Project No: 14977

Noise Impact Assessment
Mixed Use and Residential Development
142 – 146 Dudley Road, Whitebridge, NSW

Prepared for:

SNL Building Constructions Pty Ltd
P.O. Box 4222,
Cardiff NSW, 2285

Author:

Ross Hodge
B.Sc.(Hons)

Principal / Director

Review:

Neil Pennington
B.Sc., B. Math.(Hons), MAAS, MASA

Principal / Director

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INTRODUCTION

This report provides the results, findings and recommendations arising from an acoustical assessment of a proposed mixed use and residential development at 142 to 146 Dudley Road, and 2, 2A and 4 Kopa Street, Whitebridge (described as Lot 2 DP 436503, Lot 3 DP 436503, Lot 1 DP 349377, Lot 2 DP 349377, Lot 3 DP 349377, Lot 4 DP 663765, Lot 1 DP 436503, Lot 2 DP 26039, Lot 3 DP 26039).

Site details have been obtained from inspections and also with reference to plans obtained from the proponent (plans by Smith & Tzannes, dated August 2014).

The assessment was requested by SNL Building Constructions Pty Ltd to support a D.A. to Lake Macquarie City Council (LMCC).

Table 1 contains a glossary of commonly used acoustic terms and is presented as an aid in understanding this report.

TABLE 1
GLOSSARY OF ACOUSTICAL TERMS

Term	Definition
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level – The summation of noise events integrated over a selected period of time. This noise descriptor is commonly used to correlate noise exposure and human annoyance.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period
L10	Average Maximum Noise Level - the level exceeded for 10% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level.

BACKGROUND TO THE PROPOSAL

The development is to consist of residential units and retail and commercial space as shown in **Figure 1**.

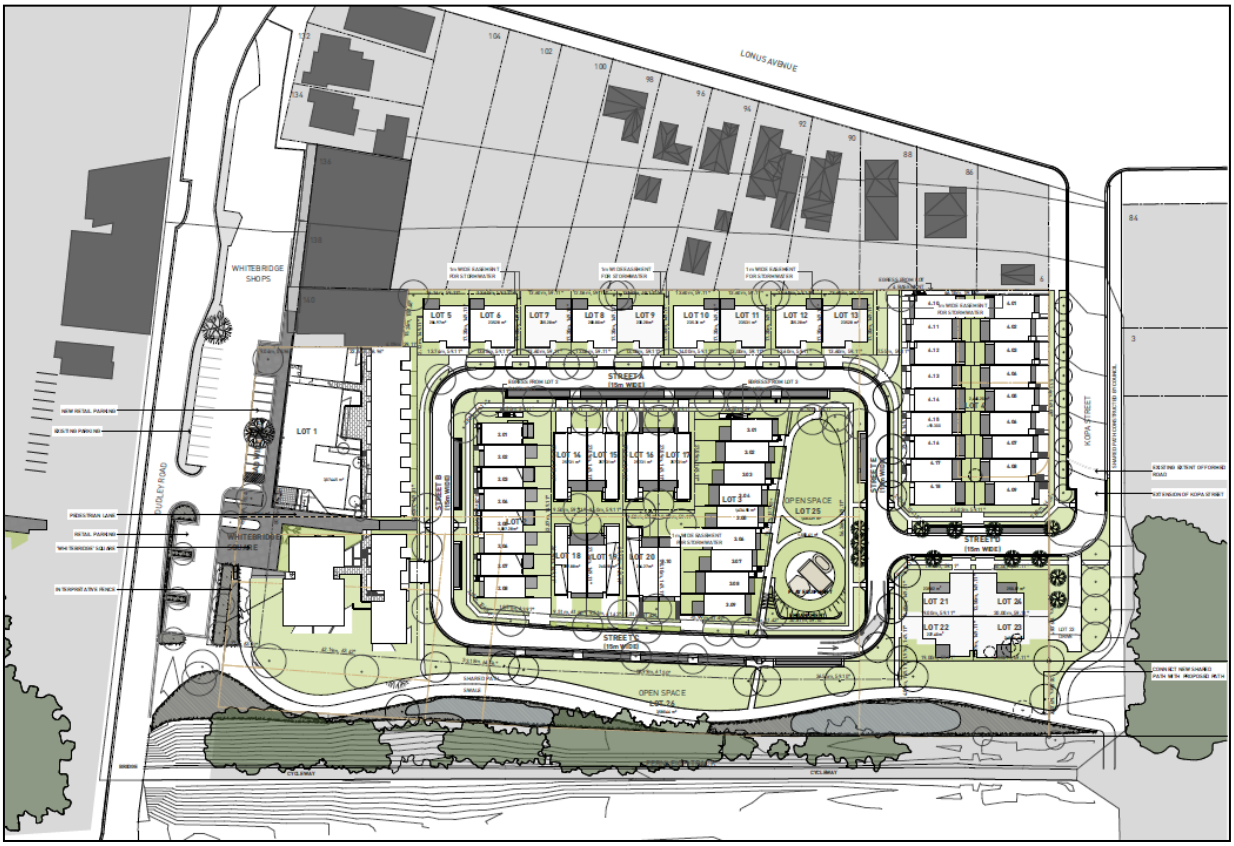


Figure 1 – Site Plan

The works are to consist of;

- Demolition of two dwelling houses and associated outbuildings on Kopa St;
- Construction of 20 x 2-3storey dwellings as small lot housing;
- Construction of 6 x 3 - 4 storey residential flat buildings containing 49 dwellings;
- Construction of a 4 - 5 storey mixed use development containing 22 dwellings; and 325m2 commercial space;
- Construction and dedication of roads, including parking, paths and drainage;
- Creation of park with play equipment,
- Landscaping and revegetation; and
- Associated earthworks access, infrastructure and utility services.

LMCC has specifically requested an acoustic assessment be undertaken prior to issue of a construction certificate for the build form of the development.

The assessment shall consider and, where necessary, make recommendations to ensure that:

• Occupants of the proposed unit development dwellings are not adversely impacted by noise from the existing adjacent commercial premises, proposed internal commercial activities, or traffic noise from Dudley Road, which is classified as an arterial road.

• Noise from the proposed development will not adversely impact on the amenity of the existing neighbourhood, and in this regard, air conditioners, mechanical plant, internal traffic noise and additional traffic flows to the existing streets.

• Noise impact from construction site noise and vibration, and the need (if any) to carry out dilapidation surveys of existing affected residential and commercial premises, if there is any likelihood of structural damage caused by pile driving, jack hammering, scrabbling or the use of vibration rollers.

EXISTING ACOUSTIC ENVIRONMENT

Two Acoustic Research Laboratories Environmental Noise Logging Monitors, Type EL-315, were installed on the site to measure the existing acoustic environment.

One logger (Logger 1) was located in the open ground off Dudley Road and the other (Logger 2) was located at the rear of number 2 Kopa Street as shown in **Appendix I**. The loggers were in place from Friday, 14th November until Friday 21st November 2014.

The instruments were programmed to accumulate environmental noise data continuously over sampling periods of fifteen (15) minutes duration for the entire monitoring period. Internal software calculates and stores the Ln Percentile Noise Levels for the chosen sampling period, which are then retrieved for detailed analysis.

Table 2 shows a summary of the relevant measured data from the Dudley Road logger which is also shown graphically in Appendix I.

TABLE 2 MEASURED AMBIENT NOISE LEVELS – LOGGER 1 142 DUDLEY ROAD 14/11/14 to 21/11/14			
	Noise Levels dB(A)		
Percentile	Day	Evening	Night
L_{90}	46	40	35
L_{eq}	55	51	49

The acoustic environment of the area is dominated by traffic noise with minor commercial and domestic noise.

The assessment of traffic noise impacts is based on the day time period being 7 am to 10 pm and the night being 10 pm to 7am. Traffic noise has the potential to create adverse impacts on parts of the development close to Dudley Road. **Table 3** shows the relevant traffic noise metrics taken from the noise logger located near Dudley Road.

TABLE 3 MEASURED TRAFFIC NOISE LEVELS – LOGGER 1 142 DUDLEY ROAD 14/11/14 to 21/11/14		
	Noise Levels dB(A)	
Percentile	Day (15hr)	Night (9hr)
L_{eq}	55	49

Table 4 shows a summary of the relevant measured data from the logger at Kopa Street which is also shown graphically in Appendix I. The data for the logger at Kopa Street contained some spurious peaks at around 7 pm for the first few evenings (of 15 to 30 minutes duration). This may have been a result of noise from birds or insects near the microphone. To avoid any undue influence the data from these periods was removed prior to further analysis.

TABLE 4 MEASURED AMBIENT NOISE LEVELS – LOGGER 2 2 KOPA STREET 21/11/14 to 28/11/14			
	Noise Levels dB(A)		
Percentile	Day	Evening	Night
L_{90}	42	36	32
L_{eq}	48	49	44

The acoustic environment of the area is characterised by noise from distant traffic with influence from natural and domestic noise sources.

NOISE ASSESSMENT CRITERIA

Mechanical Plant

The *NSW Industrial Noise Policy* (INP) sets out two separate noise criteria designed to ensure developments meet environmental noise objectives. The first criteria account for intrusive noise and the others apply to the protection of amenity of particular land uses. Depending on the existing acoustic environment, a new development is usually assessed by applying both criteria to the situation and adopting the more stringent of the two.

The amenity criterion is designed to protect areas from increasing industrial noise. As such, the acceptable noise levels for various receiver types listed in the INP refer only to noise from industrial sources.

The site of the proposed development is relatively remote from major industrial noise sources. The logger location was dominated by noise from natural and domestic sounds and traffic noise. There are commercial premises near the western extent of the proposed devolvement but noise from activity at those premises would not have significantly affected the measured results.

In this instance then the Intrusiveness criteria (background + 5dB(A)) are the ones applicable to the assessment. The Project Specific Noise Goals (PSNG) for residential receivers for the assessment are thus shown below in **Table 5**.

The PSNG's are shown for residences in a similar acoustic environment to Logger 1 (Dudley Road) and for residences in a similar acoustic environment to Logger 2 (Kopa Street).

TABLE 5
PROJECT SPECIFIC NOISE GOALS

Period	Intrusiveness Criterion* L_{eq} (15 min) dB(A)	
	Dudley Rd	**Kopa St**
Day (7am to 6pm 6 days, 8am to 6pm Sunday)	**51**	**47**
Evening (6pm to 10pm)	**45**	**41**
Night (all other times)	**40**	**37**

* - Rating Background Level (RBL) + 5 dB. RBL is the median value of each ABL (Assessment Background Level) over the entire monitoring period. The ABL is a single figure representing the "L90 of the L90's" for each separate day of the monitoring period.

Road Traffic

In relation to traffic generated by the development, the NSW Road Noise Policy (RNP) as adopted by the Transport, Roads and Maritime

Services (RMS) NSW, recommends various criteria for different road developments and uses.

Traffic generated by the current proposal will travel along local roads (initially Kopa Street and then onto the local road network). An extract from Table 3 of the RNP relating to land use developments with the potential to create traffic on local roads is shown in **Table 6**.

The RNP also details specific criteria for land use developments with the potential to create traffic on local roads and impacting on childcare facilities. These criteria (from Table 4 of the RNP) are also shown in Table 6.

TABLE 6
BASE TRAFFIC NOISE OBJECTIVE

Situation	Recommended Criteria	
	Day - (7am - 10pm)	Night (10pm – 7am)
6. Existing residences affected by additional traffic on existing local roads generated by land use developments	55 Leq(1hr) External	50 Leq (1 hr) External
8.Childcare Facilities	Sleeping rooms - 35 Leq(1hr) (internal) Indoor play areas - 40 Leq(1hr) (internal) Outdoor play areas - 55 Leq(1hr) (external)	

NOISE ASSESSMENT

Mechanical Plant

The proposed development is at the application stage. As such, locations and specifications of all mechanical plant items, such as air conditioners, have yet to be finalised.

Noise from mechanical plant may impact on surrounding residential areas. As it is possible some mechanical plant may run at any time of the day, the lower of the criteria, that for night-time, has been used here to determine any potential noise impacts. This is, **40 dB(A) Leq (15 min)** and **37 dB(A) Leq (15 min)** for nearby surrounding residential receivers.

It is envisaged that the residential units will each be individually air conditioned with split system a/c units. The major potential for adverse noise impacts, to the existing neighbourhood, from air conditioning condensers will be from those located near the boundaries of the site. That is, at Lots 1, 5 to 13 and 4.

Lot 1 will have a basement car park and all air conditioning condensers for units in this Lot will be located within that car park. Similarly, the condensers for air conditioning plant associated with the retail spaces will also be located within the car park. As the basement car park is fully enclosed noise from the condensers there will be adequately attenuated by the structure of the car park, and intervening building elements and barriers, such that further assessment of potential noise impacts from emissions from such condensers is not considered warranted.

Lots 5 to 13 will share a boundary with existing residences along Lonus Avenue.

Typically air conditioner condensers for this sort of application have an Lw in the range 64 to 70 dB(A). Assuming each condenser has an average Lw of 68 dB(A) Leq (unshielded), this means that compliance with the most stringent night time criterion (37 dB(A) Leq (15 min) will be achieved at a distance of 14m.

A condenser in Lots 5 to 13 with an outdoor Lw of 68 dB(A) must, therefore, not be located, unshielded, with 14m of the boundary of the site to Lonus Avenue.

A condenser in Lots 5 to 13 with an outdoor Lw of 64 dB(A) must, therefore, not be located, unshielded, within 9m of the boundary of the site to Lonus Avenue.

The Lw and location of each condenser unit should be reviewed by an acoustic consultant prior to installation.

Lot 4 will also have a basement car park and all condensers will be located within this. The noise from them will be adequately attenuated by elements of the building.

The potential for adverse impacts to residences within the proposed development must also be considered. Lots 2 and 3 will have basement level car parks and all condensers located within these will be adequately attenuated as discussed above.

Any condensers for Lots 14 to 20 and 21 to 24 must be located such that they are either a minimum of 9 or 14m (depending on the Lw of the condenser) from the neighbouring Lots or are adequately shielded in the direction of all other Lots by building elements or enclosures. The Lw and location of each condenser unit should be reviewed by an acoustic consultant prior to installation.

As indicated the discussion above is for the theoretical noise level based on the assumptions detailed. The results have shown, though, that compliance with the criterion can be readily achieved using

reasonable and feasible noise control techniques. It is recommended that an acoustic consultant approve final selection of plant type and location (and or construction of any enclosures) prior to construction.

It is very important that vibrating equipment such as a/c condenser units must be mounted such that vibrations cannot transfer to the surrounding building structure.

Vent Fans

The development may require car park vent fans which will have roof mounted exhaust outlets.

Noise associated with vent fans can come from both "break out" through ducting, and from "down duct" noise emanating from the end of ducting. To reduce break out noise, lined ducting should be used where there is the possibility of noise impacting on adjoining or neighbouring apartments or residences. Rectangular sheet metal duct work attenuates low frequency noise, but in doing so has increased break out noise levels. Cylindrical duct work will have a reduced break out level (useful in exposed locations) but also reduced low frequency noise attenuation.

To minimise down duct noise, a silencer, or silencers could be fitted either directly after the fan, or near the end of the ductwork. If possible, restrictions to air flow near the outlet of duct work, such as 90 degree bends etc., should be avoided.

To avoid the possibility of structure borne noise due to vibrations, all duct work for both HVAC and car park venting must be isolated from the main structure of the building. Duct and pipe penetrations must be kept free of the structure either by externally lagging or by use of non-setting sealants at the point of penetration.

A car park vent will typically extend approximately 0.5m from roof. The results of noise calculations at a theoretical reception point at 20m from a vent fan outlet are shown in **Table 7**. The scenario considers two vent fans operating in relatively close proximity.

TABLE 7
RECEIVED NOISE – CAR PARK VENT FANS

Item	dB(A) Leq
Sound Power Level (at outlet) x 2	68
Distance Loss to Receiver, (20 m)	-28
Shielding Effects (from roof)	-5
Received Noise	35
Criterion (Night)	37
Noise Impact	**0**

The results in Table 7 show that noise from the car park vent fans will comply with the most stringent night time criterion under the assessed conditions at distances of greater than 20m from the fan outlet. Given the design of the proposed development this will be readily achievable.

TRAFFIC NOISE IMPACTS

Traffic Noise Impacts on the Development

The Environment Protection Agency's (EPA) NSW Road Noise Policy (RNP, 2012), as adopted by RMS, recommends various criteria for different road developments and uses. For new residential developments near roads, the RNP advises that land use developers must meet internal noise goals in the Infrastructure SEPP (Department of Planning NSW, 2007). The SEPP (2007) is supported by the Department of Planning guideline "Development near Rail Corridors and Busy Roads – Interim Guideline" (2008) which gives the following criteria in Section 3.5:

- In any bedroom: **35 dB(A),L_{eq}** at any time 10pm – 7am, and
- Anywhere else in the building (other than a garage, kitchen, bathroom or hallway): **40dB(A),L_{eq}** at any time.

These criteria originated from the Rail Infrastructure Corporation (RIC) publication "Consideration of Rail Noise and Vibration in the Planning Process" (2003) where it is explicit that the criteria apply with windows and doors closed.

Figure 2 is a reproduction from the Interim Guideline (2008) showing a hypothetical situation of a dwelling adjacent to a busy road.

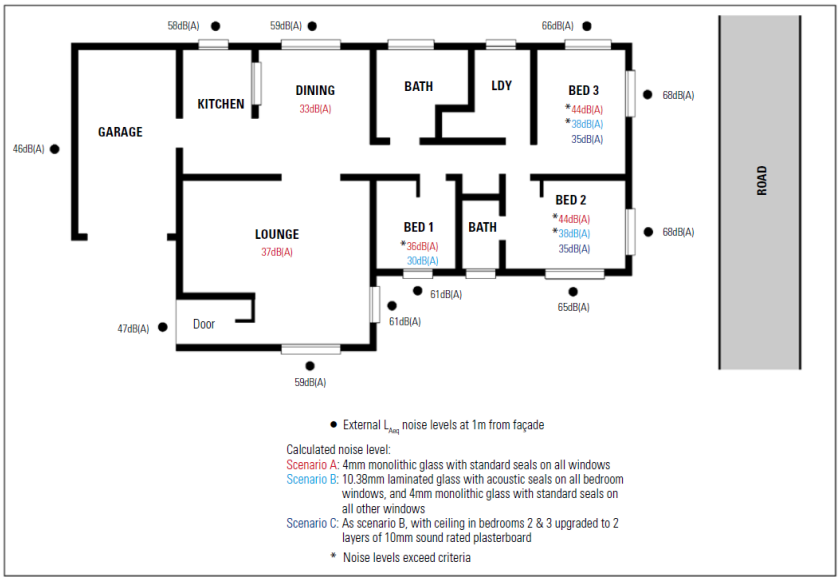


Figure 2. Traffic noise reduction for various construction types.

Acoustic consultants often use Interim Guideline (and Figure B2 specifically) in recommending architectural modifications to achieve the recommended noise levels.

Figure 2 shows that typical building construction with standard window glazing provides a 24dB reduction of traffic noise, implying the following internal traffic noise levels in rooms with windows facing Dudley Road (data taken from Logger 1 as detailed in Table 3):

Period	Traffic noise	Reduction	Internal level
Day	55 dB(A),$L_{eq(15hour)}$	24 dB	31 B(A),$L_{eq(15hour)}$
Night	49 dB(A),$L_{eq(9hour)}$	24 dB	25 dB(A),$L_{eq(15hour)}$

These levels are below the adopted internal noise criteria by 9 and 10 dB(A) for living rooms (day) and bedrooms (night) respectively. Rooms with windows not directly facing Dudley Road would experience lower internal noise levels. Based on this analysis, standard building construction and glazing, in all proposed residences, will achieve the traffic noise levels recommended in the Guideline.

Traffic volumes on roads within the site will be at significantly lower levels than those on Dudley Road. The traffic on the site will also be travelling at far lower speeds than Dudley Road. The traffic noise impacting on the façade of the receivers within the development will, therefore, be at significantly lower levels than those facing Dudley Road and they will not require specific acoustic treatment.

Traffic noise within the development will be similar to that of a typical, quiet suburban road.

Traffic Noise Impacts as a result of the Development

Noise from traffic associated with the development and travelling on the public road system is assessed against the criteria in the RNP as detailed in Table 6.

Due to the non-continuous nature of traffic flow to and from the site the OEH accepted Intermittent Traffic Noise guidelines are used to calculate traffic noise levels.

Equation 1 outlines the mathematical formula used in calculating the Leq,T noise level for intermittent traffic noise.

$$L_{eq},T = L_b + 10\log\left[1+\frac{ND}{T}\left(\frac{10^{(L\max - Lb)/10}-1}{2.3}-\frac{\left(L_{\max}-L_b\right)}{10}\right)\right]$$ *Equation 1*

Where;

- L_b is background noise level, dB(A)
- L_{MAX} is vehicle noise, dB(A)
- T is the time for each group of vehicles (min)
- N is number of vehicle trips
- D is duration of noise of each vehicle (min)

Typical vehicle noise levels were sourced from Spectrum Acoustics technical database, while background noise levels are those measured by Logger 2. The Lmax vehicle noise levels used in Equation 1 are the maximum predicted noise levels produced at the facade of a residence by vehicles travelling on local roads.

All traffic entering and leaving the site will do so via Kopa Street. The traffic will then either continue on Kopa Street or turn into Lonus Avenue. The façade of the closest residences to each of these roads is approximately 12m from the centre of the traffic flow (i.e. the centre of the road).

Table 8 shows a calculation, based on Equation 1, of traffic noise impacts at the façade of a receiver located 12m from the centre of traffic flow. Traffic studies for the development have calculated peak hourly vehicle movements based on procedures approved by RMS. A peak rate of 77 trips per hour has been determined and this has been used in the calculations for day time.

TABLE 8 TRAFFIC NOISE – NEARBY ROADS	
Typical Maximum Sound Power @ 50 kph, dB(A)Leq	92
Distance Loss to Receiver, (12 m)	30
Received Noise dB(A)Lmax	62
Traffic Volume, (cars/hr)	77
Time each vehicle audible at 50 kph (mins)	<0.1
Background Noise Level dB(A)	42
Calculated Traffic Noise, dB(A)(Leq 1 hr)	49
Criteria (Day) dB(A) (Leq 1 hr)	55

The results in Table 8 show that there will be no adverse impacts, during the day, as a result of the assessed traffic noise scenario.

The traffic study didn't define a night time peak but the results in Table 8 show that even if the peak of 77 vehicle movements per hour

occurred during the night time the RMS night time criterion would not be exceeded.

Traffic within the development will travel on a ring road with on entrance/exit to Kopa Street. The traffic noise on this road will be effectively screened from the residences in the existing neighbourhood by the building elements of the residences within the development. Upon construction of these buildings there will, therefore, be no adverse impacts on existing residences as a result of noise from traffic moving on roads within the development.

The facade of the child care centre is located approximately 15m from the centre of traffic on Lonus Avenue. Assuming all of the peak hourly traffic passes this point will result in a received noise of 49 dB(A) Leq (1hr) at the façade.

The façade of a typical masonry building with windows closed (as the child care centre is) will attenuate approximately 25 dB(A) of traffic noise (source RMS Environmental Noise Management Manual). This would equate to an internal noise level inside the child care centre of approximately 24 dB(A) Leq (1hr) which is in compliance with the most stringent criterion for a sleeping area.

The outdoor play areas are located at the rear of the child care centre, relative to Lonus Avenue, and approximately 30m from the centre of traffic. The play ground is partially shielded from traffic noise by the building structure of the centre. Under the assessed scenario the received traffic noise will be less than 45 dB(A) Leq (1 hr), which is in compliance with the criterion for an outdoor play area.

Construction Noise

The assessment of construction/demolition noise impacts in NSW is undertaken in accordance with the Office of Environment and Heritage's Interim Construction Noise Guideline (ICNG, 2009). The ICNG is a non-mandatory guideline that is usually referred to by local councils and the NSW Department of Planning and Infrastructure when construction/demolition works require development approval.

Section 1.5 of the ICNG outlines the steps for management of construction noise impacts as follows:

1. **identify sensitive land uses** that may be affected.
2. **identify hours** for the proposed construction works.
3. **identify impacts** at sensitive land uses.
4. **select and apply the best work practices** to minimise noise impacts.

Each of the above four points is assessed in detail in the following sections.

Surrounding Land Uses

The building is in a mainly residential area with some commercial premises along Dudley Road.

Residential receivers adjoin parts of the site generally to the west and north west in Lonus Avenue.

There is a child care centre across Lonus Avenue approximately 80m from the closest parts of the construction works.

There are no other sensitive land users in the near vicinity of the site.

Operating Hours

The recommended standard hours for construction works are shown in Table 1, section 2.2 of the ICNG as reproduced below.

Table 1: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

Construction works outside the hours in Table 1 is normally only permissible for delivery of oversized structures, emergency works, public infrastructure works that are supported by the affected community or where the proponent demonstrates and justifies a need to work outside the recommended standard hours (ICNG, p9).

The construction will be typical of residential or multi storey developments and will be undertaken during the “recommended standard hours” detailed above.

Impacts at Sensitive Land Uses

The ICNG provides two assessment methodologies for construction noise impacts: a ‘qualitative’ assessment where works occur for less than three weeks and a ‘quantitative’ assessment for works of longer

duration. As the construction works will take longer than three weeks, the quantitative methodology is applicable.

Table 2 of the ICNG sets out noise management levels for construction works as reproduced below.

Table 2: Noise at residences using quantitative assessment

Time of day	Management level $L_{Aeq\ (15\ min)}$ *	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Based on the measured background noise levels (from the unattended noise loggers) the daytime construction noise management level is, therefore, **56 dB(A),Leq (15 min)** for residences near Dudley Road and **52 dB(A),Leq (15 min)** for residences further removed from Dudley Road (in the vicinity of Kopa Street) in accordance with Table 2 from the ICNG.

The ICNG identifies child care centres as sensitive land uses but does not contain any specific noise criteria for these. The ICNG recommends that such land uses be identified and included in the noise management procedures for the construction.

Work Practises and Noise Sources

The proponent has advised that the construction works will be carried out over several phases. The first phase of the works will involve the demolition of the two houses on Kopa Street and minor ground clearing/preparation.

The demolition work will involve a small excavator to knock down the structures and a truck to remove the material.

The site is relatively clear and only minor site clearing will be required.

Plant such as rollers, truck and dogs, bobcats and mini excavators will be involved in various aspects of the ground preparation and construction throughout the site. This will involve preparation and construction of slabs and driveways as well as construction of any retaining walls.

For other stages of the construction an excavator will be used to excavate for the basement car parks. Material will be removed from site using a truck and dog, or similar.

It is not envisaged that there will a need for piling on the site, but if there is it will done by screw piling and not pile driving. It is anticipated that the excavation of any rock will be done by ripping.

The buildings will be constructed on conventional frames with structural steel and metal roofing.

The initial phases of the construction will involve use of concrete agitator trucks, concrete pump and vibrator during concrete pours to form slabs and bases. Cranes would be used to lift materials into place.

The Spectrum Acoustics technical database has been referenced to determine the Lw most applicable to the actual equipment proposed to be used on the site. This level is shown in **Table 9**.

By definition mobile plant such as many of those detailed in Table 9 will move about and will be, be at various operating levels (and thus producing various levels of noise) throughout any 15 minute period.

The level shown in Table 9 is based on measurements of worst case 15 minute Leq noise levels for the machinery under typical operating conditions on a construction site similar to the current project.

TABLE 9 TYPICAL EQUIPMENT SOUND POWER LEVELS	
Equipment	Lw as dB(A) Leq (15 min)
30t Excavator	105
Truck & Dog	107
Roller	106
Bobcat	102
Concrete Agitator	110
Concrete Pump	107
Vibrator	105
Mobile Crane	108

Noise emissions from the construction works will vary throughout individual days and also throughout the length of the overall project. The noise level at individual receivers will also be dependent upon the location of the various works, relative to those receivers, at different times.

To gauge some potential impacts a construction operational scenario for the excavation phase of the works has been considered where an excavator, 2 x truck and dogs and bobcat were all considered to be working in close proximity. As the excavation works will be undertaken at various distances from any individual receivers **Table 10** show the results of a sample calculation of potential noise impacts at several representative distances, as a result of the noise emissions from the described excavation works taking place.

TABLE 10 EXCAVATING NOISE as dB(A) Leq (15 min)				
	@ 30 m	@ 40 m	@ 100 m	@ 200m
Excavating Noise	112	112	112	112
Distance Loss to Receiver	38	40	48	54
Received Noise	74	72	64	58
Criterion	56/52	56/52	56/52	56/52
Impact	18/22	16/20	8/12	2/6

The results in Table 10 show that, during the excavation phase of works some residential receivers surrounding the site will be in the ”noise affected” category as defined in the ICNG. This phase may take up to a several weeks to complete in each stage of the works.

The site preparation and road works phases of the construction will have similar sound power levels as an Leq (15 min) to that of the excavation works. This indicates that the noise emissions from these phases of the works will be at similar levels and with similar impacts at the distances shown.

The calculated results in Table 10 assume a direct line of sight from the noise source (construction works) to the individual receiver. In reality, acoustic shielding from intervening structures such as fences and sheds etc. could result in received noise levels lower than those shown in the tables.

Similarly, houses further removed from the site will be, at least partially, acoustically shielded from the noise by barrier effects of houses closer to the noise source.

This would apply to the earlier of the residences constructed in the development. These would shield existing residences from construction noise further within the site.

The scenarios considered in Table 10 represent a worst case for construction noise emissions from the site. The typical operating noise levels detailed in Table 7 show that the noise from other plant and machinery to be used on the site will be at lower levels than those calculated in Table 10 or will likely be on site for significantly shorter duration. Under these circumstances, resultant received noise and/or potential impacts at the various residences around the site will, therefore, also be at lower levels than those shown in the table.

The results show that, under the assessed conditions, at distances of less than about 30m from the excavation works receivers may be in the “highly affected” zone as defined in the ICNG.

Vibration

Human Comfort

Various authorities have set maximum limits on allowable ground and building vibration in different situations. In this report, vibration criteria were obtained from the DECCW publication *“Assessing Vibration: A Technical Guideline”* (AVTG, 2006).

The AVTG indicates that the assessment of intermittent vibration should be done using a vibration dose value (VDV), which is defined as the fourth root integral with respect to time of the acceleration after it has been weighted. The VDV is fully described in British Standard BS 6472: 1992 “*Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*”.

The guideline indicates that the vibration criteria are based on the effects of vibration on people. That is, it is stated that individuals can detect building vibration values that are well below those that can cause any risk of damage to the building or its contents. The level of vibration that affects amenity is, therefore, lower than that associated with building damage.

Vibration associated with machinery carrying out construction works would be considered to be intermittent in nature. **Table 11** shows the acceptable VDV's for intermittent vibration taken from Table 2.4 of the AVTG.

TABLE 11
ACCEPTABLE VDV's FOR INTERMITTENT VIBRATION ($m/s^{1.75}$)

Area, Time	Preferred Value	Maximum Value
Residential – Day	0.20	0.40
Residential – Night	0.13	0.26

Day time is between 7am and 10pm

Based on the data presented in Table 11 and procedures set out in Appendix B of the AVTG, a maximum allowable peak particle velocity for day time of 8.4 mm/s applies to excavator induced ground vibration, which is typically at frequencies greater than 10Hz.

Building Damage

There are a number of Standards designed for the assessment of damage to building structures, one frequently referred to is German Standard DIN 4150: Part 3-1986 *Structural Vibration in Buildings – Effects on Structures*. DIN 4150 presents a series of "safe limit" values below which no damage due to vibration has been observed (as shown in **Table 12**).

Damage is specifically defined as including minor superficial cracking, the enlargement of existing cracks in cement render and the separation of partitions from load bearing walls.

TABLE 12
STRUCTURAL DAMAGE SAFETY LIMITS FOR BUILDING VIBRATION

Gp	Type of Source	Vibration Velocity in mm/s			
		At Foundations		Plane of Floor of Uppermost Story	
		<10 Hz	10 - 50 Hz	50-100 Hz	All Freqs
1	Buildings used for commercial purposes, industrial buildings and similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design or use.	5	5 - 15	15 - 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in 1, or 2 and have intrinsic value (e.g. buildings under a preservation order).	3	3 to 8	8 to 10	8

A more recent standard than DIN 4150 for assessing building damage is British Standard BS 7385: Part 2 – 1993 *Evaluation and Measurement of Vibration in Building part 2*. This standard was developed following a full review of available data, including other

international standards, publications, and a review of UK data. The standard concludes by providing guidance for threshold values corresponding to the minimum risk of cosmetic damage from vibration. Details are shown in **Table 13**.

TABLE 13
TRANSIENT VIBRATION LEVELS FOR COSMETIC DAMAGE

Line	Type of Building	Peak Particle Velocity	
		4 Hz to 15 Hz	> 15 Hz
1	Reinforced or framed structures - Industrial or heavy commercial buildings	50 mm/s	50 mm/s
2	Un-reinforced or light framed commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

BS 7385 specifically notes:

- Historic buildings should not to be assumed to be more sensitive to vibration (unless structurally unsound); and
- Structures below ground are known to sustain higher levels of vibration and are very resistant to damage, unless in poor condition.

Using the most stringent of the damage criteria for residential buildings, an allowable peak particle velocity of 5 mm/s (from **Table 12**) has been adopted as the criterion for this assessment.

The potential for vibration impacts will come from the use of the excavator and, to a lesser extent, the movement of dump trucks around the site. Typical vibration levels associated with these activities are shown below in **Table 14** (Sources: RMS Environmental Noise Management Manual and Spectrum Acoustics technical database).

TABLE 14
TYPICAL VIBRATION LEVELS – CONSTRUCTION PLANT @ 10m

Plant Item	Peak Particle Velocity mm/s
Loaded Truck	1 - 2
Excavator	< 2
Dozer	1.5 - 4
7 tonne compactor	4 - 7
Roller	4 - 6
Jackhammer	0.5

The typical vibration levels shown in Table 14 indicate that received vibration levels will be less than a peak particle velocity of 2 mm/s at distances of approximately 10 m from an excavator.

The attenuation of vibration through the ground is highly dependent upon ground type. For hard soils and densely compacted sands the attenuation is approximately inversely proportional to distance. That is, at double the distance from the source the vibration level will be halved. The attenuation through hard rock is lower than this and through soft soil significantly higher.

A detailed analysis of the ground types on the site has not been undertaken for this assessment and a hard packed soil has been assumed.

There will be no construction works undertaken within 20m of any existing residences (except those to be demolished). For the current site this indicates that received vibration levels would be below the adopted human comfort and building damage criteria at all receivers.

As indicated previously in this report, if piling is required then this will be done by screw piling methods. Vibration levels from screw piling are generally no higher than that of heavy machinery moving on site (e.g. excavator or similar). Should impact pile driving be found to be necessary then it is recommended that a site specific vibration assessment be undertaken to determine any potential impacts.

CONCLUSIONS

A noise assessment has been carried out in regard to the proposed mixed use and residential development at 142 to 146 Dudley Road, and 2, 2A and 4 Kopa Street, Whitebridge (described as Lot 2 DP 436503, Lot 3 DP 436503, Lot 1 DP 349377, Lot 2 DP 349377, Lot 3 DP 349377, Lot 4 DP 663765, Lot 1 DP 436503, Lot 2 DP 26039, Lot 3 DP 26039).

The results of the assessment have shown that noise from air conditioner condensers associated with the development can readily be controlled to achieve compliance with the applicable noise goals. The final type and location of all plant items must be reviewed by an acoustic consultant prior to construction.

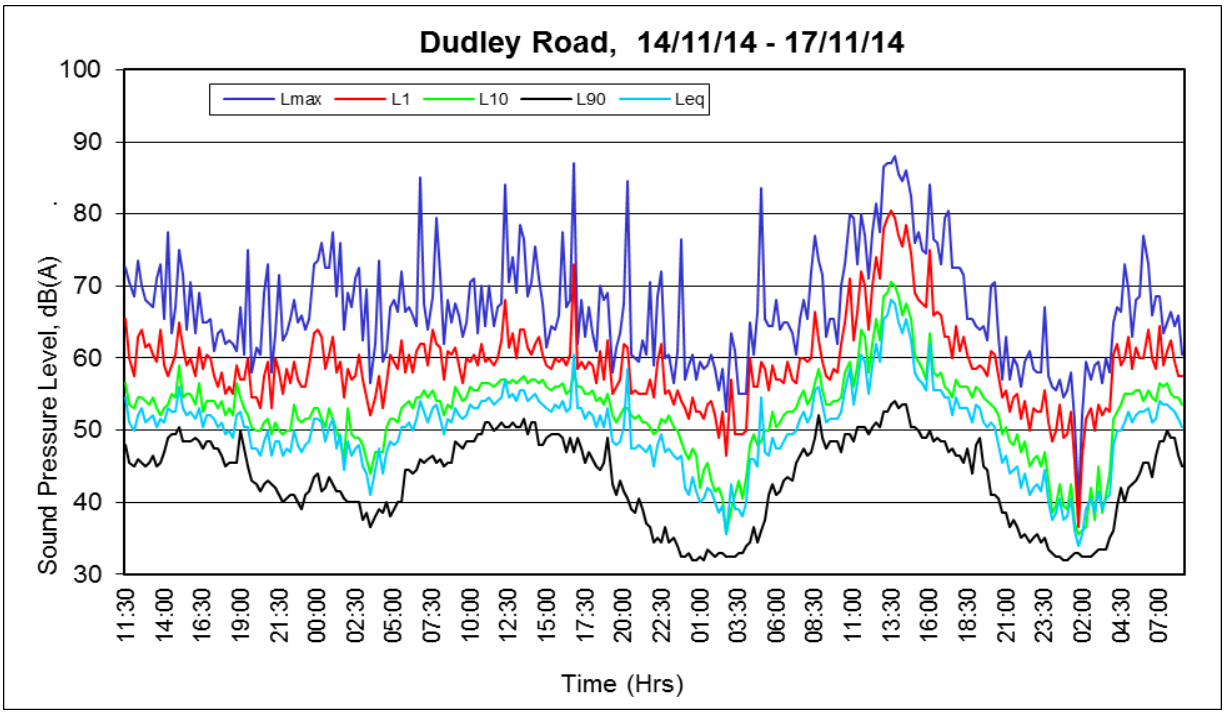
Received noise from car park vent fans will be below the most stringent noise goal at all times.

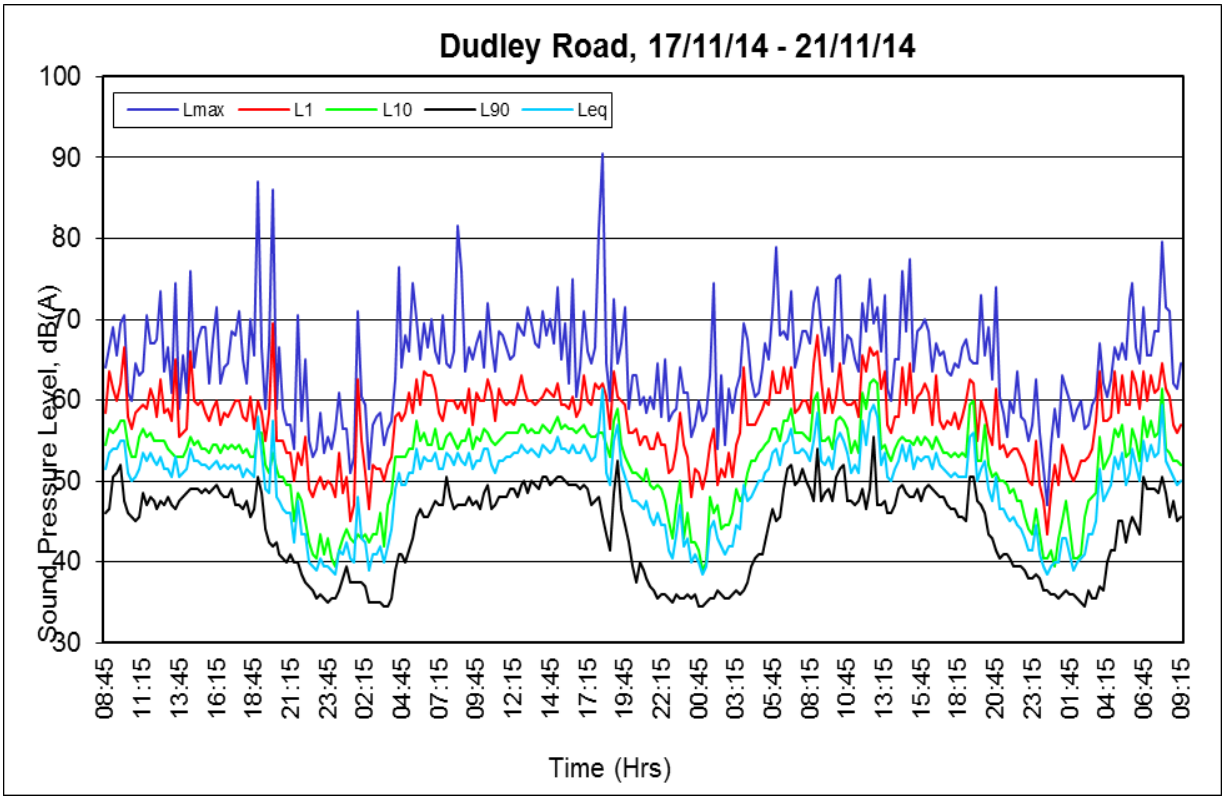
Under the assessed conditions, there will be no adverse impacts on the acoustic amenity of existing residences in Lonus Avenue as a result of noise emissions from traffic on roads within the development.

There will be no adverse noise impacts as a result of noise from traffic created by the development.

Appendix I

Noise Logger Charts


Dudley Road, 14/11/14 - 17/11/14
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
100
90
80
70
60
50
40
30
11:30
14:00
16:30
19:00
21:30
00:00
02:30
05:00
07:30
10:00
12:30
15:00
17:30
20:00
22:30
01:00
03:30
06:00
08:30
11:00
13:30
16:00
18:30
21:00
23:30
02:00
04:30
07:00
Time (Hrs)


Dudley Road, 17/11/14 - 21/11/14
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
100
90
80
70
60
50
40
30
08:45
11:15
13:45
16:15
18:45
21:15
23:45
02:15
04:45
07:15
09:45
12:15
14:45
17:15
19:45
22:15
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03:15
05:45
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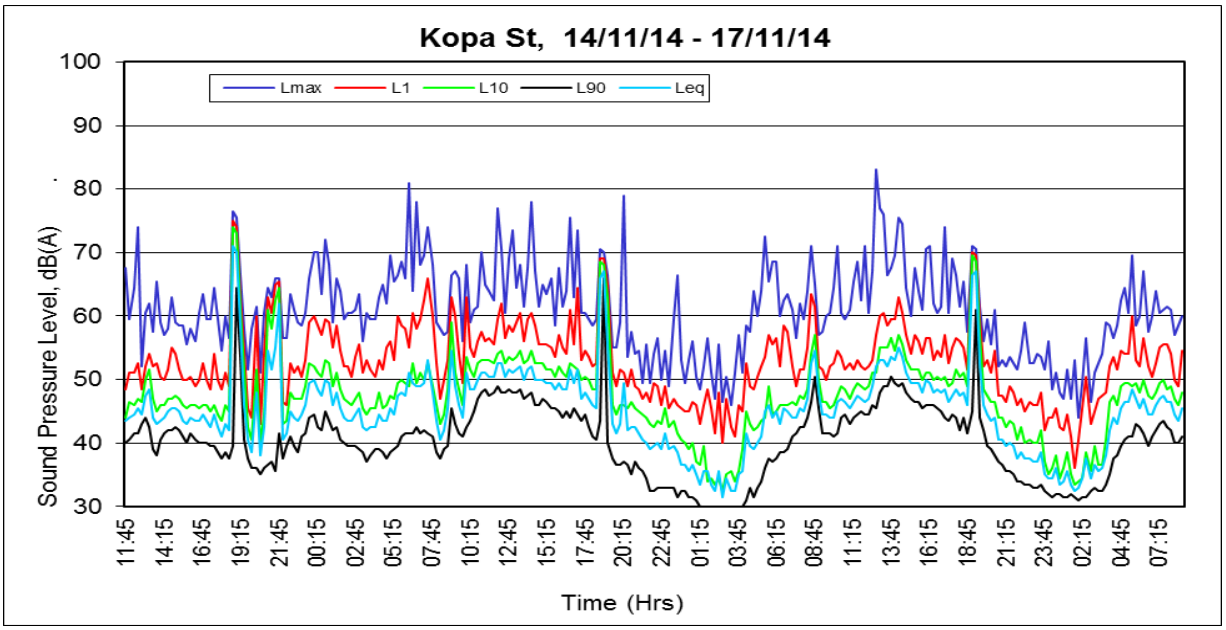
01:45
04:15
06:45
09:15
Time (Hrs)


Kopa St, 14/11/14 - 17/11/14
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
100
90
80
70
60
50
40
30
11:45
14:15
16:45
19:15
21:45
00:15
02:45
05:15
07:45
10:15
12:45
15:15
17:45
20:15
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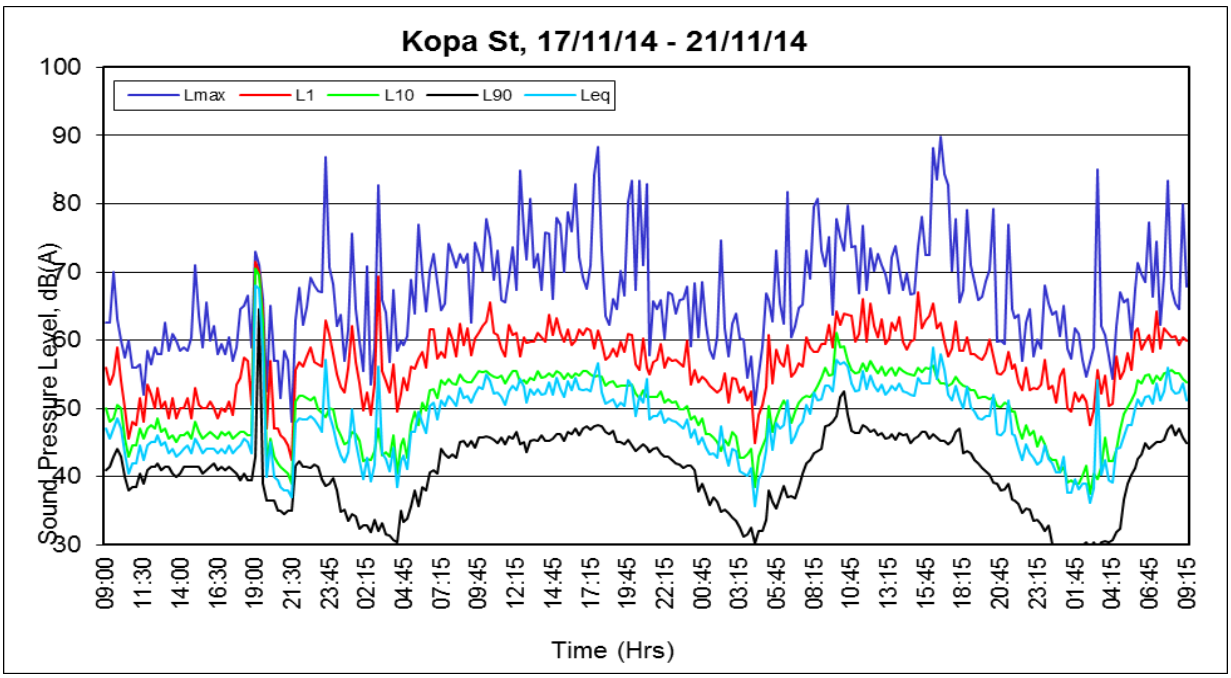
18:45
21:15
23:45
02:15
04:45
07:15
Time (Hrs)


Kopa St, 17/11/14 - 21/11/14
Lmax
L1
L10
L90
Leq
Sound Pressure Level, dB(A)
100
90
80
70
60
50
40
30
09:00
11:30
14:00
16:30
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18:15
20:45
23:15
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04:15
06:45
09:15
Time (Hrs)


Logger 2
Logger 1
Dudley Rd
Farnleigh Track
Google earth

Logger 1

Logger 2