Project No: 171389

Acoustic Assessment
Proposed Aberdeen Fair Retail & Service Centre
New England Highway
Aberdeen, NSW

Prepared for:

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1.0 - INTRODUCTION

This report presents the results, findings and recommendations arising from an acoustic assessment of the operation of the proposed Aberdeen Valley Fair Retail and Service Centre on the corner of the New England Highway and Perth Streets, Aberdeen, NSW.

The proposed development is to involve a supermarket, retail/bulky goods buildings, bottle shop, small retail and medical centre, commercial spaces, a service station (with possible takeaway drive through option) and associated car and heavy vehicle parking as shown in **Figure 1**.

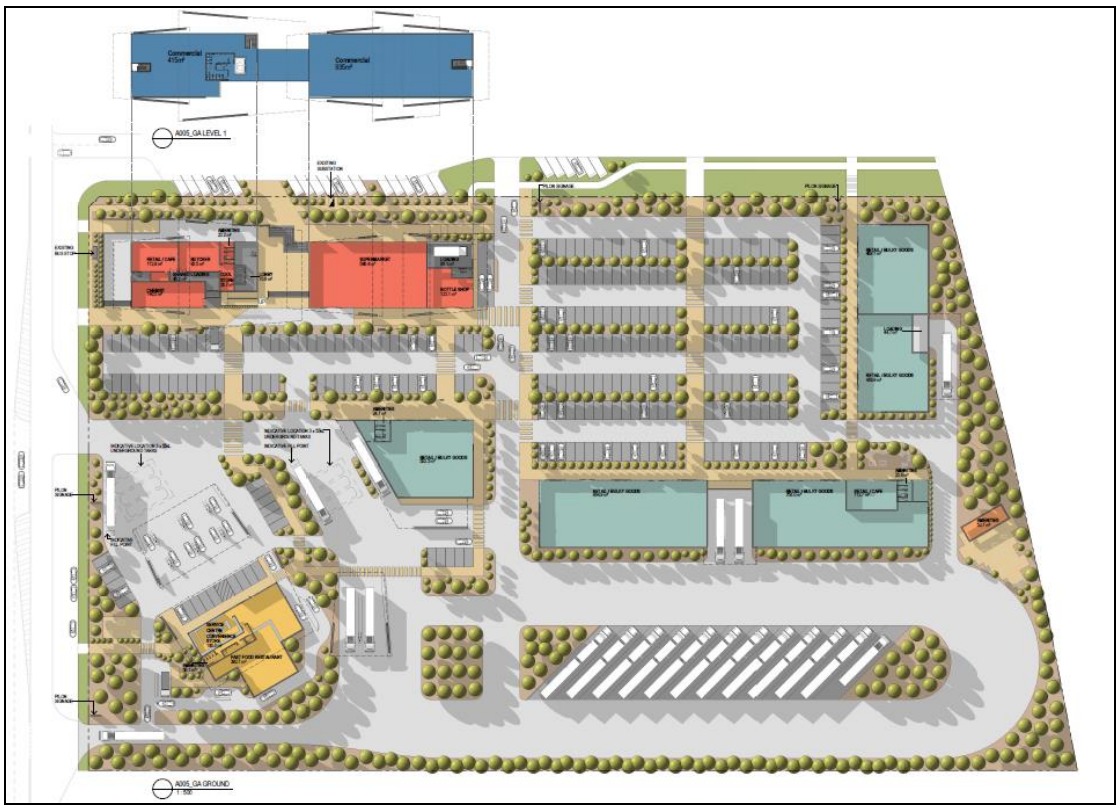


Figure 1 - Site Layout

The assessment was requested by The Mitchell Group to support a Development Application (DA) to Upper Hunter Shire Council (UHSC).

From an acoustic point of view the most significant aspects of the proposed operation include;

- Car and heavy vehicle parking noise;
- Traffic (light and heavy vehicle) movements;

- Mechanical plant and equipment including air conditioning and refrigeration equipment, and

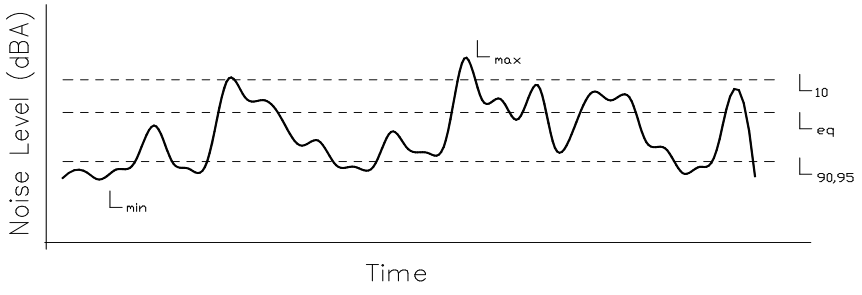
- Activities associated with and within the proposed commercial spaces (including service station and drive through restaurant).

In addition this assessment considers potential impacts from noise associated with the construction of the development and also the potential for noise from trains on the nearby rail line to impact on the development.

2.0 - TERMS AND DEFINITIONS

Table 1 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

TABLE 1
DEFINITION 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 - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
Lmax	The Maximum noise level recorded for a measurement period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level. In this instance, the L90 percentile level is representative of the noise level generated by the surrounds of the residential area.
	

3.0 – AMBIENT NOISE ENVIRONMENT AND CRITERIA

3.1 Retail and Parking Areas

The Office of Environment and Heritage (OEH) and councils generally share responsibility for the approval and control of noise emissions from commercial and industrial premises within council boundaries. These approvals are usually based on procedures and criteria detailed in the NSW Industrial Noise Policy (INP).

The INP describes intrusive and amenity criteria applicable to industrial sites. These noise criteria depend on the existing background noise level at potentially affected residential receiver areas.

To quantify the existing acoustic environment of the area, ambient noise levels were measured at two locations on the site. The logger locations are shown in **Figure 2**.

Figure 2 – Noise Logger Locations

The representative 15 minute statistical intervals were measured using two x Rion NL-42 sound level meters set up as environmental noise loggers. The measurements were done in accordance with relevant OEH guidelines and AS 1055-1997 “Acoustics – Description and Measurement of Environmental Noise”. The noise loggers used comply with the requirements of AS 1259.2-1990 “Acoustics – Sound Level Meters”, and have current NATA calibration certification.

The loggers were programmed to continuously register environmental noise levels over the 15 minute intervals, with internal software

calculating and storing Ln percentile noise levels for each sampling period. Calibration of the loggers was performed as part of the instrument's initialisation procedures, with calibration results being within the allowable ± 0.5 dB(A) range.

Logger 1 was located at the south western corner of the site, at approximately the same distance from the New England Highway as the façade of the nearest residence to the highway in this vicinity. The logger experienced battery failure after 6 days of measurements, but, as the data obtained was relatively consistent it was considered to be sufficient to be used to determine valid background noise levels.

The measurements at Logger 1 were dominated by noise from traffic on the New England Highway with some influence from noise from trains on the Main North Rail Line.

Logger 2 was located at the north eastern corner of the site, at approximately the same distance from the MNRL as the façade of the nearest commercial building in the proposed development.

The measurements at Logger 2 were dominated by noise from trains on the Main North Rail Line with influence from noise from traffic on the New England Highway.

Tables 2 and **3** shows a summary of the relevant measured data, which is also shown graphically in **Appendix I**.

TABLE 2
MEASURED AMBIENT NOISE LEVELS
LOGGER 1 - 29/3/17 to 3/4/17

	Noise Levels dB(A)		
Percentile	Day	Evening	Night
L90	42	38	34
Leq	58	54	54

TABLE 3
MEASURED AMBIENT NOISE LEVELS
LOGGER 2 - 29/3/17 to 4/4/17

	Noise Levels dB(A)		
Percentile	Day	Evening	Night
L90	39	38	33
Leq	60	61	61

The INP specifies that, in determining noise criteria, background noise levels need only be used for those times when the noise source being assessed is to operate. In this instance the retail areas and car park may be used only during the day and evening but some of the

mechanical plant and heavy vehicle parking associated with the development may operate at any time throughout 24 hours.

In setting noise goals for a particular project the INP considers both the amenity and intrusiveness criteria. The former is set to limit continuing increase in noise from industry, whilst the latter is set to minimise the intrusive impact of a particular noise source. The site under assessment is subject to very little industrial noise during the day with very little industrial noise during the evening and night.

In such cases the amenity criteria for these times are the acceptable level from the INP. Amenity criteria are dependant upon the nature of the receiver area as well as the existing level of industrial noise. Per definitions in the INP the residential areas near the site are best described acoustically as suburban (due to the influence of traffic noise).

The intrusiveness criteria are based on the Rating Background Level (RBL) for the time period, plus 5 dB(A). The RBL (L90) is defined as the overall single figure background level representing each assessment period.

Tables 4 and **5** specify the applicable base noise objectives for the site being assessed.

TABLE 4
BASE NOISE LEVEL OBJECTIVES
WEST SITE

Period	Intrusiveness Criterion* L_{eq} (15 min) dB(A)	Amenity Criterion** L_{eq} (Period) dB(A)
Day	**47**	= Acceptable level = **55**
Evening	**43**	**45**
Night	**39**	**40**

* Rating Background Level (RBL) + 5dB. RBL is the median value of each ABL (Assessment Background Level) over the entire monitoring period. The ABL is a single figure representing the "L_{90} of the $L_{90's}$" for each separate day of the monitoring period.
** Suburban zone amenity criterion per Tables 2.1 and 2.2 of INP.

The project specific noise goals (PSNG) for the residences near the western and south western side of the site are the more stringent of the intrusiveness or amenity criteria, as follows,

Day	**47 dB(A) L_{eq} (15 min)**
Evening	**43 dB(A) L_{eq} (15 min)**
Night	**39 dB(A) L_{eq} (15 min)**

TABLE 5 BASE NOISE LEVEL OBJECTIVES EAST SITE		
Period	Intrusiveness Criterion* L_{eq} (15 min) dB(A)	Amenity Criterion** L_{eq} (Period) dB(A)
Day	**44**	= Acceptable level = **55**
Evening	**43**	**45**
Night	**38**	**40**

* Rating Background Level (RBL) + 5dB. RBL is the median value of each ABL (Assessment Background Level) over the entire monitoring period. The ABL is a single figure representing the "L_{90} of the $L_{90's}$" for each separate day of the monitoring period.
** Suburban zone amenity criterion per Tables 2.1 and 2.2 of INP.

The project specific noise goals (PSNG) for the residences near the eastern and north eastern side of the site are the more stringent of the intrusiveness or amenity criteria, as follows,

Day	**44 dB(A) L_{eq} (15 min)**
Evening	**43 dB(A) L_{eq} (15 min)**
Night	**38 dB(A) L_{eq} (15 min)**

3.2 Car Park

The assessment of noise from vehicles associated with a development is covered by the INP if those vehicles are not on a public road. An example of this is vehicles using the car park of the development.

Vehicles associated with the commercial and retail parts of the development may be moving about in the car park during the day or evening time. An assessment of car park noise as a result of this use has been carried out against the lower of the PSNG's for these periods of **43 dB(A) Leq (15 min)** in the evening.

Heavy vehicles may use the parking area associated with the service centre at any hour of the day and, therefore, the assessment of this noise has been carried out against the night time PSNG's of **38 and 39 dB(A) Leq (15 min)** (i.e. the criterion varies depending on the receiver area).

3.3 Road Traffic Noise

Noise generated by road traffic associated with the use of the development is assessed separate to site noise. This has been done using the EPA accepted Intermittent Traffic Noise guidelines due to the non-continuous nature of traffic flow to and from the site.

The NSW Road Noise Policy (RNP) recommends various criteria for different road developments and uses. Based on definitions in the RNP, McQueen Street (New England Highway) is classified as an arterial road and Perth Street is a sub-arterial road.

An extract from Table 3 in the RNP relating to land use developments with the potential to create traffic on various road types is shown in **Table 6**. For road traffic noise day time is from 7 am to 10 pm.

TABLE 6 TRAFFIC NOISE OBJECTIVE		
Situation	Recommended Criteria	
	Day - (7am - 10pm)	Night (10pm – 7am)
3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	60 Leq (15hr)	55 Leq (9hr)

3.4 Sleep Disturbance

In relation to the potential for sleep disturbance the Application Notes accompanying the INP state;

"*Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.*

Research on sleep disturbance is reviewed in the RNP. This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, the EPA recognised that the current sleep disturbance criterion of an LA1, (1 minute) not exceeding the LA90, (15 minute) by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, the EPA will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or LA1, (1 minute), that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the RNP. Other factors that may be important in assessing the extent of impacts on sleep include:

- *how often high noise events will occur*
- *time of day (normally between 10pm and 7am)*

- *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*

The LA1, (1 minute) descriptor is meant to represent a maximum noise level measured under 'fast' time response. The EPA will accept analysis based on either LA1, (1 minute) or LA, (Max)".

Based on the measured night time background noise levels from the noise loggers the sleep disturbance guideline criterion is set at;

49 dB(A) L1 (1 min) western receivers

48 dB(A) L1 (1 min) eastern receivers

3.5 Rail Traffic Noise Intrusion

The development lies on land adjacent to the Main North Railway Line and parts of it may, therefore, be potentially impacted by noise emissions from rail traffic.

The Infrastructure SEPP (Department of Planning NSW, 2007) and the supporting Department of Planning guideline "Development near Rail Corridors and Busy Roads – Interim Guideline" (2008) (Noise Guideline) doesn't contain criteria in relation to commercial or retail premises.

The criterion for these areas has, therefore, been taken from AS/NZS 2107 2000, Acoustics—Recommended design sound levels and reverberation times for building interiors.

This Standard details recommended design sound levels small retail outlets or show rooms as **45 dB(A) Leq**, and this will be adopted here for the commercial areas.

4.0 - NOISE ASSESSMENT

The operation of the various parts of the development may occur over different times of the day and impact on different receiver areas and are, therefore, considered separately here.

4.1 Service Station and Drive Through Restaurant

The service station is to be located adjacent to the New England Highway with access directly from that road as shown in **Figure 3**. There is to be a service station concourse with service centre and a drive through fast food style restaurant.

From an acoustic point of view activities with the potential to create adverse impacts as a result of the operation may include;

- Movement of heavy vehicles around the site,
- Operation of the service station concourse,
- Refuse removal and station refuelling,
- Operation of the restaurant and drive through,
- Air/water filling point, and
- Mechanical plant associated with the service station and restaurant.

Figure 3 shows the service station development's approximate location within the subject site and the location of the various noise sources.

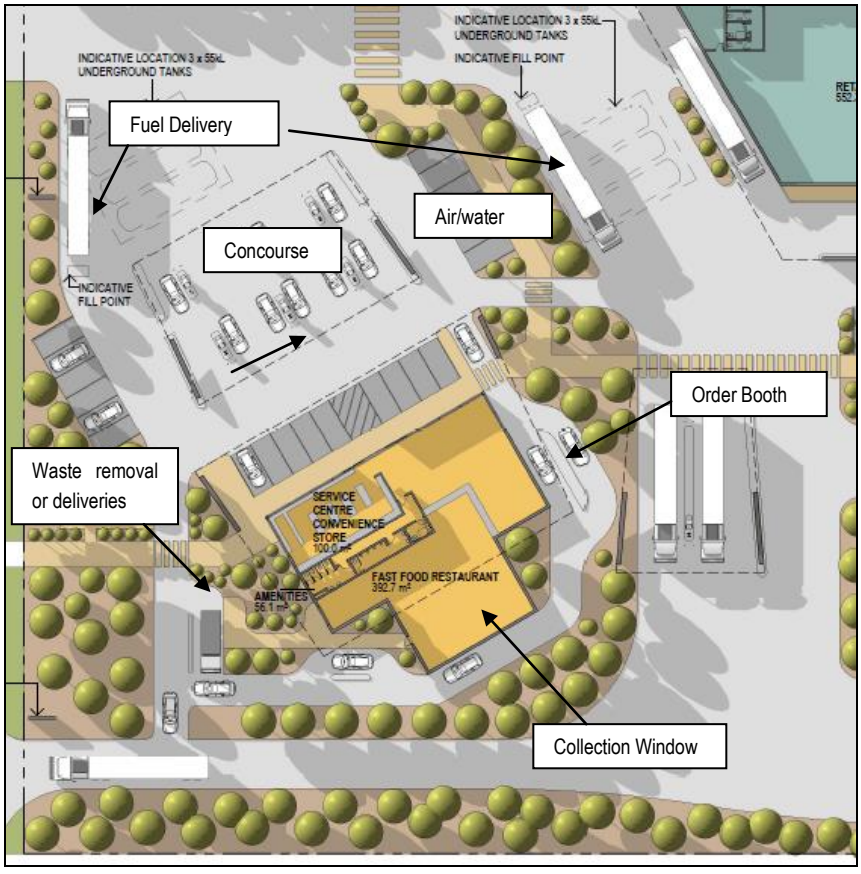


Figure 3 – Service Station Noise Sources

4.2 Sound Power Levels

Sound power levels of the major noise sources previously measured by Spectrum Acoustics are shown in **Table 7**. The following sections assess Leq noise emissions for each source. Sleep disturbance is considered separately following the Leq assessment.

TABLE 7
SOUND POWER LEVELS OF MAJOR NOISE SOURCES.

Source		dB(A)	Octave band centre frequency, Hz						
			63	125	250	500	1k	2k	4k
Reverse alarm[1]	L_{max}	102	--	--	--	--	102	--	--
Door slam	L_{max}	90	63	72	78	81	84	83	79
Speaker (front)	L_{max}	86	39	49	59	80	83	77	58
	$L_{eq(15min)}$	64	15	26	39	58	61	56	40
Speaker (side)	L_{max}	80	44	47	55	72	79	72	46
	$L_{eq(15min)}$	58	26	24	35	50	56	50	21
Operator[2] at pick-up window	L_{max}	80	38	49	57	71	75	77	69
	$L_{eq(15min)}$	61	-4	-4	37	51	52	58	51
Vehicles in drive-through	L_{max}	92	54	82	76	82	86	85	79
	$L_{eq(15min)}$	68	38	58	58	62	62	61	58
Service Station Concourse	$L_{eq(15min)}$	83	63	70	71	71	76	79	76
Heavy Vehicle on Driveway	$L_{eq(15min)}$	90	74	76	75	83	85	85	80

[1] Alarm on fuel delivery and waste trucks.
[2] Unamplified raised speech at the order and pick-up windows.

4.3 Truck Parking and Driveway

There is to be a heavy vehicle parking for up to 15 trucks along the south eastern part of the site, behind the commercial buildings. To access this parking area, heavy vehicles would enter the site via the service station driveways and leave via the driveway along the southern boundary of the site. It is envisaged that heavy vehicles may arrive and depart at any time throughout the day or night.

Trucks moving around the site will do so slowly. In relation to nearby receivers, trucks travelling at, say, 10kph will move about 165m in one minute. The noise from a truck travelling this distance relative to a receiver at, for example, the mid point of such a traverse would rise from the background level to a peak and back to background level over an approximately 30 second period. The sound power level of 102 dB(A) has been taken from the Spectrum Acoustics technical database (which contains several site noise measurements of trucks moving at such speeds).

For individual receivers, then, a single truck would produce the sound power level shown above for about 30 seconds in a 15 minute period as it traverses the site. This equates to an effective Lw of 87 dB(A) Leq (15 min) for each truck (i.e. a factor of 10xlog 0.5/15 to represent site noise for 30 seconds out of a 15 minute period).

For the determination of potential impacts at the closest receivers, a scenario was assessed where two trucks were assumed to be on the driveway leaving the site in a single 15 minute period at night. Based on the discussion above the Lw of the trucks would be 90 dB(A) Leq (15 min).

Most of the noise coming from a truck moving at slow speeds comes from the engine and exhaust with minor contribution from tyre noise. For the calculation of potential impacts a noise source height of 4m was used to approximate the top of the truck exhaust. Preliminary calculations indicated that noise control in the form of a noise barrier would be required. The truck noise source was considered to be 15m from the noise barrier (on the site boundary).

As it is unlikely that people will be in the outdoor areas of the residences for much of the night time period for the assessment of night time impacts the distance loss has been calculated to a theoretical receiver 10m inside the yard (near the closest residence)

Table 8 shows the result of the calculation of potential impacts at the residences to the south of the site in Jean Obryan Close.

TABLE 8
CALCULATED SPL AT NEAREST RESIDENTIAL RECEIVER – SOUTH
HEAVY VEHICLES ON DRIVEWAY

		Octave Band Centre Frequency, Hz						
Item	dB(A)	63	125	250	500	1k	2k	4k
Vehicle Noise as Leq (15 min)	90	74	76	75	83	85	85	80
Distance Loss to receiver (22m[1])		35	35	35	35	35	35	35
Barrier Loss (4m)		7	8	9	12	15	18	21
SPL @ receiver Leq (15 min)	41							
Criterion Leq (15 min)(Night)	38							
Impact	**3**							

1. See text before the table

The results in Table 8 show that, under the assessed conditions, there may be an exceedance of the night time noise criterion. Under the same conditions there may be up to four trucks use the driveway in a single 15 minute period during the evening before the criterion is exceeded and eight in a 15 minute period during the day.

The results in Table 8 are dependent on a minimum 4m high acoustic barrier being constructed along the southern boundary of the site.

4.4 Service Station Concourse Noise

The acoustic environment of the residential areas near the site is dominated by noise from traffic on the New England Highway. Noise from the concourse/fuelling area and the associated convenience store and restaurant will come from vehicles arriving, departing and refuelling whilst on site. This noise will be of similar character to the existing acoustic environment.

Usage of the service station will generally be in line with the amount of traffic using the New England Highway. That is, the peak number of vehicles at the service station will coincide with peak traffic volumes on the highway, typically during the morning and evening. At such times the traffic noise is also at its highest. At other times the traffic volume and, therefore use of the service station, will be at lower levels.

The layout of the site will provide optimum attenuation of noise from the fuelling and parking areas to the residences to the south. That is, the building elements of the service station and restaurant will adequately shield Leq (15 min) noise from the fuelling area in the direction of those residences.

It is anticipated that vehicles would either stop at the bowsers and refuel or park directly in front of the convenience store.

Vehicles moving around a service station would typically do so at very low speeds and, therefore, produce relatively low noise levels. A road worthy vehicle moving at low speed or at idle has an average sound power level of between 80 and 85 dB(A) Leq.

To determine potential impacts at other receivers to the west, noise measurements from an operating service station and convenience store were taken from the Spectrum Acoustics technical database. This contains data from the typical operation of a service station concourse and convenience store in the Hunter Valley, NSW. The measurements were made during the early part of the day when there was a steady (acoustically constant) flow of vehicles into, and out of, the site. Noises included engine noise, vehicles starting and stopping, car doors opening and closing, raised voices of customers etc.

Table 9 shows a calculation of noise from the service station concourse and impacting on the nearest receiver to the west on the other side of the New England Highway.

The calculation assumes a noise source as described above, located near the centre of the service station concourse at an average distance

of 65m from the residential boundary. The calculation assumes a busy day or early evening time when the noise source is constant for a full 15 minute assessment period.

The noise criteria in the INP relate to external noise levels and, therefore, the theoretical noise levels have been predicted to a standard 1.5m high reception point inside the boundary of the nearest receiver.

The measurements in the database are based on a peak operating period where the concourse is in almost constant use. Obviously, this will not always be the case during normal operations, particularly at night. During the night, when traffic numbers drop off, the number of vehicles using the service station would also be reduced.

Assuming that usage at night is approximately 10% of that during the peak times the resultant received noise would be 10 dB(A) Leq (15 min) lower than for peak times.

TABLE 9
CALCULATED SPL AT NEAREST RESIDENTIAL RECEIVER – WEST CONCOURSE NOISE

		Octave Band Centre Frequency, Hz						
Item	dB(A)	63	125	250	500	1k	2k	4k
Concourse Noise as Leq (15 min)	83	63	70	71	71	76	79	76
Distance Loss to receiver (70m)		45	45	45	45	45	45	45
SPL @ receiver Leq (15 min) Evening	38	18	25	26	26	31	34	31
Criterion Leq (15 min) Evening	43							
Impact	**0**							
SPL @ receiver Leq (15 min) Night	28							
Criterion Leq (15 min) Night	33							
Impact	**0**							

The results in Table 9, and the discussion preceding the table, show that there will be no exceedance of the day, evening or night time noise criteria as a result of the assessed noise emissions from the service station concourse.

4.5 Refuse Removal and Station Refuelling

Refuse removal will likely be undertaken by a commercial contractor from a service area located at the western end of the service station building. It is anticipated a truck will enter the site, pick up and empty a skip and depart. The entire process would, typically, take approximately two minutes to complete.

The Lw of an operating refuse truck is 105 dB(A) including the noise from lifting and replacing a skip and dumping waste . If present for two minutes over a 15 minute period this equates to a noise level of 96

dB(A) Leq (15 min). Noise emissions towards receivers to the north of the site will be adequately attenuated by the elements of buildings in the development.

In the direction of receivers to the south, the noise from the refuse truck will be attenuated by the 4m acoustic barrier along the southern boundary (as per the discussion earlier in this report).

Table 10 shows a calculation of noise from refuse removal impacting on the nearest receiver to the west on the other side of the New England Highway.

TABLE 10
CALCULATED SPL AT NEAREST RESIDENTIAL RECEIVER – WEST
REFUSE REMOVAL

		Octave Band Centre Frequency, Hz						
Item	dB(A)	63	125	250	500	1k	2k	4k
Vehicle Noise as Leq (15 min)	96	77	82	80	89	90	91	86
Distance Loss to receiver (50m)		42	42	42	42	42	42	42
SPL @ receiver Leq (15 min)	54							
Criterion Leq (15 min)(Day)	47							
Impact	**7**							

The results in Table 10 show that there is a potential for noise from the refuse removal to exceed the day time noise criterion. As noted above, however, it is anticipated that the removal of refuse will take place over approximately two minutes per day. To minimise potential noise impacts it is recommended that refuse removal not be carried out during the early morning.

Noise associated with site refuelling is that of the tanker arriving and departing and the operation of pumps during the refuelling. The major noise source is that of the tanker moving at slow speed.

At slow speed a heavy vehicle such as a tanker has a sound power level of 102 dB(A) Leq. Assuming that this noise is present for two minutes out of a 15 minute assessment period as the truck manoeuvres into position, this equates to 93 dB(A) Leq (15 min).

Similar calculations to those detailed in Table 10 were undertaken for the noise from the refuelling. The received noise would be about 50 dB(A) at the most affected residences. Similar to the refuse removal, this exceeds the day time noise criterion but the noise will only be present for about two minutes per day on a couple of days per week.

The character of the noise from the refuse removal and a tanker moving about on site would be of a similar character to the general traffic noise

in the area and, therefore, is unlikely to cause a significant impact on the acoustic amenity of the nearby residential receivers.

Other vehicles associated with the various parts of the operation of the service station and convenience store and will be limited to delivery vehicles which will arrive at various times, only through the day. Noise associated with these vehicles will not be discernible over the existing traffic noise levels.

4.6 Air/Water Filling Point

The air/water point for the service station is most likely to be located near the western side of the concourse as shown in Figure 3. The compressor to supply air for tyres etc. would most likely be located ground level in an enclosure near the main building.

The compressor enclosure should have no openings in the direction of any residential receivers. The walls and roof of the enclosure will provide adequate acoustic attenuation in all other directions. The design of the compressor enclosure should be approved by an acoustic consultant prior to construction.

Noise from the tyre/water point will come from cars at idle and moving slowly in the parking adjacent to the filling point. Cars using an air/water point would not be expected to be there for a full 15 minute period and the assessment of worst case potential impacts assumes a vehicle filling tyres at idle for 5 minutes out of the 15 minutes.

Table 11 shows the result of the calculation of potential impacts at the nearest receiver to the west across the New England Highway.

TABLE 11
CALCULATED SPL AT NEAREST RESIDENTIAL RECEIVER – WEST
AIR/WATER FILLING POINT

		Octave Band Centre Frequency, Hz						
Item	dB(A)	63	125	250	500	1k	2k	4k
Vehicle Noise as Leq (15 min)	80	63	61	69	73	75	75	69
Distance Loss to receiver (90m)		47	47	47	47	47	47	47
SPL @ receiver Leq (15 min)	34	17	15	22	27	29	29	23
Criterion Leq (15 min)(Evening)	43							
Impact	**0**							

The results in Table 11 show that there will be no exceedance of the evening noise criterion at the nearest potentially affected residential receivers as a result of the assessed operation of the air/water point.

It is not envisaged that the air/water point will be used often during the night and, therefore, the potential for any adverse impacts is considered minimal.

4.7 Drive Through

Given the layout of the site the most potential for impact from noise from the fast food drive through will be emissions from vehicles in the service lane.

The orientation of the drive-through is such that the speaker at the order point would be side-on to the nearest residences and levels from speech are not as great as those from vehicle movements. Vehicles at or near the collection window will be at the closest point to the residential boundaries, as compared with other sources on site.

Table 12 shows the result of the calculation of potential impacts at the residences to the south. As the drive through may be in use during the evening the barrier insertion loss calculation was based on a theoretical receiver standing 5m inside the yard of the closest residence (with distance loss determined to the boundary only).

TABLE 12
CALCULATED SPL AT NEAREST RESIDENTIAL RECEIVER – SOUTH
RESTAURANT DRIVE THROUGH

		Octave Band Centre Frequency, Hz						
Item	dB(A)	63	125	250	500	1k	2k	4k
Vehicle Noise as Leq (15 min)	68	38	58	58	62	62	61	58
Distance Loss to receiver (20m)		34	34	34	34	34	34	34
Barrier Loss (4m)		8	10	13	16	19	22	24
SPL @ receiver Leq (15 min)	16	<0	14	11	12	9	5	0
Criterion Leq (15 min)(Evening)	43							
Impact	**0**							

The results in Table 12 show that worst case noise emissions from the drive through will be significantly below of the noise criteria for the residential areas.

4.8 Air-conditioning and refrigeration plant

The location and type of mechanical plant to be used at the site had not been finalised at the time of undertaking this NIA. For the purpose of considering a worst case it is envisaged that all mechanical plant associated with the service station and drive through restaurant section of the development will be mounted on a plant podium on the roof of the new service station building.

For a roof top refrigeration unit the sound power level (in the horizontal plane) is typically 80-85 dB(A). This reduces to 41-46 dB(A) at 35m, the distance from the centre of the roof to the nearest residential boundary to the south. This is between up to 2 to 7 dB above the night-time noise criterion and noise control for roof-top plant will be required. This relatively small noise reduction may be achieved by setting the mechanical plant back from the roof edge a sufficient distance so that the line of sight to the residences is broken.

Alternatively, and this is often the case, the perimeter walls of the buildings could extend above the roof level to form parapet walls sufficiently high to screen the plant from the receiver. A third option would be to install three-sided noise barriers around the plant.

All of the calculations above assume the simplistic situation where the roof of each building is flat with no impediments for the passage of sound. Should the roof be angled in any way or have other shielding etc. in the direction of resident(s) then the received noise would be less than that shown.

4.9 Sleep Disturbance

Maximum noise events at night are most likely to be associated with heavy vehicles arriving or departing the parking area at the southern side of the site.

The main sources of noise from this may come from the heavy vehicles starting up during the night or in the early morning (e.g. engine revs, tray rattles, reverse alarms air brake release etc.).

The L1 (1 min) noise level will vary with each individual event but, in a parking area such as is proposed L1 (1 min) levels of 115 dB(A) may be expected from the sort of events indicated above. The frequency spectrum of such L1 (1 min) events would typically be dominated by noise in the mid frequency octave bands (500 and Ik Hz).

The calculation of impacts assumes a noise source near the centre of the parking area with a source height at 1.5m. The distance loss is calculated to the rear of the nearest residences. The sleep disturbance criterion is applicable at the outside of a bedroom window. As the internal layout of the residences is not known the worst case has been assessed which assumes that there are bedroom windows facing the site.

Table 13 shows the result of the calculation of potential sleep disturbance impacts at the residences to the south. The calculation assumes the 4m acoustic barrier on the southern boundary of the site as per the detail in Section 4.3

TABLE 13 CALCULATED L1 (1 min) AT NEARST RESIDENTIAL RECEIVER - SOUTH.								
	Octave Band Centre Frequency, Hz							
Item	dB(A)	63	125	250	500	1k	2k	4k
Truck Noise	115	83	89	96	99	105	111	111
Distance Loss (50m)		42	42	42	42	42	42	42
Barrier loss (4m)		7	9	11	14	17	20	22
SPL @ L1 (1 min)	53	34	38	43	43	46	49	47
Criterion L1 (1 min)	49							
Impact	**4**							

The results in Table 13 show that the received L1 (1 min) noise level may exceed the sleep disturbance screening criterion.

The data from the unattended noise loggers, as shown graphically in Appendix I, and observations on site indicates that the acoustic environment of the area is significantly influenced by noise from traffic on the New England Highway and also noise from trains on the Main North Rail Line.

The traffic mix on the highway changes at night with an increased percentage of heavy vehicles. Lmax emissions from these heavy vehicles and also from freight and coal trains would be a regular feature of the acoustic environment.

4.10 Retail and Commercial Activity and Deliveries

From an acoustic point of view the retail and commercial parts of the development will be largely self-contained. The noise from inside the various areas of occupancy will be controlled by the structure and facades of the various buildings. The activities with potential to create adverse impacts may include;

- Loading docks activities,
- Car park noise, and
- Mechanical plant.

4.11 Loading Dock Activities

Figure 4 shows the locations of the various loading docks for the entire development.

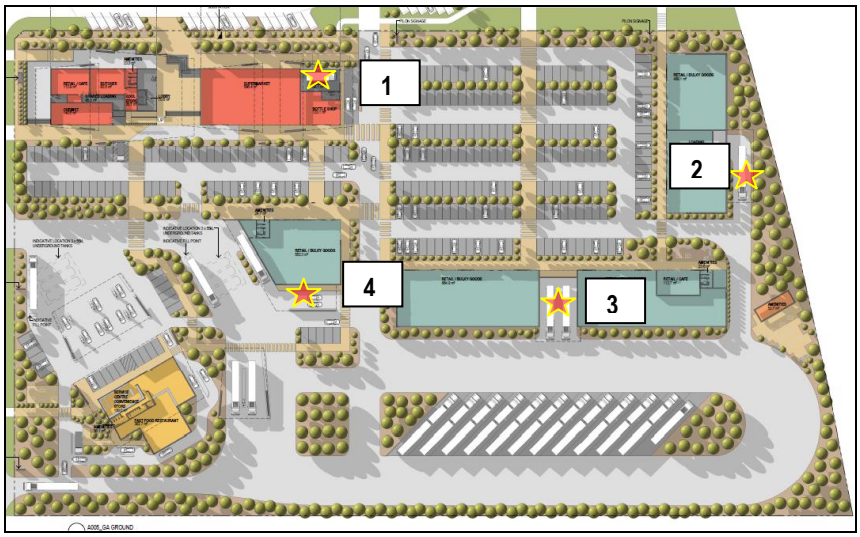


Figure 4 – Loading Dock Locations

Delivery dock 2 will be acoustically shielded from any residential receivers by the structure of the adjacent building and the enclosure of the dock itself. Delivery docks 3 and 4 will be acoustically shielded from the most potentially affected receivers to the south by the acoustic barrier proposed for attenuating heavy vehicle/driveway noise. As such no further assessment of noise from those loading dock is considered warranted here.

Delivery dock 1 will be located to the northern side of the building housing the bottle shop. Delivery vehicles will enter via the Perth Street driveway and reverse into the dock area. The total distance from the driveway entrance to the loading dock is approximately 30m.

The noise level from a truck entering a delivery dock was taken from the Spectrum Acoustics technical database. The measurement in the data base was of a pantech style truck arriving at a loading dock entrance and reversing into place. The Leq noise level for the truck reversing (with reverse alarm) at 5 kph was 100 dB(A).

A truck travelling at 5 kph will travel 30m in approximately 30 seconds. For the calculation of potential impacts the Leq noise level has been adjusted by a correction factor of -15 dB(A) to reflect the time taken for the truck to enter the loading dock.

Table 14 shows a calculation of received noise from a vehicle arriving at the loading dock when determined at the most potentially affected receivers in Perth Street, 40m away.

TABLE 14 CALCULATED SPL AT NEAREST RESIDENTIAL RECEIVER - NORTH LOADING DOCK 1 (Leq (15 min))	
Source	Noise Level
Truck Entering Dock 1	85
Distance loss to Receiver (40m)	-40
Received Noise from Dock	**45**
PSNG - Day	44
Impact	**1**

The results in Table 14 show that, under the assessed scenario, the received noise from loading dock activities may exceed the day time noise criterion at the most potentially affected receiver by up to 1dB(A). Such an exceedance of a noise criterion would, typically, be regarded as marginal and control of this noise would provide very minimal change to the acoustic environment.

Vehicles will reverse fully to the loading dock. All unloading of goods will take place within either the body of the truck or inside the loading dock itself. Noise emissions from these activities will be significantly attenuated by the structure of the building and the body of the truck. There will be no deliveries or use of the loading dock during night time hours.

4.12 Car Park

The entire development will have approximately 360 car parking spaces located in various configurations around the site. For the current assessment the car park noise will be considered as the Retail and Bulky Goods car park and the Supermarket/Commercial car park.

The use of each of the car parking areas will vary throughout the day with car parks becoming occupied and unoccupied at different times and not all necessarily used in a specific 15 minute noise assessment period.

Noise in car parks typically comes from people walking to and from cars, doors opening and closing etc., as well as vehicles moving at slow speeds. Each noise event is characterised by a brief peak which when averaged out over a 15 minute period has a relatively low Leq. The impact of each noise event on any single receiver is also variable depending upon the location of individual cars within a car park and as they move in and out. In addition to this, people arriving or departing a mosque would normally be expected to do so in a relatively quiet and orderly fashion.

Typical noise levels from car parks have been sourced from the Spectrum Acoustics technical database. This contains noise measurements from a series of vehicles arriving and departing a car park with people moving to and from vehicles. The measurements

were made over a representative period to ascertain a typical noise level from these activities. The measurements were made at varying distances from each car to approximate the situation in relation to an adjacent residence over a 15 minute interval. That is, at any time throughout each 15 minute interval various car parks, at different distances from the nearest residences, will be in use.

The measurements in the database show a noise level of 53 dB(A) Leq measured over a 5 minute period where up to 6 vehicles moved in and out of a car park. The measurements were made at an average distance of 7m.

Assuming the noise from the 6 vehicles is consistent for a full 15 minutes at a distance of 7m this equates to a sound power level of 73 dB(A) Leq (15 min) for car park noise.

Due to the layout of the car park, individual parking spaces will be at various distances from receivers. The proposed layout is for a series of "banks" of parking spaces. To assess potential impacts the car park was considered to consist of banks of ten parking spaces each with a worst case average Lw of 73 dB(A) Leq (15 min) (that is to represent 5 to 6 cars using a car parking space in a 15 minute period. Received noise levels were determined for each "bank" and the combined result calculated for the most potentially affected receivers.

The noise from the car park will be at different levels when measured at various points on any individual receiver boundary. That is, depending on the distance from individual cars/noise events etc.

To assess the practical impacts the noise was calculated for a single theoretical reception point at the boundary of the nearest residence to the west of the site, across the New England Highway. The noise from car parks labelled 1 to 6 (see **Appendix II**) were used in this calculation.

The noise was also calculated to a single reception point at the boundary of number 1 Alexander Close (on the corner of Perth Street) using the noise from car parks labelled 7 to 29.

To ensure consideration of the absolute worst case for the current assessment it was assumed that all of the car parks would be used in a single 15 minute period as described above.

A summary of the results of the assessment of car park noise to the residence to the west on the New England Highway, as described above, is shown in **Table 15**. Car park numbers referred to in the tables are as shown diagrammatically in Appendix II.

TABLE 15 CALCULATED SPL – NEW ENGLAND HIGHWAY Leq (15 min) - CAR PARK	
Car Park Number	New England Highway
1	29
2	29
3	27
4	24
5	25
6	24
Total Leq (15 min)	**35**
Criterion Leq (15 min)	**47**

The results in Table 15 show there will be no exceedance of the day time noise criterion as a result of the assessed car park noise.

A summary of the results of the assessment of car park noise to the residence to the north at 1 Alexander Close is shown in **Table 16**. Car park numbers are as per Appendix II.

TABLE 16 CALCULATED SPL – 1 ALEXANDER CLOSE Leq (15 min) - CAR PARK	
Car Park Number	1 Alexander Close
7	24
8	25
9	25
10	25
11	25
12	25
13	25
14	26
15	26
16	27
17	27
18	27
19	27
20	28
21	28
22	29
23	29
24	29
25	29
26	31
27	31
28	24
29	25
Total Leq (15 min)	**41**
Criterion Leq (15 min)	**47**

The results in Table 16 show there will be no exceedance of the day time noise criterion at any receivers as a result of the assessed car park noise.

As discussed the measured noise level was during a time of almost constant use of the car park during the afternoon. At most other times, including during the evening, it is envisaged that the car park usage will be less than this and, therefore, the received noise level will be lower than that shown in Tables 15 and 16, and there will be no adverse impacts at any time.

4.13 Road Traffic Noise

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

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

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)

Vehicles arriving and departing the supermarket may do so via a number of routes. The car park for the site will have three driveways, one to Perth Street and two to the New England Highway with vehicles moving in both directions along these roads.

For this assessment a scenario of 300 vehicle movements in an hour through each driveway was considered. Of these movements half of the vehicles were considered to travel in each direction.

That is, of the 300 vehicle movements in an hour, 150 vehicles were considered to be travelling east on Perth Street and 150 vehicles were considered to be travelling west on Perth Street. Similarly 150 vehicles were considered to be travelling north on the New England Highway and 150 travelling south on that road. Each vehicle was considered to be travelling at 60 kph.

Noise levels from the vehicles have been assessed to a point 1m from the facade of the residences, at a nominal distance of 20 m from the centre of the roadway. Results are shown in **Table 17**.

TABLE 17 ROAD TRAFFIC NOISE	
Element	dB(A)
No. of Vehicles/hr	150
Lw per vehicle	92
Distance Loss (20m)	30
Received Noise (Leq 1 hour) from eqn. 1	50
Criterion – Day (Leq 15 hour)	60
Exceedance	**0**

The results shown in Table 17 indicate that, under the assessed scenario the noise from traffic generated by the proposal will be below the adopted RTA criterion for the worst case one hour period. It is noted that the noise criterion is applicable over the entire day time period (i.e. 15 hours) and therefore the received noise from traffic will not create any adverse impacts.

4.14 Sleep Disturbance

The supermarket will be open only between 7 am and 9 pm (8 am and 8 pm Sundays). There will be no deliveries, collection of trolleys or use of the car park for the supermarket outside of these hours and, therefore, there will be no potential sleep disturbance impacts as a result of maximum noise events to be considered from them.

The bulky goods stores will be open during normal business hours only and there will be no night time activity.

The only noise producing items to be in use at night may be mechanical plant associated with refrigeration equipment. This will be located inside the various supermarket and bottle shop buildings and will be adequately attenuated by the elements of those buildings and there will be no adverse noise impacts as a result of emissions from that plant.

To ensure there will be compliance with the sleep disturbance criteria it is recommended that the locations and specifications for the refrigeration plant be reviewed by an acoustic consultant prior to it being approved for installation.

4.15 Rail Noise and Vibration

Logger 2 was located near the railway line at approximately the same distance from the line as the nearest façade of the retail/bulky goods building. The measured noise levels ranged between 60 and 61 dB(A) Leq (see Table 3).

The adopted internal noise criterion of 45 dB(A) will require a noise reduction of up to 16 dB(A).

The buildings are to be constructed of tilt up concrete panels and it is not envisaged that there will be any windows or openings which face the rail line from the showroom areas. (That is, typically, these types of businesses have store room facilities at the rear of the showrooms which would isolate the rail noise from the noise sensitive areas).

It is generally accepted that the façade of a masonry building will attenuate up to 25 dB(A) of road traffic noise (which may be approximated to rail traffic noise in this instance). This would equate to an internal noise level of around 35 dB(A) in the rear parts of the buildings. This is significantly lower than the adopted internal noise criterion and no further assessment of potential impacts is considered warranted.

For a general indication of the vibration levels associated with the movement of coal trains, Wilkinson Murray P/L conducted an investigation in the Hunter Valley in 1997. The study looked at ground vibration levels induced by passing coal trains. The worst-case results of that study showed a peak particle velocity, at a central frequency of 40 Hz, of approximately 0.11 mm/s at a distance of 20m from the rail line. This is approximately the same from the line as the nearest façade of the retail/bulky goods building.

As a rule of thumb it can be considered that vibration levels are inversely proportional to distance. Based on the Wilkinson Murray results for coal trains this means that, under typical conditions, vibration levels less than 0.5 mm/s would be experienced at distances greater than about 5m from the railway line.

As most people do not readily notice vibration levels of less than 0.5 mm/s, future users of the proposed retail premises are unlikely to notice vibration caused by train pass bys.

Various Standards detail findings that vibration at levels of less than 5mm/s are unlikely to cause any damage to any buildings.

4.16 Construction Noise

The assessment of construction noise is undertaken in accordance with the *Interim Construction Noise Guideline* (ICNG, 2009) and *Assessing Vibration: A Technical Guideline* (AVTG, 2006). These guidelines are non-mandatory but are usually referred to by local councils and the NSW Department of Planning and Infrastructure (DP&I) when construction/demolition works require development approval.

The proponent has advised that the entire project will take between 10 and 12 months to complete.

Initial demolition works will be followed by site preparation work and site excavation. The final phase of the works will involve erection of buildings and fitting out of these

4.16.1 Interim Construction Noise Guideline (ICNG)

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.

4.16.1.1 Surrounding Land Uses

The subject site is in a suburban area influenced by traffic and train noise as confirmed by background noise monitoring conducted by Spectrum Acoustics for the noise assessment for the site. There are existing residential receivers adjacent to the site as shown in Figure 1.

Potential noise impacts at these residences will require assessment.

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

4.16.1.2 Operating Hours

The recommended standard hours for construction works are shown in Table 1 from 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 works are proposed to take place during the normal construction hours as described.

4.16.1.3 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 construction works on the site will take longer than three weeks, the quantitative methodology is applicable.

4.16.1.4 Noise management Levels

Table 2 from the ICNG is shown in extract below. It details the noise management levels for construction works.

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 background noise levels obtained from the unattended logging the relevant daytime construction noise management levels determined in accordance with Table 2 are, therefore, **52 dB(A),Leq (15 min)**, at residential receivers to the west and south west and, **49 dB(A),Leq (15 min)**, at residential receivers to the north and north east.

4.16.2 Noise Sources and Impact Assessment

The proponent has advised that the construction works will be carried out over several phases. These will involve demolition of existing buildings, site preparation and construction of the new structure. The final stages of works will involve internal fitouts of the new building.

The Spectrum Acoustics technical database has been referenced to determine the Lw of typical construction equipment likely to be used on the site, as shown in **Table 18**.

By definition mobile plant such as those detailed in Table 18 will move about and will be at various operating levels (and thus producing various levels of noise) throughout any 15 minute period.

The levels shown in Table 18 are based on measurements of worst case 15 minute Leq noise levels for the machinery under maximum operating conditions on a construction site.

TABLE 18
TYPICAL EQUIPMENT SOUND POWER LEVELS

Equipment	Lw as dB(A) Leq (15 min)
22t Excavator	105
Truck & Dog	107
Drill Rig	111
Concrete Agitator	110
Concrete Pump	107
Vibrator	105
Mobile Crane	108
General Construction	105

The figure shown as “general construction” in the above table is an arithmetical average of several measurements of noise emissions from typical construction activity, over representative 15 minute periods, at a construction site similar to the current proposal. It represents a scenario of a truck and dog, a mobile crane, two excavators a compressor and a generator all working in close proximity at typical operating levels (that is, variously moving about and being in different orientations relative to the microphone and also working at different throttle levels throughout a full 15 minute period). Noise measurements were made at a location fully exposed to the construction noise with no shielding from site sheds, topography or other structures.

Noise emission 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.

The demolition works will involve an excavator, jackhammers and demolition saws with trucks taking the waste material off site.

The excavation phase of the works for foundations etc. will be done using an excavator, trucks and concrete pump. .

The buildings will be constructed on conventional frames with pre-cast concrete walls, structural steel and metal roofing. The construction will involve use of concrete agitator trucks, concrete pump and vibrator during concrete pours and cranes to lift panels into place.

The level shown as the Lw for the assessment in Table 4 is taken from the Spectrum Acoustics technical database and 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.

To gauge some potential construction noise impacts a typical operational scenario for the initial phases of construction has been considered where an excavator, dump truck and dozer were all working in close proximity to each other. All three items were considered to be at the worst case Leq (15 min) noise levels shown in Table 4.

Table 19 shows the results of a sample calculation of potential noise impacts at receivers at various distances from the site, as a result of the assessed operations taking place.

TABLE 19
CONSTRUCTION NOISE – as dB(A) Leq (15 min)

	@ 50m	@ 100m	150m	200m
Construction works noise source	106	106	106	106
Distance loss to receiver	42	48	52	54
Received noise	63	58	54	52
Criterion	52/49	52/49	52/49	52/49
Impact	11/14	6/9	2/5	0/3

The results in Table 19 show there may be an exceedance of the construction noise criterion at some residential receivers surrounding the site. Such an exceedance will be of a short term nature and need to be weighed against the long term social and economic benefits of the project.

The calculated results shown in Table 19 assume a direct line of sight from the receiver to the noise source. In reality, acoustic shielding from intervening structures such as fences and sheds etc. may result in received noise levels at some residences that are lower than those shown

The scenario considered in Table 19 represents the worst case for construction noise emissions from the site. The typical operating noise levels detailed in Table 18 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 19. Resultant received noise at the various residences around the site will, therefore, also be at lower levels.

5.0 – CONCLUSION

An acoustical assessment of theoretical noise emissions has been undertaken for the operation of the proposed Aberdeen Valley Fair Retail and Service Centre on the corner of the New England Highway and Perth Streets, Aberdeen, NSW.

The proposed development is to involve a supermarket, retail/bulky goods buildings, bottle shop, small retail and medical centre, commercial spaces, a service station (with possible takeaway drive through option) and associated car and heavy vehicle parking.

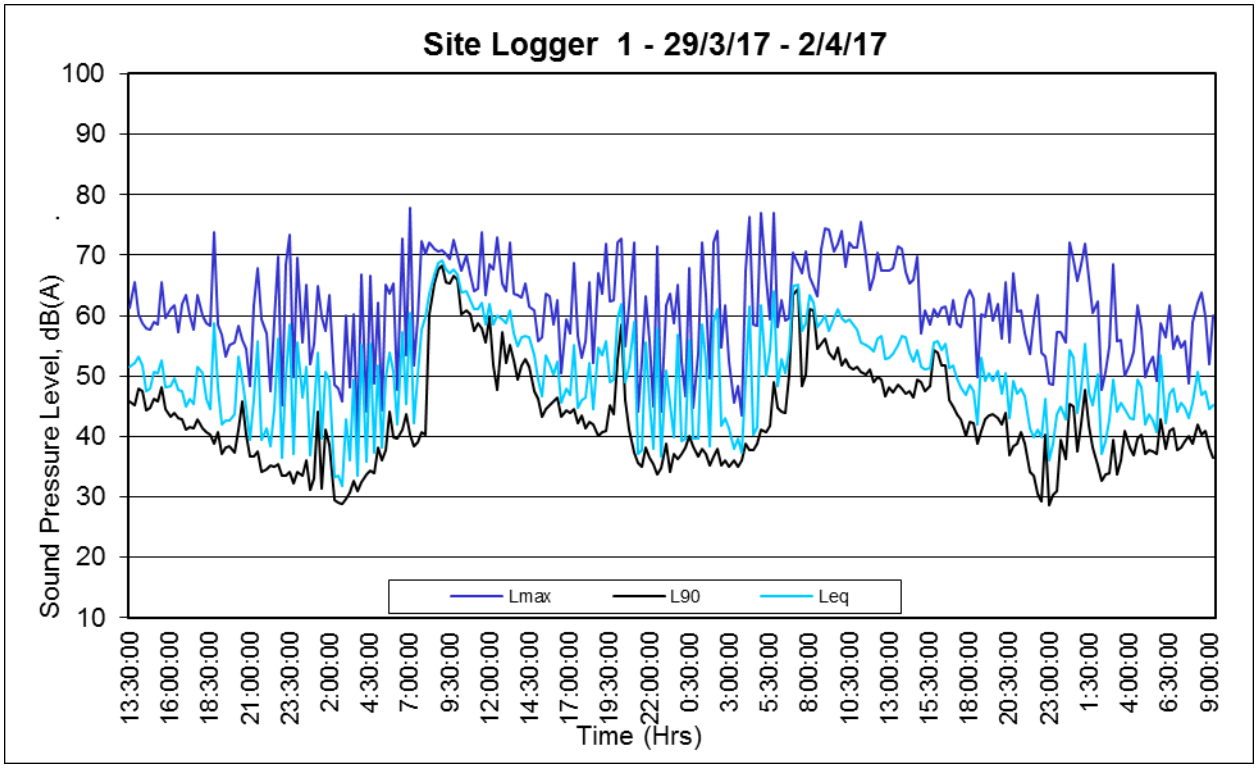
The assessment considered the potential impacts of noise from;

- Service station and Drive Through Restaurant;
- Heavy vehicle and car park noise;
- Traffic movements;
- Mechanical plant and equipment including air conditioning and refrigeration equipment, and
- Activities associated with and within the proposed commercial spaces.

The assessment has shown that there may be some minor exceedances of the various noise criteria. The adverse impacts of this noise will be minimised provided there is a minimum 4m high acoustic barrier constructed along the southern boundary of the site.

APPENDIX I

NOISE LOGGER CHARTS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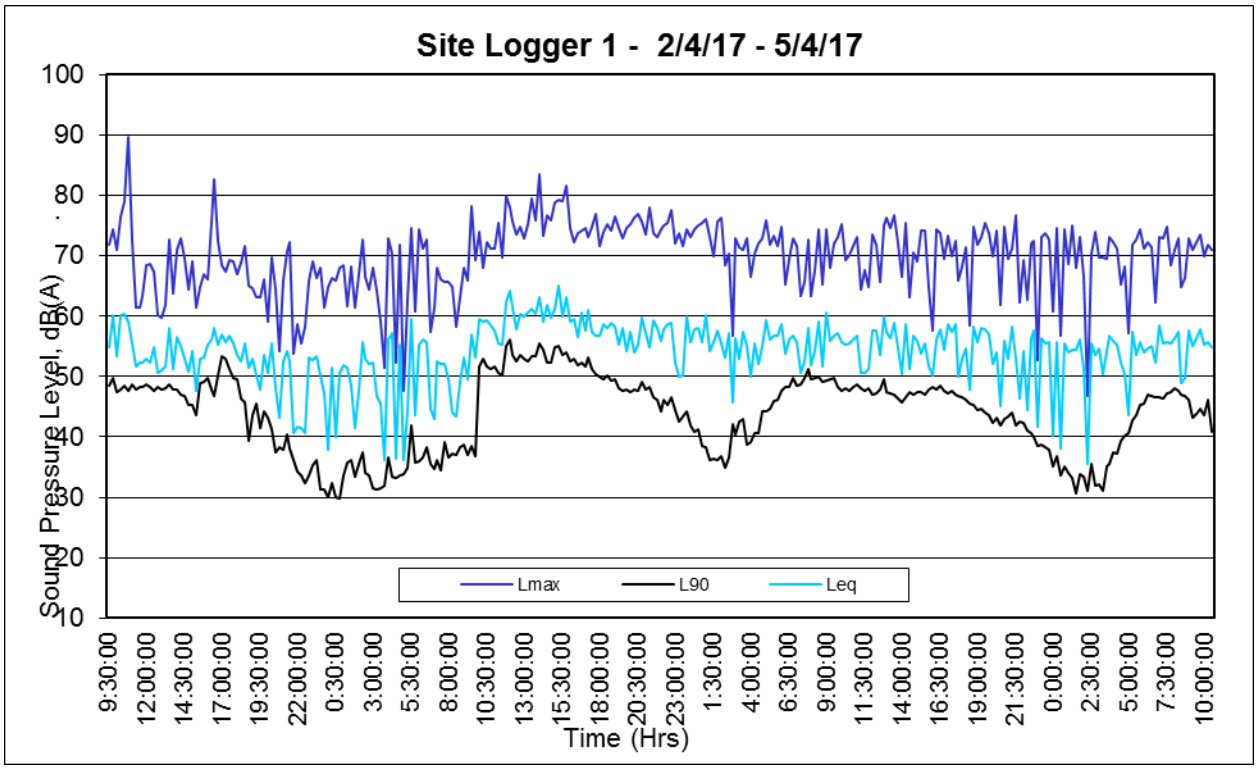
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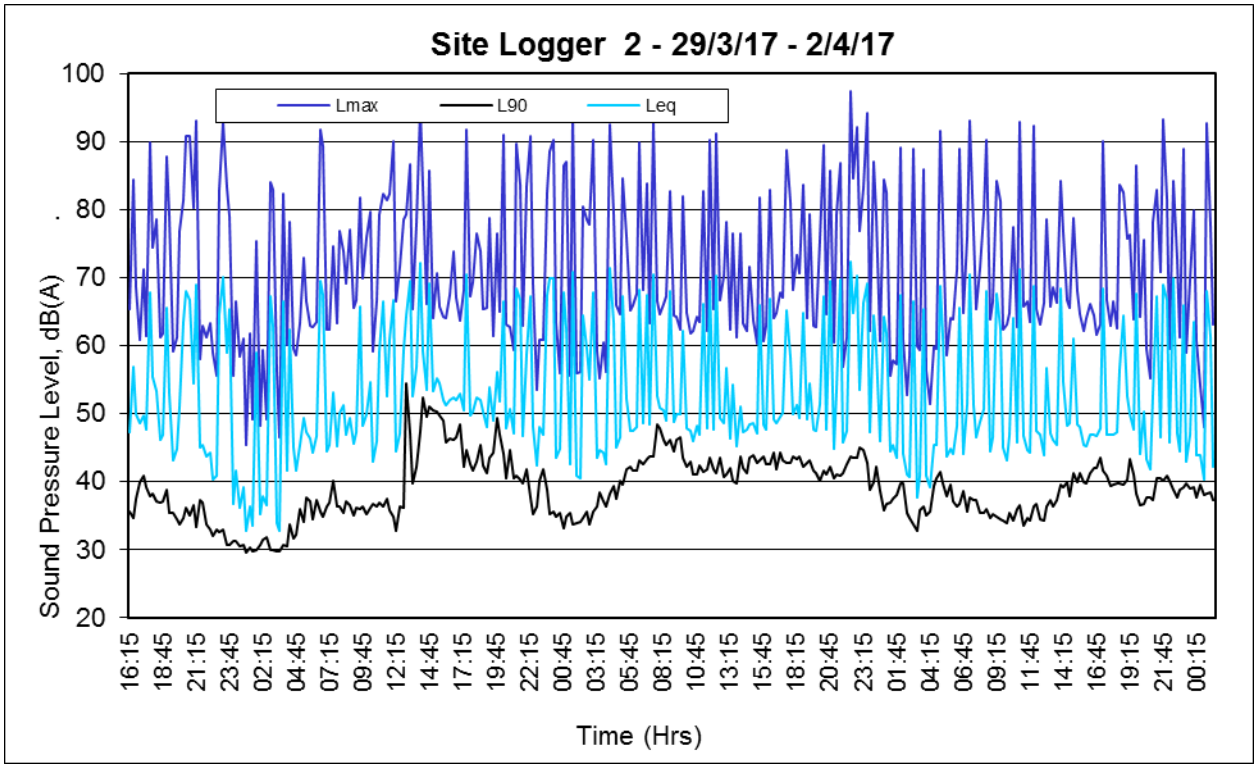
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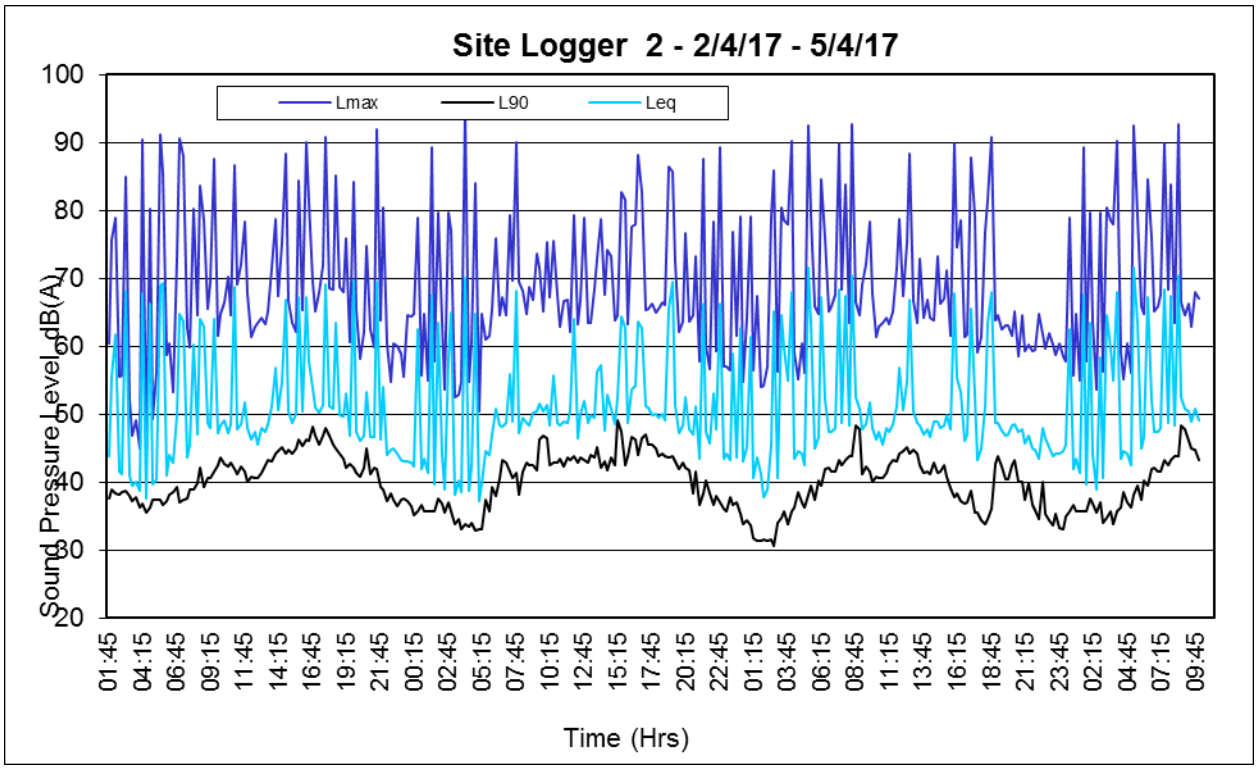
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Time (Hrs)

APPENDIX II

CAR PARK NOISE SOURCE LOCATIONS


28
29
27
24
21
18
15
12
9
26
20
23
17
14
11
8
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22
16
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1
2
A005_G4 GROUND

25 July 2018

Ref: 171389/7925

The Mitchell Group Pty Ltd
c/- DWP Suters

RE: ADDENDUM ACOUSTIC REPORT – PROPOSED ABERDEEN FAIR RETAIL & SERVICE CENTRE

This addendum report provides the results, findings and recommendations arising from the additional acoustic assessment in relation to the proposed Aberdeen Fair retail and service centre. It follows on from the original acoustic assessment for the site undertaken by Spectrum Acoustics (Report number 171389/7064, dated May 2017) and the address to queries from Upper Hunter Shire Council (Report number 171389/7341, dated November 2017) and, for completeness, should be read in conjunction with those reports. The proposed site layout is shown in **Figure 1**.

In a review of the original plans for the project Roads and Maritime Service (RMS) of NSW have indicated that the traffic flow into and out of the site be rearranged such that vehicles leaving the site to travel north do so via the egress to Perth Street. In light of this an extract from the updated traffic study by SECA Solution (Section 3.2.1) is shown below;

3.2.1 Driveway Location	Separate entry and exit driveways will be provided from the New England Highway with entry only located to the northern side of the service station. The egress driveway to the south shall allow for southbound connection onto the New England Highway only, with a raised central median to be provided to physically control right turns. A combined entry/exit driveway will be provided off Perth Street adjacent to the proposed supermarket. This driveway will also provide for northbound access onto the New England Highway for vehicles exiting the service station, including B-doubles. Directional signage shall be provided throughout the site to assist drivers exiting the site.

In relation to the current assessment, the revised internal traffic flow will result in the following;

- The vast majority of expected traffic using the site, including trucks travelling from north and south, would be entering the site from the service station entry on the New England Highway,
- All south bound vehicles would leave the site via the exit directly to the New England Highway,

- Only vehicles travelling north would leave the site via the Perth St exit,
- Perth St is a residential road with a 50-60km/h speed limit, reducing the need for speed and compression braking for heavy vehicles,
- The vast majority of expected traffic using the site would be coming from the north, travelling south bound.

From an acoustic point of view the most significant aspect of these changes will be the movement of north bound cars and heavy vehicles out of the site, particularly during the night. That is those cars and trucks which will exit the site via the driveway to Perth Street.

The project specific noise goals (PSNG) for the residences in the Perth Street area were previously determined as part of the original assessments and are as detailed below;

Day	**44 dB(A) L_{eq} (15 min)**
Evening	**43 dB(A) L_{eq} (15 min)**
Night	**38 dB(A) L_{eq} (15 min)**

The previously determined sleep disturbance screening criterion for the Perth Street area is **48 dB(A) L1 (1 min)**.

In relation to the most potentially affected receivers in Perth Street the vehicles would be moving towards them over approximately 120m along the driveway (from either the truck parking area or the rear of the service station). The worst case for noise generation would occur when trucks are leaving the site.

The most potentially affected receivers will be at 46 and 48 Perth Street which are across the road from the proposed exit. The noise at other receivers will be further attenuated by the additional distance loss and the acoustic screening, or partial screening, by the buildings in the proposed development.

Trucks moving around the site will do so slowly. In relation to nearby receivers, trucks travelling at, say, 10kph will move 130m in about 45 seconds. To assess a practical scenario a truck was considered to be a series of four point noise sources, travelling along the driveway at various distances from the exit as shown in Figure 1.

The sound power level (Lw) of 102 dB(A), for a slow moving truck, has been taken from the Spectrum Acoustics technical database (which contains several site noise measurements of trucks moving at such speeds). Each noise source was considered to be producing the sound power level shown above for about 10 seconds in a 15 minute period as it traverses the site. This equates to an effective Lw of 82 dB(A) Leq (15 min) for each truck noise point source as shown on Figure 1 (i.e. a factor of 10xlog 10/900 to represent site noise for 10 seconds out of a 15 minute period).

For the determination of potential impacts at the closest receiver, a scenario was assessed where two trucks were assumed to be on the driveway leaving the site in a single 15 minute period. Based on the discussion above the combined Lw of two trucks would be 85 dB(A) Leq (15 min).

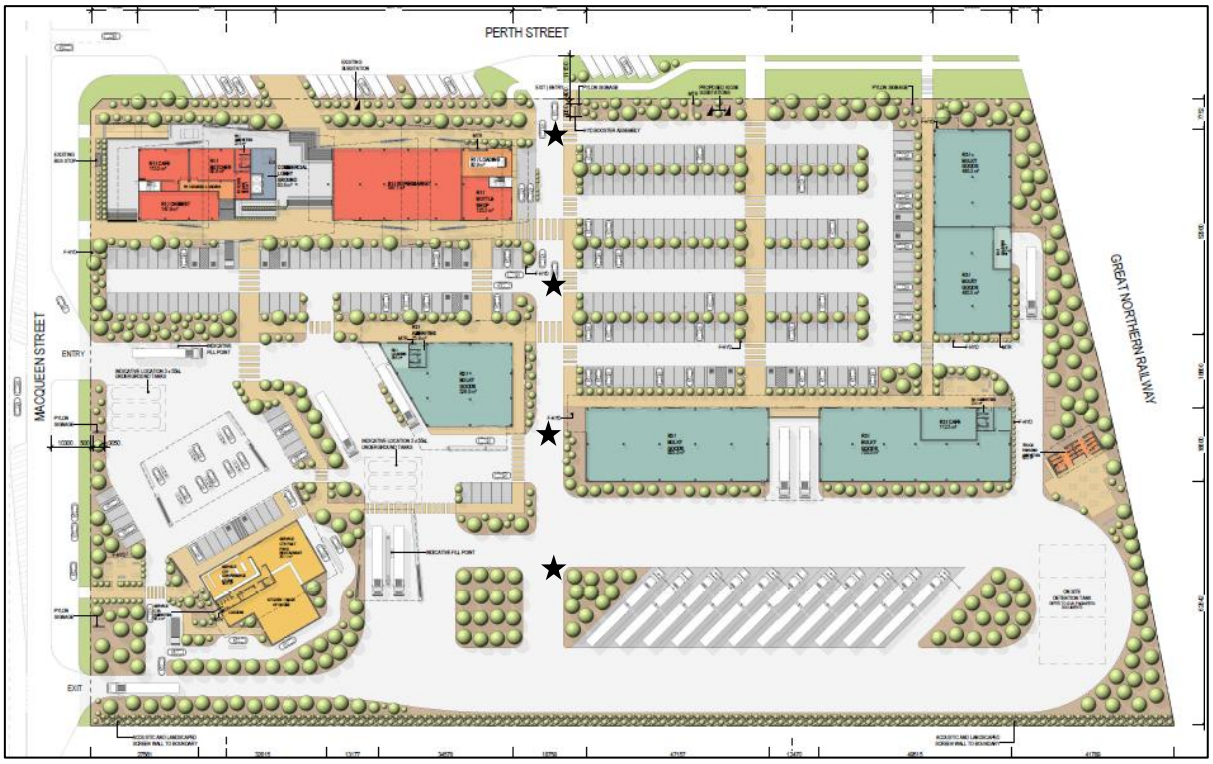

Figure 1. Site Plan

Most of the noise coming from a truck moving at slow speeds comes from the engine and exhaust with minor contribution from tyre noise. For the calculation of potential impacts a noise source height of 4m was used to approximate the top of the truck exhaust. **Table 1** shows the result of the calculation of potential impacts at number 46 Perth Street (the most potentially affected receiver).

To consider a practical scenario, the distance loss has been calculated to a theoretical receiver in the yard, 5m from the house (at the closest residence). The distance of each noise source from the reception point is indicated in Table 1.

TABLE 1
CALCULATED SPL AT 46 PERTH STREET
HEAVY VEHICLES ON DRIVEWAY

Item	Source 1 (160m)	Source 2 (120m)	Source 3 (80m)	Source 4 (40m)
Vehicle Noise as Leq (15 min)	85	85	85	85
Distance Loss to receiver (m[1])	52	50	46	40
SPL @ receiver Leq (15 min)	33	35	39	45
Total Noise Leq (15 min)	46.5			
Criterion Leq (15 min)(Day/Evening/Night)	44/43/38			
Impact	2.5/3.5/8.5			

1. See text before the table

The noise from cars moving about the site and using the car parks etc. has been assessed and detailed in the original reports. The movement of cars out of the site at night also needs consideration. Cars moving at slow speeds would, typically have an Lw of up to 85 dB(A) Leq. Based

on the same assumptions as for heavy vehicles this would equate to point noise sources at 65 dB(A) Leq (15 min).

For the determination of potential impacts at the closest receiver, a scenario was assessed where ten cars were assumed to be on the driveway leaving the site in a single 15 minute period at night. Based on the discussion above the combined Lw of ten cars would be 75 dB(A) Leq (15 min). **Table 2** shows the result of the calculation of potential impacts at number 46 Perth Street.

TABLE 2
CALCULATED SPL AT 46 PERTH STREET
CARS ON DRIVEWAY

Item	Source 1 (160m)	Source 2 (120m)	Source 3 (80m)	Source 4 (40m)
Vehicle Noise as Leq (15 min)	75	75	75	75
Distance Loss to receiver (m^1)	52	50	46	40
SPL @ receiver Leq (15 min)	23	25	29	35
Total Noise Leq (15 min)	36.5			
Criterion Leq (15 min)(Day/Evening/Night)	44/43/38			
Impact	0			

Maximum noise events at night are most likely to be associated with heavy vehicles moving out of the site. The main sources of noise from this may come from engine revs or tray rattles from the vehicles as they move off site at low speed. The sleep disturbance assessment (L1 (1 min) noise levels) is only applicable to noise emissions from vehicles that are on site. It is not applicable once vehicles pass onto the public road.

The L1 (1 min) noise level will vary with each individual event but, in a driveway such as is proposed L1 (1 min) levels in the range from 100 to 110 dB(A) may be expected from the sort of events indicated above.

Table 3 shows the result of the calculation of potential sleep disturbance impacts at the most potentially affected residence at number 46 Perth Street. The sleep disturbance criterion is applicable at the outside of a bedroom window. As the internal layout of the residences is not known the worst case has been assessed which assumes that there are bedroom windows facing the driveway and the distance loss has been calculated to this facade.

TABLE 3
CALCULATED L1 (1 min) AT 46 PERTH STREET

Item	dB(A)
Truck Noise	105
Distance Loss (40m)	40
SPL @ L1 (1 min)	65
Screening Criterion L1 (1 min)	49

Research on sleep disturbance is reviewed in the NSW Road Noise Policy (RNP). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research, the EPA recognised that the current sleep disturbance criterion of an LA1, (1 minute) not exceeding the LA90, (15 minute) by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, the EPA will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover the maximum noise level or LA1, (1 minute), that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the RNP. Other factors that may be important in assessing the extent of impacts on sleep include:

- *how often high noise events will occur*
- *time of day (normally between 10pm and 7am)*
- *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*

The LA1, (1 minute) descriptor is meant to represent a maximum noise level measured under 'fast' time response. The EPA will accept analysis based on either LA1, (1 minute) or LA, (Max)".

To undertake the more detailed analysis of the potential for sleep disturbance impacts site data was obtained from attended noise monitoring done at the roadside across from number 46 Perth Street on June 26/27 (as shown in **Figure 2**). The attended noise measurements were made continuously between 11.15pm (on 26th) and 3.00am (on 27th).

Figure 2. Attended Noise Measurement Location (Source for base map: Google earth).

Attended noise monitoring was conducted with a Brüel & Kjær Type 2250 Precision Sound Analyser. This instrument has Type 1 characteristics as defined in AS1259-1982 “Sound Level Meters” and has current NATA calibration. Field calibration is carried out at the start and end of the monitoring period.

A-weighted noise levels were measured over the monitoring period with data acquired at 1 second statistical intervals and the meter set to “fast” response. Each 1 second measurement is accompanied by a third-octave band spectrum from 20 - 20k Hz which is required for analysing INP ‘modifying factors’. Time based field notes allow for determination of the contribution of each measured noise source to the overall noise level.

The microphone had full line of sight to the road (and traffic) and was approximately the same distance from the edge of traffic on the New England Highway as the closest facade of the residence at number 46 Perth Street.

During the period of the monitoring there was a total of 70 truck and 65 car passbys along the New England Highway. There were also four trains past the site on the Main North Rail Line. The summary of the noise measurements is shown in **Table 4**.

TABLE 4
MEASURED NOISE LEVELS PERTH STREET
26/27 June 2018

Item	dB(A) Leq	Range - dB(A) L1 (1 min)
Trucks on Highway	65	59 - 70
Cars on Highway	55	48 – 62
Trains	52	60 – 70
Total	48.5	-

Discussion of Results

A comparison of the theoretically calculated results in Tables 1, 2 and 3 with the measurement results in Table 4 show that the calculated Leq (15 min) noise level from trucks is lower than the existing measured Leq noise level during the measurement period (that is calculated noise of 46.5 dB(A) and a measured noise of 48.5 dB(A)).

Under the assessed conditions, the combined calculated noise from the trucks and the “existing” traffic noise wold be 50.5 dB(A) Leq. It is noted that the total measured noise was of a 3.75 hour period whilst the calculated noise level is for the assessed 15 minute compliance period.

The calculated L1 (1 min) noise level is within the range of L1 (1 min) noise levels measured from truck and train passbys.

The results of the measurements made on site show that, over the 3.75 hour period, there were 70 trucks past the site (on the New England Highway), or an average of one truck every 3.2 minutes. Similarly, there was an additional 65 cars past the site on the New England Highway, or an average of one every 3.5 minutes.

In total, based on the period of the site measurements and observations, a vehicle passes the site on the New England highway approximately every 1.7 minutes. The L1 (1 min) noise emissions from these vehicles ranges from 48 to 70 dB(A) when measured at the same distance from the traffic as the façade of the residence most potentially affected by noise from the proposal.

In addition to the road traffic, on the night of the measurements there were four trains past the site at an average of one per hour. The L1 (1 min) noise from trains ranged from 60 to 70 dB(A). The train noise was above 52 dB(A) Leq for an average of four minutes per train.

It can be concluded from the above discussion that the existing night time acoustic environment of the residential areas in Perth Street, near the proposed development, is dominated by noise emissions from traffic travelling along the New England Highway. The contribution of noise from train is significant, but intermittent during the night time.

The addition of noise from occasional vehicles leaving the site of the proposed development, via the Perth Street exit, would, therefore, not be out of character with the existing acoustic environment.

We trust this report fulfils your requirements at this time, however, should you require additional information or assistance please do not hesitate to contact the undersigned.

Yours faithfully

SPECTRUM ACOUSTICS PTY LIMITED

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Acoustical Consultant