AECOM

Hudd Street, Bowen Hills
Laing O'Rourke
20 December 2011

Acoustics, Vibration and Air Quality

Development Application Brief

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Prepared for

Laing O'Rourke

Prepared by

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1.0 Introduction

1.1 Project Description

AECOM Australia Pty Ltd (AECOM) was commissioned by Laing O'Rourke to provide Acoustical and Air Quality consultancy services in support of a Development Application for the Hudd Street, Bowen Hills development (the Development). The Development involves a Mixed Use Development (Commercial and Retail). The site falls within the bounds of the Bowen Hills Urban Development Area and is therefore under the jurisdiction of the Urban Land Development Authority (ULDA).

The site is located directly adjacent the Bowen Hills train station and is included within Precinct 1 (Bowen Hills Heart) of the Bowen Hills Development Scheme. Precinct 1 is to include high intensity retail, commercial and residential activities and public spaces.

The development is proposed for Sub-precinct 1b, which to be carried out in 3 stages. The proposed scheme represents Stage 1 of the overall development. The proposal will therefore need to address the following 2 levels:

1. Stage 1 Area (the subject of this application)
2. Whole Development Site (sub-precinct 1b)

Precinct 1 is shown in the precinct plan in Figure 1 below. The Development site is shown in Figure 2 overleaf.

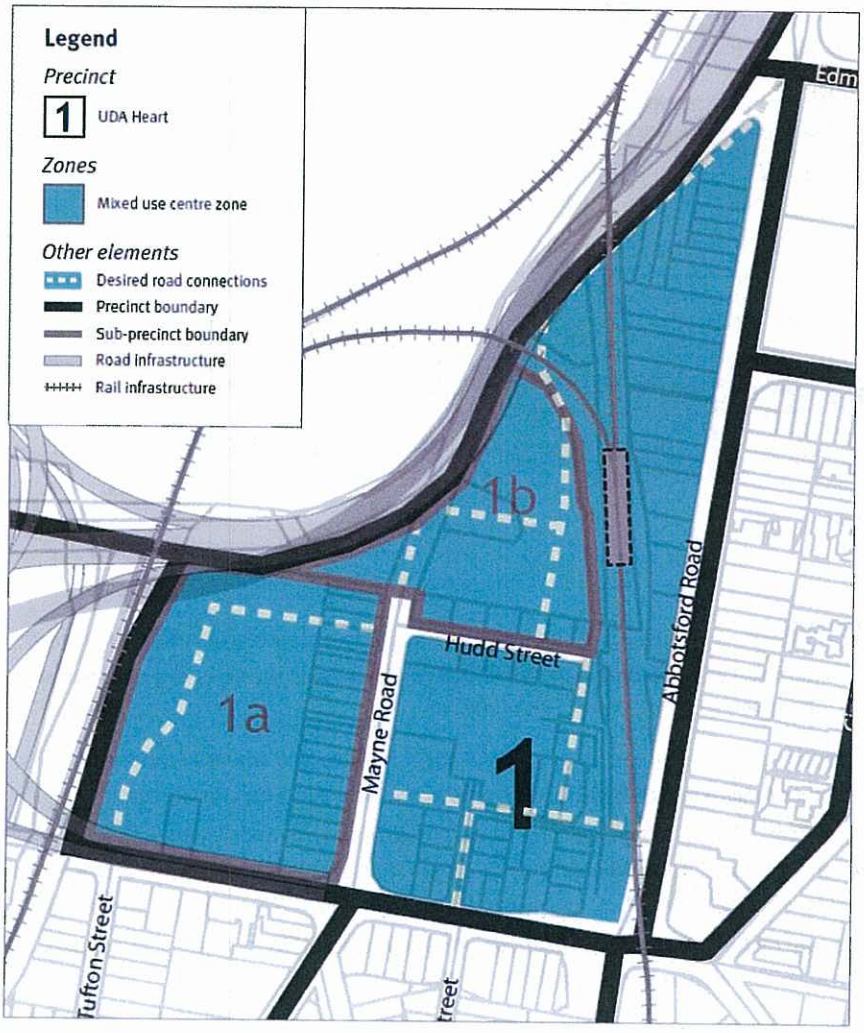

Figure 1 – Precinct 1: Bowen Hills Heart, part of the Bowen Hills ULDA.

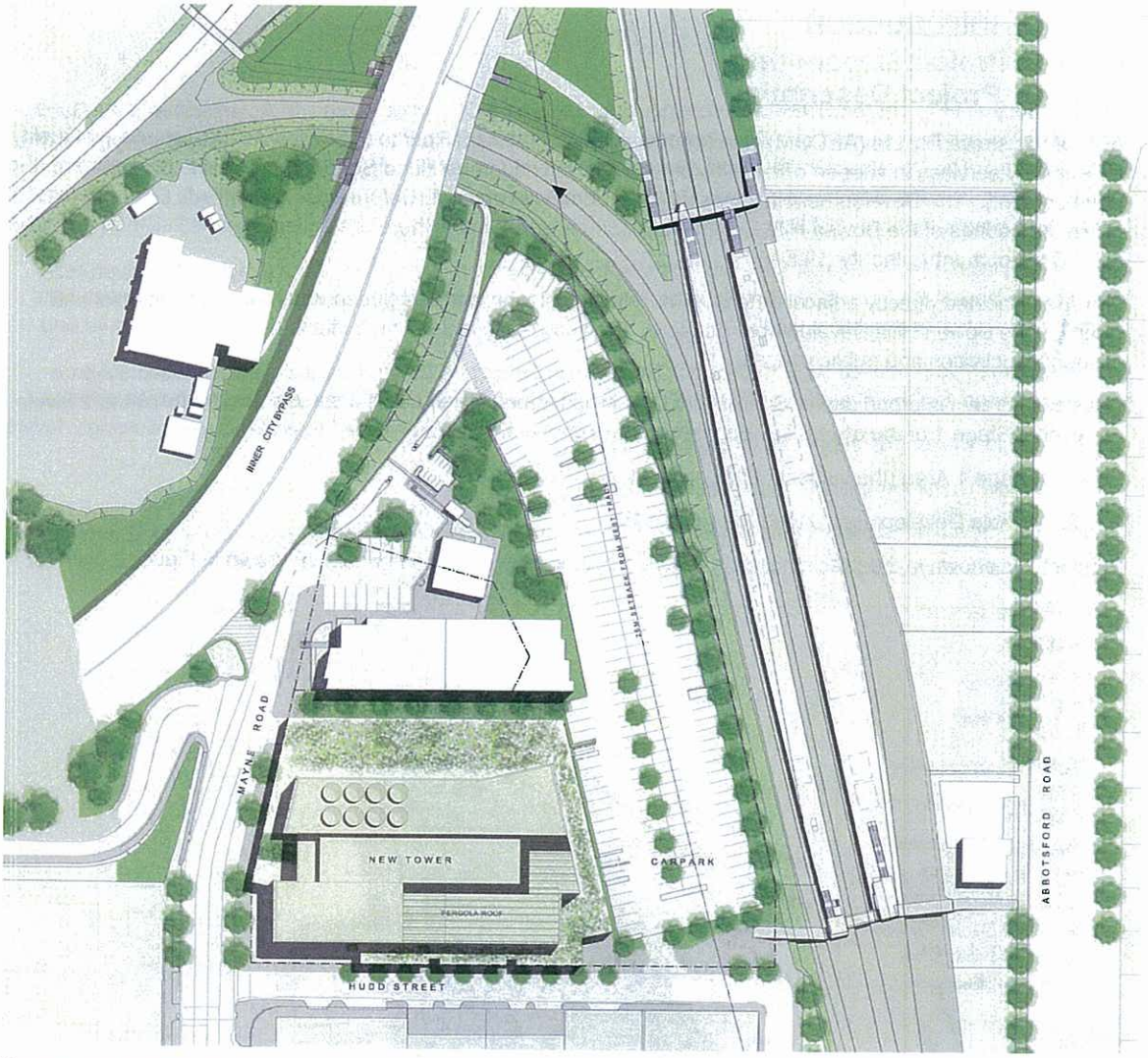

Figure 2 – Site Plan, Staging Masterplan 1

1.2 UDLA requirements

The "*Bowen Hills Urban Development Area Development Scheme*" (the Scheme) lists the following requirements in relation to noise, vibration and air quality in Section 3.9 – Environment.

General noise requirements

The design, siting and layout of development must address noise impacts and where necessary incorporate appropriate noise mitigation measures.

Development is to achieve acceptable noise levels for noise sensitive uses in affected areas - Refer to the Environmental Protection (Noise) Policy 2008.

Where determined necessary by the ULDA, an acoustic report will be required to evaluate and address potential noise impacts and recommend appropriate noise mitigation measures.

General Air Quality

Development must:

- *limit exposure and risk associated with pollutants that could have a potentially adverse affect on human health*
- *be in accordance with best practice air quality guidelines and standards – refer to Brisbane City Council's Air Quality Planning Scheme Policy and the Queensland EPA Guidelines on Odour Impact Assessment from Developments.*

In addition, the Scheme notes the following specific requirements for Precinct 1:

> *The design of the new civic plaza will need to consider noise impacts from Campbell Street and Abbotsford Road and the rail corridor, as well as minimise noise impacts from the plaza on surrounding residents and businesses. Buildings in proximity to the plaza will need to be designed to minimise exposure to noise from the space.*

This will need to be considered in the design of the Hudd Street Development, which may overlook the plaza in the future.

1.3 Department of Public Works requirements

The Department of Public Works (DPW) is a future tenant of the Hudd Street development, and has set a number of requirements for the Hudd Street Development in their *DPW Project Brief.* Particularly relevant is section 2.11 of Volume 4 relating to Acoustic Requirements. These are summarised below.

- Qualified Acoustic Engineering Consultant to provide full acoustic engineering service, refer Volume 4 Appendix 5.
- Acoustic design and treatment is to meet all applicable Australian Standards.
- The minimum acoustic rating requirement is STC 41.
- Building services noise must meet the recommended design sound levels provided in Table 1 of AS/NZS2107:2000.
- Base Building partitions around amenities, plant, communications and equipment rooms must be provided with sufficient sound attenuation to so that adjacent spaces have the minimum acoustic conditions as required by the criteria.
- External noise intrusion from steady or quasi steady sources (including road traffic noise intrusion) must meet the recommended design sound levels provided in Table 1 of AS/NZS2107:2000.
- Aircraft noise intrusion must meet the indoor design sound levels outlined in Table 3.3 of AS2021:2000.
- Rail noise intrusion must be no higher than 10dB above the maximum recommended design sound level of Table 1 of AS/NZS2017:2000.
- Lift pass-by noise levels must be no higher than 5dB above the maximum recommended design sound level of Table 1 of AS/NZS2017:2000.
- Vibration generated by plant and equipment at the site must be controlled to meet the levels of AS2670.2.
- Speech privacy between spaces within the facility must be in accordance with the requirements outlined in the Association of Australian Acoustical Consultants Guidelines for Commercial Buildings Acoustics September 2010.
- The office floors and areas shall be designed to achieve a minimum NR 38 to ensure an environment with sufficient noise level to provide masking for speech privacy, but low enough not to be disruptive. This measurement shall be achieved within 1m of the external façade.
- Reverberation times must meet the criteria provided in Table 1 of AS/NZS 2107:2000. Ensure audible and verbal information can be clearly heard by people with a hearing impairment.
- Provide an independent acoustic engineers report on anticipated results that will be achieved by any atria to confirm that an acceptable acoustic performance level will be achieved.
- Noise from gymnasium is not to exceed 40dBA

2.0 Acoustical Assessment

2.1 Key Issues

The key acoustical issues for the development are:

- Control of noise emission from plant rooms and plant areas
- Control of noise intrusion from road and rail traffic and pedestrian noise
- Internal acoustical design

This report recommends minimum acoustic performance criteria and typical methodologies to achieve the criteria as referenced from applicable acoustic design codes and regulations governing the site.

2.2 Noise Emission

2.2.1 Design Criteria

Noise emission from the site is to be governed by the provisions of the Environmental Protection (Noise) Policy 2008 (EPP(Noise)).

The document has two key requirements:

1) controlling background creep, with the target that *to the extent it is reasonable to do so, noise from an activity must not be –*
   a) for noise that is continuous noise measured by $L_{A90,T}$ — more than nil dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$; or
   b) for noise that varies over time measured by $L_{Aeq,adj,T}$ — more than 5 dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$.
2) meeting the acoustic quality objectives, as outlined in Table 1 below.

Table 1 - EPP (Noise) 2008 Acoustic Quality Objectives at Dwellings and Commercial & Retail Spaces

Sensitive Receptor	Time of Day	Acoustic Quality Objectives (measured at the receptor) dB(A)		
		$L_{Aeq, adj, 1hr}$	$L_{A10, adj, 1hr}$	$L_{A1, adj, 1hr}$
Dwelling (Outdoors)	Daytime and Evening	50	55	65
Dwelling (Indoors)	Daytime and Evening	35	40	45
	Night	30	35	40
Commercial and Retail Activity (Indoors)	When the activity is open for business	45	-	-

The criteria for controlling background creep will apply to noise emission from new continuously operating mechanical plant. Background noise measurements will be taken at the site in early 2012 to determine the existing acoustic environment. These measurements will then be used to set criteria for controlling background creep at neighbouring properties, which will apply to any new continuously operating plant at the sub-precinct.

Noise emission from variable noises such as pedestrian and retail activities to neighbouring sites will be assessed against the L_{Aeq} criteria outlined above, and also compared to the Acoustic Quality Objectives outlined in Table 1. This approach will apply to the whole of the sub-precinct,

Noise transfer between different uses within the sub-precinct will be compared to the Acoustic Quality Objectives in Table 1.

2.2.2 Discussion

2.2.2.1 Mechanical Plant.

A number of major items of plant may be provided as part of the Development, including pumps, fans, air handling units, condensers, cooling towers, chillers and generators. Treatments to plantrooms and externally located plant to control noise emission will be determined during detailed design phases once specific plant has been selected. Techniques used to control this noise emission will consist of a combination of:

- enclosed plantrooms
- silencers
- lined ductwork
- acoustic barriers
- acoustic louvres
- acoustically rated doors
- lining of plantrooms with acoustic insulation
- selection of quiet plant.

2.2.2.2 Refuse Collection

The collection of garbage from the site may generate noise that has the potential to be considered a nuisance. The noise generated from garbage collection will typically be from: garbage trucks, lifting and placement of garbage bin, and the noise of garbage falling into the garbage collector. It is expected that refuse collection occurs during the day-time period and is no more intrusive than existing refuse collection activities in the area.

2.2.2.3 Car Park & Driveway Use

Noises associated with car park use such as doors slamming, idling engines, accelerating cars etc. have the potential to cause annoyance at neighbouring areas. The potential for noise from the car park to be considered annoying is greatest during the night. Vehicle movements associated with a commercial development are expected to occur predominantly between the house of 8am and 6pm, with occasional movements between 7am and 8am, and between 6pm and 8pm. Turnover rates for commercial buildings are generally low and the amount of traffic generated on nearby roads such as Abbotsford Road and the Inner City Bypass is expected to be negligible compared to existing traffic flows. Vehicle movements during night-time hours (i.e. between 10pm and 6am) are expected to be infrequent. As such, noise impacts of car park and drive way use are expected to be minor.

2.2.2.4 Pedestrian and Retail Noise Emission

There is potential for noise from activities associated with the use of the retail spaces such as patron and music noise to be considered annoying at the adjoining neighbours. These noises will be assessed in more detail as the design progresses, but are expected to be confined to daytime hours, reducing the likely impact on neighbouring properties.

2.3 Noise Intrusion

Sub-precinct 1B is bounded by a number of significant noise sources, including the Inner City Bypass to the North West corner, the Bowen Hills rail corridor along the Eastern boundary and a future public plaza to the South. These will need to be considered in the development of the sub-precinct as a whole, and in the design of the Hudd Street Development.

2.3.1 Design Criteria

2.3.1.1 Bowen Hills ULDA requirements - Environmental Protection (Noise) Policy 2008

The Environmental Protection (Noise) Policy described in Section 2.2.1 also applies to noise intrusion into commercial and retail developments in the sub-precinct.

As noted in Table 1, an Acoustic Quality Objective of $L_{Aeq,adj,1hr}$ 45 dB is recommended for Commercial and Retail activity during office hours. This criterion is relevant for noise intrusion into the current proposed Hudd Street development, and any future commercial or retail developments in the sub-precinct.

2.3.1.2 DPW requirements - Australian Standard AS/NZS 2107:2000

In addition to the ULDA requirements, DPW specifies that noise intrusion from all steady or quasi-steady noise sources be controlled to meet the recommended design sound levels in Australian Standard, *AS2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors.* Relevant parts of this standard are replicated below in Table 2.

These requirements will apply to the Hudd Street Development only at this stage. However it is worth noting that the EPP (Noise) 2008 requirements are consistent with the maximum design sound level for a general office area or retail area in AS/NZS 2107, and therefore a development that complies with the EPP(Noise) requirements will also comply with this standard.

Table 2 – AS2107 Recommended Design Sound Levels

Type of Occupancy/Activity	Recommended Design Sound Level $L_{Aeq,T}$ dB(A)		Recommended Reverberation Time (T), s
	Satisfactory	Maximum	
OFFICE AREAS			
Board and conference rooms	35	40	0.6 to 0.8
Cafeterias and food courts	45	50	*
Computer rooms	45	50	*
Corridors and lobbies	45	50	0.4 to 0.6
General office areas	40	45	0.4 to 0.6
Private offices	35	40	0.6 to 0.8
Public Spaces	40	50	0.5 to 1.0
Restrooms and tea rooms	40	45	0.4 to 0.6
Toilets	50	55	–
Undercover carparks	55	65	–
RETAIL AREAS			
Show rooms	45	50	*
Small retail stores (general)	45	50	*
Specialty shops (where detailed discussion is necessary in transactions)	40	45	*

Note: * Minimise Reverberation Time as far as practical

2.3.1.3 DPW requirements – Rail Noise Intrusion

DPW requires that rail noise intrusion must be no higher than 10 dB above the maximum recommended design sound level of Table 1 of AS/NZS2017:2000, shown in Table 2 above. These requirements will apply to the Hudd Street Development only at this stage.

2.3.1.4 DPW requirements – Aircraft Noise Intrusion

DPW requires that aircraft noise intrusion meet the indoor design sound levels outlined in Table 3.3 of AS2021:2000 and replicated below. Note that the Bowen Hills ULDA falls outside of the ANEF 20 contour for Brisbane airport, and it is therefore expected that these criteria will be met with standard building treatments.

Table 3 – AS2021 Recommended Design Sound Levels

Type of Occupancy/Activity	Indoor Design Sound Level L_{max} dB(A)
Private offices, conference rooms	55
Drafting, open offices	65
Typing, data processing	70
Shops, Showrooms	75

2.3.2 Discussion

Control of noise intrusion will be a key design consideration for the facade of the buildings in the sub-precinct.

Preliminary calculations indicate that a facade equivalent to 10.38mm laminated glass will be required at lower levels of the Hudd Street building to control noise intrusion from road and rail traffic. This will be refined through computer modelling and on-site measurements during concept design.

Noise intrusion into the winter garden areas will also be assessed. The design will consider the use of acoustically rated operable glass and absorptive treatments to the space, with a target of achieving criteria for 'general office areas' with the windows closed, and 'public space' criteria with the windows open.

2.4 Internal Acoustical Design

Key issues for the internal acoustical design of the Hudd Street Development are:

- acoustic separation of base building areas such as lifts and toilets from office areas
- acoustic separation between different areas within the DPW fitout
- control of mechanical services noise within spaces
- control of reverberation times to provide suitable levels of speech privacy
- Green Star requirements.

2.4.1 Separation of Base Building Areas

DPW nominates the following requirements for the separation of base building areas from office areas:

- Base Building partitions around amenities, plant, communications and equipment rooms must be provided with sufficient sound attenuation to so that adjacent spaces have the minimum acoustic conditions as required by the criteria.

These criteria will be met through the selection of appropriate lift suppliers, and through the design of base building partitions to control noise to meet the recommended design sound levels of AS/NZS2017:2000 described in Table 2 above.

2.4.2 Separation of fitout areas

DPW nominates the following requirements for the separation of fitout areas:

- The minimum acoustic rating requirement is STC 41.
- Speech privacy between spaces within the facility must be in accordance with the requirements outlined in the Association of Australian Acoustical Consultants Guidelines for Commercial Buildings Acoustics September 2010.
- Noise from gymnasium is not to exceed 40dBA.

These criteria will be met through the design of partitions, partition junctions, ceiling treatments and penetration details to achieve the required levels of acoustic separation.

2.4.3 Control of building services noise

DPW nominates the following requirements for the separation of base building areas from office areas:

- Building services noise must meet the recommended design sound levels provided in Table 1 of AS/NZS2107:2000.
- The office floors and areas shall be designed to achieve a minimum NR of 38 to ensure an environment with sufficient noise level to provide masking for speech privacy, but low enough not to be disruptive. This measurement shall be achieved within 1m of the external façade.
- Lift pass-by noise levels must be no higher than 5dB above the maximum recommended design sound level of Table 1 of AS/NZS2017:2000.
- Vibration generated by plant and equipment at the site must be controlled to meet the levels of AS2670.2.

These criteria will be met where practicable through the selection of key items of plant and equipment, and through the design of the mechanical services system.

2.4.4 Control of reverberation

DPW nominates the following requirements for the control of reverberation:

- Reverberation times must meet the criteria provided in Table 1 of AS/NZS 2107:2000. Ensure audible and verbal information can be clearly heard by people with a hearing impairment.
- Provide an independent acoustic engineers report on anticipated results that will be achieved by any atria to confirm that an acceptable acoustic performance level will be achieved

These criteria will be met where practicable through the selection of finishes to key spaces, including carpet and absorptive ceilings in office areas and treatments to atrium spaces.

2.4.5 Green Building Council of Australia (GBCA) Green Star requirements

2.4.5.1 Green Star Office Design Version 3

The Green Star rating system is described in the "Green Star Office Design V3 Technical Manual" produced by the Green Building Council of Australia. Section IEQ-12 deals with Internal Noise Levels.

Up to 2 points are awarded where 95% of the project's NLA does not exceed the 'satisfactory' ambient noise levels in accordance with AS/NZS 2107:2000, as follows:

- Building Services Design – One point where, within the entire base building general office space, noise from the building services does not exceed 40 dB(A) $L_{Aeq,}$
- Overall Building – One point is awarded where within the base building office space, the sound level does not exceed 40 dB(A) L_{Aeq} (assuming open plan offices)

In order to comply with the point for Overall Building, the combined noise levels from both mechanical services AND external noise intrusion must not exceed 40 dB(A) L_{Aeq} in general office space. In order to achieve this, mechanical noise levels alone must be designed to achieve less than 40 dB(A), and noise intrusion through the facade must be designed to achieve less than 40 dB(A), such that the combined noise levels remain less than 40 dB(A). This can have significant cost implications which must be considered as the design develops. Moreover, achieving an overall noise level greater than NR 38 (as required by DPW) and less than 40 dB(A) (as required by the Green Star point) may not be practicable, as only a very small range of noise levels can be tolerated across the whole building. As such, the merits of achieving these two points will be evaluated as the design develops.

2.4.5.2 Green Star Office Interiors Version 1.1

The Green Star rating system for building fitouts is described in the "Green Star Office Interiors v1.1 Technical Manual" produced by the Green Building Council of Australia. Section IEQ-10 deals with Internal Noise Levels.

One point is awarded where:

- it is demonstrated that ambient internal noise levels are 40-45 dBLAeq in general offices and 35-40 dBLAeq in private offices, with the tenancy ready for occupancy but unoccupied as per AS/NZS 2107:2000; AND
- Where a reverberation time (RT60) of 0.4-0.6 seconds for general offices and a RT60 of 0.6 - 0.8 seconds for private offices is achieved.

These requirements are in keeping with the DPW brief, and will be achieved where practicable through the fitout design.

3.0 Vibration Assessment

Train movements along the Bowen Hills railway line have the potential to generate excessive levels of vibration on the site. Vibration may also be generated on the site during construction phase, which could potentially affect other buildings on the site and nearby infrastructure such as the rail corridor.

The effects of ground vibration may be segregated into the following two categories:

- human exposure – disturbance to building occupants, arising from vibration which inconveniences or possibly disturbs the occupants or users of the building
- effects on building structures – vibration which may compromise the integrity of the building structure itself.

This is discussed in more detail below.

3.1 Design Criteria

3.1.1 Human Exposure

The use of vibration criteria from the Australian Standard AS 2670.2-1990 - *"Evaluation of Human Exposure to Whole-Body Vibration"* is recommended for this project to assess the effects of vibration on building occupants.

AS 2670.2 specifies maximum allowable vibration levels in terms of a baseline curve, with multipliers depending on the sensitivity of the space. These values have been summarised in Table 4, expressed as PPV (peak particle velocity) for vibration in any direction, with frequency between 8 and 80 Hz.

Different values are recommended for continuous or intermittent vibration and transient vibration. In most cases, the vibration generated on site (by e.g. vehicle movements, train pass-bys and construction activities) is continuous or intermittent in character and therefore subject to the lower value.

Table 4 Building vibration combined direction (x,y,z) vibration goals in mm/s (PPV)

Type of building occupancy	Continuous or intermittent vibration (mm/s)	Transient vibration excitation with several occurrences per day (mm/s)
Office	0.6	8.5 – 18.1
Workshop	1.1	12.7 – 18.1

Note: Combined vibration is the peak vector sum of the three vibration axes.

It is noted that the values are designed to provide guidance as to the likelihood of adverse comment, where the probability of reaction is low if values fall below the recommended levels. Exceeding the recommendations does not imply complaints will be likely and complying with the recommendations does not exclude complaints from occurring.

Nevertheless, these criteria will be used to assess the impacts of vibration from construction activities and rail movements on occupants of the Hudd Street Development and future developments within the sub-precinct.

3.1.2 Structural Effects

Currently no Australian Standard exists for assessment of building damage caused by vibration. German Standard DIN 4150 - Part 3 - *Structural Vibration in Buildings - Effects on Structures* is widely used in Australia to provide recommended maximum levels of vibration that are designed to reduce the likelihood of building damage. The DIN 4150 criteria are maximum levels measured in any direction at the foundation, or, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor, and are summarised in Table 5. The maximum levels are referred to as peak particle velocities (PPV).

For this project, most buildings will fall into the first group.

Table 5 Structural damage 'safe limits' for building vibration

Group	Type of structure	Vibration velocity (PPV) in mm/s At foundation at a frequency of		
		1–10 Hz	10–50 Hz	50–100 Hz[1]
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or use (i.e. residential)	5	5 to 15	15 to 20
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. heritage-listed)	3	3 to 8	8 to 10

The DIN 4150 criteria levels are 'safe limits' up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. DIN 4150 states that when vibrations higher than the 'safe limits' are present, it does not necessarily follow that damage will occur.

3.2 Discussion

Vibration goals for human disturbance are more stringent than vibration criteria for building structural damage. Hence, compliance with the more stringent limits dictated by human exposure generally means that compliance is also achieved for the effects on building structures category.

On this basis, the criteria nominated above for human exposure will be used as the basis for the assessment of vibration from operational sources such as train movements or mechanical plant to occupied spaces of buildings in the sub-precinct. For construction phase, temporary exceedances of the human exposure criteria can often be tolerated if properly managed.

The criteria for structural damage will be used as the basis of the assessment of the impacts of vibration on unoccupied buildings and general structures.

3.2.1 Rail movements

The vibration produced by rail movements varies depending on the type of train and the nature of the wheel surface interaction (i.e. the wheel roughness, presence of flat sections in the wheel, corrugations in the rails etc). Approximate ground vibration levels produced by typical operations are shown in Table 6[2].

Table 6 – Approximate Ground Vibration Levels

Distance from track centreline (m)	5	10	15	20	50
Vibration velocity (mm/s PPV)	2.8	1.4	0.71	0.28	0.14

On this basis, vibration levels at 5 m from the track centre line are likely to be well within structural damage criteria, and vibration levels at 20 m from the track centre line are likely to be well within human exposure criteria for office spaces.

[1] For frequencies above 100 Hz, the higher values in the 50–100 Hz column should be used.
[2] The approximate upper range ground vibrations have been adapted from Transit Noise and Vibration Impact Assessment, US FTA 2006, with 5 dB (re 25 x 10 - 6 mm/s) has been added to account for future track wear.

Vibration can be amplified as it enters a building structure, and it then attenuates as it travels from floor to floor. As such, vibration levels on the first floor are typically greater than vibration levels on ground, with lower vibration expected on upper floors.

The actual vibration levels at the site will be evaluated during concept design. It is considered likely that vibration levels will comply with nominated criteria. However, in the event that vibration levels are expected to exceed the criteria outlined above, mitigation will be considered. This may include locating office spaces on higher levels of the buildings, or incorporating vibration isolation into the building structure.

3.2.2 Construction Vibration

The exact construction methodology or plan is unknown at this stage. Typical levels of construction vibration can however be estimated through considering vibration levels generated for a selection of typical worst-case construction equipment; namely hydraulic hammers, vibrating rollers and piling activities.

It is generally the piling activities on a construction site which will generate the highest level of vibration, such that compliance with the defined goals and criteria for piling generally means that compliance is also achieved for less significant construction vibration sources.

Reference was made to the Australian Transport Infrastructure Development Corporation's (TIDC) publication entitled *Construction Noise Strategy (Rail Projects) (CNS)* and previous AECOM studies. From these reference documents, distances at which vibration from general construction activities are expected to achieve the relevant human comfort vibration goals and structural criteria were determined, and are provided in Table 7.

Table 7: Screening distances for structural damage and human comfort.

Plant	Estimated Buffer Distance (m)	
	Structural Damage	Human Exposure
Small hydraulic hammer	4	10
Medium hydraulic hammer	12	30
Large hydraulic hammer	40	90
Sheet piling	6	30
10T vibrating roller (high setting)	15	50

The buffer distances for human exposure will be used to assess the likelihood of adverse comment arising from construction works. For example, where sheet piling is proposed within 30m of an occupied building, adverse comment is likely. Mitigation in the form of community engagement will be considered, and incorporated into a construction noise and vibration management plan.

The buffer distances for structural damage will be used to inform the design of the construction plan. This will consider existing infrastructure on the site (such as rail corridor infrastructure) and any buildings that have been constructed in the area prior to construction. Where buffer distances cannot be achieved, and equipment cannot be substituted, a more detailed vibration assessment will be carried out.

In this manner, vibration from construction activities can be controlled to avoid significant adverse impacts on the surrounding area.

4.0 Air Quality Assessment

4.1 Key Issues

The key air quality issues for the development are:

- Control of air emissions from development at the site
- Control of intrusion from nearby road and rail sources to occupied areas at the site.

This report recommends criteria and typical methodologies to achieve the criteria as referenced from applicable design codes and regulations governing the site.

4.2 Control of emissions

4.2.1 Design Criteria

Emission from the site is to be governed by the provisions of Brisbane City Council (BCC)'s *Air Quality Planning Scheme Policy* and the Queensland Department of Environment and Resource Management (DERM)'s *Guidelines on Odour Impact Assessment from Developments*. The BCC policy is outlined further below.

4.2.1.1 BCC's Air Quality Planning Scheme Policy

This policy aims to manage impacts by reducing emissions and exposure of people to pollution in local areas. The policy specifies a number of general requirements for the management of emissions relevant to the development:

- Identify and characterise air emissions from the development.
- Undertake a full evaluation of best practice environmental management and best available technology options to demonstrate best practicable reduction in air emissions.
- Determine whether emissions are of a local or regional concern.
- Undertake appropriate air dispersion modelling if the local or modelling thresholds are exceeded. The modelling thresholds are presented in Table 8.

Table 8 Emission based assessment thresholds for modelling

Pollutant	Local level modelling (grams/ second)	Regional level modelling (grams/ second)
Nitrogen oxides	0.03	5.0
Carbon monoxide	0.03	n/a
Sulfur dioxide	0.016	n/a
TSP (total suspended particulates)	0.03	n/a
PM_{10} (particles <10μm in diameter)	0.016	2.5
Total VOC (volatile organic compounds)	0.016	1.0

Furthermore, the policy specifies ambient air quality ground level criteria for any sensitive receiving environments (neighbouring properties) surrounding the development. These criteria are presented in Table 9.

Table 9 Ambient air quality design ground level concentrations

Pollutant	Goals for all areas	Design ground level concentration for sensitive receiving environment	Averaging time
Nitrogen dioxide	0.16 ppm	0.11 ppm	1 hour
PM_{10}	150 mg/m^3(1)	50 mg/m^3 (1)	24 hours
$PM_{2.5}$ (particles < 2.5µm in diameter)	n/a	25 mg/m^3 (1)	24 hours
Carbon monoxide	8 ppm	3.5 ppm	8 hours
Toluene	1 mg/m^3 n/a	n/a 0.65 mg/m^3	30 min 3 min
Benzene	n/a	0.1 mg/m^3	3 min
Odour	10 OU	5 OU	1 hour

(1) Units as specified in the policy. This is assumed to be a typo as the units specified in the EPP (Air) 2008 are in $\mu g/m^3$.

It is noted that the BCC criteria are substantially similar to criteria specified in the Australian *National Environmental Protection (Ambient Air Quality) Measure* and the Queensland *Environmental Protection (Air) Policy 2008* [EPP (Air) 2008]. The BCC criteria will be adopted as the basis for this assessment.

4.2.2 Discussion

The Development may include co-generation or tri-generation plant, which have the potential to emit air pollutants to neighbouring properties. Should these proceed, they would be the subject of a separate Development Application in the future, which would address any treatments required to comply with the criteria nominated in Section 4.2.1 above.

There are no other significant sources of air pollutant emissions proposed for the Development.

4.3 Control of intrusions

Sub-precinct 1B is bounded by a number of significant sources of air pollutants, including the Inner City Bypass to the North West corner and the Bowen Hills rail corridor along the Eastern boundary.

In addition to these sources, the venting stacks for the present Clem 7 tunnel and the proposed Legacy Way and Airport Link tunnels are all located in the area surrounding the development. Emission plumes from these stacks are expected to impact the development under certain meteorological conditions, especially upper floors of the proposed tower.

4.3.1 Design Criteria

Workplace health and safety exposure standards applicable to the development are contained within the Australian Hazardous Substances Information System (HSIS) which amend the Australian *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC: 1003(1995)].*

Table 10 Occupational Exposure Standards from HSIS

Pollutant	TWA (ppm)	TWA mg/m3)	STEL (ppm)	STEL(mg/m3)
Nitrogen dioxide	3	5.6	5	9.4
Benzene	1	3.2	n/a	n/a

Pollutant	TWA (ppm)	TWA mg/m3)	STEL (ppm)	STEL(mg/m3)
Toluene	50	191	150	574
Xylene	80	350	150	655
Formaldehyde	1	1.2	2	2.5
Sulfur dioxide	2	5.2	5	13

4.3.2 Discussion

To fully assess the potential air quality impacts on the development, a reverse sensitivity assessment will be conducted based on emissions from existing and future sources. This assessment will include a desktop study of existing ambient air quality and predicted emissions from the proposed venting stacks discussed above. Ground level impacts can be determined from existing air quality monitoring data combined with modelling results from the EIS's conducted for each venting stack.

Determining pollutant concentrations at winter gardens of the proposed tower would require a more in-depth modelling study. A modelling study to determine concentrations at winter garden height would collate existing modelling data from the venting stacks with background ambient concentrations. Cumulative pollutant concentrations at specified heights above ground (corresponding with the proposed winter gardens) could be predicted and compared with the criteria nominated in Section 4.3.1.

5.0 Conclusion

This report has identified the major issues relating to Air Quality and Acoustics for the Hudd Street Development and sub-precinct 1B, and nominated criteria for the assessment and mitigation of these issues.

Sources of potential noise emission from the site have been described in Section of this report. Noise emission criteria have been nominated in Section 2.2.1 for mechanical plant, refuse collection and other activities at the site in Section 2.2.2 in accordance with the requirements of the EPP(Noise) regulations and in-principle treatments recommended to control these sources. On this basis, it is expected that noise emission from the Development can be controlled to meet the nominated criteria.

The potential for noise intrusion from surrounding noise sources has been discussed in section 2.3, with criteria discussed in Section 2.3.1 and potential treatments discussed in Section 2.3.2. Noise intrusion into the Development will be controlled through the facade, which will be developed in more detail as the design progresses.

Approaches to the internal acoustical design of the building have been outlined in Section 2.4.

Vibration has also been assessed, both in terms of the impact of rail movements past the site on the development; and in terms of the impact of construction activities occurring on site on the surrounding area. Buffer distances and in-principle mitigation techniques have been described that will allow vibration to be controlled to avoid adverse impacts.

Air quality has also been discussed. Criteria for the assessment of air pollutant emission from the site are outlined in Section 4.2. As any co-generation or tri-generation system would be the subject of a separate development approval, there are no major sources of air pollutants proposed for the development and no further investigation is required at this stage.

The site also has the potential to be affected by the air pollutants produced by the major transportation infrastructure in the area. Criteria for the assessment of this have been outlined in Section 4.3.1, with the approach outlined in Section 4.3.2. More detailed modelling will be required to assess this as the design progresses.