

MANAGING DIRECTORS

MATTHEW PALAVIDIS
VICTOR FATTORETTO

DIRECTORS

MATTHEW SHIELDS
BEN WHITE



Harbour Control Tower, Barangaroo

Demolition Noise and Vibration Assessment

SYDNEY

A: 9 Sarah St Mascot NSW 2020

T: (02) 8339 8000

F: (02) 8338 8399

SYDNEY MELBOURNE BRISBANE CANBERRA

LONDON DUBAI SINGAPORE GREECE

www.acousticlogic.com.au

ABN: 11 068 954 343

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1 EXECUTIVE SUMMARY

Noise and vibration impacts arising from the proposed demolition of the Sydney Harbour Control Tower at Barangaroo Headland Park have been assessed.

Noise and vibration levels arising from the proposed works have been predicted at the surrounding receivers. The EPA Interim Construction Noise Guideline and other guidelines have been used to establish noise and vibration management levels for receivers around the site. The predicted levels have been assessed in against these management levels.

This assessment has identified the receivers potentially impacted by the proposal (amenity and risk damage to structures), and the demolition activities producing these impacts, so that these impacts can be appropriately addressed and managed.

The assessment indicates that:

- Noise impacts will primarily be limited to the resident group located in Merriman and Bettington Streets. Noise Management Level exceedences at these residences are predicted to occur during all phases of the demolition period. However, no exceedences of the Highly Noise Affected Management Level are predicted.
- Ground vibration generated by the proposed activities would not impact nearby railway infrastructure, and are unlikely to impact nearby residential or commercial buildings. Notwithstanding, recommendations are made to safeguard existing residences in Merriman Street due to hammering that might occur using excavator mounted hammers.

A Preliminary Noise and Vibration Management Plan (NVMP) has been devised that will be developed and used by the contractor to manage the identified impacts. The Plan outlines the development of controls and safeguards that would be applied to all activity on the site. The objective of these controls is to ensure that all work is carried out in a highly controlled and predictable manner that will minimise emissions and protect the amenity of the sensitive receivers surrounding the site.

The Preliminary NVMP is based on a conceptual demolition strategy. This strategy would be developed by the Contractor undertaking the works. The Preliminary NVMP would also be developed by the Contractor into a Project NVMP to address the selected strategy. It would specifically identify the controls and safeguards to be applied to the works to minimise noise and vibration impacts in line with the objectives of the Plan. Further reviews of the Project NVMP would be undertaken through the demolition period as required in response to revised methods and equipment, as well as in response to the monitoring and evaluation of actual impacts.

The NVMP describes the ongoing noise and vibration monitoring that would be carried out to record and verify the noise and vibration levels being achieved at sensitive receiver locations.

The processes adopted in the Management Plan will minimise noise and vibration emissions, to meet the overall objectives of Environment Protection Authority Interim Construction Noise Guideline, minimising and ameliorating any impacts caused by these activities to the extent that it is feasible and reasonable.

2 INTRODUCTION

This document presents a noise and vibration assessment of the activities that are likely to occur during the demolition of the Sydney Harbour Control Tower (HCT), and the management plan that will be used to manage construction related noise and vibration.

3 PROJECT DESCRIPTION

Works associated with the construction of the Barangaroo Headland Park and Northern Cove are currently occurring on the site and will continue during the proposed works. The subject proposal seeks to modify the consent for the Headland Park main works to include the demolition of the Demolition of the HCT.

Demolition is expected to occur between July 2015 and March 2016. Landscaping and integration works associated with the Headland Park are expected to occur between September 2015 and February 2016.

The HCT is located on the eastern edge of the Headland Park site, and is bounded Merriman Street to the east and Clyne Reserve to the North. Refer Figure 1.

The tower consists of a reinforced concrete column (incorporating an internal lift and stair) with a steel and glass observation deck and operations centre.

A number of demolition methodologies have been considered based on the location and height of the HCT, proximity to public infrastructure and construction works being undertaken at the Headland Park site below. These include:

- Induced Collapse.
- Structural demolition.
- Structural dismantling.

The induced collapse option is not possible due to the constraints imposed by the adjoining boundaries to public and private properties, and the works below at the Headland Park site, preventing an adequate exclusion zone (at least one and a half times the height of structure). Of the remaining methodologies, the structural dismantling option will result in the lowest number of demolished elements, minimising the overall risk exposure to surrounding community, number of exclusion zones and noise impacts to surrounding receivers, and hence is the preferred option.

This methodology proposes to demolish the tower in a number of stages:

- Stages 1 & 2 – Site Establishment – this includes establishment of hoarding, fencing, isolation zones, site facilities, lifting/access equipment and loading locations.
- Stage 3 – Working Level Removal – this stage is proposed to occur over two phases:
 - Phase a – Roof Removal – this will include removal of roof cladding, glazed elements and any other external cladding to concrete floor level.
 - Phase b – Floor and Upper Core Removal – this will include removal of both levels of concrete floor above tower core, all beams and shaft walls.
- Stage 4 – Concrete Tower/Core Removal – this will include demolition/cutting of tower core and removal of fire stair..
- Stage 5 – Concrete Tower Base Removal – this will include demolition of the remaining 8m tower core and plinth base.

A brief description of the indicative demolition methodology is presented below. Refer to HTC Demolition Review document prepared by Evans & Peck, dated November 2013, for detailed description of demolition methodology.

Stages 1 & 2 – Site Establishment

- Establish hoarding, fencing and isolation zones.
- Establish site facilities at the northern end of Merriman Street.
- Establish a tower crane in the roundabout at the northern end of Merriman Street. This would include drilling of rock anchor supports in Merriman Street.
- Establish work zones and/or road closures for loading into disposal trucks.
- Erect mast climbers/scaffold to perimeter of main core of tower.
- Install man and materials hoist and scaffold stair.

Stage 3 – Working Level Removal

- Removal of section of roofing to crane bins into control tower working level.
- Strip out all internal fittings, services, finishes and glazed elements.
- Demolish the observation deck/control room section by cutting and lowering structural steel onto trucks located in Merriman Street for removal from site. Concrete floor will be sawn and lowered to disposal trucks in Merriman Street.
- Demolish the remainder by (a) removing any cladding, (b) cutting beams into sections, then (c) cutting (horizontal and vertical cuts) masonry elements (concrete floor, shaft walls etc.) into pieces. Items removed from the tower would be lowered onto disposal trucks using the crane located in Merriman Street and removed from site.

Stage 4 – Concrete Tower/Core Removal

- Reconfigure mast climbers, screens, access, etc. as required.
- Progressively demolish the concrete tower section by (a) cutting the internal stair into sections, then (b) cutting the masonry elements into pieces. Horizontal cuts would be made using a wire saw and vertical cuts using a hydraulic wall saw. Items removed from the tower would be lowered onto disposal trucks using the crane located in Merriman Street and removed from site.

Stage 5 – Concrete Tower Base Removal

- Mast climbers/ or scaffolding are removed from site.
- A 45tonne excavator and Bobcat would be lowered to the tower base level. The excavator would be used to demolish the remainder 8m of the tower core and raised plinth base, using hydraulic hammers and shears. The Bobcat would be used to load the spoil into bins which would be raised to Merriman Street level and loaded onto disposal trucks. Reconfigure mast climbers, screens, access, etc. as required.
- Once the demolition reaches the plant room level the tower crane would be removed and a mobile crane would be used instead.
- Complete re-instatement works.

4 ACTIVITIES TO BE CONDUCTED AND ASSOCIATED NOISE SOURCES

The proposed main works activities assessment is based on the preferred demolition methodology outlined in “Demolition Review – Proposed Removal of Sydney Harbour Control Tower” (Evans and Peck, 2013). A description of each of the identified noise producing processes and the associated equipment is presented below.

The review includes an assessment of potential methods considering:

- Access constraints.
- Safety
- Efficiency
- Noise and vibration generation

The strategy adopted in the preferred demolition methodology seeks to minimise noise and vibration impacts by minimising demolition works on site, which includes removing the tower in the largest possible sections for processing off-site. The review considered other methodologies that would further minimise impacts however these were not feasible or reasonable. These included:

- Induced collapse – this methodology is not possible as it is not possible to establish the required exclusion zone.
- Structural demolition – Increased risk of wind blown debris, higher noise impacts.
- Removal of spoil through the Cultural site –structural and other considerations limit the size of trucks possible. As pieces would have to be cut smaller, more noise would be generated, the overall program for demolition extends as does the consequential impact to the HP program. Noise impact by using larger vehicles accessing via Merriman Street results in overall lower noise impact.

Stages 1 & 2 – Site Establishment

The following noise sources are anticipated during this phase:

- Mobile Crane (to install the temporary crane, site facilities, etc.)
- Tower Crane
- Anchor Drill
- Portable hand tools.

Stage 3 – Working Level Removal

- Wire Saw
- Hydraulic Saws
- Tower Crane
- Disposal Truck
- Hand electric power tools and core drill
- Access Equipment (hoists, etc.)

Stage 4 – Concrete Tower/Core Removal

- Wire Saw
- Hydraulic Saws
- Tower Crane
- Disposal Truck
- Hand electric power tools and core drill
- Access Equipment (hoists, etc.)

Stage 5 – Concrete Tower Base Removal

- Tower Crane
- Mobile Crane (after tower crane dismantled)
- 45t Excavator with hydraulic hammer or concrete shears attachments
- Bobcat

Dewatering of Groundwater Inflow into Extraction Area

In the event groundwater inflow interferes with the demolition process a small pump will be used pump water into holding stations for flocculation and discharge to stormwater drain.

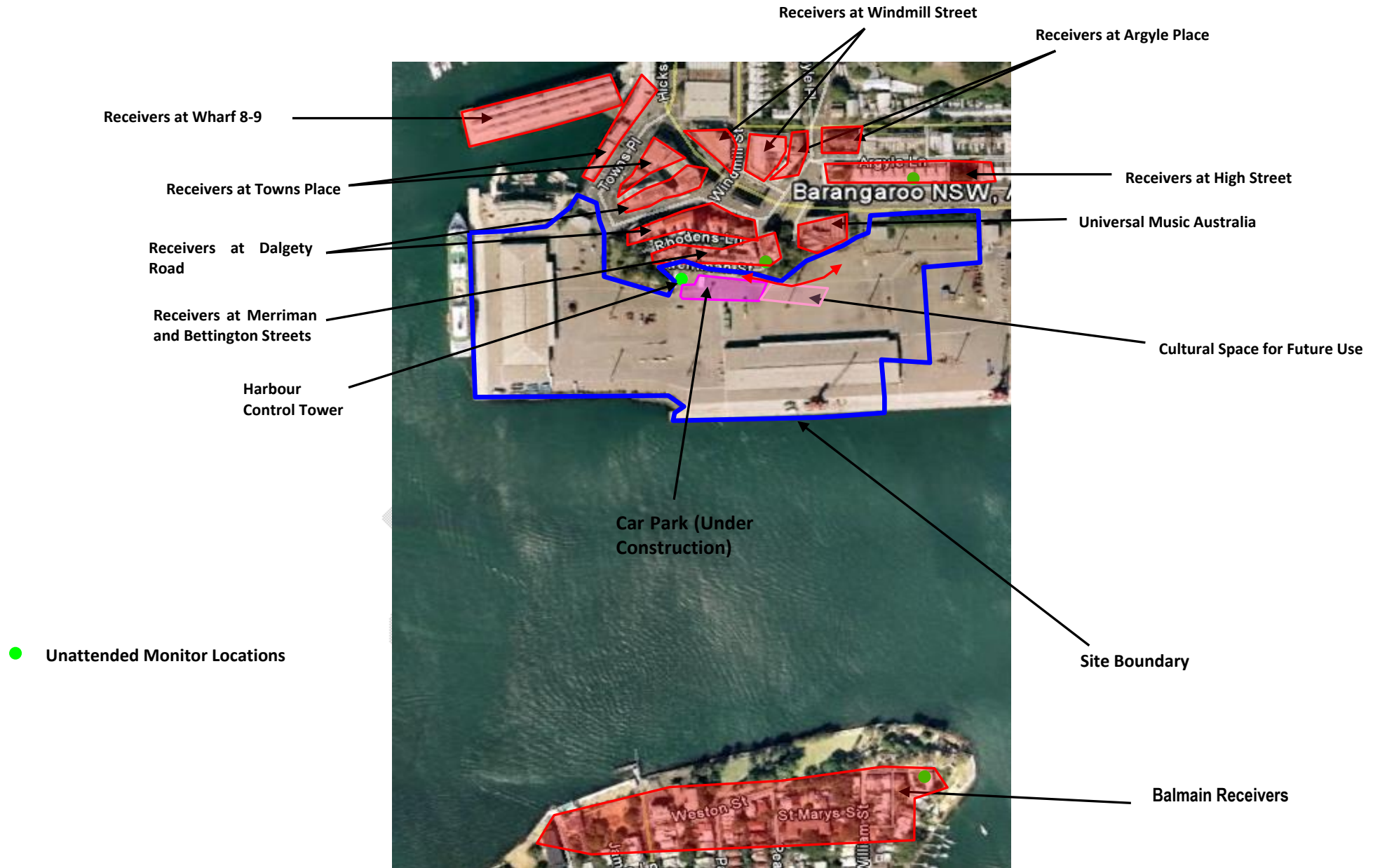


Figure 1 – HCT Tower Location, Headland Park Project Site Boundary and Sensitive Receivers

4.1 SOURCE NOISE LEVELS

The A-weighted sound power levels for typical equipment/processes anticipated to be used are outlined in Table 1 below.

Table 1 – Sound Power Levels

EQUIPMENT /PROCESS	SOUND POWER LEVEL dB(A)
<i>Stages 1 & 2 – Site Establishment</i>	
Mobile Crane	104
Tower Crane	105
Anchor Drill	111*
Portable hand tools (electric)	102*
<i>Stage 3 – Working Level Removal</i>	
Wire Saw	101*
Hydraulic Saws	107*
Tower Crane	105
Access Equipment (hoists) - ELECTRIC	92
Hand Tools (electric) and Core Drill	102*
Truck	108
<i>Stage 4 – Concrete Tower/Core Removal</i>	
Wire Saw	101*
Hydraulic Saws	107*
Tower Crane	105
Access Equipment (hoists) - ELECTRIC	92
Hand Tools (electric) and Core Drill	102*
Truck	108
<i>Stage 5 – Concrete Tower Base Removal</i>	
Tower Crane	105
Mobile Crane	104
Hydraulic Hammer on 45t Excavator	125*
Concrete crusher (tracked)	112
Truck	108
Bobcat	105

* - Predictions were made with 5 dB(A) added to tabled noise levels to account for tonality or impulsive character.

The noise levels presented in the previous table are derived from the following sources:

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

4.2 TRAFFIC GENERATION ON LOCAL ROADS

Merriman Street would be used to access the site. A minimal number of vehicle movements (passenger and heavy vehicles) are expected to be produced by the demolition activities due to the nature of the demolition. It is expected that the average number of heavy vehicles would be less than 2 per day, with a maximum of 5 movements during roof demolition. These would enter/leave via Pottinger Street and Hickson Road route.

Earth moving equipment, cranes and other demolition machinery would be delivered at the start of the project/phase and generally remain on site for extended periods. Heavy vehicle traffic would include large rigid and articulated trucks.

4.3 HOURS OF WORK

Work is proposed to be undertaken during the approved Main Works hours:

- 7am to 6pm Monday to Fridays.
- 8am to 3pm Saturdays.

Exceptions to these hours apply for the delivery of oversize loads or certain materials as required for safety reasons and for emergency response. Furthermore, certain construction activities may be allowed to occur outside the hours above on a planned basis with the prior written approval of the Director-General or as provided for under separate legislation.

No works or deliveries would take place on Sundays and public holidays.

5 NOISE AND VIBRATION GOALS

Noise and vibration goals in the existing approval for the Main Works have been included in Appendix 1. Broadly they require compliance with:

- Compliance with EPA Interim Construction Noise Guideline
- Compliance with EPA “Assessing Vibration”
- The Contractor to develop a detailed Noise and Vibration Management Plan

5.1 NOISE MANAGEMENT GUIDELINES

The applicable guidelines and standards are:

- EPA Interim Construction Noise Guideline. This guideline nominates a methodology for assessing and managing construction noise (and vibration) impacts.

A quantitative assessment is undertaken involving the prediction of likely noise levels from activities at sensitive receivers, and these noise levels are compared to noise management goals. This process identifies the processes causing emissions that may exceed the goals, so that feasible and reasonable management of those processes can be assessed and implemented to these processes.

- Australian Standard 2436-1981 “Guide to Noise Control on Construction Maintenance and Demolition Site”. In particular, the requirements stipulated in Section 3 of the standard will be followed.

Section 3 of AS 2436 states that care shall 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.

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

- That reasonable suitable noise criterion is established.
- That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes on parts of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours
- The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the building site.
- The City of Sydney also has a comprehensive code for the regulation of noise emissions from construction sites “Construction Hours/Noise within the Central Business District Code of Practice (1992)”. The Code divides the week into different categories corresponding to different times. Category 1 is regarded as standard hours, up to Category 4 hours which covers the most sensitive periods. Different noise assessment goals apply for the different categories:

- Category 1 - Monday to Friday 7am to 7pm and Saturday 8am to 5pm – Background + 5 dB(A) + 5 dB(A) (10dB(A) total). The extra 5 dB(A) is applied on a case by case basis and is usually included unless there is a specific noise sensitive occupancy impacted.
- Category 2 - Monday to Friday 7pm to 11pm and Saturday 5pm to 11pm – Background + 5 dB(A).
- Category 3 – Sundays and Public Holidays 7am to 5pm – Background + 3 dB(A).
- Category 4 – All other times– Background + 0 dB(A)

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

- The existing approval for the demolition of structures on the Barangaroo site adopted a noise management level of background + 10 dB(A) at all receiver locations. A large part of this demolition work was successfully undertaken prior to the World Youth Day in 2007/8, and is continuing, using these goals and the Management Plan developed. It is noted that the management goals adopted in the EPA ICNG are more stringent than the City of Sydney Code, and the goals previously used to regulate noise emissions from the Barangaroo site.

In assessing the methodologies in these documents, for “normal” construction hours:

- All the standards indicated above adopt a broadly similar approach – construction noise emissions should be managed to meet established management goals where feasible and reasonable.
- For residential receivers, EPA, City of Sydney and the demolition approval all adopt a general noise management goal based on a 10 dB(A) exceedence of the background noise level for the bulk of the proposed demolition times. City of Sydney adopts a more stringent goal between 7am and 8am on Saturdays.
- For commercial receivers, the EPA guideline adopts an external or internal amenity goal (independent of background noise level), whereas the City of Sydney and the previous demolition approval use a background + 10 dB(A) approach as for residential receivers.

The EPA guideline will be used to set management goals for the project. However, the other guideline documents will also be used where there are project specific situations/receiver types that are not specifically defined in the EPA guideline.

The following procedure will be used to assess noise emissions (based on these guidelines):

- Predict noise levels produced by demolition activities at the sensitive receivers.
- Define a “Noise Affected” Management” level for each receiver type using the methodology outlined in the EPA ICNG. Where there are not specific recommendations in the ICNG, or where these are not seen as appropriate, use other guideline documents to determine an appropriate management level.

- Where levels exceed “Noise Affected Management Level” (NAML), investigate and implement all reasonable and feasible techniques to limit noise emissions.
- For residential receivers, if noise levels exceed EPA “Highly Noise Affected” Management Level (75dB(A)) after applying all practical engineering controls to limit noise emissions investigate time management and other techniques to further mitigate noise emissions.

5.2 PROJECT SPECIFIC NOISE MANAGEMENT LEVELS

5.2.1 Potentially Affected Receivers

A survey of potentially affected sensitive commercial and residential receivers has been conducted. The receiver locations identified as being potentially most impacted by the proposed activities are:

- Hickson Road – Commercial premises including offices
- Merriman Street and Bettington Street – Residential premises
- Moore’s Wharf Building and surrounds
- Dalgety Road – Residential premises
- Windmill Street – Commercial premises including offices and cafés.
- Towns Place – Commercial premises including offices and cafés and residential premises.
- Pier 8-9 – Commercial premises including offices.
- Argyle Place – Commercial premises including offices and cafés and residential premises.
- High Street – Residential premises
- Balmain Peninsula – Residential premises

5.2.2 Ambient Noise Monitoring

In order to establish noise goals, background noise levels were measured at locations representing the most sensitive receiver groups.

Extensive background noise monitoring was undertaken for the Headland Park Main Works Application based on a combination of attended and unattended monitoring. Because of the influence of construction activities currently occurring on the Barangaroo site, it is not possible to undertake background noise monitoring at this time to confirm that levels have not changed significantly since the last study. As there is no reason why background noise levels would have changed significantly during that period, the background noise levels and noise management goals used in the previous main works assessment will be adopted.

5.2.3 Residential Receiver Noise Goals

At residential receivers, noise generated by plant and equipment operating during normal hours throughout the duration of the project will be managed to generally comply with the background + 10dB(A) goal, and where that is exceeded noise will be managed in strict compliance with AS2436 and the EPA ICNG.

Table 2 – Residential Receivers Noise Affected Management Level

Location	Noise Affected Management Level dB(A) L_{eq}⁽¹⁾	Highly Noise Affected Management Level dB(A) L_{eq}
Residences on Merriman and Bettington Streets	54	75
Residential Receivers on Windmill Street	61	75
Residential Receivers on Towns Place	63	75
Commercial and Residential Receivers on Argyle Place	62	75
Residences on High Street	61	75
Residences Balmain Peninsula	58	75

(1) Background noise level + 10 dB(A)

For plant that may need to operate 24 hours per day, the noise criterion will be set at 5 dB(A) above the night time background noise level as determined from the long term monitoring locations, in accordance with the EPA ICNG.

Table 3 - Noise Criteria for Plant Operating 24 hours Per Day/7 Days Per Week

Location	Noise Level dB(A) L_{eq}
Residences on Merriman and Bettington Streets	42
Residences on High Street	45*
Residences Balmain Peninsula	44

* Noise level will be limited to 45 dB(A), equal to the urban night time amenity level in the EPA INP.

5.2.4 Commercial and Other Receivers

The ICNG adopts the following external management levels for commercial and industrial receivers:

- Commercial (offices, retail outlets) – 70 dB(A) L_{eq}
- Industrial 75 dB(A) L_{eq}
- Other occupancies – Project specific based on type of occupancy, perhaps using “maximum” recommended level in AS 2107 to assist in determining relevant internal levels.

For the commercial receivers around the site the “standard” 70 dB(A) external noise goal may not be appropriate. For example:

- Some commercial receivers around the site are not located outside buildings, or are in buildings that provide almost no attenuation. For these receivers, the standard noise goal proposed in the ICNG may need to be made more stringent in order to appropriately manage impacts at these receivers.
- Some of the receivers are commercial properties (primarily office buildings) that have fixed, high performance glazing (or glazing that is normally closed) and are air conditioned. For these buildings the application of external noise goals may be excessively stringent. Internal noise goals will be adopted for these receivers rather than the external noise level.

In these instances the ICNG recommended external noise level will be used as an initial screening test, and these will be modified, or internal noise goals used, where appropriate.

5.2.5 Internal Noise Goals – General Commercial

As indicated above, some of the commercial receivers potentially impacted have modern, sealed facades that achieve a high level of external noise reduction. In these cases simply using the external noise goal would result in unnecessarily restrictive goals.

It is noted that the standard ICNG external noise goal of 70 dB(A) L_{eq} would typically result in internal noise levels of:

- 60 dB(A) L_{eq} in buildings that are not air conditioned and have openable windows.
- 50 dB(A) L_{eq} in buildings with a closed facade but with standard, unsealed windows.

The ICNG refers to setting internal noise goals using the AS 2107 “maximum” recommended level for guidance. AS 2107 nominates a noise level of 45 dB(A) L_{eq} for general office areas.

The levels that would occur in typical commercial buildings based on the ICNG 70 dB(A) external level would exceed the 45 dB(A) L_{eq} .

In our experience of managing demolition/construction noise from the Barangaroo site and within the Sydney CBD indicates that:

- A significant level of complaints of excessive construction noise in office situations are unlikely when the level of construction noise is less than 55 dB(A) within commercial spaces.
- This is the level typically adopted when assessing noise to the City of Sydney Construction Noise Code.
- A 55 dB(A) goal was successfully adopted for the management of noise from the Demolition of Structures on the Barangaroo site.

Notwithstanding EPA has requested that the lower 45 dB(A) level be adopted as an internal management goal. At this level, construction noise will be clearly acceptable within commercial tenancies and there would be minimal impact.

5.2.6 Noise Goals – Moores Wharf

It is understood that the Moores Wharf building is used as an office building, and that boat maintenance is undertaken at the berths on the eastern side of the building and other maintenance related activities around the building.

The Moores Wharf building is a historic sandstone building that is unlikely to have a high performance façade acoustically. For the Moores Wharf building a Noise Affected Management Level (NAML) of 70 dB(A) L_{eq} outside the building is applicable in accordance with EPA guidelines.

The EPA Management Level applying for the external maintenance activities is 75 dB(A).

Given the moorings are largely screened from the construction activities by the Moores Wharf building or the headland, and the higher management level for the maintenance activities, the 70 dB(A) external management level for the Moores Wharf building will be the governing requirement.

5.2.7 Noise Goals – External Cafes

The proposed works may affect cafes with external seating.

For these receivers, a 70 dB(A) L_{eq} external level may be unacceptable especially during peak use periods around lunch time. For these occupancies it is proposed to set the management level during these periods at 10 dB(A) above the prevailing background noise level, and in any case not exceeding 70 dB(A).

5.2.8 Summary of Noise Goals

Following table provides a summary of the noise management levels for operations not occurring 24 hours per day.

Table 4 – Noise Management Level*

Location/Receiver	Noise Affected Management Level dB(A) L_{eq}	Highly Noise Affected Management Level Limit	Comment
Residences on Merriman and Bettington Streets	54	75	
Residential Receivers on Windmill Street	61	75	
Residential Receivers on Towns Place	63	75	
Residential Receivers on Argyle Place	62	75	
Residences on High Street	61	75	
Residences Balmain Peninsula	58	75	
External Cafes around Argyle Place	62/70	-	Lower goal applies during peak use periods
Commercial Buildings Generally	70 externally 45 internally if 70 level exceeded.	-	
Moore's Wharf	70 externally 45 internally if 70 level exceeded.	-	

* Assessed at the most affected part of the occupancy

Following provide a summary of the noise management levels for operations occurring 24 hours per day at the most impacted receivers.

Table 5 – Noise Criteria – 24 Hour Operations

Location/Receiver	Noise Criterion dB(A) L_{eq}
Residences on Merriman and Bettington Streets	42
Residences on High Street	45
Residences Balmain Peninsula	44

5.3 VIBRATION MANAGEMENT GUIDELINES AND STANDARDS

5.3.1 Structure Damage

The following vibration guidelines have been adopted to assess vibration impacts:

- German Standard DIN 4150-3 (1999-02): “Structural Vibration – Effects of Vibration on Structures” – which will be used to assess and limit building damage risk.
- EPA Interim Construction Noise Guideline – which contains guidelines to assess and limit impacts on building occupant’s amenity based on the “Assessing Vibration: A Technical Guide”.

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

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 1.

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

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

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

5.4 PROJECT SPECIFIC VIBRATION MANAGEMENT LEVELS

5.4.1 Damage Limits

Project specific vibration limits have been developed based on:

- The recommendations in Table 2.
- The construction and type of building potentially impacted.

The following table summarises the recommended limits applied to sensitive structures around the site.

Table 7 – Recommended Damage Vibration Limits

Building	Recommended Damage Limits
Moores Wharf	Category 3
Terrace Houses and other sandstone buildings	Category 3
Modern Residential Buildings Around Towns Place, etc.	Category 2
Modern Commercial Buildings Around Towns Place etc.	Category 1

5.4.2 Assessing Amenity

For the type of vibration producing activities proposed (excavator hydraulic hammer and drilling for the crane base) vibration induced within the occupied levels of the adjacent buildings is likely to impact amenity well before the damage limits are reached.

The EPA Interim Construction Noise Guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings. The recommendations of this guideline should be adopted to assess and regulate vibration from proposed activities. (Refer Table C1.1 reproduced from the EPA ICNG below)

Where vibration levels would exceed the amenity goals, feasible and reasonable measures should be investigated to minimise vibration with a view to limiting vibration to the nominated goals.

Table C1.1 Criteria for exposure to continuous and impulsive vibration

Place	Time	Assessment criteria					
		¹ rms acceleration (m/s ²) (& vib. accel. value) (dB re 10 ⁻⁶ m/s ²)		² rms velocity (mm/s) (& vib. velocity value) (dB re 10 ⁻⁹ mm/s)		² Peak velocity (mm/s)	
		Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous vibration							
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day- or night-time	0.0050 (74 dB)	0.010 (80 dB)	0.10 (100 dB)	0.20 (106 dB)	0.14	0.28
Residences	Daytime ³	0.010 (80 dB)	0.020 (86 dB)	0.20 (106 dB)	0.40 (112 dB)	0.28	0.56
	Night-time	0.0070 (77 dB)	0.014 (83 dB)	0.14 (103 dB)	0.28 (109 dB)	0.20	0.40
Offices	Day- or night-time	0.020 (86 dB)	0.040 (92 dB)	0.40 (112 dB)	0.80 (118 dB)	0.56	1.1
Workshops	Day- or night-time	0.040 (92 dB)	0.080 (98 dB)	0.80 (118 dB)	1.6 (124 dB)	1.1	2.2
Impulsive vibration							
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day- or night-time	0.0050 (74 dB)	0.010 (80 dB)	0.10 (100 dB)	0.20 (106 dB)	0.14	0.28
Residences	Daytime ³	0.30 (110 dB)	0.60 (113 dB)	6.0 (136 dB)	12.0 (142 dB)	8.6	17.0
	Night-time	0.10 (100 dB)	0.20 (106 dB)	2.0 (126 dB)	4.0 (132 dB)	2.8	5.6
Offices	Day- or night-time	0.64 (116 dB)	1.28 (122 dB)	13.0 (142 dB)	26.0 (148 dB)	18.0	36.0
Workshops	Day- or night-time	0.64 (116 dB)	1.28 (122 dB)	13.0 (142 dB)	26.0 (148 dB)	18.0	36.0

¹ Values derived from z-axis critical frequency range 4–8 Hz. Where required, a more detailed analysis can be conducted as per BS 6472–1992.

² Values given for the most critical frequency range >8 Hz assuming sinusoidal motion. Where required, a more detailed analysis can be conducted as per AS 2670.2–1990. Sufficient justification should accompany the use of a peak velocity approach if used in an assessment.

³ Specific values depend on social and cultural factors, psychological attitudes and expected degree of intrusion.

6 ASSESSMENT OF POTENTIAL NOISE EMISSIONS

6.1 PREDICTED NOISE LEVELS

The proposed demolition is likely to occur during construction of the Headland Park Main Works and Northern Cove. It is anticipated that the excavation phase of the main works would be complete and erection and fit out of structure will be occurring during the demolition of the HCT.

Demolition noise levels at various locations representing the range of potentially affected receivers around the site have been predicted for each phase and for each plant item. A range of worst case noise levels corresponding to different works location (from top to bottom of the tower) has been assessed.

The cumulative worst case noise level was calculated by adding the individual contributions from the demolition noise sources occurring concurrently. Accumulation effects from the remainder of construction activities on the Main Works site have separately reviewed (refer Section 6.4.)

This form of presentation is used to identify those plant items /activities significantly contributing to noise levels or cause exceedences of the noise goals. The ICNG requires that conceptual treatment of those noise sources be considered, which is included in the attached Preliminary NVMP.

The Main Works Project Approval and ICNG require a final evaluation of noise levels and mitigation to be developed post-development approval once there is sufficient detail for evaluation and planning. It is noted that this assessment has adopted an anticipated demolition methodology that may not be adopted by the Contractor undertaking the works (in part or full), nor may the demolition occur at the anticipated time during the main works programme. The final assessment and management plan would be amended to incorporate any changes to methodology or programme.

Where noise emissions to all receivers located in a group would be attenuated by existing built or natural barriers this attenuation has been included. Otherwise, the noise predictions represent worst case noise levels (without screening). Using this methodology, the worst case noise levels are presented: those receivers benefiting from additional screening would receive correspondingly lower noise levels.

6.2 ASSESSMENT OF RECIEVER IMPACTS

6.2.1 Residents Along Merriman and Bettington Streets

Existing residential properties located along Merriman Street will potentially be the worst affected receivers from the proposed demolition of the Harbour Control Tower. As detailed in section 3 above, a tower crane is proposed to be located at the end of this cul-de-sac street, with all trucking activities (removal of demolished material) associated with the subject proposal also occurring on this street.

The southern façade of single and double storey townhouses along this street will have a direct, unrestricted view of the Control Tower and associated plant. The sandstone cliff of the Barangaroo Headland Park Site will screen these receivers from majority of Stage 4 and Stage 5 (demolition of tower shaft below Merriman Street level) works. Residences located along Bettington Street will also be impacted by the proposed activities on site, but not to the same extent as the Merriman Street receivers. There receivers are located further away from the proposed demolition equipment (distance attenuation) and will also be screened by the Merriman Street properties.

Demolition works noise emission predictions are detailed in the table below.

Table 8 – Predicted Noise Levels – Residential Receivers along Merriman and Bettington Streets

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stages 1 & 2 – Site Establishment			
Mobile Crane	57 – 82	64 – 89 Cumulative impacts are highly unlikely during this phase of works. Mobile crane will be the only constant, transitory plant on site (to install tower crane and other site facilities), with anchor drill and other hand held tools used intermittently on individual occasions (rock anchor supports for crane, mast climber and materials hoist/scaffold stair).	54
Anchor Drill	64 – 89		
Portable hand tools	55 – 80		

Equipment/Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 3 – Working Level Removal			
Wire Saw	52 – 57	59 – 76 The wire saw and hydraulic saw will not operate at the same time. The individual items of equipment will generally not operate together, or operate together intermittently. Cumulative impacts during this phase of works are not expected. Cut pieces of the tower will be loaded into trucks using the tower crane.	54
Hydraulic Saw	58 – 63		
Tower Crane	56 – 61		
Access equipment (e.g. Hoists)	43 – 48		
Portable hand tools and core drill	53 – 58		
Truck	51 – 76		
Stage 4 – Concrete Tower/Core Removal			
Wire Saw	53 – 69	60 – 76 The wire saw and hydraulic saw will not operate at the same time. The individual items of equipment will generally not operate together, or operate together intermittently. Cumulative impacts during this phase of works are not expected. Cut pieces of the tower will be loaded into trucks using the tower crane.	54
Hydraulic Saw	59 – 75		
Tower Crane	56 – 61		
Access equipment (e.g. Hoists)	44 – 60		
Portable hand tools and core drill	54 – 70		
Truck	51 – 76		

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 5 – Concrete Tower Base Removal			
Mobile Crane	57 – 82	63 – 82 The excavator will be used to demolish the remainder of the tower, footings and plant room structure using crushing (grinding) and hammering where required. A bobcat will be used to load rubble into bins which will then be lifted by the crane into trucks located along Merriman Street. There would be minimal overlapping of these activities. However, there is a possibility of some cumulative impacts resulting from the crane lifting and bobcat loading operations. This is unlikely to add to the noise level resulting from the operation of the tower crane, as the bobcat is located at the base of the tower, shielded by the sandstone cliff from these receivers. Hammering is likely to occur only near at the base of the tower which is screened from the receivers.	54
Tower Crane	56 – 61		
Hydraulic Hammer on 45t Excavator	63 – 74		
Concrete Crusher	50 – 61		
Bobcat	43 – 54		
Truck	51 – 76		

The predictions indicate that in worst case situations, a majority of the activities associated with the demolition of the Harbour Control Tower will exceed the noise affected management level at these receivers. Noise impacts to these receivers from these activities should be managed in accordance with the PCNVMP contained in Appendix 2.

6.2.2 Residents Along Dalgety Road

These receivers are located approximately 40m to the north of the Harbour Control Tower. The existing residential properties along Merriman Street and Rhodes Lane will screen these receivers from the ground level (Merriman Street level), part Stage 4 (at Merriman Street level and below) and Stage 5 activities on site. However, these receivers will have line of site to the activities associated with the demolition of the upper work platform and tower shaft (between Merriman Street Level and the upper amenities level).

Demolition works noise emission predictions are detailed in the table below.

Table 9 – Predicted Noise Levels – Residential Receivers along Dalgety Road

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stages 1 & 2 – Site Establishment			
Mobile Crane	37 – 47	44 – 54	61
Anchor Drill	44 – 54		
Portable hand tools	35 – 45		
Stage 3 – Working Level Removal			
Wire Saw	51 – 56	58 – 63	61
Hydraulic Saw	57 – 62		
Tower Crane	56 – 60		
Access equipment (e.g. Hoists)	42 – 47		
Portable hand tools and core drill	52 – 57		
Truck	31 – 41		

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 4 – Concrete Tower/Core Removal			
Wire Saw	51 – 57 (High Level) 31 – 40 (Merriman Street Level)	58 – 64 (At higher level – not shielded by Merriman Street Houses) 56 – 60 (At lower level – where barrier affect resulting from Merriman Street Structures) The proposed activities on the site (except the crane) will be screened by the exiting residential properties along Merriman Street and Rhodes Lane, halfway through this phase (when tower shaft is lower than level of these residential properties).	61
Hydraulic Saw	57 – 63 (High Level) 37 – 46 (Merriman Street Level)		
Tower Crane	56 – 60		
Access equipment (e.g. Hoists)	42 – 48 (High Level) 22 – 31 (Merriman Street Level)		
Portable hand tools and core drill	52 – 58 (High Level) 32 – 41 (Merriman Street Level)		
Truck	31 – 41		
Stage 5 – Concrete Tower Base Removal			
Mobile Crane	37 – 47	56 – 63	61
Tower Crane	56 – 60		
Hydraulic Hammer on 45t Excavator	56 – 63		
Concrete Crusher	48 – 55		
Bobcat	36 – 43		
Truck	31 – 41		

The predictions indicate that in worst case situations, some minor exceedences are predicted from high level hydraulic sawing operations (when this activity is not screened by existing properties along Merriman Street and Rhodes Lane) and the Stage 5 excavator operations (at the foot of the control tower) if hydraulic hammering is required. None of the operations would produce exceedences of the HANML.

6.2.3 Residents Along Towns Place

These receivers are located approximately 90m to the north/north-west of the Harbour Control Tower. The existing residential properties along Merriman Street and Dalgety Road will screen these receivers from the ground level (Merriman Street level), part of Stage 4 (at Merriman Street level and below) and Stage 5 activities on site. However, these receivers will have line of site to the activities associated with the demolition of the upper work platform and tower shaft (between Merriman Street Level and the upper amenities level).

Demolition works noise emission predictions are detailed in the table below.

Table 10 – Predicted Noise Levels – Residential Receivers along Towns Place

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{L_{eq}(15mins)}	Cumulative Noise Level at Receiver dB(A) _{L_{eq}(15min)}	Noise Affected Management Level dB(A) _{L_{eq}(15min)}
Stages 1 & 2 – Site Establishment			
Mobile Crane	33 – 39	40 – 46	63
Anchor Drill	40 – 46		
Portable hand tools	31 – 37		
Stage 3 – Working Level Removal			
Wire Saw	49 – 53	56 – 60	63
Hydraulic Saw	55 – 59		
Tower Crane	53 – 58		
Access equipment (e.g. Hoists)	40 – 44		
Portable hand tools and core drill	50 – 54		
Truck	27 – 33		

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 4 – Concrete Tower/Core Removal			
Wire Saw	49 – 53 (High Level) 29 – 34 (Merriman Street Level)	56 – 60 (At higher level – not shielded by Merriman Street Houses) 53 – 58 (At lower level – where barrier affect resulting from Merriman Street Structures) The proposed activities on the site (except the crane) will be screened by the existing residential properties along Merriman Street, Rhodes Lane and Dalgety Road, halfway through this phase (when tower shaft is lower than level of these residential properties).	63
Hydraulic Saw	55 – 59 (High Level) 35 – 40 (Merriman Street Level)		
Tower Crane	53 – 58		
Access equipment (e.g. Hoists)	40 – 44 (High Level) 20 – 25 (Merriman Street Level)		
Portable hand tools and core drill	50 – 54 (High Level) 30 – 35 (Merriman Street Level)		
Truck	27 – 33		
Stage 5 – Concrete Tower Base Removal			
Mobile Crane	33 – 39	53 – 58	63
Tower Crane	53 – 58		
Hydraulic Hammer on 45t Excavator	53 – 58		
Concrete Crusher	45 – 50		
Bobcat	33 – 38		
Truck	27 – 33		

The predictions indicate that even in worst case situations, exceedence of the noise affected management level at these receivers is unlikely from the proposed activities.

6.2.4 Residents Along Windmill Street

These receivers are located approximately 130m to the north/north-east of the Harbour Control Tower. The existing residential properties along Merriman Street and Dalgety Road will screen these receivers from the ground level (Merriman Street level), part Stage 4 (at Merriman Street level and below) and Stage 5 activities on site. However, these receivers will have line of site to the activities associated with the demolition of the upper work platform and tower shaft (between Merriman Street Level and the upper amenities level).

Demolition works noise emission predictions are detailed in the table below.

Table 11 – Predicted Noise Levels – Residential Receivers along Windmill Street

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stages 1 & 2 – Site Establishment			
Mobile Crane	30 – 34	37 – 41	61
Anchor Drill	37 – 41		
Portable hand tools	28 – 32		
Stage 3 – Working Level Removal			
Wire Saw	47 – 50	54 – 57	61
Hydraulic Saw	53 – 56		
Tower Crane	51 – 54		
Access equipment (e.g. Hoists)	38 – 41		
Portable hand tools and core drill	48 – 51		
Truck	24 – 28		

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 4 – Concrete Tower/Core Removal			
Wire Saw	47 – 50 (High Level) 27 – 31 (Merriman Street Level)	54 – 57 (At higher level – not shielded by Merriman Street Houses) 51 – 54 (At lower level – where barrier affect resulting from Merriman Street Structures) The proposed activities on the site (except the tower crane) will be screened by the exiting residential properties along Merriman Street, Rhodes Lane and Dalgety Road, halfway through this phase (when tower shaft is lower than level of these residential properties).	61
Hydraulic Saw	53 – 56 (High Level) 33 – 37 (Merriman Street Level)		
Tower Crane	51 – 54		
Access equipment (e.g. Hoists)	38 – 41 (High Level) 18 – 22 (Merriman Street Level)		
Portable hand tools and core drill	48 – 51 (High Level) 28 – 32 (Merriman Street Level)		
Truck	24 – 28		
Stage 5 – Concrete Tower Base Removal			
Mobile Crane	30 – 34	51 – 54	61
Tower Crane	51 – 54		
Hydraulic Hammer on 45t Excavator	50 – 53		
Concrete Crusher	42 – 45		
Bobcat	30 – 33		
Truck	24 – 28		

The predictions indicate that even in worst case situations, exceedence of the noise affected management level at these receivers is unlikely from the proposed activities.

6.2.5 Residents Along High Street

These receivers are located approximately 180m to the north-east of the Harbour Control Tower. The existing residential properties along Merriman, Bettington Streets and Dalgety Road will screen these receivers from the ground level (Merriman Street level), part Stage 4 (at Merriman Street level and below) and Stage 5 activities on site. However, these receivers will have line of site to the activities associated with the demolition of the upper work platform and tower shaft (between Merriman Street Level and the upper amenities level).

Demolition works noise emission predictions are detailed in the table below.

Table 12 – Predicted Noise Levels – Residential Receivers along High Street

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stages 1 & 2 – Site Establishment			
Mobile Crane	26 – 31	33 – 38	61
Anchor Drill	33 – 38		
Portable hand tools	24 – 29		
Stage 3 – Working Level Removal			
Wire Saw	43 – 47	50 – 54	61
Hydraulic Saw	49 – 53		
Tower Crane	47 – 51		
Access equipment (e.g. Hoists)	34 – 38		
Portable hand tools and core drill	44 – 48		
Truck	20 – 25		

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 4 – Concrete Tower/Core Removal			
Wire Saw	43 – 48 (High Level) 23 – 38 (Merriman Street Level)	50 – 55 (At higher level – not shielded by Merriman Street Houses) 47 – 51 (At lower level – where barrier affect resulting from Merriman Street Structures)	61
Hydraulic Saw	49 – 54 (High Level) 29 – 34 (Merriman Street Level)		
Tower Crane	47 – 51		
Access equipment (e.g. Hoists)	34 – 39 (High Level) 14 – 19 (Merriman Street Level)		
Portable hand tools and core drill	44 – 49 (High Level) 24 – 29 (Merriman Street Level)		
Truck	20 – 25		
Stage 5 – Concrete Tower Base Removal			
Mobile Crane	26 – 31	47 – 51	61
Tower Crane	47 – 51		
Hydraulic Hammer on 45t Excavator	47 – 51		
Concrete Crusher	39 – 43		
Bobcat	27 – 31		
Truck	20 – 25		

The predictions indicate that even in worst case situations, exceedance of the noise affected management level at these receivers is unlikely from the proposed activities.

6.2.6 Residents at Balmain (along Weston Street)

These receivers are located approximately 600m to the south of the Harbour Control Tower, across the Harbour. Residential properties along Weston Street will be the potentially worst affected receivers on this peninsula, with the northern façade of these receivers having line of sight to the Barangaroo construction site. A screen has been constructed along the southern boundary of the Barangaroo Headland Park and Northern Cove construction site, which will screen these receivers from the activities proposed along the foot of the control tower and also along Merriman Street.

However, noise emissions from activities associated with the demolition of the upper work platform and tower shaft (between Merriman Street Level and the upper amenities level) may still impact these receivers.

Demolition works noise emission predictions are detailed in the table below.

Table 13 – Predicted Noise Levels – Residential Receivers along Weston Street (Balmain)

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stages 1 & 2 – Site Establishment			
Mobile Crane	30 – 31	37 – 38	58
Anchor Drill	37 – 38		
Portable hand tools	28 – 29		
Stage 3 – Working Level Removal			
Wire Saw	37 – 38	44 – 45	58
Hydraulic Saw	43 – 44		
Tower Crane	41 – 42		
Access equipment (e.g. Hoists)	28 – 29		
Portable hand tools and core drill	38 – 39		
Truck	24 – 25		

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 4 – Concrete Tower/Core Removal			
Wire Saw	37 – 38 (High Level) 27 – 28 (Merriman Street Level and below)	44 – 45 (At higher level – > 5m above Merriman Street Level) 41 – 42 (at Merriman Street level and below) The proposed activities on the site (except the tower crane) will be screened by the structures associated with the Headland Park and Northern Cove phase of works, halfway through this phase (when tower shaft is near Merriman Street level or lower).	58
Hydraulic Saw	43 – 44 (High Level) 33 – 34 (Below Street Level)		
Tower Crane	41 – 42		
Access equipment (e.g. Hoists)	28 – 29 (High Level) 18 – 19 (Below Street Level)		
Portable hand tools and core drill	38 – 39 (High Level) 28 – 29 (Merriman Street Level and below)		
Truck	24 – 25		
Stage 5 – Concrete Tower Base Removal			
Mobile Crane	30 – 31	47 – 51	58
Tower Crane	41 – 42		
Hydraulic Hammer on 45t Excavator	47 – 51		
Concrete Crusher	33 – 34		
Bobcat	31 – 32		
Truck	24 – 25		

The predictions indicate that even in worst case situations, exceedence of the noise affected management level at these receivers is unlikely from the proposed activities.

6.2.7 Commercial Receiver – Universal Studios Australia

Universal Studios Australia commercial tenancy is located approximately 120m to the south of the Harbour Control Tower, across the Harbour. The existing residential properties along Merriman and Bettington Streets will screen these receivers from the ground level (Merriman Street level), part Stage 4 (at Merriman Street level and below) and Stage 5 activities on site. However, these receivers will have line of site to the activities associated with the demolition of the upper work platform and tower shaft (between Merriman Street Level and the upper amenities level).

Demolition works noise emission predictions are detailed in the table below.

Table 14 – Predicted Noise Levels – Universal Studios Australia Commercial Receiver

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{L_{eq}(15mins)}	Cumulative Noise Level at Receiver dB(A) _{L_{eq}(15min)}	Noise Affected Management Level dB(A) _{L_{eq}(15min)}
Stages 1 & 2 – Site Establishment			
Mobile Crane	36 – 38	43 – 45	70
Anchor Drill	43 – 45		
Portable hand tools	34 – 36		
Stage 3 – Working Level Removal			
Wire Saw	47 – 49	54 – 56	70
Hydraulic Saw	53 – 55		
Tower Crane	51 – 53		
Access equipment (e.g. Hoists)	38 – 40		
Portable hand tools and core drill	48 – 50		
Truck	30 – 32		

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 4 – Concrete Tower/Core Removal			
Wire Saw	47 – 50 (High Level) 33 – 35 (Below Street Level)	54 – 57 (At higher level – not shielded by Merriman Street Houses) 51 – 53 (At lower level – where barrier affect resulting from Merriman and Bettington Street Structures)	70
Hydraulic Saw	53 – 56 (High Level) 39 – 41 (Below Street Level)		
Tower Crane	51 – 53		
Access equipment (e.g. Hoists)	38 – 41 (High Level) 24 – 26 (Below Street Level)		
Portable hand tools and core drill	48 – 51 (High Level) 34 – 36 (Below Street Level)		
Truck	30 – 32		
Stage 5 – Concrete Tower Base Removal			
Mobile Crane	35 – 37	56 – 58	70
Tower Crane	51 – 53		
Hydraulic Hammer on 45t Excavator	56 – 58		
Concrete Crusher	43 – 45		
Bobcat	36 – 38		
Truck	30 – 32		

The predictions indicate that even in worst case situations, exceedence of the noise affected management level at this receiver is unlikely from the proposed activities.

6.2.8 Commercial Receiver – Moore’s Wharf

Moore’s Wharf located approximate 125m to the north-west of Harbour Control Tower, serves as the operational headquarters of the Sydney Ports Corporation. This building is primarily used as an office building with boat maintenance berths located along its eastern boundary. The sandstone cliff at Clyne Reserve will screen this receiver from the ground level (Merriman Street level), part Stage 4 (at Merriman Street level and below) and Stage 5 activities on site. However, these receivers will have line of site to the activities associated with the demolition of the upper work platform and tower shaft (between Merriman Street Level and the upper amenities level).

Demolition works noise emission predictions are detailed in the table below.

Table 15 – Predicted Noise Levels – Moore’s Wharf Commercial Receiver

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stages 1 & 2 – Site Establishment			
Mobile Crane	36 – 39	43 – 46	70
Anchor Drill	43 – 46		
Portable hand tools	34 – 37		
Stage 3 – Working Level Removal			
Wire Saw	47 – 50	54 – 57	70
Hydraulic Saw	53 – 56		
Tower Crane	51 – 54		
Access equipment (e.g. Hoists)	38 – 41		
Portable hand tools and core drill	48 – 51		
Truck	30 – 33		

Equipment/ Process	Predicted Noise Level at Receiver dB(A) _{Leq(15mins)}	Cumulative Noise Level at Receiver dB(A) _{Leq(15min)}	Noise Affected Management Level dB(A) _{Leq(15min)}
Stage 4 – Concrete Tower/Core Removal			
Wire Saw	47 – 50 (High Level) 32 – 35 (Below Street Level)	54 – 57 (At higher level – not shielded by Merriman Street Houses) 51 – 54 (At lower level – where barrier affect resulting from Clyne Reserve sandstone cliff)	70
Hydraulic Saw	53 – 56 (High Level) 38 – 41 (Below Street Level)		
Tower Crane	51 – 54		
Access equipment (e.g. Hoists)	38 – 41 (High Level) 23 – 26 (Below Street Level)		
Portable hand tools and core drill	48 – 51 (High Level) 33 – 36 (Below Street Level)		
Truck	30 – 33		
Stage 5 – Concrete Tower Base Removal			
Mobile Crane	35 – 38	51 – 54	70
Tower Crane	51 – 54		
Hydraulic Hammer on 45t Excavator	51 – 54		
Concrete Crusher	38 – 41		
Bobcat	31 – 34		
Truck	30 – 33		

The predictions indicate that even in worst case situations, exceedence of the noise affected management level at this receiver is unlikely from the proposed activities.

6.2.9 Railway Assets

The nearest operational railway tunnels are located under the Bradfield Highway and under York Street, and are at least 600m from any activities. Given the distance separation, noise (and vibration) from the proposed activities would not impact upon this infrastructure.

6.3 DISCUSSION

Worst case noise levels from activities during normal working hours at the potentially most affected receivers have been predicted in order to identify those activities or plant that may cause noise levels exceeding the management levels.

These activities or processes would need to be managed so as to minimise noise impacts, either by using alternative processes, alternative equipment, time management, or using other mitigation such as noise barriers to the extent that it is feasible or reasonable using the process outlined in the Noise and Vibration Management Plan and the EPA ICNG.

Without management or mitigation, the following commercial receivers would receive noise levels exceeding the management goals:

- Residents Along Merriman and Bettington Streets
- Residents Along Dalgety Road (minor exceedences)

For all other residential and commercial receivers the worst case predicted noise levels do not exceed the Noise Affected Management Level. Therefore, these receivers would not be adversely impacted by the proposed activities.

Of the two identified impacted residence groups, the Dalgety Road residents would at times experience noise levels exceeding the established NML. However, only minor exceedences are predicted for limited proportion of the total demolition period.

Due to their proximity to the works, the residential properties in Merriman Street will be the most affected receivers. Exceedences of the NML are predicted for these residences from a number of the operations. Exceedences of the HANML are not predicted however. A preliminary noise and vibration management plan has been developed which would be used post approval to manage plant and equipment that may exceed the management levels and noise limits.

6.4 ASSESSMENT OF CUMULATIVE IMPACT OF HCT DEMOLITION, MAIN WORKS AND OTHER BARANGAROO ACTIVITIES

Noise emissions from the main works and Barangaroo South occurring at the potentially receivers have been predicted based on the anticipated construction activities occurring on the main works site during demolition.

Negligible construction noise from either the main works/Barangaroo South activities, or HCT activities is expected at the following receivers:

- High Street
- Towns Place
- Universal Music
- Windmill Street
- Argyle Place
- Moore's Wharf
- Balmain

Therefore, the impact of HCT noise would not be increased due to any accumulation of noise at these locations.

There would be some cumulative increase at the Merriman/Bettington and Dalgety Road receivers due to noise emissions from the sites combining. The level of increase will depend on the relative level of noise emissions as demonstrated by the following table.

Table 16 – Cumulative Noise Impacts

Relative Noise Level at Receiver	Noise Increase Due to Noise Accumulation
Other Works >9 dB(A) louder than HCT Works	No measureable increase
Other Works 5-9 dB(A) louder than HCT Works	1 dB(A)
Other Works 2-4 dB(A) louder than HCT Works	2 dB(A)
Other Works up to 1 dB(A) louder than HCT Works	3 dB(A)
Other Works same level as HCT Works	3 dB(A)
HCT Works up to 1 dB(A) louder than Other Works	3 dB(A)
HCT Works 2-4 dB(A) louder than Other Works	2 dB(A)
HCT Works 5-9 dB(A) louder than Other Works	1 dB(A)
HCT Works > 9 dB(A) louder than Other Works	No measureable increase

As can be seen in the table the greatest impact will occur when both contributions are nearly the same, which will not typically occur. For all other noise level combinations, the cumulative impact will be between 0 and 2 dB(A). Given that a 2 dB(A) change in noise level is not generally perceptible, this indicates that cumulative impacts will typically not be perceptible.

6.5 ASSESSMENT OF POTENTIAL NOISE EMISSIONS – 24 HRS OPERATION

Works outside approved Main Works hours of construction would be limited to activities that are required to be undertaken outside normal construction hours, for example dewatering of the site (if required) and emergency maintenance activities. A separate assessment would need to be undertaken by the Demolition Contractor as required by the Noise and Vibration Management Plan.

7 ASSESSMENT OF VIBRATION

Vibration will be minimised by the extensive use of saws and grinders. Notwithstanding this, it is anticipated that hydraulic hammering of the HCT footings may be required. This is the only activity with the potential to produce perceptible ground vibration at the receivers around the site.

The potentially most impacted receivers are the residential receivers on Merriman Street due to the proximity of these receivers to the activities. Safeguards are recommended for these receivers.

Hammering of the HCT footings would occur at the base of the tower. This location is separated from the nearest receivers and the predicted receiver vibration levels are relatively low. We are advised that the monitoring that occurred during Main Works rock excavation vibration indicated vibration levels within the established goals and limits. Vibration generated by the proposed tower demolition is not expected to exceed the levels generated by excavation associated with the main works already completed.

Notwithstanding, in order to protect the sensitive structures and amenity, monitoring to confirm vibration levels at the Merriman Street residences is recommended, as described in the Noise and Vibration Management Plan.

8 TRAFFIC NOISE GENERATION

The proposal would generate a minimal number of heavy vehicle or passenger vehicle movements. Therefore, no adverse impacts are expected from movements on local roads. Noise emissions from trucks manoeuvring in the construction zone have been assessed as part of the demolition noise emissions assessment.

9 CONCLUSION

A noise and vibration assessment has been undertaken of the proposed demolition of the Sydney Harbour Control Tower to identify whether these activities would impact sensitive receivers around the site.

EPA Interim Construction Noise Guide guidelines have been used to establish noise and vibration management levels for the receivers around the site.

Noise and vibration emissions from the proposed works have been predicted at potentially impacted commercial and residential receivers. The predictions indicate that:

- Noise impacts will primarily be limited to the resident group located in Merriman and Bettington Streets. Noise Management Level exceedences at these residences are predicted to occur during all phases of the demolition period. However, no exceedences of the Highly Noise Affected Management Level are predicted.
- Ground vibration generated by the proposed activities would not impact nearby railway infrastructure, and are unlikely to impact nearby residential or commercial buildings. Notwithstanding, recommendations are made to safeguard existing residences in Merriman Street due to hammering that might occur using excavator mounted hammers.

A Preliminary Noise and Vibration Management Plan has been devised that will be developed and used by the contractor to manage impacts. The plan outlines the development of controls and safeguards that would be applied to all activity on the site. The objective of these controls is to ensure that all work is carried out in a highly controlled and predictable manner that will minimise emissions and protect the amenity of the sensitive receivers surrounding the site.

The controls and safeguards implemented as a result of the analysis recommended in the plan would be reviewed at a number of stages as required to respond to local conditions, revised methods and equipment, as well as in response to the monitoring and evaluation of actual impacts. This management plan outlines the procedures that would be adopted during the planning and execution phases by the contractor.

Prepared by



ACOUSTIC LOGIC CONSULTANCY PTY LIMITED
Victor Fattoretto

APPENDIX 1
NOISE AND VIBRATION RELATED CONDITIONS
– MAIN WORKS APPROVAL EXTRACT

2. A detailed plan for in-situ classification of waste material, including the sampling locations and sampling regime that will be employed to classify the waste, particularly with regards to the identification of contamination hotspots.
3. A commitment to retaining all sampling and classification results for the life of the project to demonstrate compliance with DECCW's Classification Guidelines.
4. Details in relation to the "Concrete Crushing and Screening Plant" to be installed at the site and its use, including (at a minimum):
 - a. Location and specifications of the concrete crushing and screening plant;
 - b. Estimated quantities of concrete to be crushed per day;
 - c. Measures that will be employed to prevent or minimise the emission of dust from the crushing activity; and
 - d. Measures that will be employed to prevent or minimise the emission of noise from the crushing activity.
5. Details in relation to the transport of waste material around the site (on-site) and from the site, including (at a minimum):
 - a. A traffic plan showing transport routes from the southern to the northern end of the site;
 - b. Location of the stockpiles at each stage as they migrate from the southern end of the site to the northern end of the site;
 - c. Details of any garden waste mulching processes and garden waste stockpiles, including considerations for odour generation;
 - d. A commitment to retain waste transport details for the life of the project to demonstrate compliance with the Protection of the Environment Operations Act; and
 - e. The name and address of each licensed facility that will receive waste from the Barangaroo site (if appropriate);
6. Details of the de-watering process, including the specifications for any on-site water treatment plant.
7. A contingency plan for any event that may affect excavation and contaminated soil treatment operations at the site, particularly in relation to the expected volumes materials excavated/generated at the site.

B22 NOISE AND VIBRATION

1. The proponent must prepare and implement a detailed Construction Noise and Vibration Management Plan (CNVMP), to be approved by the Director General of the Department of Planning before commencement of works, that includes but is not necessarily limited to;
 - (a) identification of the specific activities that will be carried out and associated noise sources at the premises,
 - (b) identification of all potentially affected sensitive receiver locations,
 - (c) quantification of the rating background noise level (RBL) for sensitive receivers, as part of the CNVMP, or as undertaken in the EA,
 - (d) the construction noise, ground-borne noise and vibration objectives derived from an application of the DECCW Interim Construction Noise Guideline (ICNG), as reflected in conditions of approval,
 - (e) prediction and assessment of potential noise, ground-borne noise (as relevant) and vibration levels from the proposed construction methods expected at sensitive receiver premises against the objectives identified in the ICNG and conditions of approval,
 - (f) where the objectives are predicted to be exceeded, an analysis of feasible and reasonable noise mitigation measures that can be implemented to reduce construction noise and vibration impacts,
 - (g) description of management methods and procedures, and specific noise mitigation treatments / measures that will be implemented to control noise and vibration during construction,
-

- (h) where the objectives cannot be met, additional measures including, but not necessarily limited to, the following should be considered and implemented where practicable; reduced hours of construction, the provision of respite from noisy / vibration intensive activities, acoustic barriers / enclosures, alternative excavation methods or other negotiated outcomes with the affected community,
 - (i) where night time noise management levels cannot be satisfied, a report shall be submitted to the Director General outlining the mitigation measures applied, the noise levels achieved and justification that the outcome is consistent with best practice,
 - (j) measures to identify non-conformances with the requirements of the CNVMP, and procedures to implement corrective and preventative action,
 - (k) suitable contractual arrangements to ensure that all site personnel, including sub-contractors, are required to adhere to the noise management provisions in the CNVMP,
 - (l) procedures for notifying residents of construction activities that are likely to effect their noise and vibration amenity,
 - (m) measures to monitor noise performance and respond to complaints,
 - (n) measures to reduce noise related impacts associated with offsite vehicle movements on nearby access and egress routes from the site,
 - (o) procedures to allow for regular professional acoustic input to construction activities and planning; and,
 - (p) effective site induction, and ongoing training and awareness measures for personnel (e.g. tool box talks, meetings etc).
2. All construction work at the premises must be conducted between 7am and 6pm Monday to Friday and between 8am and 3pm Saturdays and at no time on Sundays and public holidays, unless inaudible at any residential premises. Works outside these hours are not permitted except as explicitly specified below or in other conditions and include:
- (a) the delivery of materials which is required outside these hours as requested by Police or other authorities for safety reasons;
 - (b) emergency work to avoid the loss of lives, damage to property and/or to prevent environmental harm;
 - (c) other works expressly approved by the Director General of the Department of Planning;
 - (d) Out of standard hours works identified in a CNVMP approved by the Director General of the Department of Planning.
3. Construction noise management levels (NML) derived in accordance with the DECCW Interim Construction Noise Guidelines apply to this project, and are required to be identified in an approved CNVMP. Any activities that have the potential for noise emissions that exceed the NMLs must be identified and managed in accordance with the CNVMP. The Proponent must implement all Reasonable and Feasible noise mitigation and management measures with the aim of achieving the NMLs.
4. Vibration caused by Construction and received at any sensitive receiver outside the project must be assessed against the guidelines contained in the DECCW publication "Environmental Noise Management - Assessing Vibration: a technical guideline" and in accordance with the CNVMP.
- In addition to the conditions above, it is normal practice for DoP to impose "Construction Noise Management" conditions, for example conditions 31-34 in the project approval for the City West Cable Tunnel (http://www.planning.nsw.gov.au/asp/pdf/05_0178_dgreport.pdf). These conditions are also recommended for imposition in any project approval for the Barangaroo site.
5. All mechanical plant and equipment associated with post-construction facilities at Headland Park (e.g. air conditioning plant, generators, chillers, pump stations, treatment plants etc) are to not emit noise more than 5dBA above background, in accordance with the NSW Government's Industrial Noise Policy.

PART D - DURING CONSTRUCTION

D1 NOISE AND VIBRATION

The proponent must monitor noise levels at the most affected receiver location during rock hammering, rock sawing, rock breaking and any other such noisy activities. If levels exceed LAeq, (15 minute) 70 dB(A) for 12 consecutive fifteen minute periods (3 hours) within the approved hours of works, the proponent must incorporate respite periods of 1 hour every 3 hours.

D2 ARCHAEOLOGICAL DISCOVERY DURING EXCAVATION

- (a) The recommendations of the nominated site archaeologists should be carried out, including determining whether any further site archaeological monitoring is required during excavation works.
- (b) Should any historical relics likely to be of significance be unexpectedly discovered on the site during excavation, all excavation or disturbance to the area is to stop immediately and the Heritage Council of NSW should be informed in accordance with section 146 of the *Heritage Act 1977*.
- (c) Should any Aboriginal relics be unexpectedly discovered then all excavation or disturbance of the area is to stop immediately and the National Parks and Wildlife Service is to be informed in accordance with Section 91 of the *National Parks and Wildlife Act 1974*.
- (d) Any relics found on site that are capable of being included in the site's heritage interpretation or public art, are to be kept safe for consideration of their incorporation into site fixtures.

D3 VEHICLE FOOTWAY CROSSING

A separate application is to be made to, and approved by, the relevant road authority for the construction of any proposed vehicle footway crossing or for the removal of any existing crossing and replacement of the footpath formation where any such crossings are no longer required.

All disused or redundant vehicle crossings and laybacks must be removed and footway and kerb reinstated in accordance with design and construction details as prepared by a suitably qualified Civil Engineer, to suit the adjacent finished footway and edge treatment materials, levels and details. All construction and replacement works are to be completed in accordance with the approved plans prior to the issue of a final Occupation Certificate.

D4 COVERING OF LOADS

All vehicles involved in the excavation and/or demolition process and departing the property with demolition materials, spoil or loose matter must have their loads fully covered before entering the public roadway.

D5 TRAFFIC IMPACT ASSESSMENT & CONSTRUCTION TRAFFIC MANAGEMENT PLAN

- (a) Construction works will be undertaken generally in accordance with the Traffic Impact Assessment & Construction Traffic Management Plan prepared by Halcrow, Issue 1.3 dated 26 October 2010, except where modified elsewhere in this condition.
 - (b) Under the current legislation the use of lengthy vehicles in the CBD is prohibited within certain time frames. All lengthy vehicles must comply with this regulation as stipulated in the NSW Road Rules. A map indicating the prohibited area and definitions of lengthy vehicles are included in the Road Rules.
 - (c) Personnel using stop/slow signage are not permitted in Hickson Road or Sussex Street on weekdays between the hours of 7.00am to 9.00am and 4.00pm to 7.00pm. However, personnel using stop/slow signage will be permitted on Hickson Road, north of the intersection of Hickson Road and Napoleon Street, when it is required to ensure safe truck access at designated site access points, provided that vehicle queue lengths generated as a result of the traffic control do not exceed more than six vehicles in either direction.
 - (d) Truck movements should be staged and coordinated to prevent trucks circling CBD streets whilst awaiting access to the site. There should be holding areas outside the CBD on the fringes or sufficient space within the site to store trucks and heavy vehicles.
 - (e) To minimise impacts on public transport, trucks should avoid where possible the use of York Street to access the development site between 2.00pm to 8.00pm Monday to Friday.
 - (f) The Proponent is also to enter into an 'Operational Protocol' regarding the traffic management arrangements where the haul route between the Stage 1 excavation site and
-

APPENDIX 2
PRELIMINARY NOISE AND VIBRATION
MANAGEMENT PLAN

MANAGING DIRECTORS

MATTHEW PALAVIDIS
VICTOR FATTORETTO

DIRECTORS

MATTHEW SHIELDS
BEN WHITE



Sydney Harbour Control Tower

Demolition Noise and Vibration Management Plan

SYDNEY

A: 9 Sarah St Mascot NSW 2020
T: (02) 8339 8000
F: (02) 8338 8399

SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

www.acousticlogic.com.au

ABN: 11 068 954 343

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1 EXECUTIVE SUMMARY

The Noise and Vibration Management Plan (NVMP) outlines the development of controls and safeguards that would be applied to all activity on the site by the contractor. The objective of these controls is to ensure that all work is carried out in a highly controlled and predictable manner that will minimise emissions and protect the amenity of the sensitive receivers surrounding the site.

Likely noise and vibration emissions from likely processes and activities have been assessed. The assessment identified the activities likely to exceed noise and/or vibration goals. The noise and vibration management plan will be used to manage impacts from all activities, with particular reference to those activities that might generate emissions greater than the noise goals.

The controls and safeguards implemented would be reviewed at a number of stages during the extraction period in response to revised methods and equipment, or monitoring and evaluation of actual impacts. This management plan outlines the procedures that would be adopted by the contractor during the detailed planning and execution phases.

2 INTRODUCTION

This document presents the noise and vibration plan that will be used to manage noise and vibration from activities associated with the Demolition of the Sydney Harbour Control Tower.

3 HOURS OF WORK

Work is proposed to be undertaken during the following hours:

- 7am to 6pm Monday to Fridays.
- 8am to 3pm Saturdays.

Exceptions to these hours apply for the delivery of oversize loads or certain materials as required for safety reasons and for emergency response. Furthermore, certain construction activities may be allowed to occur outside the hours above on a planned basis with the prior written approval of the Director-General or as provided for under separate legislation.

No works or deliveries would take place on Sundays and public holidays.

4 CONSTRUCTION NOISE AND VIBRATION GOALS

The noise and vibration goals for the proposed activities are indicated in Section 5 of the Sydney Harbour Control Tower Demolition Noise and Vibration Assessment.

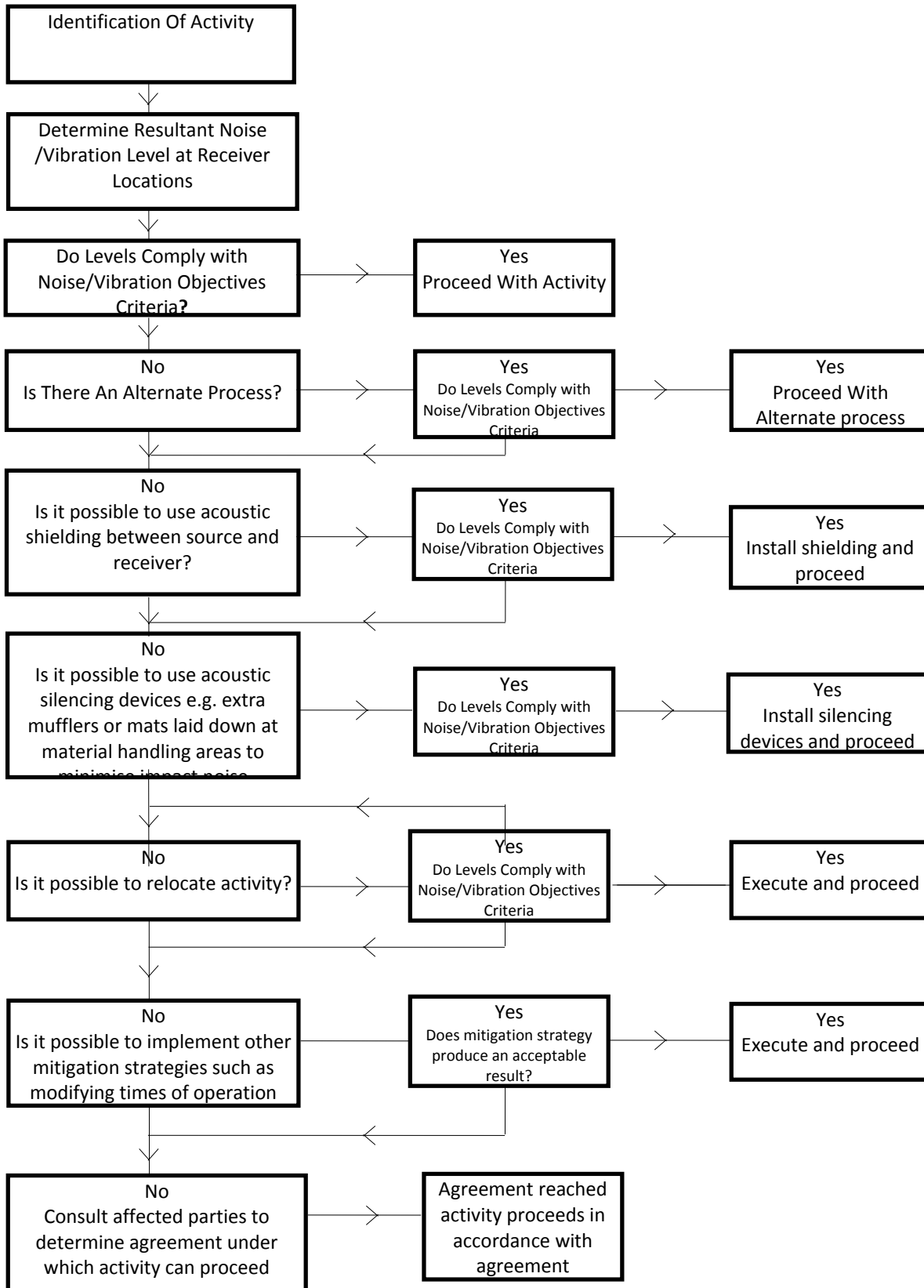
5 ASSESSMENT METHODOLOGY

5.1 NOISE ASSESSMENT PROCESS

The flow chart that follows illustrates the process followed to assess extraction and construction activities.

Measures to mitigate sources causing exceedences of the noise and vibration goals have been determined based on the analysis noise and vibration emissions and the process indicated in the following sections. The recommended noise control measures are indicated in the following tables for the various times and operations.

CONTROL OF NOISE FLOW CHART



5.2 GENERAL NOISE CONTROL / MITIGATION METHODS

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

5.2.1 Selection of Alternate Appliance or Process

Where a particular activity or appliance is found to generate noise levels that exceed the criteria, 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.

5.2.2 Acoustic Barriers

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). Placing barriers at the source cannot effectively attenuate equipment which is on the move or working in rough or undulating terrain.

Barriers can also be placed between the source and the receiver. The degree of noise reduction provided by barriers is dependent 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 the barrier does not obstruct line of sight, 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 10 dB(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.

5.2.3 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.

5.2.4 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).

5.2.5 Treatment of Specific Equipment

In certain cases it may be possible to specially treat a piece of equipment to reduce the sound levels emitted. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

5.2.6 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

As part of the development of the detailed plans and methods for the works to be carried out, noise emissions of the proposed methods and/or equipment should be reviewed in reference to the noise assessment. Noise emissions requirements for major noise producing plant should be included (where possible) as part of plant procurement requirements and confirmed on site.

5.2.7 Strategic Positioning of Processes On-Site

Where practicable, particular processes or activities can be located in particular positions on site to minimise noise to surrounding sensitive receivers.

For example, stationary plant may be positioned where direct line of sight shielding can be achieved using natural barriers, or may maximise the distance to the nearest sensitive receiver.

5.2.8 Combination of Methods

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

5.2.9 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 that may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process that allows for the adjustment of control methods and criteria for the benefit of all parties.

The objectives of the consultation process are 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 the options available.
- Identify group concerns generated by the project, so that they can be addressed.

It is recommended that a community liaison forum/group be established to facilitate the free flow of information and feedback between the parties. This group would meet at regular intervals (as agreed by the group). The forum also establishes points of contact and channels of communication within affected organisations.

5.2.10 Management Training

All site managers should be made aware of noise and vibration limits, applicable control measures and methods. They should ensure that all agreed noise and vibration measures are carried out by employees and sub-contractors.

5.3 SPECIFIC NOISE CONTROL/MITIGATION METHODS

Potential noise impacts and mitigation methods have been assessed in accordance with the procedures outlined above. Following are the recommended specific actions arising from our analysis (including analysis of 24 hr noise sources) to mitigate noise from these activities predicted to significantly exceed the noise management levels. It is noted that noise emissions from other less significant sources will still be subject to analysis using the Control of Noise Flow Chart. However this would be undertaken when more detailed planning regarding including possible actual plant locations, actual plant being used, etc are known.

5.3.1 Activities

The noise and vibration assessment indicates that many of the operations to complete the demolition would produce noise levels exceeding the management goal at the most affected receivers.

The selection of the preferred demolition methodology has already considered potential noise impacts by:

- Minimising any percussive demolition until required, and when demolition is almost to the base of the tower where the hammering point will be screened from sensitive receivers.
- Minimising on-site activity by demolishing the tower by cutting into sections that are the largest able to be transported from site.
- Maximising the use of cutting and shearing methods in preference to hammering.

Hammering should only be undertaken where non-percussive extraction method is not feasible or reasonable and performed according to the following:

- Using the smallest equipment as is practical and provides benefits in terms of the noise/time to complete balance. (In other words a smaller hammer may be quieter but may result in significantly extended period of operation, leading to no overall benefit.)
- The local community should be informed via a liaison committee (or other method as appropriate) as to the nature, period and times of hammering.

5.3.2 Activities – 24 HR Operations

It is only proposed to undertake operations outside the normal project construction hours in case of emergency or where it is unavoidable (eg dewatering). Additional safeguards are proposed for these periods, as follows:

- Dewatering plant would (and other plant) that needs to operate on a 24 hours per day basis to clear groundwater from the site would be located and treated so that noise emissions would be reduced to levels required for permanently operating plant as per the EPA Industrial Noise Policy.

Plant should be located as far as practical or in locations that are screened from residential receivers to minimise noise emissions, notwithstanding that items may not exceed the noise goals.

5.3.3 Traffic Movements

There will be heavy vehicle movements primarily to transport demolished material from the site. Average daily movements are expected to be low (less than 2) and no specific mitigation of impacts is likely to be required.

6 VIBRATION

The only activities potentially generating vibration at the surrounding structures is:

- Hammering at the base of the tower using a excavator mounted hammer.
- Drilling of the road surface for the tower crane anchoring points.

Due to the vertical and horizontal distance separation, it is unlikely that the receiver vibration goals will be exceeded by hammering. Drilling would generate lower ground vibration levels but is proposed to occur closer to dwellings. While excessive vibration levels are not expected, safeguards are recommended for these activities given the age, significance and form of construction of nearby structures.

It is recommended that vibration levels and regenerated noise levels within the nearby buildings be measured to confirm these levels and to establish “safe” working distances that prevent damage or adverse amenity impacts. This should occur at the commencement of the two operations identified above.

7 COMPLAINTS HANDLING

A register of noise complaints should be maintained within the site office and be made available to interested parties listing the source of the complaint, time and nature of the complaint.

The following procedure should be adopted where complaints are received.

- The particular activity causing the complaint should be suspended pending further investigation.
- Noise and/or vibration monitoring of the activity should be carried out on a trial basis.
- Where monitoring indicates that the noise or vibration emission goal is exceeded then additional noise or management control should be investigated in accordance with the flow chart.
- The activity should proceed with the additional mitigation methods in place and the resultant noise impact reassessed.

8 MONITORING

Monitoring would be conducted:

- As an ongoing indicator of noise/vibration emissions from the site as part of the monitoring regime established for the Main Works site.
- In response to complaints.
- Where specific monitoring is needed. For example where ground vibration is produced near sensitive structures to confirm safe working as indicated in Section 6.

Attended or unattended long term monitoring may be used as appropriate.

Monitoring should identify the levels of noise/vibration emitted from the site and the noise/vibration sources present, and comment on the measured levels in relation to the established goals.

Where works may be needed to occur within established safe working zones, an additional targeted monitoring regime should be established that should include some form of continuous monitoring of structures.

9 CONCLUSION

The management plan outlines the development of controls and safeguards that would be applied to all activity on the site. The objective of these controls is to ensure that all work is carried out in a highly controlled and predictable manner that will minimise emissions and protect the amenity of the sensitive receivers surrounding the site.

The plan provides a framework for ongoing management of the site including:

- Ongoing assessment and management of processes and activities including selection of processes and mitigation.
- Responding to unforeseen processes not included in this plan as required in response to changed circumstances or in response to monitoring or community reaction.
- Community communication and liaison.
- Training
- Monitoring
- Complaints Handling

The controls and safeguards implemented as a result of the analysis recommended in the plan would be reviewed at a number of stages in response to revised methods and equipment, and to the monitoring and evaluation of actual impacts. This management plan outlines the procedures that would be adopted during the detailed planning and execution phases by the contractor.

Prepared by



Acoustic Logic Consultancy Pty Ltd
Victor Fattoretto