UNIVERSITY OF TECHNOLOGY SYDNEY

MULTI PURPOSE SPORTS HALL
NOISE ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 09233
VERSION B

WILKINSON MURRAY

UNIVERSITY OF TECHNOLOGY SYDNEY

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OCTOBER 2009

PREPARED FOR

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C/O PTW ARCHITECTS
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1 INTRODUCTION

The University of Technology Sydney (UTS) proposes to build a multi-purpose sports hall (MPSH) and Alumni Green at the existing Alumni Green UTS Broadway Precinct of City Campus. The site will be excavated and the MPSH constructed below ground level. The MPSH will then be covered to form a new Alumni Green.

This report assesses noise and vibration associated with the construction and operation of the MPSH. The assessment is based on Revision 01 plans issued by Peddle Thorpe Walker (PTW) Architects dated 30 September 2009.

2 PROJECT DESCRIPTION

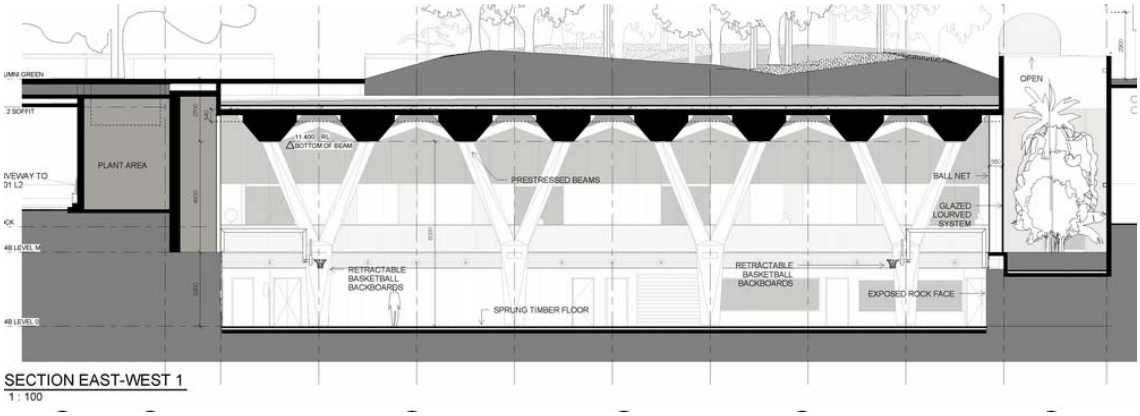
The MPSH project comprises the following spaces:

- sports hall,
- gymnasium;
- dance studio;
- tutorial room;
- store rooms;
- office; and
- male and female change rooms.

The MPSH will be built below ground level of the existing Alumni Green. The site will be excavated to allow construction underground and then covered to form a new Alumni Green.

A cross section through the MPSH is shown on Figure 2-1.

Figure 2-1 Cross Section through MPSH



The sports hall, gymnasium and dance studio will include acoustically absorbent panels on the walls to control internal acoustics. Suitable panels would be slotted or perforated plywood.

2.1 Surrounding Receivers

The site at the Alumni Green on Thomas Street is surrounded by UTS buildings.

The nearest residences in the vicinity have been identified as:

- Location A - Apartments at the corner of Ultimo Road and Harris Street (200m from the site but very well shielded by buildings;
- Location B - Apartments at 732 Harris Street, and;
- Location C - Apartments under construction on Wattle Street (approximately 230m from the site, shielded from most of the site).

There are two sets of apartments under construction on Wattle Street. The closest multi-storey apartment building at the bottom of Thomas Street appears near completion and may be occupied by the time construction begins at UTS. Another residential building adjacent to this one has commenced construction but is much less advanced and therefore not significant with respect to construction noise.

Other surrounding commercial and educational receivers are:

- TAFE buildings across Thomas Street to the North.
- ABC studios on Harris Street to the East

Figure 2-2 shows the location of residences and other noise sensitive buildings.

Figure 2-2 Aerial of Site Showing Surrounding Receivers

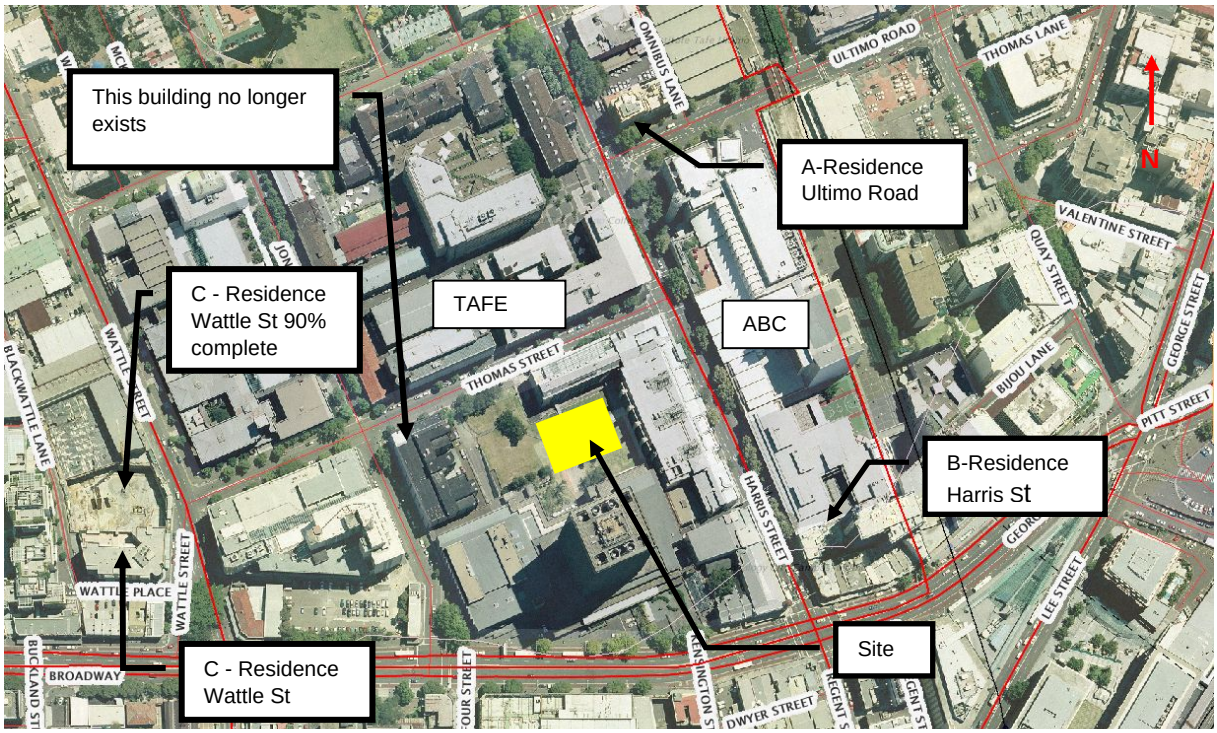
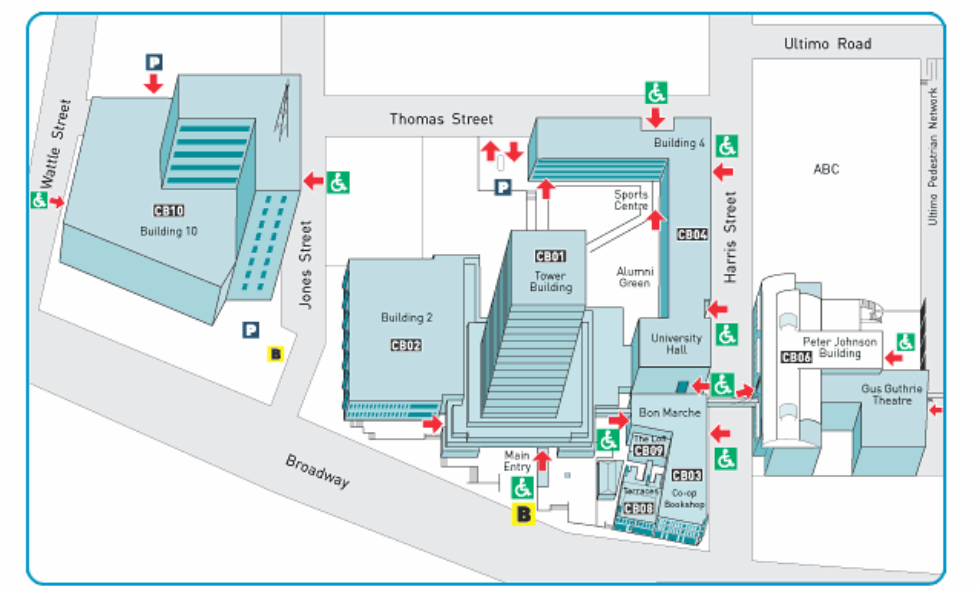


Image source: Dept of Lands

The surrounding buildings are shown on Figure 2-3.

Figure 2-3 Campus Map



It is noted that the Thomas Street wing of Building 4 houses laboratories with sensitive equipment and is very close to the site of excavation.

3 CONSTRUCTION NOISE IMPACT

The following sections detail the impact of construction noise and vibration on the surrounding environs.

3.1 Construction Noise Criteria

3.1.1 Residential Receivers – Background Noise Levels

Daytime background levels were measured at residences during our site visit on 27 August 2009. The L_{A90} background level was 57dBA in Wattle Street, and 58dBA in Harris Street.

Due to the distance to neighbours it was not considered necessary to do long term noise monitoring to establish background noise levels at other times. Wilkinson Murray has measured background levels in the city for many previous projects, and lowest background levels are typically 55dBA during evenings and 50dBA during night time. These levels were used to set conservatively low criteria for construction noise assessment.

3.1.2 Residential Receivers – DECCW Criteria

The Department of Environment, Climate Change and Water (DECCW) has recently released (July 2009) the Interim Construction Noise Guideline. The guideline provides suitable noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the noise should not exceed the L_{A90} background noise by more than 10dBA. This is for standard hours: Monday to Friday 7am to 6pm, and Saturday 8am to 1pm. Outside the standard hours the criterion would be background + 5dBA. A more complete description of the guidelines is in Table 3-1.

Table 3-1 Construction Noise Goals at Residences using Quantitative Assessment

Time of Day	Management Level LAeq,(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 LAeq,(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. • 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.

Time of Day	Management Level LAeq,(15min) *	How to Apply
	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 proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. • If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.

Daytime background levels were measured by Wilkinson Murray at residences during our site visit on 27 August 2009. The background level measured was 58dBA in Harris Street (Locations A and B), and 57dBA in Wattle Street (Location C). These noise levels are consistent with our experience of city noise levels.

Accordingly the flowing construction noise goals are applicable

- Locations A & B Harris Street 68dBA
- Location C Wattle Street 67dBA.

3.1.3 Residential Receivers – City of Sydney Criteria

The City of Sydney Code of Practice 1992 *Construction Hours/Noise within the Central Business District* describes the criteria presented in Table 3-2.

Table 3-2 City of Sydney Construction Noise Criteria

Day	Time Zone	Category	Noise Criteria (Background is L_{A90}, Noise is L_{Amax})
Monday to Friday	00.00-07.00	4	Background+0dBA
	07.00-08.00	1	Background+5dBA
	08.00-19.00	1	Background+5dBA +5dBA to be determined on a site basis

Day	Time Zone	Category	Noise Criteria (Background is L_{A90}, Noise is L_{Amax})
	19.00-23.00	2	Background+3dBA
	23.00-24.00	4	Background+0dBA
Saturday	00.00-07.00	4	Background+0dBA
	07.00-08.00	1	Background+5dBA
	08.00-17.00	1	Background+5dBA +5dBA to be determined on a site basis
	17.00-23.00	2	Background+3dBA
	23.00-24.00	4	Background+0dBA
Sundays and Public Holidays	00.00-07.00	4	Background+0dBA
	07.00-17.00	3	Background+3dBA
	17.00-24.00	4	Background+0dBA

3.1.4 Educational and Commercial Receivers

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.

Some of the facades at UTS are likely to reduce noise by more than 30dBA, so an external level of 70 dBA would be conservative (that is; it would result in an internal noise level of 40dBA). For consistency the recommend internal noise level of 45dBA has been set as an appropriate goal for offices.

For classrooms at UTS and TAFE the DECCW goal is specified as L_{Aeq} 45dBA internal noise level. We also note that ABC building is well insulated against noise intrusion from Harris Street traffic. An external noise criterion of 70dBA for construction noise is considered conservative.

3.2 Construction Methodology

Construction noise varies depending of a number of factors such as the number and type of equipment, location on the site, the depth of the excavation, and operator behaviour.

The MPSH Construction Traffic Management Plan (Halcrow Pacific Pty Ltd, September 2009) indicates that there will be, at most, 3 to 5 heavy vehicles per hour accessing the site throughout the day. These will enter the site from Thomas Street.

In addition, it has been assumed that two hydraulic excavators will be used to excavate the site. These excavators could be used as rock breakers, rock saws, or loading spoil into the trucks.

The typical L_{Aeq} sound power levels of excavators working on the site are:

- Rock breaking 120dBA;
- Rock sawing 115dBA; and
- Truck Loading 110dBA.

Construction noise predictions were established using computer noise modelling using the CadnaA noise modelling software. Factors that are addressed in the noise modelling are:

- Equipment sound level emissions and location;
- Screening effects from buildings;
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground Absorption; and
- Atmospheric absorption.

3.3 Construction Noise Assessment to UTS Buildings

The construction noise impact at buildings close to the site will be similar at all floors. In the case of the tower internal construction noise levels within the building will decrease beyond Level 10. The lower levels of Building 10 are well shielded and would be subject to a reduced noise impact when compared to higher levels.

Internal noise levels have been predicted assuming that all windows are a minimum of 4mm thick fixed glazing. The windows in some buildings, particularly the University Hall and Tower, have extra shielding from building elements and the areas of the windows tend to be a smaller percentage of the overall facade than the windows in Building 4.

Two possible construction scenarios were modelled. These are not absolute and could be varied according by the contractor. The modelled scenarios are:

Scenario 1

Two excavators on site all working at surface level and four delivery trucks per hour;

Scenario 2

Two excavators on site at 5m below surface level and four delivery trucks per hour.

The excavators could be used with rock breaker, rock saw, or loader attachments. The rock

saws or rock breakers would probably not be necessary until a depth of 4m has been reached.

Noise predictions have been conducted for typical and worst case locations when the excavators are working centrally and at the closest point to the buildings and on site, respectively. Table 3-3 presents predicted noise levels outside the buildings.

Table 3-3 External Construction Noise Levels, L_{Aeq} dBA

UTS Building	Scenario 1 -Equipment at surface			Scenario 2 - Equipment 5m below surface		
	Rock Breaker	Rock Saw	Excavator	Rock Breaker	Rock Saw	Excavator
Building 4 North	79-94	74-89	69-84	78-88	73-83	69-79
Building 4 East	76-91	71-86	66-81	76-86	71-81	66-76
University Hall and Tower	78-88	73-83	68-78	77-87	72-82	67-77
Building 10	65-70	60-65	56-61	58-63	53-58	50-55

Corresponding internal noise levels are presented in Table 3-4. Numbers in bold in Table 3-4 exceed the 45dBA criterion for classrooms and offices.

Table 3-4 Internal Construction Noise Levels, L_{Aeq} dBA

Building Name	Scenario 1 -Equipment at surface			Scenario 2 - Equipment 5m below surface		
	Rock Breaker	Rock Saw	Excavator	Rock Breaker	Rock Saw	Excavator
Building 4 North	**54-69**	**49-64**	44-**59**	**53-63**	**48-58**	44-**54**
Building 4 East	**51-66**	**46-61**	41-**56**	**51-61**	**46-56**	41-**51**
University Hall and Tower	**48-58**	43-**53**	38-48	**47-57**	42-**52**	37-**47**
Building 10	40-45	35-40	31-36	33-38	28-33	25-30

At University Hall and the Tower the internal levels will comply with the noise criteria except during use of rock breakers and rock saws. It would depend on the location of equipment with respect to the receiver. As the excavation deepens lower windows would be shielded from different parts of the worksite, whereas the upper levels of the tower would always be exposed.

At Building 4 the internal noise levels will exceed the criteria while any equipment works at the closest point to the building. In most cases, however, in the case of rock saws and excavators, the resultant noise would only exceed the criterion by up to 5dBA. This has the potential to disrupt some tutorials, but is less likely impact on offices for limited amounts of time.

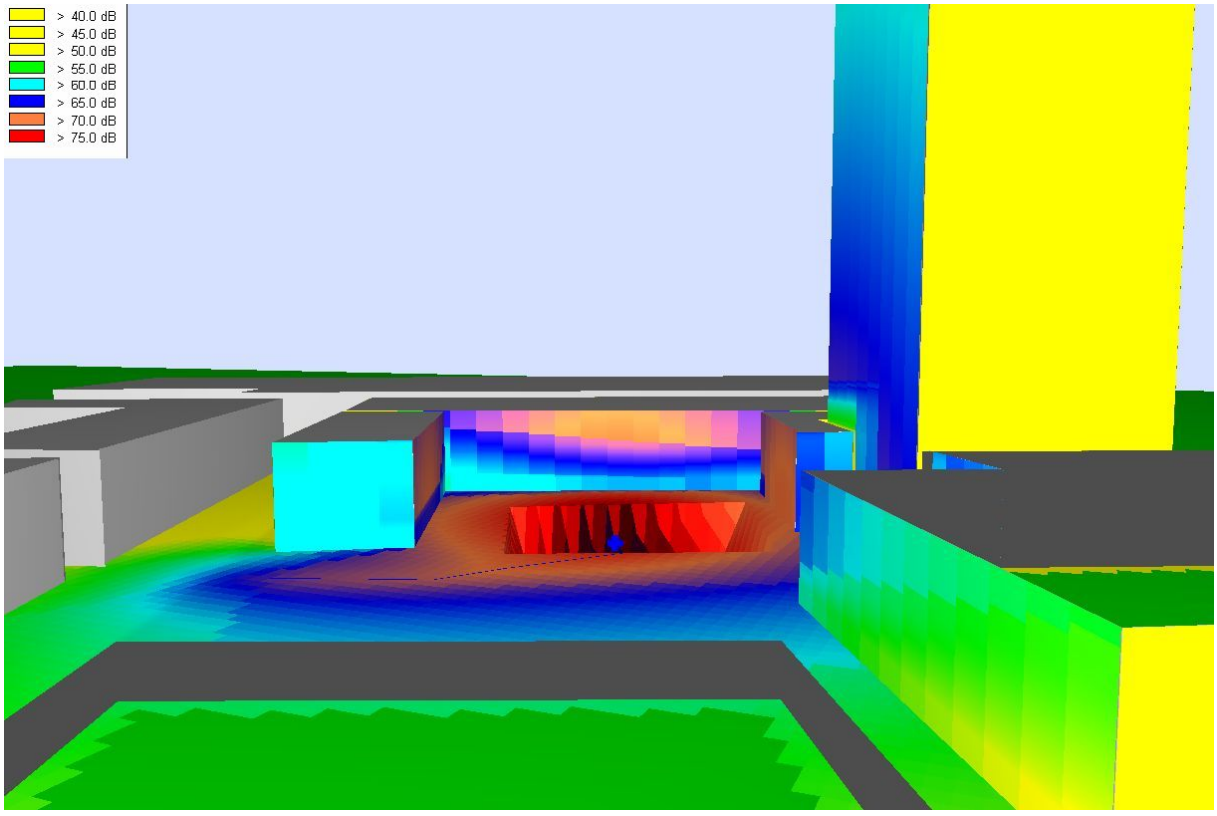
The use of rock breakers would nearly always exceed the internal goal. Rock breaker noise is impulsive it is more disruptive than, for example, an excavator at the same noise level. It is possible that rock breakers may not be used due to vibration constraints at the site.

Figure 3-1 shows noise contours illustrating sound propagation across surrounding building facades are shown for the Scenario 2. In this case a rock saw is close to the eastern face of the excavation. Trucks are also included in the noise model. Areas coloured blue, green and yellow colours indicate that construction noise inside the building would be below 45dBA, and therefore acceptable. At facade coloured orange, internal noise levels would be approximately 45dBA.

The figure indicates that with this scenario the internal noise goals would be met at all buildings for most of the time.

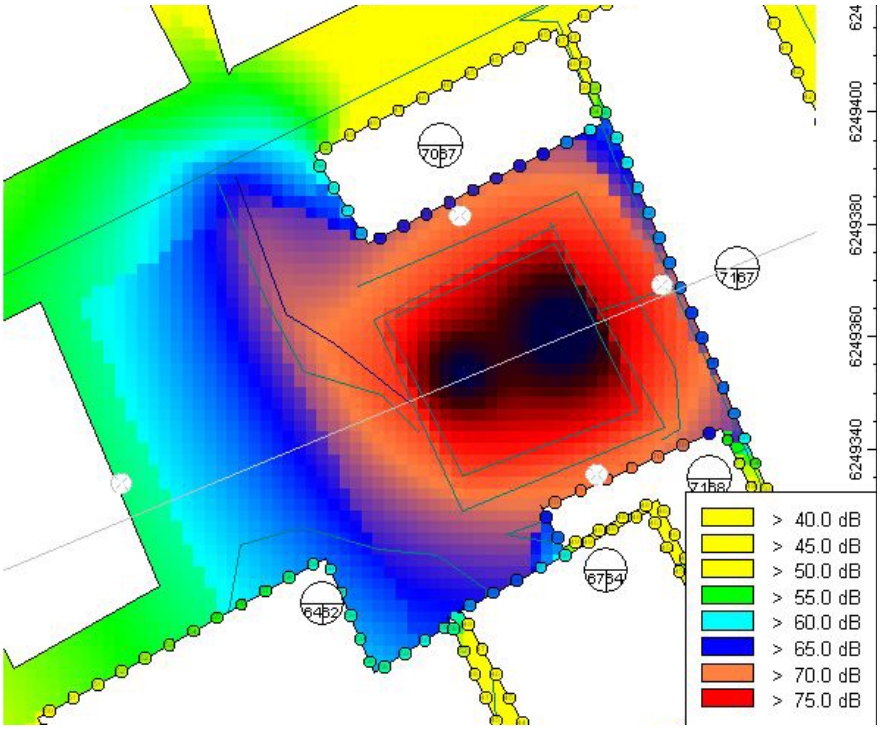
As the UTS are the owner of the site internal management of construction noise and vibration issues should be able to be implemented on site. Construction noise impact to UTS buildings will be managed by UTS and the building contractor.

Figure 3-1 Construction Noise Levels for Scenario 2 with a Rock Saw



A plan of the noise contours is shown in Figure 3-2. This is a plan view of the same scenario, calculated at a receiver height 8m above ground level.

Figure 3-2 Noise contours on campus



3.4 Construction Noise at TAFE Buildings

Predicted noise levels at TAFE buildings across Thomas Street are presented in Table 3-3 for the construction scenarios described in Section 3.3.

Table 3-5 External Construction Noise Levels, L_{Aeq} dBA

Building Name	Scenario 1 -Equipment at surface			Scenario 2 - Equipment 5m below surface		
	Rock Breaker	Rock Saw	Excavator	Rock Breaker	Rock Saw	Excavator
TAFE External Noise Level	65-70	60-65	56-61	58-63	53-58	50-55
TAFE Internal Noise Level	40-45	35-40	31-36	33-38	28-33	25-30

At the TAFE buildings the internal noise level are predicted to comply with the 45dBA criterion at all times.

3.5 Construction Noise Assessment to Neighbouring Buildings

Noise levels at residences and the ABC have been predicted based on the “worst case” scenario of two rock breakers operating at ground level on the site, these levels are presented in Table 3-6. Construction noise will comply with the INP criteria at all neighbouring buildings at any time during construction.

Note also that the minimum criterion based on the City of Sydney Code of Practice would be 50dBA for construction at night. As construction noise is predicted to be at most 42dBA at any residence, night time construction noise would also comply with the minimum criterion.

Table 3-6 Worst Case Construction Noise at Neighbouring Buildings

Building	Predicted Noise Level L_{Aeq} dBA	Noise Criterion, $L_{Aeq(15\ min)}$ dBA	Compliance with Noise Criteria
Residence A - Harris Street	39	68	Yes
Residence B - Harris St	42	68	Yes
Residence C - Wattle St	39	67	Yes
ABC	42	70	Yes

4 CONSTRUCTION VIBRATION ASSESSMENT

4.1 Construction Vibration Criteria

The DECCW publication "Assessing Vibration: a technical guideline (February 2006)" considers impacts of vibration in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). The guideline gives "preferred" and "maximum" vibration levels at buildings exposed to continuous and impulsive vibration. For construction noise the guideline is to apply the criteria for maximum continuous vibration. These levels are summarised in Table 4-1.

In relation to building damage from vibration, suitable levels are determined from German Standard DIN 4150 and BS 7385: Part 2 – 1993, and British Standard BS 6472. The limits interpreted from these Standards are included in Table 4-1

Table 4-1 Human Comfort Vibration Criteria

Receiver	Vibration Criteria, Maximum Peak Velocity (mm/s)	
	Human Comfort	Building Damage
Residential/ Commercial buildings during daytime	0.28	10
Residential/ Commercial buildings during night time	0.20	10

4.2 Vibration Criteria for Laboratory Spaces

Building 4 houses laboratory equipment that is sensitive to extraneous vibration. Published literature for the semi-conductor industry suggests the following criteria for vibration-sensitive equipment:

- Operating theatres: 0.1mm/s RMS.
  (Also suitable for optical microscopes up to 100x magnification.)
- 400x magnification: 0.05mm/s RMS.
- 1000x magnification: 0.025mm/s RMS.

These criteria are very conservative, and intended for design of facilities where the sensitivities of the equipment is unknown.

4.3 Equipment Vibration Levels

Table 4-2 presents estimated vibration levels at a range of distances from the various construction equipment. The attenuation with distance is dependant on the nature of the rock strata at the site.

Table 4-2 Typical Vibration Emission Levels from Construction Plant

Activity	PPV Vibration Level (mm/s) at Distance			
	5 m	10 m	20 m	30 m
Rock Sawing	<1.5	0.5	0.3	0.2
Hydraulic Hammer (30t)	4.5	3	1.5	1.0
Light Rock Hammer (e.g. 600kg)	0.2	0.06	0.02	0.01
Rock drill (estimate)	<1.5	0.5	0.2	0.1
Bored Piling	<0.6	0.2	<0.1	-

4.4 Predicted Vibration Levels

Application of the levels in Table 4-2 to the construction phases discussed previously results in the predicted vibration levels shown in Table 4-3. A review indicates that even with the use of rock saws instead of hydraulic hammers, the vibration criteria for laboratories will not be achieved.

Table 4-3 Predicted Vibration Levels, PPV mm/s

Receiver Location	Hydraulic Hammer (30t)		Light Hammer (600kg)		Rock Saw	
	Min – 5m	Typical – 20m	Min – 5m	Typical – 20m	Min – 5m	Typical – 20m
Building 4 Ground Level	4.5	1.5	0.2	0.02	1.5	0.3
Building 4 Level 1	3.6	1.2	0.2	0.016	1.2	0.2
Building 3 Level 2	2.9	1	0.2	0.013	1	0.16

In addition vibration from rock breakers has the potential to affect human comfort when in close proximity.

4.5 Potential for Building Damage

The vibration criterion associated with building damage to buildings (10mm/s) is typically compliant for the distances that any construction activities will occur. The compliance with the criterion indicates that there is a low risk of building damage from the proposed construction works.

4.6 Vibration Mitigation Measures

In order to manage the issue of potential vibration impact to UTS occupants and sensitive equipment. This can be adopted in vibration management plan which can form part of the project Environmental Management Plan

Measures that can be adopted can consist of:

- Test vibration measurements ,
- Use of rock saws instead of rockbreakers,

- Use of small capacity equipment, and ;
- Scheduling high impact activities outside sensitive hours.

The first step is to understand whether the equipment is damaged by vibration, or is simply rendered inoperable during times of vibration. If the second is the case it is usual to manage vibration by negotiation of construction and laboratory work schedules, as outlined in Section 5.

A vibration monitor could be used during the initial phases of construction to better understand the transmission of vibration through the rock strata at this site.

Alternative methodologies that will reduce vibration impacts include using a rock saw to delineate a work area and then using ripping and/or an excavator with a bucket to remove the spoil, rather than simply using a rockbreaker for everything. Also, as can be seen in Table 4-2, a smaller excavator with hammer (600tonne) produces much less vibration than a larger 1500-tonne unit (although noise output is similar).

4.7 Vibration to Other Remote Buildings

The nearest non-UTS building is the TAFE which is approximately 40m from the site. Vibration levels at this building are predicted to be well below the comfort criteria for commercial and residential buildings.

The ABC building is approximately 70m from this site. Vibration levels would be below the applicable criteria. Further, vibration will not produce audible regenerated noise in the ABC concert hall.

5 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT

Construction noise and vibration should be managed by the following strategies recommended generally by DECCW Interim Construction Noise Guideline (ICNG), and DECCW Assessing Vibration: A Technical Guideline.

Construction noise and vibration could be managed by developing a Construction Noise and Vibration Management Plan. The plan would be developed by the building contractor in consultation with UTS.

Suitable procedures are outlined here.

5.1 Consultation and notification

The community is more likely to be understanding and accepting of noise/vibration if the information provided is frank, does not attempt to understate the likely noise level, and if commitments are firmly adhered to.

Notification before and during construction

- Provide, reasonably ahead of time, information such as total building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur.
- Maintain good communication between the community and project staff.
- Appoint a liaison officer.
- Facilitate contact with people to ensure that everyone can see that the site manager understands potential issues, that a planned approach is in place and that there is an ongoing commitment to minimise noise.

Complaints handling

- Provide a readily accessible contact point, for example, through a 24 hour toll-free information and complaints line.
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint.
- Keep a register of any complaints, including details of the complaint such as date, time, person receiving complaint, complainant's contact number, person referred to, description of the complaint, work area (for larger projects), time of verbal response and timeframe for written response where appropriate.

5.1.1 Plant and equipment

In terms of both cost and results, controlling noise at the source is one of the most effective methods of minimising the noise impacts from any construction activities.

Use quieter methods

- Examine and implement, where feasible and reasonable, alternatives to rock-breaking work methods, such as hydraulic splitters for rock and concrete, hydraulic jaw crushers, chemical rock and concrete splitting, and controlled blasting such as penetrating cone fracture. The suitability of alternative methods should be considered on a case-by-case basis.
- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric-controlled units where feasible and reasonable.

Use quieter equipment

- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine. For example, rubber wheeled tractors can be less noisy than steel tracked tractors.
- Noise labels are required by NSW legislation for pavement breakers, mobile compressors, chainsaws and mobile garbage compactors. These noise labels can be used to assist in selecting less noisy plant.
- Pneumatic equipment is traditionally a problem – select supersilenced compressors, silenced jackhammers and damped bits where possible.
- When renting, select quieter items of plant and equipment where feasible and reasonable.
- When purchasing, select, where feasible and reasonable, the most effective mufflers, enclosures and low-noise tool bits and blades. Always seek the manufacturer's advice before making modifications to plant to reduce noise.

Operate plant in a quiet and efficient manner

- Reduce throttle setting and turn off equipment when not being used.
- Examine and implement, where feasible and reasonable, the option of reducing noise from metal chutes and bins by placing damping material in the bin.

Maintain equipment

- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.
- Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.
- For machines with enclosures, check that doors and door seals are in good working order and that the doors close properly against the seals.
- Return any hired equipment that is causing noise that is not typical for the equipment – the increased noise may indicate the need for repair.
- Ensure air lines on pneumatic equipment do not leak.

5.1.2 Work Scheduling

Scheduling was an important aspect of noise management during construction.

Schedule activities to minimise noise and vibration impacts

- Organise work to be undertaken during the recommended standard hours where possible.
- Schedule work classes are not in session at UTS.
- Consult with affected neighbours about scheduling activities to minimise noise impacts.

5.1.3 Monitoring

Permanent vibration monitoring is recommended in the Thomas Street wing of Building 4.

The monitor should be capable of SMS alerts.

Noise monitoring is not considered necessary for noise impacts to buildings outside UTS.

6 OPERATIONAL NOISE ASSESSMENT

6.1 Noise to Residences

Noise criteria at identified surrounding residences is based on the NSW Department of Environment, Climate Change and Water's (DECCW) Industrial Noise Policy (INP). The "intrusiveness" criterion being that the $L_{Aeq,15min}$ noise level emanating from the premises should not exceed the Rating Background Level (RBL) by more than 5dBA.

Further, the noise should not increase total industrial noise to above the "amenity" criterion, which for urban residence is 65dBA daytime, 55dBA evening, and 50dBA night time.

As discussed in Section 3.1.1, daytime background levels were measured at residences during our site visit on 27 August 2009. The L_{A90} background level was 57dBA in Wattle Street, and 58dBA in Harris Street. The intrusive noise goals are then 62dBA daytime for Wattle Street, and 63dBA for both apartment buildings in Harris Street.

Due to the distance to neighbours it was not considered necessary to do long term noise monitoring to establish background noise levels at other times. Wilkinson Murray has measured background levels in the city for many previous projects, and lowest background levels are typically 55dBA during evenings and 50dBA during night time. These levels were used to set conservatively low noise criteria for operational assessment.

Accordingly the following noise criteria are applicable:

Table 5-1 Operational Noise Criteria at Residences

Location	Intrusiveness $L_{Aeq,15min}$			Amenity $L_{Aeq,period}$		
	Day	Eve	Night	Day	Eve	Night
Residence A& B - Harris St	63	60	55	65	55	50
Residence C - Wattle St	62	60	55	65	55	50

6.1.1 Predicted Operational Noise to Residences and Recommendations

Noise from activities inside the MPSH will be inaudible at all residences due to distance, shielding from surrounding buildings and the fact that the facility is to be located underground.

Mechanical services noise will be designed to meet the criteria detailed in Table 5-1. Given the distance to the residences and the relatively high background noise level in the city, this will be easily achieved using standard noise attenuation components of mechanical services. The details of any necessary noise treatment will be determined at detailed design stage.

6.2 Noise to TAFE Buildings

The INP recommends that

- At commercial premises noise should not exceed 65dBA (when in use).
- At classrooms the internal noise should be below 35dBA when the classroom is in use.

6.2.1 Predicted Operational Noise to TAFE and Recommendations

Noise from activities inside the MPSH will be inaudible at the TAFE buildings due to distance, shielding from surrounding buildings and the fact that the facility is to be located underground.

Mechanical services noise would be designed to meet the 65dBA external criterion, and the internal 35dBA criterion.

6.3 Noise to UTS

6.3.1 External Spaces

The INP recommends a level of L_{Aeq} 50dBA for areas of passive recreation, such as the Alumni Green.

Noise from inside the MPSH is predicted to be below 50dBA at the Alumni Green. Noise will sometimes be audible, depending on the internal activities and if the MPSH louvres are open.

Mechanical services noise will be designed to meet the 50dBA criterion at the Alumni Green at detailed design stage.

6.3.2 UTS Internal Areas

Criteria for noise to rooms within UTS are given in AS2107 Acoustics – Recommended design sound levels and reverberation times for building interiors. For private offices the recommended levels are 35 to 40dBA. For general offices the recommended levels are 40-45dBA for offices.

The INP recommendation for classrooms is that the noise should be below 35dBA when the classroom is in use.

Noise from inside the MPSH will generally be inaudible at UTS internal spaces.

7 CONCLUSION

Construction and Operational Noise and Vibration from the proposed MPSH at UTS have been assessed with respect to applicable criteria, proposed construction and operation of the facility.

Due to the close proximity of the site to UTS buildings there is predicted to be a significant potential noise impact. This will need be managed by the building contractor and the UTS. As the UTS are the owner of the site internal management of construction noise and vibration issues should be able to be implemented on site.

Construction vibration could cause some impact at the Building 4 laboratory near the construction site. This impact will be managed by UTS.

In the case of surrounding receivers off the UTS site both noise and vibration associated with construction will meet the criteria and no adverse impact is predicted.

In the case of operational noise from within the MPSH it has been determined that noise from activities will be inaudible at all non-uts buildings. It may occasionally be audible outside the MPSH on the Alumni Green.

Operational noise from mechanical services would be designed to meet site specific noise criteria that have been determined at all neighbouring residential and commercial properties. Although the systems have not been designed the noise levels could be achieved with standard equipment due to the distance to the residential and commercial buildings.

Version	Status	Date	Prepared by	Checked by
A	Final	30 September 2009	George Jenner	Brian Clarke
B	Final	12 October 2009	George Jenner	Brian Clarke

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.

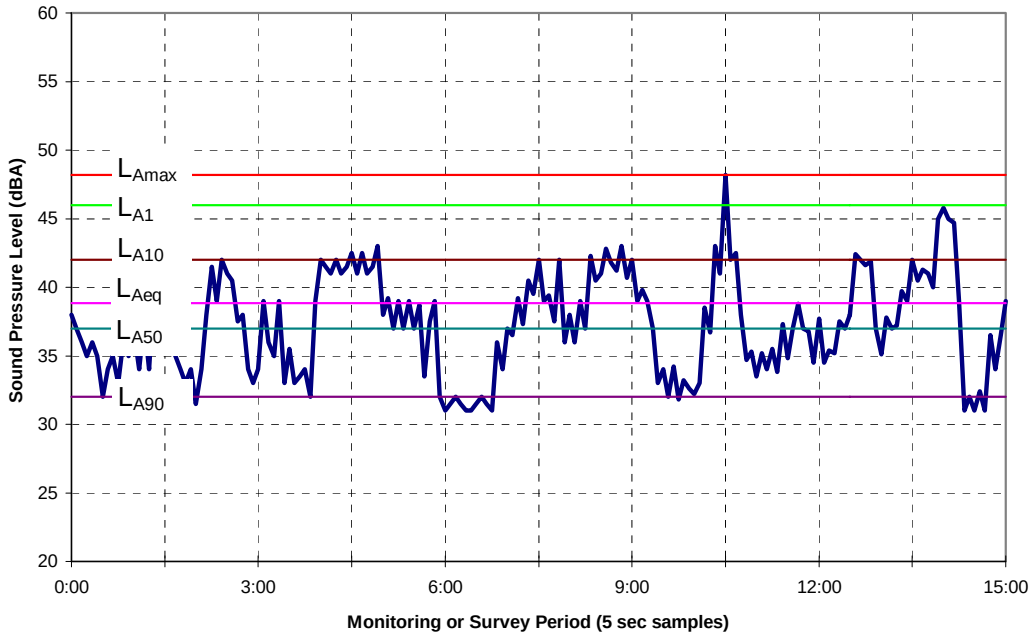
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise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