Appendix E – Noise Assessment

Report No 06176
Version A

CROSS CITY TUNNEL

NOISE ASSESSMENT OF PROPOSED MODIFICATIONS TO SURFACE TRAFFIC ARRANGEMENTS

June 2006

WILKINSON MURRAY

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June 2006

Prepared for

Roads & Traffic Authority

Prepared by

WILKINSON MURRAY PTY. LIMITED
ABN 41 192 548 112
1ST FLOOR, 123 WILLOUGHBY ROAD, CROWS NEST, NSW 2065 AUSTRALIA
TEL (02) 9437 4611 FAX (02) 9437 4393 EMAIL acoustics@wmpl.com.au

TABLE OF CONTENTS

1 INTRODUCTION

The Cross City Tunnel motorway runs between the eastern side of Darling Harbour and Kings Cross, linking the Western Distributor to New South Head Road. There is also a connection between the Cross City Tunnel and the Eastern Distributor. A connection to the Domain Tunnel allows traffic from the eastern suburbs to directly access the harbour crossings. In addition to the construction of the tunnel, the project included surface works to address traffic distribution and access issues. Key surface works included widening and upgrading of footpaths in Park and William Streets and the provision of bus lanes and transit lanes along selected streets.

The Environmental Impact Statement (EIS) for the Project (Initial EIS) was prepared in accordance with the provisions of the EP&A Act, the *Environmental Planning and Assessment Regulation 2000,* and the requirements of the Director-General of the then Department of Urban Affairs and Planning (DUAP). The Initial EIS was publicly exhibited between 2 August 2000 and 6 October 2000, a Representations Report and Addendum were prepared following public exhibition of the initial EIS, and these documents were submitted to the then Minister for Urban Affairs and Planning (Planning Minister) for approval. The then DUAP assessed the Project, and the Planning Minister approved the Project on 3 October 2001.

Following a comprehensive tendering process for the design, construction, operation and maintenance of the Tunnel, the RTA sought to modify the Project as approved in 2001. The RTA and prepared and publicly exhibited a Supplementary EIS, which was publicly exhibited between 31 July 2002 and 31 August 2002, and the RTA then prepared a Supplementary Representations Report and submitted these documents to the Department of Planning (DoP). Following an assessment by the Department of Planning, the Planning Minister approved the modifications to the project in December 2002.

To avoid confusion, the 2000 EIS and associated assessment documents including the 2001 Representations Report and Director-General's Assessment Report are referred to as "initial" documents and the EIS prepared in 2002 and associated assessment documents are referred to as "supplementary" documents.

The construction of the Cross City Tunnel started in January 2003. Construction of the Tunnel was completed in mid 2005 and the Tunnel opened to traffic on 28 August 2005. Most of the remaining surface works were essentially completed by May 2006 (with some exceptions).

The RTA is currently proposing the following changes to surface traffic arrangements of the Cross City Tunnel (Proposed Modifications):

- Reopening Druitt Street to general traffic running westbound between Kent Street and Clarence Street;
- Retaining two right turn lanes from Elizabeth Street northbound into Park Street eastbound and not install a new bus lane southbound on Elizabeth Street between Park Street and Bathurst Street;
- Provision of an additional traffic lane eastbound along William Street east of Palmer Street to McElhone Street;
- Removal of cycle lanes on Kings Cross Road eastbound between Darlinghurst Road and Ward Avenue and westbound on Craigend Street between Roslyn Street footbridge and Darlinghurst Road;
- The following changes in and around Sir John Young Crescent:
    - Removing the seagull island at the intersection of Sir John Young Crescent and Cowper Wharf Road to allow direct access to the harbour crossing from Palmer Street/Sir John Young Crescent;
    - Reintroducing traffic signals at the intersection of Palmer Street and Sir John Young Crescent to assist efficiency of traffic flow;
    - Changing Palmer Street from one lane northbound and one lane southbound between Sir John Young Crescent and Cathedral Street to two lanes northbound; and,
    - Reinstall second right turn lane from Cahill Expressway off ramp to Cowper Wharf Road.
- Provision of a dedicated right turn lane at Queens Cross for a turning movement from Darlinghurst Road northbound into Kings Cross Road eastbound; and,

The RTA is also considering the reopening of Bourke Street south of William Street to left in-left out movements, under Condition 288 of the Minister of Planning's Approval for the Project. Although this does not form part of the Proposed Modifications, the RTA has requested that the works associated with this arrangement also be considered in this Report.

Construction of these works would require some lane and/or road closures, some elements of the required construction work would need to be undertaken at night. The construction works may potentially give rise to the following types of impacts:

- Airborne noise affecting the amenity of residential and commercial premises; and,
- Vibration disrupting human comfort within occupied spaces.

This Noise Assessment Report has been prepared to assess the potential noise and vibration impacts for the above works. This Report also includes consideration of the likely operational noise impacts of the proposed changes to traffic arrangements in Section 7.

This Report considers the existing Minister for Planning's Approval (MPA) Conditions which relate to design construction issues, and makes specific reference to some of those conditions, for the purpose of providing an appropriate assessment for the Proposed Modifications in the context of the Project as a whole. However, it is not intended that this would affect the stated position that the Conditions of the Approval would not apply to the carrying out of the Modification Works.

The following MPA Conditions are identified as relevant to the construction noise assessment of the Proposed Modification works:

- Condition No. 122 which regulates the hours of work which is recommended to be revised in the Environmental Assessment Report being prepared by the RTA on the proposed modifications to reflect the required night works;
- Condition No. 126 which sets out mitigation measures to be implemented where reasonable and feasible;
- Condition No. 129 which requires consultation with any affected schools;
- Condition No. 131 which regulates the use of public address systems. The use of public address systems would only occur during the construction of the Proposed Modifications in the event of an emergency;
- Condition No. 134 which specifies that the Palmer Street Compound is only to be used for light construction activities. It is noted that the use of the Palmer Street Compound as an ancillary construction compound for the Proposed Modifications is in accordance with this Condition;
- Condition No. 135 which specifies only dampened and/or "city" rock hammers are to be utilised;
- Condition No. 137 which requires the investigation of all reasonable and feasible noise source controls;
- Condition No. 139 which ensures that noisiest activities associated with night works are scheduled wherever possible to be completed before midnight; and,
- Condition No. 146 which sets out vibration criteria and relevant standards; and,
- Condition No. 147 which sets out vibration criteria specific to heritage buildings and sensitive structures.

MPA Condition No. 123 is not relevant to the construction noise assessment as it sets out construction noise criteria for long-term construction works. Notwithstanding, for consistency, the construction noise criteria established under Condition of Approval No. 123 has been used to assess construction noise impacts.

This Report covers airborne noise and ground borne vibration likely to be generated by the construction proposed works and addresses the effect upon nearby residences. Background noise levels have been measured in the surrounding area and noise and vibration levels have been predicted. The predicted noise levels have been compared with the objective set in Condition 123 and the predicted vibration levels have been

compared with the limits set in Conditions 146 and 147. Noise mitigation and management measures are proposed to control the noise and vibration impacts.

2 CONSTRUCTION OPERATIONS

Details of the Proposed Modifications and associated construction methodology and timing are provided below.

The description and estimates of duration of construction works are subject to refinement and possibly some change during detail design and scheduling.

2.1 Palmer Street Compound

The Palmer Street Compound would be utilised for car parking, materials lay down, equipment storage and amenities during the construction period. It is anticipated that these works would be completed in a three-month period.

Sensitive receivers to this site are:

- Residents on the west side of Palmer street (approximately 30 metres); and,
- Residents on the west side of Bourke Street backing on to the site (approximately 10 metres).

The light usage of the Palmer Street site Compounds has been assessed consistent with MPA Condition 134.

2.2 Reopening Druitt Street

The reopening Druitt Street to general traffic running westbound between Kent Street and Clarence Street would require the following construction works:

1. Remove temporary barriers;
2. Milling and re-sheeting to remove red pavement;
3. Traffic signal phasing adjustment; and,
4. Adjustments to sign posting and line marking.

Plant and equipment to be used includes:

- Small trucks;
- Rotomill;
- Small asphalt roller;
- Back hoe/ bobcat;
- Street sweeper; and
- Concrete saw.

As this work would require full closure of Druitt Street it would need to be undertaken at night-time. It is anticipated that these works could be completed over five nights.

Sensitive receivers to this site are:

- Residents (Hotel) directly adjacent to the works (approximately 5 to 10 metres); and
- Convenience store directly adjacent to the works.

2.3 Changes to Bus Lanes in Elizabeth Street

It is proposed to retain two right turn lanes from Elizabeth Street northbound into Park Street eastbound and not install a new bus lane southbound on Elizabeth Street between Park Street and Bathurst Street.

This change would retain the current lane layout and does not require any construction works as the approved works have not been constructed.

2.4 Provision of an Additional Traffic Lane on William Street

The provision of an additional traffic lane eastbound along William Street east of Palmer Street to McElhone Street would involve:

1. Demolition and adjustment to a length of median island;
2. Removal of existing line marking and possible mill and re-sheeting of asphalt;
3. Replacement of line marking;
4. Adjustment of traffic signal outreach arms;
5. Cutting new detector loops; and,
6. Adjustment/relocation to traffic signal lanterns and signage.

Plant and equipment to be used includes:

- Small trucks;
- Concrete trucks;
- Concrete saw;
- Rotomill
- rock hammers;
- Back hoe/ bobcat; and,
- Street sweeper.

If the mill and re-sheeting is required then the plant and equipment to be used will also include:

- Rotomill;
- Asphalt paver
- Asphalt trucks; and
- Asphalt rollers;

As this work would require closure of lanes in William Street, it would need to be undertaken at night. It is anticipated that this work would be completed over ten nights, plus an additional ten nights if the mill and re-sheeting is required.

Sensitive receivers to this site are:

- Residents directly adjacent to the works(approximately 10 metres);
- Hotel southern side of William Street (approximately 50 metres); and
- Convenience store, Cafes, general business directly adjacent to the works (approximately 10 metres).

2.5 Removal of Cycle Lanes near Eastern Portal

The removal of cycle lanes on Kings Cross Road eastbound between Darlinghurst Road and Ward Avenue and on Craigend Street between Roselyn Street footbridge and Darlinghurst Road would require adjustments to pavement line marking and signage.

Plant and equipment to be utilised includes:

- Small trucks;
- Rotomill; and,
- Street Sweeper.

This work could be completed with some lane closures and under traffic control. As this work connects to a busy intersection some works would need to be undertaken at night. It is anticipated that this work would be completed over four days and two nights.

Sensitive receivers to this site are residents directly adjacent to the works in both Kings Cross Road and Craigend Street (approximately 5 to 10 metres).

2.6 Changes In and Around Sir John Young Crescent:

The proposed changes in and around Sir John Young Crescent would require the following construction works:

(a) Removing the seagull island at the intersection of Sir John Young Crescent and Cowper Wharf Road to allow direct access to the harbour crossing from Palmer Street/Sir John Young Crescent:

1. Removal of concrete seagull island;
2. Installation of new concrete barrier and pavement repairs;
3. Modification/relocation of traffic signal posts; and,
4. Adjustments to sign posting and line marking.

Plant and equipment to be used includes:

- Small trucks;
- Rotomill;
- Concrete trucks;
- Concrete saw;
- Jack hammers;
- Back hoe/ bobcat; and,
- Street sweeper.

As this work would require lane closures and traffic diversion, it would need to be undertaken at night. It is anticipated that approximately 8 nights of work would be required to complete this work.

The works are contained within a cutting. Sensitive receivers (in this case, residents) are shielded and approximately 100 metres away.

(b) Reintroducing traffic signals at the intersection of Palmer Street and Sir John Young Crescent to assist efficiency of traffic flow:

1. Adjustment to concrete kerbs using saws;
2. construction of new kerbs and concrete blister island;
3. Installation of electrical conduits (including trenching across Sir John Young Crescent and Palmer Street);
4. Installation of additional signal posts; and,
5. Adjustments to sign posting and line marking.

Plant and equipment to be used includes:

- Small trucks;
- Rotomill;
- Concrete trucks;
- Concrete saw;
- Rock hammers;
- Back hoe/ bobcat; and,
- Street sweeper.

As this work would require lane closure and traffic diversion some of it would need to be undertaken at night or, if possible, on the weekend. It is anticipated that this work would take approximately three weeks, with up to 15 nights of work.

Sensitive receivers to this site are residents directly adjacent to the works approximately 5 to 10 metres away, Backpackers approximately 30 metres away and the Domain Apartments approximately 60 metres away.

(c) Changing Palmer Street from one lane northbound and one lane southbound between Sir John Young Crescent and Cathedral Street to two lanes northbound:

1. Adjustments to traffic signal lanterns at Cathedral Street; and,
2. Adjustments to line marking and sign posting between William Street and Sir John Young Crescent.

Plant and equipment to be used includes:

- Small trucks;
- Rotomill; and
- Street sweeper.

As this work would require closure of Palmer Street it would need to be undertaken at night. It is anticipated that this work would take seven nights to complete.

Sensitive receivers to this site are residents directly adjacent to the works on Palmer Street approximately 5 metres to 30 metres away.

(d) Reinstalling second right turn lane from Cahill Expressway off ramp to Cowper Wharf Road:

1. Adjustments to line marking;
2. Construction of a concrete kerb extension;
3. Installation of additional sign posting; and,
4. Reinstatement existing detector loop.

Plant and equipment to be used includes:

- Small trucks;
- Rotomill;
- Jack hammers; and,
- Street sweeper.

As this work would require closure of one lane on the ramp and traffic diversion, it would need to be undertaken at night. It is anticipated that this work would take four nights to complete.

Sensitive receivers to this site are residents on the corner of Bourke Street and Cowper Wharf Road approximately 60 metres away and on the corner of Lincoln Crescent and Cowper Wharf Road which are approximately 90 metres away. The Wharf apartments are approximately 150 metres away from the proposed works.

2.7 Changes at Queens Cross

The provision of a dedicated right turn lane at Queens Cross for a turning movement from Darlinghurst Road northbound into Kings Cross Road eastbound would require:

1. Removal and realignment of granite/concrete kerb and traffic island;
2. Pavement milling and re-sheeting;
3. Installation of a new detector loop; and,
4. Adjustments to sign posting and line marking.

Plant and equipment to be used includes:

- Small trucks;
- Concrete trucks;
- Concrete saw;
- Rotomill;
- Jack hammers; and,
- Street sweeper.

As this work would require lane closures it will need to be undertaken at night. It is anticipated that the works would take approximately 7 nights to complete.

Sensitive receivers to this site are residents in the Elan Apartments and adjacent residents within 50 metres of the proposed works.

2.8 Reopen Bourke Street Intersection

The reopening the Bourke Street intersection to the Southern side of William Street for left in/ left out movements would involve the following works:

1. Relocation of temporary concrete barriers;
2. Confirmation of the required signal post and conduit locations;
3. Traffic signal adjustments (including the installation of a new detector loop);
4. Adjustments to line marking and sign posting; and,
5. Removal of the temporary concrete barriers.

Plant and equipment to be used includes:

- Small trucks;
- Concrete saw;
- Grinder; and
- Street sweeper.

As these works would require lane closure on William Street, some night time work is required. It is anticipated that the works would be completed over 10 days and five nights

Sensitive receivers to this site are:

- Residents directly adjacent to the works (approximately 5 to10 metres); and
- Convenience store, Cafes, general business directly adjacent to the works (approximately 10 metres); and
- SCEGGS (approximately 50 metres away).

3 BACKGROUND NOISE AND NOISE CRITERIA

The noise impact has been determined by measuring background noise levels at residential premises, setting noise criteria at residential premises, predicting L_{A10} noise levels from the noisier periods of the works and assessing these noise levels against the set criteria. Noise mitigation measures have then been considered.

3.1 Residential Background Noise Levels

Background noise levels were measured for the purpose of assessing construction noise impacts during the tunnel construction. Relevant measurement locations to gain an appreciation of the background noise levels for the areas where the surface traffic changes are proposed are as follows:

- No. 4 Sir John Young Crescent (Sir John Young Crescent works which relate to works described in Sections 2.1, 2.6(a), 2.6(b), 2.6(c) and 2.6(d));
- Oakford Apartments, Druitt Street (Druitt Street works which relate to works described in Section 2.2);
- Altair Apartments (Craigend Street and Kings Cross Road works which relate to works described in Section 2.5 and 2.7); and,
- No. 1 Rosebank Street (William Street and Bourke Street works which relate to works described in Section 2.4 and 2.8).

The background noise levels as defined in the *NSW Industrial Noise Policy (INP)* are the Rating Background Level (RBL) values (Appendix A). Measured background levels are shown in Table 3-1.

Table 3-1 Measured Background Noise Levels

No	Location	Date	Rating Background Level (dBA)		
			Day (1)	Evening (1)	Night (1)
1	4 Sir John Young Crescent	14/06/02 to 25/06/02	61	58.5	47.5
2	Oakford Apartments, Druitt Street	1/07/02 – 17/07/02	66.5	64.0	57.0
3	Altair	28/08/02 - 05/09/02	63	60	49
4	1 Rosebank Street	-	65	64	54

Note: (1) Day - 7.00am - 6.00pm Evening - 6.00pm - 10.00pm Night time - 10.00pm - 7.00am

3.2 Residential Noise Criteria

Construction noise impacts have been assessed consistent with Condition 123 of the MPA Conditions which sets a noise level objective of the background noise levels +5dBA, applying to the L_{A10} level. Taking the background level as the Ratings Background Level (RBL) the objective becomes:

- RBL +5dBA.

The conditions require specific noise mitigation and management actions to be taken where these objectives cannot be achieved.

Based on the measured RBL values in Section 3.1 and the Supplementary EIS for the project, the residential objectives are shown in Table 3-2.

Table 3-2 Residential Noise Criteria

	Location	L_{A10} Noise Criteria (dBA)		
		Day (1)	Evening (1)	Night (1)
1	4 Sir John Young Crescent	66	64	53
2	Oakford Apartments,	72	69	62
3	Altair	68	65	54
4	1 Rosebank Street	70	69	59
5	Palmer Street	63(2)	-	-
6	Queens Cross	68(2)	-	-

Note: (1) Day - 7.00am - 6.00pm Evening - 6.00pm - 10.00pm Night time - 10.00pm - 7.00am
(2) From CCT Supplementary EIS.

4 EQUIPMENT AND SOUND POWER LEVELS

Noise levels from construction activities were predicted for the surrounding area. These predictions allowed for equipment noise generation, distance attenuation (including ground effects and air absorption) and any intervening noise shielding.

Assumptions were made as to what activities were likely to occur simultaneously on the site. Calculations were then carried out for typical construction scenarios, as follows.

4.1 Palmer Street Compound

This work involves the following equipment (sound power levels shown in brackets):

- Cars (105dBA); and,
- Trucks (109dBA).

4.2 Reopening Druitt Street

This work involves the following equipment:

- Small trucks (109dBA);
- Rotomill (114dBA);
- Asphalt paving plant(114dBA)
- Small asphalt roller (107dBA);
- Back hoe/ bobcat (107dBA);
- Street sweeper (107dBA); and,
- Concrete saw (116dBA).

4.3 Changes to Bus Lanes in Elizabeth Street

This change would retain the current lane layout and does not require any construction works as the approved works have not been constructed.

4.4 Provision of an Additional Traffic Lane on William Street

This work involves the following equipment:

- Small trucks (109dBA);
- Concrete trucks (109dBA);
- Rotomill (114dBA);
- Concrete saw (116dBA);
- rock hammers - One Excavator with Hydraulic Hammer (122dBA);
- Back hoe/ bobcat (107dBA); and,
- Street sweeper (107dBA).

If the mill and re-sheeting is required then the plant and equipment to be used will also include:

- Rotomill (114dBA)
- Asphalt paver (114dBA)
- Asphalt trucks(109dBA)
- Asphalt rollers (109dBA);

4.5 Removal of Cycle Lanes near Eastern Portal

This work involves the following equipment:

- Small trucks (109dBA);
- Rotomill (114dBA); and,
- Street sweeper (107dBA).

4.6 Changes In and Around Sir John Young Crescent:

(a) Removing the seagull island at the intersection of Sir John Young Crescent and Cowper Wharf Road to allow direct access to the harbour crossing from Palmer Street/Sir John Young Crescent.

This work involves the following equipment:

- Small trucks (109dBA);
- Rotomill (114dBA);
- Concrete trucks (109dBA);
- Concrete saw; (116dBA);
- Jack hammers (113dBA);
- Back hoe/ bobcat (107dBA); and,
- Street sweeper (107dBA).

(b) Reintroducing traffic signals at the intersection of Palmer Street and Sir John Young Crescent to assist efficiency of traffic flow.

Plant and equipment to be used includes:

- Small trucks (109dBA);
- Rotomill (114dBA);
- Concrete trucks (109dBA);
- Concrete saw (116dBA);
- Rock hammers - One Excavator with Hydraulic Hammer (122dBA);
- Back hoe/ bobcat (107dBA); and,
- Street sweeper (107dBA).

(c) Changing Palmer Street from one lane northbound and one lane southbound between Sir John Young Crescent and Cathedral Street to two lanes northbound.

Plant and equipment to be used includes:

- Small trucks (109dBA);
- Rotomill (114dBA); and,
- Street sweeper (107dBA).

(d) Reinstall second right turn lane from Cahill Expressway off ramp to Cowper Wharf Road.

Plant and equipment to be used includes:

- Small trucks (109dBA);
- Concrete trucks (109dBA);
- Rotomill (114dBA);
- Jack Hammer (113dBA); and,
- Street sweeper (107dBA).

4.7 Changes at Queens Cross

The provision of a dedicated right turn lane at Queens Cross for a turning movement from Darlinghurst Road northbound into Kings Cross Road eastbound

Plant and equipment to be used includes:

- Small trucks (109dBA);
- Concrete trucks (109dBA);
- Concrete saw (116dBA);
- Rotomill (114dBA);
- Jack hammers (113dBA); and,
- Street sweeper (107dBA).

4.8 Reopen Bourke Street Intersection

Reopening the Bourke Street intersection to the Southern side of William Street for left in / left out movements.

Plant and equipment to be used includes:

- Small trucks (109dBA);
- Concrete trucks (109dBA);
- Grinder (109dBA); and,
- Street sweeper (107dBA).

The scenarios shown represent the noisiest periods of construction at the site (i.e. with plant and equipment typically all working concurrently).

5 NOISE IMPACT PREDICTIONS FROM CONSTRUCTION WORKS

Noise levels have been calculated for the scenarios described above. These predictions have been made assuming that all of these activities occur at all locations where there will be surface works.

Table 5-1 summarises the highest noise levels to be expected at noise sensitive locations. As the majority of properties are the same distance from William Street and surface works are relatively generic, noise level predictions are generally the same for most receivers.

Table 5-1 Predicted Highest L_{A10} Noise Levels (with Noise Mitigation Measures)

No.	Construction works	L_{A10} Noise Levels (dBA) at specific distances				
		5 metres	10 metres	20 metres	50 metres	100 metres
2.1	Palmer Street Compound	78-82	72-76	66-70	58-62	52-56
2.2	Reopening Druitt Street	86-89	80-83	74-77	66-69	60-63
2.4	Provision of an Additional Traffic Lane on William Street	86-95*	80-89*	74-83*	66-75*	60-69*
2.5	Removal of Cycle Lanes near Eastern Portal	86	80	74	66	60
2.6(a)	Changes In and Around Sir John Young Crescent	86-89	80-83	74-77	66-69	60-63
2.6(b)		86-95*	80-89*	74-83*	66-75*	60-69*
2.6(c)		86	80	74	66	60
2.6(d)		86	80	74	66	60
2.7	Changes at Queens Cross	87	81	75	67	61
2.8	Reopen Burke Street Intersection	86	80	74	66	60

Note: * Figure refers to hydraulic hammering.

It is noted that the proposed removal of the bicycle lane on Craigend Street westbound (2.5), may be completed concurrently with the provision of the additional eastbound lane on William Street (2.4). Similarly, reintroducing the traffic signals at the intersection of Palmer Street and Sir John Young Crescent (2.6 (b)) may be completed concurrently with the conversion of Palmer Street to two lanes northbound (2.6 (c)). Given the nature of these proposed works, no increase in noise impact is likely, provided noisy activities are carefully scheduled to avoid concurrent use.

5.1 Preliminary Assessment of Site Noise Impact

Comparing the predicted construction noise levels (Table 5.1) with the residential noise criteria (Table 3-2) and considering the distance of sensitive receivers to the work sites, here is potential for substantial construction noise impacts.

5.2 Noise Mitigation

RTA's assessment is undertaken consistent with MPA Conditions 126 and 137, it is RTA's policy to consider all reasonable and feasible noise mitigation measures where it is either predicted or actually results that construction noise impacts exceed the relevant noise criteria at receivers. The RTA's Construction Manager for the work associated with the Proposed Modifications will be responsible for ensuring that due care will be taken to manage noisy operations so as to minimise the noise and vibration emissions to sensitive receivers.

The nature and short-term duration of the construction works associated with the Proposed Modifications, combined with the elevated position of many of the potentially affected residences, means that it would not be practicable to construct effective noise hoardings around the works.

The works in this area will incorporate several mitigation measures to reduce noise impacts. These measures include:

- Where practicable, surface breaking will be conducted by means other than hydraulic hammers or jackhammers. Where this is not practicable, jackhammers will be used in preference to hydraulic hammers. Only damped rock hammers will be used;
- Public address systems will only be used in the event of an emergency;
- Equipment will be oriented away from nearby residents where practicable and loading and unloading will be carried out away from noise sensitive areas, where practicable to minimise impacts;
- Plant and equipment is should not be left standing with engines running when not in use;
- Works will be staged where practicable to avoid the co-incidence of noisy plant working at the same time close together and adjacent to sensitive receivers;
- All site personnel will be tool boxed on these management strategies and the need to keep noise to a minimum; and
- A comprehensive community notification strategy will be implemented to ensure adjacent residents businesses are informed of construction works and scheduling.

5.3 Construction Noise Monitoring

Given that the proposed construction works would be undertaken intermittently over a three-month period, routine construction noise monitoring would not be required. Notwithstanding, in the event of a construction noise complaint, the RTA should consider the need to conduct construction noise monitoring.

5.4 Night Time Activities

Some noise-generating surface construction works are proposed to occur outside of normal construction hours. This is due to the need to avoid peak traffic flows for lane closures to occur. Consistent with MPA Condition 139, where possible these activities will be conducted before midnight, however some works will be required in some locations beyond midnight. These construction works are described in Section 2 with their likely duration and guidance as to the plant likely to be used during these works.

Currently MPA Condition 122 requires any night time works be subject to the approval of the DEC / Department of Planning. As an Environment Protection Licence is not required to construct the proposed modifications, changes are recommended to Condition 122 to allow the night time construction works to proceed, subject to the above outlined mitigation measures, without any additional approvals.

6 VIBRATION IMPACT ASSESSMENT

Vibration levels have been calculated at the nearest premises and have been assessed against the limits specified in MPA Conditions 146 and 147.

6.1 Vibration Limits

Condition 146 sets vibration limits to protect against building damage and human comfort within buildings. The human comfort limits are the more stringent limits.

British Standard BS6472:1992 sets the following vibration limits for human comfort (above 8Hz):

- 0.28mm/s peak velocity within residences during daytime
- 0.56mm/s peak velocity within offices during daytime

In regard to potential building damage, the German Standard DIN4150 suggests a limit of 10mm/s peak particle velocity (ppv) within any normal building and the British Standard BS7385:Part 2 - 1993 sets a limit within buildings which depends upon the vibration frequency and varies from 7.5mm/s ppv at 4Hz to 25mm/s at 40hz and above. Given that the bulk of the vibration energy from construction activity will fall in the range 10-100Hz, it is reasonable to adopt an overall vibration limit of 10mm/s ppv.

Condition 147 sets a vibration limit of 3mm/s (ppv) at the foundation of heritage buildings and sensitive structures. This limit is appropriate for:

- William House, 101-111 William Street;
- Telopea, Merrol and Baringa, 119-129 William Street;
- RTA Building, 132 William Street;
- Former ABC Building, 171-175 William Street; and
- Grenville House, 177-185 William Street.

6.2 Generated Vibration Levels

Ground borne vibration levels generated by typical construction activities associated with the Street surface works will depend upon the response of the ground at that site. Figure 6-1 shows the highest anticipated vibration levels from typical construction equipment.

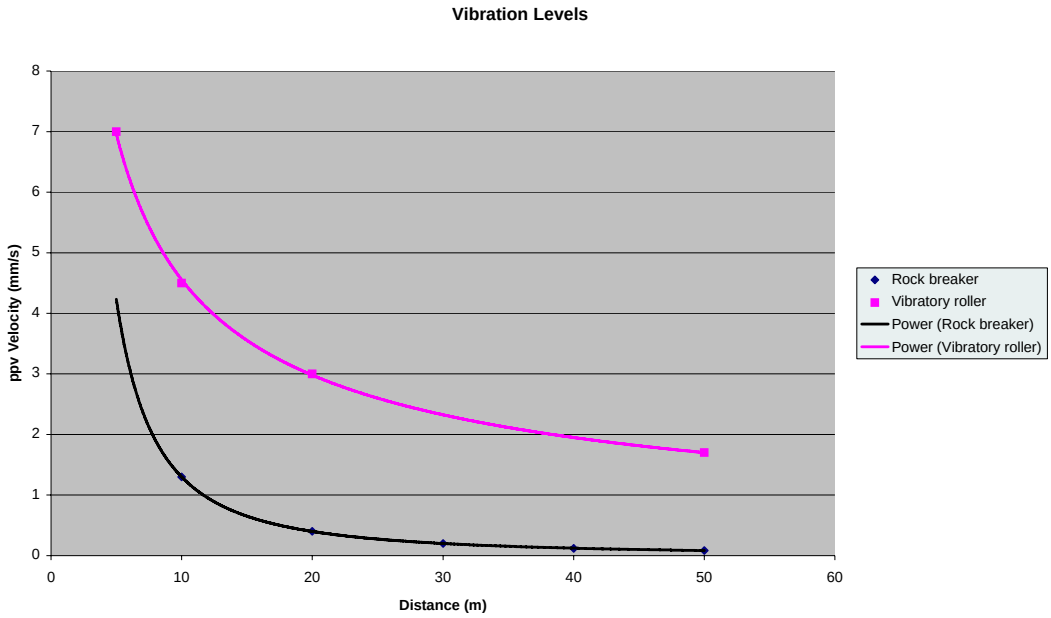


Figure 6-1 Typical Construction Vibration Levels

Excavators fitted with hydraulic hammers will generate the highest vibration levels operating close to buildings.

Table 6-1 gives an indication of the maximum vibration levels to be expected at typical distances from the hydraulic hammer to the nearest building.

Table 6-1 Approximate Vibration Levels Expected at the Closest Buildings

	Min. Distance (m)	Peak Particle Velocity (mm/s) Hydraulic Hammer
Vibration levels at various distances	3	5
	10	1.3
	50	0.1

6.3 Vibration Impact

In respect of potential damage, it is unlikely that the 3mm/s limit for heritage buildings and sensitive structures be exceeded at the closest buildings.

It is, however, recommended that in areas near sensitive buildings, alternatives to hydraulic hammers should be used for surface breaking, where practicable.

In regard to human comfort, the 0.28mm/s is likely to be exceeded for brief periods at nearby residences when construction (rock breaking) occurs within approximately 25 metres.

6.4 Vibration Monitoring

Given that the proposed construction works would be undertaken intermittently over a three-month period, routine construction vibration monitoring would not be required. Notwithstanding, in the event of a construction vibration complaint, the RTA should consider the need to conduct construction vibration monitoring.

7 OPERATIONAL NOISE ASSESSMENT

The proposed modifications may potentially give rise to operational traffic noise impacts. The proposed modifications would result in a redistribution of traffic flows on streets around the project compared to the forecasted traffic flows for the Approved activity. Changes to traffic flows on individual surface streets resulting from the proposed modifications are presented in Table 7-1. The information in this Table has been extracted from the work completed by Masson Wilson and Twiney assessing the operational traffic impacts of the proposed modifications

Table 7-1 Forecasted changes in traffic volumes for surface streets in Central Sydney.

Street		Two way ADT			
		2006		2011	
		Approved Project	Proposed changes to surface traffic arrangements.	Approved Project	Proposed changes to surface traffic arrangements.
Kings Cross Tunnel		30,656	32,200	29,105	30,469
William St	East of College St	30,230	32,161	29,163	31,671
Park St	at Hyde Park	24,028	29,833	22,441	28,220
Park St	East of George St	19,221	33,265	20,663	35,321
Druitt St	East of Kent St	0	16,387	0	17,105
Market St	East of Kent St	27,330	18,719	28,943	22,523
Druitt St	on ramp to Western Distributor	14,656	15,288	16,190	16,907
Market St	on ramp to Western Distributor	39,397	34,069	41,494	36,078
Palmer St	North of William St	13,070	14,824	12,959	14,320
Riley St	North of William St	6,186	7,155	4,869	5,424
Cowper Wharf Road	East of Cahill Expressway Ramp	15,333	12,667	14,711	11,854
Sir John Young Cres	on ramp to Cahill Expressway	5,303	12,957	6,365	13,725

The proposed modifications would appear to substantially increase surface traffic on Druitt Street, Park Street and Sir John Young Crescent. Minor increases in surface traffic would appear to occur on Palmer Street and Riley Street. Reductions in surface traffic would appear to primarily occur on Market Street and Cowper Wharf Road.

Table 7-2 provides an indication of the extent of road noise impact associated with the proposed modifications by comparing the noise changes from the Approved Project and

the Project including the proposed modifications (i.e. the relative change in noise level between the Approved Project and the Project including the proposed modifications).

Table 7-2 Indicative noise level change for surface streets as a result of the proposed changes to the surface roads.

Streets		Change in noise level, dBA	
		2006	2011
		Approved Project / Proposed changes to surface traffic arrangements.	Approved Project / Proposed changes to surface traffic arrangements.
Kings Cross Tunnel		0.2	0.2
William St	East of College St	0.3	0.4
Park St	at Hyde Park	0.9	1.0
Park St	East of George St	2.4	2.3
Druitt St	East of Kent St	>2	>2
Market St	East of Kent St	-1.6	-1.1
Druitt St	on ramp to Western Distributor	0.2	0.2
Market St	on ramp to Western Distributor	-0.6	-0.6
Palmer St	North of William St	0.5	0.4
Riley St	North of William St	0.6	0.5
Cowper Wharf Road	East of Cahill Expressway Ramp	-0.8	-0.9
Sir John Young Cres	on ramp to Cahill Expressway	3.9	3.3

The indicative noise level changes as a result of the proposed changed surface traffic arrangements indicate the possible significant (greater than 0.5dB) increase in noise in the following streets:

- Druitt Street;
- Park Street;
- Palmer Street;
- Riley Street; and,
- Sir John Young Crescent.

MPA Condition 150 requires the RTA to develop an operation noise management sub plan (ONMSP) prior to the completion and opening of the Cross City Tunnel. This ONMSP was approved by the Director-General of the Department of Planning on 29 June 2005.

The approved ONMSP specifies a process to measure and assess road traffic noise on the surface streets consistent with the NSW government Environmental Criteria for Road Traffic Noise (ECRTN).

The ONMSP identifies surface streets that may potentially be affected by increased traffic noise. A noise monitoring program and assessment process is established in the ONMSP to identify the potential noise impacts and possible noise mitigation for these surface streets.

It recommended that Druitt Street, Park Street, Palmer Street, Riley Street and Sir John Young Crescent be included in the noise monitoring program and assessment process established in the ONMSP to identify the potential noise impacts and possible noise mitigation as the changed surface traffic arrangements may increase traffic noise levels.

8 CONCLUSION

8.1 Construction Noise Impact

This assessment considers potential construction noise and vibration impacts resulting from the construction of the proposed modifications to surface traffic arrangements.

The assessment identifies the receivers potentially most affected by works at the site, the significant stages of construction works, and the likely worst case noise and vibration emission scenarios. Due to the need for lane closures, a relatively large amount of work will be required to be conducted during evening/night time. Where possible, this will be completed in the hours 9pm to midnight, but some works will be required after midnight.

Due to the short term nature of the proposed construction works combined with the elevated position of many of the potentially affected residences it will not be practicable to construct effective noise hoardings around the works.

The predicted noise levels show that, at times, the noise levels criteria will be exceeded to a substantial degree. These exceedances generally occur when machinery operates at very short distances to residences. These short distances only occur for short periods and at most locations for most of the time noise levels would be significantly lower.

No impacts are anticipated in respect to truck traffic movements associated with these works as truck movement numbers will be low and ambient noise levels are relatively high.

The following management and mitigation measures will be adopted to manage any noise and vibration impacts from the each site:

- Where practicable, surface breaking will be conducted by means other than hydraulic hammers or jackhammers. Where this is not practicable, jackhammers will be used in preference to hydraulic hammers. Only damped rock hammers will be used.
- Public address systems will only be used in the event of an emergency.
- Equipment will be oriented away from nearby residents where practicable and loading and unloading will be carried out away from noise sensitive areas, where practicable to minimise impacts.
- Plant and equipment will not left standing with engines running when not in use.
- Works will be staged where practicable to avoid the co-incidence of noisy plant working at the same time close together and adjacent to sensitive receivers.

- All site personnel will be tool boxed on these management strategies and the need to keep noise to a minimum
- A comprehensive community notification strategy will be implemented to ensure adjacent residents businesses are informed of construction works and scheduling.

Given that the proposed construction works would be undertaken intermittently over a three-month period, routine construction noise and vibration monitoring would not be required. Notwithstanding, in the event of a construction noise and/or construction vibration complaint, the RTA should consider the need to conduct construction noise monitoring.

8.2 Operational Noise Impact

The proposed changed surface traffic arrangements indicate the possible significant (greater than 0.5dB) increase in noise in the following streets:

- Druitt Street;
- Park Street;
- Palmer Street;
- Riley Street; and
- Sir John Young Crescent.

It recommended that Druitt Street, Park Street, Palmer Street, Riley Street and Sir John Young Crescent be included in the noise monitoring program and assessment process established in the ONMSP to identify the potential noise impacts and possible noise mitigation as the changed surface traffic arrangements may increase traffic noise levels.

Version	Status	Date	Prepared by	Checked by
A	Draft	8 June 2006	John Wassermann	-
A	Final	11 June 2005	John Wassermann	Ben Lawrence

APPENDIX A

NOISE DESCRIPTORS

NOISE DESCRIPTORS

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.

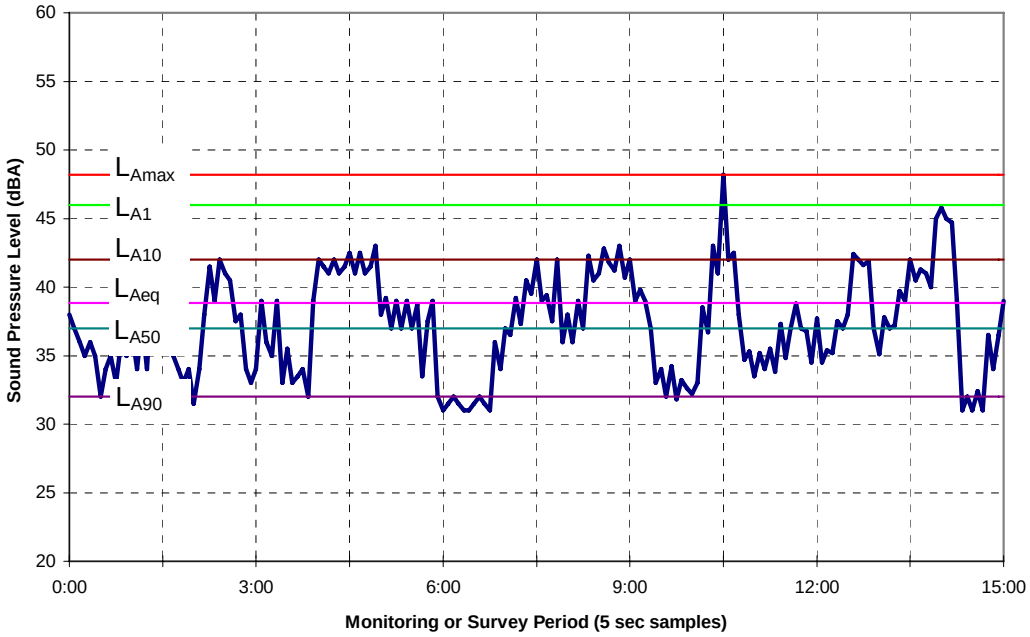
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise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


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)