NSW HEALTH

Liverpool Hospital Redevelopment - Stage 2

Infrastructure and Ancillary Hospital Works

Project Application and Environmental Assessment

Appendix R
Acoustic Reports

- Construction Noise Impact Statement
- Construction Noise and Vibration Plan

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In conjunction with: Acoustic Logic, Bovis Lend Lease

For: Department of Planning

On behalf of : NSW Health

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Prepared for: Bovis Lend Lease

MILESTONE 5 & 6

LIVERPOOL HOSPITAL REDEVELOPMENT STAGE 2.1

CONSTRUCTION NOISE IMPACT STATEMENT

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1. SUMMARY

This report presents an approach to noise associated with the demolition, excavation and construction of the Milestone 5 & 6, Liverpool Hospital Redevelopment Stage 2.1. This report was commissioned by Bovis Lend Lease and presents an advanced study of noise emanating from the site. The study has been undertaken to determine the levels of noise emissions, which will result at the various premises which either border or are in close proximity to the site.

The report identifies that noise levels will vary from the different construction processes. Noise levels from all activities are calculated to all potentially worst affected receiver locations. If noise levels are acceptable at these locations they will also be acceptable further a field. The receiver locations studied in this report are:

1. Existing hospital adjacent to the western boundary of M6.
2. Liverpool Girls High School located along Forbes St.
3. Residential buildings located immediately across Forbes St which are approximately 150m distance western to the site separated by the existing school and hospital building.

Detailed site map and noise receiver locations refer to Figure 1 below.

Figure 1 Site Map and Noise Receiver Location

The results of the calculations are presented in a tabulated form for each receiver location. The tables identify provide the following information;

1. The time period,
2. The subject construction activity,
3. The resultant noise level at the affected premises, the calculated noise levels also take into account any mitigate measures which will be applied to the construction activities, and represent the attenuated level.
4. The measured background noise levels,
5. The relative magnitude of the activity to the background noise level.
6. The resultant internal noise levels at the receiver location from the subject construction activity,
7. The relative magnitude of the activity to the nominated internal noise criterion.
8. The construction noise criterion,
9. The nomination whether noise from the construction activity complies with the nominated criterion.

A critical component of this report is the formulation of noise control strategies for all the different construction processes. These strategies include the formulation of site management procedures, whether they can be operational or time based. The formulation of noise mitigative treatments including the erection of noise barriers, wrapping of hydraulic hammers and the selection of alternate equipment have been reviewed. The practical achievable noise reduction from the attenuation measures is determined and included in the calculations of noise impact. The level of attenuation which may be potentially provided is either calculated or based on measurements taken on other construction projects. A detailed noise management plan forms part of this report.

The objective of this study in all cases is to minimise noise emissions from the construction process.

In the report construction noise criteria are formulated based on the following factors;

1. The sensitivity of the various receiver locations,

2. A consideration of the procedures and requirements set out Australian Standard 2436-1981' Guide to Noise Control on Construction, Maintenance and Demolition Sites".

3. The requirements to control noise emissions from the construction site to levels, which does not cause undue disturbance to the identified receiver locations.

4. The noise mitigation measures available.

5. EPA Construction Noise Objective

The calculated noise levels presented in this report will be verified by on-site measurements, and a noise monitoring programme. In addition, the implementation of noise control measures as detailed in this report will also be monitored, and an appropriate reporting format will be devised so that this information can be presented to Council on a regular basis.

In conclusion, provided all measures outlined in this report are fully implemented, excavation and construction noise from the project site will be strictly controlled, and the impact on the surrounding environs minimised.

2. NOISE CONTROL STRATEGY

This report presents the strategy which will be followed to regulate noise emissions from the construction site of Milestone 5 & 6, Liverpool Hospital Redevelopment Stage 2.1.

3. CONSTRUCTION NOISE CRITERION

All construction work shall comply with the NSW EPA Environmental Noise Manual for the control of construction noise that specifies that:

Construction period of 4 weeks and under – The L_{10} level measured over a period of not less than 15 minutes when the construction site is operating must not exceed the background level by more than 20 dB(A).

Construction period greater than 4 weeks and not exceeding 26 weeks- The L_{10} level measured over a period of not less than 15 minutes when the construction site is operating must not exceed the background level by more than 10 dB(A).

Silencing- All possible steps should be taken to silence construction site equipment.

The application of the standard EPA environmental criterion to a major construction site represents a non-workable and unrealistic approach. Activity on a building site takes place over a period of time and involves a series of complicated processes and activities, from, demolition/excavation, the delivery of materials to site, to the pumping of concrete, and the erection of building structure. All these processes generally occur in the open, and are required for the erection of a building. It is practically impossible to reduce noise emissions from these activities to a standard such as 10dB(A) above background.

Sydney City Council is currently in the process of reviewing their Code of Practice for Construction Hours/Noise 1992, as they have found the criteria in the Code to be unworkable. Construction sites are not able to comply with the criteria, and this is leading to unnecessary complications and restriction of work.

In this regard, it is appropriate to note that if the standard EPA criterion of 10 dB(A) above background was applied to building sites throughout Sydney, and was strictly enforced, no building work would take place for the simple reason that it would be impossible to comply. The EPA and Council's would have to halt all building work. Nothing would be built.

This does not only apply to commercial construction but also to small scale domestic work. For example, the noise emission from a single detached dwelling being built in the suburbs would easily exceed 10dB(A) above background. Every time an electric saw or a hammer used, a bobcat brought on-site, or a cement mixer arriving to pour a ground slab, noise levels would exceed background by between 10 to 40dB(A).

It is relevant to note that the noise level criterion for major construction sites recently completed or currently under construction in Sydney generally have adopted the SAA standards. Where a specific noise criterion has been applied to a site and has been found to be inappropriate and/ or unworkable, the authorities have exhibited suitable flexibility in amending the criterion to permit construction work to proceed as expeditiously as possible. Appropriate noise management plans have been prepared and submitted to the authorities to satisfy concern that all reasonable construction management techniques are being applied to mitigate noise levels at adjacent residential and/ or business premises.

Examples of such major construction works are:

A. The Pinnacle Residential Development
B. Innovation Place, North Sydney
C. 40 Miller Street, North Sydney
D. Broadway Shopping Centre
E. Broadway Student Accommodation project.

3.1 SUITABLE NOISE STANDARD FOR CONSTRUCTION NOISE ASSESSMENT

The standard typically used on construction sites to regulate noise is Australian Standard 2436-1981 *"Guide to Noise Control on Construction Maintenance and Demolition Site"*.

AS2436-1981 is the standard, which is applied by other inner city councils for the regulation of construction noise and represents a practical and acceptable application for the control of construction noise. The standard recommends in Section 3, that care be taken in applying criteria that normally would be used to regulate noise emitted from industrial, commercial and residential premises to construction, particularly for those activities which are transitory and of short duration. In other words, AS2436-1981 clearly recommends against the used of highly conservative criteria for construction sites.

For the control and regulation of noise from demolition, excavation and construction sites AS2436 nominates the following:

1. That reasonable suitable noise criterion is established.

2. 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.

3. The undertaking of noise monitoring to assist in the management and control of noise emission from the building site.

3.2 RECOMMENDED SUITABLE CONSTRUCTION NOISE CRITERIA

The following external noise criteria are nominated for each of the receiver locations, individually recognising the requirements and the levels of sensitivity of each location;

- *Residential areas, 'Background + 20 dB(A)'.*

- *Retail and Commercial areas, 'Background + 25 dB(A)': These spaces will generally have internal background noise levels which are 5 to 10dB(A) higher than the residential premises, therefore the criteria have been adjusted. With doors closed the internal noise levels will generally be no more than 10dB(A) above the existing background noise levels.*

4. NOISE MANAGEMENT

The finding of this report, which studied the noise impact of the site, indicates that ***'the site can work during normal construction hours and fully comply with the above proposed criteria'.***

5. STUDY OVERVIEW

This report presents evaluation of potential noise emissions from the Milestone 5 & 6. Liverpool Hospital excavation and construction activities as part of the proposed redevelopment.

The following report presents a number of proposed strategies to be used by the Bovis Lend Lease to reduce *Environmental Noise Impact* and the possibility of complaint.

The aim of this study is to undertake an analysis of noise impact arising from site activities undertaken in normal construction hours, i.e. 7:00am to 5:00pm Monday to Friday, and 7:00am to 1:00pm Saturday. No work is permitted on Sundays or Public Holidays.

During the above hours it is anticipated that works will fully comply with suitable noise control criteria. These activities will be carefully managed and appropriate noise mitigative measures will be strictly implemented where required. The formulation of noise management plans for the various activities will arise from the assessment carried out in this report and the strict enforcement of all determined control measures.

6. CONSTRUCTION NOISE

The level of noise generated by a construction site is largely dependent on the activities, which are in progress. It can not be categorically stated that all construction sites emit the same level of noise no matter what stage or part of the construction programme they are at.

The generalisation, that all construction work is noisy is fallacious. The levels of noise generated are dependent on the activities occurring. In addition, it is possible to undertake construction work in a controlled manner so that noise is minimised. This requires the formulation of noise control strategies, and stringent supervision.

A study of a typical construction site is presented below to show the varying levels of noise generation from various activities.

6.1 CATEGORISATION OF CONSTRUCTION ACTIVITIES

The construction activities, which occur during the typical process in constructing a building from start to finish, can be separated into five categories, namely;

1. Excavation

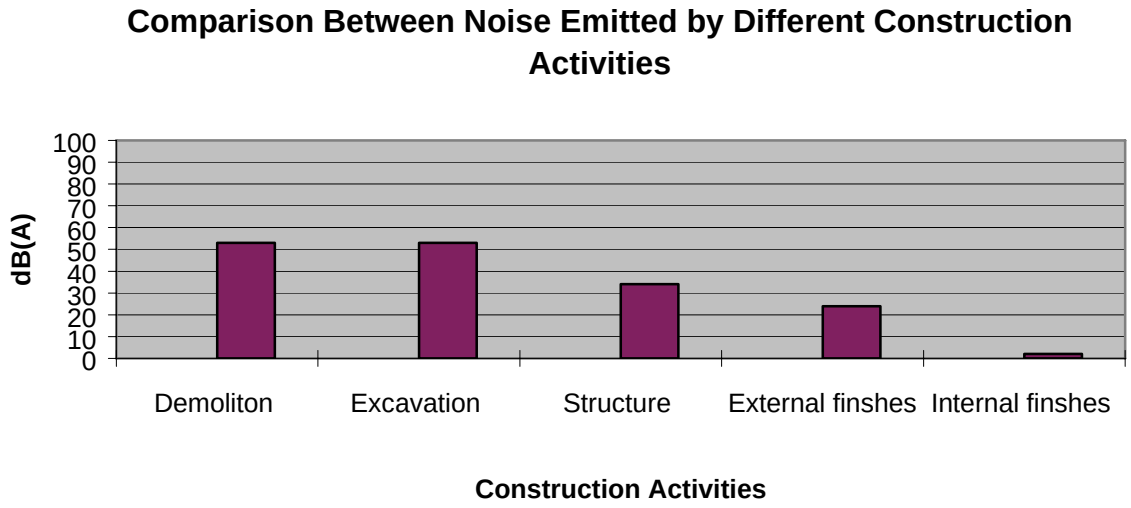
2. Erection of structure

3. Installation of facade/external finishes

4. Internal fit out/internal finishes

The noise levels generated by each of these activities will vary and be largely dependent on the process undertaken. The graph below illustrates typical sound pressure levels resultant at a residential location (approximately 55 metres) from an active construction site. The levels in the table below are derived from measured field attenuation from the GPO Re-Development, No. 1 Martin Place site to a residential receiver. As such these levels represent a real case scenario and are not theoretical. The objective of presenting these sound levels is to present a relative comparison between the five categories of construction activities described above. The comparative levels presented below indicate the maximum noise, which can be generated by the specific activities.

The histogram below shows that the nosiest construction activities are the demolition and excavation, which generate equivalent noise levels due to the similar activities

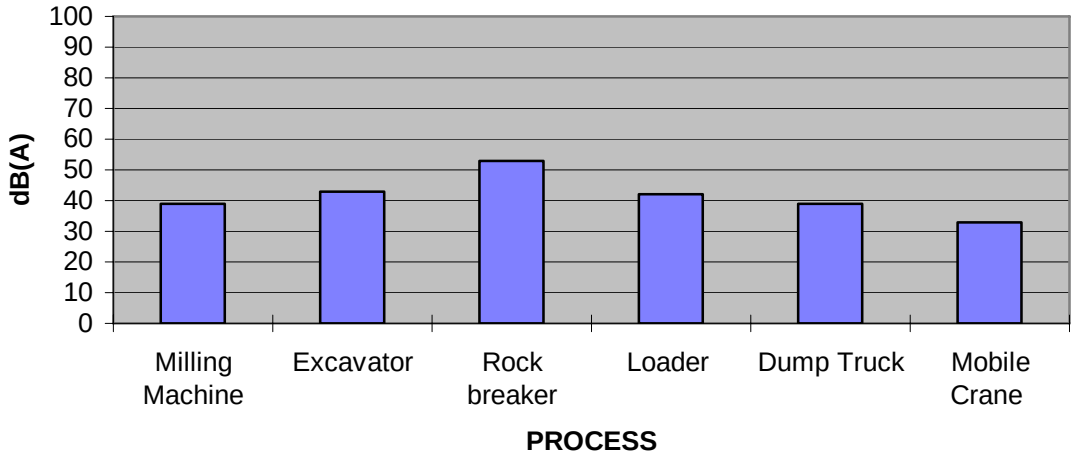


Erection of the structure is next, and then external finishes. Internal finishes is the quietest of activities as it occurs internally. The histogram above represents the maximum noise levels emitted by the entire construction activity, but does not take into account, that within each process there are loud and quiet component processes. To further clarify this point each of the five construction activities outlined above will be further broken down into discrete processes. This will permit the determination of which components of a particular process generate the highest noise levels.

6.2 EXCAVATION

The excavation process on the site involves the removal of top soil/clay/fill layers with the remainder of spoil being predominately Shale which is easier to remove than other materials such as sandstone and therefore less noise is generated during excavation The work is generally undertaken by the use of a bulldozer and scraper attached, rock breakers and milling machines. The spoil will be excavated and relocated internally on site and the use of off site trucks to remove the spoils. Truck traffic will enter via the Campbell Street entrance and travel down the laneway (north of the existing multi-storey / on ground car park) to a set of gates near the mental health building where they will be let in by security / traffic control personnel.

COMPARISON OF NOISE LEVELS EMITTED BY DIFFERENT PROCESSES DURING EXCAVATION



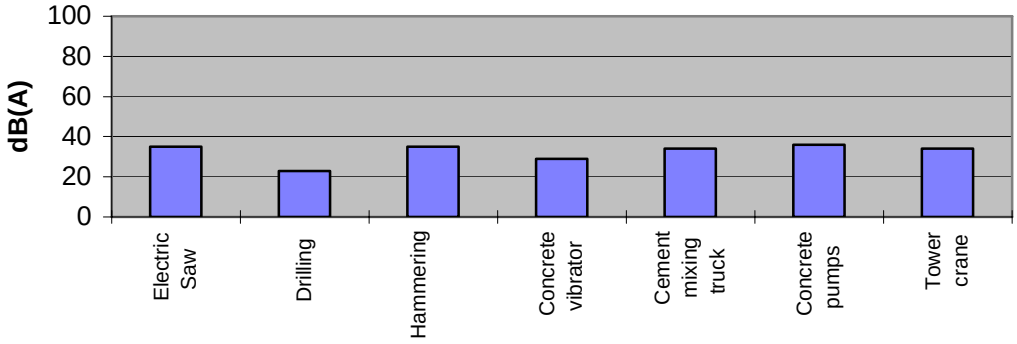
The above histogram clearly illustrates that the nosiest part of the excavation process is the use of hydraulic hammers the other process are generally 10 to 15dB(A) quieter.

6.3 ERECTION OF STRUCTURE

This activity refers to the erection of the structure of the building, which includes lift cores, and general building structure. Lift cores are generally constructed in advance of the remainder of the building structure using either jump or slip forms.

The general processes involved in this activity include the delivery of materials, erection of formwork, installation of structural steel, pouring of concrete, and stripping of formwork. All materials for form working and structural steel are transported to the work face using the site tower cranes and man/material hoist. Concrete is pumped up the building using concrete pumps.

COMPARISON OF NOISE LEVELS EMITTED BY DIFFERENT PROCESSES DURING ERECTION OF STRUCTURE



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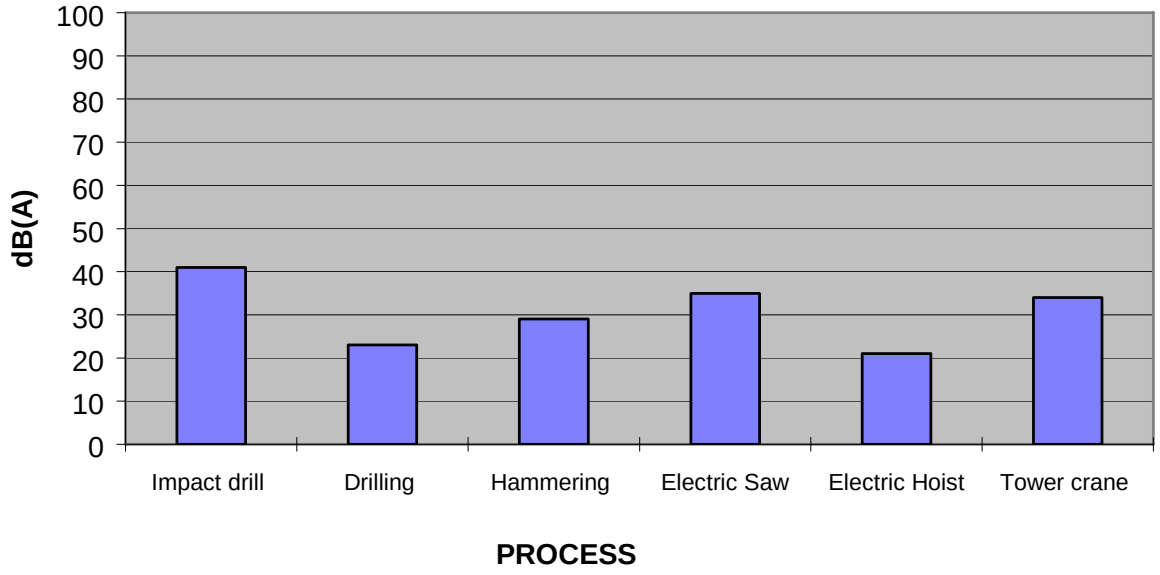
6.4 EXTERNAL FINISHES

This can involve processes ranging from the erection of facade systems, curtain walls pre-cast etc, to the installation of windows and the fixing of stone. Typical noise levels, which may be generated by this activity, are illustrated in the chart, which follows.

COMPARISON OF NOISE LEVELS EMITTED BY DIFFERENT PROCESSES DURING EXTERNAL FINISHES



6.5 INTERNAL FINISHES

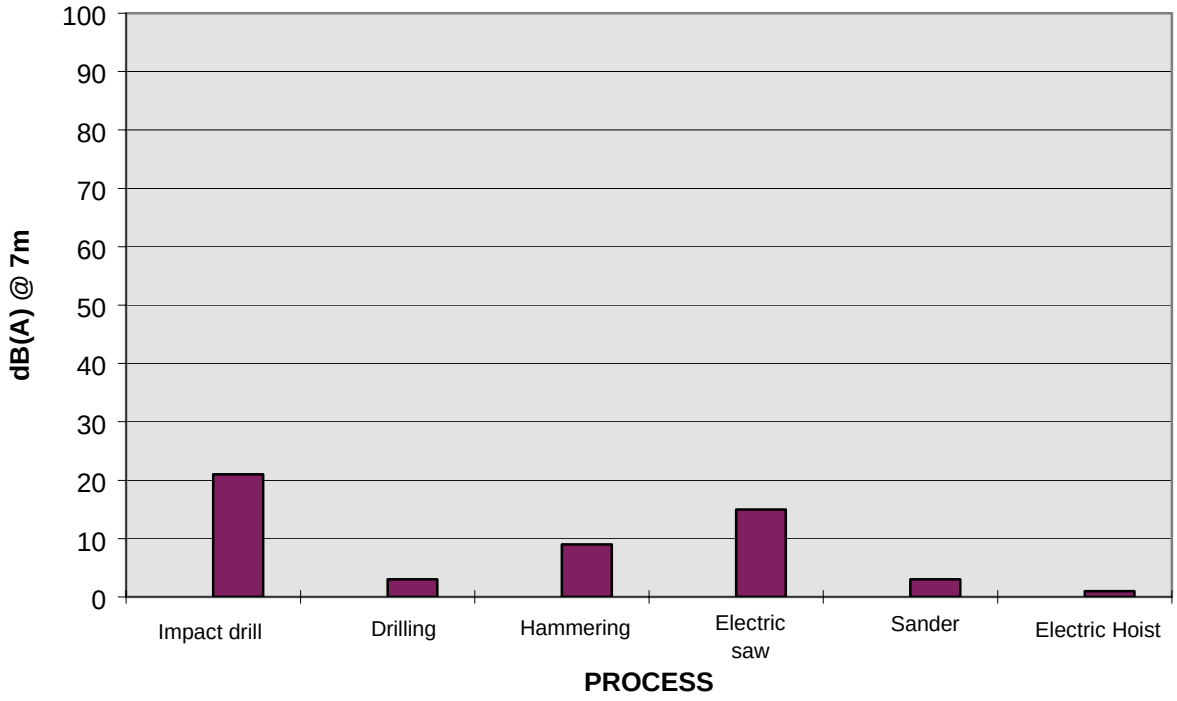
This involves all internal fit out work including painting, partitioning joinery and the laying of carpet and other finishes, as well as the installation of services.

This work is generally carried out once the facades have been erected. All work covered under this section will be contained within the building, with the facade providing a barrier to the direct transmission of noise to the exterior.

The services work includes plumbing mechanical, lifts, fire and electrical.

Typical noise levels, which may be generated by this activity, are illustrated in the chart, which follows.

COMPARISON OF NOISE LEVELS EMITTED BY DIFFERENT PROCESSES DURING INTERNAL FINISHES



The above histogram clearly shows that noise levels emitted from this activity are significantly quieter than the four previously discussed activities

6.6 DISCUSSION

From the information presented in the above Section it can be clearly seen that the noise emitted from a construction site will be dependent on which activities are taking place. More specifically, the particular process within those activities. For example there is a difference of 16dB(A) between using a hydraulic hammer and loading a truck during demolition. A difference of 16dB(A) is substantial. Therefore by limiting the activities which take place on a construction site at particular time's, noise emissions can also be regulated.

7. SITE DESCRIPTION AND POTENTIALLY AFFECTED LOCATIONS

The site of the subject development is located along South Line rail corridor within hospital site. The project site is set primarily amongst existing hospital buildings and commercial land uses. Residential buildings are approximately 150m distance away from the site separated by the existing hospital building. The following are the noise sensitive locations in close proximity to the site.

Location 1.Existing hospital building along the western boundary of the Milestone 6.

Location 2. Liverpool Girls High School located northern to the site.

Location 3.Residential buildings located immediately across Forbes St.

As construction will be carried out during 7am to 5pm Mondays to Fridays and 7am to 1pm on Saturdays the above listed premises will not be affected at night.

8. NOISE CRITERIA

- *Residential/hospital areas, 'Background + 20 dB(A)': The residential buildings located in close proximity to the construction site are flat buildings, and do not feature large areas of external living space. In addition to this, during a normal working day minimal usage would be expected in these spaces.*
- *Retail and Commercial areas, 'Background + 25 dB(A)': These spaces will generally have internal background noise levels which are 5 to 10dB(A) higher than the residential premises, therefore the criteria have been adjusted. With doors closed the internal noise levels will generally be no more than 10dB(A) above the existing background noise levels.*

9. VIBRATION CRITERIA

Two sets of vibration criteria will be used on this project, namely;

Australian Standard 2187

- British Standard BS 6472:1992 *"Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*.

The criteria and the application of these Standards are discussed in separate sections below.

9.1 AS2187

Australian Standard 2187-1993, "SAA Explosives Code, Part 2 - Use of Explosives" stipulates in Section 11 acceptable levels of ground vibration to limit the probability of structural damage and human discomfort. The criteria presented in this Standard are summarised below.

AS2187 RECOMMEND PEAK PARTICLE VELOCITY

	Type of building or structure	Particle velocity (Vp) mm/s
1.	Historical buildings and monuments, and buildings of special value and significance	2
2.	House and low rise residential buildings: Commercial buildings not included in item 3 below	10
3.	Commercial and industrial buildings or structures of reinforced concrete or steel construction	25

This standard will be used principally for the determination of potential structural damage to surrounding buildings. The Standard does not provide suitable criteria for the determination of acceptable levels of vibration for human comfort in sensitive areas such as dental surgeries for example.

9.2 BRITISH STANDARD BS 6472:1992

British Standard BS 6472:1992 develops criteria relating to levels of building vibration that may be expected to give rise to "*adverse comment*", in the frequency range most applicable to impacts associated with construction, which is 1 to 80Hz. These threshold values are used as criteria for assessing the loss of amenity and are presented below in Table below.

BS 6472:1992 Criteria to Avoid *"Adverse Comment"*

Type of Occupancy	Time of Day	Peak Particle Velocity (mms^{-1}) between 1Hz to 80Hz Likely to Cause *"Adverse Comment"*			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration Excitation with Several Occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.3 to 0.6	0.8 to 0.6	8.4 to 12.6	24 to 36
	Night	0.2	0.6	2.8	8
Offices	Day	0.6	1.6	18	51
	Night	0.6	1.6	18	51
Workshops	Day	1.2	3.2	18	51
	Night	1.2	3.2	18	51

10. DETERMINATION OF CONSTRUCTION NOISE IMPACT

Using the noise levels presented in Table 1 below, the resultant noise impact was determined at the worst affected locations. These locations were identified in Section 7, above. If noise levels comply with the criteria at these locations, then they will be acceptable at all other locations.

All construction noise sources were assumed to be located at the nearest point on the construction site to the receiver locations under study. In this way the worst and majority case noise level situations are determined, with noise levels arising from an activity occurring on any other part of the site being equal to or lower than those determined for the nearest point scenario.

The calculations determine the A-Weighted max noise levels over a 15-minute period, from all sources, which may operate simultaneously. Noise emanating from the respective activities will comply with the required criterion, provided all noise from all individual plant and equipment comply.

11. SOUND POWER LEVELS

Noise impact will be determined from all processes and equipment, which are involved in the activities outlined below by defining the levels of sound, which they generate.

The A-weighted sound power levels for all the component parts of the above-described activities are outlined in the tables below.

Table 1 - Sound Power Levels

CONSTRUCTION ACTIVITY	EQUIPMENT /PROCESS	TYPICAL PLANT OR EQUIPMENT	SOUND POWER LEVEL - dB(A)
Excavation	Bored Pier		90
	Bulldozer	Caterpillar D7, D9	113
	Bulldozer	Caterpillar D10	118
	Front End Loader	Wheeled	115
	Jack Hammers	With Silencer Bags	110
	Scraper	Caterpillar 631	114
	Scraper	Caterpillar 651	110
	Grader	Caterpillar 16	110
	Compactor	Caterpillar 825	110
	Compactor	Vibrating Plate	117
	Vibratory Roller	10-12 Tonne	114
	Water Cart		113
	Dump Trucks	35 Tonne	121
	Excavator	Kato 750	111
	Truck		105
	Crane	Truck Mounted	110
	Compressor	600 CFM	100
	Compressor	1500 CFM	105

	Backhoe		113
	Spreader	Asphalt, concrete	95
	Asphalt Truck		117
	Asphalt Paver		114
	Tip Truck		108
	Generator	Diesel	104
	Spraying Machine		100
	Mechanical Broom		108
	Piling Hammer	For piles and casing	118
	Concrete Truck		108
	Concrete Pump		109
	Concrete Vibrators		105
Construction	Drill	Air	110
	Drill	Pneumatic	110
	Welders		110
	Concrete Saw		118
	Concrete Leveller		115
	Cherry Picker	On truck	105

The noise levels presented in the above table are derived from the following sources, namely:

1. On-site measurements, data provided by Bovis Lend Lease
2. Table D2 of Australian Standard 2436-1981
3. Data held by this office from other similar studies.

12. NOISE PREDICTION

The external noise emission /intrusion into the nearest commercial and residential receivers are predicted as below by taking account the distance attenuation, barrier effect, façade transmission loss, etc. The predicted noise levels have been presented below for different stages.

12.1 EXCAVATION

LOCATION 1 EXISTING HOSPITAL BUILDING FAÇADE ALONG WESTERN BOUNDARY OF M6 - MONDAY TO SATURDAY							
PERIOD HOURS	ACTIVITY	EXTERNAL LEVEL OF NOISE AT AFFECTED OCCUPANCY L_{10} dB(A)	INTERNAL NOISE LEVEL AT AFFECTED L_{avmax} dB(A)	MEASURED EXISTING INTERNAL AMBIENT NOISE LEVELS dB(A)	LEVEL OF ACTIVITIES RELATIVE TO INTERNAL CRITERION	PERMISSIBLE EXCEEDENCE ABOVE B'GROUND/ CRITERION	COMPLIES YES/NO
Mon – Fri 07.00 to 17.00 Sat 07.00 to 13.00	Excavation	72-89	48*	40-49	-4 to +8	10	YES

Notes * Install a single layer of 12mm plywood inset from the existing façade. All gaps through the construction are to be acoustically sealed. Joints are to caulked or backed with framing/noggings to minimise noise leakage. Install insulation within the formed cavity between the glass and the plywood. Nominal 10.8kg/m^3 50mm thick Glasswool equal to Bradford insulation manufacture. If light required through the plywood install strips of 6mm thick Plexiglass/Perspex in lieu of the plywood in predetermined bands.

LOCATION 2 LIVERPOOL HOSPITAL GIRLS HIGH SCHOOL - MONDAY TO FRIDAY							
PERIOD HOURS	ACTIVITY	EXTERNAL LEVEL OF NOISE AT AFFECTED OCCUPANCY L_{10} dB(A)	INTERNAL NOISE LEVEL AT AFFECTED L_{avmax} dB(A)	ASSUMED EXISTING INTERNAL AMBIENT NOISE LEVELS dB(A)-AS2107	LEVEL OF ACTIVITIES RELATIVE TO INTERNAL CRITERION	PERMISSIBLE EXCEEDENCE ABOVE B'GROUND/ CRITERION	COMPLIES YES/NO
Mon – Fri 07.00 to 17.00	Excavation	69	44*	40	+4	10	Yes

Notes * Assumed the existing glazing facing the site is minimum 4mm thick with acoustic seals around.

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LOCATION 3 RESIDENTIAL BUILDINGS LOCATED IMMEDIATELY ACROSS FORBES ST.						
PERIOD HOURS	ACTIVITY	EXTERNAL LEVEL OF NOISE AT AFFECTED OCCUPANCY L_{10} dB(A)	MEASURED EXISTING EXTERNAL AMBIENT NOISE LEVELS L_{90} dB(A)	LEVEL OF ACTIVITIES RELATIVE TO EXTERNAL CRITERION	PERMISSIBLE EXCEEDENCE ABOVE B'GROUND/ CRITERION	COMPLIES YES/NO
Mon – Fri 07.00 to 17.00 Sat 07.00 to 13.00	Excavation	62	43	+19	20	Yes

12.2 CONSTRUCTION

LOCATION 1 EXISTING HOSPITAL BUILDING FAÇADE ALONG WESTERN BOUNDARY OF M6 - MONDAY TO SATURDAY							
PERIOD HOURS	ACTIVITY	EXTERNAL LEVEL OF NOISE AT AFFECTED OCCUPANCY L_{10} dB(A)	INTERNAL NOISE LEVEL AT AFFECTED L_{avmax} dB(A)	MEASURED EXISTING INTERNAL AMBIENT NOISE LEVELS dB(A)	LEVEL OF ACTIVITIES RELATIVE TO INTERNAL CRITERION	PERMISSIBLE EXCEEDENCE ABOVE B'GROUND/ CRITERION	COMPLIES YES/NO
Mon – Fri 07.00 to 17.00 Sat 07.00 to 13.00	Construction	77-89	37-50*	40-49	-3 to +10	10	YES

Notes * Install a single layer of 12mm plywood inset from the existing façade. All gaps through the construction are to be acoustically sealed. Joints are to caulked or backed with framing/noggings to minimise noise leakage. Install insulation within the formed cavity between the glass and the plywood. Nominal 10.8kg/m^3 50mm thick Glasswool equal to Bradford insulation manufacture. If light required through the plywood install strips of 6mm thick Plexiglass/Perspex in lieu of the plywood in predetermined bands.

LOCATION 2 LIVERPOOL HOSPITAL GIRLS HIGH SCHOOL - MONDAY TO FRIDAY							
PERIOD HOURS	ACTIVITY	EXTERNAL LEVEL OF NOISE AT AFFECTED OCCUPANCY L_{10} dB(A)	INTERNAL NOISE LEVEL AT AFFECTED L_{avmax} dB(A)	ASSUMED EXISTING INTERNAL AMBIENT NOISE LEVELS dB(A)-AS2107	LEVEL OF ACTIVITIES RELATIVE TO INTERNAL CRITERION	PERMISSIBLE EXCEEDENCE ABOVE B'GROUND/ CRITERION	COMPLIES YES/NO
Mon – Fri 07.00 to 17.00	Construction	69	43*	40	+3	10	Yes

Notes * Assumed the existing glazing facing the site is minimum 4mm thick with acoustic seals around.

LOCATION 3 RESIDENTIAL BUILDINGS LOCATED IMMEDIATELY ACROSS FORBES ST.						
PERIOD HOURS	ACTIVITY	EXTERNAL LEVEL OF NOISE AT AFFECTED OCCUPANCY L_{10} dB(A)	MEASURED EXISTING EXTERNAL AMBIENT NOISE LEVELS L_{90} dB(A)	LEVEL OF ACTIVITIES RELATIVE TO EXTERNAL CRITERION	PERMISSIBLE EXCEEDENCE ABOVE B'GROUND/ CRITERION	COMPLIES YES/NO
Mon – Fri 07.00 to 17.00 Sat 07.00 to 13.00	Construction	47	43	+4	20	Yes

13. VIBRATION - ACCEPTABLE WORK PRACTICES

To regulate vibration emanating from the demolition, excavation and construction processes the contractors will need to operate particular machinery at certain distance from affected buildings to comply within the criteria. The following is an estimate of the distances that may be required for the various equipments.

Table 2 –Acceptable Distance

Machinery Type	Limited Working Zone from Façade of Existing Hospital
3 Ton Hammers	3m
5 Ton Hammers	3m
20 Ton Hammers	10m
30 Ton Hammers	15m
Rock Rippers	3m
Saw Cutters	3m
Tiger Claws	3m
Line Drilling	3m
Bulldozers	3m
Piling	3m
Rock Anchoring	3m

14. ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continual communication is required between all parties, which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process, which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation process is to:

Inform and educate the groups about the project and the noise controls being implemented.

Increase understanding of all acoustic issues related to the project and options available.

Identify group concerns generated by the project, so that they can be addressed.

15. STATEMENT OF INTENT TO COMPLY

The calculation procedure used to predict the noise levels above has been verified with field measurements on building sites in the inner city including the Grace Plaza, GPO, 400 George Street, Aston and Sydney Central Plaza projects.

In addition, a contact number of the Liaison Officer will be advertised outside the building site, so that residents and other interested parties may contact him, should they believe a noise breech is occurring.

16. FINAL STATEMENT

The finding of this document indicates that noise levels from demolition and excavation activities taking place on the Milestone 5 & 6 will comply with the criteria nominated in Section 2 of this report at all times, provided times of operation indicated in this document and the recommendations are observed.

Vibration levels from construction activities will fully comply with the vibration criteria nominated in Section 7, provided the recommendations in this document are observed.

Report prepared by,

Acoustic Logic Consultancy Pty Ltd

George Wei

APPENDIX: CONSTRUCTION NOISE MANAGEMENT PLAN

2 September, 2008

Report: 2008402/0109A/R0/GW

Prepared for: BOVIS LEND LEASE

MILESTONE 5 & 6

LIVERPOOL HOSPITAL

CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

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1. INTRODUCTION

This document presents a discussion on the process which will be followed in order to manage noise from the construction of the proposed Milestone 5 & 6, Liverpool Hospital Redevelopment Stage 2.1.

In recognition of the requirement to minimise noise emissions from the site to surrounding residential and commercial premises the Bovis Lend Lease have commissioned this study. The principal objective of this study is to undertake advance evaluation of all work to be performed during the demolition, excavation and construction phase of the project and forecast the potential impact of noise. The noise forecasts will be used to formulate and streamline effective regulation and mitigation measures. As a part of this process on going testing will be used to evaluate the noise regulation strategies and ensure that they are effective.

To further ensure compliance with appropriate standards on going monitoring will be instigated.

The principal issues which will be addressed in this document are:

- Identification of the specific activities that will be carried out and associated noise sources,
- Identification of all potentially affected sensitive receivers including residences, schools and properties containing noise sensitive equipment,
- Determination of appropriate noise and vibration objectives for each identified sensitive receiver,
- Noise and vibration monitoring, reporting and response procedures.
- Assessment of potential noise and vibration from the proposed construction activities including noise from construction vehicles and any traffic diversions,
- Description of specific mitigation treatments, management methods and procedures that will be implemented to control noise and vibration during construction
- Identification of the noise and vibration standards which will be applicable to this project.
- Formulation of a strategy for construction to comply with the standards identified in the above point.
- Construction timetabling to minimise noise impacts including time and duration restrictions, respite period and frequency,
- Procedures for notifying residents of construction activities that are likely to affect their amenity through noise and vibration,
- Establishment of direct communication networks between affected groups, Planning NSW, Bovis Lend Lease and Acoustic Logic Consultancy.

2. PROJECT OBJECTIVE

The objective of this management plan is to minimise noise & vibration emissions from the construction work associated with this project and assist in maintaining a satisfactory environment around the site. .

3. NOISE CRITERIA

- *Residential/hospital areas, 'Background + 20 dB(A)': The residential buildings located in close proximity to the construction site are flat buildings, and do not feature large areas of external living space. In addition to this, during a normal working day minimal usage would be expected in these spaces.*
- *Retail and Commercial areas, 'Background + 25 dB(A)': These spaces will generally have internal background noise levels which are 5 to 10dB(A) higher than the residential premises, therefore the criteria have been adjusted. With doors closed the internal noise levels will generally be no more than 10dB(A) above the existing background noise levels.*

4. VIBRATION CRITERIA

Two sets of vibration criteria will be used on this project, namely;

- Australian Standard 2187
- British Standard BS 6472:1992 "Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz).

The criteria and the application of these Standards are discussed in separate sections below.

4.1 AS2187

Australian Standard 2187-1993, "SAA Explosives Code, Part 2 - Use of Explosives" stipulates in Section 11 acceptable levels of ground vibration to limit the probability of structural damage and human discomfort. The criteria presented in this Standard are summarised below.

AS2187 RECOMMEND PEAK PARTICLE VELOCITY

	Type of building or structure	Particle velocity (Vp) mm/s
1.	Historical buildings and monuments, and buildings of special value and significance	2
2.	House and low rise residential buildings: Commercial buildings not included in item 3 below	10
3.	Commercial and industrial buildings or structures of reinforced concrete or steel construction	25

This standard will be used principally for the determination of potential structural damage to surrounding buildings. The Standard does not provide suitable criteria for the determination of acceptable levels of vibration for human comfort in sensitive areas such as dental surgeries for example.

4.2 BRITISH STANDARD BS 6472:1992

British Standard BS 6472:1992 develops criteria relating to levels of building vibration that may be expected to give rise to *"adverse comment"*, in the frequency range most applicable to impacts associated with construction, which is 1 to 80Hz. These threshold values are used as criteria for assessing the loss of amenity and are presented below in Table below.

BS 6472:1992 Criteria to Avoid *"Adverse Comment"*

Type of Occupancy	Time of Day	Peak Particle Velocity (mms^{-1}) between 1Hz to 80Hz Likely to Cause *"Adverse Comment"*			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration Excitation with Several Occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.3 to 0.6	0.8 to 0.6	8.4 to 12.6	24 to 36
	Night	0.2	0.6	2.8	8
Offices	Day	0.6	1.6	18	51
	Night	0.6	1.6	18	51
Workshops	Day	1.2	3.2	18	51
	Night	1.2	3.2	18	51

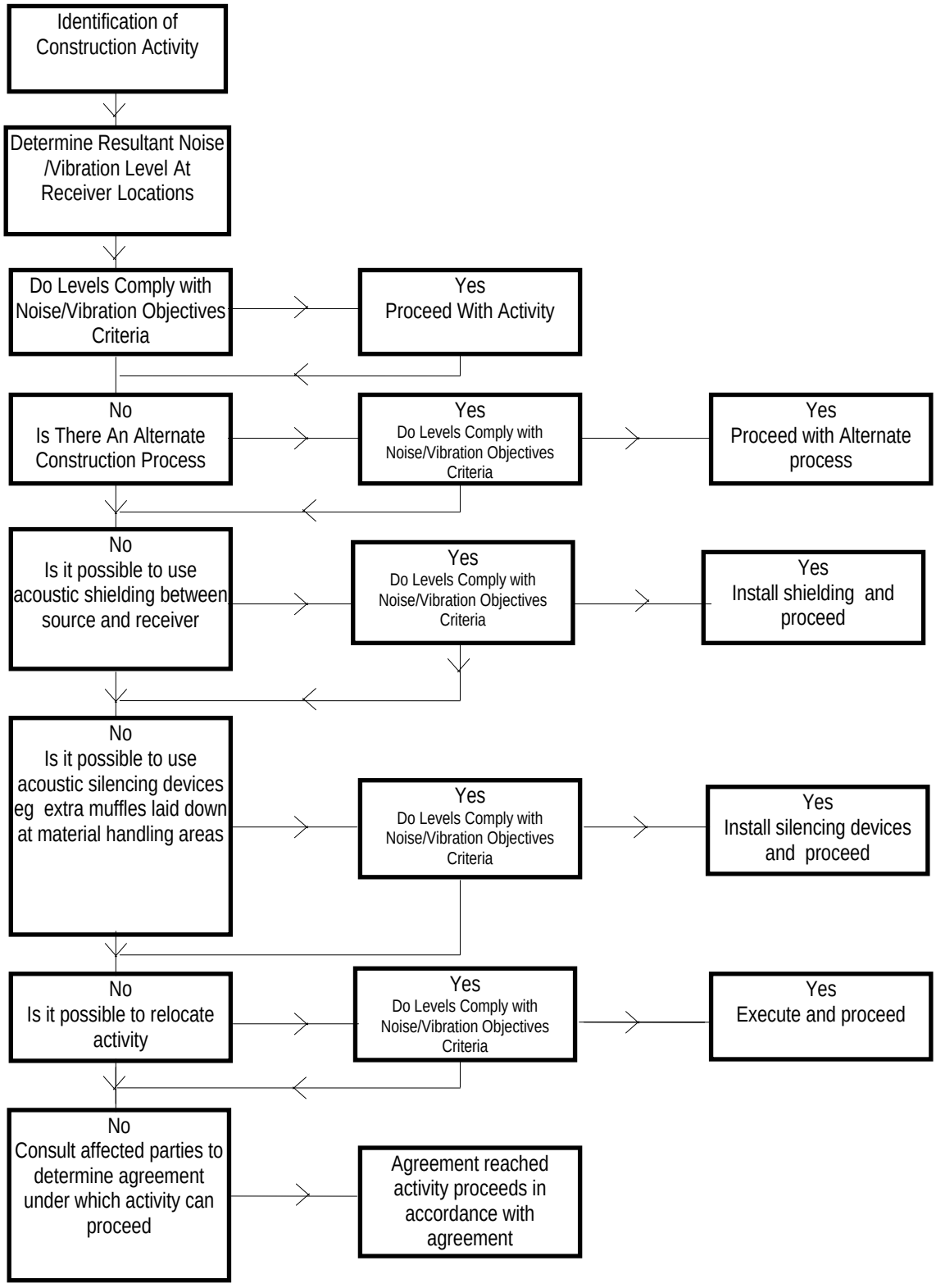
5. CONTROL OF CONSTRUCTION NOISE

As a part of the noise management plan a detailed study will be undertaken of each of the proposed activities which will occur as a part of the demolition, excavation and construction works on this project.

The execution of this work will facilitate the formulation of noise control strategies for this project.

The flow chart which follows illustrates the process which will be followed in assessing construction activities.

CONTROL OF NOISE AND VIBRATION



6. NOISE CONTROL METHODS

The determination of appropriate noise control measures will be dependant on the particular activities and construction appliances. This section provides an outline of available methods.

6.1 SELECTION OF ALTERNATE APPLIANCE OR PROCESS

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying this activity by use of pneumatic hammers, bulldozers ripping and/or milling machines lower levels of noise will result.

6.2 ACOUSTIC BARRIER

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (tower cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependant on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers.

6.3 SILENCING DEVICES

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

6.4 MATERIAL HANDLING

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

6.5 TREATMENT OF SPECIFIC EQUIPMENT

In certain cases it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

6.6 ESTABLISHMENT OF SITE PRACTICES

This involves the formulation of work practices to reduce noise generation. A noise plan will be developed for this project outlining work procedures and methods for minimising noise.

6.7 REGULAR NOISE CHECKS OF EQUIPMENT

To determine the requirement for silencing devices on machinery it is proposed to undertake fortnightly noise check. Noise levels of all machines on site will be measured and if they are found to be higher than nominated for that equipment type, items such as mufflers and engine shrouds will be examined to ensure they are in good working order.

A record of these measurements will be kept on a form similar to that shown below.

This measure is expected to maintain noise at constant levels, and prevent any increases.

Bovis Lend Lease

MILESTONE 5 & 6, LIVERPOOL HOSPITAL REDEVELOPMENT

Construction Appliance Compliance Certificate

Month .....

Year .....

Plant Item .....

Allowable Noise Level .....

Measured Noise Level .....

Complies Yes ☐ No ☐

Issuing Engineer .....

Sub-Contractor .....

Project Manager .....

6.8 NOISE MONITORING

Noise monitoring can be undertaken to determine the effectiveness of measures which are been implemented. The results of monitoring can be used to devise further control measures.

6.9 COMBINATION OF METHODS

In some cases it may be necessary that two or more control measures be implemented to minimise noise.

7. ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continual communication is required between all parties which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation processes is to:

Inform and educate the groups about the project and the noise controls being implemented.

Increase understanding of all acoustic issues related to the project and options available.

Identify group concerns generated by the project, so that they can be addressed.

Ensure that concerned individuals or groups are aware of and have access to the Bovis Lend Lease. Complaints Register which will be used to address any construction noise related problems should they arise.

To ensure that this process is effective, regular scheduled meetings will be required for a finite period, until all issues have been addressed and the evidence of successful implementation is embraced by all parties.

An additional step in this process is to produce a newsletter informing the groups of the progress of the works and the upcoming construction activities.