level during the measurement period.

4 ENVIRONMENTAL NOISE SURVEY

NSW EPA's Rating Background Noise Level (RBL) assessment procedure requires determination of background noise level for each day (the ABL) then the median of the individual days as set out for the entire monitoring period.

Appendices in this report present results of unattended noise monitoring conducted at the project site. Weather affected data was excluded from the assessment. The processed RBL (lowest 10th percentile noise levels during operation time period) are presented in Table 4-1.

Measurement Position

One unattended noise monitor was located on the existing residential site at 56-60 Hillers Road, Auburn. Attended short term measurements of traffic noise were undertaken by this office to supplement the unattended noise monitoring. Refer to Figure 1 for detailed location. Attended measurements were taken at 56-60 Hillers Road west of project site. The Sound level meter had an unobstructed view of traffic and was approximately 8m from the kerb. Refer to Figure 1 for detailed locations.

Measurement Period

Unattended noise monitoring was conducted from Friday 26th of June 2020 to Friday 10th of July 2020. Attended noise measurements were undertaken between the hours of 4:00pm and 5:00pm on Friday 10th of June 2020.

Measurement Equipment

Equipment used consisted of an Acoustic Research Laboratories Pty Ltd noise logger. The logger was set to A-weighted fast response and was programmed to store 15-minute statistical noise levels throughout the monitoring period. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted. Noise logger data is provided in Appendix 1 – Unattended Noise Monitoring. Measurements were conducted using a Norsonic 140 Sound Analyser. The analyser was set to fast response and calibrated before and after the measurements using a Norsonic Sound Calibrator type 1251. No significant drift was noted.

4.1 SUMMARISED MEASURED NOISE LEVELS

Summarised rating background noise levels for the project site and immediate surroundings are presented below.

Table 4-1 – Measured Rating Background Noise Levels (RBL)

Monitor	Time of day	Rating Background Noise Level $dB(A)_{L90(Period)}$
56-60 St Hillers Road, Auburn	Early Morning Shoulder (5am – 7am)	57
	Day (7am – 6pm)	60
	Evening (6pm – 10pm)	56
	Night (10pm – 7am)	46

Table 4-2 – Measured Traffic Noise Levels

Location	Time of Day	Noise Level – L_{eq}
56-60 Hillers Road, Auburn	Day (7am – 6pm)	72 dB(A) $L_{eq\ (11hr)}$
	Evening (6pm – 10pm)	71 dB(A) $L_{eq\ (4hr)}$
	Night (10pm – 7am)	69 dB(A) $L_{eq\ (9hr)}$

Periods of adverse weather that were determined to have affected the noise data have been eliminated when determining the rating background noise level at the site, which is presented above.

5 EXTERNAL NOISE INTRUSION ASSESSMENT

Site investigation indicates that the major external noise sources around project site are from traffic movements along St Hillers Road, to the western boundary of the site.

5.1 NOISE INTRUSION CRITERIA

A noise intrusion assessment has been conducted based on the requirements of the following acoustic noise criteria and standards:

- Cumberland City Council – '*Auburn Development Control Plan 2010*';
- Australian Standard AS2107:2016 – '*Recommended Design Sound Levels and Reverberation Times for Building Interiors.*'

5.1.1 Cumberland City Council – 'Auburn Development Control Plan 2010'

The Auburn Development Control Plan 2010 does not provide any specific criteria for noise intrusion into industrial or commercial dwellings. Therefore AS/NZS 2107:2016 will be adopted for the purposes of established noise intrusion criterion.

5.1.2 Australian and New Zealand AS/NZS 2107:2016 *'Recommended design sound levels and reverberation times for building interiors'*

AS2107:2016: Recommended design sound levels and reverberation times for building interiors specifies allowable internal noise levels for internal spaces within industrial buildings. Table 1, in Section 5 of AS2107:2016, gives the following maximum internal noise levels for commercial buildings and residential buildings near major roads.

Table 5-1 – Recommended Design Sound Levels

Space /Activity Type	Recommended Design Sound Levels
General Industrial Areas/ Warehouse	<60 dB(A)$L_{eq(when\ in\ use)}$
Private offices/Board and Conference Rooms	30-40 dB(A)$L_{eq(when\ in\ use)}$
General Office Areas	45-50 dB(A)$L_{eq(when\ in\ use)}$
Lunchrooms/break rooms	40-50 dB(A)$L_{eq(when\ in\ use)}$

5.1.3 Summarised External Noise Intrusion Criteria

The internal noise criteria adopted for each internal space is therefore summarised below based on the relevant State, Council and Australian Standard requirements.

Table 5-2 – Adopted Internal Noise Levels

Space / Activity Type	Required Internal Noise Level
General Industrial Areas/ Warehouse	60 dB(A)$L_{eq(when\ in\ use)}$
Private offices/Board and Conference Rooms	40 dB(A)$L_{eq(when\ in\ use)}$
General Office Areas	50 dB(A)$L_{eq(when\ in\ use)}$
Lunchrooms/break rooms	50 dB(A)$L_{eq(when\ in\ use)}$

5.2 RECOMMENDED CONSTRUCTIONS

Assessment of façade requirements to achieve required indoor noise levels has been undertaken. Dimensions of rooms, setbacks from roadways, window openings and floor areas have been used.

5.2.1 Glazed Windows and Doors

The following constructions are recommended to comply with the project noise objectives. Aluminium framed/sliding glass doors and windows will be satisfactory provided they meet the following criteria. All external windows and doors listed are required to be fitted with Q-lon type acoustic seals. (**Mohair Seals are unacceptable**).

Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable. The recommended constructions are detailed in Table 5-3.

Table 5-3 - Recommended Glazing Construction

Room	Glazing Thickness	Acoustic Seals
CFC Ground Office/Traffic Office	6mm Toughened	Yes
Driver breakroom	4mm Toughened	Yes
Open planned office areas L1 facing Percy Street and Boorea Street	6mm Toughened	Yes
Private offices/ Board and Conference Rooms L1 facing Percy Street	6mm Toughened	Yes
Private offices/ Board and Conference Rooms L1 facing Boorea Street	6.38mm Toughened	Yes

It is recommended that only window systems having test results indicating compliance with the required ratings obtained in a certified laboratory be used where windows with acoustic seals have been recommended.

In addition to complying with the minimum scheduled glazing thickness, the R_w rating of the glazing fitted into open-able frames and fixed into the building opening should not be lower than the values listed in Table 5-4 for all areas. Where nominated, this will require the use of acoustic seals around the full perimeter of open-able frames and the frame will need to be sealed into the building opening using a flexible sealant.

Table 5-4 - Minimum R_w of Glazing Assembly (with Acoustic Seals)

Glazing Assembly	Minimum R_w of Installed Window
6.38mm Laminated	33
6mm Toughened	29
4mm Toughened	27

Note: Façade constructions to be reviewed at CC stage based on construction drawings. The glazing types listed above are indicative and for authority approvals purposes only

5.2.2 External Roof/Ceiling Construction

External roof construction will be constructed from light wight elements, therefore; acoustic upgrading is required as per the below table.

Table 5-3 – External Light Weight Roof Construction

Space	Internal Lining	Truss System	External Lining
Private offices/ Board and Conference Rooms L1	1x13mm plasterboard	Minimum of 250mm truss with 75mm thick 11kg/m^3 glasswool insulation in cavity	0.56mm Metal Deck Roof
Open planned office areas L1	1x13mm plasterboard		
WC	1x10mm plasterboard		
Warehouse areas	1x10mm plasterboard		

In the event that any penetrations are required through the external skin, an acoustic sealant should be used to minimise all gaps.

5.2.3 External Wall Construction

The proposed external walls will be constructed from lightweight elements, these walls will require acoustic upgrading as per the below table. There should not be vents on the internal skin of external walls. All penetrations in the internal skin of external walls should be acoustically sealed.

Table 5-5 – External Light Weight Wall Construction

Area	Material
Open planned office areas (L1)	9mm fibre cement, 90mm stud with 75mm thick 11kg/m^3 glasswool insulation, 1x13mm plasterboard
Private Offices (Ground and L1)	9mm fibre cement, 90mm stud with 75mm thick 11kg/m^3 glasswool insulation, 1x13mm plasterboard
Lunchroom/ Break rooms	9mm fibre cement, 90mm stud with 75mm thick 11kg/m^3 glasswool insulation, 1x10mm plasterboard
Industrial/ Warehouse areas	0.5mm Metal Deck

6 NOISE EMISSION CRITERIA

The noise emission from the project site shall comply with the requirements of the following documents:

- Cumberland City Council Advice Letter dated 25th June 2020
- NSW Planning SEARs document (Ref: SSD-10470) dated 30th June 2020
- Cumberland City Council – '*Auburn Development Control Plan 2010,*' and
- NSW Department of Environment and Heritage, Environmental Protection Agency document – Noise Policy for Industry (NPI) 2017.

6.1 CUMBERLAND CITY COUNCIL ADVICE LETTER

Part 9 of the Cumberland City Council Advice Letter dated 25th June 2020 states the following in regard to noise emissions from the proposed site:

> 9. **Assessment of the cumulative noise impact from 24/7 operation of the facility including mechanical plant, vehicle/truck movements within site, delivery and receiving docks, and contribution to traffic noise on nearby roads from increased vehicle movements to and from the site will need to be undertaken. The assessment should be included in the EIS.**

6.2 NSW PLANNING SEARS DOCUMENT (REF: SSD-10470)

Part 9 of the NSW Planning Secretary's Environmental Assessment Requirements (Application SSD-10470) dated 30th June 2020 states the following in regard to noise emissions from the proposed site:

> 9. **Noise and Vibration** – including:
>
> · a description of all potential noise and vibration sources during the construction and operational phases of the development, including on and off-site traffic noise
>
> · a cumulative noise impact assessment of all potential noise sources in accordance with relevant Environment Protection Authority guidelines
>
> · details of noise mitigation, management and monitoring measures.

6.3 AUBURN DEVELOPMENT CONTROL PLAN 2010

The Cumberland City Council – '*Auburn Development Control Plan 2010*' details the following criterion regarding noise emissions from an industrial site:

8.2 Noise

Performance criteria

P1 Development minimises the possibility of noise to the occupants of adjoining or neighbouring dwellings. The use of premises, any plant, equipment and building services associated with a premise does not create an offensive noise or add significantly to the background noise level of a locality.

P2 Where practicable, sources of noise such as garbage collection, machinery, parking areas and air conditioning plants are sited away from adjoining properties and, where necessary screened by walls or other acoustical treatment.

Development controls

D1 All development applications for potential noise generating industries adjacent to residential zoned land shall be accompanied by relevant documentation from a qualified acoustic engineer. The documentation shall also comply with the relevant Acts, Regulations, Australian Standards and guidelines by the NSW Department of Environment, Climate Change and Water (DECCW) below, as applicable for noise, vibration and quality assurance.

- NSW Industrial Noise Policy
- Interim Construction Noise Guideline
- Noise from Rail Infrastructure Projects
- Environmental Criteria for Road Traffic Noise.

As the Auburn Development Control Plan 2010 does not specify any quantitative noise emission data, the NSW EPA Noise Policy for Industry (NPI) 2017 will be adopted.

6.4 NSW EPA NOISE POLICY FOR INDUSTRY (NPI) 2017

The EPA NPI has two criteria which both are required to be satisfied, namely Intrusiveness and amenity. The NPI sets out acceptable noise levels for various localities. The policy indicates four categories to assess the appropriate noise level at a site. They are rural, suburban, urban and urban/industrial interface. Under the policy the nearest residential receivers would be assessed against the urban criteria.

Noise levels are to be assessed at the property boundary or nearby dwelling, or at the balcony or façade of an apartment.

6.4.1 Intrusiveness Level

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

Background noise levels adopted are presented in Table 4-1. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

6.4.2 Project Amenity Level

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

Where land is zoned for industrial use according to the LEP for the area, the NPI suggests adoption of the industrial amenity level. This includes isolated residents located within industrial land zones, however it is noted that this is not applicable in this case.

The EPA's NPI sets out acceptable noise levels for various localities. The recommended noise amenity area is based upon a number of factors, including the measured noise levels at the sensitive receiver. Based on the relevant amenity levels for the resident and traffic noise levels detailed in Table 4-2, the Noise Policy for Industry suggests the adoption of the amenity noise levels in areas of high traffic noise.

Section 2.4.1 of the NPI notes the following:

> *The level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the L_{Aeq} noise level from that industrial noise source may exceed the project amenity noise level. In such cases the project amenity noise level may be derived from the $L_{Aeq,\ period(traffic)}$ minus 15 dB(A).*

The NPI also suggests the project amenity noise levels to be adjusted from a period measurement to a 15-minute interval in line with the intrusiveness goal as shown below:

> $L_{Aeq,15min}$ = *Recommended Amenity Noise Level + 3 dB(A)*

The amenity levels appropriate for the receivers surrounding the site are presented in Table 6-1 and Table 6-2.

Table 6-1 – EPA Amenity Noise Levels

Type of Receiver	Time of day	Traffic Noise Level dB(A)$L_{eq(period)}$	Recommended Amenity Noise Level dB(A)$L_{eq(period)}$	High Traffic Amenity Noise Level dB(A)$L_{eq(period)}$	Project Amenity Noise Level dB(A)$L_{eq(15\ minute)}$
Residential – Highly Traffic Noise Affected	Day	72	60	57	**60**
	Evening	71	50	56	**59**
	Night	69	45	54	**57**

Table 6-2 – EPA NPI Noise Emission Criteria (Non-Residences Surrounding Project Site)

Type of Receiver	Time of day	Recommended Noise Level dB(A)$L_{eq(period)}$
Industrial premises	When in use	70

The NSW EPA Noise Policy for Industry (2017) defines:

- Day as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays.
- Evening as the period from 6pm to 10pm.
- Night as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays

6.4.3 Sleep Arousal Criteria

The Noise Policy for Industry recommends the following noise limits to mitigate sleeping disturbance:

Where the subject development / premises night -time noise levels at a residential location exceed:

- *$L_{eq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
- *L_{Fmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*

a detailed maximum noise level even assessment should be undertaken.

Table 6-3 – Sleep Arousal Criteria for Residential Receivers

Receiver	Rating Background Noise Level (Night) dB(A)L_{90}	Emergence Level
Residences Surrounding Site Night (10pm – 5am)	46 dB(A) L_{90}	51 dB(A)$L_{eq,\ 15min}$; 61 dB(A)L_{Fmax}
Residences Surrounding Site Night (5am – 7am)	57 dB(A) L_{90}	62 dB(A)$L_{eq,\ 15min}$; 72 dB(A)L_{Fmax}

6.5 SUMMARISED NOISE EMISSION CRITERIA

Table 6-4 – EPA NPI Noise Emission Criteria (Residents Surrounding Project Site)

Time Period	Assessment Background Noise Level dB(A)L_{90}	Project Amenity Criteria dB(A) L_{eq}	Intrusiveness Criteria $L_{eq(15min)}$	NPI Criteria for Sleep Disturbance
Early Morning (5am – 7am)	57	**57**	62	**62 dB(A)$L_{eq, 15min}$; 72 dB(A)L_{Fmax}**
Day (7am – 6pm)	60	**60**	65	N/A
Evening (6pm – 10pm)	56	**59**	61	N/A
Night (10pm – 5am)	46	57	**51**	**51 dB(A)$L_{eq, 15min}$; 61 dB(A)L_{Fmax}**

The project noise trigger levels are indicated by the bolded values in the table above.

Table 6-5 – EPA NPI Noise Emission Criteria (Non-Residences Surrounding Project Site)

Type of Receiver	Time of day	Recommended Noise Level dB(A)$L_{eq(period)}$
Industrial premises	When in use	68

7 NOISE EMISSION ASSESSMENT

7.1 NOISE FROM MECHANICAL PLANT WITHIN PROPOSED SITE GENERALLY

Detailed plant selection and location has not been undertaken at this stage. Satisfactory levels will be achievable through appropriate plant selection, location and if necessary, standard acoustic treatments such as duct lining, acoustic silencers and enclosures.

Noise emissions from all mechanical services to the closest residential and commercial receivers should comply with the requirements of Section 6.5. It should be noted that the closest noise affected receivers are industrial blocks located along the northern and southern boundaries of the site at **I2** and **I4**.

Detailed acoustic review should be undertaken at CC stage to determine acoustic treatments to control noise emissions to satisfactory levels.

7.1.1 Preliminary Mechanical Treatment Advice

An indicative assessment of initial design of primary plant items is presented below.

- Generators may be used for standby power, these may require attenuation to radiators and air intakes, as well as silencers/mufflers to the exhaust.
- Refrigeration equipment:
    - Refrigeration compressors are recommended to be located within enclosure plant rooms.
    - Locate refrigeration condensers as far as practicable from adjacent noise sensitive development. Noise screening (using either a dedicated noise screen or the building shell between the condensers and noise sensitive buildings).
    - Night time operational speeds may need to be restricted.
- Major fans (typically with a sound power over 80dB(A) – such as kitchen exhaust, major toilet exhaust and major relief air fans) may require acoustic treatment if located externally near sensitive receivers. It is recommended that axial (as opposed to roof mounted fans) are to be used as this will enable acoustic treatment to be incorporated within ductwork running to atmosphere and with attenuators if necessary. Indicatively a one diameter long attenuator or with 2m of internally lined ductwork.
- The indicative location of external PAC units is spaced around the warehouse roof. Conservative calculation with a sound power up to 90 dB(A) shows compliance with noise emission levels through the erection of an acoustic barrier facing commercial receivers to break line of sight.
- The indicative location of air-cooled chillers will be above the office building. Conservative calculation with a sound power up to 90 dB(A) shows compliance with noise emission levels through the erection of an acoustic barrier facing residential receivers to break line of sight. This includes replacing sections of louvred surfaces in the rooftop plant room with imperforate walls.

Cumulative assessment of both plant noise with other noise sources is recommended when conducting acoustic design of plant items.

Compliance with EPA acoustic criteria (as set out in Section 6.5) will be achievable, provided that detailed acoustic review of plant items is undertaken once plant is selected, and acoustic treatments similar to those outlined above are adopted. **Detailed acoustic review should be undertaken at CC stage to determine acoustic treatments to control noise emissions to satisfactory levels**.

7.2 OPERATIONAL NOISE SOURCES

Assessment of operational noise emissions have been modelled with the following delineations:

1. Noise emissions from articulated trucks entering and/or exiting the driveway for inbound deliveries to the rear loading dock.

2. Noise emissions from articulated trucks manoeuvring at the rear loading dock, including reversing manoeuvres.

3. Noise emissions from outbound delivery vans (small rigid vehicles) manoeuvring in the loading dock fronting Percy Street.

4. Noise emissions from outbound delivery vans (small rigid vehicles) manoeuvring to park.

5. Noise emissions from staff parking vehicles manoeuvring in the second floor carpark.

Each individual noise source with their indicative source area has been marked in Figure 2 below as sources 1 to 5 respectively. The cumulative noise from all operational sources is presented in the following sections, based on the proposed operating scenarios.

Figure 2 – Noise Sources
Source: NSW Six Maps

Development Envelope

Source 1 – Heavy Truck Entry Driveway

Source 2 – Rear Loading Dock Activity

Source 3 – Delivery Van/ Medium Truck Loading Dock

Source 4 – Delivery Van / Medium Truck Parking & Driveway

Source 5 – Staff Parking Facilities (Elevated)

7.3 OPERATIONAL ASSUMPTIONS

7.3.1 Typical Movements from Woolworths Operational History

Woolworths has provided the following information from typical operational usage of currently operational Customer Fulfilment Centres (CFC's):

- Expected truck/ vehicle movements in typical operation during all time periods, in particular expected movements between 10pm and 7am.
    - Between 10pm and 5am an estimated 60 delivery vans returning. These vans will return to allocated parking areas with no further loading during this time.
    - Between 5am and 7am there will be 4 delivery waves (1 wave every 30 minutes starting at 5am, assuming 28 vans per wave at peak). This mean ~112 delivery vans leaving the CFC. The same number or drivers will be arriving at the facility. Assuming 30% use of public transport, approximately 78 passenger vehicles will arrive to the facility over the two hour peak period.
    - Between 10pm and 7am approximately 5 to 7 inbound truckloads are expected.
    - Between 10pm and 7am we should expect one shift change, this mean ~100 team members will be arriving and leaving the facility (Assuming 30% use of public transport)
- At peak time 28 vans are expected to be loaded simultaneously. Estimated loading time 30 minutes.

7.3.2 Noise Emissions from the Staff Carpark

Assessment of the carpark noise emissions has been undertaken based on the traffic trip generation information provided in the traffic report for the development prepared by Colston Budd Rogers & Kafes (ref: 11555/3, dated September 2020). The traffic report gives an estimated 160 maximum vehicle movements during AM and PM peak hour for two-way movement, further split into a delineation of 120 cars and 40 delivery vans. Calculations have been made to predict noise levels occurring at surrounding noise sensitive receivers during a 15-minute peak of traffic movements, with the worst affected residential receiver being the residential receiver **R1** along St Hilliers Road.

The following noise level data for vehicle-related noise sources have been used for the assessment. These noise levels have been taken from measurements by this office and from the US FHWA-TNM Technical Model 3.0, specifically the A-weighted sound pressure levels measured at 15 metres of vehicles at cruise throttle on average pavement. Noise levels below have been corrected for a sound power level, which was used for the assessment.

Table 7-1 – Sound Power Levels of Typical Automotive Movements

Automotive Movements	Sound Power Level, dB(A)	Noise Characteristic	Applied Noise Source
Automobile Manoeuvring @ 0-20km/h	84 L_{eq}	Quasi-steady	Passenger Vehicles to Carpark
Medium Truck @ 0-20km/h	100 L_{eq}	Quasi-steady	Home Delivery Vans
Heavy Truck @ 0-20km/h	106 L_{eq}	Quasi-steady	Inbound Heavy Vehicles
Truck Engine Starting	100 L_{max}	Instantaneous	Home Delivery Vans
Car Door Slamming	96 L_{max}	Instantaneous	Passenger Vehicles to Carpark
Car Starting	91 L_{max}	Instantaneous	Passenger Vehicles to Carpark

The US FHWA-TNM Technical Model 3.0 delineates each vehicle type per the following:

- *Automobiles: all vehicles having two axles and four tires – designated primarily for transportation of nine or fewer passengers, i.e., automobiles, or for transportation of cargo, i.e., light trucks. Generally, the gross vehicle weight is less than 4500 kg (9900 lb).*
- *Medium trucks: all cargo vehicles with two axles and six tires. Generally, the gross vehicle weight is greater than 4,500 kg (9,900 lb), but less than 12,000 kg (26,400 lb).*
- *Heavy trucks: all cargo vehicles with three or more axles. Generally, the gross vehicle weight I greater than 12,000 kg (26,400 lb).*

For the purpose of streamlining definitions, large articulated vehicles are to be defined as heavy trucks, small rigid trucks are to be defined as medium trucks, and cars and vans are to be defined as automobiles per the definitions above.

7.3.3 Noise Emissions from Site Loading/Truck Movements

The primary noise associated with the use of the loading dock will consist of medium and heavy trucks moving into or out of their respective loading bays. 7 large articulated vehicle loading bays are located on the eastern façade with 28 small rigid truck loading bays along the western façade of the development.

The most noise intensive use of the site occurs during the loading and entering/exiting of home delivery vehicles from the western loading dock, particularly during the early morning period (5am – 7am). Noise emission predictions during this time at the nearby development will be made based on the following data/assumptions:

- Automobile, medium and heavy truck sound power levels as defined in Table 7-1 travelling at ≤ 20 km/h.
- Reversing manoeuvres will add an additional 5 dB penalty to the sound power levels of trucks in line with Factsheet C of the NSW EPA Noise Policy for Industry. We note that an intermittent penalty is not required to be added to the predicted noise level.
- Heavy truck reversing manoeuvres will take no longer than 30 seconds and medium truck reversing manoeuvres will take no longer than 10 seconds per truck based on swept path distances presented in the traffic report.
- 54 medium truck (delivery van) movements are expected during peak loading periods (generally over a two hour time span), based on movements for similar Woolworths sites.

It is noted that the traffic report states that 10-15 inbound deliveries are expected per day, with these deliveries being made with heavy trucks (semi-trailers up to 20 metres long). For the purposes of this assessment, it has been assumed that there may be 1 semi-trailer movements in a given 15-minute period (i.e., one inbound or outbound movement).

For the assessment of sleep disturbance, peak noise levels from the site have been calculated from the staff carpark and home delivery van loading dock, being the closest unscreened locations to residential receivers.

7.4 CUMULATIVE PREDICTED NOISE EMISSIONS

7.4.1 SoundPlan Noise Modelling

Noise levels have been predicted at the receiver locations using SoundPlan™ modelling software implementing the ISO 9613-2:1996 "Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation" noise propagation standard.

Noise enhancing meteorological have been adopted as recommended by the NPI, noting that the ISO 9613 modelling approach assumes that all receivers are 'downwind' (i.e. that noise enhancing wind conditions are in effect at all times).

The following figures detail computational noise modelling for closest noise sensitive receivers and façades relating to the operational noise emissions of the site through the presentation of a façade noise map onto the respective buildings and a grid noise map at different elevations mapped to the ground model. Numerical results are presented in Section 7.4.2.

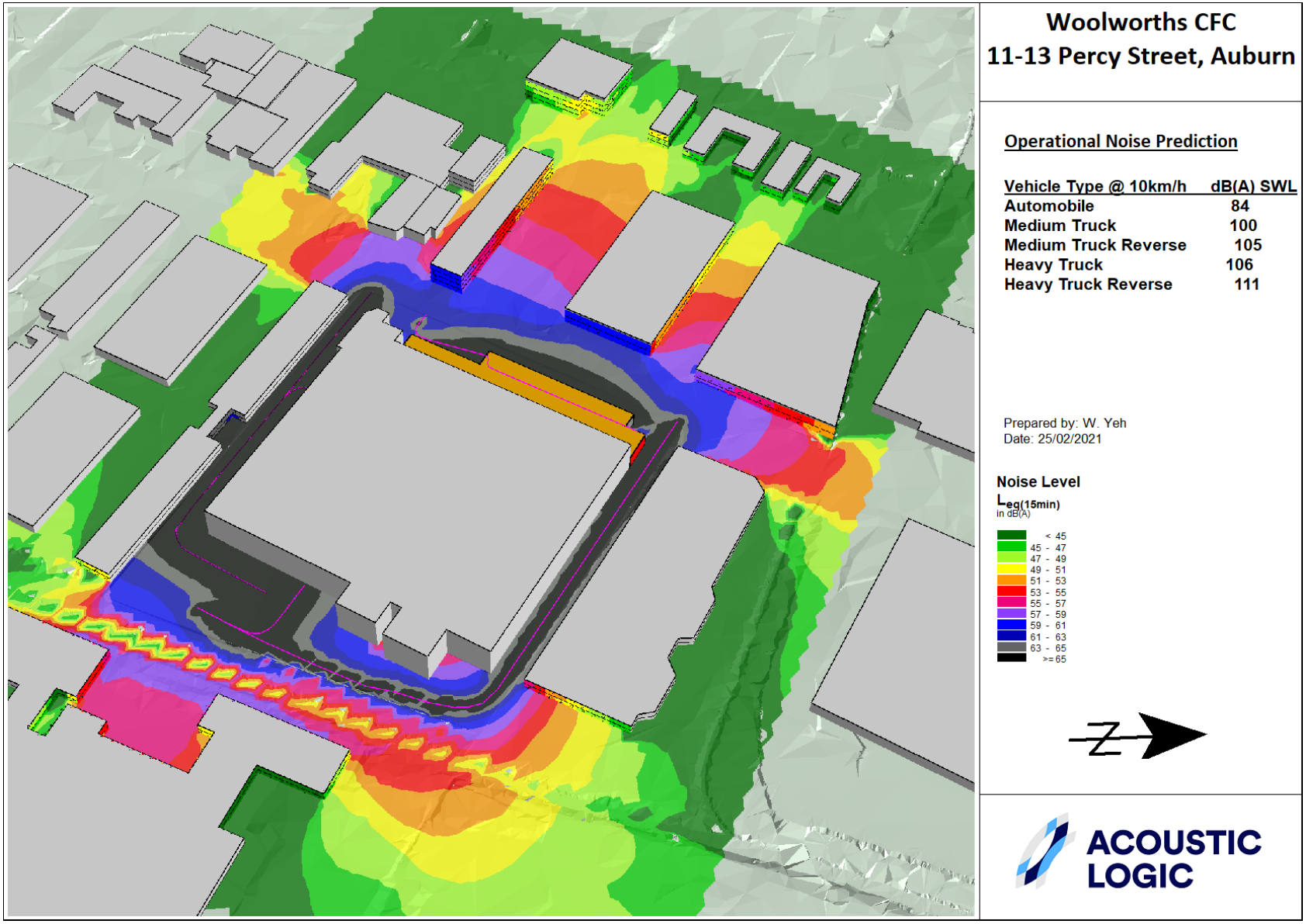


Figure 3 – Overall 3D View, Grid Noise Map at 1.5m

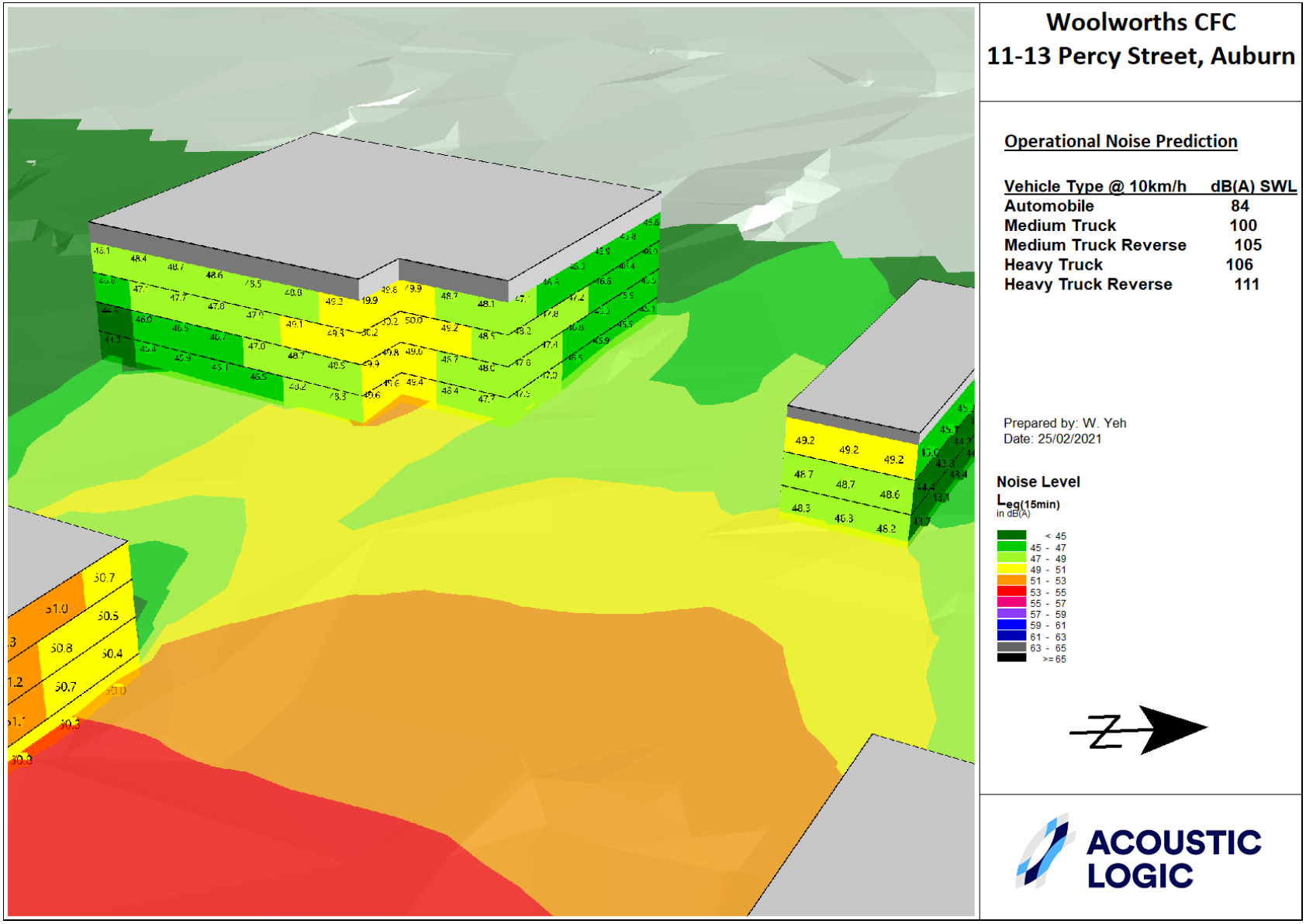


Figure 4 – 3D View of 52 and 54 St Hilliers Road, Grid Noise Map at 1.5m

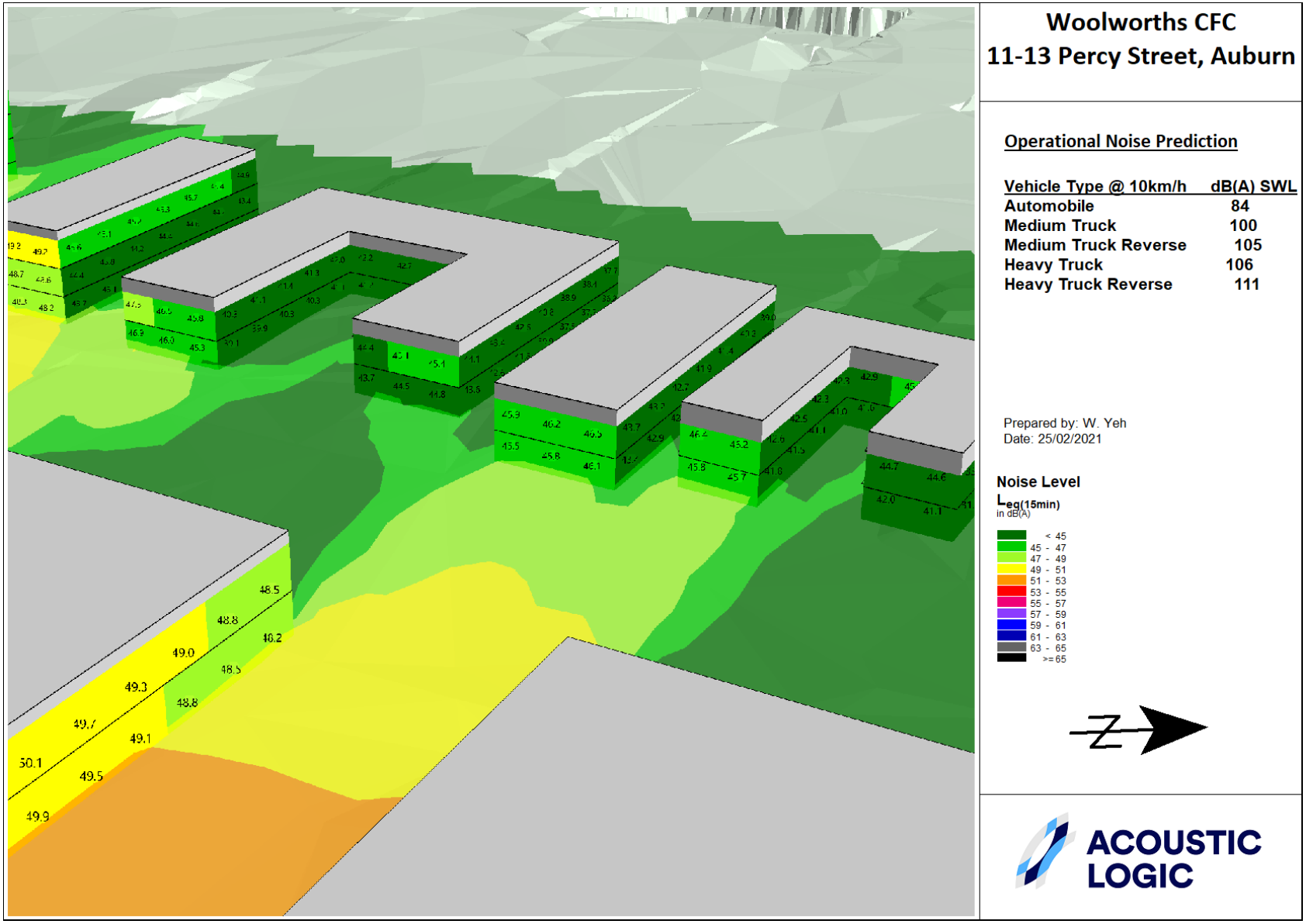


Figure 5 – 3D View of 54-66 St Hilliers Road, Grid Noise Map at 1.5m

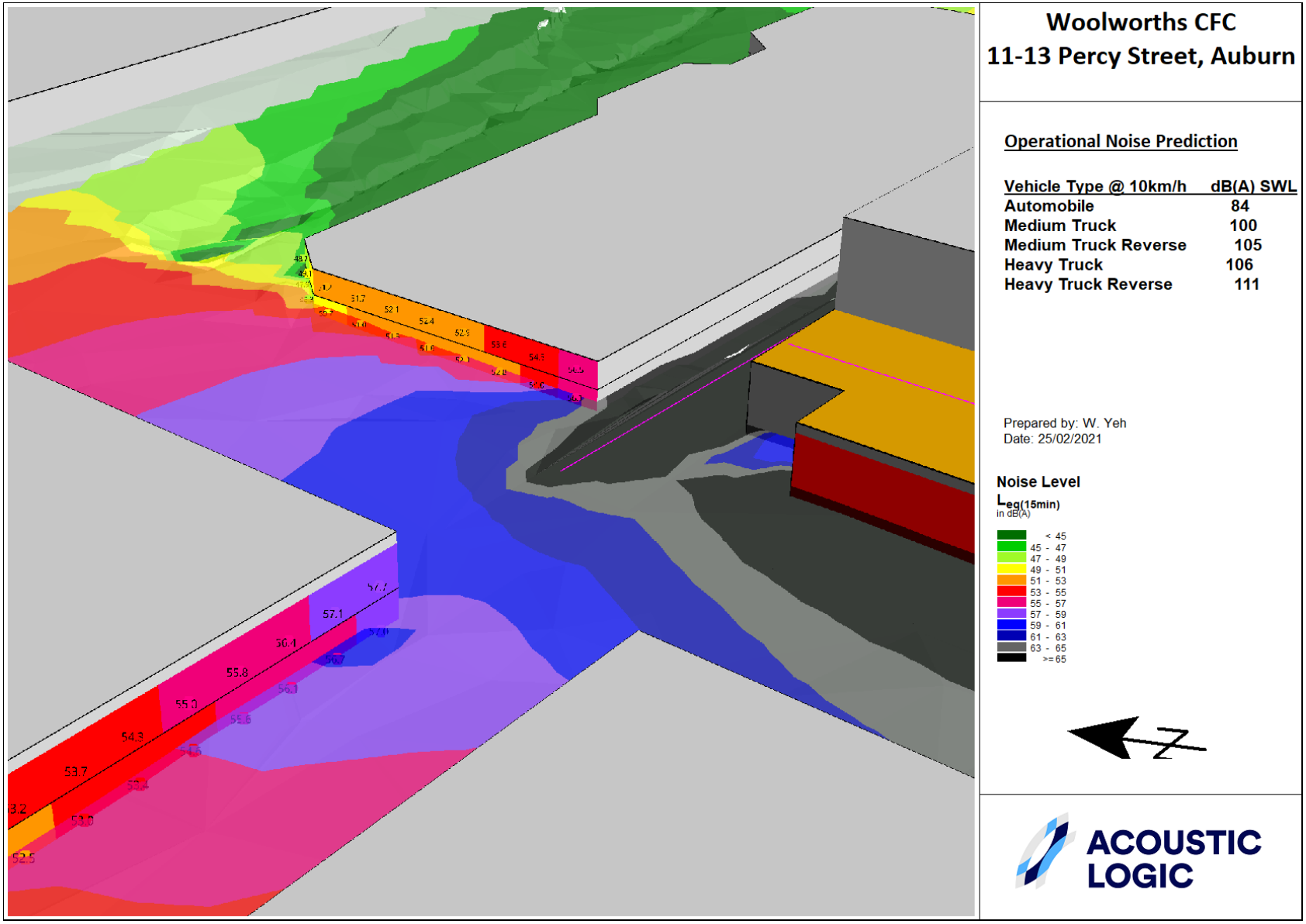


Figure 6 – 3D View of 15 Percy Street, Grid Noise Map at 1.5m

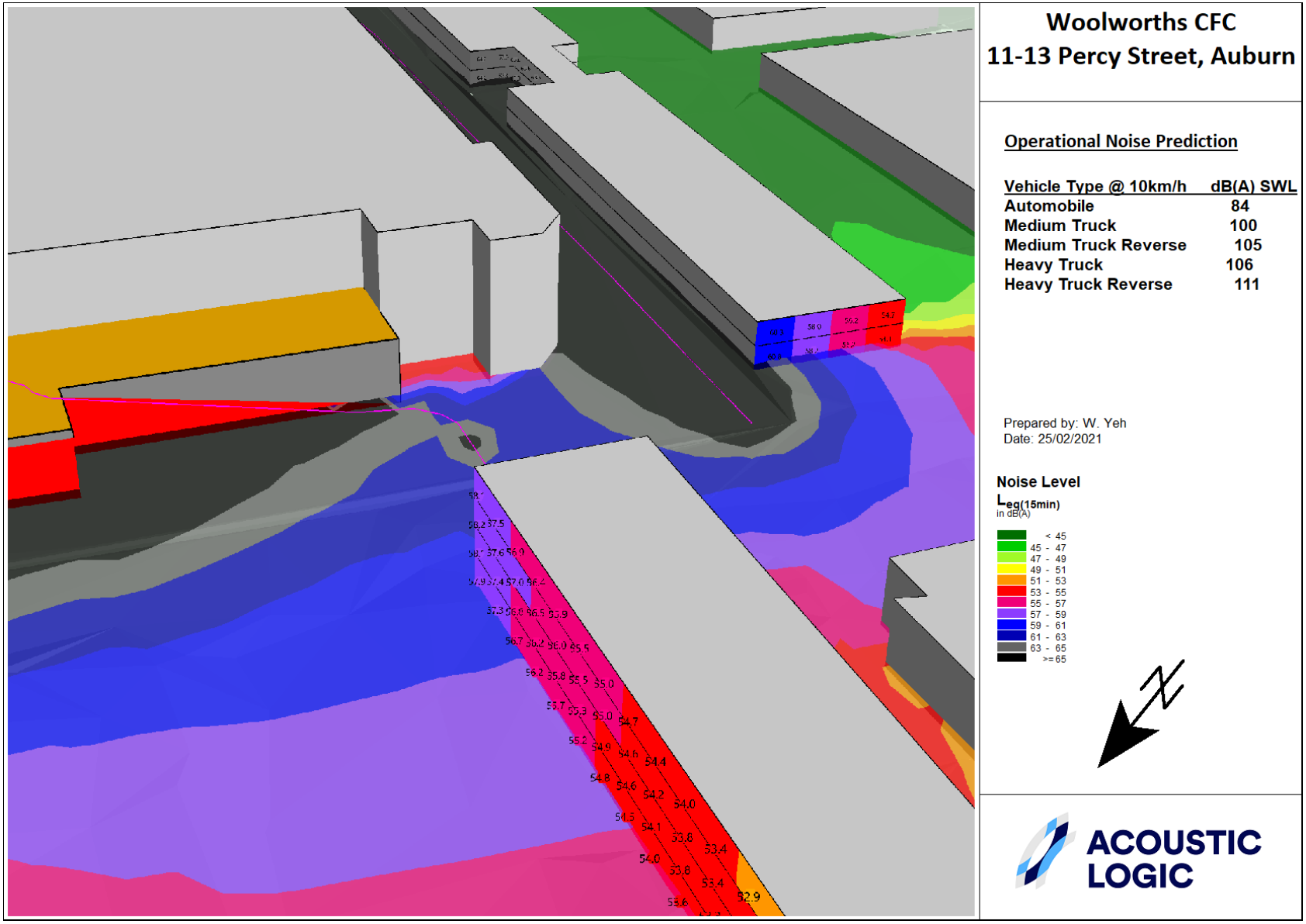


Figure 7 – 3D View of 7-9 Percy Street and 67-73 St Hilliers Road, Grid Noise Map at 1.5m

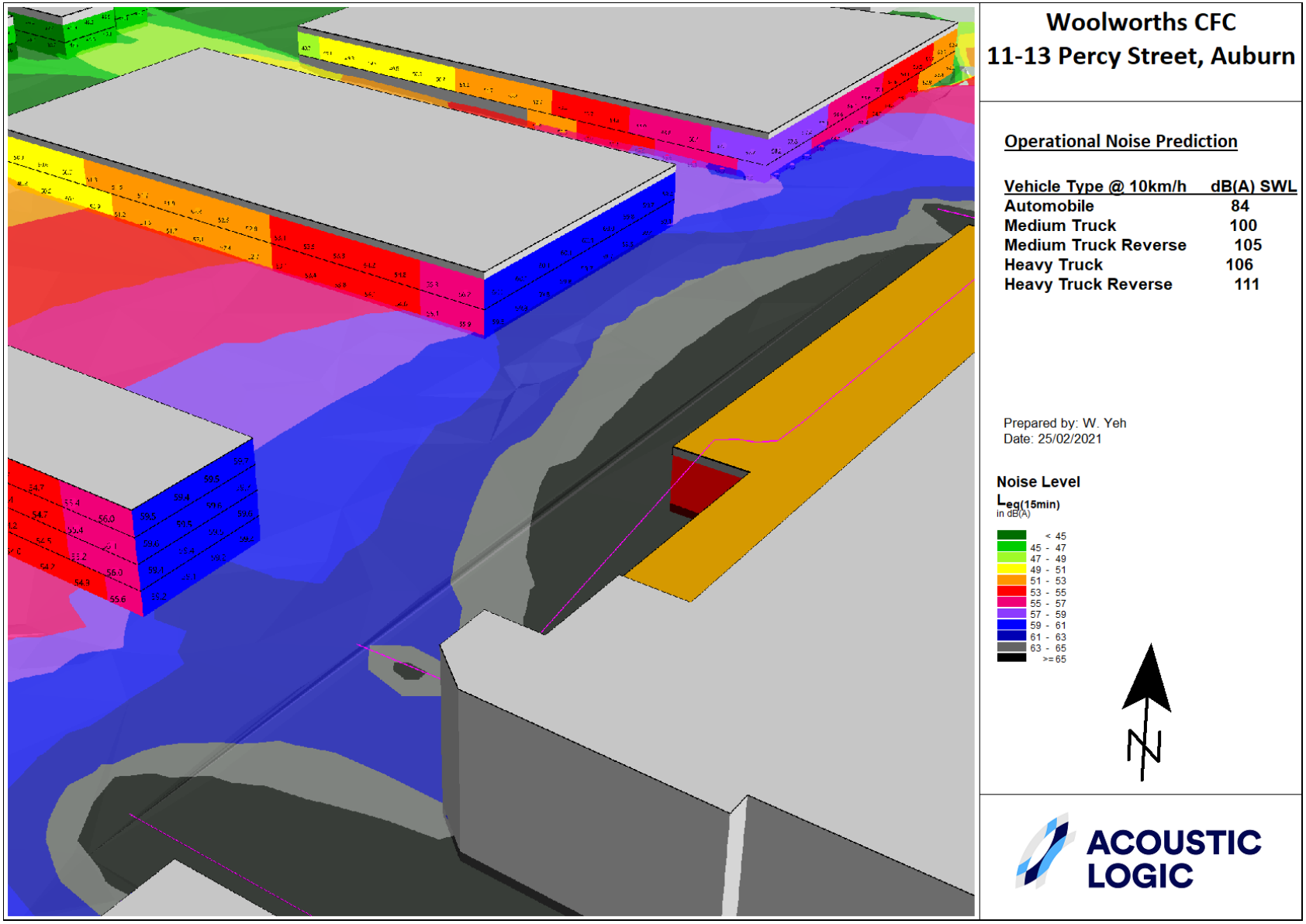


Figure 8 – 3D View of 67-77 St Hilliers Road, Grid Noise Map at 1.5m

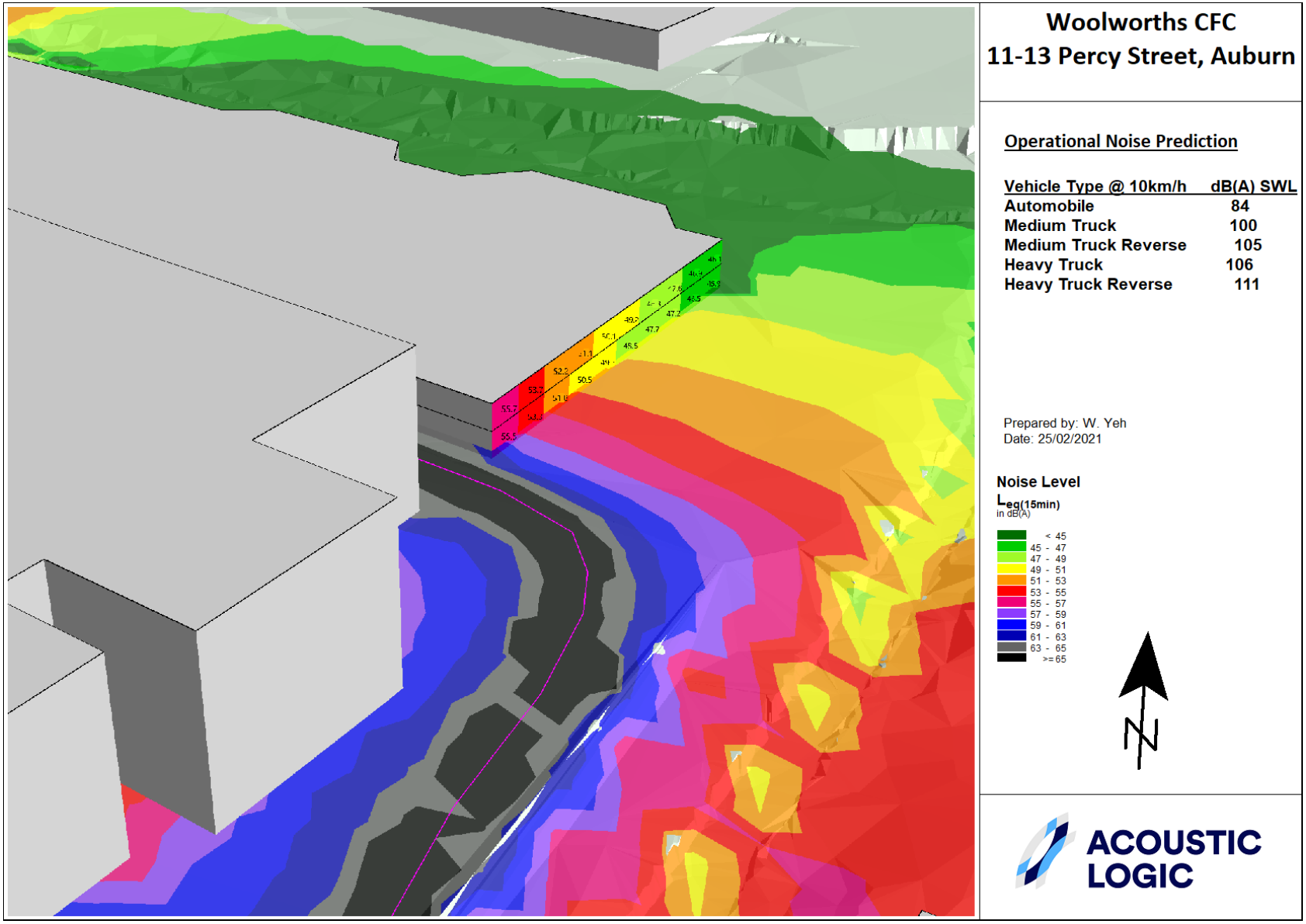


Figure 9 – 3D View of 15 Percy Street, Grid Noise Map at 1.5m

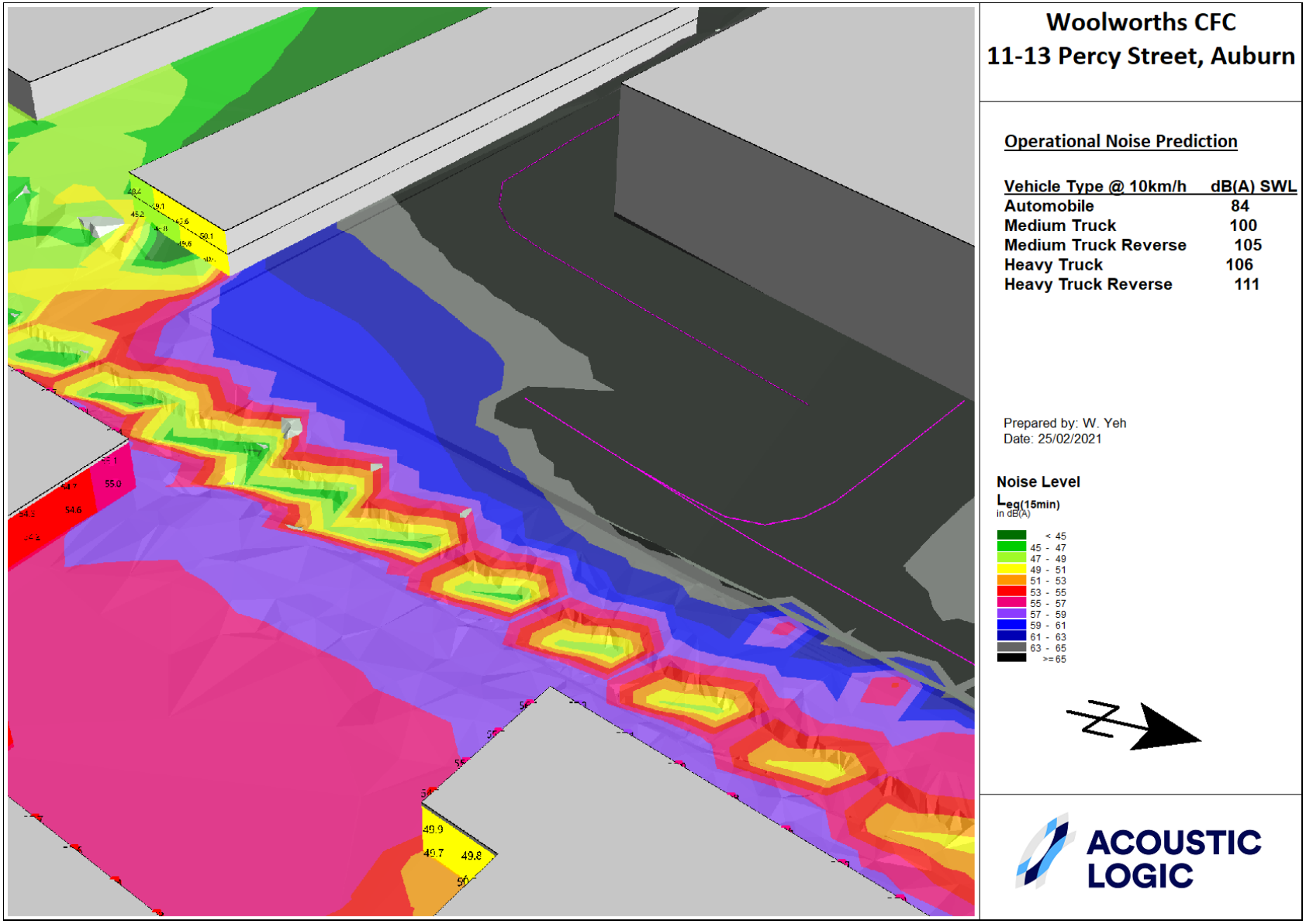


Figure 10 – 3D View of 7-9 Percy Street, Grid Noise Map at 1.5m

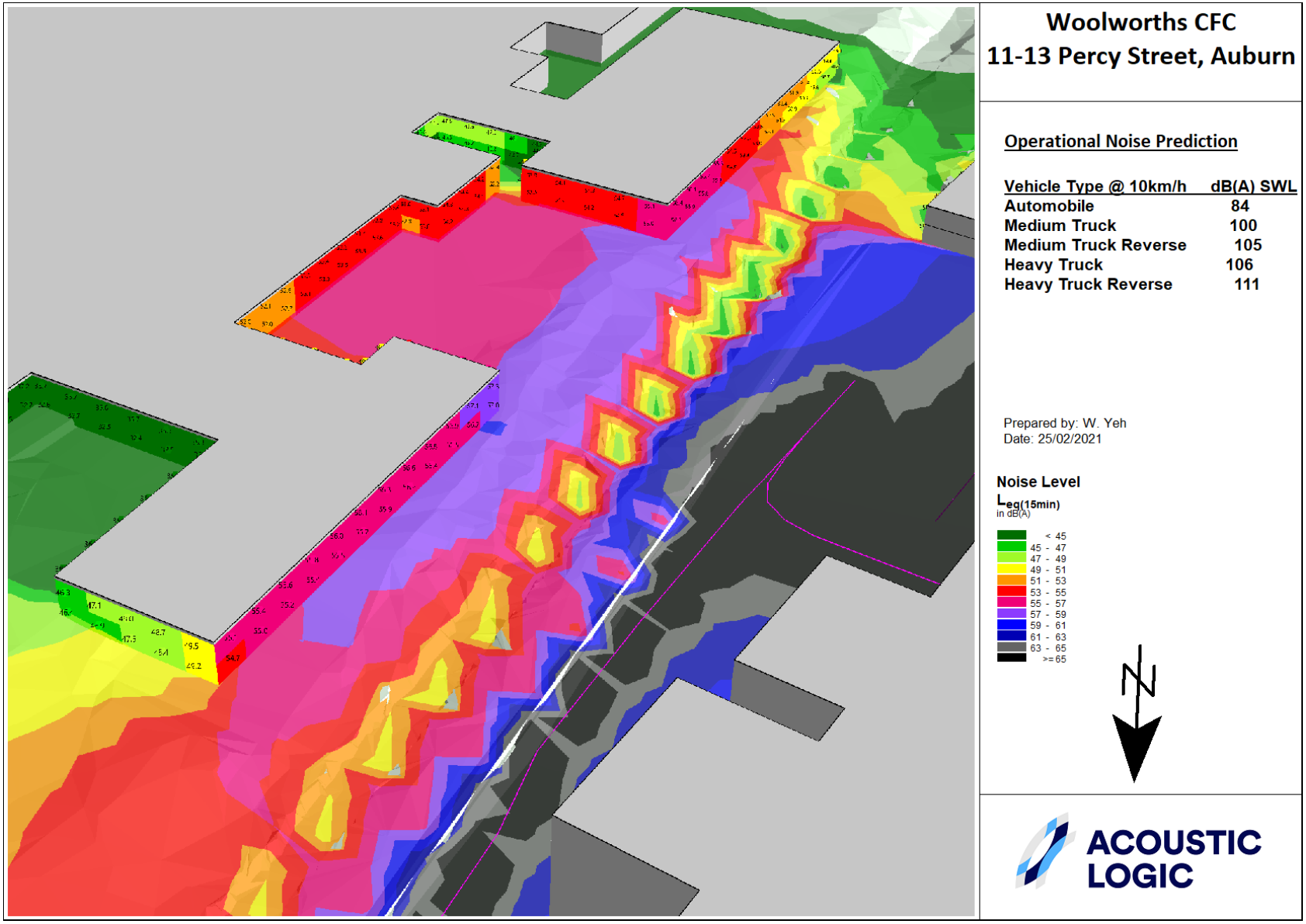


Figure 11 – 3D View of 42 Boorea Street, Grid Noise Map at 1.5m

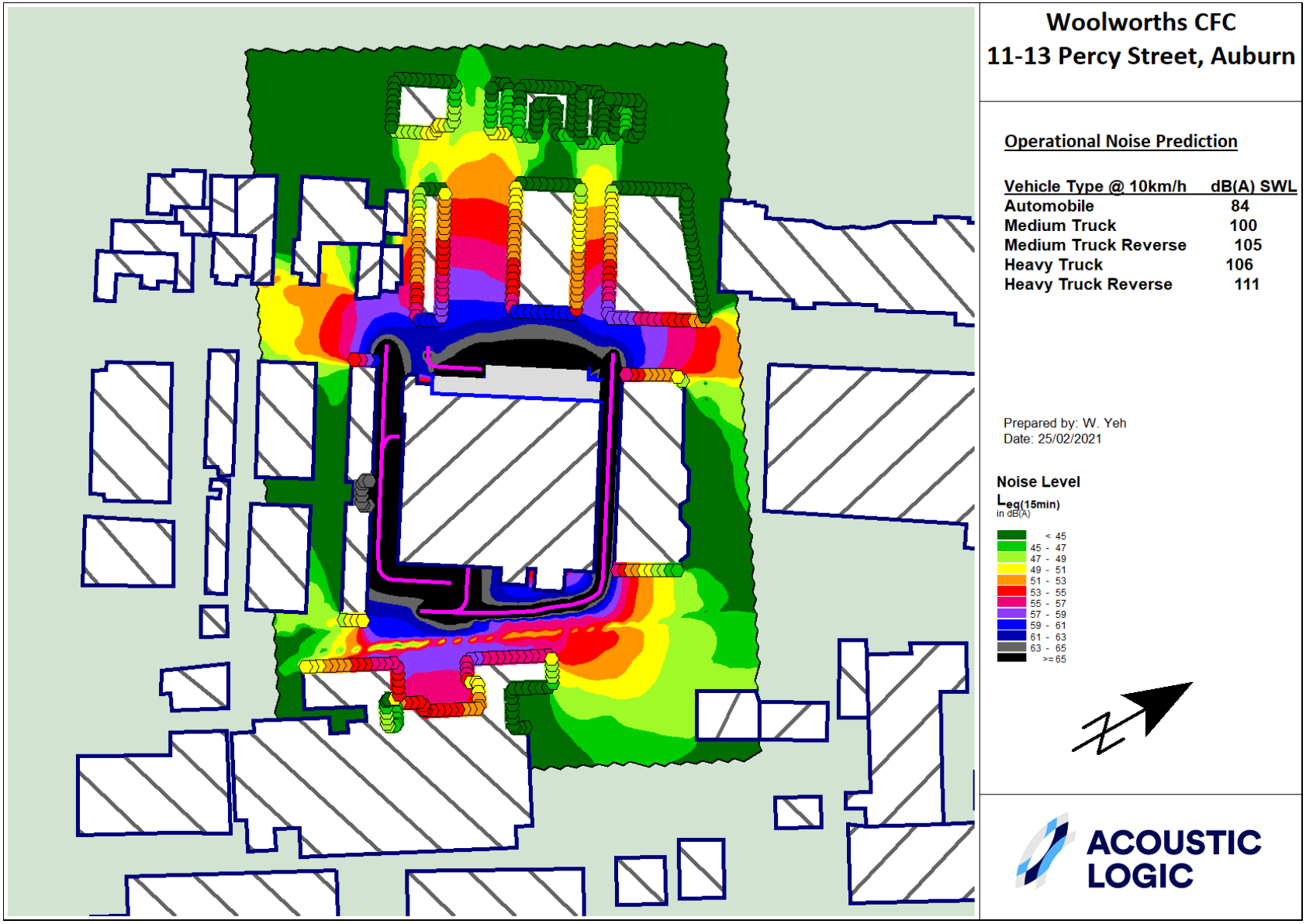


Figure 12 – Overall 2D View, Grid Noise Map at 1.5m

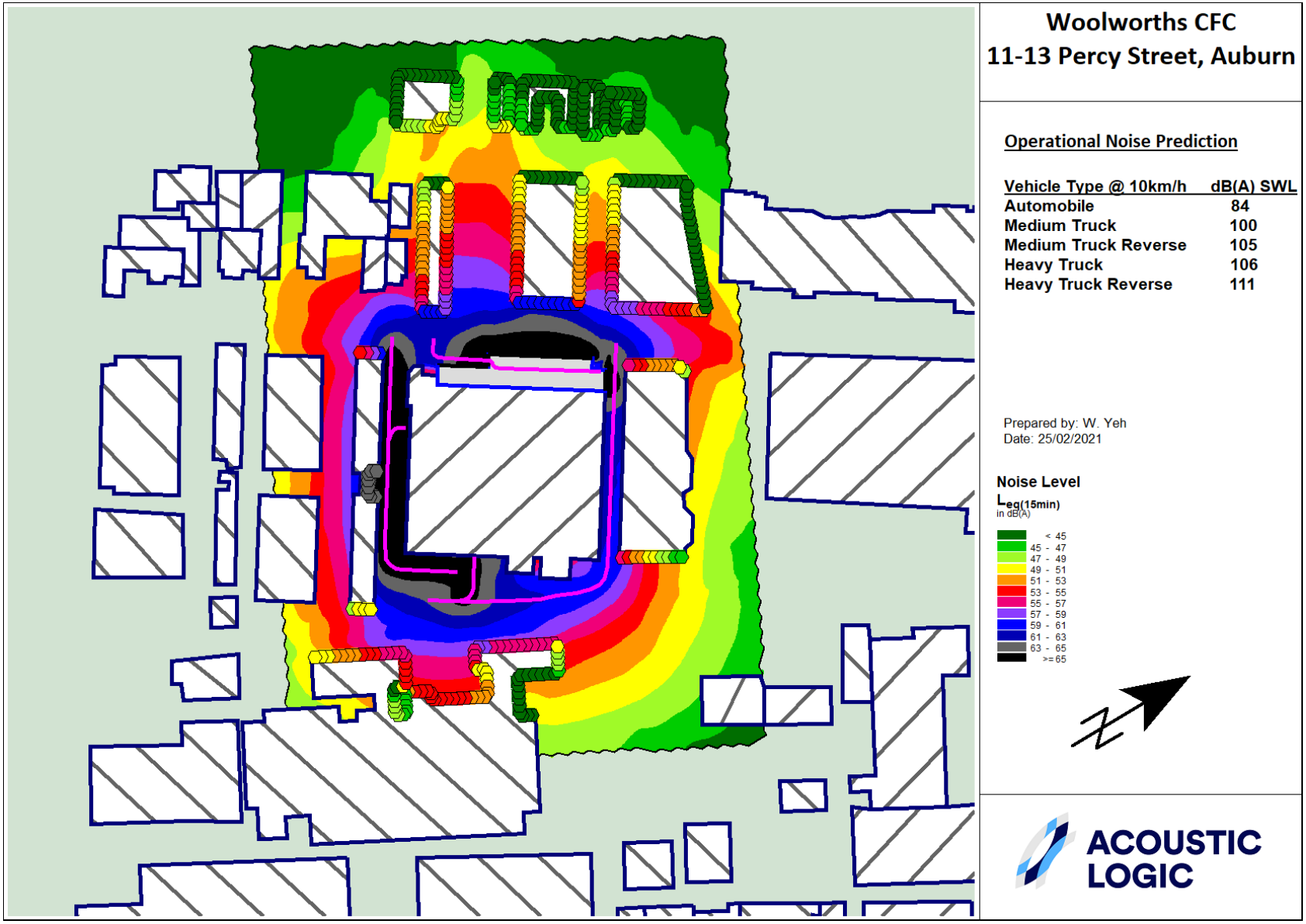


Figure 13 – Overall 2D View, Grid Noise Map at 10.5m

7.4.2 Summary

Cumulative noise emission predictions from delivery van loading and general site operations (being the most noise intensive use of the site) are presented below to the most sensitive receivers around the development. The highest predicted noise level at each receivers is summarised below.

Table 7-2 – Predicted Cumulative Noise Levels to R1: 48-52 St Hilliers Road

Operational Source	Predicted Noise Level	Criteria	Comment
Cumulative Noise from Site Operation, Including Home Delivery Loading, Staff Parking and Inbound Heavy Vehicle Deliveries Refer Section 7.3	50 dB(A) $L_{eq(15min)}$	57 dB(A) L_{eq} Early Morning (5am – 7am)	Meets NSW EPA Noise Emission Requirements
		60 dB(A) L_{eq} Daytime (7am – 6pm)	
		59 dB(A) $L_{eq,}$ Evening (6pm – 10pm)	
		51 dB(A) $L_{eq,}$ Night (10pm – 5am)	
Peak Loading Dock/Carparking Activities Refer Section 7.3	47 L_{max}	61 dB(A) L_{max}	

Table 7-3 – Predicted Cumulative Noise Levels to R1: 62 St Hilliers Road

Operational Source	Predicted Noise	Criteria	Comment
Cumulative Noise from Site Operation, Including Home Delivery Loading, Staff Parking and Inbound Heavy Vehicle Deliveries Refer Section 7.3	47 dB(A) $L_{eq(15min)}$	57 dB(A) L_{eq} Early Morning (5am – 7am)	Meets NSW EPA Noise Emission Requirements
		60 dB(A) L_{eq} Daytime (7am – 6pm)	
		59 dB(A) $L_{eq,}$ Evening (6pm – 10pm)	
		51 dB(A) $L_{eq,}$ Night (10pm – 5am)	
Peak Loading Dock/Carparking Activities Refer Section 7.3	47 L_{max}	61 dB(A) L_{max}	

Table 7-4 – Predicted Cumulative Noise Levels to Industrial Receivers

Noise Source	Receiver	Time Period	Predicted Noise Level	Criteria	Comment
Cumulative Noise from Site Operation, Including Home Delivery Loading, Staff Parking and Inbound Heavy Vehicle Deliveries Refer Section 7.3	**I1**	When in use	60 dB(A) $L_{eq(15min)}$	68 dB(A) L_{eq}	Meets NSW EPA Noise Emission Requirements
	I2		57 dB(A) $L_{eq(15min)}$		
	I3		57 dB(A) $L_{eq(15min)}$		
	I4		64 dB(A) $L_{eq(15min)}$		
	I5		60 dB(A) $L_{eq(15min)}$		

7.5 DISCUSSION & RECOMMENDATIONS

Predicted noise levels from the operation of the proposed customer fulfillment centre show that it is capable of meeting the noise emission requirements of the NSW EPA Noise Policy for Industry at all times. It is noted that the noise level from home delivery loading activities (identified as the most noise intensive use) meets the night time noise emission level, however it is not currently proposed that this activity would occur between 10pm – 5am.

It is recommended that a review and detailed design of all mechanical plant associated with the site be undertaken prior to the issue of a construction certificate to ensure plant noise levels meet the noise emission requirements detailed in Section 6.5. Any review of mechanical plant noise should take into consideration the operational noise levels from the site, such that the cumulative noise does not exceed the PNTL's.

8 VIBRATION OBJECTIVES

Vibration caused by construction at any residence or structure outside the subject site will be assessed with reference to the following:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures*; and
- For human exposure to vibration, Department of Environment and Conservation NSW "Assessing Vibration: A Technical Guideline" (Feb 2006) is based on the guidelines contained in BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)* for low probability of adverse comment.

The criteria and the application of this standard are discussed in separate sections below.

8.1 STRUCTURE BORNE VIBRATIONS

German Standard DIN 4150-3 (1999-02) provides a guideline for acceptable levels of vibration velocity in building foundations, to assess the effects of vibration on structures. The table give guidance on the maximum accepted values of velocity at the foundation and in the plane of the highest floor of various types of buildings, to prevent any structural damage.

The table below lists the peak particle velocity, which is the maximum absolute value of the velocity signals for the three orthogonal components. This is measured as a maximum value of any of the three orthogonal component particle velocities when measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 8-1 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

8.2 ASSESSING AMENITY

The NSW EPA's *Assessing Vibration – A technical guideline* is based on the guidelines contained in British Standard BS 6472-1992 '*Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz*'. This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings.

The recommendations of this guideline should be adopted to assess and manage vibration from the site. Where vibration exceeds, or is likely to exceed, the recommended levels then an assessment of reasonable and feasible methods for the management of vibration should be undertaken.

Table 8-2 – BS 6472 Vibration Criteria

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	**Time**	**Preferred**	**Maximum**	**Preferred**	**Maximum**	**Preferred**	**Maximum**
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Offices	Day or night-time	0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0
Offices	Day or night-time	0.64	1.28	13	26	18	36
Workshops		0.64	1.23	13	26	18	36

Note 1: Continuous vibration relates to vibration that continues uninterrupted for a defined period (usually throughout the daytime or night-time), e.g. continuous construction or maintenance activity. (DECC, 2006).

Note 2: Impulsive vibration relate to vibration that builds up rapidly to a peak followed by a damped decay and that may or may not involve several cycles of vibration (depending on frequency and damping), with up to three occurrences in an assessment period, e.g. occasional loading and unloading, or dropping of heavy equipment. (DECC, 2006).

9 CONCLUSION

This report presents an acoustic assessment of noise and vibration impacts associated with the development to be located at 11-13 Percy Street, Auburn.

Provided that the recommendations presented in Section 5.3 are adopted, internal noise levels for the development will comply with the acoustic requirements of the following documents:

- Cumberland City Council – '*Auburn Development Control Plan 2010';*
- Australian Standard AS2107:2016 – '*Recommended Design Sound Levels and Reverberation Times for Building Interiors.*'

External noise emissions criteria have been established in this report to satisfy the requirements from the following documents;

- Cumberland City Council Advice Letter dated 25th June 2020;
- NSW Planning SEARs document (Ref: SSD-10470) dated 30th June 2020;
- Cumberland City Council – '*Auburn Development Control Plan 2010';* and
- NSW Department of Environment and Heritage, Environmental Protection Agency document – Noise Policy for Industry (NPI) 2017.

Vibration objectives have been established in this report to satisfy the requirements of the following documents:

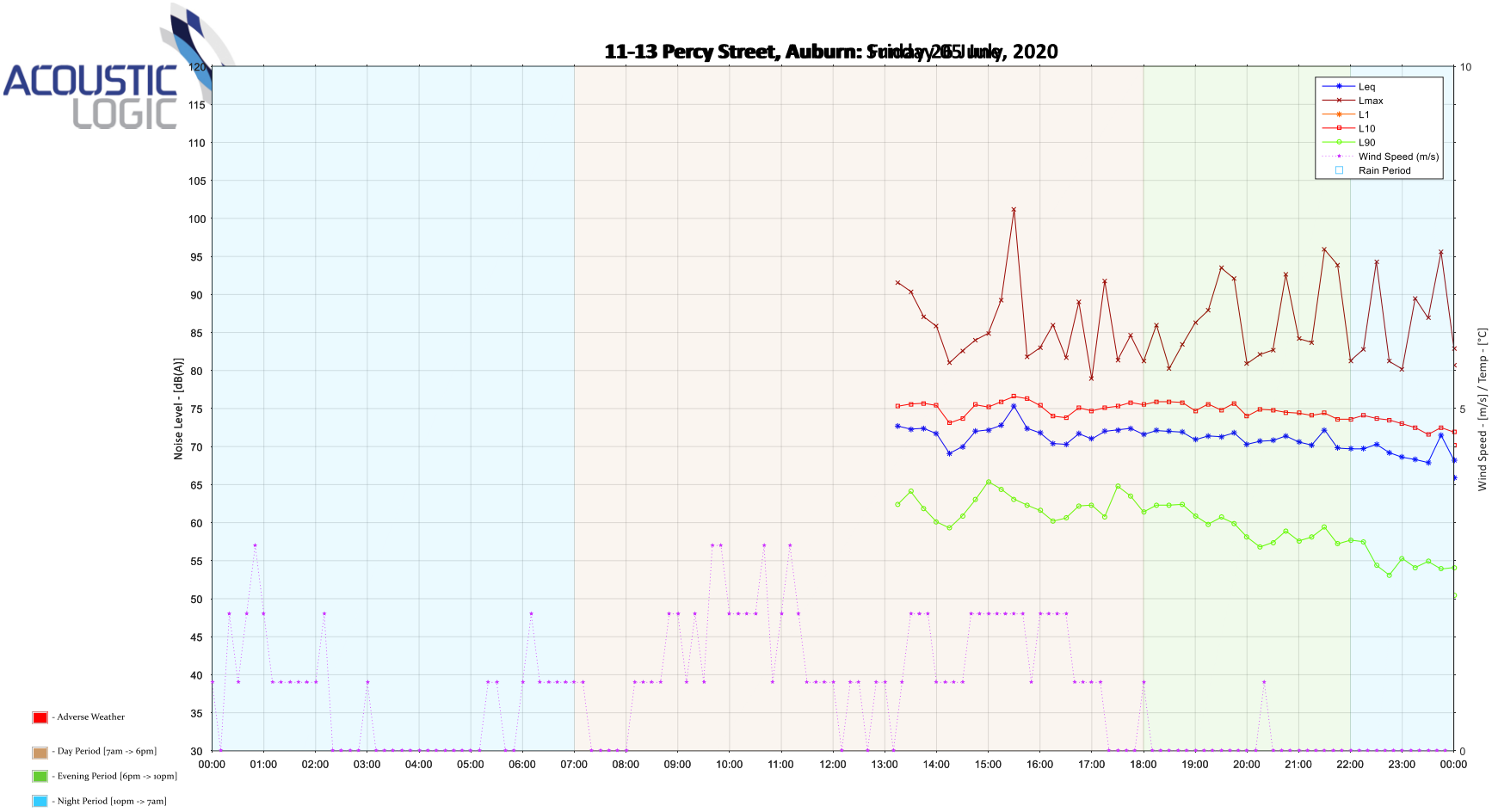
- German Standard DIN 4150-3 (1999-02); and
- NSW EPA document – '*Assessing Vibration – A Technical Guideline.*'

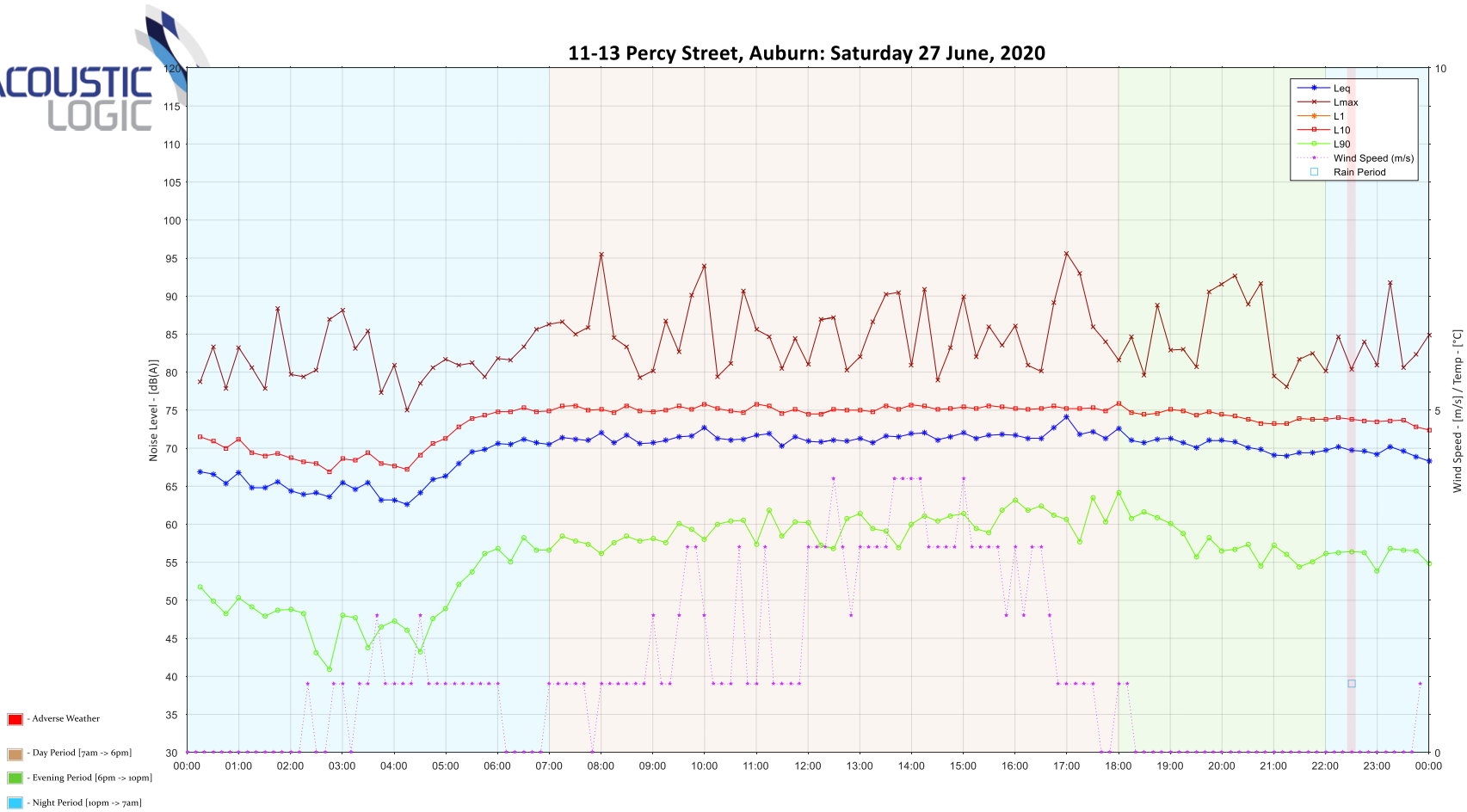
We trust this information is satisfactory. Please contact us should you have any further queries.

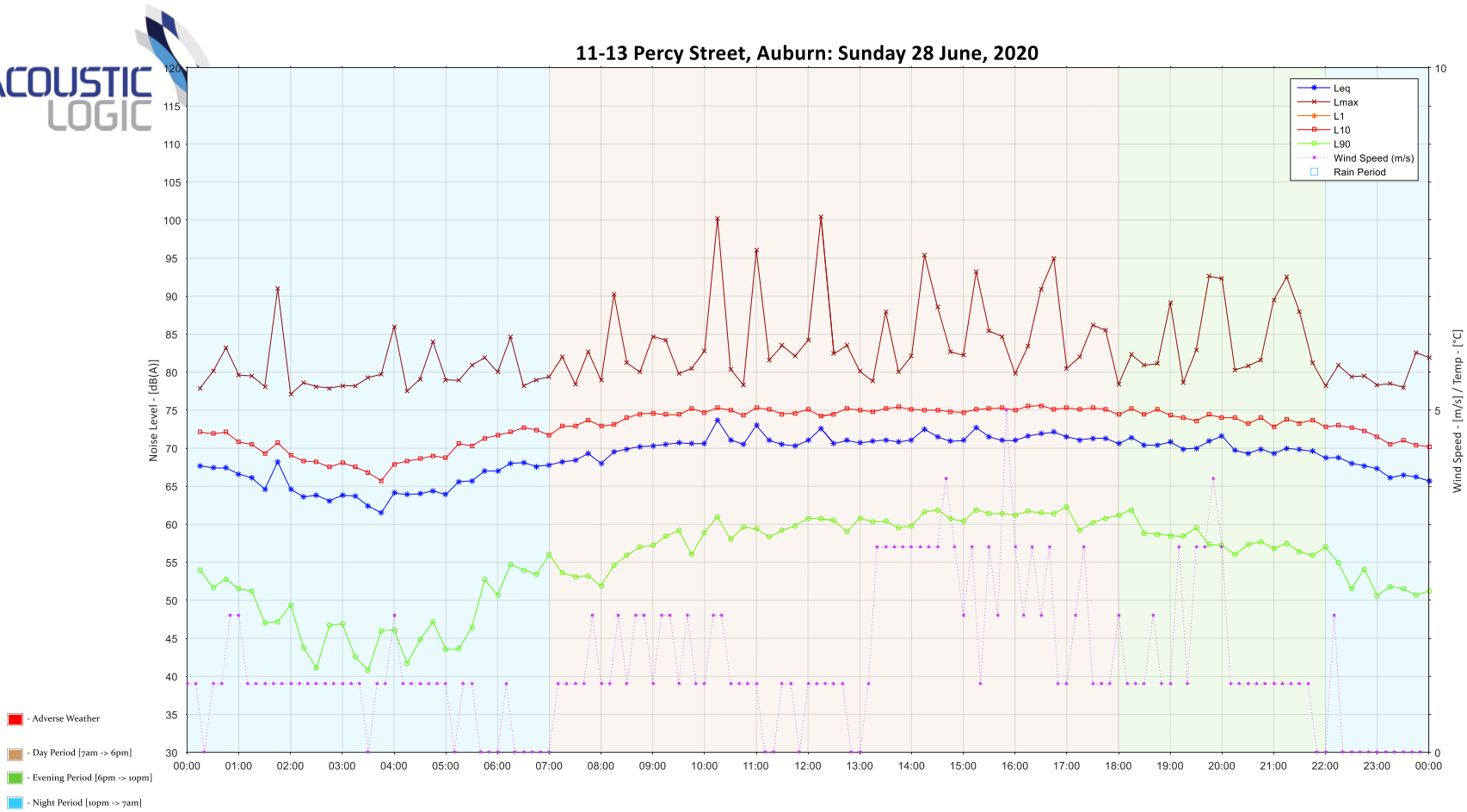
Yours faithfully,

Acoustic Logic Pty Ltd
Weber Yeh

10 APPENDIX 1 – UNATTENDED NOISE MONITORING


11-13 Percy Street, Auburn: Sunday, 5 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


11-13 Percy Street, Auburn: Saturday 27 June, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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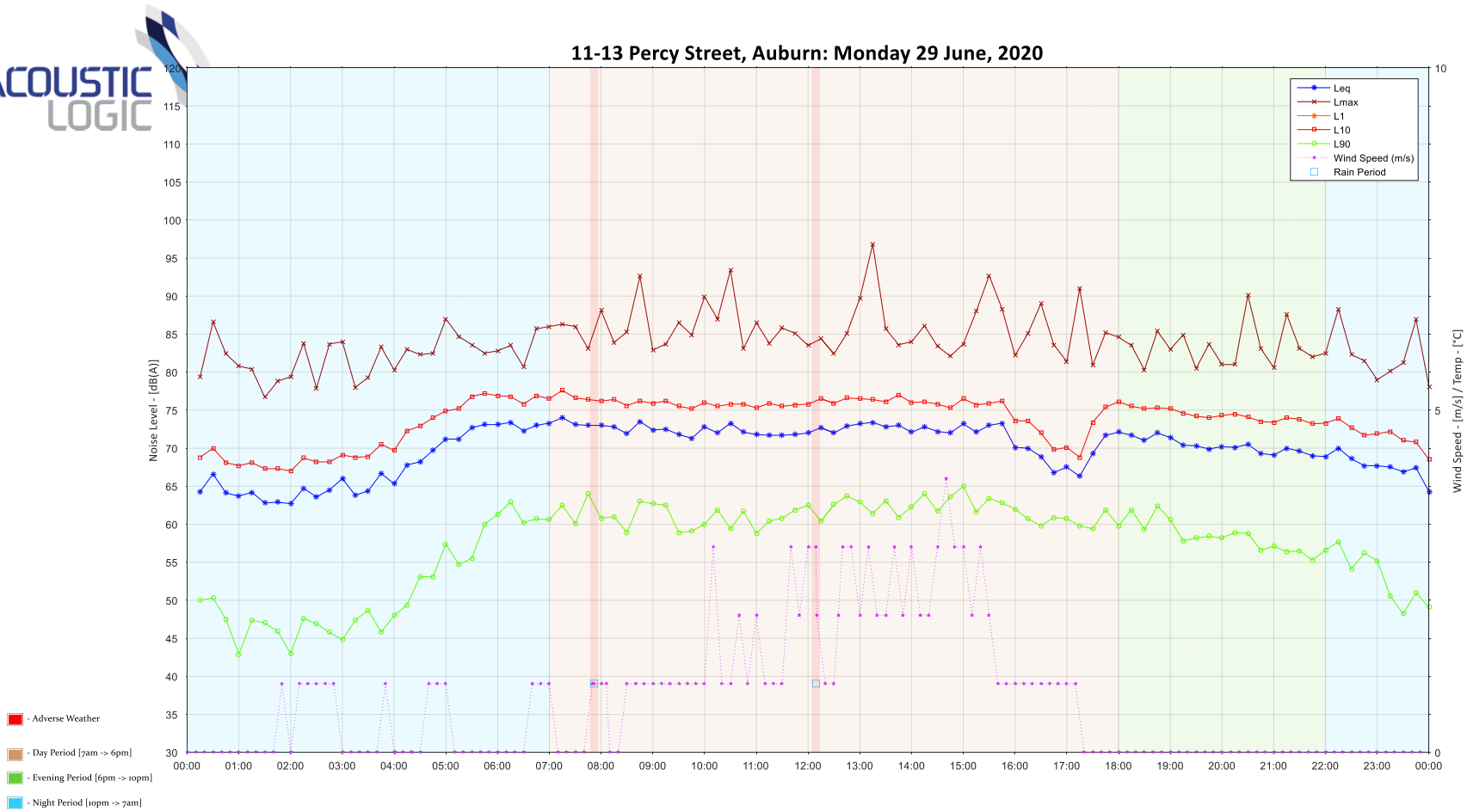
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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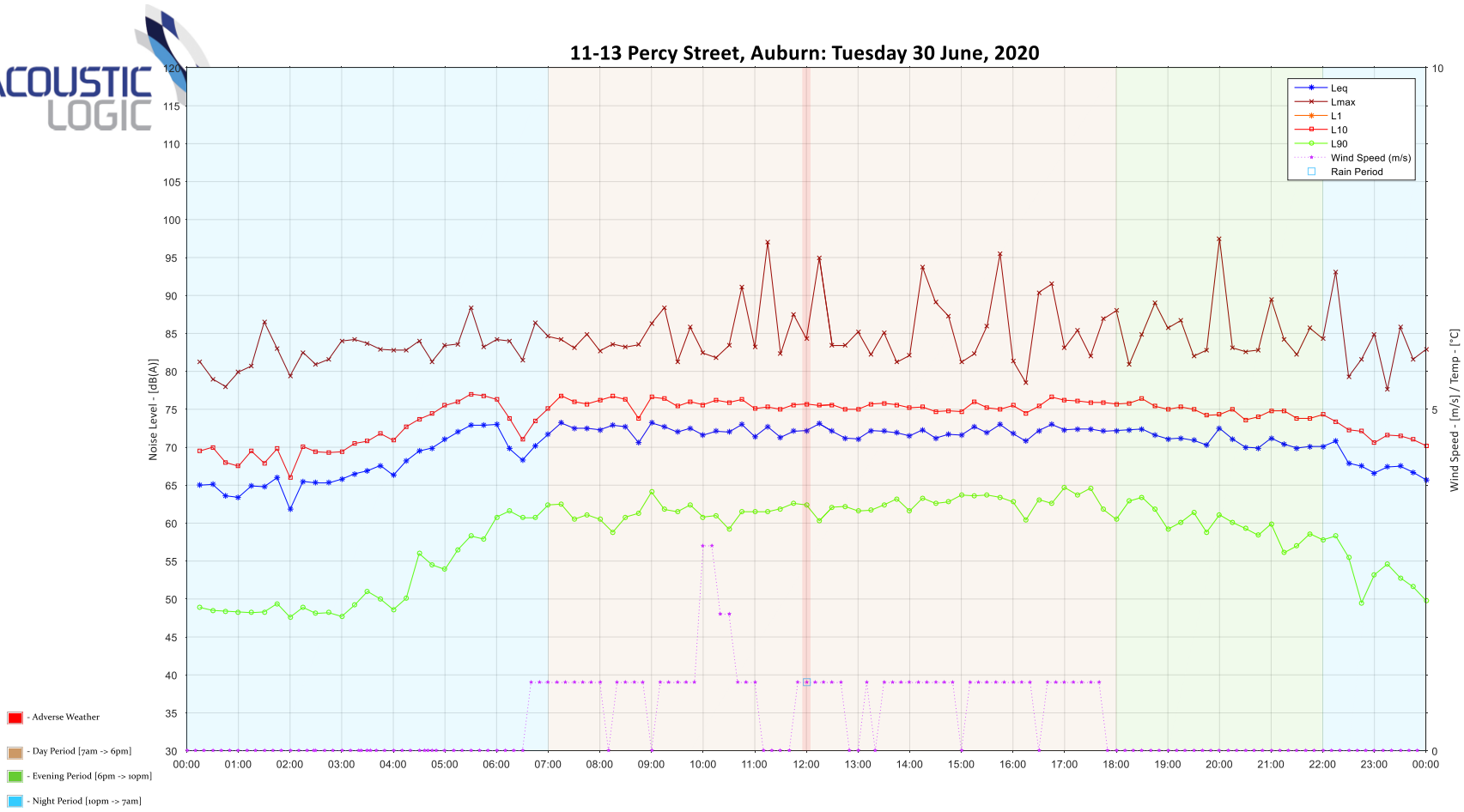
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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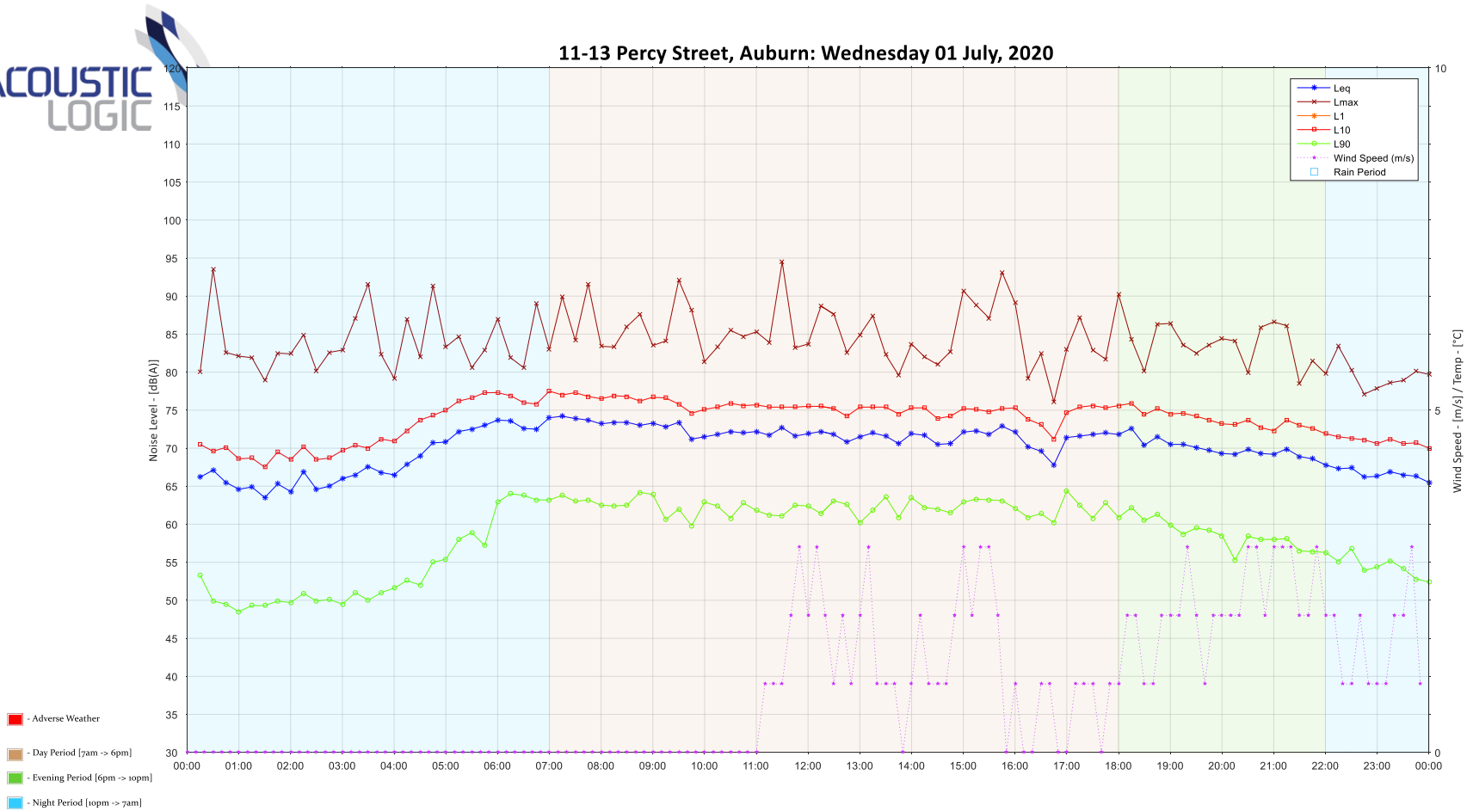
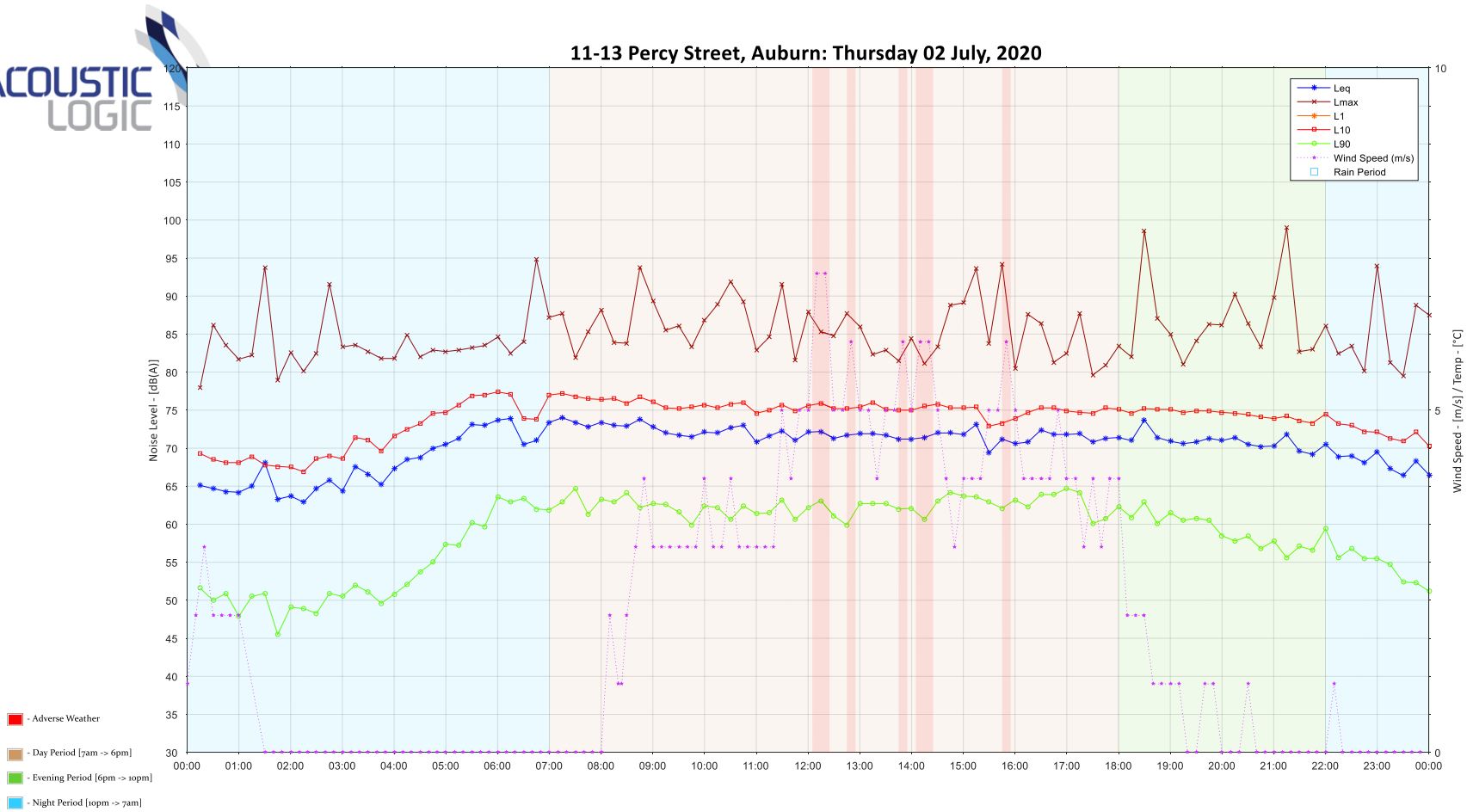
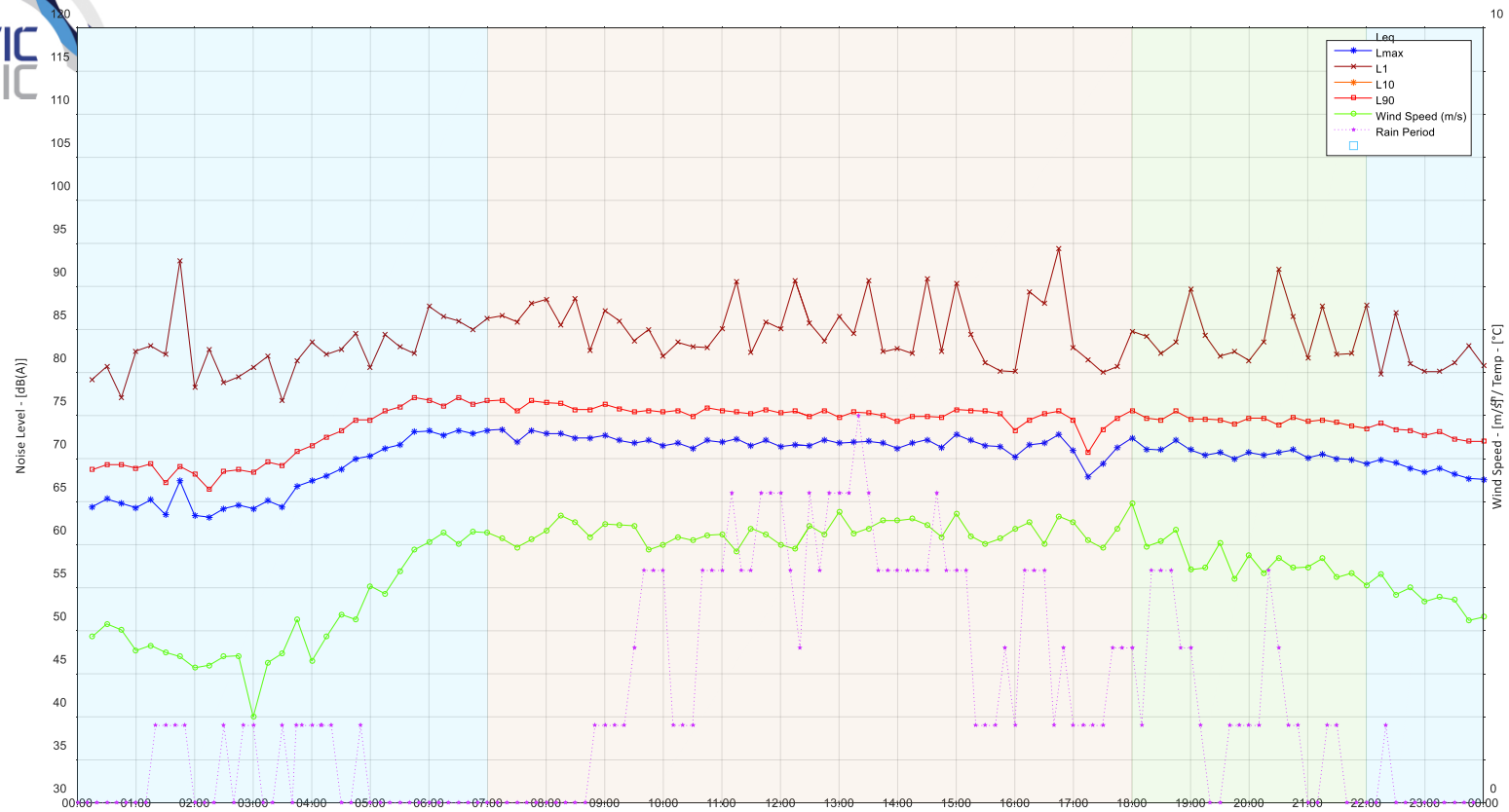
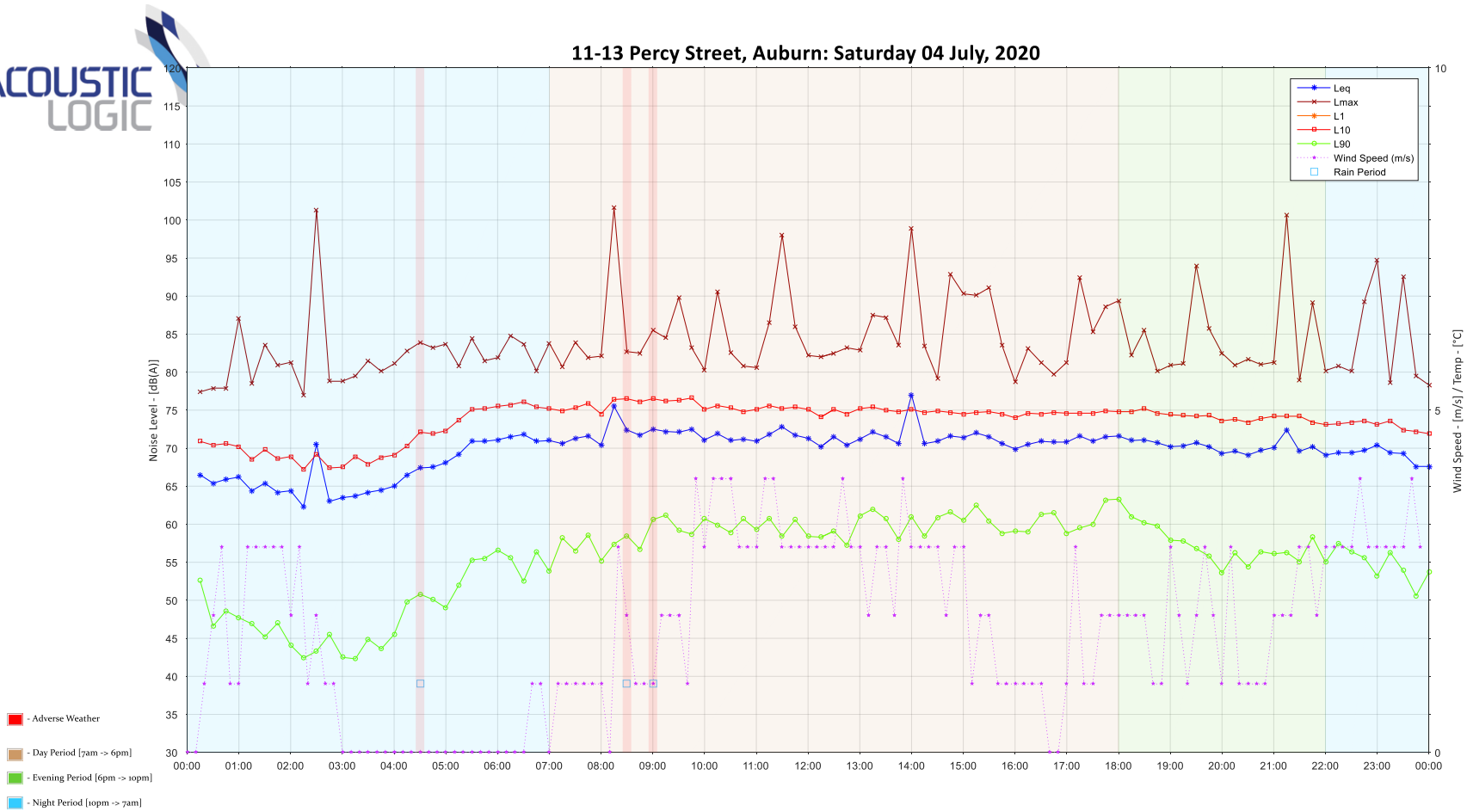
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

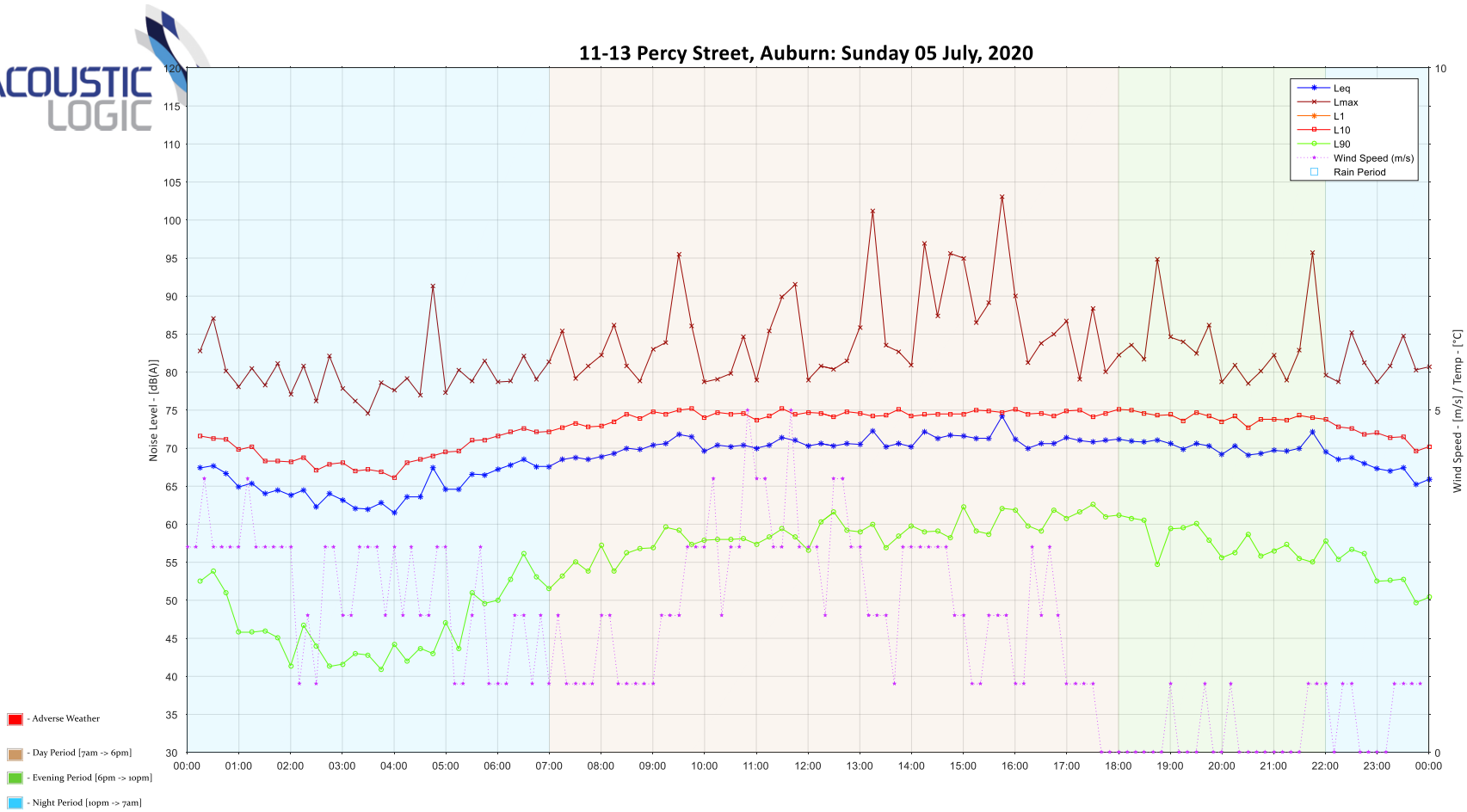

11-13 Percy Street, Auburn: Wednesday 01 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

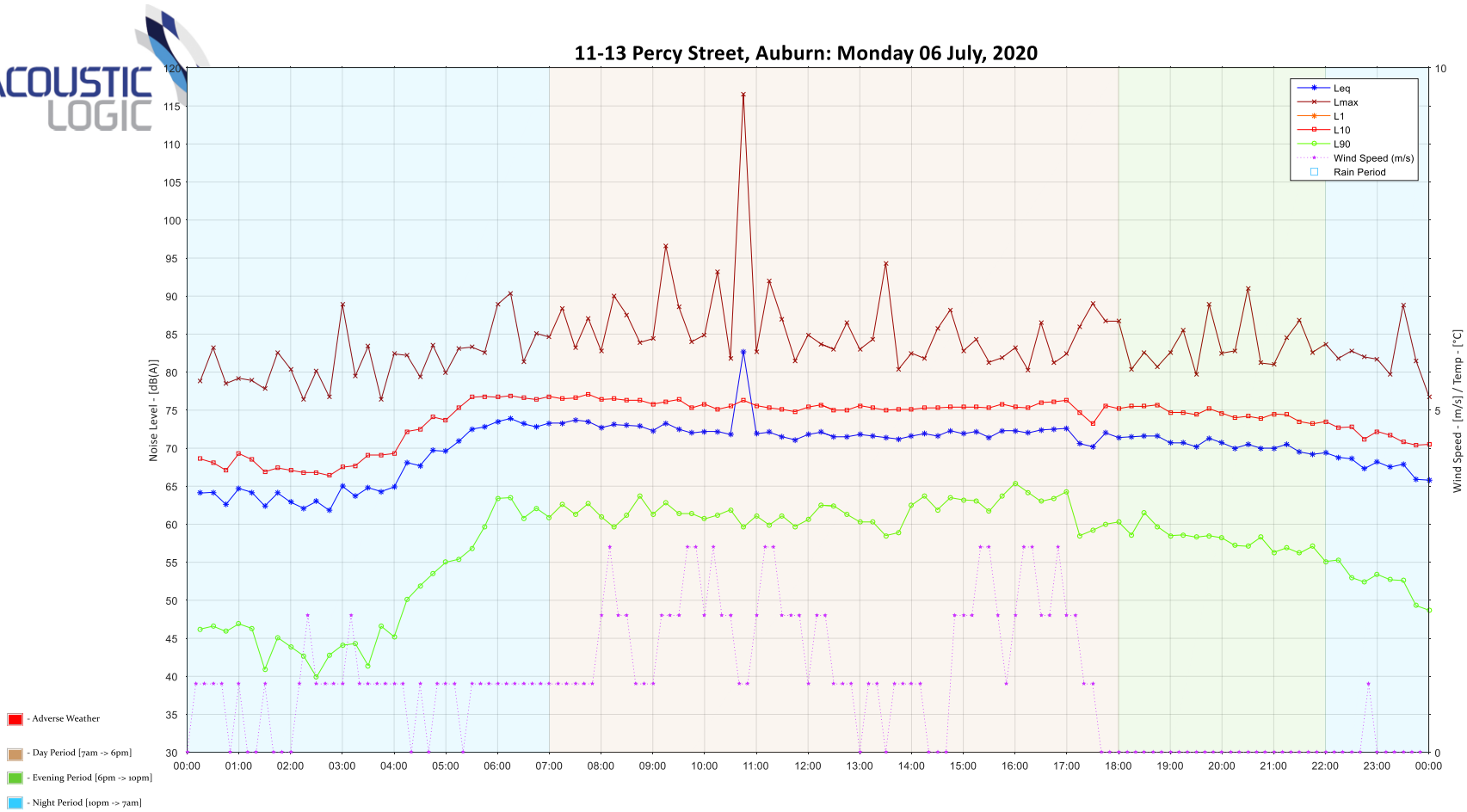

11-13 Percy Street, Auburn: Thursday 02 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

11-13 Percy Street, Auburn: Friday 03 July, 2020

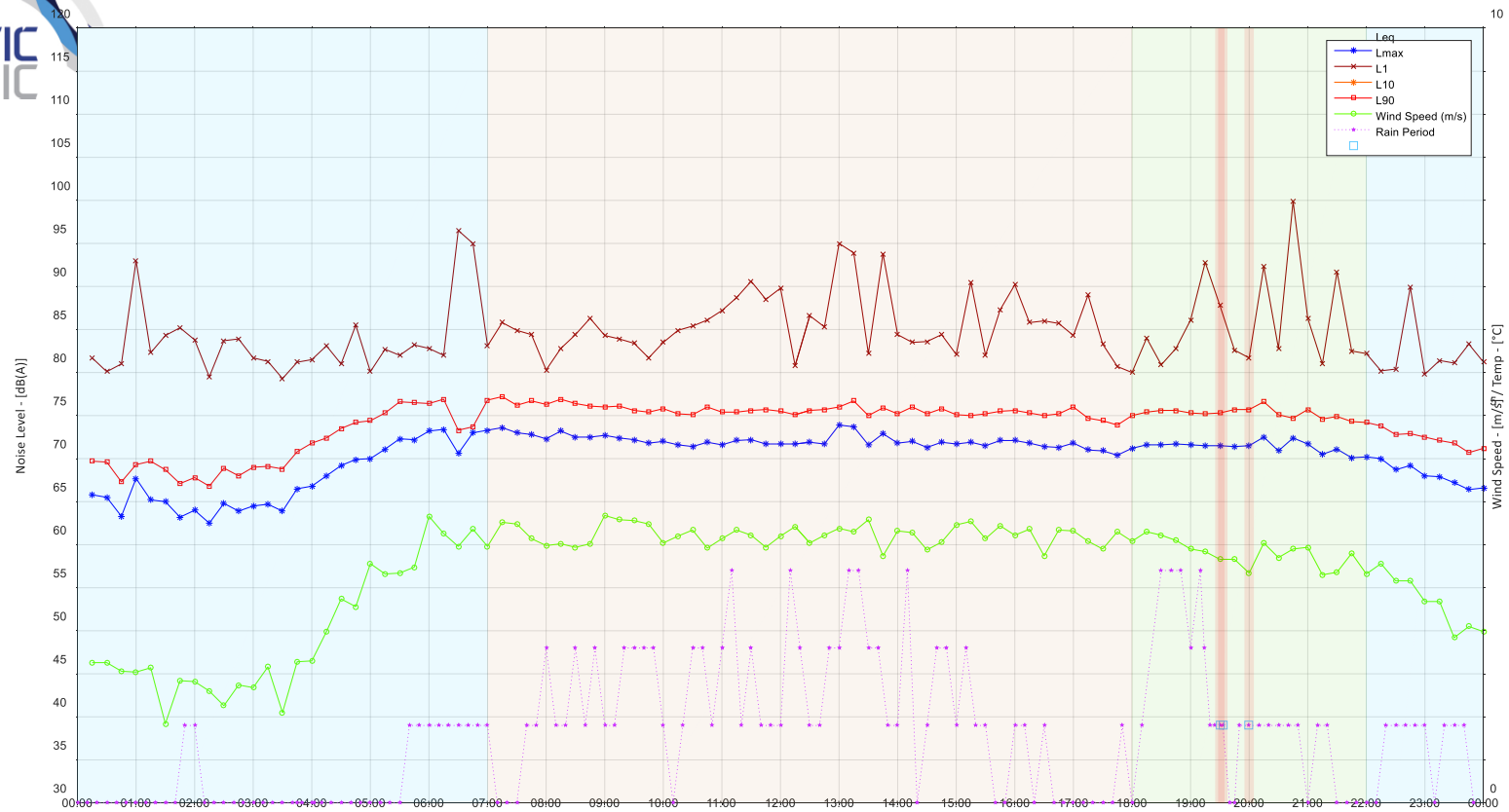


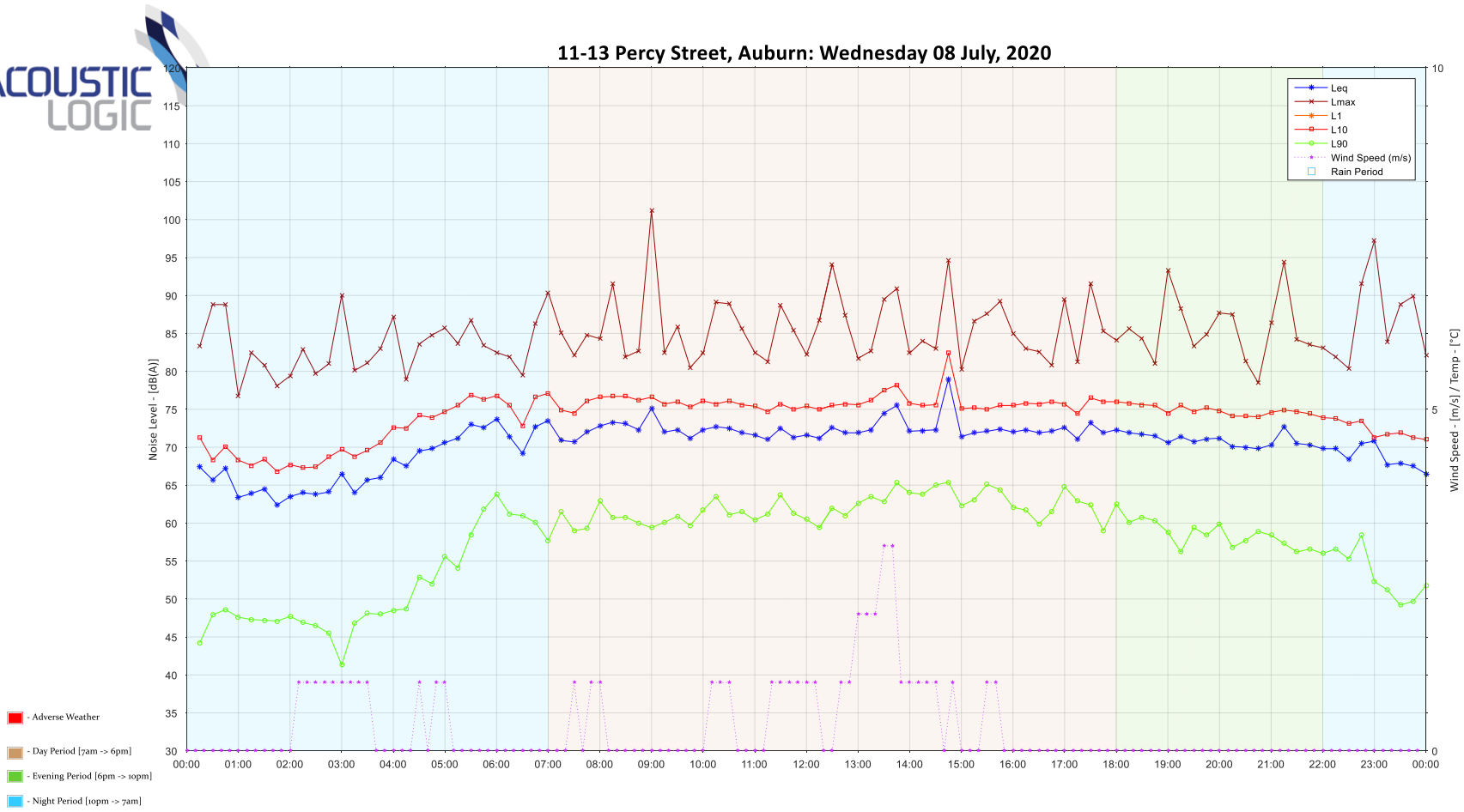

11-13 Percy Street, Auburn: Saturday 04 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

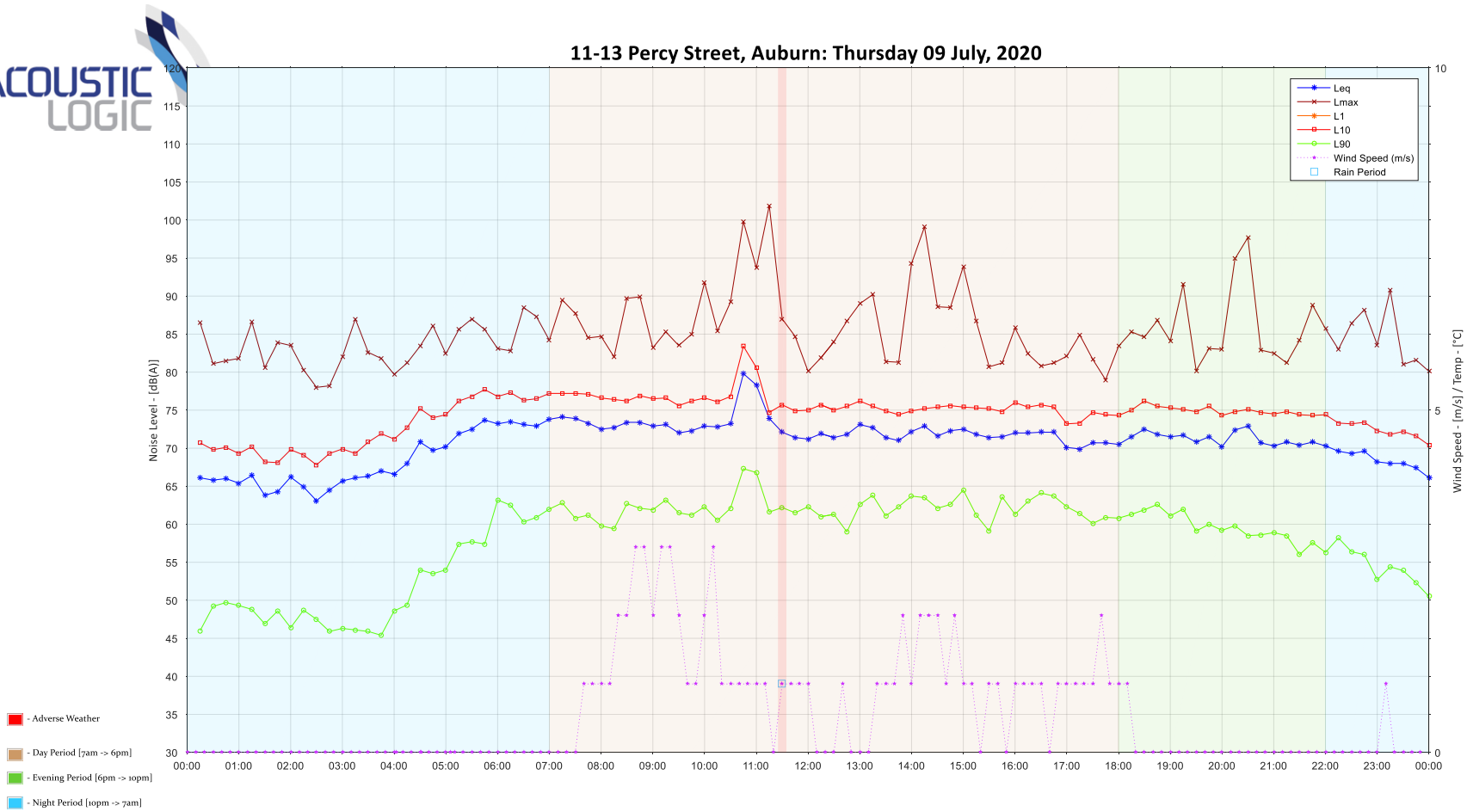

11-13 Percy Street, Auburn: Sunday 05 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

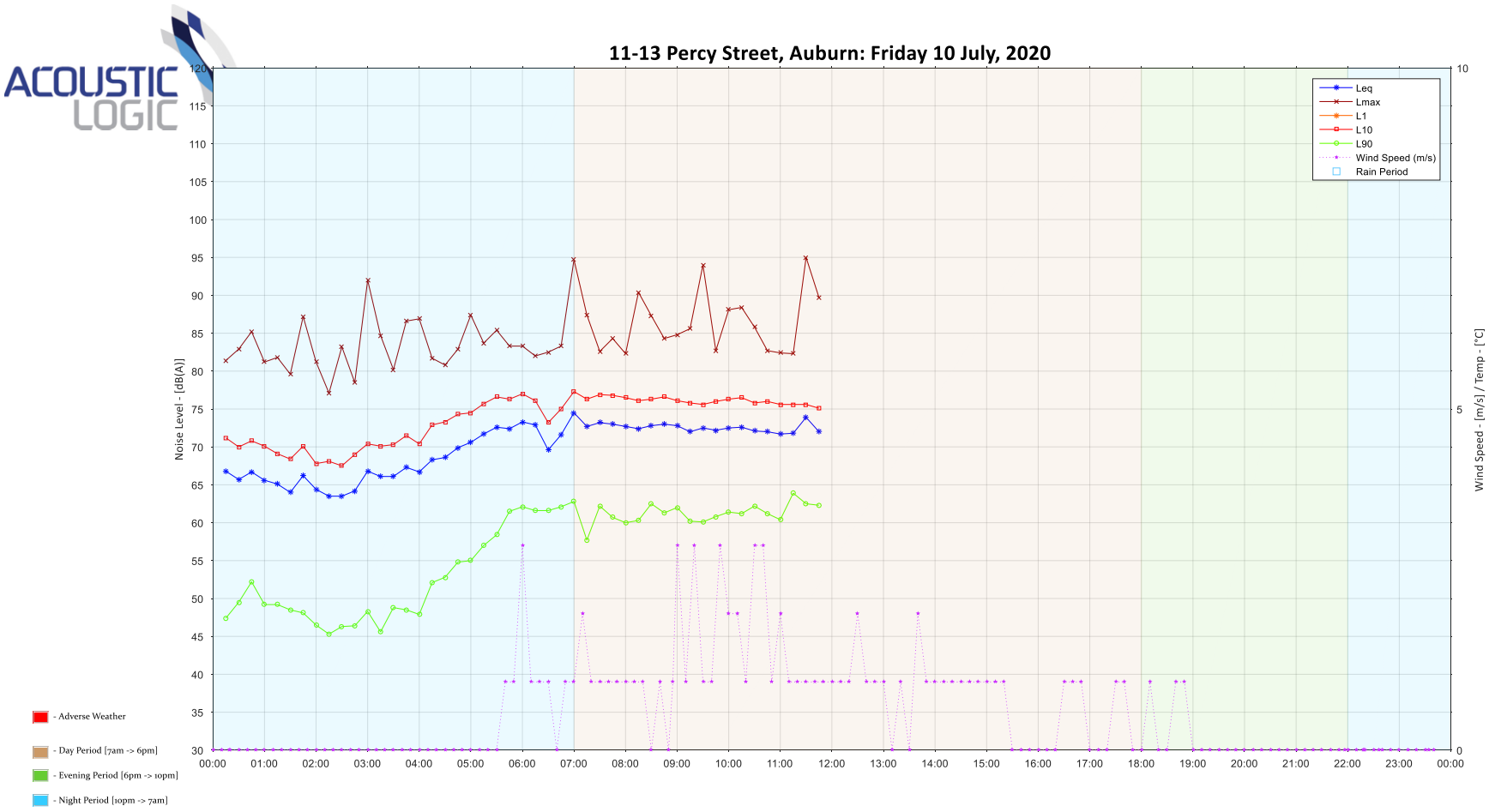

11-13 Percy Street, Auburn: Monday 06 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

11-13 Percy Street, Auburn: Tuesday 07 July, 2020




11-13 Percy Street, Auburn: Wednesday 08 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


11-13 Percy Street, Auburn: Thursday 09 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


11-13 Percy Street, Auburn: Friday 10 July, 2020
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
Lmax
L1
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]