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technical report

TURNER ROAD PRECINCT

NOISE IMPACT ASSESSMENT

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Prepared for:

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20 YEARS
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EXECUTIVE SUMMARY

Renzo Tonin & Associates were engaged to conduct an environmental noise assessment for the proposed Turner Road Precinct. The goal of the study was to identify key noise issues, quantify future noise levels, and identify possible noise management controls and constraints, to be included in the Indicative Layout Plan (ILP) for the precinct:

Key noise issues with potential to affect proposed development of the precinct were identified as:

- Road traffic noise from internal roads impacting upon future residential development;
- Noise generated by existing and future industrial development within Smeaton Grange impacting upon the Turner Road site;
- Noise generated by future industrial/commercial development within the Turner Road Precinct;
- Noise from licensed premises and community developments such as schools, childcare centres, sporting fields and multi-purpose halls; and
- Aircraft noise from Camden Aerodrome

TRAFFIC NOISE

The NSW Environmental Criteria for Road Traffic Noise (ECRTN) sets out criteria to be applied to particular types of road and land uses.

Potential traffic noise from various road types as set out in the GCC Development Code has been modelled. The results of the modelling indicate if no traffic noise mitigation measures are implemented along major and semi-major roads, residences exposed to these roads will be subject to traffic noise levels above the ECRTN noise goals.

Due to noise walls not being a desirable form of nose mitigation in residential areas, noise control through building design and facade treatment is the focus of this study. We note that the focus on building treatment rather than noise walls allows traffic noise to propagate over a larger area, resulting in a lower standard of outdoor amenity for residential areas, and an increase in the number of dwellings requiring 'better than standard' facade construction. Typical mitigation requirements for the various roads within the Precinct are set out in Table 8.

It has been determined that significant residential building treatment will be required along heavily trafficked roads in order to meet internal noise goals. For example, double glazing or single laminated glazing, and thick solid core doors will be required for facades exposed to busy roads. Where windows are required to be closed to meet the ECRTN goals, ventilation requirements (in accordance with the BCA) will also need to be considered for rooms affected. These rooms may require mechanical ventilation if adequate ventilation cannot be provided from other rooms or facades within the dwelling unaffected by road traffic noise.

Courtyards and private open space should be located away from the road, using the building as a buffer to obtain a quiet outdoor environment. If adequate outdoor space can not be provided behind the dwelling, boundary fencing on each lot may be required to reduce noise level in yard areas. This boundary fencing may need to be higher than standard fencing and would need to be of solid construction.

INDUSTRIAL NOISE

Operational noise impact from industrial or commercial developments is assessed in accordance with the guidelines set out in the NSW DEC's 'Industrial Noise Policy' (INP) document.

As background noise monitoring is not appropriate for 'greenfield' sites, reference to relevant Australian Standards has been made for estimating background noise levels for different receiver areas. In addition the amenity noise criterion has been discussed with reference to the NSW DEC's INP 'Assessment in Developing Areas'.

At this stage of the development specific developments or locations of developments are not known and therefore a full assessment of noise impacts can not be undertaken. Applicable noise criteria and management measures have been discussed to protect the noise amenity in the area. Any industrial or commercial developments are required to be assessed with a 'holistic' approach so that the total noise received from industry at any affected residential receiver will meet the relevant amenity noise criteria.

Wherever possible, buffer zones such as small retail stores, commercial offices, parks and open areas should be provided between major retail/shopping developments and residential developments so that a suitable outdoor amenity may be achieved. Loading docks are best located away from residential receivers as noise emissions from such sources are difficult to control, particularly at night.

Noise from existing and future industrial development within Smeaton Grange was identified as being a potential noise impact upon the Turner Road Precinct. However considering that residential land uses already exist along the southern most boundary of the Turner Road Precinct, and on the basis that the existing and future industrial sites within Smeaton Grange comply with the noise criteria set out in Camden Council DCP 2006 future land use within Turner Road Precinct should not be restricted.

LICENSED PREMISES AND COMMUNITY DEVELOPMENTS

In relation to licensed premises, schools, childcare centres, multi-purpose halls and sporting fields, details of such development are not yet known. However, the following design principles should be incorporated wherever possible.

- Licensed premises and restaurants with large outdoor eating areas are best located away from residential receivers as noise emissions from such sources are difficult to control, particularly at night. Distances of 100m or more to residences can be required if open-air operations are sought as physical structures are generally ineffective in reducing impacts without completely enclosing areas.

- Within schools, the location of outdoor play areas, sporting fields, bus bays and car parks should be separated from common boundaries of residential premises. Noise emanating from classrooms is not usually an issue unless classrooms and residences are both located close to a common boundary.

- Where child care centres are located adjacent to residences, noise from play areas can cause a noise nuisance. Construction of high solid boundary fences around play areas or restricting the duration of outdoor play times and the number of children outside at any one time can minimise noise impacts. Fences of around 2.5m high may be required for centres where residences are immediately adjacent.

- Where multi-purpose halls are located in close proximity to residential premises, acoustic design of the hall may be required to ensure a satisfactory noise amenity is achieved.

Where acoustic impact is not considered during the planning process, the potential uses of the development may be restricted and/or time limits imposed. It is common for usage to be restricted after 10pm.

- Noise from sporting fields is generally as a result of people noise and associated car parks. The DEC recommends the following time restrictions where separation distances to residences are not sufficient to control noise;

  7am to 6pm any weekday

  8am to 6pm Saturdays and Sundays

  6pm to 10pm two nights per week excluding Sundays or Public Holidays

AIRCRAFT NOISE

The potential impact of aircraft noise and overflights from Camden Aerodrome on the release area are assessed in accordance with AS2021-2000 'Acoustics - Aircraft noise intrusion – Building siting and construction'.

Reference has been made to the Camden Airport Master Plan 2004/05 and the Turner Road Precinct should not be adversely affected by aircraft noise.

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1. INTRODUCTION

Renzo Tonin & Associates were engaged to conduct an environmental noise assessment of the proposed Turner Road Precinct. The purpose of the assessment is to assist in development of the Indicative Layout Plan (ILP) for the precinct. This assessment examines the noise impacts on to the site from the surrounding environment and future developments within the precinct, including road traffic, industry, and aircraft. The assessment has been conducted in accordance with the Growth Centres Commission Development Code, NSW DEC noise policies, and relevant Australian Standards.

Where noise level predictions are undertaken, discussion of land usage and/or advice on in-principal noise control measures has been provided. Furthermore where noise levels can not yet be predicted, in-principal noise control planning concepts have been provided.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2. PROJECT DESCRIPTION

2.1 SITE DESCRIPTION

The Turner Road Precinct is situated some 70km from the Sydney CBD, between Liverpool (19km north-east), Campbelltown (7km south-east), and Camden (6km south-west). Camden Valley Way forms the entire north western boundary of the site, with Turner Road generally forming the south western boundary of the site. The eastern boundary comprises larger, rural living lots.

The site is to be developed for both commercial and residential land uses with associated community facilities such as a school and open spaces. It is proposed to development 4000 dwellings.

2.2 NOISE ISSUES

Excessive noise has been recognised as a major cause of disturbance to living and working environments and therefore as a key determinant of urban amenity. The major sources of noise potentially affecting the Turner Road Precinct site are:

- *Road traffic noise associated with existing roads, and roads constructed for the development*
  The site is bordered by Camden Valley Way to the west and the major internal roads being identified as Badgally Road, North Spine Road, Central Spine Road, South Creek Road, Kenny Creek Road,Southern Boulevard, South Spine Road 1 and 2, and Smeaton Grange Link Road have been investigated.

- *Industrial noise associated with the developments within the Turner Road Precinct*
  This includes retail, commercial and industrial noise sources within the Town Centre and employment zones.

- *Industrial noise associated with developments external to the Turner Road Precinct*
  This includes major industrial land uses in the process of development on the southern side of Turner Road, identified as Smeaton Grange.

- *Other Noise Generating Development*
  In addition to industrial noise sources other developments such as cafes, restaurants, bars, schools, multi-purpose halls, child care centres, and sporting ovals have the potential to generate noise impacts. Whilst specific developments are not known at this stage appropriate noise criteria and/or broad control measures are discussed.

- *Aircraft noise associated with the Camden Aerodrome*
  The south-western most point of the site is located approximately 3.5km from the north-eastern end of the Main Runway (06/24) of the Camden Aerodrome.

3. EXISTING ACOUSTIC ENVIRONMENT

Ambient noise data is useful for setting benchmark noise levels in an area already affected by traffic or industrial noise, and can also be used for validation of noise prediction models. For this project existing ambient noise levels were measured at two locations using long-term, unattended monitoring methods. The locations were selected to provide a representative sample of the acoustic environment to be found along the two major site boundaries.

Long-term noise monitoring was conducted over 7 days from 6th to 13th December, 2006 at the following locations:

- **Location M1** **55 Turner Road**
  8m setback from road, 1.5m above ground level

  Rural location, noise environment controlled by traffic noise from Camden Valley Way and intermittent traffic along Turner Road.

  Free field measurement. Traffic noise monitoring results have been facade corrected (+2.5dB(A)).

- **Location M2** **588 Camden Valley Way**
  46m setback from road, 1.5m above ground level

  Rural location, noise environment controlled by traffic noise from Camden Valley Way.

  Free field measurement. Traffic noise monitoring results have been facade corrected (+2.5dB(A)).

Appendix B details the noise monitoring methodology. The graphical recorded output from long term noise monitoring is included in Appendix C to this report.

A summary of the noise monitoring results are presented in Table 1 and Table 2 below. Table 1 presents 'free field' noise levels in accordance with the NSW DEC's 'Industrial Noise Policy' (INP) for daytime, evening and night-time periods. Table 2 presents 'facade' corrected noise levels in accordance with the NSW DEC's 'Environmental Criteria for Road Traffic Noise' (ECRTN) for daytime and night-time periods.

Table 1 – Measured Existing Background (L_{90}) & Ambient (L_{eq}) Noise Levels, dB(A)

Noise Monitoring Location	L_{90} Background Noise Levels			L_{eq} Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
M1 55 Turner Road	37	35	33	56	54	52
M2 588 Camden Valley Way	49	48	34	62	62	60

Notes:
1. *Day is defined as 7:00am to 6:00pm, Monday to Saturday; 8:00am to 6:00pm Sundays & Public Holidays.*
2. *Evening is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.*
3. *Night is defined as 10:00pm to 7:00am, Monday to Saturday; 10:00pm to 8:00am Sundays & Public Holidays.*

Table 2 – Measured Existing Weekly Road Traffic (L_{eq}) Noise Levels

Noise Monitoring Location	Road Traffic Noise Source	Distance from Road (m)	L_{eq} Traffic Noise Levels, dB(A)	
			Day	Night
M2 588 Camden Valley Way	CVW		$L_{Aeq,15hr}$ = 65	$L_{Aeq,9hr}$ = 62

Notes:
1. *Existing traffic noise levels measured at 1m from the residential facade*
2. *Day is defined as 7:00am to 10:00pm; Night is defined as 10pm to 7am*

4. ROAD TRAFFIC NOISE ASSESSMENT

4.1 ROAD TRAFFIC NOISE CRITERIA

4.1.1 NSW DEC's 'Environmental Criteria for Road Traffic Noise'

In accordance with the GCC Development Code the relevant guideline for managing road traffic noise is the NSW DEC's 'Environmental Criteria for Road Traffic Noise' (ECRTN - May 1999).

The ECRTN is used to assess the potential traffic noise impact on the site. Table 1 'Road Traffic Noise Criteria for Proposed Road or Residential Land Use Developments' divides land use developments into different categories and lists the respective criteria for each case.

Traffic noise levels are also assessed separately for daytime and night time periods, defined by the NSW DEC's 'Environmental Criteria for Road Traffic Noise' (ECRTN) as follows:

- **Day** is defined as 7:00am to 10:00pm;
- **Night** is defined as 10:00pm to 7:00am.

Table 3 sets out the road traffic noise criteria for new residential developments and road corridors.

Table 3 - DEC Road Traffic Noise Criteria, dB(A)

Type of Development	Day	Night
1. New freeway/arterial road corridor. 2. New residential land use developments affected by freeway/arterial traffic noise	$L_{Aeq(15hr)}$ = 55	$L_{Aeq(9hr)}$ = 50
4. New collector road corridor 5. New residential developments affected by collector traffic noise	$L_{Aeq(1hr)}$ = 60	$L_{Aeq(1hr)}$ = 55
9. New local road corridor in a metropolitan area 11. New residential developments affected by traffic noise from local roads	$L_{Aeq(1hr)}$ = 55	$L_{Aeq(1hr)}$ = 50

The ECRTN also sets guidelines for the assessment of traffic noise on sensitive land use developments, and are presented in Table 4 below.

Table 4 - Road Traffic Noise Criteria for Sensitive Land Use Developments

Type of Development	$L_{eq(1hr)}$,dB(A)	
	Day	Night
Proposed school classrooms	40 [1]	-
Existing school classroom	45 [1]	-
Hospital wards	35 [1]	35 [1]
Places of worship	40 [1]	40 [1]
Active recreation (eg golf courses)	$L_{eq(15hr)}$= 60 [2]	-

Type of Development	$L_{eq(1hr)}$,dB(A)	
	Day	Night
Passive recreation and school playgrounds	$L_{eq(15hr)}$= 55 [2]	-

Source: *NSW Environmental Criteria for Road Traffic Noise* (Environment Protection Authority, May 1999).

Note: 1. Internal noise criteria
2. External noise criteria
3. Not criteria specified in the DEC policy.

With regard to acceptable internal noise levels, the ECRTN states that;

> *"It is preferable for internal noise level criteria to be set by the relevant planning or building authority. The internal levels that are set may vary depending on the type of development the planning authority wants to encourage for an area. The Hornsby Shire and Sydney City councils have codes for internal noise level criteria in place. Sleeping areas are usually the most sensitive to noise impact, so in the absence of any local codes internal levels of 35 - 40 dB(A) at night are recommended. As a guide for other living areas, internal noise levels 10dB(A) below external levels are recommended on the basis of openable windows being opened sufficiently to provide adequate ventilation (refer to Building Code of Australia for additional information). For most residences this equates to a minimum of 20% of the window area left open."*

4.1.2 Australian Standard 2107-2000

Further to the criteria set out above, reference may also be made to AS2107-2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors" for recommended internal noise levels where the ECRTN external criteria can not be achieved. The standard recommends the following internal noise levels;

Table 5 – AS/NZS 2107-2000 Recommended Internal Noise Levels

Type of Occupancy – Residential Buildings		Recommended design sound level, L_{Aeq} dB(A)	
		Satisfactory	Maximum
Houses and apartments near minor roads	Living Areas	30	40
	Sleeping Areas	30	35
Houses and apartments near major roads	Living Areas	35	45
	Sleeping Areas	30	40

In addition, AS2107-2000 is appropriate for the assessment of traffic noise intrusion upon commercial and industrial developments. As the criteria are specific to the type of usage, assessment of commercial and industrial spaces should be conducted at the development application stage.

We note that the noise criteria for commercial and industrial spaces are generally less stringent than residential developments and are satisfied by careful design of the building envelope. Office spaces are often air-conditioned allowing windows to remain closed, which assists in achieving suitable internal noise levels.

4.2 ROAD TRAFFIC NOISE PREDICTION MODELLING

4.2.1 Modelling Method

Noise predictions are based on a method developed by the United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)" known as the CoRTN (1988) method. This method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board and as a result it is recognised and accepted by the Environment Protection Authority. The model predicts noise levels for steady flowing traffic and noise from high truck exhausts is also taken into account.

The noise prediction model takes into account the following:

Table 6 – Summary of Modelling Inputs

Input Parameters	Input used
Traffic volumes and mix	As described in Table 7 and Section 4.3
Vehicle speed	Upper limit of speed range as defined in Section C.3 of GCC Development Code
Gradient of roadways	flat
Source height	0.5m for car exhaust, 1.5m for car and truck engines and 3.5m for truck exhaust and detailed within CoRTN
Ground topography at receiver and road	Receiver and road at same level
Angles of view from receiver	160 degrees.
Reflections from existing barriers, structures and cuttings on opposite side of road	No significant structures or cuttings considered in modelling.
Air and ground absorption – Values vary between 0 (hard surface) to 1 (100% absorptive)	0.5 has been used in this study
Receiver Heights	1.5m above ground level for ground floor and 4.5m above ground level for 1st floor.
Facade correction	+2.5dB(A)
Australian conditions correction	-1.7dB(A)
Acoustic properties of road surfaces	Assumed dense graded asphalt
Roadside barriers	Barriers considered reflective on both sides. Mounds considered non-reflective

4.2.2 Road Design, Traffic Flow and Composition Summary

Section C.3 of the GCC's Development Code provides parameters for different road types within a development area. The parameters are summarised in Table 7 below, including an assumed setback distance from the nearest road lane to the residential facade. We understand that these parameter are currently under review and may be modified.

Table 7 – GCC Street Network Parameters

Road Type	Vehicles / 24hr day	Speed (km/h)	Minimum setback from nearest lane to residential boundary	Assumed setback from nearest lane to facade*
Arterial Road	35000+	Up to 80km/hr	Determined by RTA	110m^
Transit Boulevard	30000 - 35000	60 - 80km/hr	10.5m	15m
Sub-Arterial Road	10000 - 35000	Up to 70km/hr	6.8m	15m
Collector Street	3000 - 10000	Up to 60km/hr	5m	10m
Local Street	1000 - 3000	Up to 50km/hr	5m	10m
Minor Street	< 1000	Up to 50km/hr	To be determined through DCP	10m
Town Centre Street	20000	-	-	10m

*Notes: * Assumed by Renzo Tonin & Associates based on GCC Development Code diagrams and draft ILP.*
^ Based on nearest affected residential premises to Camden Valley Way

4.3 TRAFFIC NOISE PREDICTIONS

Specific land use zoning, lot boundaries and dwelling layouts have not yet been finalised for the Turner Road Precinct. Therefore, rather than predicting traffic noise levels at specific locations on the site, noise levels have been predicted according to road type, and the likely noise mitigation required for each road has been specified.

With respect to proposed noise mitigation treatment, we confirm that Section C.3 of GCC's Development Code "Streets – Street Hierarchy: Arterial Roads" states that;

> *"In residential areas, alternatives to noise walls should be used, such as significant landscaped areas and service roads."*

Furthermore, Camden Council has advised that noise mounds or barriers are not desirable along any roads internal to the site.

Section C.6 of GCC Development Code "Acoustical Privacy for Residential Development" also requires developers to;

> *"Design the internal layouts of apartments and the location of courtyards, terraces, balconies and openings to minimise noise transmission".*

Therefore, for internal roads, proposed noise mitigation measures focus on treatment of residential receivers in terms of building orientation, design layout, boundary fencing and building facade treatment, rather than mitigation of road noise through roadside mounds or barriers. However, Indicative noise wall heights have been included for completeness, and to provide a comparison between 'roadside' and 'building' treatments. We note that use of building treatment rather than roadside noise walls allows traffic noise to propagate over a larger area, resulting in a lower standard of outdoor amenity for residential areas, and an increase in the number of dwellings requiring 'better than standard' facade construction.

The Table 8 below presents predicted daytime traffic noise levels based on the following assumptions:

- The 24hr volumes are the maximums of the volume ranges shown in Table 7 , except for the sub-arterial which assumes 15,000 vehicles per day to provide a spread of volumes in the analysis. Also, the 24hr volume for an arterial road is assumed to be 40,000 vehicles.
- Peak hour traffic volumes are 10% of the 24hr volume
- The 15hr daytime volume is 85% of the 24hr volume
- The traffic speed is the upper limit of the range shown in Table 7
- Percentage of heavy vehicles in traffic mix is assumed to be 6% for arterial roads, 3% for transit boulevards, sub-arterials and town centre streets, and 0% for collector streets, local streets and minor streets.
- The distance from the nearside traffic lane to the residential facade is as shown in the last column of Table 7.
- Noise mounds / barriers are located midway between the road and the residential façade except in the case of Camden Valley Way where the noise mound/wall is assumed to be within 10m of the road edge.

Although there are both 'day' and 'night' traffic noise goals to be satisfied, the daytime traffic goals are usually more likely to be exceeded in a developed residential area. Night time road traffic noise levels are likely to create greater impact only where the percentage of heavy vehicles are significantly higher than the day time period. Assuming daytime is the worst case, Table 8 presents noise predictions and noise treatment to satisfy the daytime goals. If the daytime goals are satisfied, then the night time goals are also likely to be satisfied.

Noise predictions are to the first row houses alongside the road. The Option 1 building treatment in Table 8 would generally be required only for the first row of houses alongside the road since they would provide acoustic shielding to houses behind. In some cases, where there are large gaps between houses or open space alongside roads, houses set further back may also need to be acoustically treated. Furthermore, the Option 1 treatment refers to the facade facing the road and we would expect that there would be a reduction in noise impact on side and rear facades. We note that the resultant noise reduction is dependant upon the relationship of these facades to the road and therefore can not be calculated at this stage.

The following treatment recommendations provide in-principle noise control solutions to reduce traffic noise impacts to residential receivers. This information is presented as part of the ILP development and planning process, and shall not be used for construction unless otherwise approved in writing by the acoustic consultant. Assistance of an acoustic consultant must be sought at the detailed design phase of these works to provide the necessary design details and specifications prior to construction. The advice provided here is in respect of acoustics only. Supplementary professional advice should be sought in respect of fire ratings, structural design, build ability, fitness for purpose and the like.

Mitigation requirements shown are 'typical' based on GCC'c standard road cross sections and assumed vehicle speeds and setbacks, and assuming flat ground. Mitigation requirements may differ from those shown depending on ground topography (particularly elevated residences), building setback, and varying traffic volumes and mix.

For specific developments within the Turner Road Precinct developers should outline the noise control treatment option(s) to be incorporated into the development that demonstrate compliance with DEC noise standards (as outlined above) prior to approval for development being given.

Table 8 – Traffic Noise Predictions for 2029

Road Type	Peak Hour Traffic Volume	ECRTN Daytime External Noise Criteria, dB(A)	Predicted Daytime Traffic Noise Level at nearest residential facade dB(A) [1]	Typical Mitigation Requirements			Application to Turner Road Precinct
				Option 1 – Typical building treatment for first row of dwellings to satisfy internal noise goals		Option 2 – Typical Noise mounds/walls to satisfy external goals	
				Bedrooms	Living Areas		
Arterial Road	4000	$L_{Aeq,15hr}$ 55	$L_{Aeq,15hr}$ 59	Windows closed Standard glazing	Windows closed Standard glazing	2m	Camden Valley Way
Transit Boulevard	3500	$L_{Aeq,15hr}$ 55	$L_{Aeq,15hr}$ 70	Windows closed 10.38/12/6 double glazing Acoustic seals on windows and doors	Windows closed 10.38 laminated glazing Acoustic seals on windows and doors Solid core 45mm doors on external facades	4m	N/A
Sub-Arterial Road	1500	$L_{Aeq,15hr}$ 55	$L_{Aeq,15hr}$ 65	Windows closed 10.38mm laminated glazing Acoustic seals on windows and doors	Windows closed 6.38mm laminated glazing Acoustic seals on windows and doors Solid core 45mm doors on external facades	3m	Badgally Road (East)
Collector Street	1000	$L_{Aeq,1hr}$ 60	$L_{Aeq,1hr}$ 67	Windows closed 10.38mm laminated glazing Acoustic seals on windows and doors	Windows closed 6.38mm laminated glazing Acoustic seals on windows and doors Solid core 45mm doors on external facades	1.5m	Nth Spine Rd Sth Creek Rd
Local Street	300	$L_{Aeq,1hr}$ 55	$L_{Aeq,1hr}$ 60	Windows closed 6.38mm laminated glazing Acoustic seals on windows	Windows closed Standard glazing	1.5m	Ctrl Spine Rd Kenny Crk Rd Sth Boulevard

Road Type	Peak Hour Traffic Volume	ECRTN Daytime External Noise Criteria, dB(A)	Predicted Daytime Traffic Noise Level at nearest residential facade dB(A) [1]	Typical Mitigation Requirements			Application to Turner Road Precinct
				Option 1 – Typical building treatment for first row of dwellings to satisfy internal noise goals		Option 2 – Typical Noise mounds/walls to satisfy external goals	
				Bedrooms	Living Areas		
				and doors			Sth Spine Rd 1 Sth Spine Rd 2
Minor Street	100	$L_{Aeq,1hr}$ 55	$L_{Aeq,1hr}$ 55	Standard	Standard	none required	Smeaton Grange Link
Town Centre Street	2000	$L_{Aeq,15hr}$ 55	$L_{Aeq,15hr}$ 67	Windows closed 12.38mm laminated glazing Acoustic seals on windows and doors	Windows closed 6.38mm laminated glazing Acoustic seals on windows and doors Solid core 45mm doors on external facades	3m	N/A

Note: 1. Mitigation requirements shown are 'typical' based on GCC'c standard road cross sections and assumed vehicle speeds, and assuming flat ground. Mitigation requirements may vary with ground topography, building setback, and varying traffic volumes and mix.

2. Traffic noise levels are predicted to the ground floor level of a dwelling. Option 2 wall heights refer to the height required to comply at ground level. First floor facades would still require building treatment

3. Where windows need to remain closed to achieve internal noise levels, ventilation should be provided to meet BCA requirements.

4. 10.38/12/6 double glazing means 12mm air gap between 10.38mm laminated glass and 6mm float glass.

5. Building treatments are based on internal noise goals of 35dB(A) for bedrooms and 40dB(A) for living areas.

4.4 DISCUSSION OF TRAFFIC NOISE MITIGATION OPTIONS

Further to the noise mitigation requirements set out in Table 8, we provide the following information regarding traffic noise mitigation. Reference has been made to The RTA's 'Environmental Noise Management Manual' (ENMM) which gives guidance on appropriate treatment of dwellings affected by traffic noise.

4.4.1 Building Treatment & Design

Typical building treatments in the form of glazing and door requirements have been provided in Table 8 above according to road classification. Building treatments have been determined based on internal noise goals consistent with the ECRTN and Australian Standard 2107-2000.

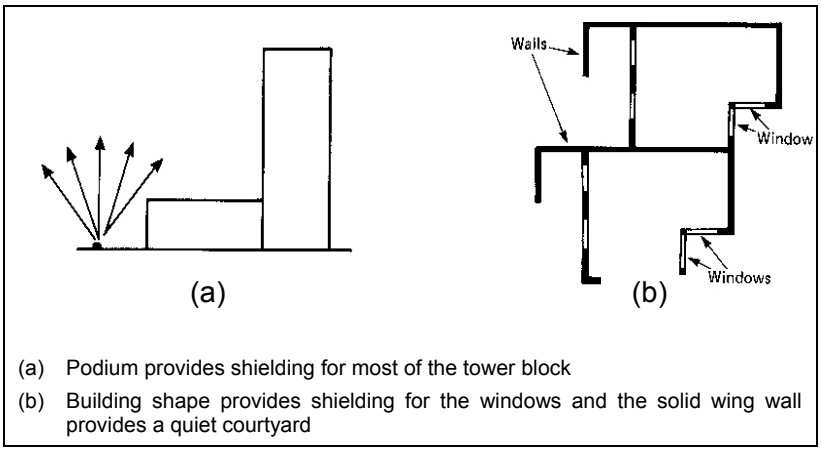
The use of building treatments rather than roadside noise walls means that internal noise levels are achieved by keeping windows and doors closed. This means that adequate ventilation (in accordance with the BCA) needs to be considered for rooms with facades facing the road. These rooms may require mechanical ventilation if adequate ventilation cannot be provided from other rooms or facades within the dwelling.

Using building treatments rather than roadside noise walls also leaves outdoor areas exposed to traffic noise. Courtyards and open space areas should be located away from the road, using the building as a buffer to obtain a quiet outdoor environment. If adequate outdoor space can not be provided behind the dwelling, boundary fencing on each lot may be required to reduce noise level in yard areas. This boundary fencing may need to be higher than standard fencing and would need to be of masonry, steel, or lapped and capped timber construction, or other solid construction of suitable mass. A standard timber paling fence would not be suitable.

Dwellings constructed in traffic noise affected areas can be designed so that their layouts minimise noise in living and sleeping areas. Within the building itself, locate less sensitive rooms closest to the road, so that these essentially form a barrier between the road and noise sensitive rooms such as bedrooms and study's.

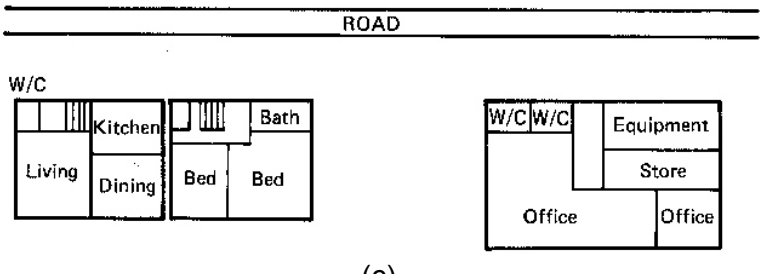
Access points to dwellings should be off smaller local roads and not via roads that are the source of high traffic noise impacts. This allows for the construction of solid boundary fences facing the traffic noise source to provide some acoustic shielding, which would otherwise be ineffective with the inclusion of openings for drive ways and the like.

Figure 1 below provides examples of 'self protecting' building design. Figure 2 shows an example of building layout to reduce noise.



(a) Podium provides shielding for most of the tower block

(b) Building shape provides shielding for the windows and the solid wing wall provides a quiet courtyard



(c)

(c) Arrangement of rooms to minimise traffic noise problems

Figure 1. Examples of 'Self-Protecting' Buildings
(Nelson P 1987 p11/16)

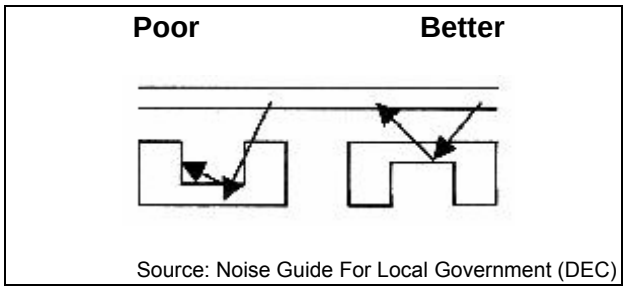


Figure 2: Example of building layout to reduce noise impact

Best practice elements for good acoustic design of development around road transport corridors include:

- locating non noise-sensitive buildings (such as commercial buildings) between the residential buildings and the road transport corridor wherever possible. Care should be taken to manage any noise impact at the residences from commercial activities;
- designing the layout of residential buildings to have bedrooms on the opposite side of the building to the road transport corridor. Non-habitable rooms (such as the bathroom, hallway, laundry, kitchen) can be placed on the road side of the building (see Figure 1(c));
- providing the residents' common or private outdoor space with as much shielding as possible from the road transport corridor. One possible way to provide shielding is by using the height of the residential building.
- include good quality seals on windows and doors and suitable glazing on the residential building facades facing the roadway, and possibly the side façade if external noise levels are high enough (see Table 8); and
- where mechanical ventilation is required to achieve the internal noise levels, it should be designed to satisfy the requirements of part F4 of the Building Code of Australia.

4.4.2 Building Setback

To achieve the ECRTN traffic noise goals, setback distances in the order of 400m from Arterial Roads, 250m from Transit Boulevards, 200m from Sub-arterials, and 100m from Collector Roads would be required.

Excluding residential development within these setback distances is likely to be unfeasible, therefore a combination of setback distance with noise barriers or building design and façade treatment should be used to achieve the set noise goals.

However where the proposed residential dwelling designs may be such that the first row of houses act as a noise barrier (i.e. with the linking of dwellings with solid noise walls), the objective is to achieve suitable outdoor amenity to the rear of residential premises. Therefore it may be more appropriate to reduce the standard residential front setback distances to allow increased land area to the rear of properties.

4.4.3 Roadside Mounds or Barriers

Roadside noise barriers can usually reduce noise levels by 5dB(A) when they are high enough to break line of site and 10 - 15dB(A) in the acoustic 'shadow zone', with a maximum total noise reduction of 20dB(A). The table below gives an indication of the degree of difficulty in attaining certain noise reductions from noise barriers.

Table 9 – Noise Barrier Attenuations

Reduction in Sound Level	Reduction in Acoustic Energy	Degree of Difficulty to attain
5dB(A)	70%	Simple
10dB(A)	90%	Attainable
15dB(A)	97%	Very Difficult
20dB(A)	99%	Nearly Impossible

(RTA's ENMM p17)

Noise barriers can be very effective for mitigating traffic noise as long as there are no breaks in the barrier. However, where the proposed dwellings at the site are to be double storey, large noise barriers would be required to mitigate noise to the upper level. There are significant issues of aesthetics and practicality when trying to shield the first floor with barriers. As a result, facade treatment is usually preferred for the first floor. Additionally, high walls may detract from streetscape character, as well as concealing houses and entrances. Combinations of earth mounds and lower height walls can reduce the scale and potential visual impacts of barriers, particularly in conjunction with landscape treatments.

Noise walls can be constructed using timber, pre-cast concrete panels, lightweight aerated concrete, fibrous cement panels, transparent acrylic panels or profiled steel cladding.

See Table 8 above for indicative noise wall heights required for roads within the Turner Road Precinct.

4.4.4 Road Pavement Surfaces

'Quiet' road pavement surfaces such as Open Graded Asphaltic Concrete (OGAC) or Stone Mastic Asphalt (SMA) can provide a 2-4 dB(A) noise reduction at the source compared to standard pavements, at speeds of greater than 80km/hr. Noise reductions are less for speeds less than 80km/hr.

The proposed speed limits for many of the internal roads within the Turner Road Precinct are less than 80km/hr. With this in mind, using a quieter pavement may be feasible, however the application may not provide a significant noise reduction. The high costs associated with the application of a quieter pavement is probably not a cost effective option considering the low noise

reductions achieved compared to the noise reduction required to comply with the ECRTN target criteria.

Designing road pavement heights to be below the natural ground level and minimising gradients can also reduce potential traffic noise problems, reducing the requirement of other mitigation measures.

4.4.5 DEC's ECRTN

The DEC's ECRTN provides the following direction in relation to new residential developments such as the Turner Road Precinct.

> *"New residential areas provide greater opportunities for noise mitigation than existing developments, because strategies can be implemented at both the planning stages of a development as well as at the individual allotment stage. In planning and designing a development it is important that noise be considered and balanced against other design considerations, such as solar access, privacy and security.*
>
> *Noise mitigation measures for new residential developments would include:*
>
> *1. Considering traffic noise impacts when planning the development of areas and incorporating suitable measures such as:*
>
> *- spatial separation between noisy activities and noise-sensitive areas through locating less noise-sensitive land uses (active recreation areas or access ways) in high noise areas*
>
> *- taking advantage of any natural topographic features that can be used to screen noise impacts when planning land use in an area*
>
> *- laying out subdivisions in ways that maximise the area shielded from noise*
>
> *- using intervening structures such as multilevel buildings to act as barriers. Buildings used as barriers should incorporate noise-quietening principles into their building design to ensure appropriate internal conditions.*
>
> *2. Appropriate building design on development around roads to minimise noise impacts, for example by:*
>
> *- including acoustic design principles when planning landscaping for a site by examining the suitability of earth berms, walls or fences to act as barriers*
>
> *- designing buildings to locate noise insensitive areas such as the kitchen, storage areas and laundry towards the noise source; minimising the numbers and size of windows oriented towards the noise source; replacing a conventional roof design with eaves by a flat roof with parapets; and using the building structure to shield outdoor areas*
>
> *- using construction techniques that pay good attention to sealing air gaps around doors and windows exposed to noise; using solid core doors; and using thicker window glass or double glazing.*

4.4.6 DEC's Future Policy and Potential Relaxation of Current Policy

The Department of Planning (DoP), in conjunction with DEC, the RTA and NSW Health, is currently developing planning guidance for development around enterprise and transport

corridors as part of Metropolitan Strategy. These planning guidelines are likely to be ready mid-2007. Although current 'best-practise' acoustic design of residences along road corridors have been mentioned in the Turner Road Precinct study, the future DoP policy may assist further in determining appropriate and cost effective mitigation measures, particularly with regard to residences on local roads.

Based on DEC's current ECRTN policy, Table 8 above indicates that even residences on some of the quieter streets within the Turner Road Precinct, such as 'collector' streets and 'local' streets, may require specific acoustic treatments such as upgraded glazing, acoustic seals and mechanical ventilation due to exceedance of the recommended noise goals. To implement these treatments adds significant costs to dwelling construction. However, we note that these exceedances are likely only to occur during the day, during AM and PM peak hour traffic periods. At other times of the day and night noise levels are likely to comply with set criteria. A relaxing of the daytime criteria by around 5dB(A) during peak hours would reduce the need for costly treatments, but still limit traffic noise levels during the rest of the day and night. We therefore recommend continuing discussions with DoP and DEC with regard to their future policy, and also the potential relaxing of current noise criteria during peak hour periods for local streets.

4.5 MAXIMUM NOISE LEVEL ASSESMENT

The DEC's policy on traffic noise does not specify a night-time L_{max} noise limit or noise goal. This is primarily because research conducted to date in this field has not been definitive and the relationship between maximum noise levels, sleep disturbance and subsequent health effects is not currently well defined.

According to the policy however, the likely maximum or peak noise levels are to be broadly assessed and reported for the night-time period, which is considered by the DEC as being 10pm to 7am.

According to Practice Note (iii) of the RTA's ENMM, a maximum noise event can be defined as any pass by for which:

$$L_{max} - L_{eq(1hr)} \geq 15dB(A)$$

Maximum noise events are most commonly caused by truck traffic. Based on maximum noise levels from truck passbys contained within our database, and consistent with our noise monitoring on site, L_{max} noise levels could reach 76-86dB(A) at houses with a 15m setback.

Whether these levels would lead to maximum noise events as defined above would depend on the ambient $L_{eq\ (1hr)}$ noise level in the area. However, it is likely that the noise mitigation implemented at the site to control L_{eq} traffic noise would also reduce the impact of any maximum noise events.

5. INDUSTRIAL NOISE ASSESSMENT

5.1 INDUSTRIAL NOISE CRITERIA

Industrial noise (including operational noise from commercial developments) is usually assessed in accordance with the NSW DEC's (formerly EPA) 'Industrial Noise Policy' 2000 (INP), and is referred to in the GCC Development Code.

The assessment procedure in terms of the DEC's 'Industrial Noise Policy' (INP), has two components:

- Controlling intrusive noise impacts in the short term for residences
- Maintaining noise level amenity for particular land uses for residences and other land uses.

5.1.1 Intrusive Noise Impacts

According to the INP, the intrusiveness of a mechanical noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5dB(A).

This intrusiveness criterion is easily applied to existing situations since the background noise level can be measured and the criteria set. However measuring the existing background noise is not suitable as the Turner Road Precinct is to be developed on a greenfield site and the background noise level is likely to increase once the site is fully developed.

It is difficult to predict precisely by how much existing background noise levels would be expected to increase as a result of the Turner Road Precinct development. However, guidance can be taken from the estimated average background noise levels provided in Appendix A of Australian Standard 1055:2-1997 'Acoustics: Description and Measurement of Environmental Noise', which provides indicative background noise levels for different residential areas in Australia. Noise area categories relevant to Turner Road Precinct are summarised below.

Table 10 – Estimated Average L_{A90} Background Noise Level from AS 1055:2-1997, dB(A)

Noise Area Category	Description of Neighbourhood	Monday to Saturday			Sundays and Public Holidays		
		0700-1800	1800-2200	2200-0700	0900-1800	1800-2200	2200-0900
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45

Areas located in close proximity to major arterial roads and commercial centres would be considered R4, areas near smaller collector roads may be considered R3 and those in general suburban areas affected mainly by local road traffic may be considered R2.

5.1.2 Protecting Noise Amenity

The Amenity Criteria are determined in accordance with Chapter 2 of the NSW INP. The INP recommends base acceptable noise levels for various receivers, including residential, commercial, industrial receivers and sensitive receivers such as schools, hospitals, churches and parks.

The amenity impact is assessed over three time periods as follows:

- **Day** is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.
- **Evening** is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.
- **Night** is defined as 10:00pm to 7:00am, Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays.

The maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the policy, the applicable parts of which are reproduced below. These criteria apply externally, at the most affected point on or within the residential property boundary.

Table 11 - DEC's Industrial Amenity Noise Criteria, dB(A)

Location	Amenity Criteria $L_{Aeq,period}$		
	Day	Evening	Night
Residence (urban)	60	50	45
Residence (suburban)	55	45	40
Commercial premises (when in use)	65	65	65

We would assume that the majority of the land use would be categorised 'suburban' whilst areas located in proximity to the future Turner Road Town Centre may be categorised 'urban'.

5.1.3 'Modifying Factor' Adjustments

Further, to the above, where the character of the noise in question is assessed as particularly annoying (i.e. if it has an inherently tonal, low frequency, impulsive or intermittent character), then an adjustment of 5dB(A) for each annoyance aspect, up to a total of 10dB(A), is to be added to the measured value to penalise the noise for its potential increase in annoyance.

Most mechanical plant emits a steady, broadband noise and as such these modifying factors do not normally apply to mechanical plant. Loading docks sometimes emit impulsive noises such as clangs and bangs from loading / unloading, and tonal noise such as reversing alarms however the most significant noise sources are usually truck engines and refrigeration plant which produce a steady noise and occur for a longer duration of time.

5.1.4 Sleep Intrusiveness Criteria

The DEC has formally produced the following statement with respect to the sleep disturbance matter:

> *"Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational*

phases of a development. The INP does not specifically address sleep disturbance from high noise level events.

DEC reviewed research on sleep disturbance in the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, DEC recognised that current sleep disturbance criterion of an LA1, (1 minute) not exceeding the LA90, (15 minute) by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, DEC will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or LA1, (1 minute), that is, the extent to which the maximum noise level exceeds the background 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 appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:

- *how often high noise events will occur*
- *time of day (normally between 10pm and 7am)*
- *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*

The LA1, (1 minute) descriptor is meant to represent a maximum noise level measured under 'fast' time response. DEC will accept analysis based on either LA1, (1 minute) or LA, (Max)."

The policy confirms that a sleep disturbance criterion of $L_{A1(1min)} < L_{A90(15min)} + 15dB(A)$, should only be used as a first step 'guide' as it is 'not ideal' and 'where it is not met, a more detailed analysis is required'. That detailed analysis includes a reference to the research material contained in the ECRTN in the assessment of the subject proposal.

The DEC has confirmed in earlier advice that the background $L_{A90(15minute)}$ includes the noise from the subject premises. This interpretation was confirmed with the Head Officer of the DEC Noise Policy Section.

The table below sets out the sleep arousal criteria for the different Noise Category Areas discussed in Section 5.1.1.

Table 12 – Sleep Intrusiveness Criteria

Noise Category Area	L_1 Criteria, dB(A)
R2	$L_1 \leqslant 35 + 15 =$ **50**
R3	$L_1 \leqslant 40 + 15 =$ **55**
R4	$L_1 \leqslant 45 + 15 =$ **60**

5.2 FUTURE INDUSTRIAL NOISE SOURCES

At this stage of the development specific developments or locations of developments are not known and therefore assessment of noise impacts can not be undertaken. However concept plans indicate that the Turner Road Town Centre is proposed to the north-east of the subject development area. For the assessment of such development Section 2.2.4 of the NSW DEC's INP sets out guidelines for '*Assessment in Developing Areas*' and relevant sections of 2.2.4 have been reproduced below.

> *"The recommended acceptable noise level from Tables 2.1 and 2.2* [reproduced in Table 11 of this report] *represents the ideal total noise level of noise from industry that should be met by a proposed development and any future, potentially noise producing, developments in the area."*
>
> *"Where several developments are proposed for an area, these are to be assessed as a group. This holistic approach allows project-specific noise levels to be set for a proposed industrial development, so that the total impact from all proposed developments does not cause amenity to deteriorate. In addition this approach provides an equitable distribution in the burden of meeting noise criteria."*
>
> *"Implementation of this 'holistic' approach involves the following steps in relation to impacts at the most sensitive receivers:*
>
> 1. *Determining the number of development proposals to be assessed.*
> 2. *Determining the amenity level according to Tables 2.1 and 2.2.*
> 3. *Determining the project specific noise level to be achieved by each development at the receiver, so that, when each is added together logarithmically, the resultant total level of noise received from industry at any affected receiver will meet the amenity level identified at Step 2."*

For example, if 10 industrial/commercial developments were proposed in an area where they may impact upon the same residential receiver then the project specific noise goal for each development at the receiver point would be 10dB(A) below the relevant amenity criteria. If only 2 developments were proposed then the project specific noise goal for each development at the receiver point would be 3dB(A) below the relevant amenity criteria.

Therefore in the preparation of the Precinct plan guidelines need to be established so that industrial or commercial developments are required to be assessed on this basis.

Therefore in the preparation of the Precinct plan, guidelines need to be established so that industrial or commercial developments are required to be assessed on this basis. The following general planning principles should be considered when planning the Turner Road employment zone indicated for the western section of the site:

- Buffer zones such as individual retail stores, commercial offices, parks and open areas should be provided between major retail/shopping developments and residential developments where suitable outdoor amenity is sought.
- Location of loading docks should not be located in proximity to residential receivers as noise emissions from such sources are difficult to control and night time operations are usually restricted in such cases.

In general the proposal of developments with potential to generate high noise levels should be located near other commercial developments where noise criteria is less stringent and noise impacts are less likely to adversely impact the receivers or operations of the proposed developments.

Furthermore, the developer should demonstrate compliance with DEC noise standards (as outlined above) prior to approval for development being given, especially with regard to cumulative impacts on any residential areas located at the boundary of the employment zones.

5.3 EXISTING INDUSTRIAL NOISE SOURCES

Smeaton Grange is an industrial zone located immediately to the south of the Turner Road Precinct. The industrial area is under continual development with future sites being approved for development up to the southern side of Turner Road.

Specific noise criteria for the industrial premises located in Smeaton Grange is set out in Part G, Chapter 16 of the Camden Council Development Control Plan 2006 and has been reproduced below:

> ***12.3 Noise***
> *(a) Noise emissions from development are not to exceed the "amenity criteria" of the NSW Industrial Noise Policy.*
>
> *(b)The industrial area adjoins residential and rural residential areas and Council wishes to ensure that the amenities of these areas are not adversely impacted upon by industrial development. More importantly, there is a high school located within the Smeaton Grange Area and the amenity of this site must be protected.*
>
> *(c) Compliance with the current provisions of Protection of the Environment Act 1997 and the associated Environmental Noise Control Manual is required in relation to any industrial activity or process and includes the use or operation of any machinery.*
>
> *(d) An industry shall be conducted so as to avoid unreasonable noise and interference to adjoining industrial occupations. Special precautions must be taken to avoid nuisance in neighbouring residential areas, particularly from warning sirens, public address systems, heavy duty compressors and the like.*
>
> *(e) Specific Noise Controls:*
> *(i) The maximum industrial noise level when measured 2 metres from all factory openings must not exceed 60 dB(A) LAeq for uses in the 4(a) zone and 55 dB(a) LAeq for uses in the 4(b) zone.*
> *(ii) For uses which involve activities that occur in the open including storage areas, the maximum industrial noise level when measured at any adjoining commercial use must not exceed 65 dB(A) LAeq and must not exceed 70 dB(A) LAeq at adjoining industrial uses.*
> *(iii)Consideration should be given to the management of heavy vehicle movements to developments during the night or early morning, in the vicinity of existing or proposed residential areas*

We note that whilst specific reference to the INP's intrusive noise criterion is not made in the Camden Council DCP 2006 we consider that the reference to the Protection of the Environment Act 1997 in section 12.3(c), use of a background + 5dB(A) criterion would be required for assessment of offensive noise.

As the existing land uses on the northern side of Turner Road is residential, provided that assessment and design of the future and existing industrial sites are in accordance with criteria set out in the Camden Council DCP 2006, future residential or commercial development should not be restricted within the Turner Road Precinct.

Furthermore as discussed in Section 5.1.1 as a result of the Precinct development background noise levels are likely to increase, resulting in reduced noise impact from developments designed to comply under the existing conditions.

6. LICENSED PREMISES AND COMMUNITY DEVELOPMENT

In addition to potential noise impacts from industrial and road traffic noise sources other developments within the proposed Turner Road Precinct have the potential to generate noise impacts on the future residential premises. Such developments include:

- Licensed premises (including bars and restaurants);
- School facilities;
- Child care centres;
- Multi-purpose halls; and
- Sporting fields.

6.1 LICENSED PREMISES

In addition to any specific Council noise criteria, premises with a Liquor Licence are required to comply with the standard noise criteria issued by the Liquor Administration Board (LAB). The LAB recommends the use of their standard noise criteria when assessing noise impact from licensed premises and when determining the occurrence of noise nuisance and annoyance. The LAB's noise criteria are stricter than the DEC's guidelines as they set limits for each octave band instead of a single overall A-weighted noise limit. The LAB's 'Standard Noise Condition' states as follows;

> *"The LA10* noise level emitted from the licensed premises shall not exceed the background noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) by more than 5dB between 7:00am and 12:00 midnight at the boundary of any affected residence.*
>
> *The LA10* noise level emitted from the licensed premises shall not exceed the background noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) between 12:00 midnight and 7:00am at the boundary of any affected residence.*
>
> *Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 7:00am.*
>
> *Interior noise levels which still exceed safe hearing levels are in no way supported or condoned by the Liquor Administration Board.*
>
> *This is a minimum standard. In some instances the Board may specify a time earlier than midnight in respect of the above condition.*
>
> **For the purposes of this condition, the LA10 can be taken as the average maximum deflection of the noise emission from the licensed premises."*

Noise emission from licensed premises is usually as a result of patron and music noise. Where outdoor dining, beer gardens and terrace areas are sought for subject developments noise emission can be difficult to contain and physical noise controls are limited. In addition, where high music noise levels are sought in venues for entertainment careful design of the building envelope is required.

Therefore location of nearby residential premises can impact the viability of such proposals and restriction of use may be required where physical noise control treatments are not practical.

Particularly where outdoor usage is proposed, depending on the background noise of the area and the capacity and operation, separation distances of 100m or more can be required to satisfy even the before midnight LAB noise criteria. We recommend special consideration of such issues where mixed use (commercial/residential) developments are proposed.

6.2 SCHOOL FACILITIES

The GCC Development Code, NSW Department of Environment and Conservation (DEC) guidelines, Australian Standards, and other regulatory codes do not provide specific noise guidelines for schools facilities.

However, it is common in situations where noise impact from such developments are required to be quantified and assessed, that reference is made to the NSW INP for activities within the school buildings.

With respect to outdoor playground areas Renzo Tonin & Associates refer to a previous NSW Land and Environment Court hearing (*MC Nicholls Pty Ltd v Ku-ring-gai Council 2000*) where the criterion determined by the case was that the $L_{Aeq(15min)}$ should not exceed background noise level (L_{A90}) plus 10dB(A). This criterion takes into account the nature and the relatively short duration of the noise.

We note that in some cases such criteria can be difficult to achieve and therefore the following broad design guidelines may be preferable in reducing potential noise impacts from schools. Such guidelines may include;

- The location of outdoor play areas and sporting fields should be removed from common boundaries of residential premises;
- Access for buses and car drop off should be should be removed from common boundaries of residential premises;

6.3 CHILD CARE CENTRES

The GCC Development Code, NSW Department of Environment and Conservation (DEC) guidelines, Australian Standards, and other regulatory codes do not provide specific noise guidelines for noise emission from child care centres. Generally a criterion of background + 5dB(A) when measured as an $L_{Aeq\ (15\text{-minute})}$ is utilised for assessing potential noise impacts at nearby residential receiver locations. Operations between 10pm and 7am would also require assessment of the sleep intrusiveness criterion.

Where child care centres are to be incorporated into school facilities, as proposed within the Turner Road Precinct, it is likely that outdoor play areas can be removed from residential boundaries and therefore minimise potential noise impacts.

Where child care centres are located adjacent to residences, noise from play areas can cause a noise nuisance. The following noise control measures can assist in minimising noise impacts;

- Construct solid boundary fences around play areas. Fences of around 2.5m high may be required for large centres where residences are immediately adjacent.

- Restrict the duration of outdoor play times and restrict the number of children outside at any one time.

Surface active play areas with rubber matting to minimise impact sounds, and limit the height of play equipment.

6.4 MULTI PURPOSE-HALLS

Multi-purpose halls may include school assembly halls/auditoria and community halls used for a variety of sporting and leisure activities. Noise emission from multi-purpose halls may include people noise, music, and noise associated with sporting activities.

The GCC Development Code, NSW Department of Environment and Conservation (DEC) guidelines, Australian Standards, and other regulatory codes do not provide specific noise guidelines for use of multi-purpose halls. However general practice is to utilise the intrusiveness criterion (as set out in Section 2.1 of the NSW INP and Section 2.4.1 of the NGLG Dec 2004) for assessing potential noise impacts at nearby residential receiver locations. Operations between 10pm and 7am would also require assessment of the sleep intrusiveness criterion. In addition, where entertainment may be provided criterion similar to that issued by the LAB (as set out in Section 6.1) may be utilised.

Where multi-purpose halls are located in close proximity to residential premises acoustic design of the hall may be required to ensure a satisfactory noise amenity is achieved. Where acoustic impact is not considered during the planning process, the potential uses of the development may be restricted. It is common for usage to be restricted after 10pm.

6.5 SPORTING FIELDS

Noise from sporting fields is generally as a result of people noise and associated car parks. As noise emission from people noise on sporting fields is difficult to contain, rather than setting specific noise criteria that may limit development, a restriction in hours of use may be required to reduce potential impacts on nearby residential premises.

Chapter 159 of the EPA's superseded 'Environmental Noise Control Manual' (ENCM) provides noise guidelines for noise emission from sporting fields. Where offensive noise occurs from the use of the sporting field, the ENCM recommends the following time restrictions;

7am to 6pm any weekday

8am to 6pm Saturdays and Sundays

6pm to 10pm two nights per week excluding Sundays or Public Holidays

7. AIRCRAFT NOISE ASSESSMENT

The Turner Road Precinct is located approximately 3.5km east of Camden Aerodrome. The potential impact of aircraft noise and overflights from Camden Aerodrome on the release area are assessed in accordance with AS2021-2000 '*Acoustics - Aircraft noise intrusion – Building siting and construction*'.

For land use planning AS2021 refers to the ANEF, being a single number index for predicting the cumulative exposure to aircraft noise in communities near aerodromes during a specified time period (normally one year). This single number index is useful for rating the compatibility of various land uses with respect to aircraft noise.

From a land use planning perspective, Table 2.1 of Australian Standard AS2021-2000 – "Acoustics – Aircraft Noise Intrusion – Building Siting and Construction" provides zoning information for sites subjected to aircraft noise. The table lists three ANEF Zones, namely, 'Acceptable', 'Conditional' and 'Unacceptable', and recommends suitable ANEF levels for different types of buildings. Table 2.1 from AS2021 is reproduced as Table 13 below, as relevant to potential land use zones within Turner Road Precinct.

Table 13 – Building Site Acceptability Based on ANEF Zones (Table 2.1 – AS2021)

Building Type	ANEF Zone of Site		
	Acceptable	Conditional	Unacceptable
House, home unit, flat, caravan park	Less than ANEF 20[1]	20 to 25 ANEF[2]	Greater than 25 ANEF
Hotel, motel hostel	Less than ANEF 25	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than ANEF 20[1]	20 to 25 ANEF[2]	Greater than 25 ANEF
Hospital, nursing home	Less than ANEF 20[1]	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than ANEF 20[1]	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than ANEF 25	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than ANEF 30	30 to 40 ANEF	Greater than 40 ANEF
Heavy industrial	Acceptable in all ANEF zones		

Notes:
1. The actual location of the ANEF 20 contour is difficult to define accurately, mainly because of variation in aircraft flight paths.
2. Within ANEF 20 to ANEF 25, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate.

In **Acceptable** zones there is usually no need for the building construction to provide protection specifically against aircraft noise. However, it should not be inferred that aircraft noise will not be noticeable outside the ANEF20 contour.

In **Conditional** zones the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedures of Clause 3.1 and 3.2 of AS2021-2000, and the aircraft noise attenuation to be expected from the proposed construction should be determined in accordance with Clause 3.3.

In **Unacceptable** zones construction of the proposed development should not normally be considered. In no case should new development take place in 'greenfield' sites deemed unacceptable because such development may impact on airport operations.

Reference has been made to the Camden Airport Master Plan 2004/05, in which Figure 16 indicates that the Turner Road Precinct is located outside the 20 ANEF for 2024/25. For areas outside the 20 ANEF contour, AS2021 states, as “noise from sources other than aircraft may dominate…there is usually no need to proceed further in this Standard as the construction of the building need not specifically be designed to provide protection against aircraft noise intrusion”.

Therefore with respect to AS2021 the Turner Road Precinct should not be adversely affected by aircraft noise.

8. CUMULATIVE NOISE IMPACT ASSESSMENT

Research has found that people tend to react differently to noise from different sources, therefore there is a need to assess noise differently for each type of noise source. This is the rational behind the DEC providing separate policies that set different guidelines for each noise type. For example, the DEC recommends different noise criteria for industrial, traffic, rail and other noise types. Also, the DEC's INP takes cumulative impact into account with its Amenity Criteria, which considers all existing industrial noise sources at each noise assessment location and sets noise criteria that avoid the cumulative build-up or 'creep' of industrial noise over time in an area.

Therefore, by following the policy guidelines, noise impact from each noise source is minimised to acceptable levels, thus minimising cumulative noise impacts upon receivers.

9. CONCLUSION

Renzo Tonin & Associates have completed an assessment of environmental noise impact for the proposed Turner Road Precinct. From our acoustic study we make the following conclusion;

- Our analysis of the site indicates that the site will be impacted by traffic noise levels above the criteria issued by the NSW Department of Environment and Conservation in the '*Environmental Criteria for Road Traffic Noise'* if no traffic noise mitigation is implemented. Several methods of traffic noise mitigation have been discussed.
- Existing and future industrial sites were identified to the south of the Turner Road Precinct, identified as Smeaton Grange. Assuming that the industrial sites comply with the noise criteria set out in Camden Council's DCP 2006 there should be no restriction on future land use within the Turner Road Precinct.
- With respect to future industrial/commercial development within the Turner Road Precinct appropriate noise criteria and broad management and control measures have been discussed.
- In accordance with AS2021-2000 the subject site should not be adversely affected by aircraft noise.

APPENDIX A – GLOSSARY OF ACOUSTIC TERMS

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse Weather — Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).

Ambient Noise — The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.

Assessment Period — The period in a day over which assessments are made.

Assessment Point — A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.

Background Noise — Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the $\mathbf{L_{90}}$ noise level (see below).

Decibel [dB] — The units that sound is measured in. The following are examples of the decibel readings of every day sounds:

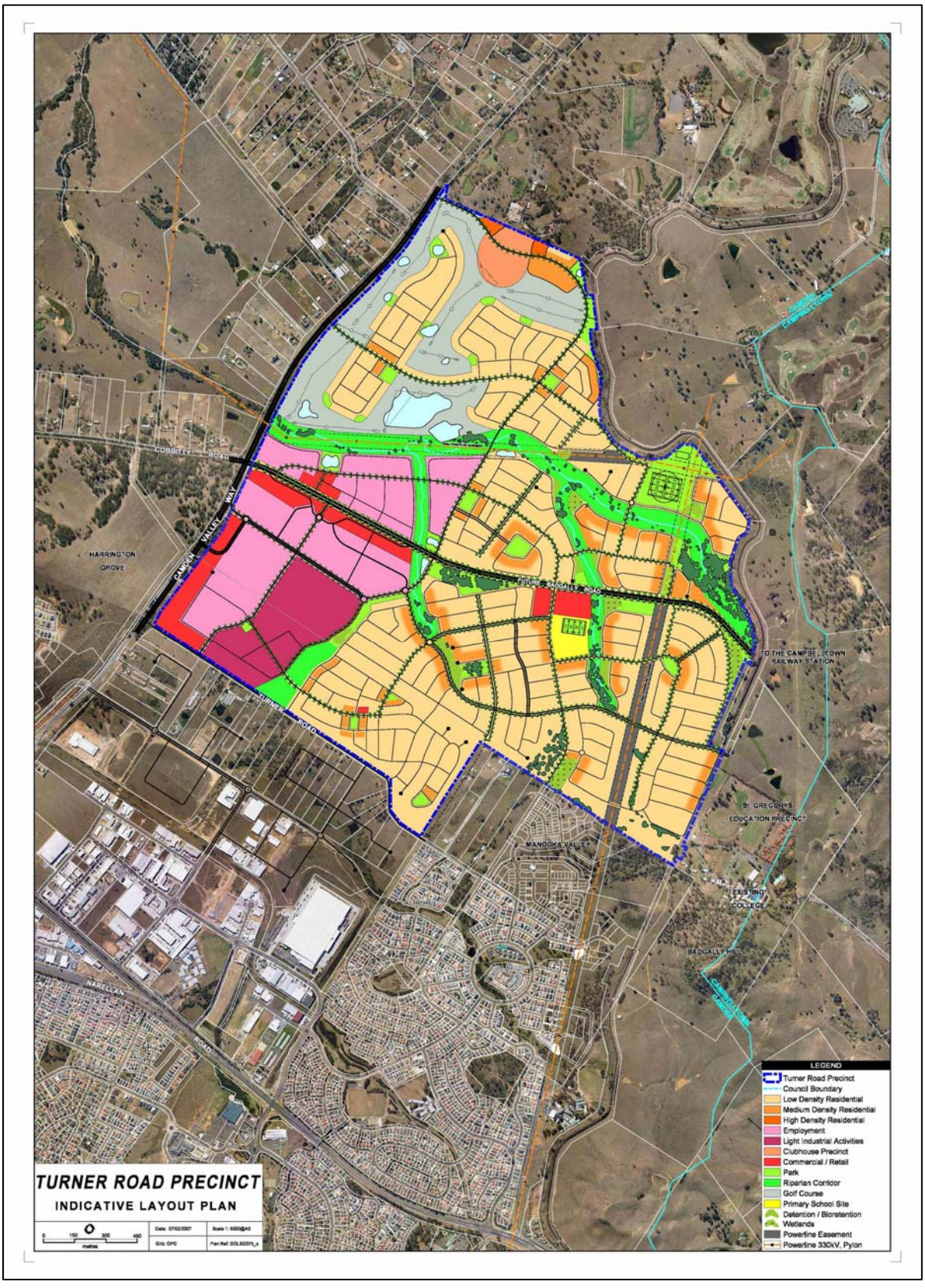
0dB The faintest sound we can hear
30dB A quiet library or in a quiet location in the country
45dB Typical office space. Ambience in the city at night
60dB Martin Place at lunch time
70dB The sound of a car passing on the street
80dB Loud music played at home
90dB The sound of a truck passing on the 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.

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.

Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
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.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B – INDICATIVE LAYOUT PLAN



APPENDIX C – LONG-TERM NOISE MONITORING RESULTS

Renzo Tonin & Associates

noise logger results

588 Camden Valley Way, Currans Hill

BACKGROUND & AMBIENT NOISE MONITORING RESULTS
NSW DEC's 'INDUSTRIAL NOISE POLICY', 2000

Day	L_{A90} Background Noise Levels[5]			L_{Aeq} Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Wednesday-06-December-2006	-	48	35	-	61	60
Thursday-07-December-2006	49	49	34	61	61	60
Friday-08-December-2006	50	46	33	61	60	58
Saturday-09-December-2006	50	49	32	60	61	57
Sunday-10-December-2006	46	49	34	60	66	61
Monday-11-December-2006	48	-	42	62	-	60
Tuesday-12-December-2006	54	47	35	64	62	61
Wednesday-13-December-2006	-	-	-	-	-	-
Representative Level	**49**	**48**	**34**	**62**	**62**	**60**

Notes:

1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Partial day's monitoring
5. Assessment Background Level (ABL)
6. Rating Background Level (RBL) for L90 and logarithmic average for Leq

TRAFFIC NOISE MONITORING RESULTS
NSW DEC 'ENVIRONMENTAL CRITERIA FOR ROAD TRAFFIC NOISE', 1999

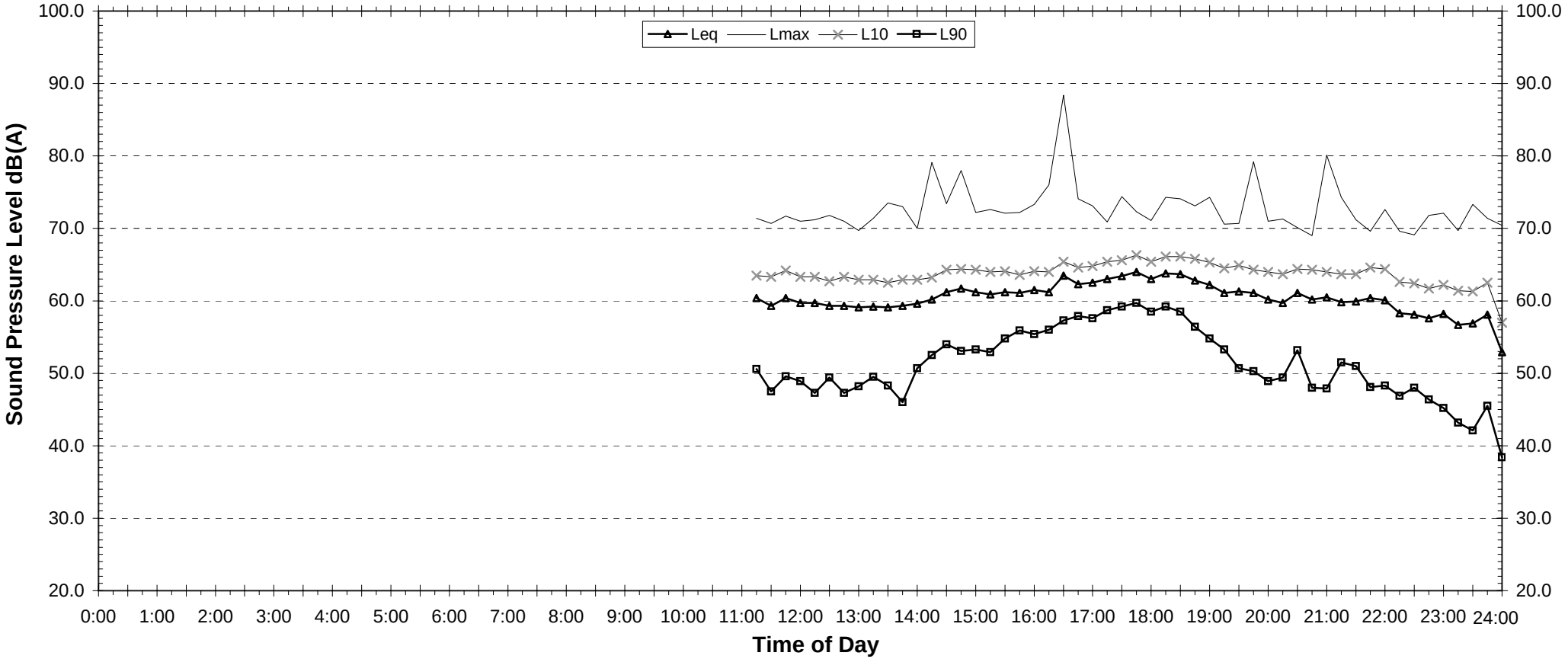
Day	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
	Day	Night	Day - Up	Day - Low	Night - Up	Night - Low
Wednesday-06-December-2006	64	62	66	62	68	54
Thursday-07-December-2006	64	62	66	62	67	55
Friday-08-December-2006	64	60	66	61	63	55
Saturday-09-December-2006	63	59	64	62	62	54
Sunday-10-December-2006	65	63	71	61	68	57
Monday-11-December-2006	66	62	72	61	68	55
Tuesday-12-December-2006	66	63	68	63	69	55
Wednesday-13-December-2006	67	-	69	64	-	-
Representative Weekday	**65**	**62**	**68**	**62**	**67**	**55**
Representative Weekend	**64**	**62**	**68**	**61**	**66**	**56**
Representative Week	**65**	**62**	**68**	**62**	**67**	**55**

20 YEARS
1982-2002 ACOUSTIC ENGINEERING EXCELLENCE

EXISTING AMBIENT NOISE LEVELS

588 Camden Valley Way, Currans Hill

Wednesday, 6 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	-	48.0	35.4
Leq (see note 3)	-	61.3	59.8

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

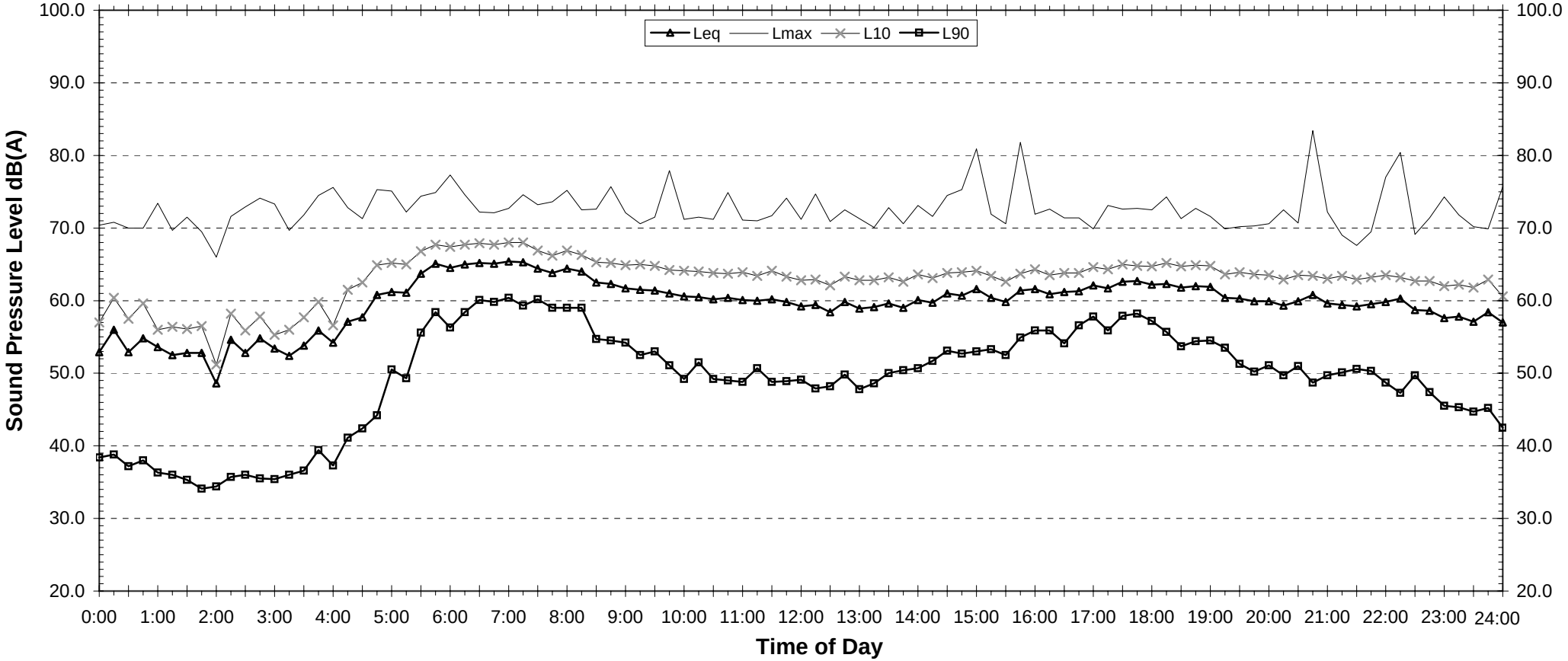
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	63.8	62.3
$L_{eq\ 1hr}$ upper 10 percentile	65.9	67.7
$L_{eq\ 1hr}$ lower 10 percentile	61.8	54.5

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	71.5	to	75.6
Lmax - Leq (Range)	15.7	to	21.3

EXISTING AMBIENT NOISE LEVELS
588 Camden Valley Way, Currans Hill
Thursday, 7 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	48.8	48.7	33.9
Leq (see note 3)	61.4	60.5	59.7

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

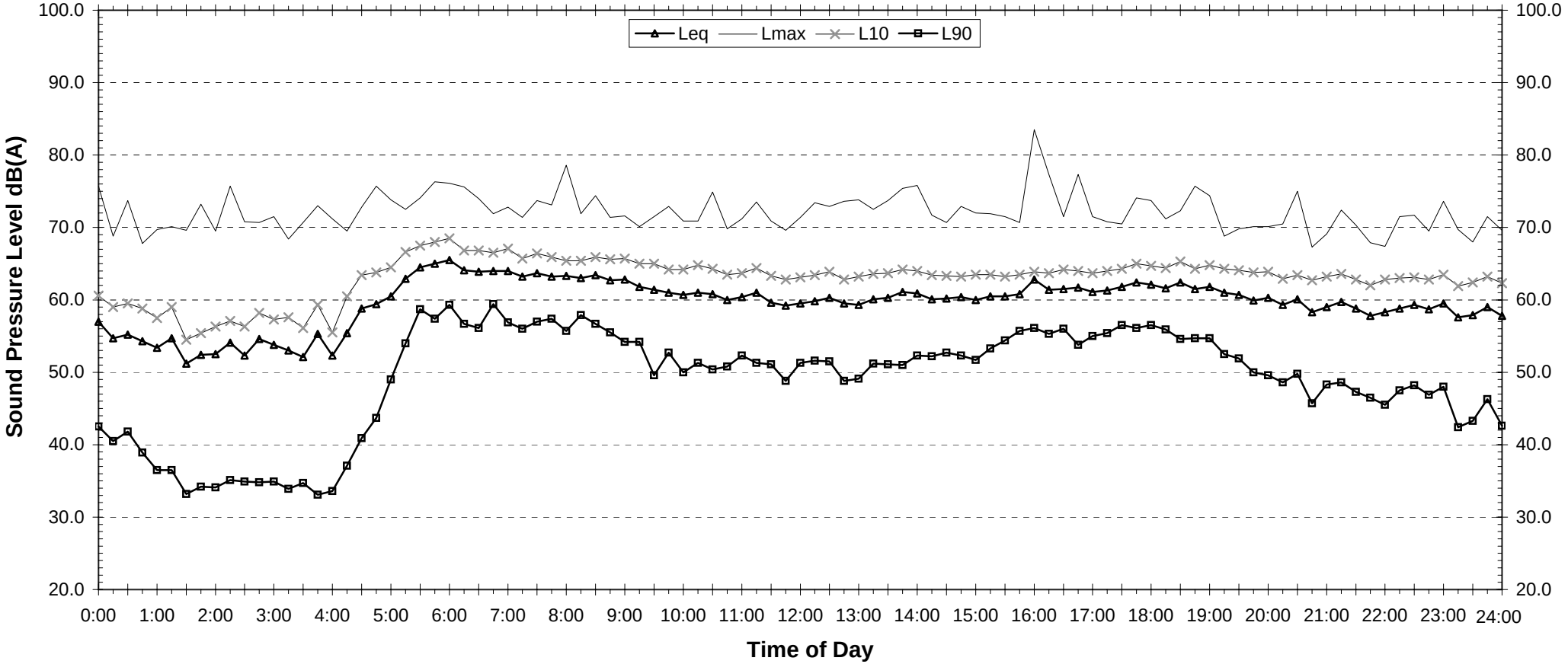
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	63.7	62.2
$L_{eq\ 1hr}$ upper 10 percentile	66.2	67.1
$L_{eq\ 1hr}$ lower 10 percentile	61.8	55.4

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	73.0	to	80.4
Lmax - Leq (Range)	16.8	to	21.9

EXISTING AMBIENT NOISE LEVELS
588 Camden Valley Way, Currans Hill
Friday, 8 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	50.0	45.7	32.7
Leq (see note 3)	61.4	60.2	57.7

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

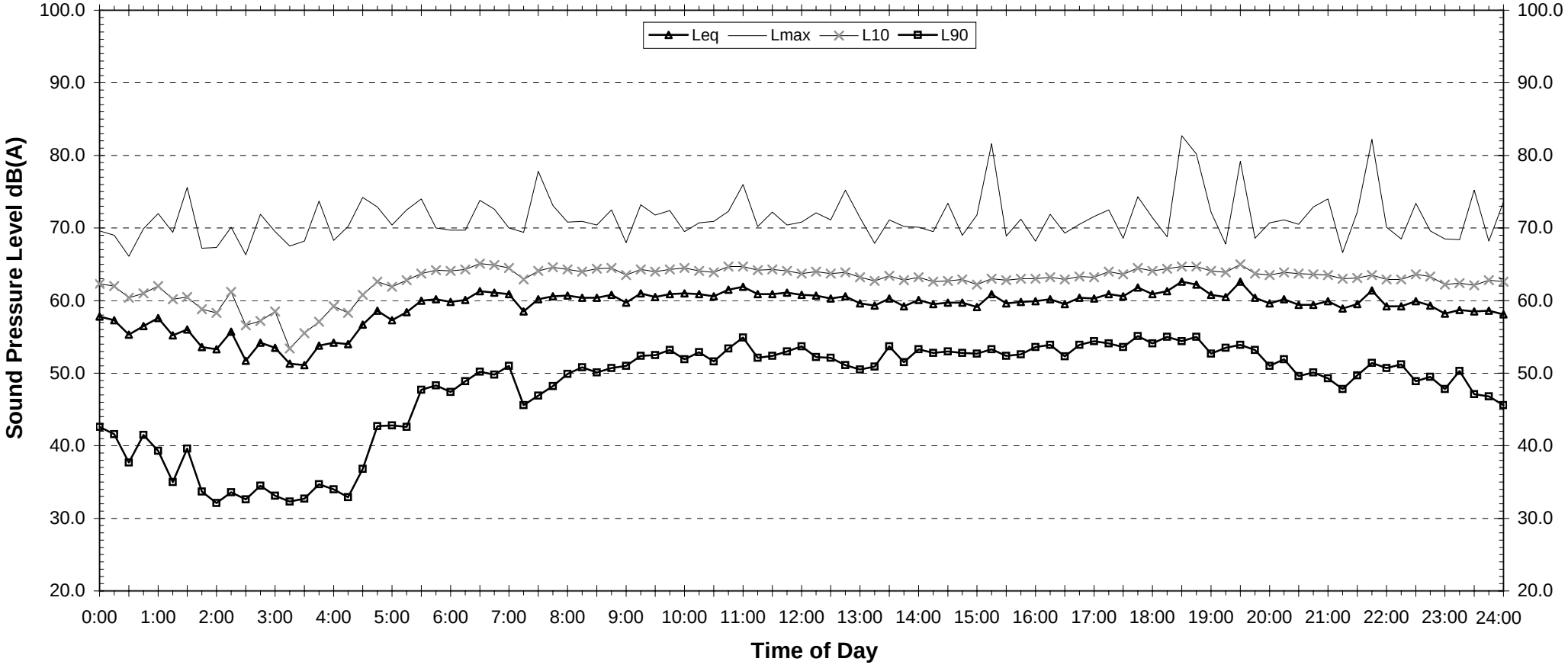
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	63.6	60.2
$L_{eq\ 1hr}$ upper 10 percentile	65.7	63.4
$L_{eq\ 1hr}$ lower 10 percentile	61.5	55.3

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	71.9	to	75.6
Lmax - Leq (Range)	15.2	to	20.9

EXISTING AMBIENT NOISE LEVELS
588 Camden Valley Way, Currans Hill
Saturday, 9 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	50.1	49.3	32.1
Leq (see note 3)	60.4	60.7	56.5

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

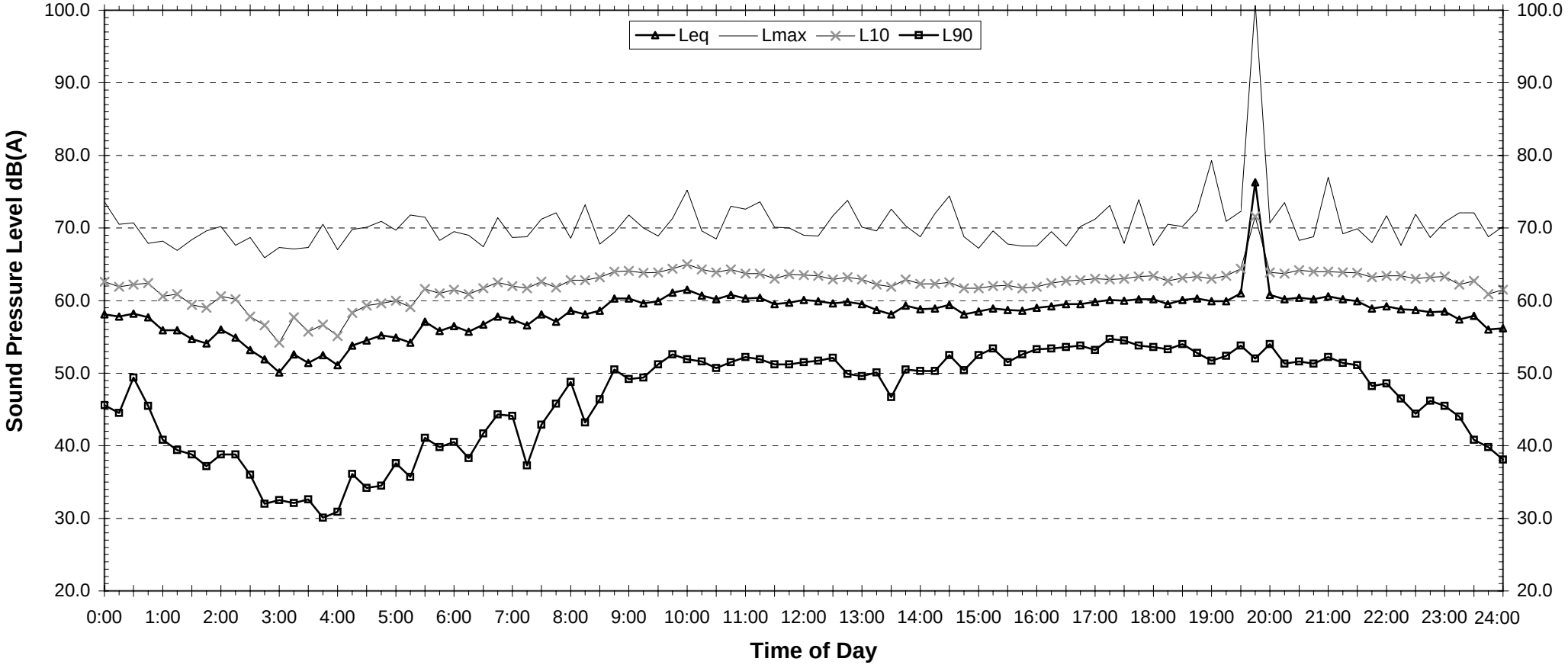
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	63.0	59.0
$L_{eq\ 1hr}$ upper 10 percentile	64.0	61.7
$L_{eq\ 1hr}$ lower 10 percentile	62.1	54.4

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	68.7	to	75.2
Lmax - Leq (Range)	15.8	to	18.6

EXISTING AMBIENT NOISE LEVELS
588 Camden Valley Way, Currans Hill
Sunday, 10 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	46.4	48.6	33.9
Leq (see note 3)	59.5	65.6	60.9

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

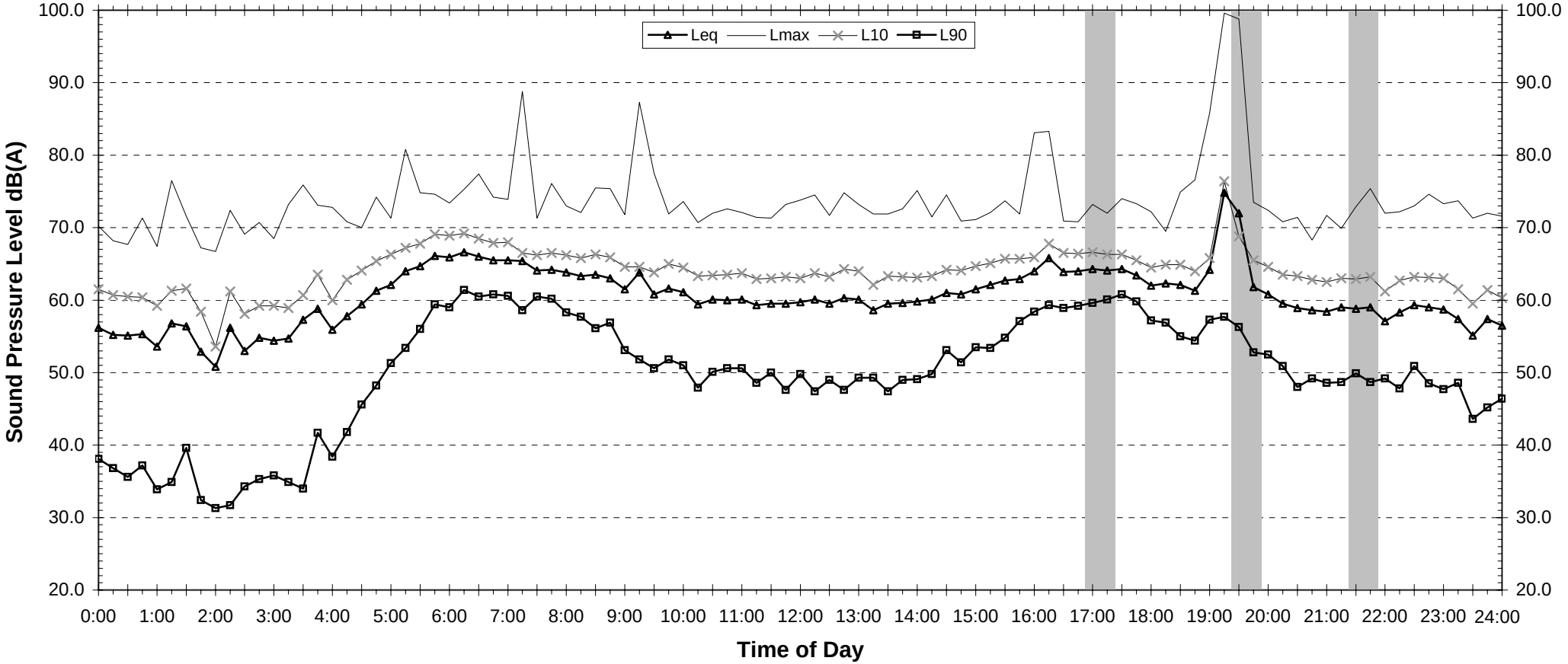
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	64.6	63.4
$L_{eq\ 1hr}$ upper 10 percentile	70.5	68.4
$L_{eq\ 1hr}$ lower 10 percentile	60.7	57.2

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	71.3	to	80.8
Lmax - Leq (Range)	15.2	to	21.6

EXISTING AMBIENT NOISE LEVELS
588 Camden Valley Way, Currans Hill
Monday, 11 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	47.9	-	41.6
Leq (see note 3)	62.1	-	59.8

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

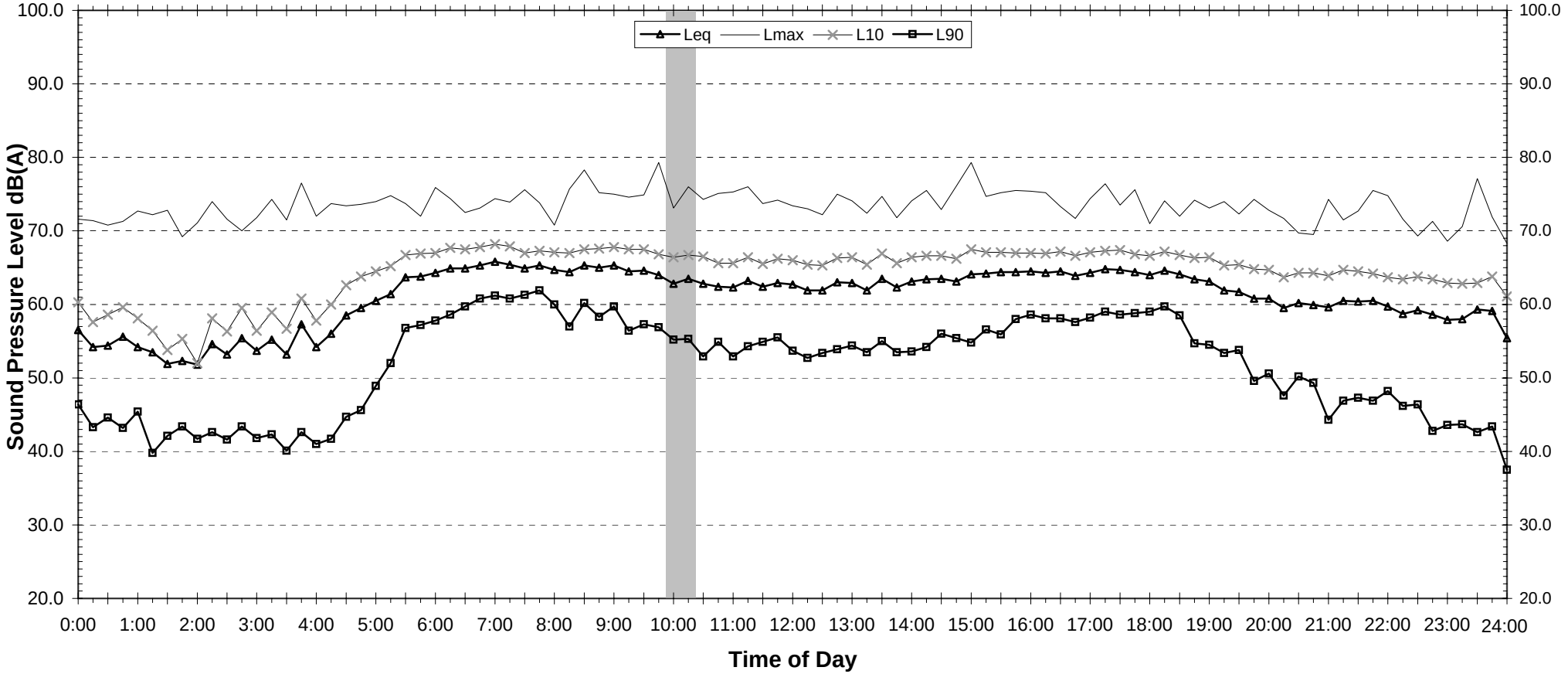
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	65.6	62.3
$L_{eq\ 1hr}$ upper 10 percentile	72.2	67.7
$L_{eq\ 1hr}$ lower 10 percentile	61.0	54.9

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	72.7	to	76.5
Lmax - Leq (Range)	15.1	to	21.2

EXISTING AMBIENT NOISE LEVELS
588 Camden Valley Way, Currans Hill
Tuesday, 12 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	53.5	46.9	34.7
Leq (see note 3)	63.9	61.6	60.6

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

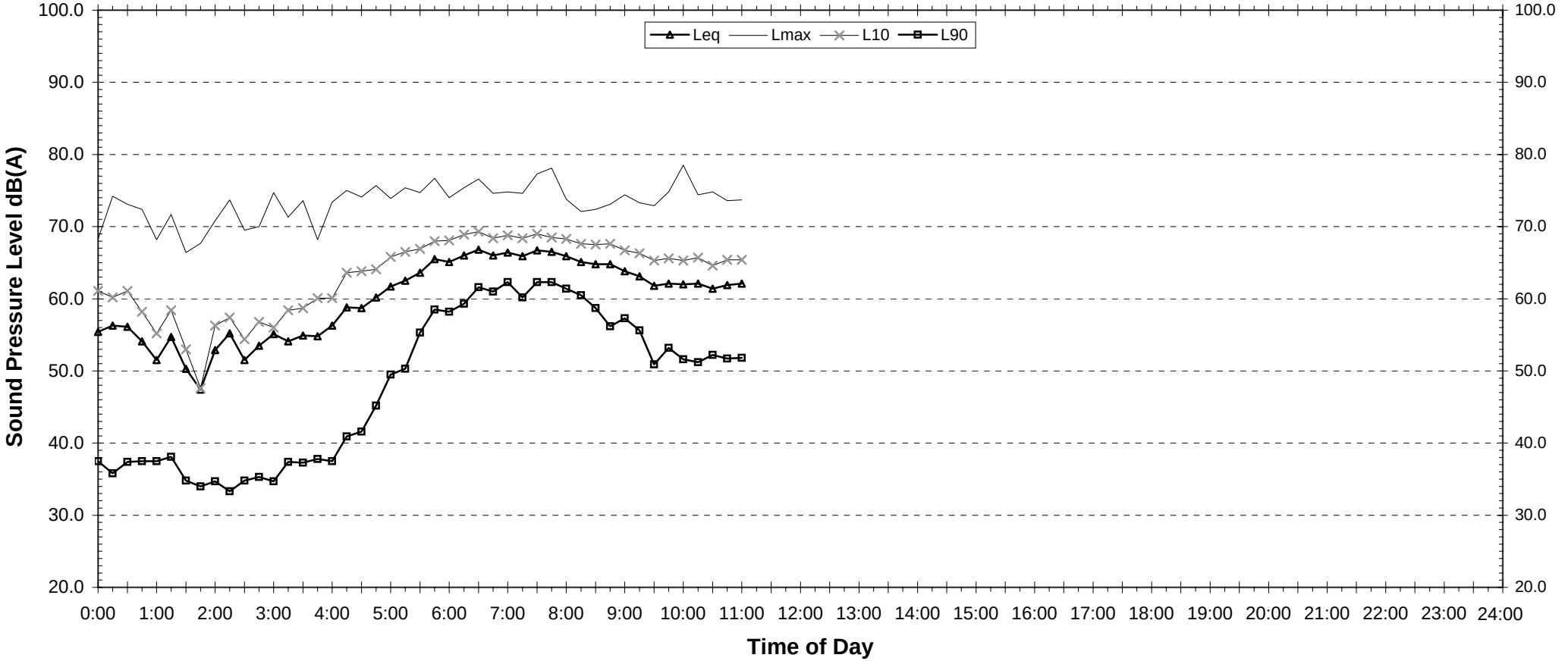
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	65.9	63.1
$L_{eq\ 1hr}$ upper 10 percentile	67.5	68.8
$L_{eq\ 1hr}$ lower 10 percentile	62.6	54.6

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	71.7	to	77.1
Lmax - Leq (Range)	15.7	to	20.6

EXISTING AMBIENT NOISE LEVELS
588 Camden Valley Way, Currans Hill
Wednesday, 13 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	-	-	-
Leq (see note 3)	-	-	-

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	66.6	-
$L_{eq\ 1hr}$ upper 10 percentile	68.8	-
$L_{eq\ 1hr}$ lower 10 percentile	64.4	-

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	-	to	-
Lmax - Leq (Range)	-	to	-

Renzo Tonin & Associates

noise logger results

55 Turner Rd - Front Yard

BACKGROUND & AMBIENT NOISE MONITORING RESULTS
NSW DEC's 'INDUSTRIAL NOISE POLICY', 2000

	L_{A90} Background Noise Levels[5]			L_{Aeq} Ambient Noise Levels		
Day	Day	Evening	Night	Day	Evening	Night
Wednesday-06-December-2006	-	34	33	-	55	52
Thursday-07-December-2006	37	36	34	56	55	53
Friday-08-December-2006	37	36	31	56	54	50
Saturday-09-December-2006	36	34	27	56	54	52
Sunday-10-December-2006	33	34	30	54	52	53
Monday-11-December-2006	37	-	39	56	-	53
Tuesday-12-December-2006	42	37	33	57	55	53
Wednesday-13-December-2006	-	-	-	-	-	-
Representative Level	**37**	**35**	**33**	**56**	**54**	**52**

Notes:

1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Partial day's monitoring
5. Assessment Background Level (ABL)
6. Rating Background Level (RBL) for L90 and logarithmic average for Leq

TRAFFIC NOISE MONITORING RESULTS
NSW DEC 'ENVIRONMENTAL CRITERIA FOR ROAD TRAFFIC NOISE', 1999

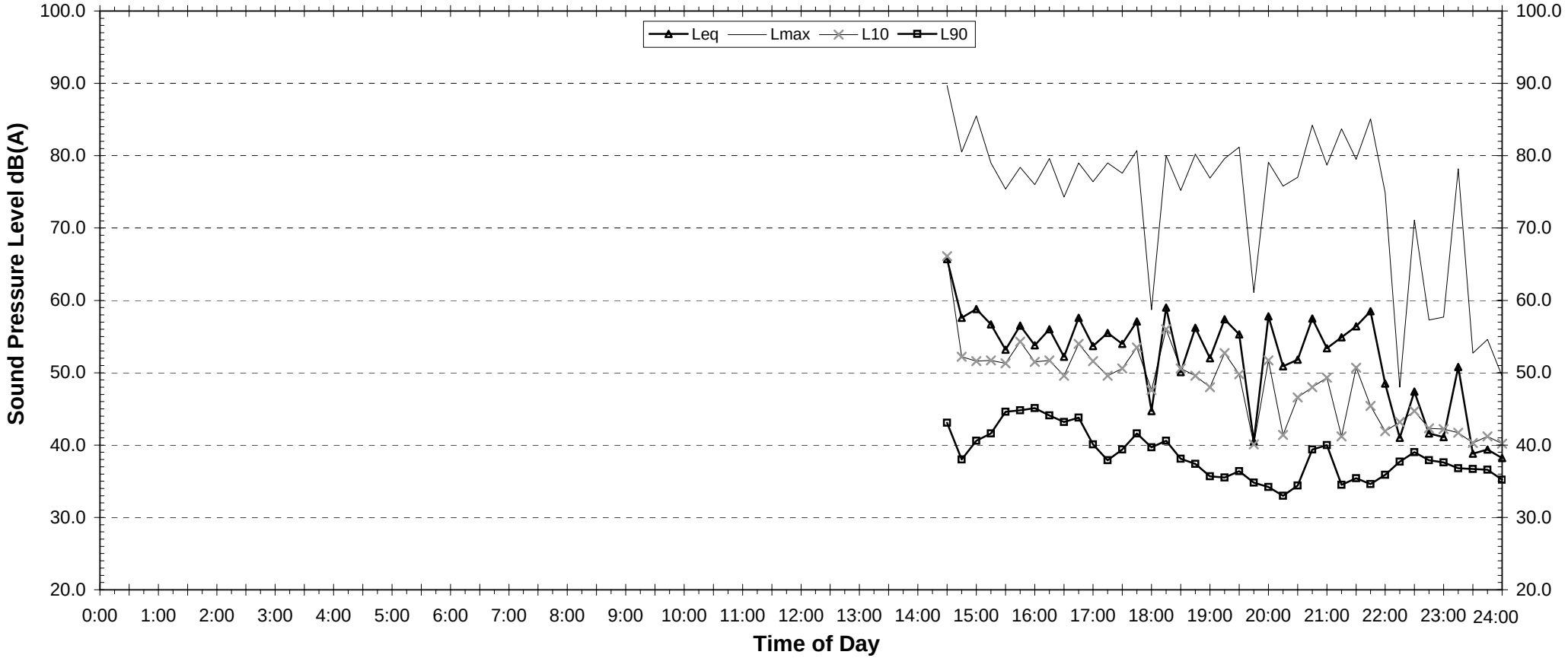
	L_{Aeq} Noise Levels		$L_{Aeq\ 1hr}$ Noise Levels			
Day	Day	Night	Day - Up	Day - Low	Night - Up	Night - Low
Wednesday-06-December-2006	59	54	65	57	61	38
Thursday-07-December-2006	58	55	61	54	62	42
Friday-08-December-2006	58	53	61	55	59	36
Saturday-09-December-2006	58	54	60	54	60	33
Sunday-10-December-2006	56	55	58	51	61	34
Monday-11-December-2006	61	56	69	55	61	47
Tuesday-12-December-2006	59	55	61	56	62	39
Wednesday-13-December-2006	59	-	60	57	-	-
Representative Weekday	**59**	**55**	**64**	**56**	**61**	**42**
Representative Weekend	**57**	**55**	**59**	**53**	**61**	**33**
Representative Week	**59**	**55**	**63**	**55**	**61**	**41**

20 YEARS
1982-2002 ACOUSTIC ENGINEERING EXCELLENCE

EXISTING AMBIENT NOISE LEVELS

55 Turner Rd - Front Yard

Wednesday, 6 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	-	34.2	32.8
Leq (see note 3)	-	55.4	51.6

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

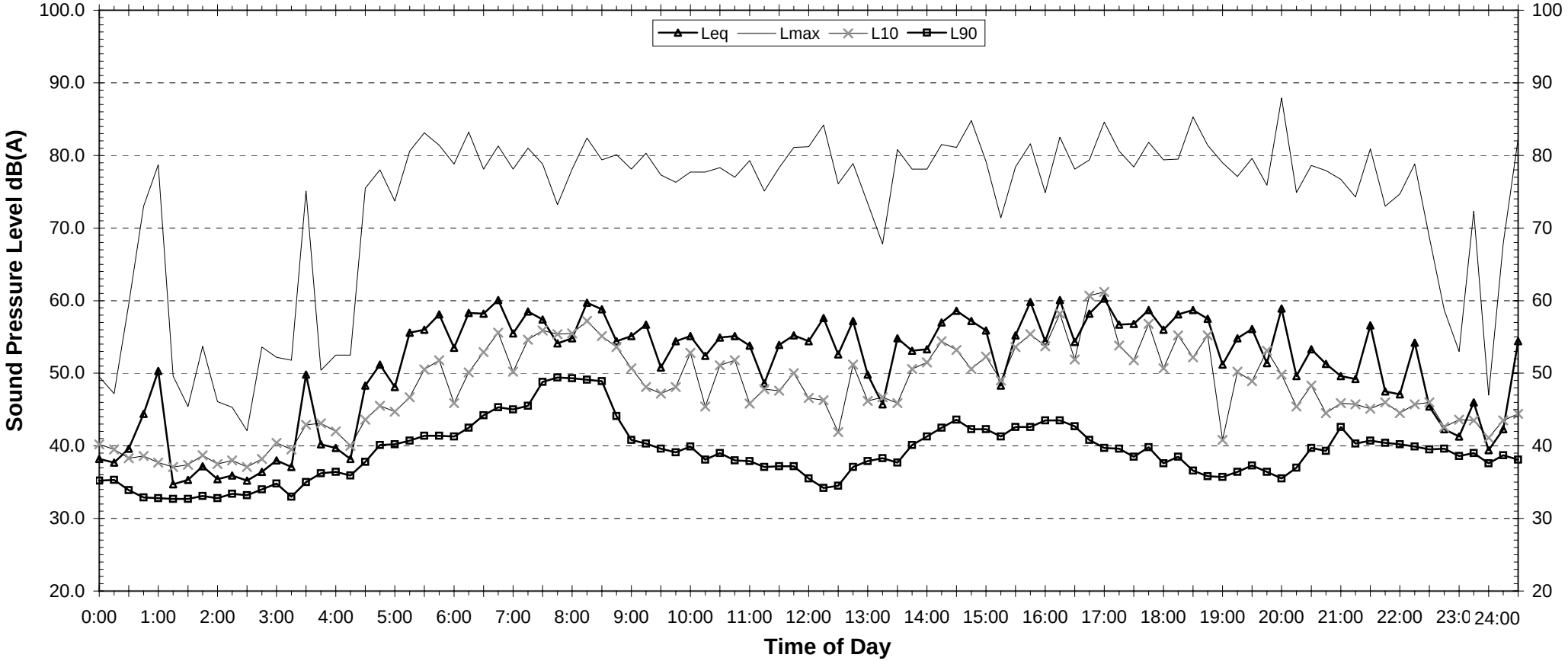
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade) (see note3)		
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	59.2	54.1
$L_{eq\ 1hr}$ upper 10 percentile	64.8	60.8
$L_{eq\ 1hr}$ lower 10 percentile	56.7	38.3

Night Time Maximum Noise Levels (see note 4)			
Lmax (Range)	71.1	to	83.2
Lmax - Leq (Range)	17.1	to	33.0

EXISTING AMBIENT NOISE LEVELS
55 Turner Rd - Front Yard
Thursday, 7 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	37.1	35.7	33.5
Leq (see note 3)	56.2	54.8	52.7

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

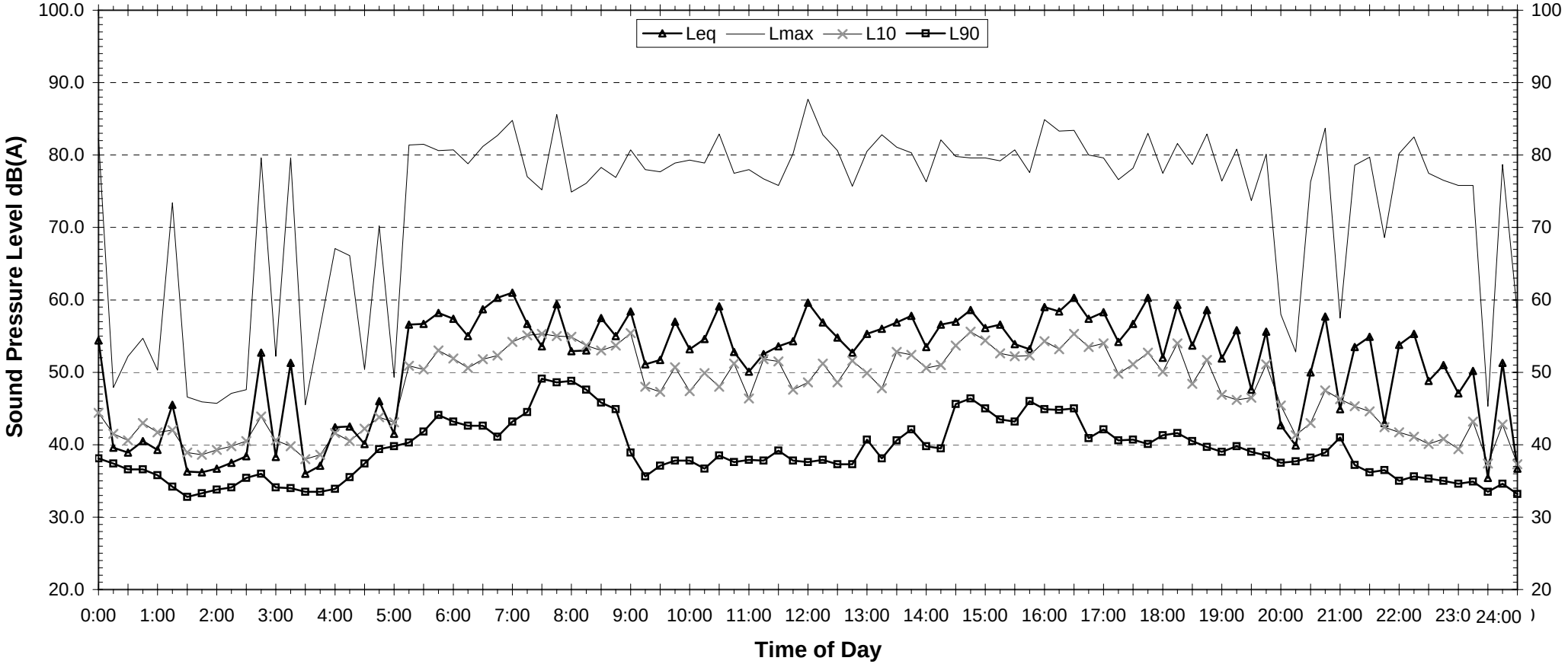
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	58.4	55.2
$L_{eq\ 1hr}$ upper 10 percentile	60.7	61.8
$L_{eq\ 1hr}$ lower 10 percentile	54.2	42.1

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	70.2	to	84.8
Lmax - Leq (Range)	15.1	to	33.5

EXISTING AMBIENT NOISE LEVELS
55 Turner Rd - Front Yard
Friday, 8 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	37.3	36.2	31.0
Leq (see note 3)	56.4	54.3	50.0

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

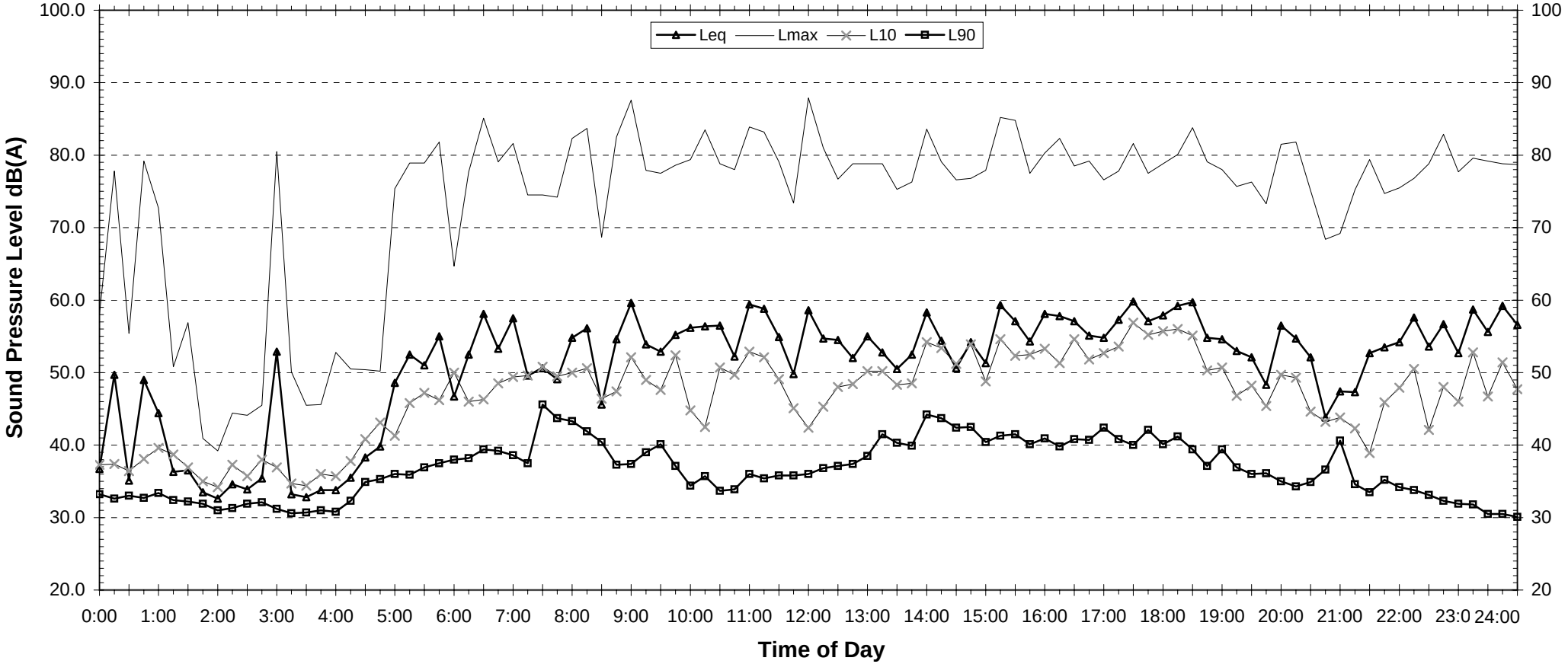
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	58.4	52.5
$L_{eq\ 1hr}$ upper 10 percentile	60.5	58.5
$L_{eq\ 1hr}$ lower 10 percentile	55.3	35.9

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	75.4	to	85.1
Lmax - Leq (Range)	19.4	to	33.4

EXISTING AMBIENT NOISE LEVELS
55 Turner Rd - Front Yard
Saturday, 9 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	35.7	34.2	26.7
Leq (see note 3)	55.8	54.5	51.9

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

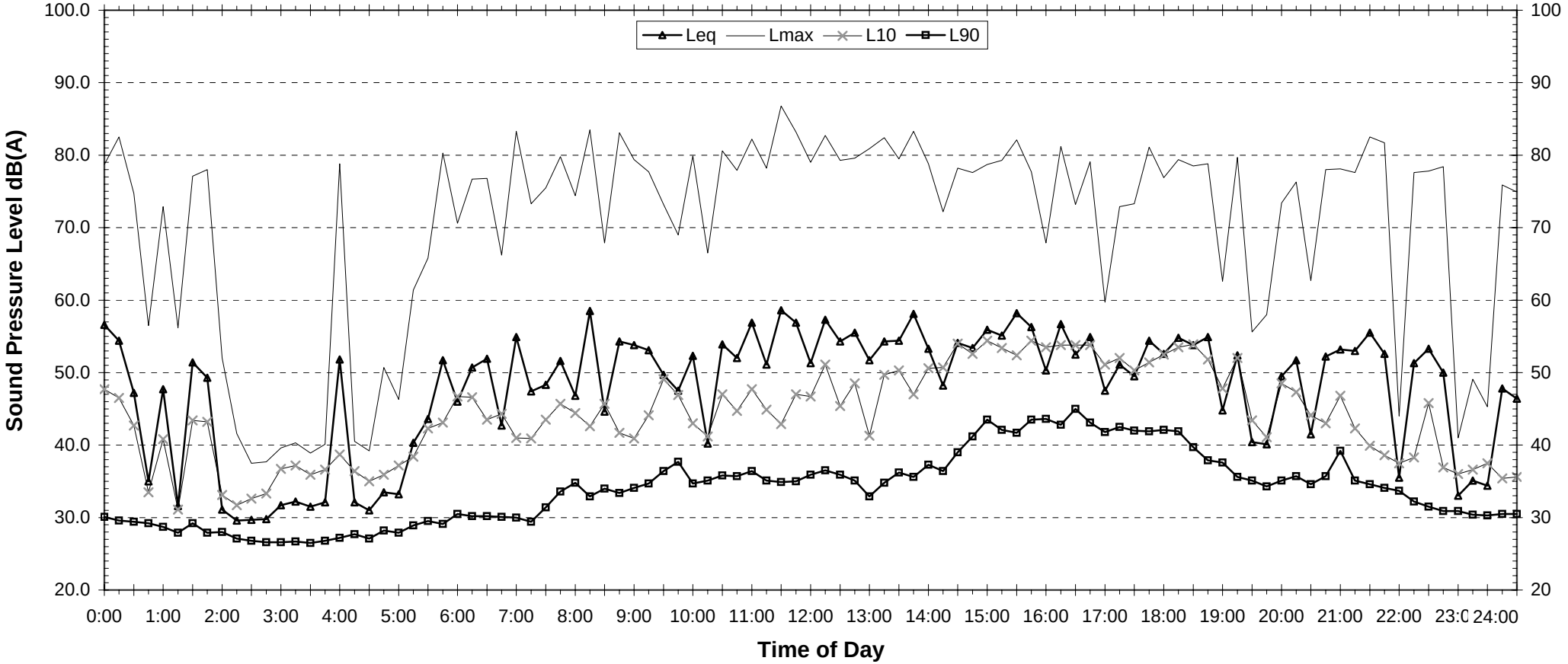
NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	58.0	54.4
$L_{eq\ 1hr}$ upper 10 percentile	60.4	60.3
$L_{eq\ 1hr}$ lower 10 percentile	54.0	32.8

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	78.0	to	83.3
Lmax - Leq (Range)	18.1	to	32.9

EXISTING AMBIENT NOISE LEVELS

55 Turner Rd - Front Yard

Sunday, 10 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	33.4	34.1	29.5
Leq (see note 3)	54.1	51.8	53.0

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

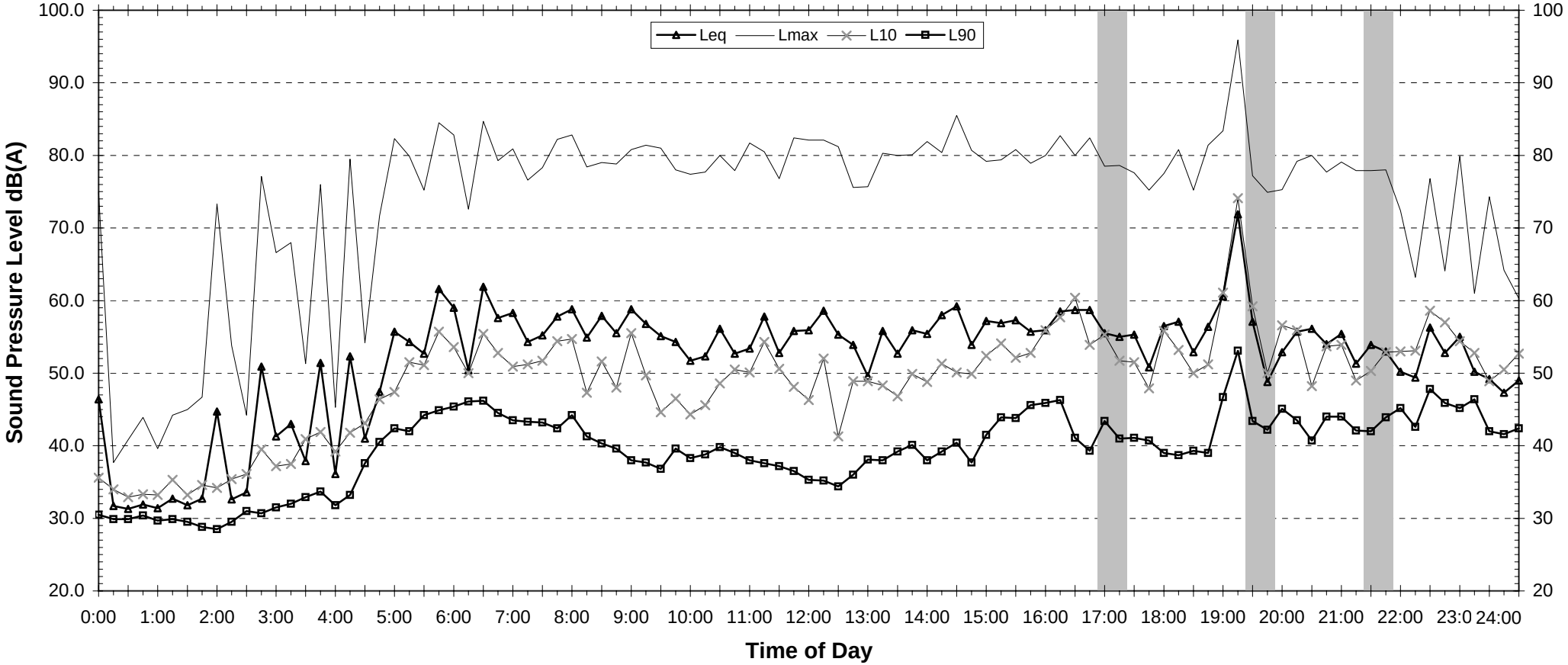
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	56.1	55.5
$L_{eq\ 1hr}$ upper 10 percentile	58.2	61.1
$L_{eq\ 1hr}$ lower 10 percentile	51.2	34.1

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	73.3	to	84.7
Lmax - Leq (Range)	26.1	to	33.9

EXISTING AMBIENT NOISE LEVELS
55 Turner Rd - Front Yard
Monday, 11 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	36.5	-	38.8
Leq (see note 3)	56.2	-	53.4

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

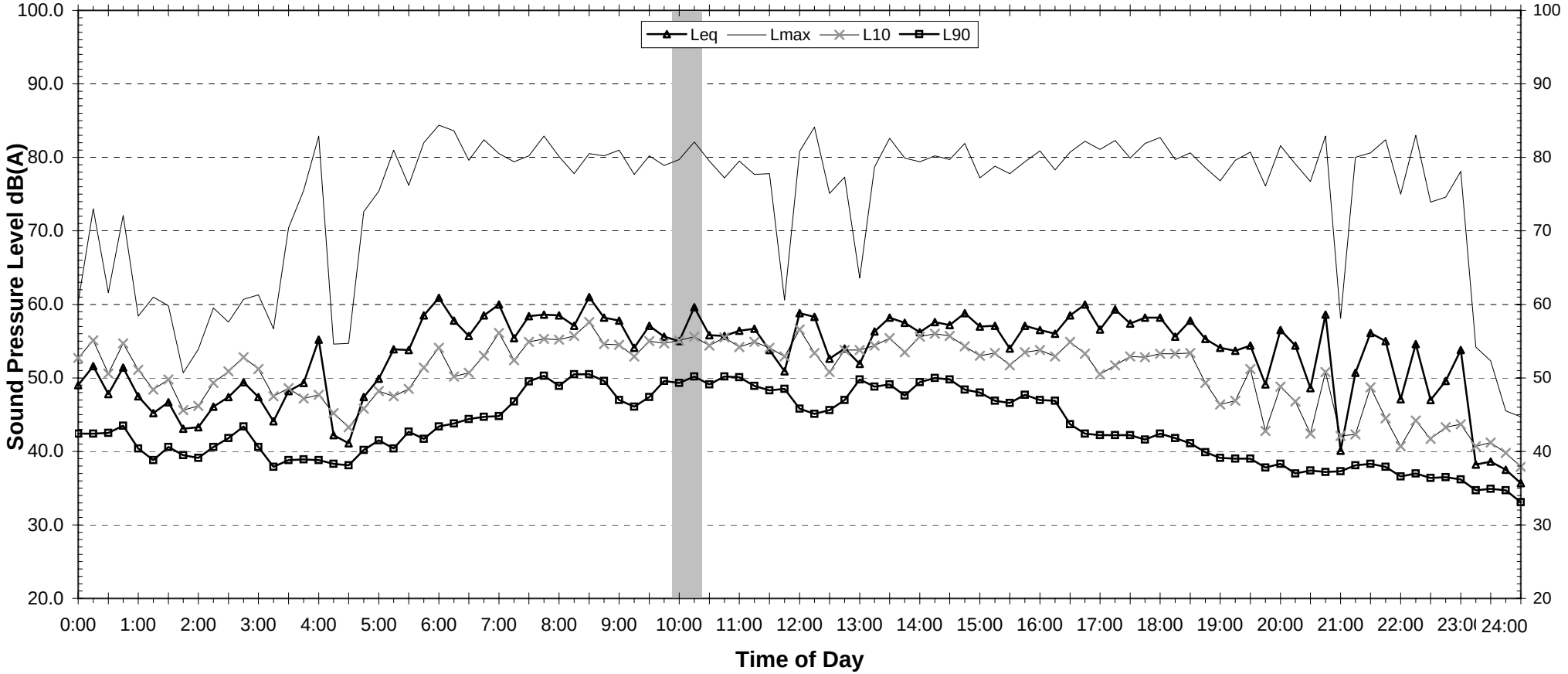
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade) (see note3)		
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	60.9	55.9
$L_{eq\ 1hr}$ upper 10 percentile	68.8	60.8
$L_{eq\ 1hr}$ lower 10 percentile	55.1	47.3

Night Time Maximum Noise Levels (see note 4)			
Lmax (Range)	73.0	to	84.4
Lmax - Leq (Range)	16.2	to	31.9

EXISTING AMBIENT NOISE LEVELS
55 Turner Rd - Front Yard
Tuesday, 12 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	42.4	37.0	32.8
Leq (see note 3)	57.2	54.6	52.6

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

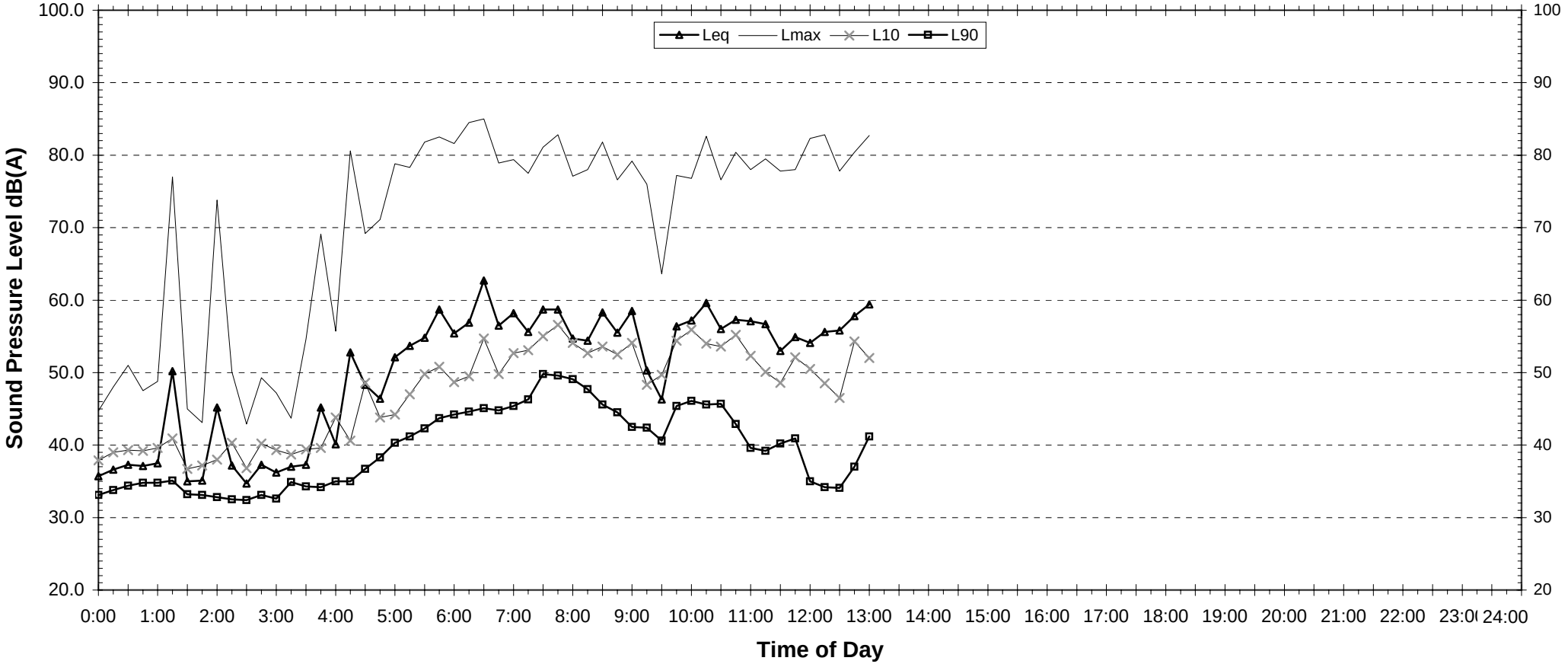
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	59.1	55.1
$L_{eq\ 1hr}$ upper 10 percentile	61.1	61.9
$L_{eq\ 1hr}$ lower 10 percentile	56.3	39.0

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	69.1	to	85.0
Lmax - Leq (Range)	16.6	to	31.4

EXISTING AMBIENT NOISE LEVELS
55 Turner Rd - Front Yard
Wednesday, 13 December 2006



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day 7am-6pm	Evening 6pm-10pm	Night[2] 10pm-7am
L_{90}	-	-	-
Leq (see note 3)	-	-	-

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

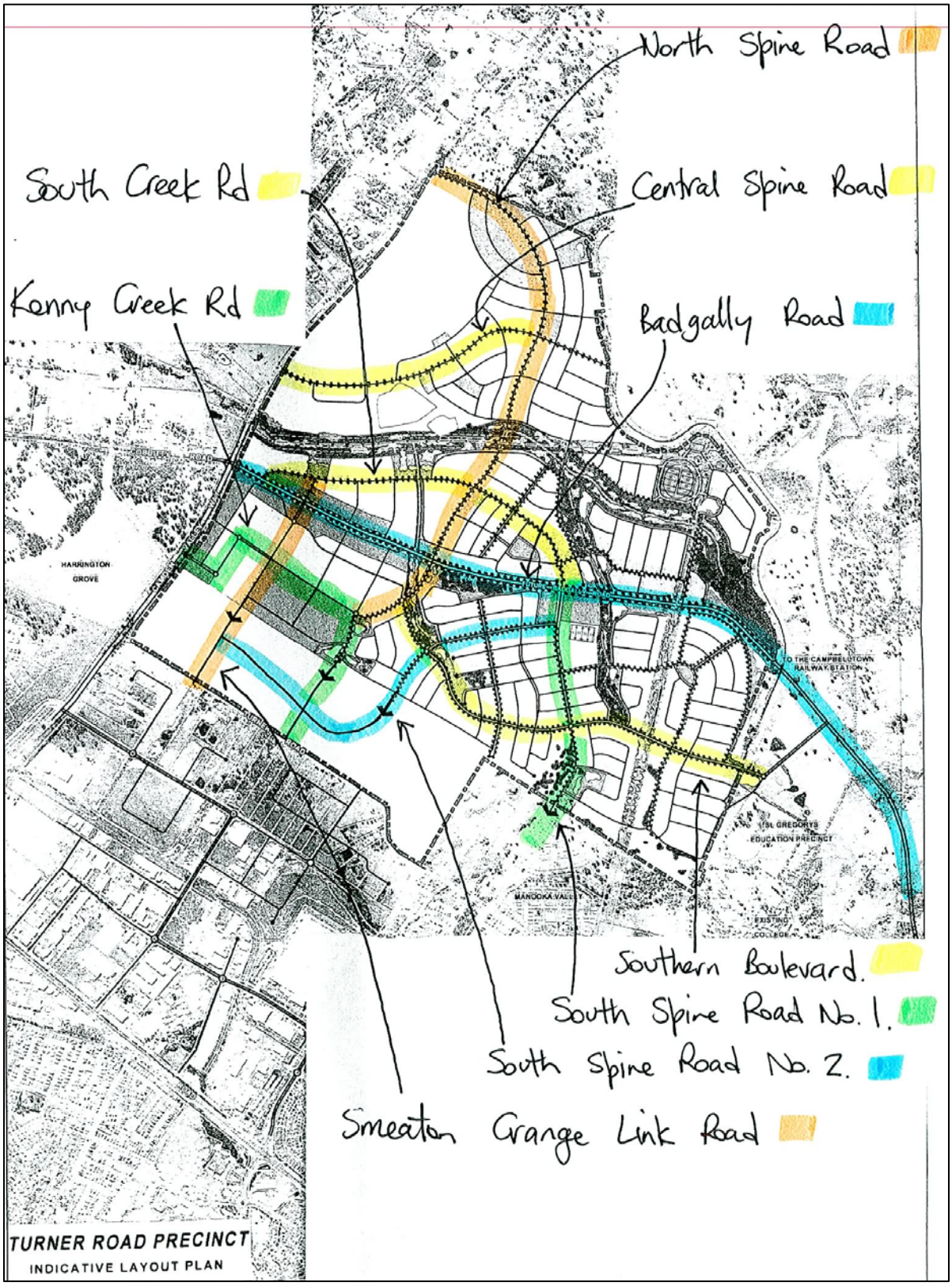
INSTRUCTIONS NOT FOLLOWED

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

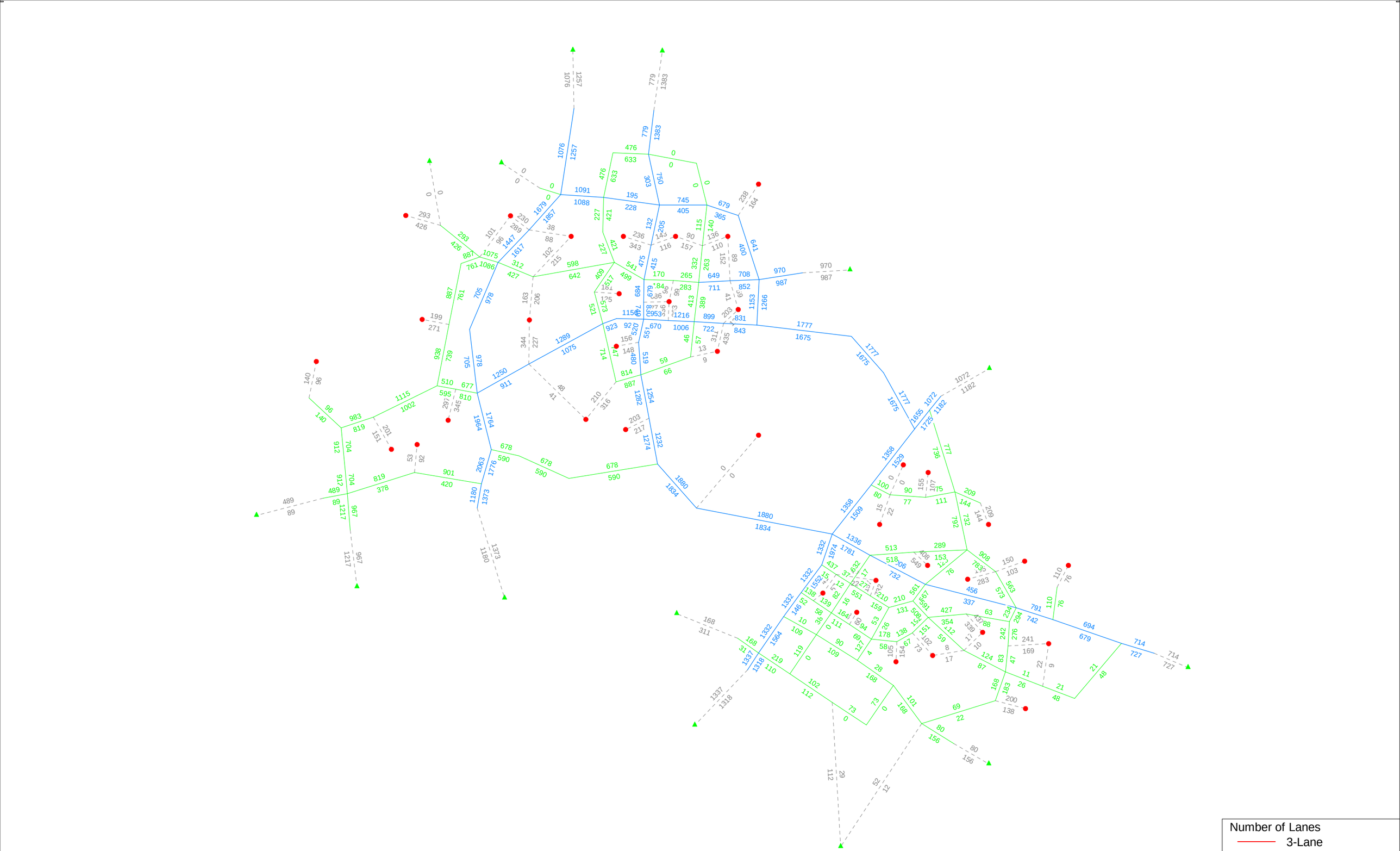
NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day 7am-10pm	Night[2] 10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	59.1	-
$L_{eq\ 1hr}$ upper 10 percentile	60.2	-
$L_{eq\ 1hr}$ lower 10 percentile	56.9	-

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	-	to	-
Lmax - Leq (Range)	-	to	-

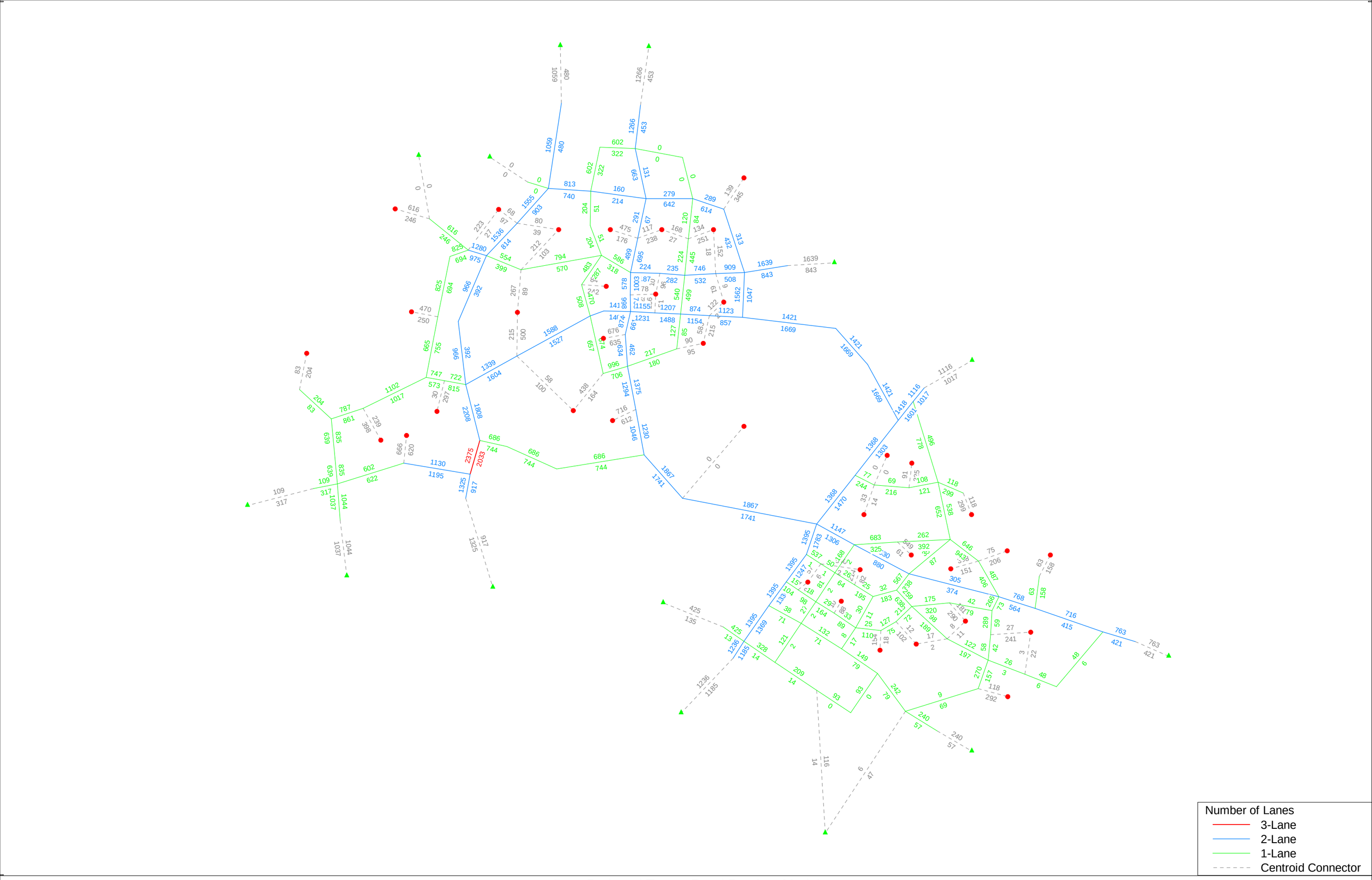
APPENDIX D – GENERIC ROAD NAME DIAGRAM



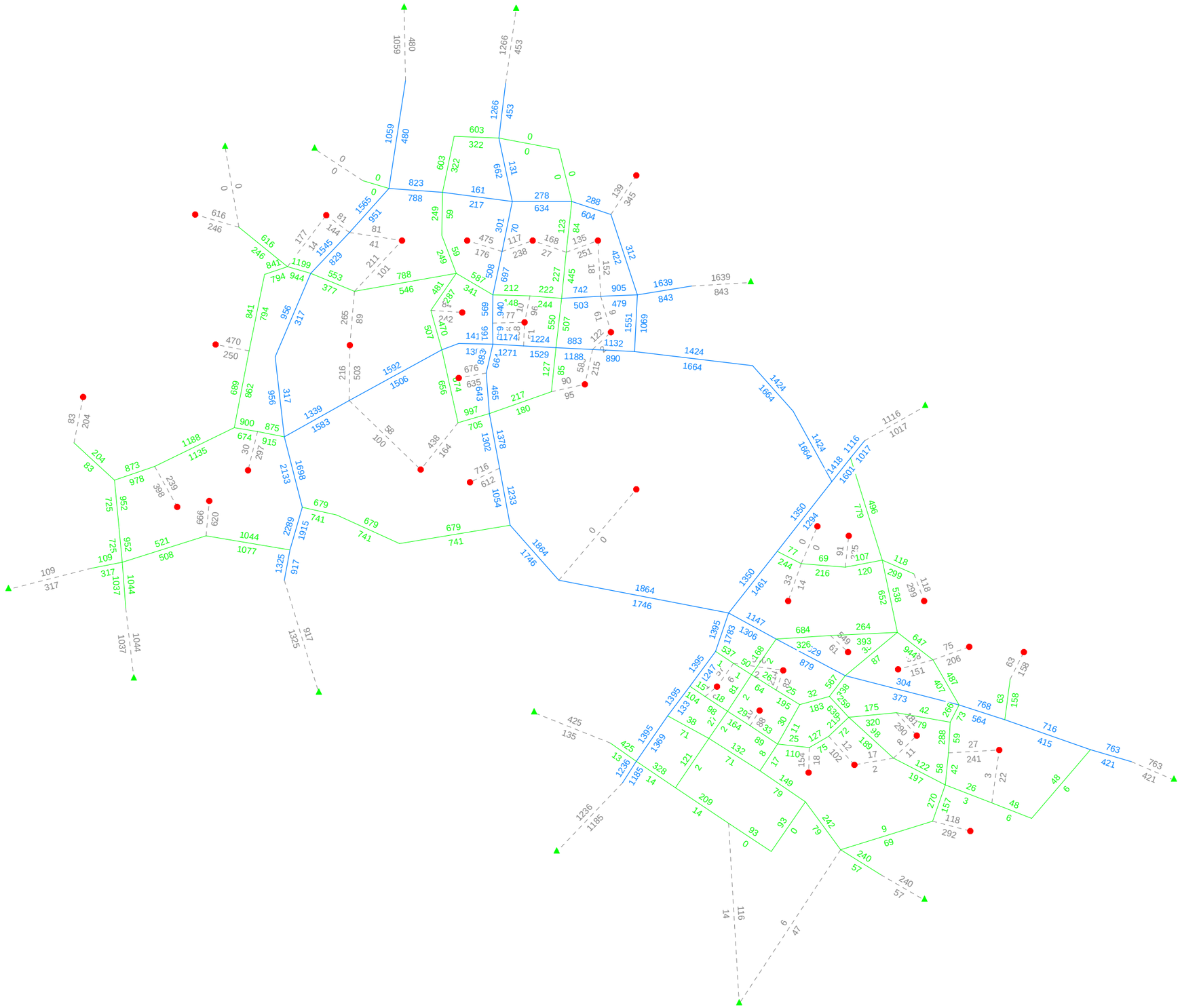
APPENDIX E – TRAFFIC VOLUME PREDICTIONS



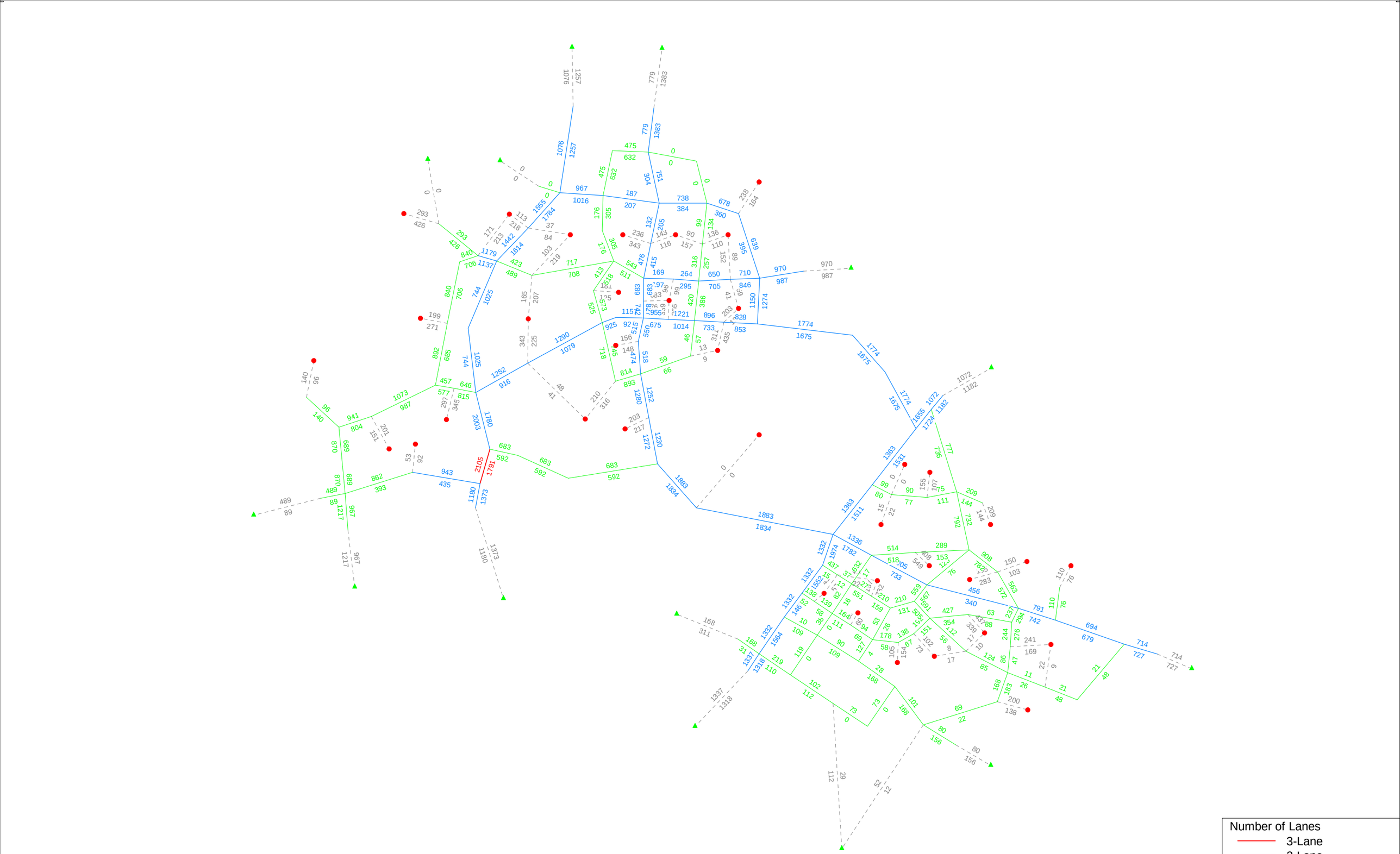
Oran Park and Turner Road Precinct Model
Year 2016 Base Network
PM Peak Hour Traffic Flow
16/01/2007



Oran Park and Turner Road Precinct Model
Year 2016 Option 1 Network
AM Peak Hour Traffic Flow
16/01/2007



Oran Park and Turner Road Precinct Model
Year 2016 Base Network
AM Peak Hour Traffic Flow
16/01/2007



Oran Park and Turner Road Precinct Model
Year 2016 Option 1 Network
PM Peak Hour Traffic Flow
16/01/2007