SYDNEY UNIVERSITY CODCD MASTER PLAN

NOISE ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 09238
VERSION A

WILKINSON MURRAY

SYDNEY UNIVERSITY CODCD MASTER PLAN

NOISE ASSESSMENT

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NOVEMBER 2009

PREPARED FOR

THE UNIVERSITY OF SYDNEY
CAMPUS INFRASTRUCTURE SERVICE
THE UNIVERSITY OF SYDNEY NSW 2006

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1 INTRODUCTION

As part of the University of Sydney 20/20 Master Plan, it is proposed to build the Centre for Obesity, Diabetes and Cardiovascular Disease (CODCD) within the grounds of the University. The CODCD will be an eight level building located between the Royal Prince Alfred Hospital (RPA) and University Oval Number 2.

This report presents a noise assessment of the project. Aspects covered include;

- Construction noise;
- Operational noise; including sleep disturbance;
- Traffic noise;
- Cumulative noise.

2 PROJECT DESCRIPTION AND SURROUNDINGS

2.1 The Project

The project location is shown on Figure 2-1. To the north of the project are the residential colleges St John's College and Sancta Sophia. To the west and northwest are buildings belonging to RPA. The hospital buildings are of various use: education, research, clinical and wards. To the South are University playing fields. To the east are University of Sydney buildings, the closest being the R.M.C.Gunn Building.

Two buildings will be demolished as part of the project: the Missenden Psychiatry Unit belonging to RPA and the HK Ward gymnasium belonging to the University.

Potential noise generation from the operational aspects of the proposal are:

- Continuous noise from mechanical plants;
- Traffic noise from students, staff or patients visiting the project; and
- Noise from delivery vehicles accessing the building.

2.2 Noise Sensitive Receivers

The locations of the CODCD and noise sensitive receivers are shown on Figure 2-1. The receivers are:

1 – St Johns College

2 – Sancta Sophia College

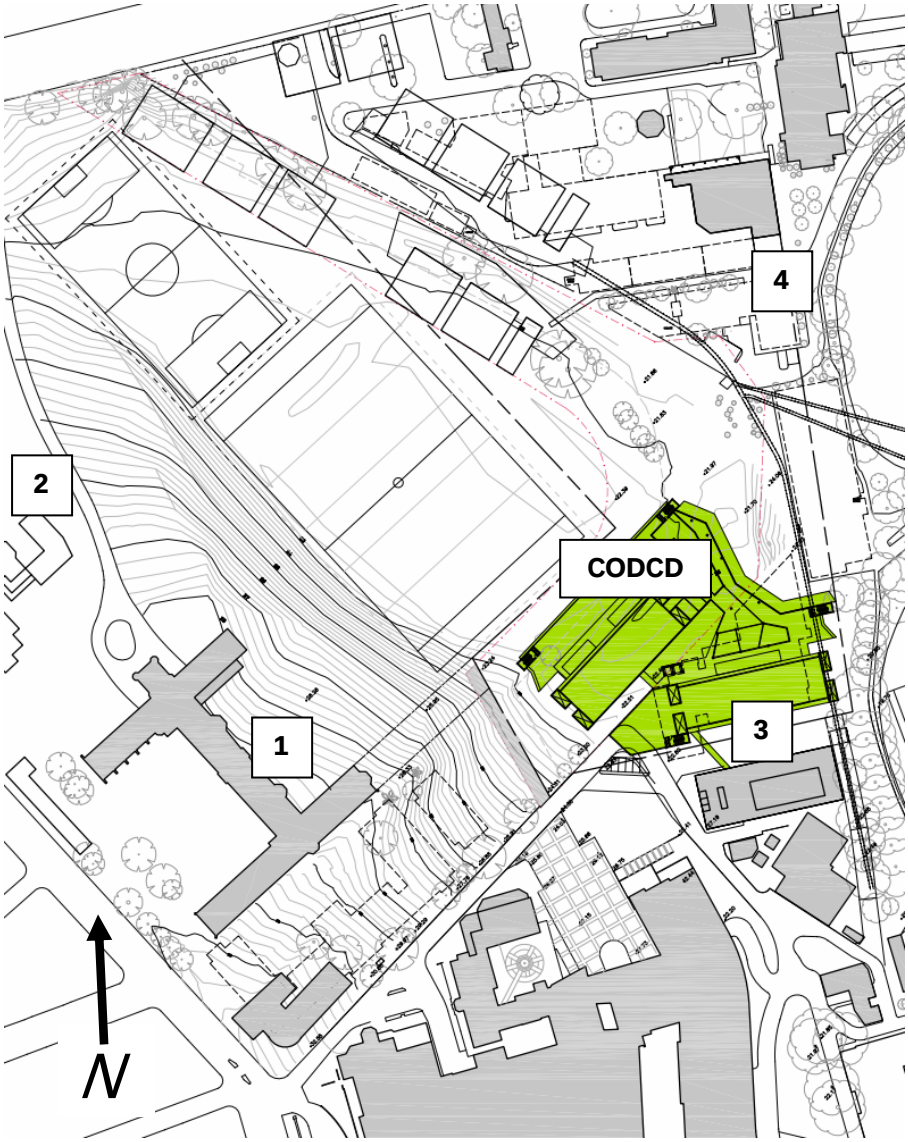
3 – The Centenary Institute (RPA Hospital)

4 – R. M. C. Gunn Building

Receivers 1 and 2 are residential colleges. Receivers 3 and 4 are commercial buildings used for teaching, or research.

The nearest residential receivers outside the university grounds are on Parramatta Road, approximately 300m north west of the site, north of the Ross Street Intersection.

Figure 2-1 Location of Project and Noise Sensitive Receivers



3 OPERATIONAL NOISE CRITERIA

3.1 Industrial Noise Policy

For sources such as the fixed plant and equipment associated with the project, appropriate noise criteria are specified in the NSW DECCW's *Industrial Noise Policy (INP).* The criterion depends on whether existing noise levels in an area are close to recommended amenity levels for different types of residential receiver areas (ie urban, rural, near existing roads).

For residential receivers, two criteria are specified in the *INP*: the intrusiveness criterion and the amenity criterion.

In general, intrusiveness criterion is that the L_{Aeq} noise level from such sources should not exceed the Rating Background Level (RBL) by more than 5dBA.

The amenity criterion sets an upper limit to control the total L_{Aeq} noise level from all industrial sources. In this case, the potentially affected residences in an area which would be classified as "Urban" and the relevant recommended "acceptable" amenity criteria for $L_{Aeq,period}$ are 60, 50 and 45dBA for daytime, evening and night time periods respectively. "Maximum" recommended levels are all 5dBA higher.

The intrusiveness criterion is applied over any 15 minute period, and will be used to assess total noise emission from the site, including truck delivery. The amenity criterion is assessed over an entire period (day, night, etc) and typically applies to mechanical plant and car parking activities.

3.1 Background Noise Levels

Noise criteria depend on the existing noise levels. Those levels were measured using both attended and unattended noise monitoring.

3.1.1 Unattended Measurements

Noise levels were monitored continuously from Wednesday 31 October to Monday 2 November 2009. The result charts of the logging are shown in Appendix B. The noise logger location is shown on Figure 3-1. As there was no secure location to leave an unattended noise monitor near the residential colleges, the logger was located at the site of the CODCD.

The noise monitoring equipment used for these measurements consisted of an environmental noise logger set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Appendix A for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. This is used for the assessment of sleep disturbance. The L_{A90} level is normally taken as the background noise level during the relevant period.

Periods of rain and wind were excluded from the results as required by the *INP*. The results from the logger were RBL 46dBA daytime, 45dBA for evening, and 43dBA for night time.

During the logging there was drilling activity occurring nearby. Hence, the daytime logger data cannot be used reliably to assess existing industrial noise at the logger site.

3.1.2 Attended Measurements

To estimate the background noise levels at the residential location a site visit was undertaken during night-time hours. The measurements were done on 27 October 2009 between 11.00pm and 12.00 midnight.

Noise levels were measured with a Bruel & Kjaer Type 2236 Sound Level Meter. The A-Weighting filter of the meter was selected and the time weighting was set to 'fast'. The meter was field calibrated both before and after the measurements with a Bruel & Kjaer Sound Level Calibrator Type 4230. No significant system drift was noted.

The noise environment at Sancta Sophia College was dominated by traffic noise from Parramatta Road and Industrial noise from mechanical Plant in the commercial area across Parramatta Road. The L_{A90} was 62dBA, and the L_{Aeq} was 68dBA.

The background noise level at St John's College was dominated by mechanical services noise from RPA Hospital. The L_{A90} and L_{Aeq} were both 63dBA. The noise source appeared to be mechanical ventilation at the hospital.

At the noise logger location the L_{A90} was 43dBA, which corresponds to the background noise level results from the logger itself. There was no obvious source of industrial noise at this location.

Some locations at both residential colleges would be shielded from the industrial noises that affected the noise measurement. It is estimated that at no location would the background be less than the 43dBA measured at the noise logger.

3.2 Site Specific Noise Criteria

Because of the high levels of industrial noise at the residential colleges, the noise criteria would be determined based on the amenity criteria.

The *INP* states that if noise levels are currently above the recommended levels, planning levels should be set to be 10dBA below the acceptable level if the noise is likely to decrease in future or 10dBA below existing levels if the noise is unlikely to decrease in future. The first consideration is considered too stringent as it would require CODCD noise emissions to be 35dBA in an environment where the current noise is 63dBA.

It is possible that noise at St John's College will decrease in future as the existing noise appeared significantly influenced from a single noisy source. However, it is considered unlikely that the noise would ever be reduced below the 43dBA measured at the noise logger. If it is assumed that this is the level of existing industrial noise (discounting the single noisy source), then the existing level is 2dBA below the "acceptable" level according to the *INP*. The *INP* would then set the planning level at 4dBA below the acceptable level – that is 41dBA.

It is also considered appropriate to use the logger noise level to set the intrusiveness criterion. The site noise criteria are therefore as given in Table 3-1. The site specific noise criteria are the most stringent of amenity and criterion, which in this case will be the intrusive criterion during

daytime period, and the amenity criteria during evening and night time.

Table 3-1 Site Specific Noise Criteria

Criterion	Day (dBA)	Evening (dBA)	Night (dBA)
Amenity, $L_{Aeq,period}$	55	45	41
Intrusive, $L_{Aeq,15min}$	51	50	48

Figure 3-1 Noise Logger Location

3.3 Sleep Disturbance

For potential truck deliveries between 10.00pm and 7.00am it is also necessary to assess the potential impact of sleep arousal from activities at the loading dock. The DECC recommends that the $L_{A1,1minute}$ noise level should not exceed the background L_{A90} level by more than 15dBA.

Using the L_{A90} measured at St Johns College or Sancta Sophia College, this would give a sleep disturbance criterion higher than 70dBA. It is considered more appropriate to use the discussion of sleep disturbance in the NSW *Environmental Criteria for Road Traffic Noise (ECRTN)*. The following conclusions are made in the *ECRTN*:

- Maximum internal noise levels below 50–55dBA are unlikely to cause awakening reactions.
- One or two noise events per night, with maximum internal noise levels of 65–70dBA, are not likely to affect health and wellbeing significantly.

The difference between the internal noise level and the external noise level is typically 10dB with windows open for adequate ventilation. Hence to avoid sleep disturbance, a suitable goal for maximum noise levels of construction noise is 65dBA at bedroom windows.

3.4 Non Residential Receivers

The recommended noise criteria from the *INP* for non-residential receivers are:

- Commercial premises – 65dBA;
- School classroom (internal) – 35dBA;
- Hospital (internal) – 35dBA; and
- Hospital (external) – 50dBA.

4 OPERATIONAL NOISE ASSESSMENT

4.1 Noise Sources

The possible noise emissions from the project are mechanical services, traffic noise and delivery noise. As mechanical services are at a preliminary stage of design, it is not possible to do a detailed noise assessment. However, it was discussed that because of the high criterion and the distance from the project to the nearest residential receivers that there is no technical impediment to a satisfactory acoustical design for mechanical services.

The sources of noise emission from the CODCD are;

- Mechanical services;
- Traffic noise from cars on the University or hospital grounds;
- Truck deliveries.

The noise criteria apply to the total noise emitted from the operation, which would be the combined level of all these sources.

4.2 Operating Hours

The CODCD would have some 24-hour function; however most of the activity would take place in normal office hours. There is provision for after hours tanker delivery of gases which would take place in the basement.

Some mechanical ventilation would operate throughout the night, including fume cupboards from laboratories.

4.3 Mechanical Services

Mechanical plant associated with the proposed development can have the potential to impact on neighbouring residential properties if not adequately treated. At this stage of the project, the selection of the type and location of mechanical plant associated with the proposed development is at a schematic stage only.

There will be plant rooms on the roof and at ground level. There will also be carpark exhaust fans approximately six metres above ground facing St John's College and University No. 2 oval.

Most mechanical services would operate from 7.00am to 8.00pm. However, there would be some fume cupboard exhaust fans operating continuously. Some air conditioning will also be necessary at night and car park exhausts if necessary.

The design of mechanical services is as yet only at preliminary stage and detailed noise predictions cannot be undertaken. However, given distance to residences, and the scope of mechanical services, it is considered that there is no technical impediment to meeting the noise criteria. If the mechanical services for the entire building were considered as one source, a total sound power level of 105dBA would achieve the 45dBA criterion at St John's College. Hence, if noise attenuation and fan selection were chosen to satisfy this 105dBA criterion, then the noise goal would be satisfied.

At the detailed design stage of the project the selected plant noise levels must be assessed with respect to established site specific noise criteria. Should an exceedance be indicated it is

envisaged that standard noise control measures will be adopted to ensure that the acoustic amenity of nearby residences is maintained.

Indicative engineering treatment methods that can be adopted are:

- Judicious selection of plant and equipment behind built elements to provide shielding to residences;
- Acoustic screens/enclosures;
- Acoustic louvres for plant rooms;
- Silencers, for example on carpark exhaust fans; and
- Acoustically lined ductwork.

The attenuation required can easily be met using standard methods.

4.4 Internal Traffic

Internal traffic refers to traffic generated on the grounds of the University or RPA Hospital. While still on the public road network the noise from vehicles would be considered as traffic noise and is discussed in Section 5. Information from the traffic study indicates that the vehicle movements to and from the CODCD carpark would be;

- AM Peak – 120 vehicles per hour;
- PM Peak – 80 vehicles per hour.

Traffic noise was predicted using the *Calculation of Road Traffic Noise (CORTN)* algorithms, and assuming a speed of 50kmph on the internal roads.

Noise from the internal traffic would be at most L_{Aeq} 35dBA at Sancta Sophia, and 33dBA at St John's College.

Noise at the nearest university buildings would be up to L_{Aeq} 50dBA.

Noise levels from internal traffic are predicted to meet the criteria.

4.5 Noise from Deliveries

There will be up to 10 deliveries per hour during daytime hours. There will also be a tanker delivery of gases after hours. All deliveries will be below ground in the basement car park of the building, and after hours vehicles will approach the CODCD from the University side. Noise levels from trucks accessing the building would be less than $L_{Aeq,15min}$ 40dBA at both residential colleges and would comply with the noise criterion.

4.6 Combined Noise Levels

The noise criteria apply to the total noise emission from the site. Typically the highest noise emission occurs when peak traffic flows coincide with the arrival of delivery vehicles. Noise attenuation is designed if necessary for each noise source. In this case, it is predicted that noise from both internal traffic and delivery will be well below the criterion. The noise control for the mechanical services can then be designed so that total noise complies with the criterion. Table 4-1 illustrates the process of deriving the noise goal for mechanical services. In the case of both colleges and the nearest university building the sum of predicted noise from traffic and deliveries is 9dBA below the criterion. Hence mechanical services noise should be designed to be at most 1dBA below the criterion in order that the combined noise complies with the

criterion.

Table 4-1 Derivation of Design Goal for Mechanical Services

Noise Source	Noise Level at Sancta Sophia, $L_{Aeq, 15min}$	Noise Level at St John's College, $L_{Aeq, 15min}$	Noise level at Nearest University Building, $L_{Aeq,11hour}$
Traffic (predicted)	35	33	50
Truck Deliveries (predicted)	40	40	55
Sum of noise from traffic and deliveries	41	41	56
Criterion (Daytime)	**51**	**51**	**65**
Maximum Design Goal for Mechanical Services	50	50	64

This process is only one example. It may be decided at design stage that it is more appropriate to mitigate noise from traffic and truck deliveries. However it is usually the case that there is more scope for mitigation of noise from mechanical services.

4.7 Sleep disturbance

The only noise source that would potentially give rise to a sleep disturbance event is the arrival and departure of delivery vehicles.

The maximum L_{A1} noise level from truck delivery would be approximately 45dBA at Sancta Sophia College and the northern end of St John's College. This complies with the sleep disturbance criterion of 65dBA. The noise event would be from a vehicle accessing the CODCD from the new road between the CODCD and Parramatta Road. Once inside the basement car park the vehicles would be inaudible at the residential colleges.

4.8 Diesel Generator and Smoke Exhaust Systems

There will be an emergency standby diesel generator and smoke exhaust systems that would both be tested during daytime hours. As the exact location of the generators is not known, an accurate noise assessment is not possible.

The noise criteria for emergency generators are typically based on the guidelines of the DECCW's *Environmental Noise Control Manual*. They are:

- For residences –
    - during daytime and evening (7.00am to 10.00pm) the noise L_{A10} noise should not exceed the background by more than 10dBA at the residential boundary, up to a maximum of 55dBA;

- during night time (10.00pm to 7.00am) the noise L_{A10} noise should not exceed the background by more than 5dBA at the residential boundary, up to a maximum of 45dBA.

- For commercial receivers the noise L_{A10} noise should not exceed the background by more than 15dBA at the residential boundary, up to a maximum of 65dBA.

Hence the criteria are:

- for residences the criteria are 55dBA for daytime, and 48dBA for night time; and
- for the commercial and educational buildings the criterion is 61dBA at any time.

It is typical for standby diesel generators in commercial environments to require acoustically designed enclosures. The ventilation to the generators will probably require attenuators, as will the cooling fan for the dummy load.

The attenuation required can easily be met using standard methods.

5 CUMULATIVE NOISE

The "cumulative noise" refers to the impact on the overall noise environment, and how the proposal would cause the overall noise to increase. The amenity criterion sets an upper limit to control the total L_{Aeq} noise level from all industrial sources.

Cumulative noise is controlled by setting an appropriate amenity criterion, and ensuring noise controls are designed so that the development can meet that criterion. Compliance with the amenity criterion was discussed in previous sections.

6 TRAFFIC NOISE

6.1 Traffic Noise Criteria

The *Environmental Criteria for Road Traffic Noise (ECRTN)* sets out criteria for assessment of noise from vehicles on public roads.

The *ECRTN* sets out noise criteria for 'arterial', 'sub-arterial', 'local roads' and 'collector roads'.

Parramatta Road would be considered as an arterial road and Missenden Road a collector road. Criteria for "land use developments with potential to create additional traffic" are as follows (the difference is that for arterial roads the assessment period is all day or all night, and for collector roads the assessment period is one hour):

- Arterial Roads
  - Daytime (7.00am-10.00pm) $L_{Aeq,15hr}$ = 60dBA
  - Night Time (10.00pm-7.00am) $L_{Aeq,9hr}$ = 55dBA
- Collector Roads
  - Daytime (7.00am-10.00pm) $L_{Aeq,1hr}$ = 60dBA

- Night Time (10.00pm-7.00am) $L_{Aeq,1hr}$ = 55dBA

Where existing levels exceed these criteria, the development should not increase existing levels by more than 2dBA. This criterion is to be met at a time ten years after the opening of the development.

6.2 Traffic Noise Assessment

From RTA published data the average annual daily traffic (AADT) flow on Parramatta Road at Camperdown in 2005 was 67,707 vehicles. The addition of 120 vehicles during the morning peak hour would cause an increase by less than 0.1dBA at residences along Parramatta Road. No noise impact is predicted.

Some service vehicles may access the site through Missenden Road. There is no traffic information available for Missenden Road. However, as Missenden Road is a busy collector road for the area, no noise impact is predicted.

7 CONSTRUCTION NOISE

7.1 Construction Schedule

Construction is expected to take approximately 30 months. The dates and duration proposed are:

- Demolition: 2 months (mid July to mid September 2010);
- Excavation: 4 months (mid September 2010 to January 2011); and
- Construction: 24 months (June 2011 to May 2013).

7.2 Construction Noise Criteria

Guidelines for the assessment of construction noise in New South Wales (NSW) are specified in the DECCW Interim Construction Noise Guideline (ICNG). The management noise levels for residences, and how they are to be applied, are set out in Table 7-1.

Table 7-1 Construction Noise Goals at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining, regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after schools for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL +5dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and the noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 (of ICNG)

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

For work outside standard hours the ICNG requires analysis of the maximum noise level, and the extent and number of times the maximum noise level exceeds the RBL. The ICNG does not set levels, but refers to the discussion of sleep disturbance in the NSW *Environmental Criteria for Road Traffic Noise (ECRTN).* The following conclusions are made in the *ECRTN*:

- Maximum internal noise levels below 50–55dBA are unlikely to cause awakening reactions.
- One or two noise events per night, with maximum internal noise levels of 65–70dBA, are not likely to affect health and wellbeing significantly.

The ICNG states that as a guide, the difference between the internal noise level and the external noise level is typically 10dB with windows open for adequate ventilation. With construction noise there will typically be more than two maximum noise events per night. Hence to avoid sleep disturbance, a suitable goal for maximum noise levels of construction noise is 65dBA at bedroom windows.

Given the adopted daytime background level of 46dBA, the goal for construction noise would be 56dBA at residences. This is considered conservative given the noise environment near the residential colleges, as there are some locations where the existing industrial noise is above 60dBA, as previously discussed.

7.2.1 Non Residential Receivers

Noise guidelines for sensitive land uses other than residences are given in Table 7-2.

Table 7-2 Noise Guidelines at Sensitive Land Uses other than Residences

Land Use	Management Level, $L_{Aeq,15min}$ (applies when the properties are in use)
Classrooms at schools and other educational institutions	Internal noise level 45dBA
Hospital wards and operating theatres	Internal noise level 45dBA
Places of worship	Internal noise level 45dBA
Active recreation areas (St John's Oval, Uni no. 2 Oval)	External noise level 65dBA
Passive recreation areas	External noise level 60dBA

There are two guidelines for offices:

- An external level of 70dBA; or
- An internal goal based on levels given in AS2107 Acoustics – Recommended design sound levels and reverberation times for building interiors – which is 45dBA for offices.

For classrooms the DECCW goal is specified as L_{Aeq} 45dBA internal noise level.

The facades at neighbouring buildings are likely to reduce noise by more than 25dBA, so an external level of 70dBA is an appropriate goal for both offices and educational buildings.

7.3 Construction Noise Assessment

The predicted construction noise levels are given in Table 7-3. Numbers in bold represent exceedances of the noise goals indicating times and locations where noise may require management.

Table 7-3 Construction Noise Predictions

Receiver	Criterion, L_{Aeq} dBA	Demolition		Earthworks		Superstructure	
		Maximum	Typical	Maximum	Typical	Maximum	Typical
St Johns	56	**63**	**60**	**60**	**58**	**58**	56
Sancta Sophia	56	**59**	**58**	56	55	54	53
Centenary Institute	70	**83**	**75**	**80**	**72**	**78**	70
Gunn Building	70	58	64	55	61	**78**	59

Exceedances of the criterion are predicted at the residential colleges. However, as discussed the noise goal is considered conservative, and the exceedances are considered manageable.

There would also be exceedances at parts of St Johns Oval and the university ovals, particularly during excavation stages.

8 CONCLUSION

The University of Sydney proposes to build the CODCD as part of its 2020 Master Plan. This report considered noise aspects of the CODCD, including operational, construction and traffic noise.

The existing noise environment at the nearest residential receivers is such that the L_{A90} background levels are very high. Consideration was given to the industrial noise policy and background noise levels measures at the site of the CODCD in order to set appropriate planning levels for noise emissions from the project.

The possible noise emissions from the project are mechanical services, traffic noise and delivery noise. As mechanical services are at a preliminary stage of design, it is not possible to do a detailed noise assessment. However, it was discussed that because of the high criterion and the distance from the project to the nearest residential receivers that there is no technical impediment to a satisfactory acoustical design for mechanical services.

Noise from traffic on site will add to the existing traffic noise at receivers. Noise from this source will comply with the criterion.

The combined noise from all sources was discussed. It was shown that, because noise from traffic and truck deliveries is predicted to be well below the noise criteria, the noise goal for mechanical services can be lowered slightly so that the combined noise will meet the criteria.

The project could potentially add extra vehicles to the existing public road network outside the university. The extra vehicles will cause an insignificant increase in traffic noise and no noise impact is predicted from this source.

Construction noise will cause significant impact at the neighbouring commercial, research and hospital buildings. A construction noise management plan would minimise the impacts.

Version	Status	Date	Prepared by	Checked by
A	Final	24 November 2009	George Jenner	John Wassermann

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

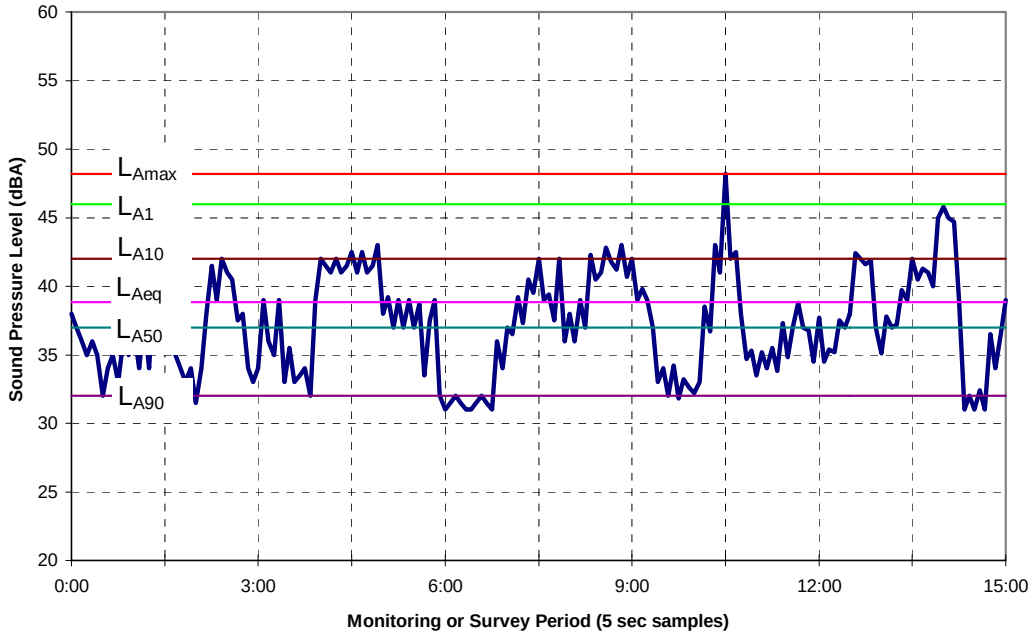
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night time.

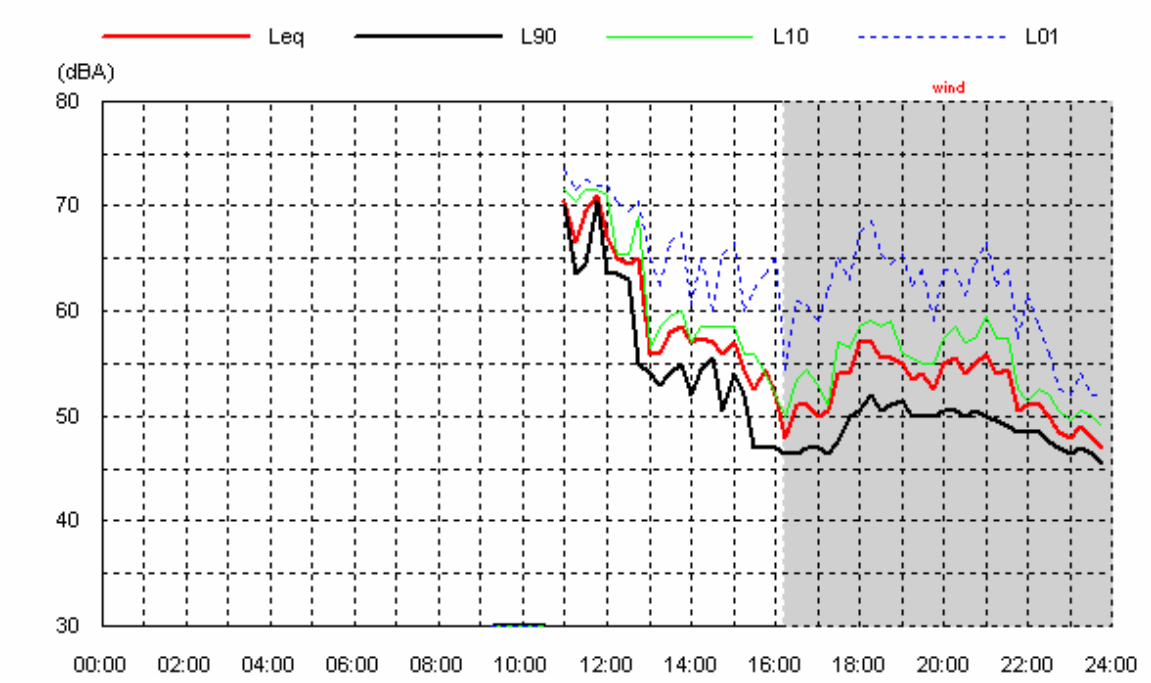

60
55
50
45
40
35
30
25
20
Sound Pressure Level (dBA)
LAmax
LA1
LA10
LAeq
LA50
LA90
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

APPENDIX B

NOISE MEASUREMENT RESULTS

Location: H. K. Ward Gym - St John's Oval
Data shaded: wind

Wed 21 Oct 09



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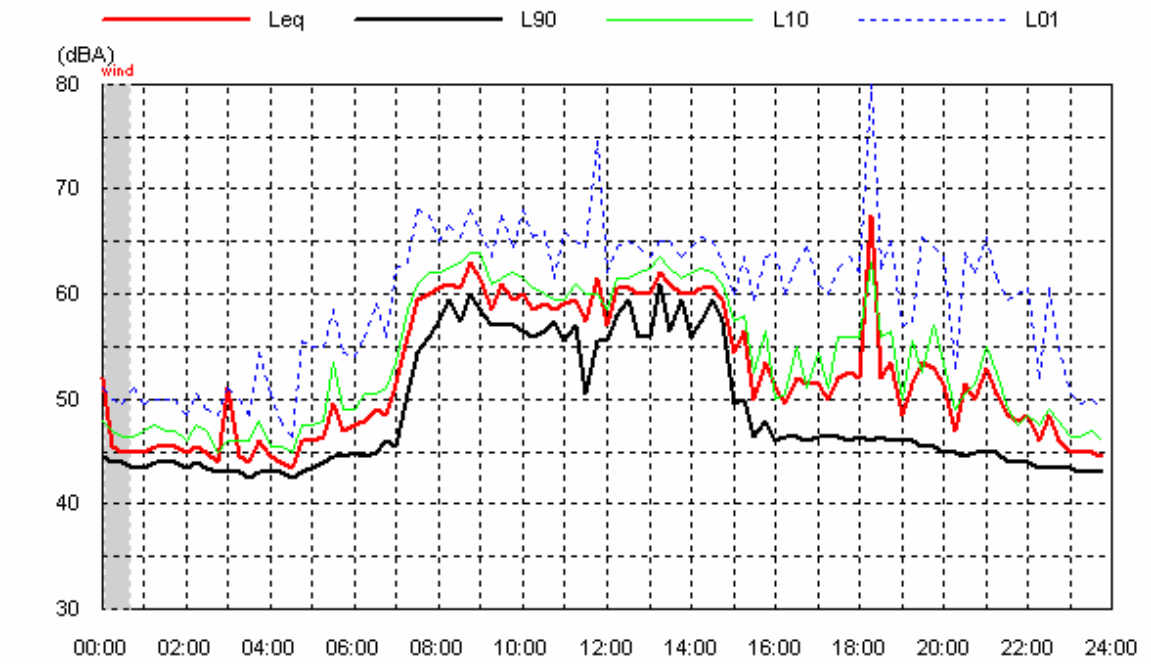
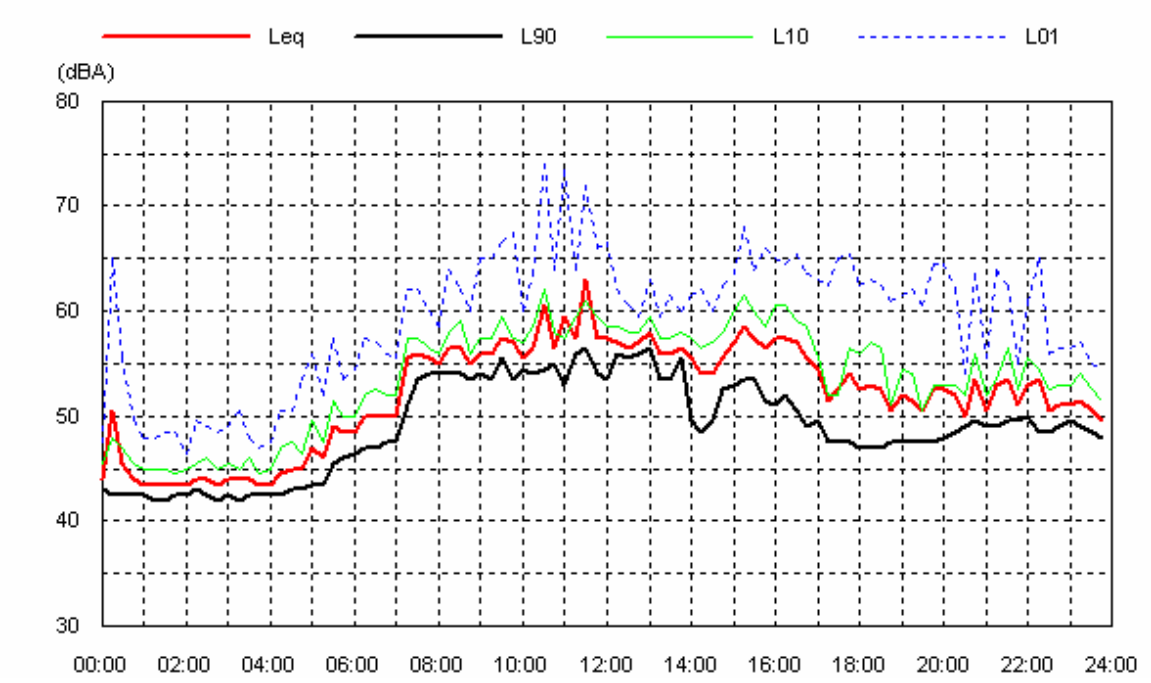
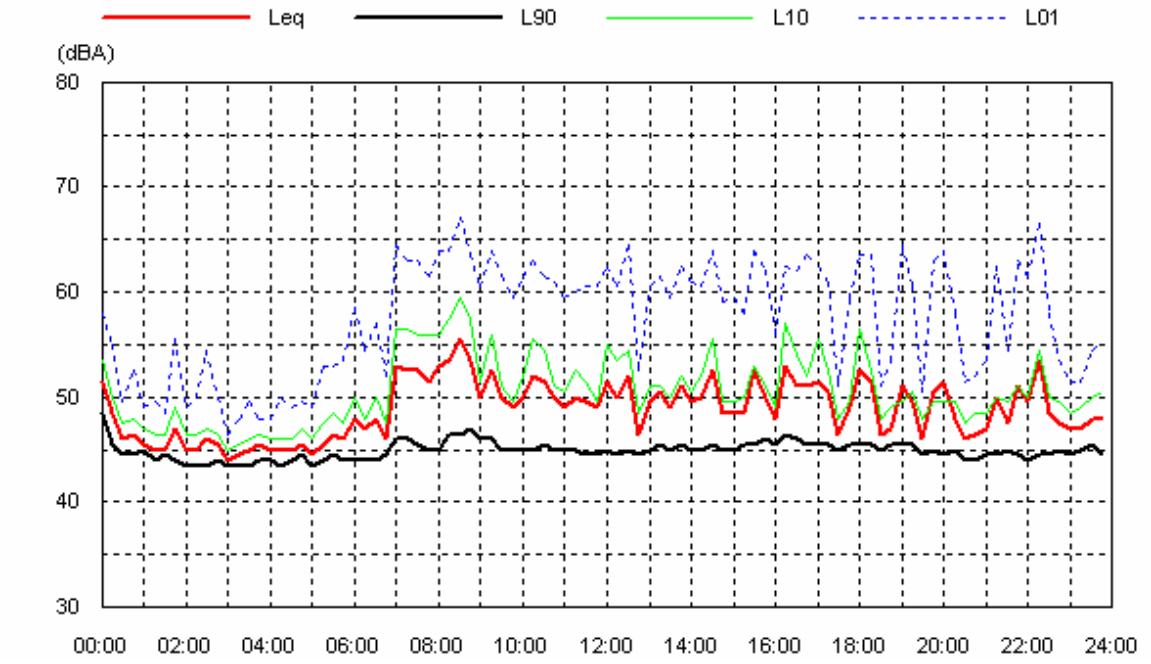


Location: H. K. Ward Gym - St John's Oval
Data shaded: wind

Fri 23 Oct 09

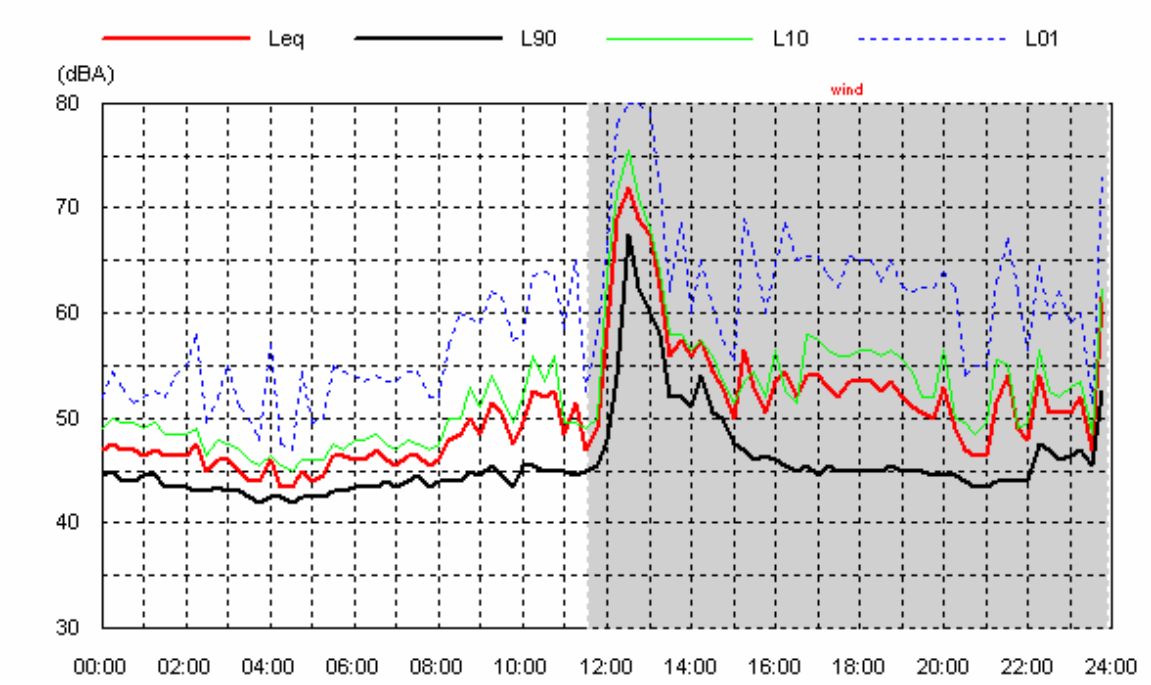


Sat 24 Oct 09

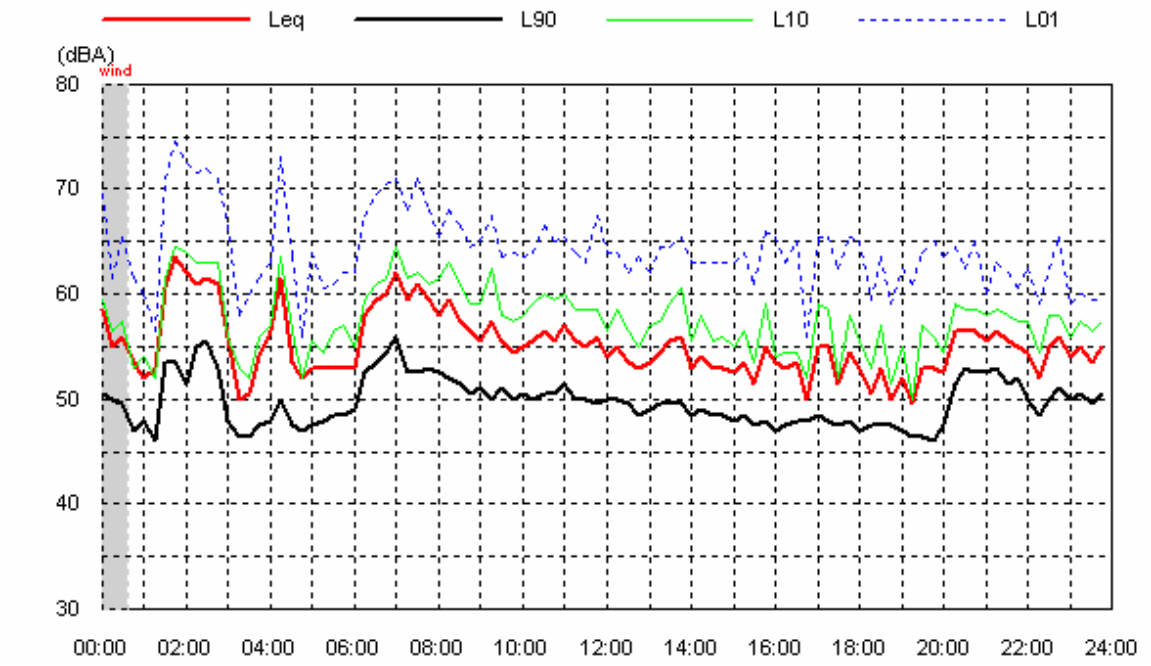


Location: H. K. Ward Gym - St John's Oval
Data shaded: wind

Sun 25 Oct 09

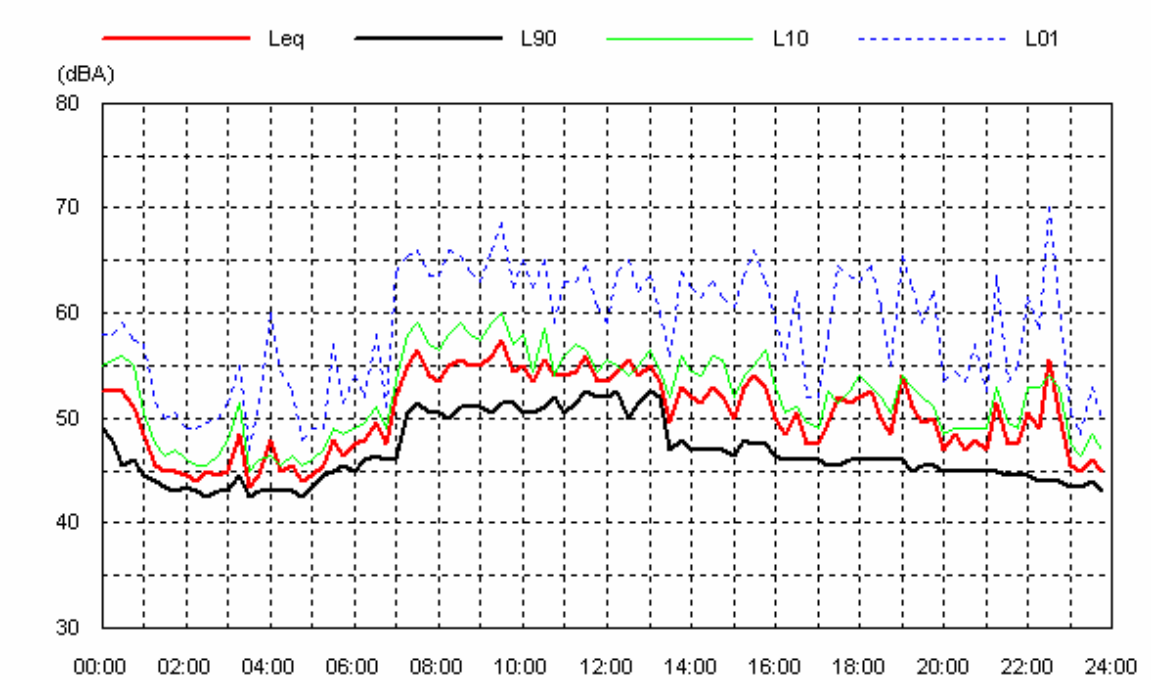


Mon 26 Oct 09

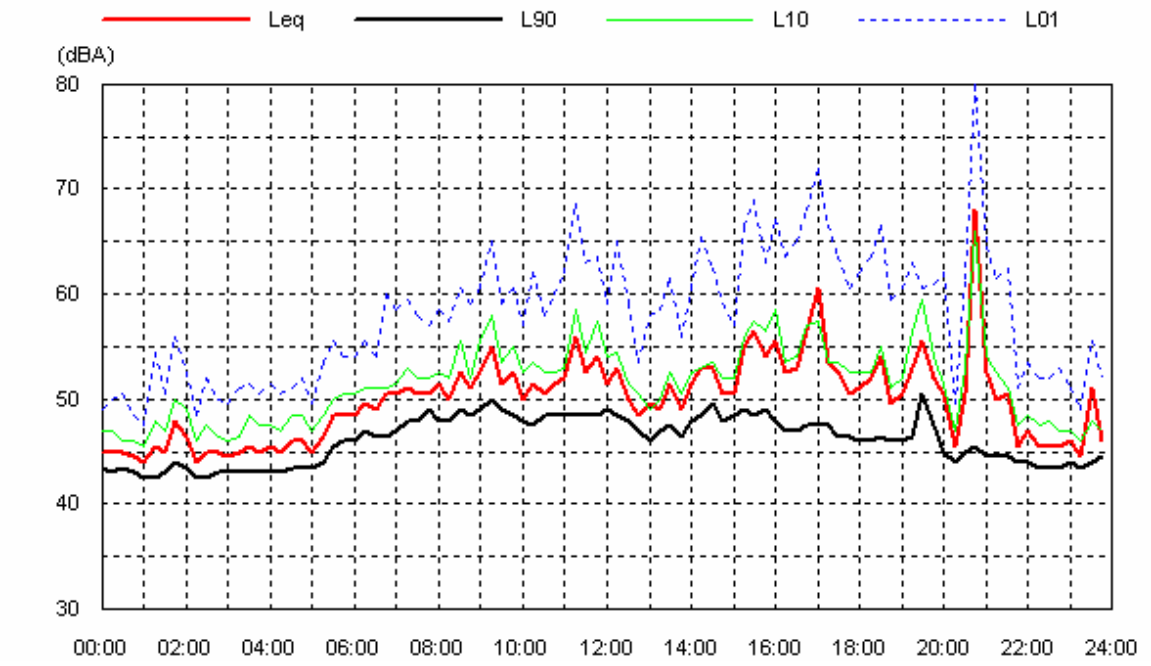


Location: H. K. Ward Gym - St John's Oval
Data shaded: wind

Tue 27 Oct 09

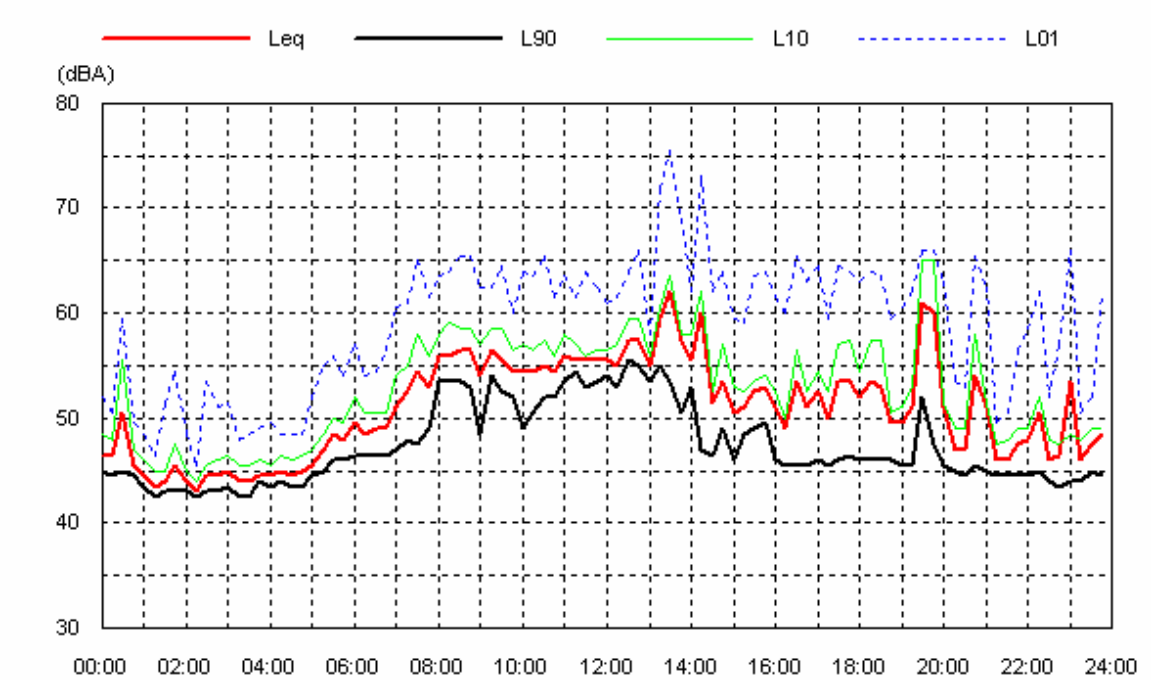


Wed 28 Oct 09

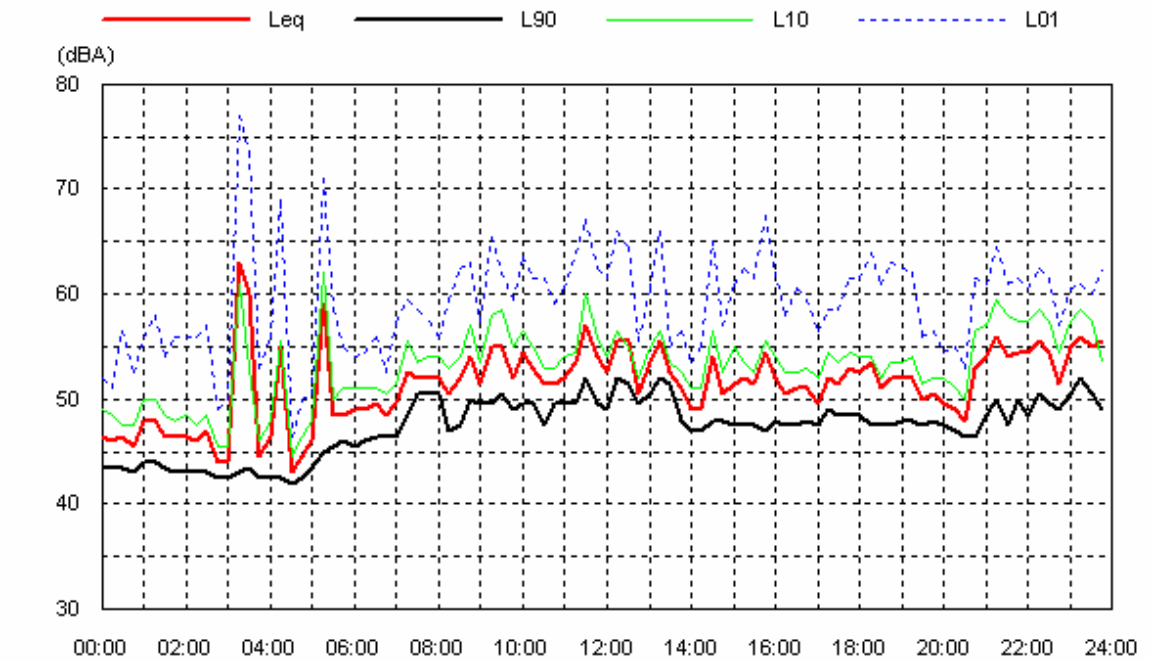


Location: H. K. Ward Gym - St John's Oval
Data shaded: wind

Thu 29 Oct 09

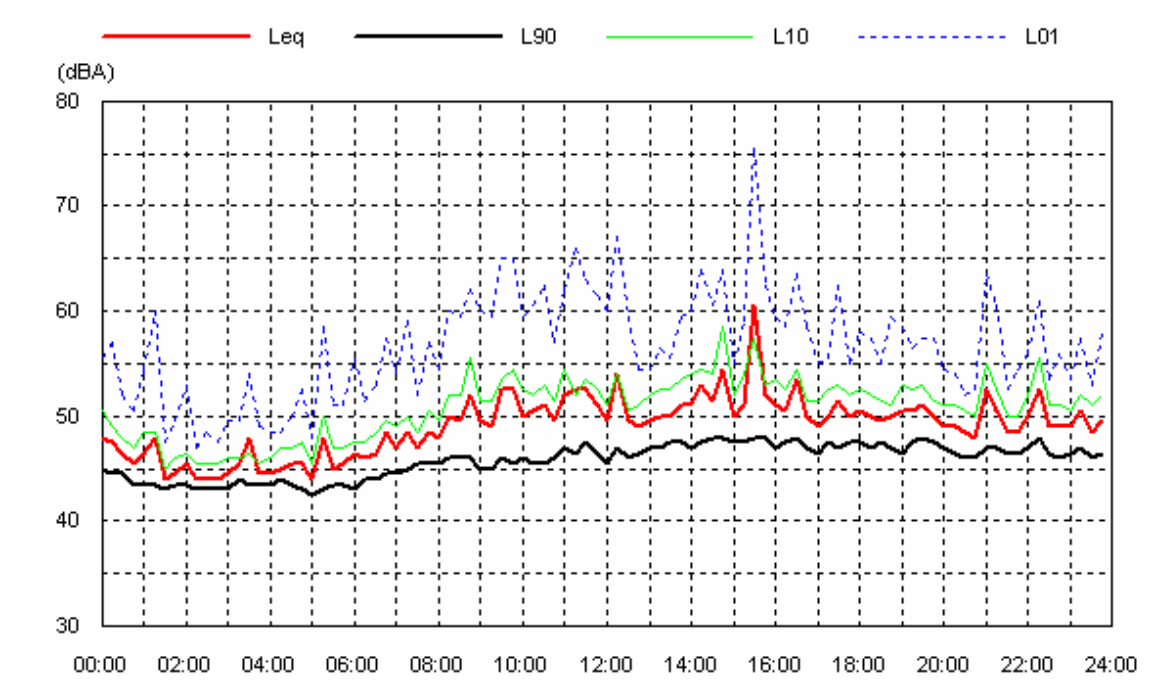


Fri 30 Oct 09

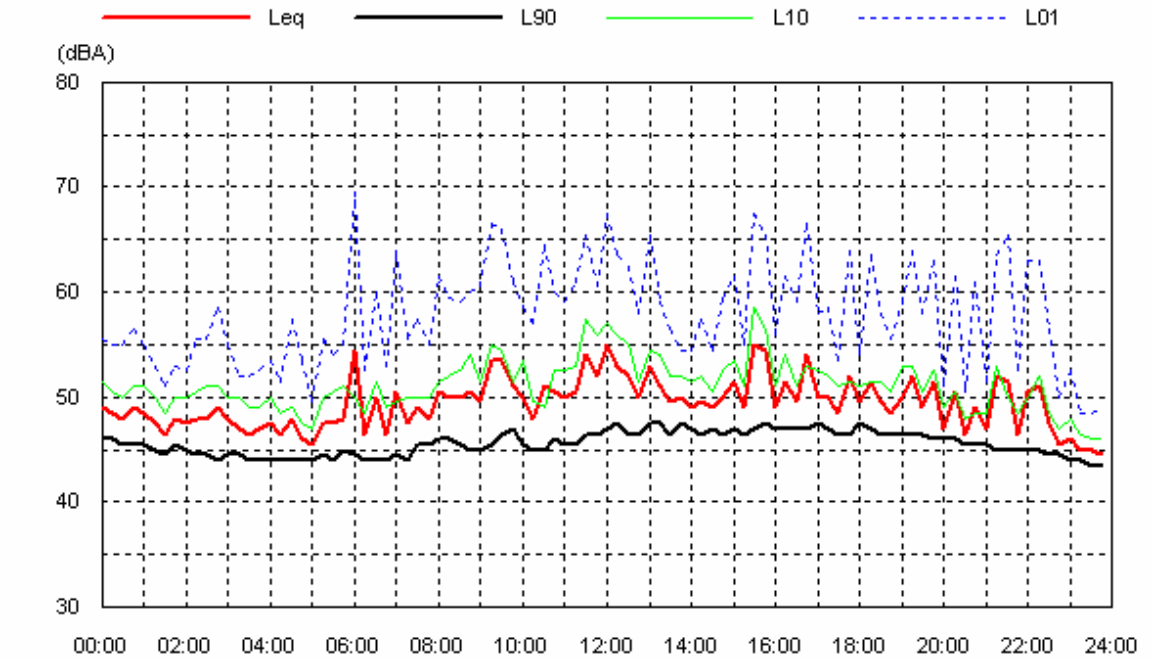


Location: H. K. Ward Gym - St John's Oval
Data shaded: wind

Sat 31 Oct 09



Sun 01 Nov 09



Location: H. K. Ward Gym - St John's Oval
Data shaded: wind

Mon 02 Nov 09