Barber Avenue, Kingswood

DA Acoustic Assessment

SYDNEY
A: 9 Sarah St Mascot NSW 2020
T: (02) 8339 8000
F: (02) 8338 8399

SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

www.acousticlogic.com.au
ABN: 11 068 954 343

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1 INTRODUCTION

This report presents our DA acoustic assessment for the proposed mixed-use development at Barber Avenue, Kingswood.

In this report we have:

- Conducted an external noise intrusion assessment (primarily traffic and train noise) and recommend acoustic treatments to ensure that a reasonable level of amenity is achieved for future occupants. The internal train /traffic noise levels shall comply with the requirements of Council DCP, the NSW Department of Planning SEPP Infrastructure 2007 and Australian Standard 2107-2000.

- Conducted a rail vibration impact assessment and if necessary provide recommendations regarding vibration isolation. The assessment has been done in accordance with NSW Department of Planning Development Near Rail Corridors and Busy Roads – Interim Guideline.

- Carried out background noise measurement to determine noise emission goals for future use of the development to meet the requirements of Council DCP and NSW EPA Industrial Noise Policy.

The assessment is based on the architectural drawings Job No.09007 provided by Turner + Associates Architects dated 18th April 2012.

2 SITE DESCRIPTION

The proposed development is located at Barber Avenue, Kingswood.

The development includes 3 separate buildings in two stages. Stage 1 consists of a seven-storey residential building and a six-storey mixed retail and residential building. Stage 2 consists of a nine-storey mix-used building which will be a future application and are not included in this assessment.

The site is bounded to the north by the Great Western Highway and to the west by Parker Street; both carry high volumes of traffic. Across the Great Western Highway is the Western Railway line which carries suburban and freight trains.

Located to the south east of the development site is the Nepean Private Hospital.

A detailed site map of the development site and measurement locations is shown in Figure 1 below.

Figure 1 Site Map and Measurements Location

Stage 1

Stage 2 (Future application)

3 NOISE DESCRIPTORS

Traffic noise constantly varies in level, due to fluctuations in traffic speed, vehicle types, road conditions and traffic densities. Accordingly, it is not possible to accurately determine prevailing traffic noise conditions by measuring a single, instantaneous noise level. To accurately determine the effects of traffic 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. These parameters are used to measure how much annoyance would be caused by a particular noise source.

In the case of 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 interval.

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 measurement period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of traffic noise.

Current practice favours the L_{eq} parameter as a means of measuring traffic noise, whereas the L_{10} parameter has been used in the past and is still incorporated in some codes. For the reasons outlined above, the L_{90} parameter is not used to assess traffic noise intrusion.

4 NOISE INTRUSION ASSESSMENT

The major noise sources affecting the amenity of the residents and commercial tenants at the proposed development are as follows:

- Traffic noise from the Great Western Highway and Parker Street
- Train noise from the western railway line across the Great Western Highway

4.1 NOISE INTRUSION CRITERIA

The following documents are used to determine the external noise intrusion assessment criteria for this project:

- Penrith City Council DCP
- NSW Department of Planning's Developments Near Rail Corridors and Busy Roads – Interim Guidelines 2008.

4.1.1 Penrith Council Criteria

The Penrith city council DCP states:

I. The amenity of residential development is influenced substantially by privacy. Privacy is affected by:

a) External sources of noise such as major roads and railways; and

b) Within residential developments: rooms and areas that are sources of noise and overlooking; and

c) Rooms within dwellings that tend to be sensitive to noise and overlooking;

d) Orientation and screening of windows;

e) Internal zoning of dwellings

II. Recommended night-time internal noise levels in living and sleeping areas is 35-40 dB(A)

4.1.2 NSW Department of Planning

The Development Near Rail Corridors and Busy Roads – Interim Guideline states the following:

***For Clauses 87 (Rail) and 102 (Road):**
If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

- in any bedroom in the building : 35dB(A) at any time 10pm–7am
- anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dB(A) at any time.

4.1.3 Commercials and Retails

The noise intrusion into the commercial and retail areas of the development is assessed based on the internal noise requirements of AS2107:2000 and are summarised in Section 4.1.4.

4.1.4 Summary of Traffic and Train Noise Airborne Criteria

The noise criteria for the subject development for road and rail noise are specified in the table below. The criterion has been adopted from the Penrith City Council, SEPP and AS2107:2000 requirements.

Table 1 – Internal Noise Criteria

TYPE OF OCCUPANCY	APPLICABLE TIME PERIOD	NOISE LEVEL L_{Aeq} dB(A)*
Sleeping Areas (bedroom)	Night (10pm-7am)	35
Other Habitable Rooms (excl. garages, kitchens, bathrooms and hallways)	Day (7am-10pm)	40
Retail	At any time	50
Commercial (General Office Areas)	At any time	45

*Internal Noise Level Criteria based on the time period as follows; Bedroom-Night time L_{eq}(9 hour) and Living Areas- Day time L_{eq}(15 hour)

If internal noise levels with windows or doors open exceed the criteria by more than 10 dB(A), the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also provide an alternative outside air source or air conditioning in compliance with the relevant mechanical and ventilation codes.

4.2 NOISE MEASUREMENTS

Attended and unattended noise measurements were undertaken on site to measure the train and traffic noise levels and the background noise levels.

4.2.1 Attended Noise Monitoring

Attended monitoring was conducted at two locations on the proposed site. The first location was on the boundary of the Great Western Highway and the second was on the boundary of Parker Street. Both measurement positions are detailed in figure 1 of this report.

The attended measurements were carried out on 6th August 2010.

Measurements were taken using a Norsonic-140 precision sound level analyser, set to A-weighted slow response. The sound level meter was calibrated before and after the measurements using a RION NC73 precision sound calibrator and no significant drift was recorded.

4.2.2 Unattended Monitoring

Unattended monitoring was also conducted at the site on the Great Wester Highway boundary.

The monitoring period was from Tuesday 27th July till Friday 6th August 2010, using an Acoustic Research Laboratories Pty Ltd noise monitor. The monitor was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of the measurements using a Rion NC-73 calibrator, no significant drift was detected. Measurements were taken on an A-weighted fast response mode.

4.2.3 Measured Noise Levels

The noise levels from attended and unattended monitoring are presented below. Monitor results are also presented in Appendix 1.

Table 2 – Attended and Unattended Traffic Noise Monitoring Data

LOCATION	TIME OF DAY	CALCULATED NOISE LEVEL dB(A)
Great Western Highway (approx 8m from curb)	Day (7am-10pm)	67 $L_{Aeq\ (15hour)}$
	Night (10pm-7am)	63 $L_{Aeq\ (9hour)}$
Parker Street (approx 5m from curb)	Day (7am-10pm)	65 $L_{Aeq\ (15hour)}$
	Night(10pm-7am)	62 $L_{Aeq\ (9hour)}$

4.3 EVALUATION OF NOISE INTRUSION

For the proposed development, internal noise levels will primarily be as a result of noise transfer through the windows and doors, as these are relatively light building elements that offer less resistance to the transmission of sound. The walls and roof are of masonry construction and will not require upgrading.

The predicted noise levels through the windows, doors, walls and roof are discussed below. The predicted noise levels have been based on the expected level and spectral characteristics of the external noise, the area of building elements exposed to train and traffic noise, the absorption characteristics of the rooms and the noise reduction performance of the building elements.

Calculations were performed taking into account the orientation of windows, barrier effects (where applicable), the total area of glazing, facade transmission loss and the likely room sound absorption characteristics. In this way the likely interior noise levels can be predicted.

In all cases, the selected glazing type detailed in Section 4.3.1 reduces internal noise levels to within the nominated criteria for the various space types.

4.3.1 Glazing Constructions

The recommended glazing assemblies are indicated in Table 3 below. The glazing thicknesses recommended are those needed to satisfy acoustic requirements and do not take into account other requirements such as structural, safety or other considerations. These additional considerations may require the glazing thickness to be increased beyond the acoustic requirement.

Table 3 – Glazing Requirement

Building	Space	Façade	Glazing Thickness	Acoustic Seals
A	Bedrooms	North (Facing Great Western Highway)	10.38mm laminated	Yes
		North (Facing Atrium)	6mm float	Yes
	Living Areas	North (Facing Great Western Highway)	10.38mm laminated	Yes
		North (Facing Atrium)	6mm float	Yes
		East, West (northern tower)	10.38mm laminated	Yes
		East, West (Southern Tower)	6mm float	Yes
	Retail	All	6mm toughened	Yes
	Commercial	North, East, West	6.38mm laminated	Yes
		South	6mm toughened	Yes
B	Bedrooms	East, West, South	6.38mm laminated	Yes
		North	6mm float	Yes
	Living Areas	East, West, South	6.38mm laminated	Yes
		North	6mm float	Yes

In addition to complying with the minimum scheduled glazing thickness, the STC/R_w rating of the glazing fitted into operable frames and fixed into the building opening should not be lower than the values listed in the Table 6 below.

Where nominated, this will require the use of acoustic seals equal to Schlegel Q-lon series *(acoustic bulb seal)* around the full perimeter of operable frames. The frame will need to be sealed into the building opening using a flexible 100% polyurethane sealant equal to Selly's Pro Series FIreblock. Note that mohair seals and/or mohair/plastic fin combination seals in windows and doors are **not** acceptable where acoustic seals are required.

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

Table 4 – Minimum STC/R_w of Glazing Requirements

Glazing Assembly	Acoustic Seals	Minimum STC/R_w of Installed Window
4mm float	Yes	27
6mm float	Yes	29
6.38mm laminated	Yes	31
10.38mm laminated	Yes	35

4.3.2 Roof

The proposed concrete construction for the roof will be acoustically acceptable without further upgrades.

4.3.3 Walls

The external walls are constructed of masonry and will be acoustically acceptable without further upgrades.

5 RAILWAY VIBRATION ASSESSMENT

Train induced ground borne vibration that is transmitted through the subsoil. These vibrations can be perceptible close to railways, as tactile vibrations and as structure borne noise.

5.1 PROJECT VIBRATION OBJECTIVES

5.1.1 Tactile Vibration

Human comfort is normally assessed with reference to the British Standard BS 7385 Part 2 1993 or Australian Standard AS 2670.2 1990.

The Interim Guideline references the OEH *Assessing Vibration- A technical guideline* which recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)".

British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" is recommended by the RIC's and SRA's Interim Guidelines for Councils "Consideration of rail noise and vibration in the planning process" as this standard includes guidance for the assessment of human response to building vibration including intermittent vibrations such as that caused by trains.

Human response to vibration has been shown to be biased at particular frequencies, which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 "Evaluation of Human Exposure to Vibration and Shock in

Buildings (1 to 80Hz)" which represents the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

This standard assesses the annoyance of intermittent vibration by using the Vibration Dose Value (VDV). Alternatively the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the "Daytime" (6am-10pm) and "Night time" (10pm-6am). The overall value is then compared to the levels in Table 5. For this project the aim will be for a low probability of adverse comment.

Table 5 - Vibration Dose Values ($m/s^{1.75}$) above which various degrees of adverse comment may be expected in residential buildings.

Place	Low Probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings 16hr day (Daytime)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8hr night (Night time)	0.13	0.26	0.51

5.1.2 Structure Borne Noise

The Department of Planning 'Development Near rail Corridors and Busy Road – Interim Guideline' only requires structure borne noise assessment to be conducted where buildings or adjacent lands are over railway tunnels. Section 3.6.2 of the standard states the following:

"…Where building are constructed over or adjacent to land over tunnels, ground-born noise may be present without the normal masking effects of air born noise. In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-born LAmax noise limit of 40 dB(A)(daytime and 35 dB(A) (nigh time)measured using the "slow" response time setting on a sound level meter."

"As a general guide, ground borne noise may be an issue in habitable rooms which are shielded from airborne noise from the railway. Examples are rooms that are not facing the railway, and where cuttings or noise barriers block the line of sight between the receiver room and the rail line. In addition, some structures such as suspended slabs can lend to vibration amplification."

In this case, the proposed development is not located over or adjacent to railway, and from the vibration testing conducted on site we found that the predicted structure borne noise are low and the normal masking effects of air borne noise are effective. Therefore, the groundborne noise is not assessed for this project.

5.2 RAIL VIBRATION MEASUREMENTS

The train vibration measurements were obtained at the development site boundary facing the Great Western Highway, as detailed in figure 1.

The attended measurements were carried out on Friday 6th August 2010.

A Svan958 four–channel sound and vibration meter and analyser fitted with a Dytran triaxial accelerometer was used for the vibration measurements.

5.2.1 Measured Vibration Levels

The maximum train pass-by ground vibration acceleration, the typical pass-by period (gained from both the noise and vibration measurements) and the estimated number of train pass-bys were used calculate the overall VDV values for each period of the day as detailed in the British and Australian Standards. The results are presented in Table 6.

Table 6 – Vibration Dose Values

TIME PERIOD	CALCULATED VDV m/s$^{1.75}$	CRITERIA VDV m/s$^{1.75}$	COMPLIES
Day (7am-10pm)	< 0.05	0.2	Yes
Night (10pm-7am)	< 0.05	0.13	Yes

The result of the tactile vibration investigation indicates that internal levels of human comfort will comply with the relevant criteria without any additional acoustic treatments.

6 NOISE EMISSION ASSESSMENT

Noise emissions goals for the site will be developed to ensure that the amenity of nearby land users (both new occupants in the development and residents in nearby properties) is not adversely affected.

The nearest affected properties are the residential properties to the west of the development across Parker Street and the Nepean Hospital to the south east of the site.

Criteria for the following noise sources will be calculated:

- Mechanical plant noise
- Noise from the loading dock

6.1 BACKGROUND NOISE MONITORING

Unattended monitoring was conducted at the site on the Great Wester Highway boundary.

The monitoring period was from Tuesday 27th July till Friday 6th August 2010, using an Acoustic Research Laboratories Pty Ltd noise monitor. The monitor was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of the measurements using a Rion NC-73 calibrator, no significant drift was detected. Measurements were taken on an A-weighted fast response mode.

The measured background levels are shown in Section 6.2.1, Table 7 below.

6.2 ACOUSTIC OBJECTIVES

As there are no specific noise emission guidelines in the Penrith City Council DCP the criteria will be obtained from the EPA Industrial Noise Policy.

The Industrial Noise Policy provides guidelines for assessing noise impacts from industrial developments. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The Industrial Noise Policy has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion.

6.2.1 Intrusiveness Criteria

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 5 dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

Table 7 below provides the measured background noise levels and the resulting intrusiveness criteria. For the purposes of this condition:

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

- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

Table 7 – Intrusiveness Criteria Acceptable Levels

TIME OF DAY	MEASURED BACKGROUND LEVELS – dB(A)L_{90}	RECOMMENDED ACCEPTABLE NOISE LEVEL - dB(A)$L_{eq(15min)}$ BACKGROUND + 5dB(A)
Day (7am-6pm)	56	61
Evening (6pm-10pm)	51	56
Night (10pm-7am)	38	43

6.2.2 Amenity Criterion

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

The Industrial Noise Policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Table 8 provides the recommended ambient noise levels for the suburban residential receivers for the day, evening and night periods. For the purposes of this condition:

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

Table 8 – INP Recommended Acceptable Noise Levels

TYPE OF RECEIVER	TIME OF DAY	RECOMMENDED ACCEPTABLE NOISE LEVEL dB(A) L_{eq}
Residential (Suburban)	Day	55
	Evening	45
	Night	40
Hospital - Internal - External	 Noisiest 1-hour period Noisiest 1-hour period	 35 50

6.3 RECOMMENDATIONS

6.3.1 Mechanical Plant

Mechanical plant items are not typically selected at selected at DA stage.

Detailed review of all external mechanical plant should be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to the levels set out in section 6.1 of this report.

All plant can be satisfactorily attenuated to levels complying with noise emission criteria through appropriate location and (if necessary) standard acoustic treatments such as noise screens, enclosures, in-duct treatments (silencers/lined ducting) or similar.

6.3.2 Carpark Noise

The proposed carpark and loading dock are located on basements 1, 2 and ground floor of building A. Noise from vehicle movements and use of the loading dock within the undercover carpark will not generate significant noise to the nearby sensitive receivers . The majority of the noise will come from vehicles entering/exiting carpark through the access via Barber Avenue.

The most potentially affected receivers are:

- Proposed serviced apartment (Building B);
- Nepean private hospital.

Noise levels at the nearby receivers are assessed based on TMAP Study by Traffix and the assumptions below:

- Based on the traffic report: afternoon peak hour vehicles in – 125 / vehicles out 165.
- We assumed that average vehicle speed is 10km/hour with typical sound power level 86 dB(A).
- We assumed that at peak hour 4 medium rigid truck entering/existing carpark at 10km/hour speed with typical sound power level 100 dB(A)
- Windows in building B are installed in accordance with the glazing requirement set out in Section 4.3.1.
- Windows in Nepean Private Hospital western façade are 6mm float, fixed glazing.

Table 9 – Predicted Internal Noise Levels

Space	Predicted Internal Noise Level	Assessment Criteria	Compliance
Building B rooms facing east	39 dB(A) L_{eq}	40 dB(A) L_{eq}	Yes
Nepean Private Hospital room facing west	34 dB(A) L_{eq}	35 dB(A) L_{eq}	Yes

7 CONCLUSION

This report provides the results of our acoustic assessment for the proposed development located at Barber Avenue, Kingswood.

Assessment of noise emissions has been conducted with reference to the Penrith City Council and EPA acoustic requirement. Provided recommendations set out in section 6.3 are adopted, noise impacts on nearby properties will be acceptable.

Railway vibration and train and traffic noise intrusion into the proposed mixed use development has been assessed. The assessment has been conducted in accordance with the requirements of NSW Government Department of Planning "Development Near Rail Corridors and Busy Roads"- Interim Guideline and The Australian Standard AS2107 and council requirements.

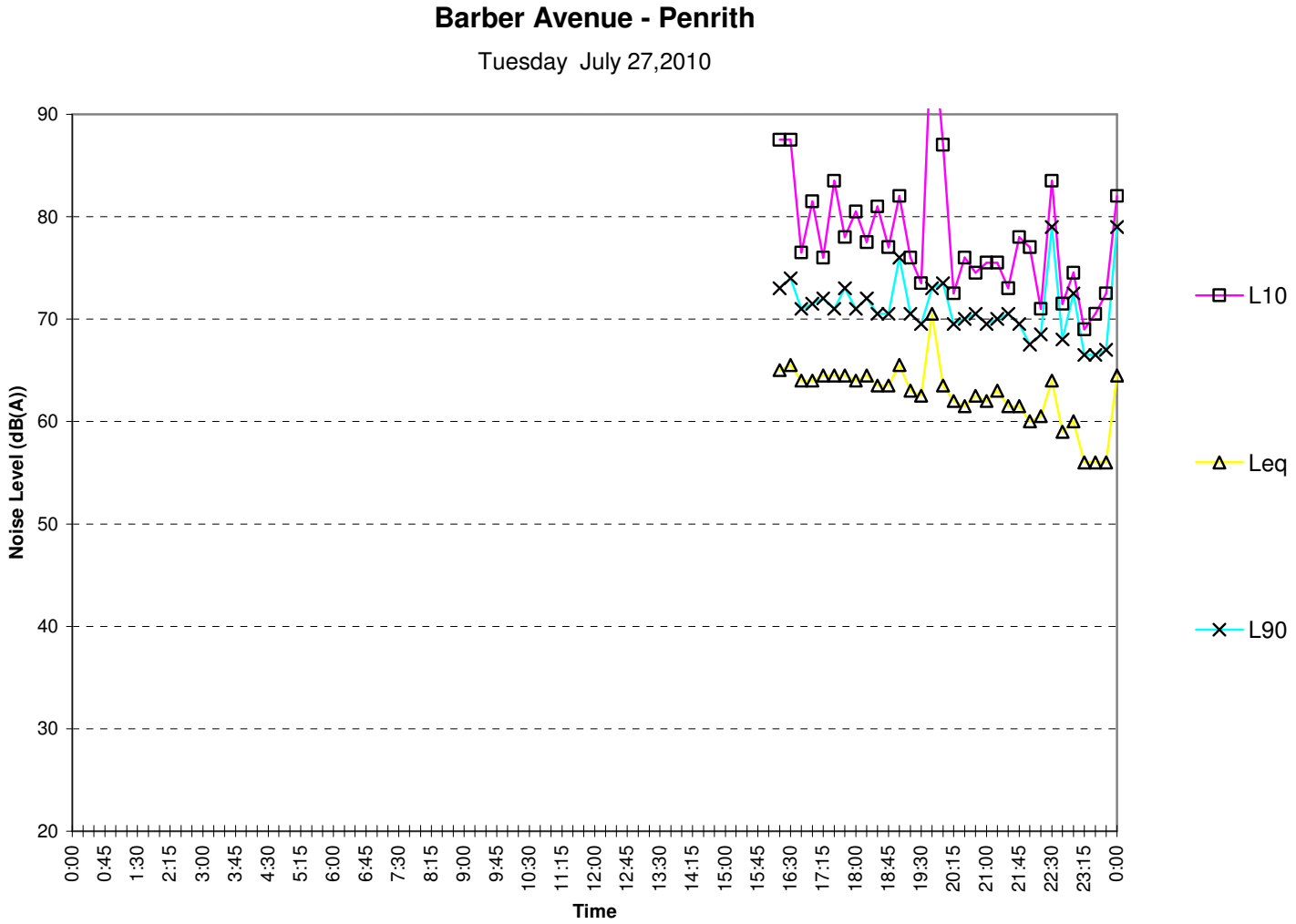
Provided noise intrusion recommendations in Section 4.3 are adopted external noise impacts will be satisfactory.

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

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
Johnny Zhang

APPENDIX 1: NOISE LOGGING DATA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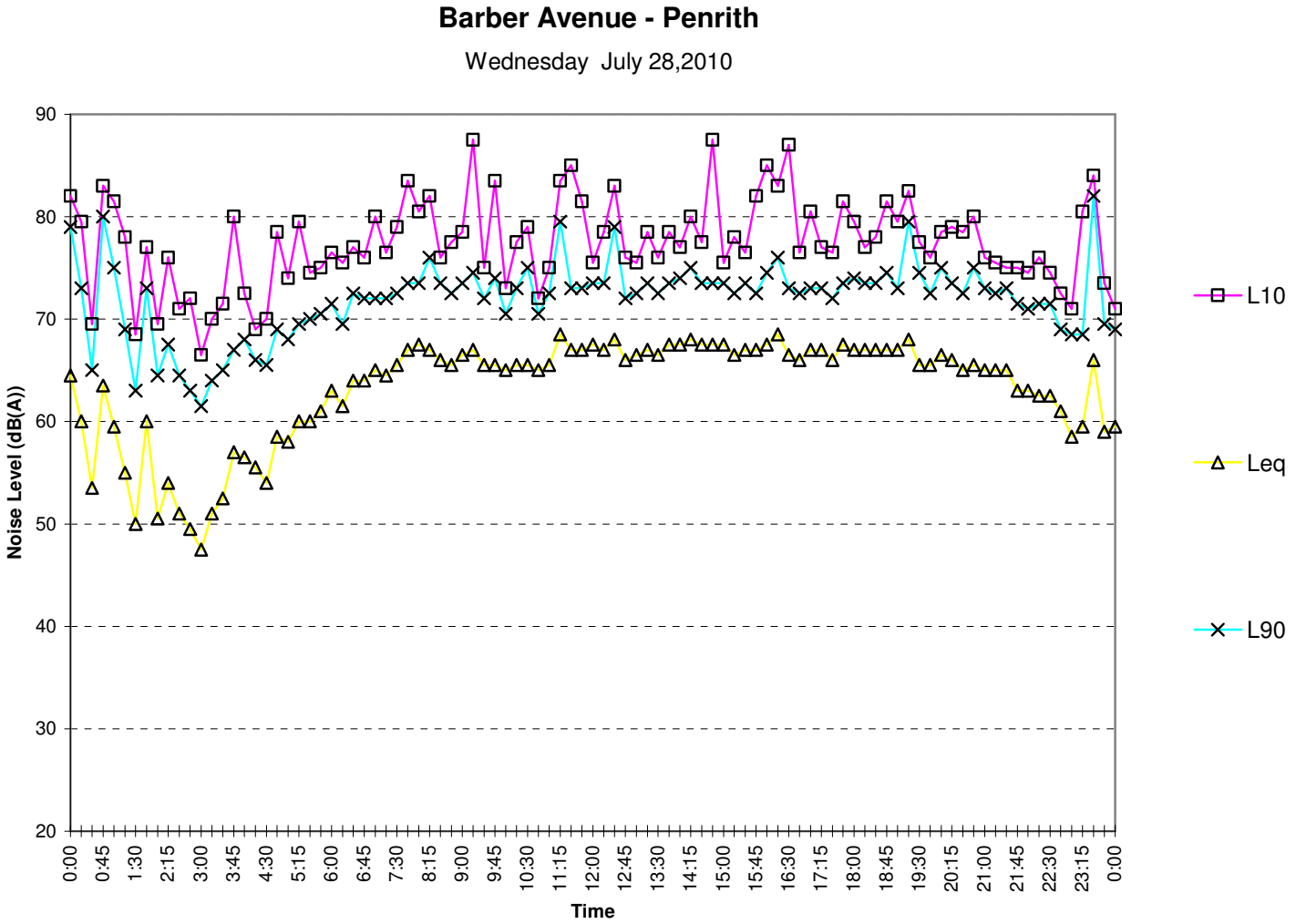
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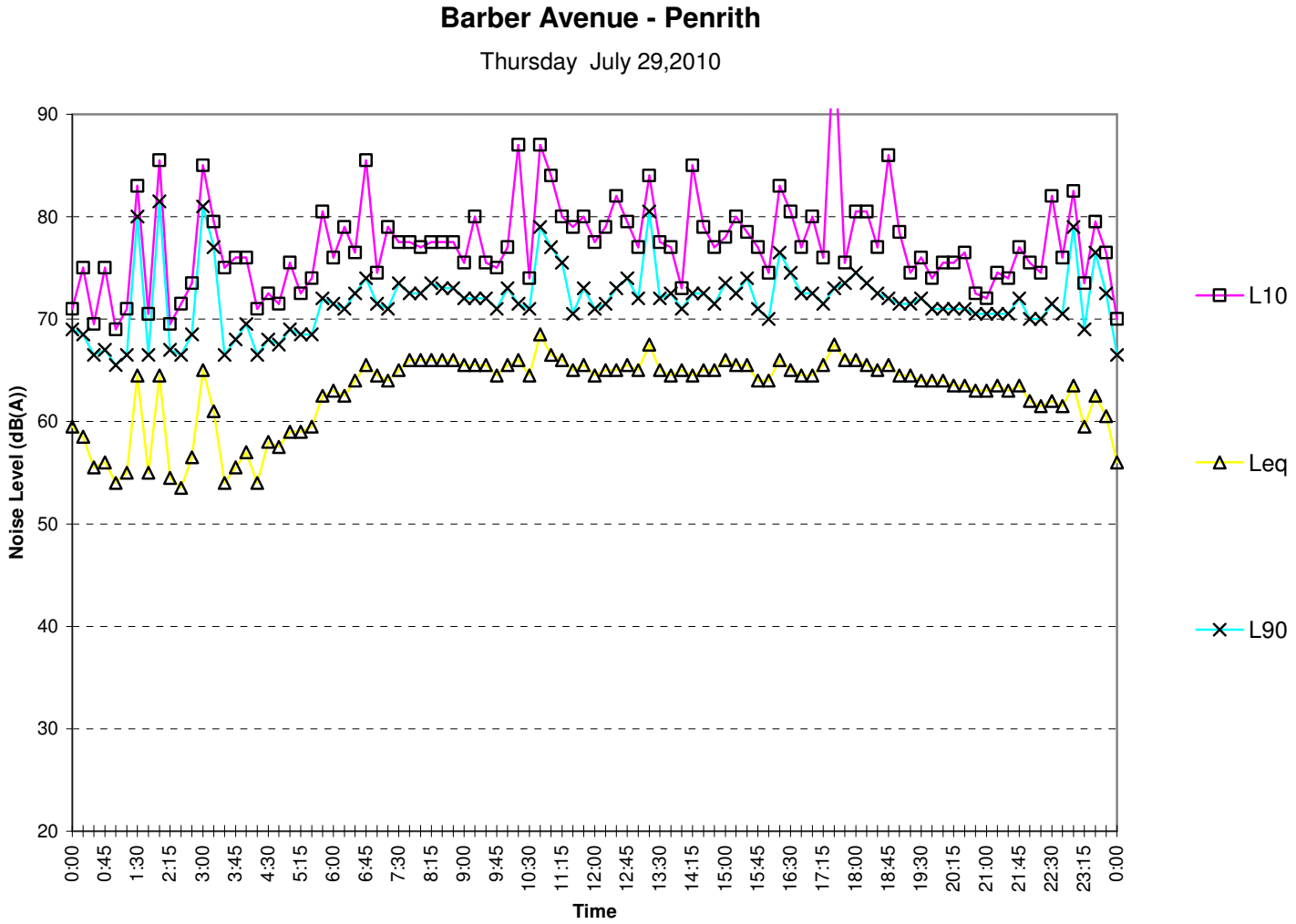
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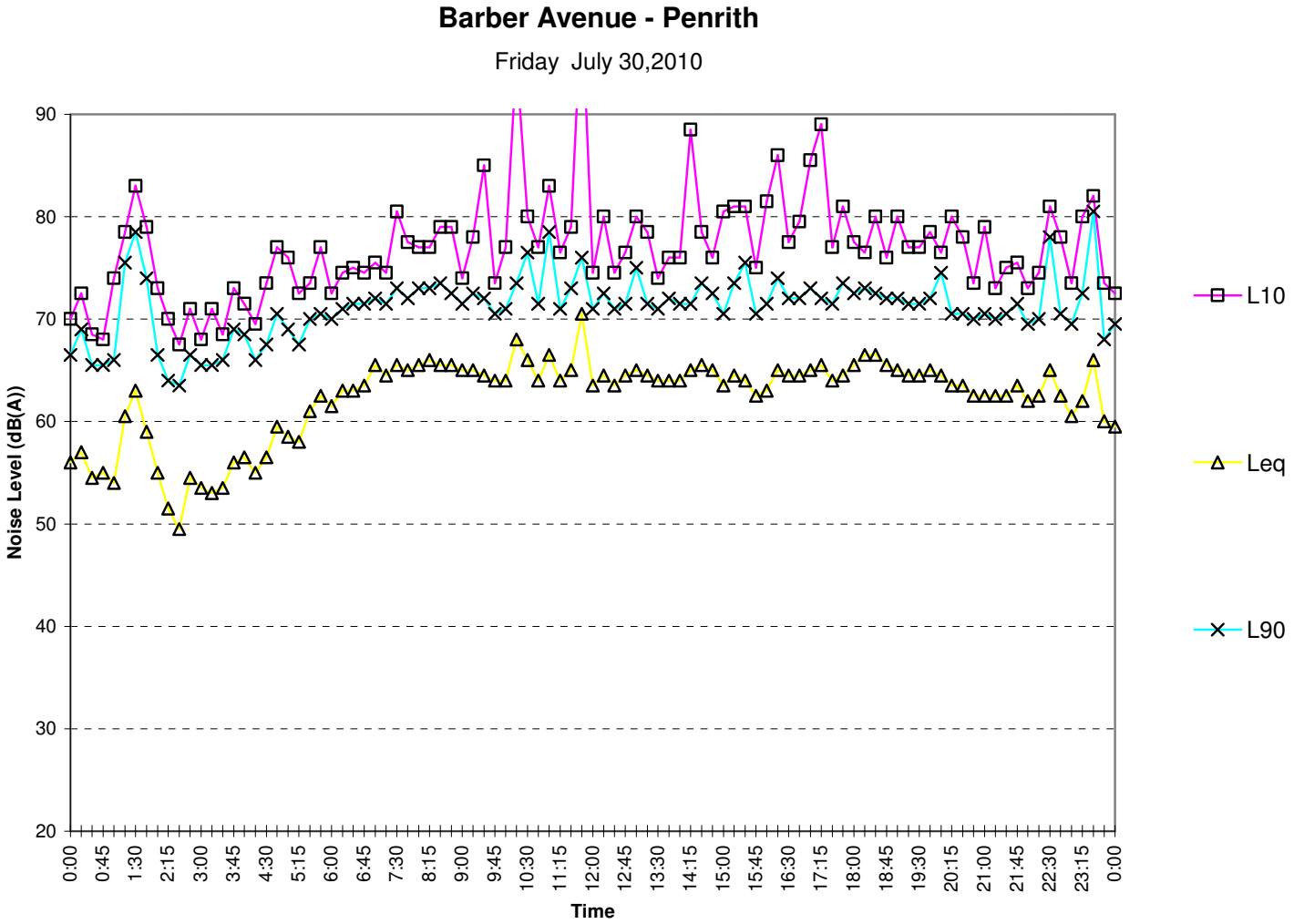
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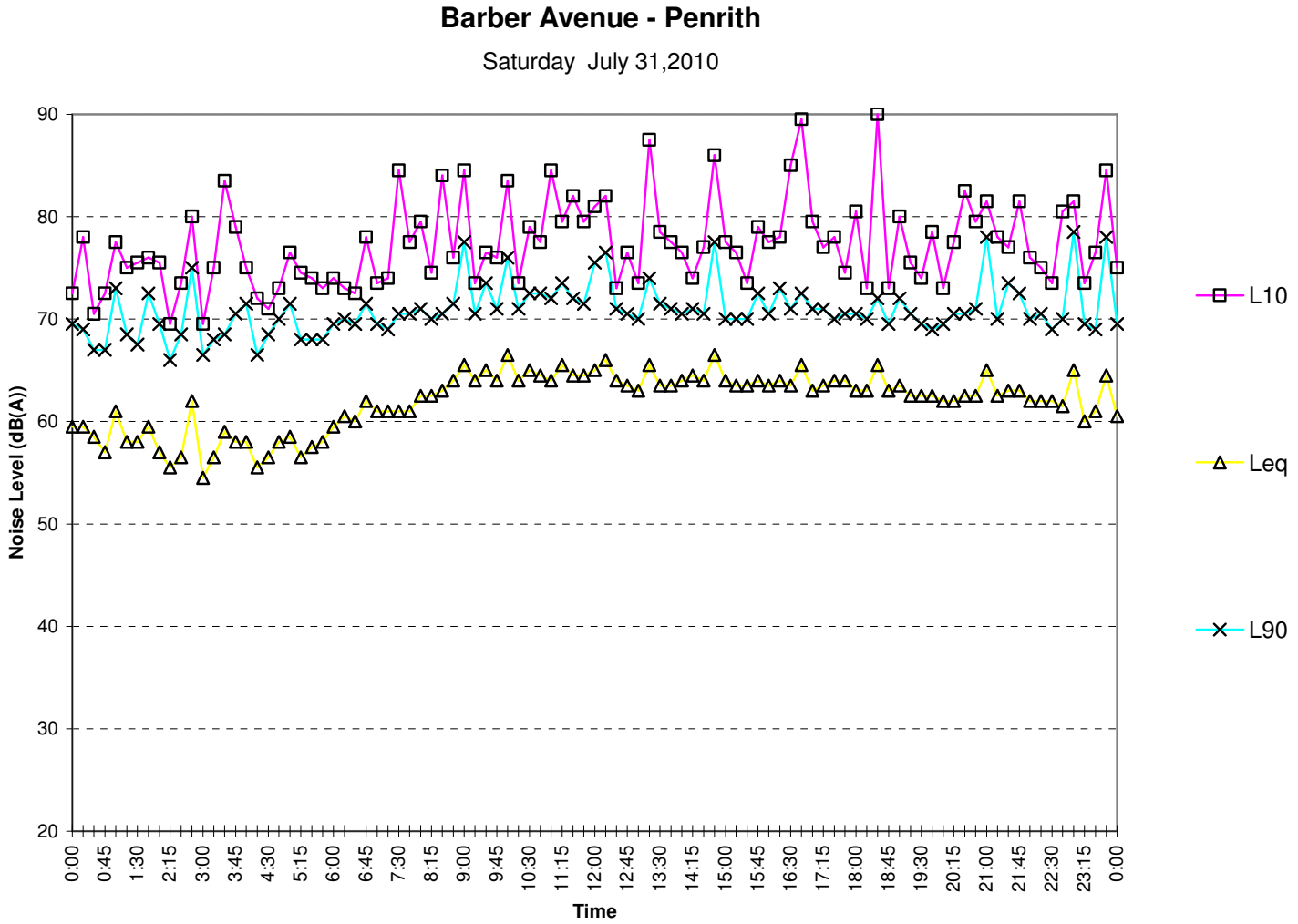
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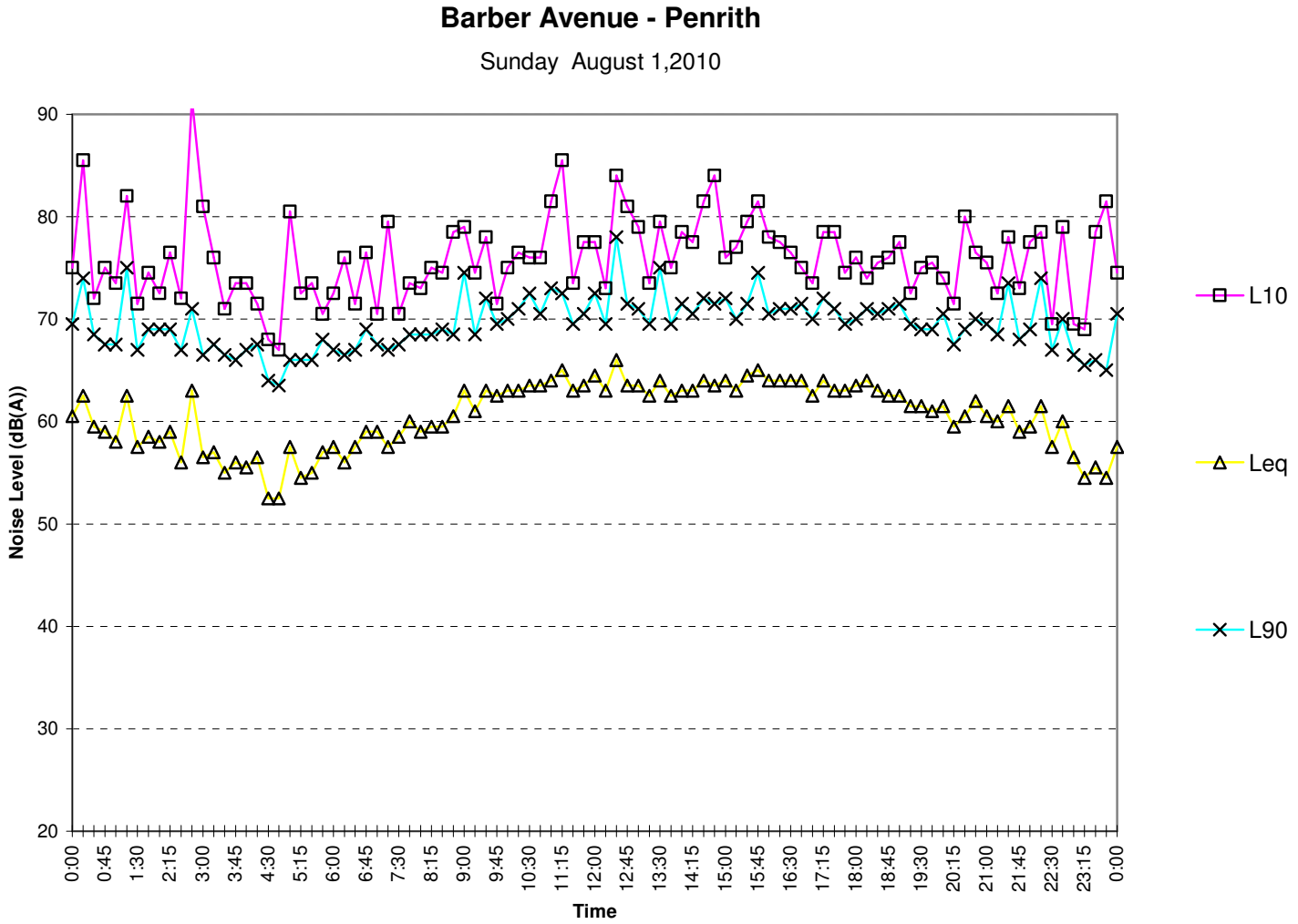
Barber Avenue - Penrith
Sunday August 1,2010
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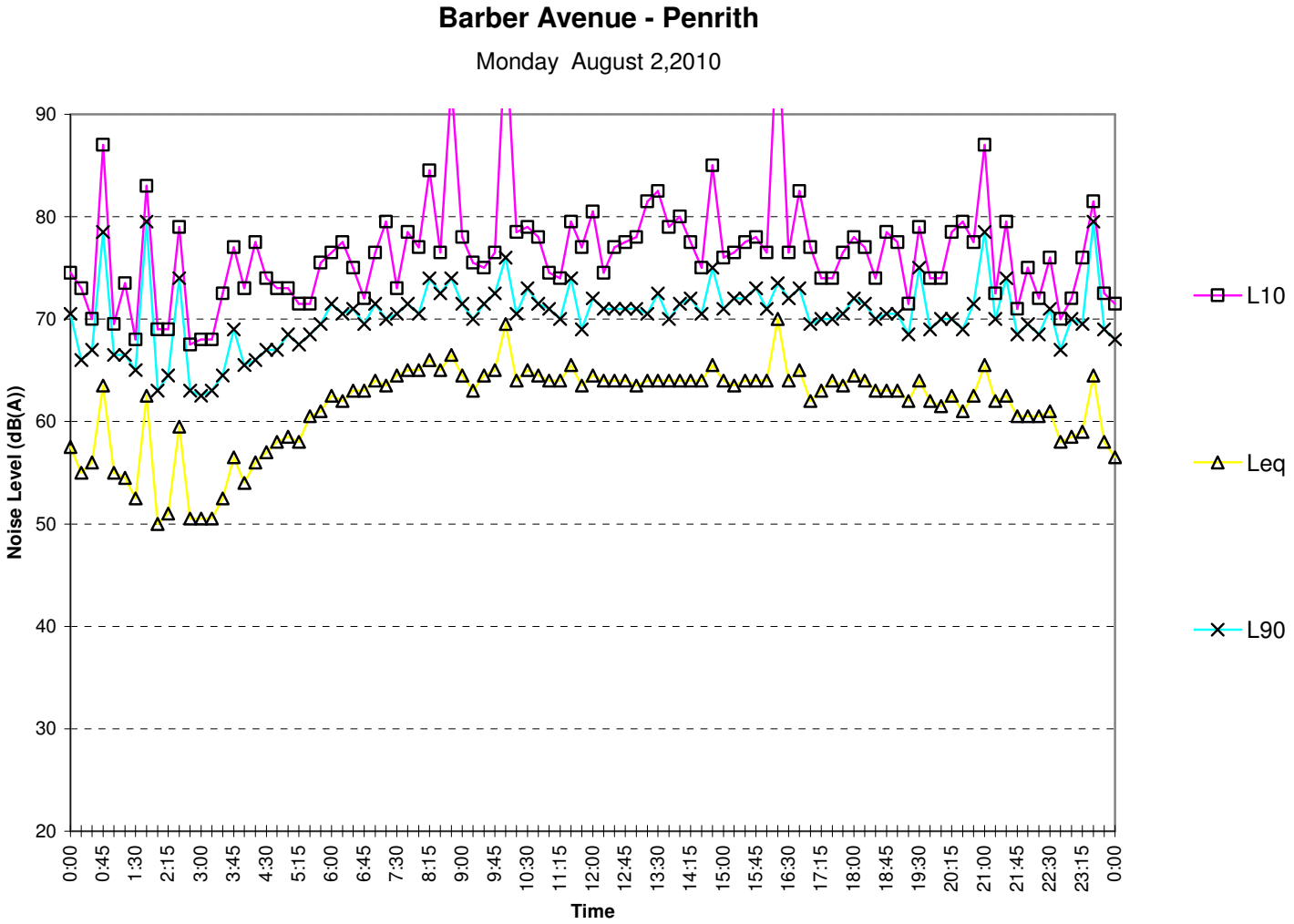
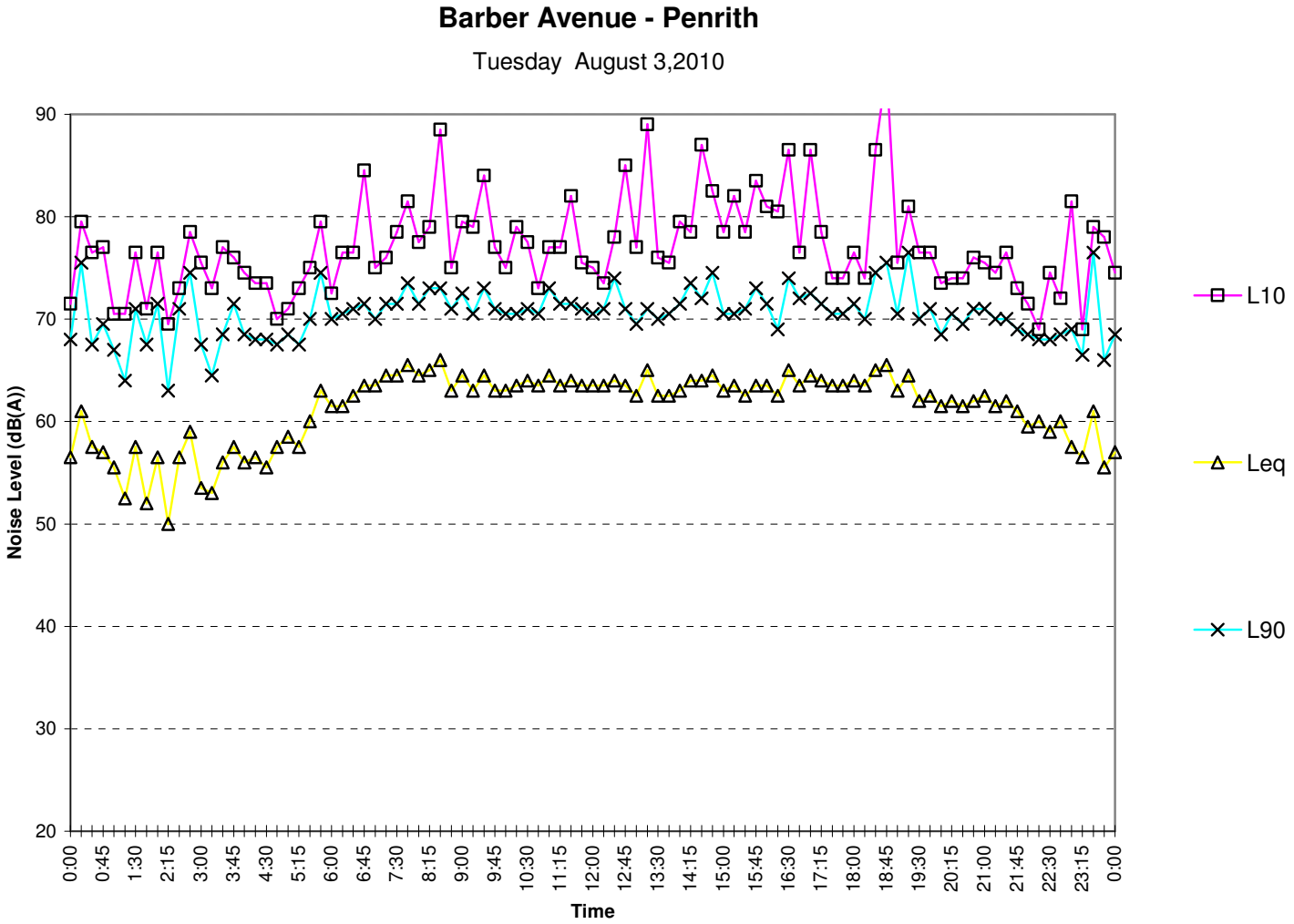
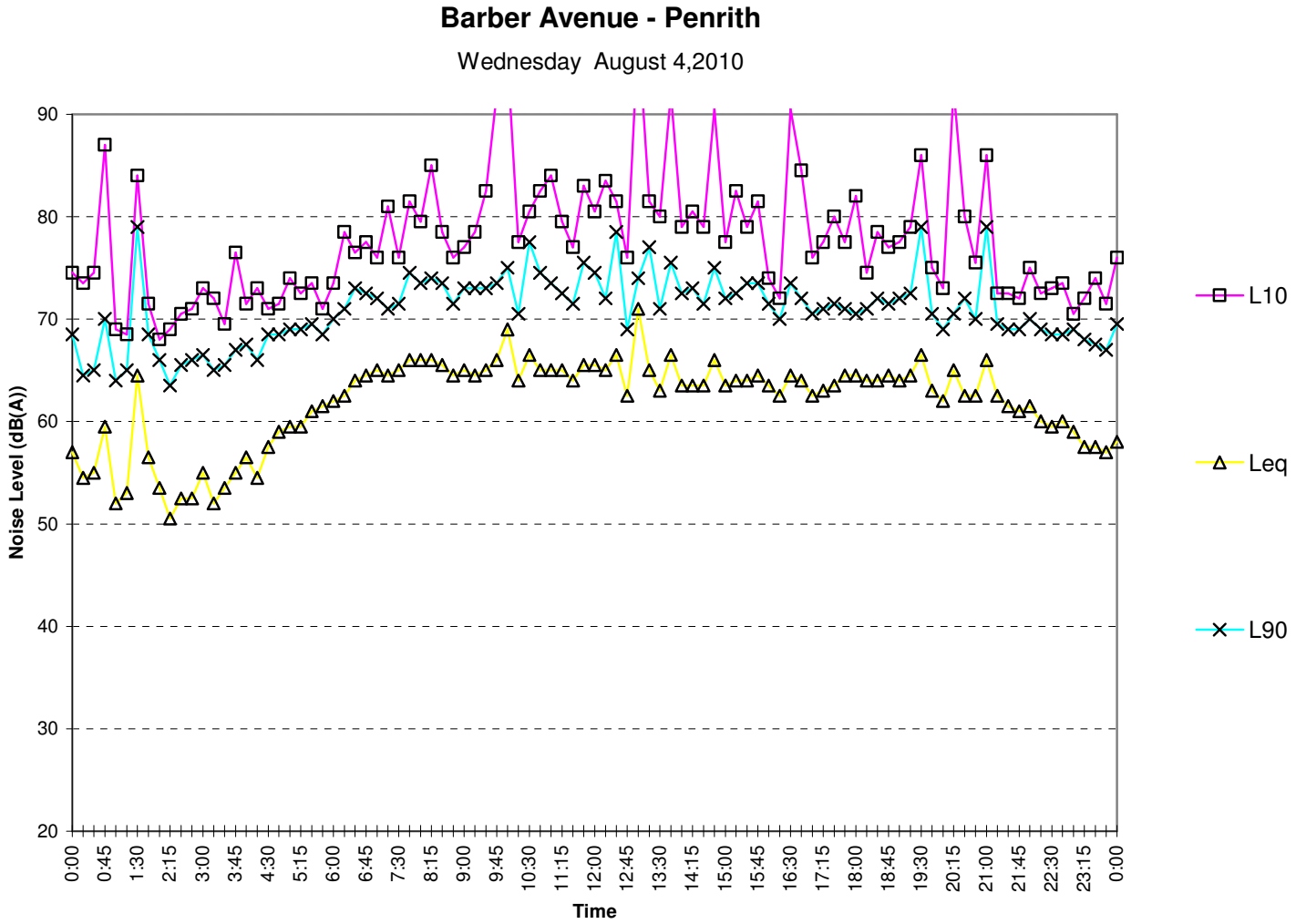
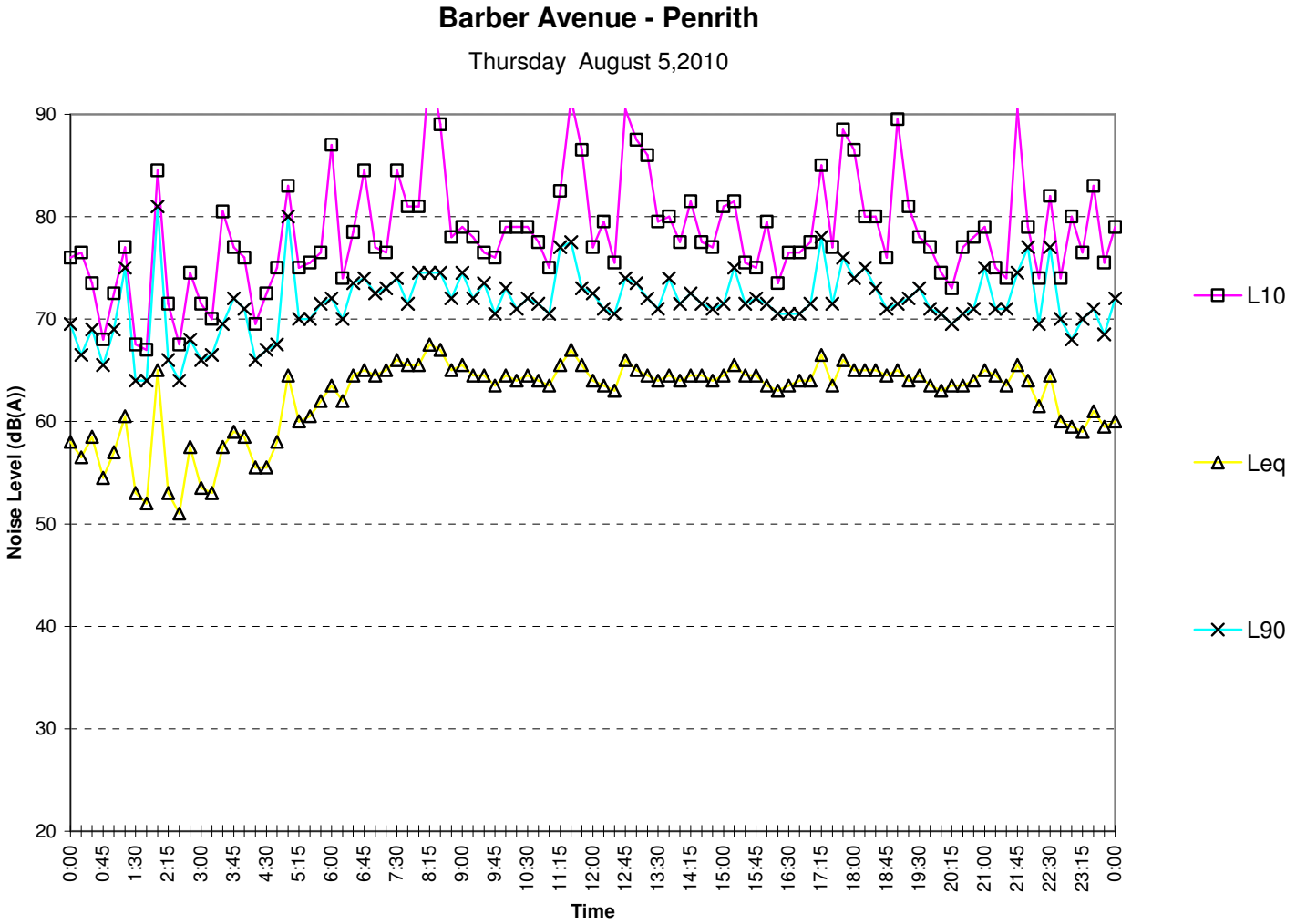
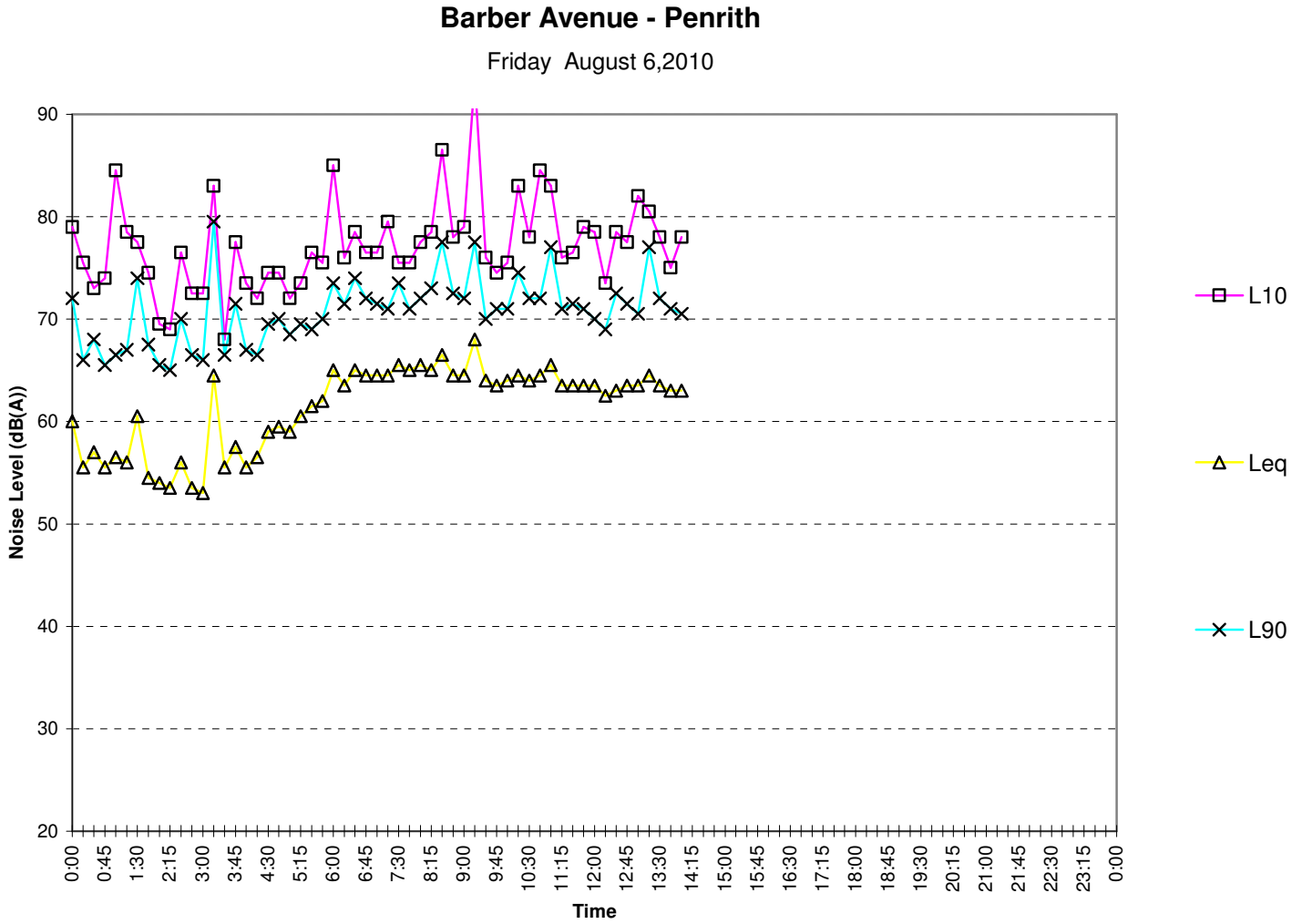
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90


Barber Avenue - Penrith
Monday August 2,2010
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90


Barber Avenue - Penrith
Tuesday August 3,2010
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90


Barber Avenue - Penrith
Wednesday August 4,2010
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90


Barber Avenue - Penrith
Thursday August 5,2010
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90


Barber Avenue - Penrith
Friday August 6,2010
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
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12:00
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13:30
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15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
L10
Leq
L90