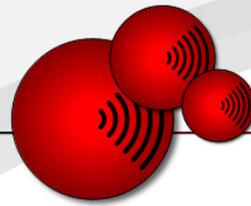


Appendix 15: Construction Noise and Vibration Assessment – Acoustic Engineering Services



Report Number: AC18127 – 03 – R2

Dee Street Hotel development, Invercargill: Assessment of Construction Noise Effects

Prepared for:

The Building Intelligence Group
PO Box 448
CHRISTCHURCH 8140

20 June 2018

Acoustic Engineering Services
Level 2, 518 Colombo Street
Christchurch 8011
PO Box 549
Christchurch 8140
Ph 03 377 8952
Email: office@aeservices.co.nz



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Author:



Ms Clare Dykes
MBS, MASNZ
Acoustic Engineer

Reviewed & Approved:



Dr Jeremy Trevathan
Ph.D. B.E.(Hons.) Assoc. NZPE® MASNZ
Managing Director

On behalf of Acoustic Engineering Services Limited 20 June 2018

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1.0 BACKGROUND

Acoustic Engineering Services (AES) has been engaged by the Building Intelligence Group on behalf of the Applicant to undertake an assessment of construction noise effects in relation to a Resource Consent Application for the development of a hotel on the corner of Dee Street and Don Street, in Invercargill. The Applicant requires an assessment of the construction noise emitted by this activity, with regard to the Resource Management Act (RMA).

We have based our analysis on the following documentation:

- Concept architectural drawings titled *ILT New Hotel, Dee Street*, as prepared by Warren and Mahoney, and dated the 2nd of May 2018.
- Geotechnical Desktop Study titled *73-81 Dee Street, Invercargill*, as prepared by GeoSolve Limited, and dated April 2018.
- Demolition Management Plan titled *ILT Hotel Site, Corner Don and Dee Streets, Invercargill*, as prepared by Ryal Bush Demolition, and dated the 19th of April 2018.
- Demolition report titled *Invercargill Licensing Trust: Demolition of 57-81 Dee Street*, as prepared by Beca Limited, and dated the 6th of June 2018.
- Master Programme titled *ILT Master Program 10.04.18*, as prepared by The Building Intelligence Group, and dated the 10th of April 2018.

1.1 Site and surrounding area

The subject site is located on the corner of Dee Street and Don Street in Invercargill, and comprises of sites 1 – 11 Don Street, and 57 – 81 Dee Street. The site is bound by Don Street to the north, a Wilsons car park to the east, the 55 Arcade and \$2 shop to the south, and Dee Street to the west.

The site is located within the Invercargill District Business 1 zone, as shown in the Invercargill District Plan (Planning Map 9), as are those to the north across Don Street, to the west across Dee Street, and to the east and south.

The site currently contains four buildings. The Langford Building (73 – 81 Dee Street) is located on the corner of Dee and Don Street and is a three-storey concrete / brick building. To the east of this is the Kiln / Art Gallery building (5 – 7 Don Street) which is single storey and comprised of concrete / concrete block. The State Insurance Building (11 Don Street) is further to the east and is a double storey brick / concrete building. To the south of the Langford Building is a two-storey concrete / brick building (57 – 67 Dee Street) currently occupied by Barluca and Nudax. There is a small car park accessed from Don Street located behind 11 Don Street.

The site is surrounded by mixed retail, hospitality and commercial buildings, along with several residential and visitor accommodation facilities, as shown in figure 1.1 below. The closest of these are residential apartments located in the upper level of the historic Alexandra Buildings across the road at 83 Dee Street, and apartments in the upper level of 55 Dee Street, directly adjoining the site. Across Dee Street is The Grand Accommodation and the Tuatara Backpackers.

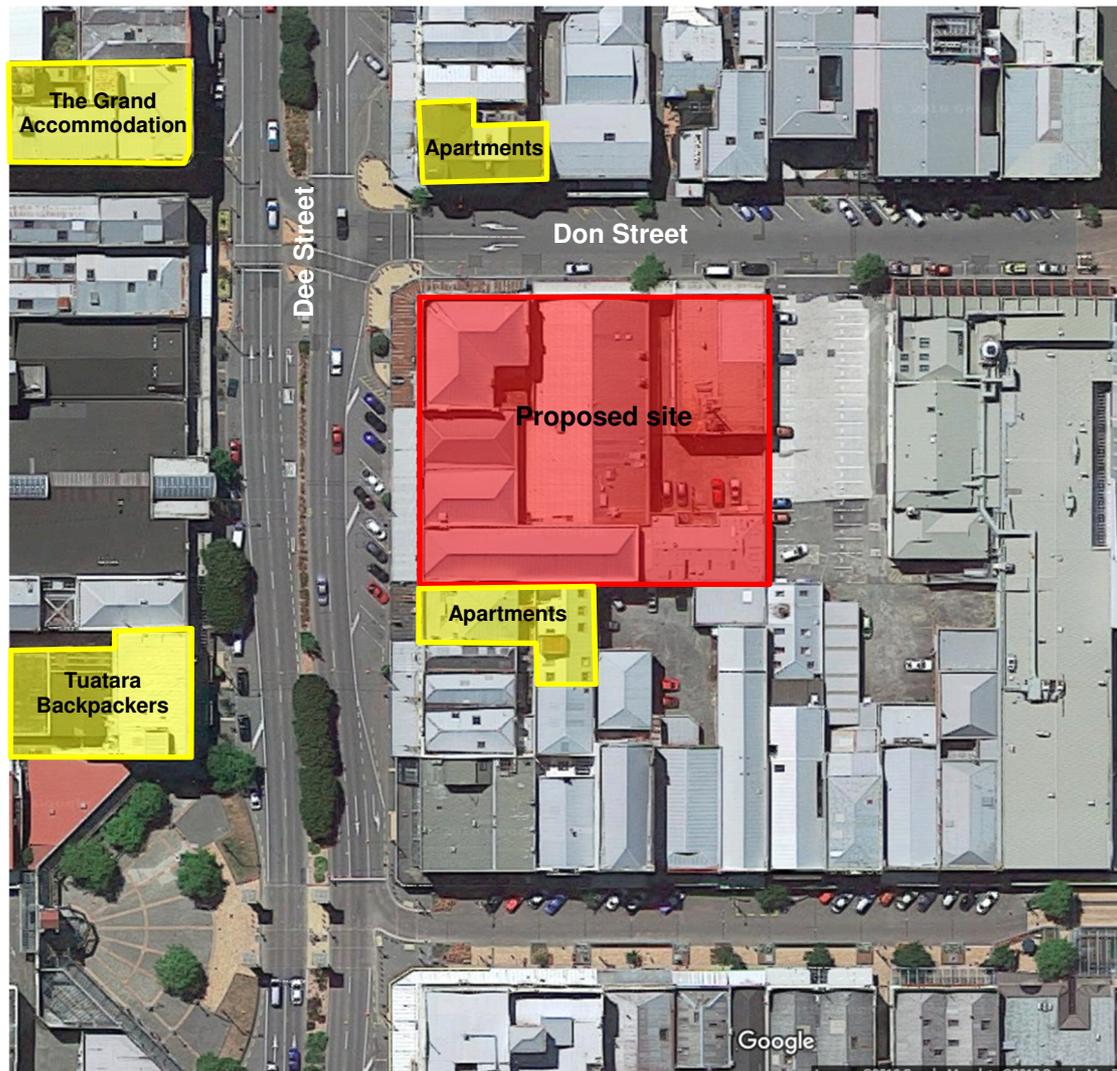


Figure 1.1 – Site and surrounding area

1.2 Proposed redevelopment

The existing buildings on the site are to be demolished to allow the new hotel to be constructed. The hotel will comprise of a building along the northern portion of the site, and carparking to the south. The overall development will house 80 bedrooms with associated car parking, restaurant, café / bar and functions rooms.

2.0 ACOUSTIC CRITERIA

2.1 Invercargill District Plan

The site and those surrounding are located within a Business 1 zone as defined in the Invercargill District Plan. Therefore, the following rule outlined in *Section 3 Rules, 3.13 Noise, 13.13.4* applies to the site as follows:

3.13.4 *Construction noise is to comply with the following noise limits:*

<i>Days and Times</i>	<i>Noise Limit</i>
<i>Monday to Saturday 0730 – 1800</i>	<i>70 dB L_{Aeq} and 85 dB L_{Amax}</i>
<i>All other times</i>	<i>45 dB L_{Aeq} and 75 dB L_{Amax}</i>

2.2 New Zealand Standard NZS 6803:1999

NZS 6803:1999 contains guidelines for the setting of construction noise limits, as these limits will depend on different situations, as explained in section C7.1.1: “*The acceptability of construction noise in any community is likely to depend on the potential for interfering with activities, the expected duration of the noise and the existing background sound level at the places affected...*”.

The standard provides noise limits for construction activities for three durations. This is because higher noise levels are tolerable for short term activities as opposed to those of a more permanent nature. As the project demolition and construction timeframe is expected to be more than two years, the noise limits for ‘long-term duration’ (more than 20 weeks) would apply. These noise limits apply at 1 metre from the noise-sensitive neighbouring buildings.

Table 2.1 – Noise limits for construction noise received in commercial areas for all days of the year outlined in NZS6803:1999

Time period (hours)	Duration of work		
	Typical duration (dB)	Short-term duration (dB)	Long-term duration (dB)
	L _{Aeq}	L _{Aeq}	L _{Aeq}
0730-1800	75	80	70
1800-0730	80	85	75

However, as discussed above there are residential and visitor accommodation facilities within the vicinity of the site which are more noise sensitive than a standard commercial building during the night-time period.

NZS 6803 states that the night time limits in table 2.2 below shall “*apply to activities carried out in industrial or commercial areas where it is necessary to prevent sleep interference, specifically where there are residential activities, hospitals, hotels, hostels, or other accommodation facilities located within commercial areas*”.

Table 2.2 – Noise limits for construction noise received in residential zones and dwellings in rural areas outlined in NZS6803:1999

Time of week	Time period	Duration of work					
		Typical duration (dB)		Short-term duration (dB)		Long-term duration (dB)	
		L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}	L _{Aeq}	L _{Amax}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

We note that NZS6803:1999 states that best practicable options for noise avoidance or mitigation should be applied to construction activities on the site; however if the best practicable options are applied and the noise limits are still not met, discretion is able to be applied.

2.3 Conclusions regarding appropriate noise levels

Based on a review of the District Plan and New Zealand Standard NZS 6803:1999, we consider that as far as practicable, compliance with the long-term construction noise limits set out in NZS 6803:1999 is appropriate and would result in reasonable and acceptable noise effects. Where higher noise generating activities do not comply with these limits even with all practicable mitigation adopted, then managerial controls will be required to minimise impact on neighbours. Key aspects will include consultation with neighbours to identify less intrusive times to undertake the high noise activities, and generally limiting the hours on site.

As discussed above, surrounding landowners should be notified before any of these high noise activities occur on site. We note that the specific sensitivity of the neighbours may need to be considered and the best method for minimising effects will need to be considered on a case by case basis. For some neighbours there may be a temporary disturbance when these higher noise activities occur so notifying any affected neighbours will allow them to adjust their daily routine so they have less of an adverse effect.

We note that the properties which directly adjoin the site – 55 Dee Street and 34-36 Esk Street – have solid concrete block walls which face onto the site. The solid façades will be effective in reducing construction noise received within these buildings, and we expect noise levels in excess of the NZS 6803:1999 long-term duration noise limits to be acceptable when received in these locations. We have however considered in more detail the noise levels received at the facades of these buildings which include windows or doors, as this will be more relevant in determining the level of noise effect on these neighbours.

3.0 NOISE GENERATING ACTIVITIES

The main noise sources associated with the demolition / construction of the hotel development are therefore expected to be:

- Noise from excavator with pneumatic breaker (and other equipment) demolishing the existing buildings on site
- Noise from machinery hard filling for foundations
- Noise from installing piles
- Noise associated with the formation of the foundations (concrete pouring, concrete pumping etc.)
- Noise from vehicles associated with the construction (including heavy vehicles)

There are several additional noise sources which will likely be present on site; however, we would expect the noise levels from these to be less than the sources identified above and that this noise will be able to be controlled through good practice and the adoption of a Construction Noise Management Plan. These include:

- General construction equipment and plant
- Construction of the internal fit-out
- Noise from tradespeople talking on site

We note that effects will vary between neighbouring properties depending on the specific sensitivity of the individuals within the properties, along with the construction of the external façade of the buildings. Therefore, where the construction noise levels are expected to be close or exceed the limits outlined in section 2.0 above, the neighbours should be consulted.

3.1 Demolition

We understand that the demolition work on site will comprise of two main stages – 3-4 weeks of identified removal of asbestos, followed by the main demolition activities, which is anticipated to take in the order of 12 weeks.

The main demolition activity will be restricted to 0730 to 1800 hours Monday to Saturday, and will comprise of the following:

- A 45 tonne high reach excavator for work at heights
- A smaller 20 – 30 tonne excavator to assist with demolition and load and sort waste

The Demolition Management Plan for the site outlines a number of measures that will be implemented to reduce the noise emissions throughout the demolition process, including:

- Using the hydraulic jaw / crusher as the primary breaker, and only using the nibbler attachment where stubborn concrete needs to be weakened before breaking into truckable sizes.
- Moving rubble 25 metres from the site boundaries before further breaking is undertaken.
- Not leaving truck engines idling when not in use.
- Fitting all mechanical plant with approved muffler devices and ensuring that all plant and equipment is well maintained and working in accordance with the manufacturer's specifications.

The demolition will likely vary in noise emissions throughout the process. We have therefore based our analysis on a worst-case situation with the highest noise level which could be emitted.

While the overall sound levels of the specific equipment will vary on site depending on the specific equipment we have based our preliminary analysis on a high reach excavator fitted with breaker with a sound power of 119 dB L_{WA} , as outlined NZS6803:1999.

Depending on the location/stage of the demolition, the existing buildings on site will provide a degree of shielding for the majority of the activity. To achieve the greatest benefit from this we recommend that if practical the demolition activity is undertaken from the central portion of the site moving outwards.

To illustrate an example of the worst-case noise levels that could be present on site we have considered two scenarios.

Scenario 1 – 73 Dee Street façade

In scenario 1 we have considered a situation where the high reach excavator fitted with pneumatic breaker is demolishing the western façade of 73 Dee Street at a height of 5 metres for a continuous 15-minute period. We have assumed that the remaining buildings on the site have been demolished and therefore offer no additional screening.

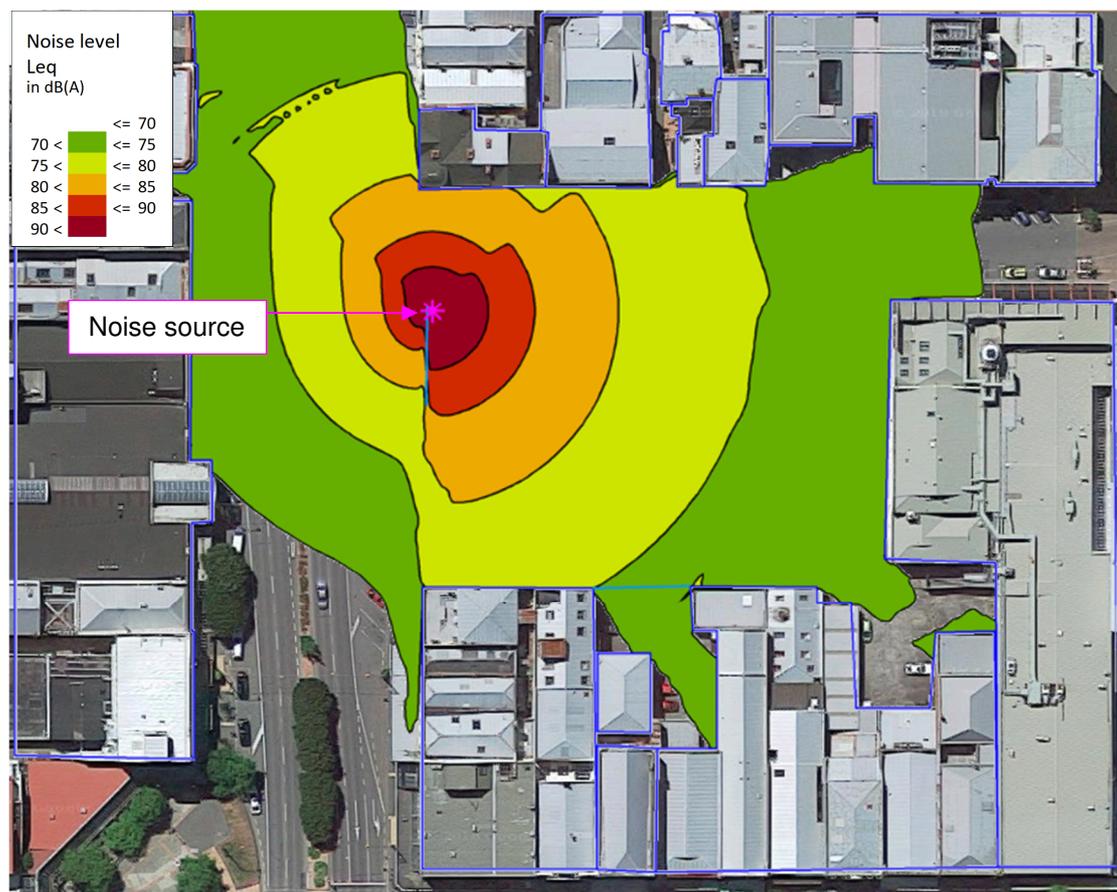


Figure 3.1 – Scenario 1 – Noise emissions from demolishing in northwest corner when received at 4.5 metres

As shown in figure 3.1 above, noise levels of up to 82 dB L_{Aeq} are expected at the upper levels of the properties to the north, 72 – 73 dB L_{Aeq} at the upper level of the properties to the west, 73 dB L_{Aeq} at the other side of the Wilson carpark to the east, and 74 – 78 dB L_{Aeq} at the properties to the south.

The following noise levels are expected at the residential / visitor accommodation facilities in the vicinity of the site:

- 83 Dee Street – 82 dB L_{Aeq}
- 55 Dee Street
 - Dee Street façade – 74 dB L_{Aeq}
 - Skylight – 73 dB L_{Aeq}
- 76 Dee Street – 75 dB L_{Aeq}

Scenario 2 – 57 Dee Street façade

In scenario 2 we have considered a situation where the high reach excavator fitted with pneumatic breaker is demolishing the western façade of 57 Dee Street at a height of 4 metres and operates continuously for 15-minutes. We have assumed that the remaining buildings on the site have been demolished and therefore offer no additional screening.

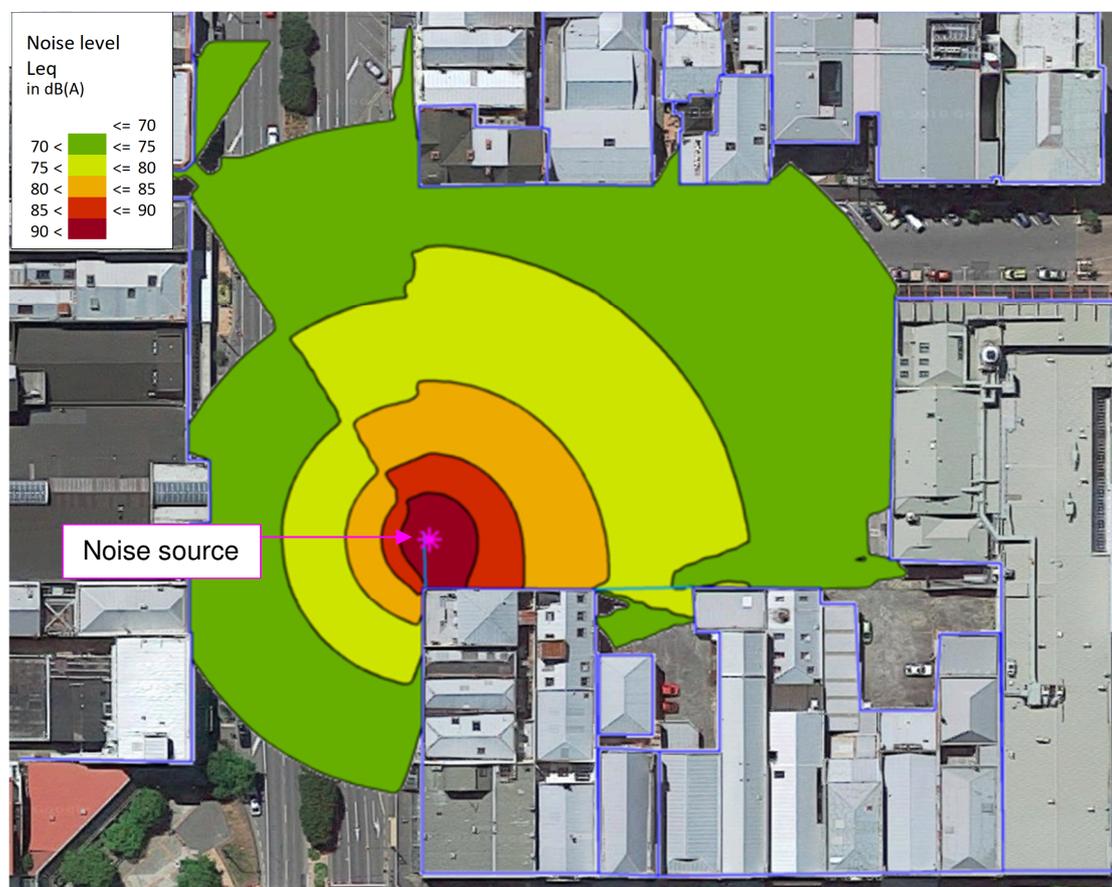


Figure 3.2 – Scenario 2 – Noise emissions from demolishing in southwest corner when received at 4.5 metres

As shown in figure 3.2 above, noise levels of up to 72 – 74 dB L_{Aeq} are expected at the upper levels of the properties to the north, 70 – 72 dB L_{Aeq} at the upper level of the properties to the west, 72 dB L_{Aeq} at the other side of the Wilson carpark to the east, and 74 – 92 dB L_{Aeq} at the properties to the south.

The following noise levels are expected at the residential / visitor accommodation facilities in the vicinity of the site:

- 83 Dee Street – 74 dB L_{Aeq}

- 55 Dee Street
 - Dee Street façade – 83 dB L_{Aeq}
 - Skylight – 75 dB L_{Aeq}
- 76 Dee Street – 72 dB L_{Aeq}

Due to the height of the building façade, no further physical mitigation is practical for these scenarios, as additional site hoarding would be ineffective when the breaker is so high above the hoardings. However, as the façade heights are reduced solid site hoarding would be an appropriate physical mitigation to reduce the noise levels to surrounding sites. We therefore recommend that when the portion of the site is cleared enough to construct them that the following is installed on the site:

- A three metre screen / fence installed to the north, east, and south site boundaries, with a two metre screen to the west as site hoardings. This could be constructed of a range of materials; however, in order to be effective, it will need to meet the following specifications:
 - Surface mass – 8.0 kg/m²
 - The fences must be continuous and maintained with no gaps or cracks.

It would be acceptable to have a gate to access the site; however, it would be required to be of solid construction, and would need to be kept closed when high noise activities are being undertaken within the site.

Overall, this analysis indicates that when the external facades of the site are to be demolished at high level noise levels may exceed 70 dB L_{Aeq} ; therefore, neighbour consultation regarding predefined times of operation as well as limiting the operating hours further should be considered as operational mitigation so neighbours can plan around these high noise times.

We note that these examples are worst-case scenarios, and we expect that the remaining demolition activities on the site will produce significantly lower noise levels.

Considering the above, we expect that the noise effects from the demolition to be acceptable provided all practicable steps are taken to minimise noise levels and that neighbours are consulted before any activity which may exceed the construction noise limits is undertaken.

We therefore recommend that the following mitigation measures are implemented on site (a number of which are already detailed within the Demolition Management Plan):

- Starting from the central portion of the site and working outwards to maximise screening from existing buildings
- Limiting demolition to 0730 to 1800 hours Monday to Saturday as far as practical
- Not leaving truck engines idling on site
- Installing solid site hoarding as described above
- Neighbour consultation and complaints procedures

3.2 Hardfilling

Once the existing buildings on the site have been demolished and the rubble removed, we understand that the entire site (including the existing basements on the site) will be hardfilled. We anticipate that this will largely comprise of trucks bringing material to site, an excavator distributing the materials, and compaction equipment.

We anticipate that it will be the compaction that will generate the most noise on site and have therefore considered this as the worst-case for this stage of the construction. We have considered a worst-case scenario with a vibratory roller on the site, which based on NZS6803:1999 we have assumed a sound power of 108 dB L_{WA} .

We recommend that the solid site hoarding described above is retained through all stages of construction and therefore have included this within our modelling. We have considered a worst-case situation where the roller is operating in the southwestern portion of the site. The resultant noise contour when considering the site hoarding is shown in figure 3.3 below at a height of 4.5 metres above ground (i.e. the upper level of neighbouring buildings). This is where the highest noise levels will be expected, as the site hoardings will reduce noise levels at ground level.

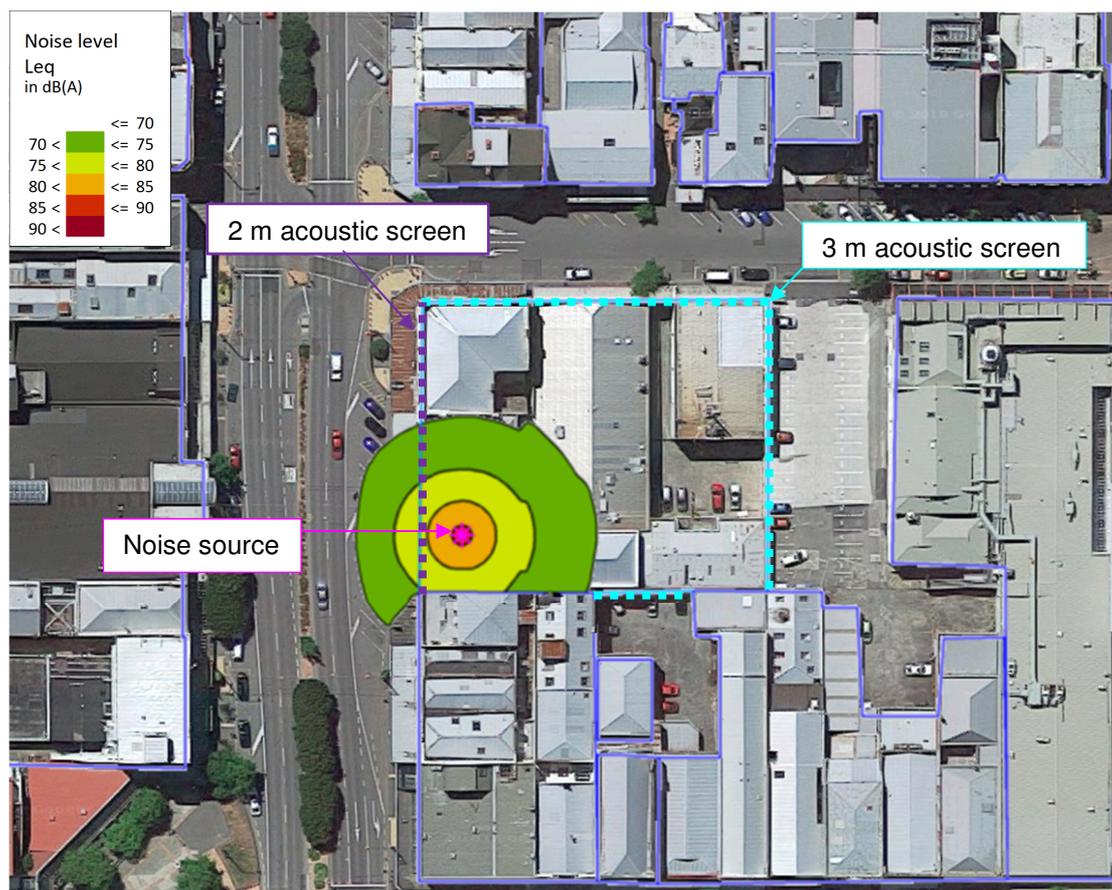


Figure 3.3 – Noise emissions from vibratory roller in southwest corner when received at 4.5 metres

This analysis shows that it is realistic for noise levels from the hardfill compaction to comply with a noise limit of 70 dB L_{Aeq} at the neighbouring dwellings to the north, east and west, and at the nearest window of 55 Dee Street façade. Noise levels of 62 dB L_{Aeq} are expected at the skylight of 55 Dee Street.

3.2 Noise from piling

We understand that bored piles are to be used for the development. This process includes drilling a hole, inserting a steel cage within the hole, and then filling the hole with concrete. Based on NZS6803:1999 and other more general guidance relating to this type of equipment we have assumed a worst-case sound power of 116 dB L_{WA} for the crane mounted auger, which we anticipate to be the highest noise generator within this process.

In order to illustrate the scale of noise levels that may be experienced, we have considered two worst-case scenarios:

1. Piling in the southwest corner of the site, and;
2. Piling in the northwest corner of the site

As above, we have included the noise reduction associated with the solid site hoarding described above.

Scenario 1 – Piling in the southwest corner

We have modelled a scenario where the piling rig is drilling a hole for the bore pile in the southwest corner of the site. The resultant noise contour when considering the solid site hoarding is shown in figure 3.4 below at a height of 4.5 metres above ground (i.e. the upper level of neighbouring buildings). We have considered the drilling rig is operating continuously for a 15-minute period.

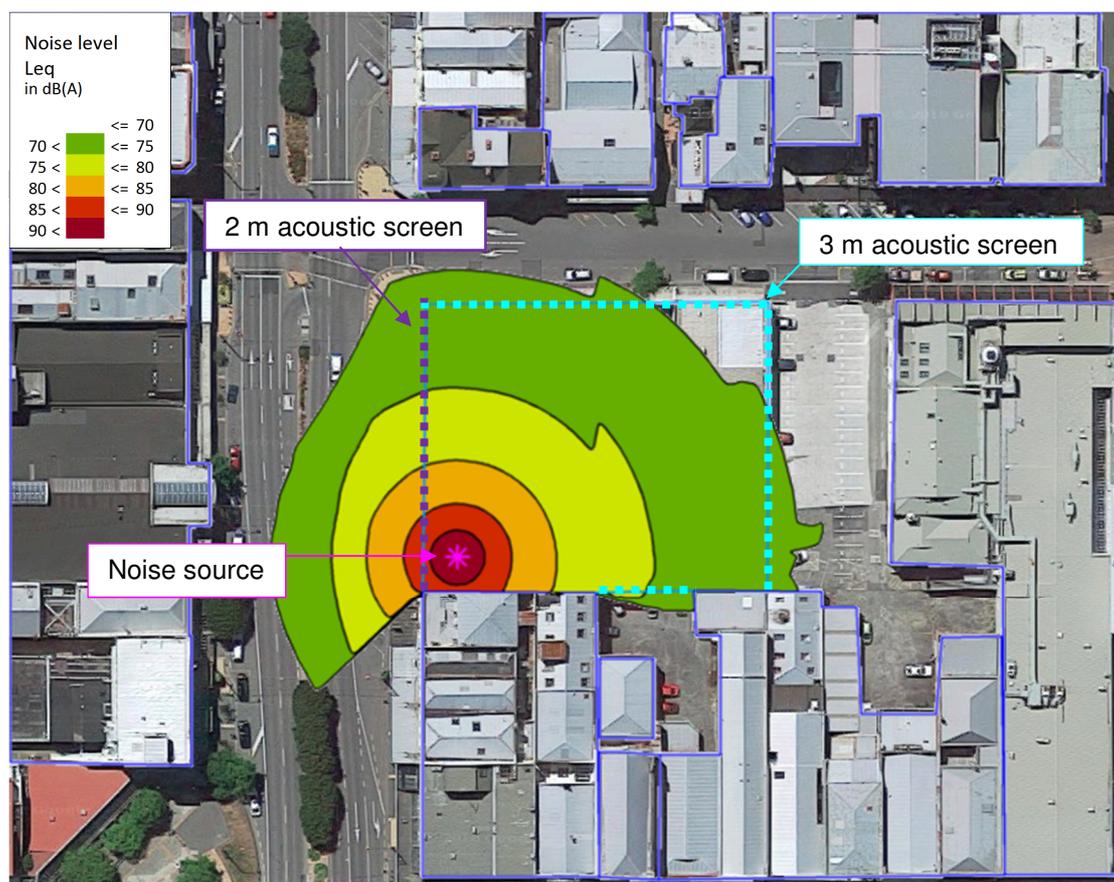


Figure 3.4 – Scenario 1 – Noise emissions from piling equipment located in southwest corner when received at 4.5 metres

This scenario results in noise levels of 77 – 90 dB L_{Aeq} at 55 Dee Street overlooking the site, and 70 – 73 dB L_{Aeq} at 34 – 36 Esk Street to the south.

Noise levels of less than 70 dB L_{Aeq} are expected at the facades of all other neighbouring properties, including the skylight and Dee Street frontage of 55 Dee Street.

Scenario 2 – Piling in the northwest corner

We have also considered the expected noise levels where the piling rig is drilling a hole for the bore pile in the northwest corner of the site. The resultant noise contours when considering the solid site hoarding is shown in figure 3.5 below at a height of 4.5 metres above ground (i.e. the upper level of neighbouring buildings). We have considered the drilling rig is operating continuously for a 15-minute period.

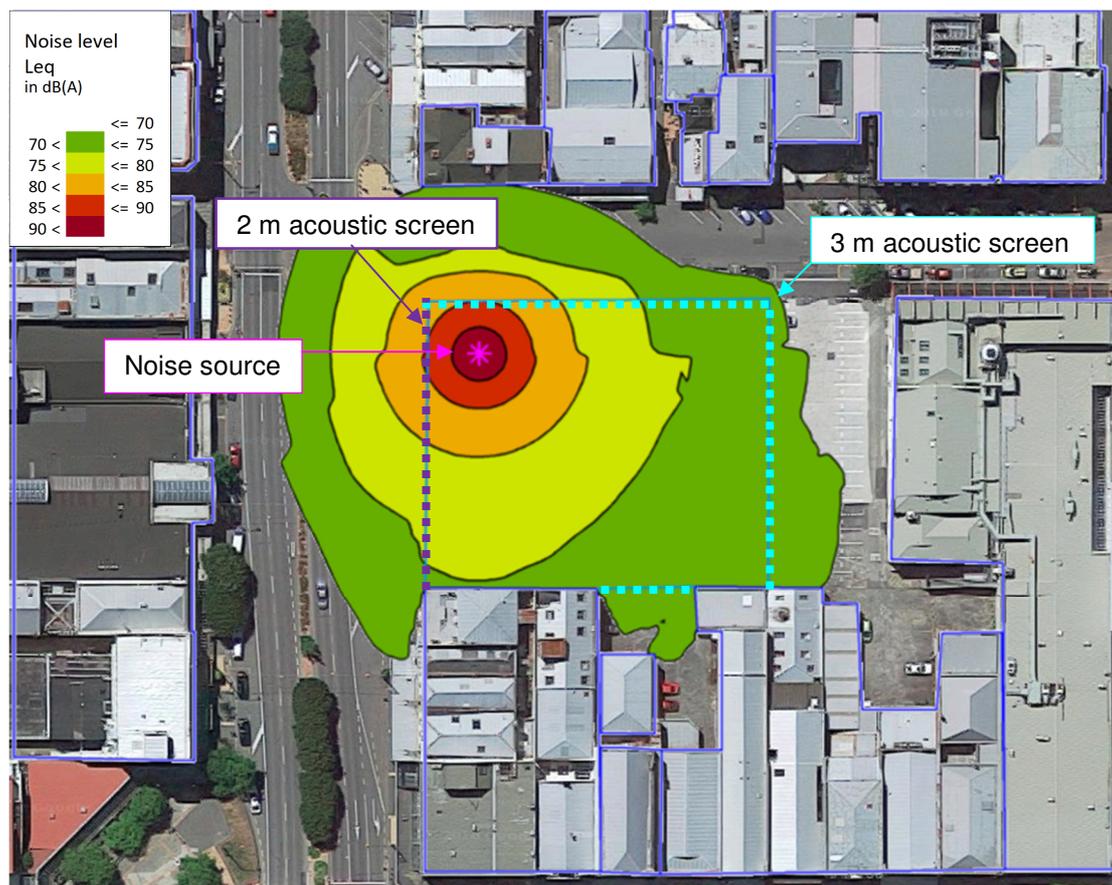


Figure 3.5 – Scenario 1 – Noise emissions from piling equipment located in northwest corner when received at 4.5 metres

This scenario results in noise levels of up to 71 dB L_{Aeq} at the Alexandra Building to the north, up to 75 dB L_{Aeq} at 55 Dee Street overlooking the site, and 70 – 73 dB L_{Aeq} at 34 – 36 Esk Street to the south.

Noise levels of 72 dB L_{Aeq} are expected at the skylights of 55 Dee Street, and less than 70 dB L_{Aeq} of the Dee Street frontage of 55 Dee Street.

The above scenarios demonstrate that it is realistic to comply with the noise limit of 70 dB L_{Aeq} at the majority of neighbouring properties; however, in some cases the noise limit will be exceeded. Due to the high noise generation of this activity, we recommend that piling is limited to between 0730 and 1800 hours Monday to Friday, and that the neighbours are consulted regarding predefined times of operation so neighbours can plan around these high noise times.

We note that the noise levels for this type of equipment can vary considerably depending on the ground, and the specific machinery used on site. If a more detailed analysis is required, then we recommend that the actual equipment that is to be used on site is tested to determine the associated sound power.

3.3 Noise from concrete activities

We expect there will be two main noise emitting processes during the concrete and foundation activities:

- Concrete trucks discharging concrete into the concrete pump and concrete pump pumping the concrete to the site.
- Concrete power floats being used on the slab.

Concrete pumping / pouring

We anticipate that the pump will be set up on the site or roadside, with the concrete trucks located behind. The noise levels emitted by the equipment will vary throughout the process as different tasks are undertaken. For example, we expect the concrete pump will steadily idle most of the time, with higher noise emissions when the engine increases in speed to move the nozzle over the site. Similarly, the concrete trucks will be idling most of the time but will generate higher noise emissions when their engine speed is increased before transferring the concrete to the pump.

Based on our experience, we have based our analysis on a sound power level of 105 dB L_{WA} , which we expect would be equivalent to the loudest phases of the above process.

Based on this sound power level and the likely location of the pump and truck, we would expect that the pumping activity can comply with the noise limit of 70 dB L_{Aeq} to the north, east and south. Due to the likely close proximity of the truck and pump to 55 Dee Street, noise levels of greater than 70 dB L_{Aeq} would be expected at 55 Dee Street.

Due to the close proximity of residential / visitor accommodation facilities, we recommend that this activity is limited to 0730 to 1800 hours. Due to the high noise generation of this activity, we recommend that concrete pouring is limited to between 0730 and 1800 hours Monday to Friday, and that the neighbours are consulted regarding predefined times of operation so neighbours can plan around these high noise times.

Concrete floating

Once the concrete has been poured we understand that a concrete float may be used to finish the setting slab. While the overall sound levels of the specific equipment on site will vary (due to the range of concrete floats available) we have based our preliminary analysis on a concrete float with a sound power of 100 dB L_{WA} , as outlined in NZS 6803:1999.

Based on this sound power level, we expect full compliance with the long-term construction noise limit at the neighbouring properties when the concrete float is being used at ground level with the site hoarding (apart from the solid facades of 55 Dee Street and 34 – 36 Esk Street), between the hours of 0730 to 1800 hours.

We have also assessed noise from a power float working on the upper level foundations, centrally located to the north on the site, as shown in figure 3.6 below. This indicates that noise levels would be less than 70 dB L_{Aeq} at the north, east and west neighbouring site boundaries. A noise level of 70 dB L_{Aeq} could be exceeded at those directly to the south if the activity was undertaken in close proximity to this boundary. Therefore, if concrete floats are to be used in close proximity to 55 Dee Street at upper levels, additional localised screening should be considered.



Figure 3.6 – Concrete floating at upper levels of building when received at 4.5 metres

We note that noise levels would exceed the more stringent recommended construction limits outside of 0730 to 1800 hours, and therefore if activity was to occur outside these times lower noise emitting equipment, or secondary localised screening will be required.

The noise levels can vary significantly for different types of power floats; therefore, we recommend that prior to use on site that noise measurements are undertaken on the actual concrete floats which will be used on site to determine the level of mitigation required.

3.4 Noise from vehicles movements

The arrival and departure of heavy vehicles will be associated with the removal of demolition material on site during this phase, delivery of hardfill as well as the general construction deliveries. Heavy trucks will be required to travel along Dee Street and Don Street to the site. We understand that site access will be via Dee Street to the south of the site.

Truck movements are expected to occur between 0730 and 1800 hours Monday to Saturday (excluding public holidays). We have assumed that during a worst-case 15-minute period, two truck movements would occur (one departing and one arriving on site). Calculations for the truck movements have been based on a single vehicle movement having an SEL of 110 dB L_{wA} , and the site entrance located a minimum 10 metres from 55 Dee Street. Based on the above, noise levels of up to 45 dB L_{Aeq} are expected to be associated with heavy vehicles entering and exiting the site when received at 55 Dee Street.

The noise levels generated by heavy vehicles travelling around the site are therefore expected to be less than 70 dB L_{Aeq} at all adjacent properties.

With regards to construction vehicles travelling along Dee Street and Don Street, we note that the criteria against which assessment should be made is unclear. Nevertheless, we note that it

is best practice to consider the effects of placing additional vehicle traffic on the existing roading network.

In this situation, we consider that the best approach in reducing the noise levels would be through operational measurements outlined within the Construction Noise and Vibration Management Plan which would cover the following:

- Limitations on the arrival and departure times of the heavy vehicles to within 0730 to 1800 hours.
- No engine brakes to be used in the vicinity of the site.
- Reversing beepers to be limited in terms of sound level and frequency of use.
- Discouragement of vehicles idling on site for extended periods of time. This could be included as part of the site foreman's responsibilities.
- No use of horns unnecessarily.

4.0 VIBRATION

The demolition, and the use of the compactor and piling equipment have the potential to cause adverse vibration effects at the neighbouring properties. Vibration effects are typically considered in two ways – with regard to possible structural or cosmetic damage to buildings, and human response.

These activities are expected to generate continuous vibration for short periods of time. This vibration may potentially result in two main effects for occupants within the neighbouring buildings – perceptible (structure-borne) vibration, i.e. vibration of walls, floors etc. which is perceived by occupants through tactile sensation or audible motion such as rattling of windows; and low frequency noise, where sound waves radiated by the vibrating surfaces inside buildings are perceived by the human ear as noise – often referred to as ground-borne noise. Guidance regarding measurement of vibration is provided in ISO 4866:2010 *Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibration and evaluation of their effects on structures*. Guidance as to appropriate levels is provided in BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2:Vibration*.

We note that effects will vary between buildings depending on the specific sensitivity of the individuals within the properties, along with ground conditions between the source and receiver, and foundation type of the building.

The mitigation of construction vibration is very difficult – in most cases limiting the times the activity can occur and increasing the distance between the activity and noise-sensitive receivers are the only options available. We therefore recommend that this is considered further in the Construction Noise and Vibration Management Plan, and that the demolition and piling activity undertaken in closest proximity to the southern properties are undertaken at the least vibration sensitive times (determined in consultation with the neighbours).

Individuals can detect building vibration levels that are well below those required to cause any risk of damage to the building or its contents. A structural engineer would be best placed to consider any impacts with regard to building damage. However, given the close proximity of the neighbouring buildings, it may be reasonable for the buildings closest to the applicant site to be inspected pre-construction and/or after high vibration events as well as post-construction by a structural engineer to ensure no structural or cosmetic has occurred.

5.0 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

As demonstrated above, a number of operational and management strategies need to be adopted by the Applicant to control and reduce noise emissions and vibration from the construction activity. Therefore, we recommend that the applicant establishes a Construction Noise and Vibration Management Plan outlining the measures which will be employed to ensure that noise and vibration impacts on neighbouring properties are minimised as far as practicable.

The Construction Noise and Vibration Management Plan would need to include:

- Restrictions on the operational hours of construction on site such that all works on site are to be generally undertaken between 0730 and 1800 hours, with no work on Sundays or public holidays. However, some demolition activity may occur outside these hours. Notification will be provided to these neighbours a minimum of a week before this occurs.
- The requirement for specific equipment to be tested prior to being used on site and the physical mitigation required to result in complying levels, including acoustic screening, and the like.
- Limitations on the arrival and departure times of heavy vehicles, and operating recommendations.
- Details of complaints procedures and the need for and responsibilities of a Noise Liaison Officer for the community.
- No heavy vehicles will enter or exit the site before 0730 hours, or after 1800 hours.
- Consultation with the neighbouring properties prior to high level demolition, piling, and concrete pouring.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Construction noise from all sources expected to be associated with the Dee Street Hotel development on Dee Street, in Invercargill, has been assessed.

As discussed above, we consider that as far as practicable, compliance with the long-term construction noise limits set out in NZS 6803:1999 is appropriate and would result in reasonable and acceptable noise effects. Where higher noise generating activities do not comply with these limits even with all practicable mitigation adopted, then managerial controls will be required to minimise impact on neighbours. Key aspects will include consultation with neighbours to identify less intrusive times to undertake the high noise activities, and generally limiting the hours on site.

The hours which these high noise events occurs are proposed to be limited. We note that the activities generating noise exceeding the construction noise limits will occur for short periods of the overall demolition / construction timeframe and for the majority of the time levels are expected to be lower.

To give confidence that noise effects associated with the construction of the development are managed appropriately, we recommend the following mitigation measures be adopted during the construction process:

- All construction activities on the site shall comply with the long-term constructions noise limits outlined in Table 2 of NZS6803:1999 as far as is practical.
- A three metre screen / fence should be installed to the north, east, and south site boundaries, with a two metre screen to the west as site hoardings. This could be constructed of a range of materials; however, in order to be effective, it will need to meet the following specifications:
 - Surface mass – 8.0 kg/m²
 - The fences must be continuous and maintained with no gaps or cracks.
- An appropriately qualified person shall prepare a Construction Noise Management Plan (CNMP) for the activity prior to the construction of the development for approval by the Invercargill City Council. The CNMP shall contain mitigation measures relating to:
 - Machinery to be used;
 - Site layout;
 - Acoustic barriers, and;
 - Duration of work.
- Consultation with the neighbouring properties prior to high level demolition, demolition occurring on a Sunday, piling, and concrete pouring.

