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Acoustic Assessment of New Wing

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1 INTRODUCTION

Acoustic Logic have been engaged to conduct an acoustic assessment of the proposed new wing at Norwest Private Hospital, Bella Vista.

This report has been prepared in order to satisfy the acoustic reporting requirements of Director General Requirement 6.

In this report we will:

- Identify operational noise emissions which will be generated by the site (primarily noise from external mechanical plant) and recommend acoustic and management controls in order to reduce noise impacts on nearby properties to levels complying with relevant acoustic criteria.

- Provide a discussion on construction noise and vibration controls and provide discussion of potential issues and acoustic treatments.

In each case, we will identify acoustic criteria to be used for assessment.

2 SITE DESCRIPTION / PROPOSAL

Norwest Private Hospital is located on Norbrik Drive, Bella Vista.

The proposed works involve the construction of a new three storey wing adjacent to the south-western corner of the existing hospital building. The new wing will be constructed over an existing car park.

The proposed new wing will consist primarily of:

- Five new operating theatres with associated recovery areas and plant rooms and

- A 55 bed in-patient unit.

The site is located within a commercial precinct. The nearest noise sensitive development is as follows:

- Existing hospital building (original building and recently constructed wing north of the proposed new wing.

- Residential development to the south and east of the site, approximately 270-300m away.

See aerial photo below.


Proposed New Wing
Recently constructed wing
Norwest Hospital Site
Residential Development
Noise Monitoring Location

3 NOISE DESCRIPTORS

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

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

In analysing environmental noise, three-principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

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

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

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

4 BACKGROUND NOISE MONITORING

Ambient noise levels in the vicinity of the site were measured to quantify the existing acoustic environment.

Unattended noise monitoring was conducted between 24 to 27 April 2008 prior to the construction of the main hospital building (and so monitoring represents ambient conditions in the absence of any noise generated by the site).

The long term noise logger was installed near property boundary of the residences to the south of the site, as shown in the aerial photograph in section 2.

Monitoring was conducted using an Acoustic Research Laboratories monitor set on A-weighted fast response mode. The monitor was calibrated before and after the measurements using a Rion Type NC-73 calibrator. No significant drift was recorded.

Measured background noise levels from long term logging are presented below. Refer to Appendix 1 for unmanned noise monitoring data.

Table 1 – Measured Background Noise Levels – Long Term Noise Logging

Location	Background noise level dB(A)L_{90}		
Unattended noise logger	Daytime (7am-6pm)	Evening (6pm-10pm)	Night time (10pm-7am)
	38	38	31

5 ASSESSMENT REQUIREMENTS AND ACOUSTIC CRITERIA

This report has been prepared in order to satisfy the acoustic reporting requirements of Director General Requirement 6, which states:

- *Identify the main noise and vibration generating sources and activities at all states of construction and any noise sources during operation. Outline measures to minimise and mitigate potential noise and vibration impacts on surrounding occupiers of land during both construction and operation.*

  Relevant Policies and Guidelines:

  - *NSW Industrial Noise Policy.*
  - *Interim Construction Noise Guidelines.*
  - *Assessing Vibration: A Technical Guideline.*

Relevant acoustic criteria from these guidelines are outlined below.

5.1 EPA INDUSTRIAL NOISE POLICY

5.1.1 Intrusiveness Criteria (Residential Receivers Only)

The Intrusiveness guideline is intended to limit the audibility of noise emissions at a residential property and requires that noise emissions measured using the $L_{eq(15min)}$ descriptor not exceed the background noise level by more than 5 dB(A) (i.e- noise from a particular noise source, when averaged over a 15 minute period, must not exceed background noise levels by more than 5dB(A).

The allowable noise level for all times of day is set out below.

Table 2 – EPA Intrusiveness Criteria

PERIOD/TIME	BACKGROUND NOISE LEVEL dB(A)L_{90}	ACCEPTABLE LEVEL dB(A)$L_{eq(15min)}$
Daytime (7am-6pm)	38	43
Evening (6pm-10pm)	38	43
Night (10pm-7am)	31	36

5.1.2 EPA Industrial Noise Policy - Amenity Objectives

Amenity noise criteria are applied to residential and commercial receivers and for the existing hospital.

Noise emission objectives for suburban residential receivers based on the Industrial Noise Policy are presented below. Amenity criteria are assessed using the $L_{eq(Period)}$ descriptor – ie noise from the a particular noise source is average over the entire daytime/evening/night time period.

In addition, criteria for impact on the neighbouring commercial development and the existing hospital is also presented.

Table 3 - Amenity Objectives

Location	Time of Day	Amenity Noise Objective dB(A)$L_{eq(Period)}$
Potentially Affected Residential Properties.	Day Time (7am – 6pm)	55
	Evening (6pm – 10pm)	45
	Night (10pm-7am)	40
Potentially Affected Commercial Properties	When in use	65
Hospital Ward	Any	35 (internally) 50 (externally)

5.2 CONSTRUCTION NOISE

Relevant guidelines are:

- The DECCW (now EPA) Interim Construction Noise Guidelines and
- Australian Standard 2436.

5.2.1 DECC Interim Construction Noise Guideline

This guideline nominates acceptable levels of noise emissions above the background noise level. For projects within the recommended standard hours the guideline recommends a noise level of 10dB(A) above the background – this level is referred to as the "noise effected level". The noise emission goals for nearby development is as follows:

Table 4 – Noise Emission Goal – Residential Properties

TIME OF DAY	MEASURED BACKGROUND LEVELS – dB(A)L_{90}	NOISE EFFECTED LEVEL BACKGROUND + 10dB(A)$L_{eq(15min)}$
Day (7am-6pm)	38	48

Table 5 – Noise Emission Goal – Non-Residential Noise Receivers

Noise Receiver	Noise Emission Goal dB(A)$L_{eq(15min)}$
Hospital Ward	45 (internal noise level)*
Commercial	70

*Assuming standard façade construction, and external noise level of 70-75dB(A) will result in an internal noise level of 45dB(A).

Where noise from the construction works is above the "noise affected level", the proponent should apply any feasible and reasonable work practices to minimise noise.

If noise emissions are likely to exceed 75dB(A)$L_{eq(15min)}$, the receiver is deemed to be "highly noise affected". Introduction of management controls such as scheduling of noisy periods, or respite periods is recommended.

5.2.2 Australian Standard 2436-1981 "Guide to Noise Control on Construction Maintenance and Demolition Site".

Where compliance with DECCW cannot be achieved, noise emissions are to be managed in accordance with principles in AS2436:

- That reasonable suitable noise criterion is established (ie – adopt DECC/Council guidelines).
- That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes on parts of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours.
- The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the building site.

5.3 CONTRUCTION VIBRATION

Vibration caused by construction should comply with:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures; and*
- For human exposure to vibration (amenity), the EPA guidelines " *Assessing Vibration: A technical guideline* will be adopted.

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

5.3.1 Building Damage Criteria

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented below.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 6 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

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

5.3.2 Assessing Amenity

Department of Environment and Conservation NSW (now the EPA) document "*Assessing Vibration: A Technical Guideline*" will be adopted as a guideline or vibration impact on amenity.

Relevant construction vibration goals are set out below.

Table 7 - DECC Recommended Vibration Criteria

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Offices	Any	0.02	0.04	0.4	0.8	0.56	1.1
Critical Areas (Operating Theatre)	Any	0.005	0.01	0.1	0.2	0.14	0.28
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0
Offices	Any	0.64	1.25	13	26	18	36
Critical Areas (Operating Theatre)	Any	0.005	0.01	0.1	0.2	0.14	0.28

6 ACOUSTIC ASSESSMENT

6.1 OPERATIONAL NOISE

Operational noise impacts from the site are not anticipated to be significant. In this regard we note:

- The site is located within a commercial/hospital precinct, and so immediately adjacent development is not as noise sensitive as a primarily residential area.

- The nearest residences are located approximately 300m away. In addition, the existing hospital buildings to the north and east of the site will provide some noise screening to the nearest residences (also to the north and east of the site).

- Noise created by any increase in vehicle movements or deliveries/service vehicles attending the site are not likely to create any significant increase in noise compared to the noise generated by the existing hospital (and new wing).

- The primary operational noise emissions associated with the new wing will be from new mechanical plant. All external plant will be selected and (if necessary) acoustically treated to meet the noise emission goals set out in section 5.1.

- Primary external plant items would typically consist of roof top cooling towers. Given the distance to the nearest residential properties, it is unlikely that plant associated with the new wing would perceptibly increase the noise currently generated by the main hospital building.

- However, in the event that in detailed design it is found that cooling tower (or other roof to plant) noise)is significant, standard acoustic treatments will be sufficient to meet noise emission requirements. Typical treatments would consist of:

    - Use of variable speed drives on cooling towers (to reduce noise emissions during night time/low load periods).

    - Acoustically treated plant (sound attenuators to cooling towers or similar).

    - Noise screens around roof top chillers or condensers.

- With respect to noise impacts to internal areas, in-duct acoustic treatments such as internal lining or acoustic attenuators will be sufficient to ensure compliance with Australian Standard 2107 recommended internal noise levels within hospital buildings.

- With respect to vibration impacts from new plant, standard vibration isolation systems (springs, pads and inertia bases) will be sufficient to ensure vibration levels within the new and existing hospital buildings comply with EPA vibration guidelines.

Compliance with EPA noise emission and vibration criteria will be achievable. Detailed acoustic design to demonstrate compliance should be undertaken once plant selections and locations are finalised.

6.2 NOISE AND VIBRATION GENERATED DURING CONSTRUCTION

Noise impacts on nearby development will be dependant on the activity and where on the site the activity is undertaken.

Initial analysis indicates:

- Excavation and piling works tend to be the loudest (and most vibration intensive) typical construction activity. As the new wing is to be constructed on top of an existing car park, excavation/piling work will not be required.

- Given this, it will be structural works impacting the existing car park slab (the footing for the new wing) and the existing hospital which will have the greatest potential to create noise/vibration impacts. During erection of structure, it is the use of hand tools (angle grinders etc) and concrete pumps which are the loudest typical activity (sound power levels of approximately 105-110dB(A)$L_{eq(15min)}$).

- Given the distance to the nearest residences, construction noise impacts on the residential properties will be generally consistent with EPA guidelines.

- Of primary concern however will be the impact of construction activities on the existing hospital (to the east) and the recently constructed wing (to the north).

- Airborne noise:

    - It is rooms on the western facade of the existing hospital which are likely to be most affected, given their proximity to the work site. To a lesser degree, the southern façade of the recently constructed wing to the north will also be impacted.

    - Assuming standard glazing to the existing hospital building shell, use of powered hand tools and concrete pumps noise levels are likely to intermittently exceed the 45dB(A) noise goal in ward rooms on levels 2 and 3 of the eastern façade of the existing hospital.

    - On level 1 of the existing hospital, it is primarily corridor areas which are located on the façade (with the level 1 operating theatres set back from the façade). Airborne noise impacts on the level 1 operating theatres are not likely to be excessive.

    - Noise levels are likely to be generally compliant with the 45dB(A) noise goal in the recently constructed wing to the north, however there may also be intermittent exceedances depending on the number of activities undertaken and the position of fixed plant such as concrete pumps.

    - Obviously, once construction of the building shell is complete, noise from hand tools will be relatively low, as the new building façade will provide considerable noise attenuation. Once the building shell is largely complete, use of hand tools in internal areas is unlikely to exceed EPA recommended levels.

- Vibration:
    - Construction of the level 3 link bridge and works on the existing ground floor slab have greatest potential to create noise and vibration impacts on the existing hospital.
    - To a lesser degree, works impacting the existing ground floor slab of the car park will potentially create vibration impacts to the level 1 operating theatres of the existing hospital.

Typically, noise and vibration impacts can be minimised using the following:

- Selection of equipment and process.
- Location of static plant (particularly concrete pumps).
- Use of screens or enclosures (typically only feasible for static plant).
- Scheduling of noisy activities and provision of respite periods.

Detailed construction noise planning is typically undertaken after engagement of a builder and a construction program is prepared. Therefore, detailed planning is not possible at this stage.

Indicatively, we recommend:

- On completion of the construction program, detailed acoustic review of proposed construction activities and plant/methods should be undertaken to identify work items likely to exceed EPA guidelines.
- For those activities likely to generate high noise levels, the duration of the activities should be reviewed to assess potential impact.
- For activities likely to result in significant exceedance of noise level goals which will have more than 1-2 days duration, mitigation treatments should be investigated. These should include:
    - Consideration of respite periods.
    - Location of static plant (concrete pump) as far as practicable from the hospital building (to the east) and the recently constructed wing (to the north). Indicatively, a minimum distance of 25m from the facades of the existing buildings should be targeted. Alternatively, use of localised noise screens around the pumps could be adopted.
    - Use of temporary secondary glazing (magnetite system or similar) to the ward rooms in the existing hospital façade directly adjacent to the work site (approximately 7m away).
    - During initial structural works, location of vibration monitors (with SMS warning capability) should be considered:
        - On level 1, as close as practicable to the western most operating theatre.
        - On level 3, as close as practicable to the proposed link bridge.

- For activities where acoustic controls and management techniques still cannot guarantee compliant noise levels, implement a notification process whereby nearby development is made aware of the time and duration of noise intensive construction processes should be undertaken.

Through adoption of the above, noise impacts on nearby development can be suitably managed to prevent excessive impact.

7 CONCLUSION

Potential noise and vibration impacts associated with proposed new wing at the Norwest Private have been assessed to address the acoustic requirements of Director General Requirement 6.

An assessment of both noise and vibration generated by the site (both during construction and operation) has been undertaken.

Primary sources of potential noise/vibration generation has been identified as being from construction activities and from mechanical plant (once the hospital is operating).

Provided that a suitable construction noise management plan is prepared and acted upon, and provided that appropriate acoustic treatments are included in mechanical plant design, compliance with EPA acoustic controls will be achieved.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
Thomas Taylor

Appendix 1

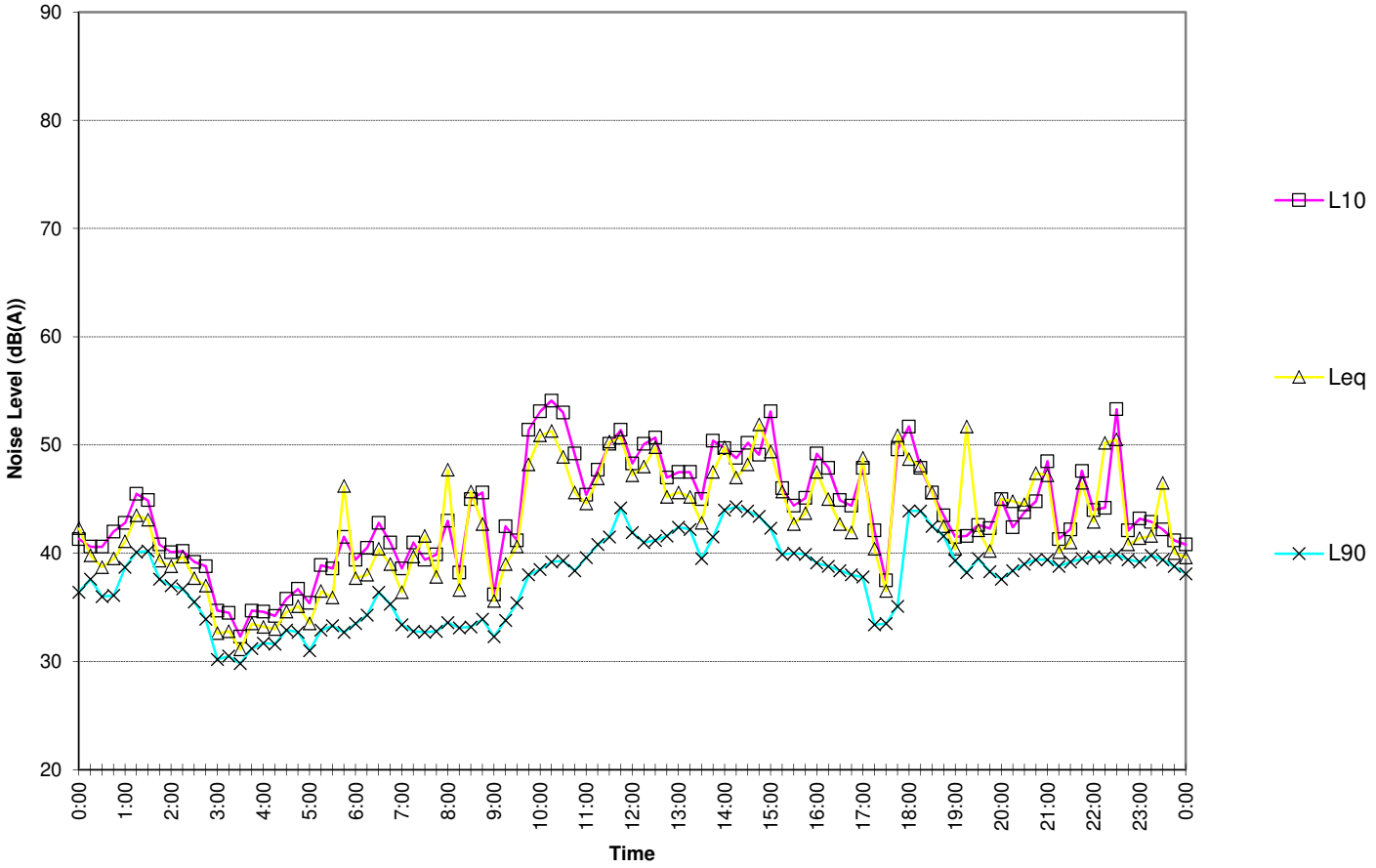
Noise Logging Data

Norwest site

Friday April 24,2009

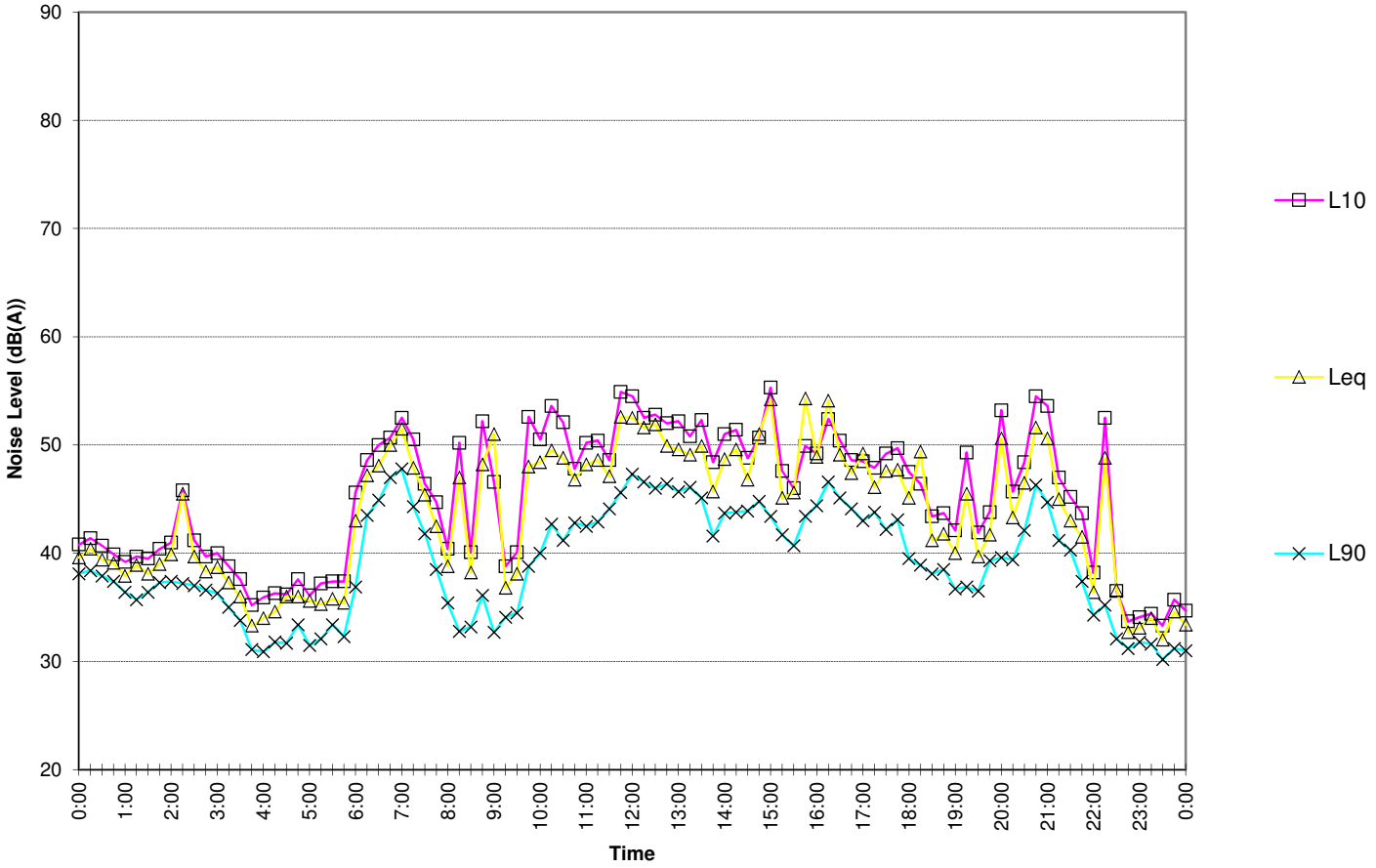
Norwest site

Saturday April 25,2009



Norwest site

Sunday April 26,2009



Norwest site

Monday April 27,2009