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Traffic and Rail - Noise and Vibration Assessment

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1 INTRODUCTION

This report presents our assessment of the impact of traffic and rail noise and vibration impacts on the amenity of the future occupants of the proposed commercial development at 84-86 Kiora Road, Miranda. A preliminary review of noise emissions during construction (excavation construction etc) of the site has also been undertaken.

This assessment has been conducted as required by the Department of Planning's Director Generals Requirements (DGR) number 15 for 84-86 Kiora Road, Miranda.

The assessment has been based on noise and vibration levels generated by train movements on the Eastern Suburbs and Illawarra Train Line which runs parallel to the south of the site, and traffic noise generated by traffic on Urunga Parade and Kiora Road.

Noise and vibration results have been used to predict internal noise levels within the development. Where necessary, appropriate noise/vibration attenuation treatments have been recommended to prevent excessive impacts on future tenants.

This report is based on architectural plans by Geoform Design Architects dated December 2010.

2 SITE DESCRIPTION & PROPOSED DEVELOPMENT

The 7 storey proposed commercial development is to consist of:

- Dental surgery, commercial/retail properties on the upper & lower ground floor.
- Dental hospital surgery and ancilliary suites from the upper ground to the fifth floor;
- fully automatic basement level car parking with a total of 42 car parking spaces; and
- A further shared loading / disabled parking space at ground level, accessed via Urunga Lane;

Figure 1 details the site, surrounding noise sources and measurement positions.

The subject site is located at the corner of Kiora Road and Urunga Lane, Miranda. These roads carry medium volumes of traffic including bus traffic.

The development could potentially be impacted by traffic noise from Kiora Road and Urunga Lane which respectively bounds the West and the North of the site.

To the South of the site is the Eastern Suburbs & Illawarra Train Line. The site lies between commercial buildings to the South and the East and could potentially be impacted by train noise and railway vibration from the adjacent railway line.

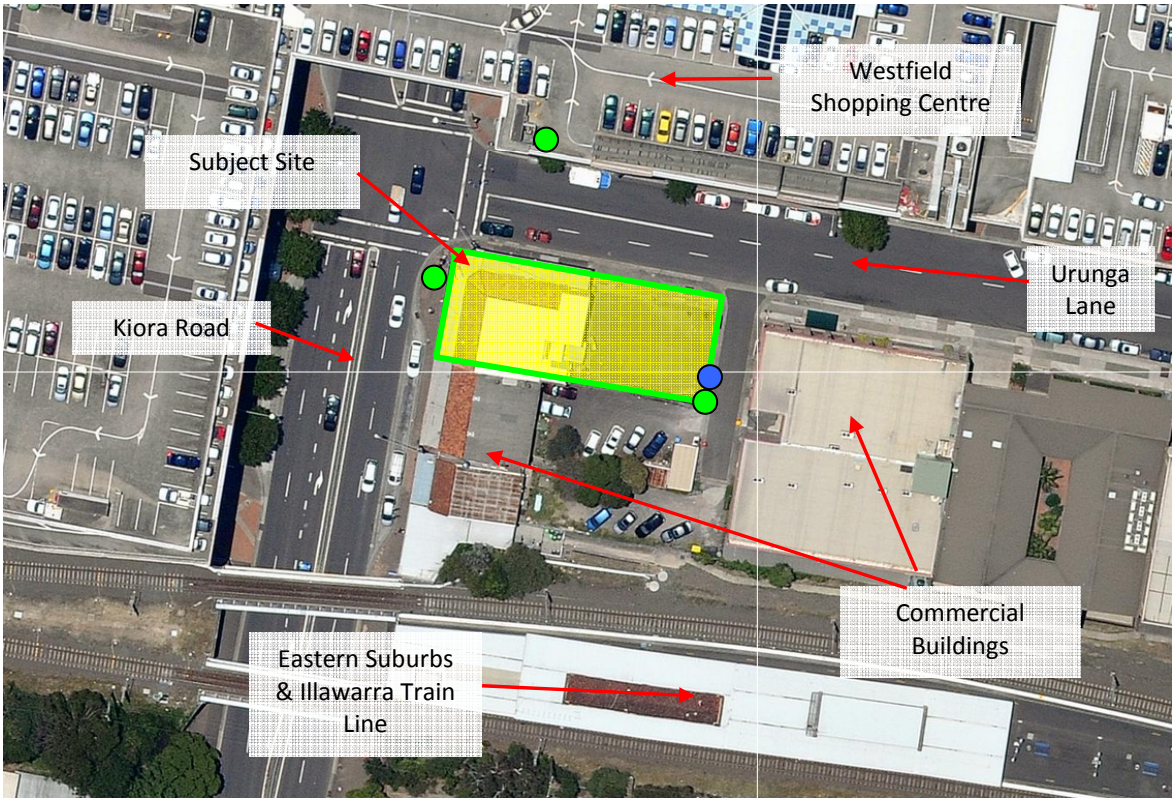


Figure 1 – Site and Measurement Locations

- Attended noise measurements
- Attended vibration measurements

3 NOISE DESCRIPTORS

Traffic and rail noise constantly varies in level, due to fluctuations in speed, vehicle types, road/rail conditions and traffic densities. Accordingly, it is not possible to accurately determine prevailing traffic noise conditions by measuring a single, instantaneous noise level. To accurately determine the effects of traffic noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters. These parameters are used to measure how much annoyance would be caused by a particular noise source.

In the case of environmental noise three principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced at the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of traffic noise.

4 AIRBORNE NOISE ASSESSMENT

4.1 TRAFFIC & TRAIN NOISE

4.1.1 Acoustic Criteria

As the Sutherland Shire Council's Development Control Plan contains no specific requirements for internal noise levels from traffic noise intrusion for commercial areas, this assessment shall be conducted in accordance with Australian Standards AS2107-2000 "Recommended Design Sound Levels and Reverberation Times for Building Interiors" as well as AS3671-1989 "Acoustics – Road Traffic Noise Intrusion – Building, Siting and Construction".

Based on AS2107-2000 and AS 3671-1989 the following assessment criteria would apply to the proposed development.

Table 1 - Internal Railway Noise Level Criteria

Space/Activity Type	Noise Level dB(A) $L_{eq\ (9Hour)}$
Office Areas	45dB(A) L_{Aeq}
Dental Clinic	45dB(A) L_{Aeq}

4.1.2 Measurement Procedure

Traffic noise measurements were obtained along Kiora Road (See Figure 1) during the morning of 29 March 2011. Noise measurements were obtained using a Norsonic 140 Sound Level Analyser, set to A-weighted fast response. The sound level meter was calibrated before and after the measurements using a Norsonic 1251 Sound Level Calibrator. No significant drift was recorded.

4.1.3 Measured Noise Levels

The results of traffic noise monitoring at are detailed in the table below.

Table 1 - Measured Traffic Noise Levels – Kiora Road

Time of Day	Noise Level - $LA_{eq\ (9Hour)}$
9:00am – 10:00pm	72 dB(A) L_{Aeq}

4.2 RAILWAY & TRAFFIC NOISE ASSESSMENT

4.2.1 Acoustic Criteria

The Sutherland Shire Council requires that development located near the railway corridor be assessed in accordance with the SEPP (Infrastructure) 2007 and the Department of Planning's *Development near Rail Corridors and Busy Roads –Interim Guideline*. As the guideline does not provide internal noise criteria for commercial areas, Australian Standard 2107:2000 will be the subject of application for the purposes of nominating criteria for these commercial spaces. These are detailed in the table below.

Table 3 - Internal Railway Noise Level Criteria

Space/Activity Type	Noise Level dB(A) $L_{eq\ (9\ Hour)}$
Office Areas	45dB(A) $L_{Aeq\ (when\ in\ use)}$
Dental Clinic	45dB(A) $L_{Aeq\ (when\ in\ use)}$

4.2.2 Measurements Procedure

Attended train & traffic noise measurements were conducted on 29 March 2011. Noise measurements were obtained using a Norsonic 140 Sound Level Analyser, set to A-weighted fast response. The sound level meter was calibrated before and after the measurements using a Norsonic 1251 Sound Level Calibrator. No significant drift was recorded.

4.2.3 Measurement Results

The external noise levels from measurements conducted on site are detailed in the table below.

Table 4 –External Noise Levels

Location	Day dB(A) $L_{eq,9hr}$
South-eastern Boundary (trains)	51 dB(A) $L_{eq\ 9hr}$
Corner of Kiora Road & Urunga Lane (traffic)	70 dB(A) $L_{eq,9hr}$

4.3 EVALUATION OF NOISE INTRUSION

Internal noise levels will primarily be as a result of noise transfer through the windows and doors and roof, as these are relatively light building elements that offer less resistance to the transmission of sound. **All external walls are proposed to be heavy masonry or concrete elements that will not require upgrading.**

The predicted noise levels through the windows, doors and roof are discussed below. The predicted noise levels have been based on the measured level and spectral characteristics of the external noise, the area of building elements exposed to traffic noise, the absorption characteristics of the rooms and the noise reduction performance of the building elements.

Calculations were performed taking into account the orientation of windows, barrier effects (where applicable), the total area of glazing, facade transmission loss and the likely room sound absorption characteristics. In this way the likely interior noise levels can be predicted.

Recommended acoustic treatments presented below will satisfactorily control both rail and traffic airborne noise.

4.3.1 Recommended Glazing

The following constructions are recommended to comply with the traffic/rail noise objectives stated in Section 3 and 4. Aluminium framed/sliding glass doors and windows will be satisfactory provided they meet the following criteria listed below.

Table 5 –External Noise Levels

Level	Room	Glazing	Seals
All	All	6.38lam /12 airgap/6.38lam	Yes

Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable.

4.3.2 Roof / Ceiling

The roof over the office is to be constructed of a concrete slab and will not require upgrading. The metal deck roof over the warehouse will not require any acoustic upgrading.

4.3.3 External Walls

External walls composed of concrete or masonry elements would not require upgrading.

4.3.4 Mechanical Ventilation

As internal noise levels cannot be achieved with windows open it is required that an alternative outside air supply system or air conditioning be installed to meet AS 1668.2 requirements. Any mechanical ventilation system that is installed should be acoustically designed such that the acoustic performance of the recommended constructions are not reduced by any duct or pipe penetrating the wall/ceiling/roof. Noise emitted to the property boundaries by any ventilation system shall comply with Council requirements.

5 RAIL INDUCED VIBRATION

Trains induce ground borne vibration that is transmitted through the subsoil. This vibration can be perceptible close to railways, both a tactile vibration and as structure borne noise.

5.1 TACTILE VIBRATION CRITERIA

As the site is located within 60m of the Illawara Railway, a vibration assessment is recommended by the Rail Infrastructure Corporation "Interim Guidelines for Councils - Consideration of rail noise and vibration in the planning process". This Guideline recommends that habitable rooms should comply with the criteria in British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" as this standard includes guidance for the assessment of human response to building vibration including intermittent vibrations such as that caused by trains.

Human response to vibration has been shown to be biased at particular frequencies which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 "Evaluation of Human Exposure to Vibration and Shock in Buildings (1 to 80Hz)" which represents the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

The standard assesses the annoyance of intermittent vibration by using the Vibration Dose Value (VDV). Alternatively the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the "Daytime" (7am-10pm) and "Night time" (10pm-7am). The overall value is then compared to the levels in Table 1. For this project the aim will be for a low probability of adverse comment

Table 2 - Vibration Dose Values (m/s1.75) above which various degrees of adverse comment may be expected in residential buildings.

Place	Low Probability of adverse comment	Adverse comment possible	Adverse comment probable
Commercial buildings 16hr day	0.4	0.8	1.6
Commercial buildings 8hr night	0.4	0.8	1.6

5.2 STRUCTURE BORNE NOISE

Vibration generated by train passbys adjacent to the proposed development will potentially generate structure borne vibration which will be radiated of internal building elements such as walls, floors and ceiling as audible noise. Internal noise levels associated with structure borne noise generated from train passbys is required to comply with SRA noise level objectives which are detailed in the table below.

There are no documented rail structures borne noise level objectives for commercial buildings. For this reason, the rail structure borne noise level objectives will be based on the noise level

recommended by Rail Infrastructure Corporation for residential buildings. The residential requirement is that the resulting structure borne noise level should not exceed 40 dB(A) L_{max}. Assuming this has been applied to limit loss of amenity in residential bedrooms, the corresponding difference in noise levels recommended in AS 2021 for these spaces will be used to adjust the bedroom level. AS 2021 recommends a noise level of 50 dB(A) L_{max} in sleeping areas, 65 dB(A) in generally office areas and 75 dB(A) in retail areas. Extrapolating this difference to railway induced noise gives a requirement of 55 dB(A) L_{max} in office areas. At this level, structure radiated noise levels may be audible but would not be excessively intrusive.

Table 6 - Internal Railway Noise Level Criteria

Location	dB(A) $L_{MAX,9hr}$
Office Areas	55

Train vibration measurements conducted as part of this assessment will be used to calculate internal noise levels generated from structure borne vibration.

5.3 RAIL TRAFFIC VIBRATION MEASUREMENTS

Train vibration measurements were taken conducted on a number of locations within the site.

The manned measurements were carried out from 8:30am to 10:00am on 29 March 2011.

Equipment used consisted of:

- A Svan 958 AE Sound and Vibration Analyser was used for the vibration measurements. The analyser was connected to a SV08 four channel input module fitted with a Dytran triaxial accelerometer (tri-axial measurements).

Measurements were undertaken at the location set out in Figure 1.

5.3.1 Measurement Results: Vibration Dose Values

The maximum train passby ground vibration acceleration, the typical passby period (gained from both the noise and vibration measurements) and the estimated number of train passbys were used to calculate the overall eVDV values for each period of the day. The results are presented in the table below.

eVDV values were determined based on the number of trains during the daytime. The VDV per train used in the eVDV calculation was determined by using the highest measured vibration level during a passby.

Table 3 - Vibration Dose Values

Test Location	Time Period	Calculated eVDV $m/s^{1.75}$	Criteria eVDV $m/s^{1.75}$	Complies
South-eastern boundary of the site	Day (7am – 10pm)	0.039	0.4	Yes

In the event the future train use increases, say by 10%, predicted eVDV will not increase significantly (no more than approximately 0.02 more than the levels predicted in the table above) and will not impact recommended vibration isolation treatments.

5.4 STRUCTURE BORNE NOISE MEASUREMENTS

Internal noise levels as a result of structure borne noise have been calculated at a number of positions within the development. Noise levels have been determined based on on-site measurements of rail induced vibration.

Table 4 - Structure Borne Vibration Levels

Level	Noise Level Criteria dB(A)L_{MAX}	Calculated/Measured Noise Level dB(A)L_{Max}	Complies
Ground	55	32	Yes

5.5 RECOMMENDATIONS

The results of the investigation of vibration generated from train passbys from the Eastern Suburbs & Illawarra Train Line revealed that the internal regenerated noise levels will comply with recommended noise level recommendations, and no additional vibration isolation treatment is needed.

6 CONSTRUCTION NOISE EMISSIONS

The Director General Requirement Number 15 states the following with relation to noise emissions during the demolition and construction of the development.

> *"15. Noise and Vibration*
>
> *· Provide a quantitative assessment of the potential demolition, construction, operation and traffic noise impacts of the project."*

We note that detailed methodology statements for the demolition, excavation and construction of the development are not available at Part 3A Application stage, and as such, an assessment and subsequent treatment of items cannot be undertaken at this stage. We recommend that a detailed assessment of noise emissions from construction activities be undertaken at Construction Certificate Stage. Notwithstanding this, we make the following general recommendations in order to limit noise and vibration emissions:

- During excavation – use of ripping where possible rather than hammering.
- Use bored piles rather than any driven piles where possible;

The implementation of the above significantly reduces the affects of vibration to adjacent occupancies.

It is the responsibility of the engaged contractor to ensure vibration monitoring is conducted where necessary.

Once a construction methodology has been developed, a construction noise and vibration management plan can be developed in order to address the acoustic requirements of the DECC Interim Construction Noise Guidelines and AS2436.

7 CONCLUSION

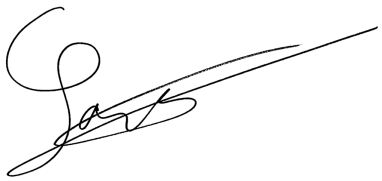
This report provides the results of our assessment of train vibration and traffic noise effects on the amenity of tenants within the proposed commercial development at 84-86 Kiora Road.

The assessment has been conducted with reference to the SEPP (Infrastructure) 2007 and the Department of Planning's *Development near Rail Corridors and Busy Roads –Interim Guideline* as required by the Sutherland Shire Council, and AS2107.

Provided that the treatments set out in section 4.3 and 5.5 of this report are adopted noise/vibration impacts on tenants will comply with relevant acoustic criteria.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,



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