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Part 3A Acoustic Report
88 Walker St and 77-81 Berry St North
Sydney
Eastmark Holdings Pty Ltd

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1. Introduction

This report details the acoustic assessment of the proposed development at 88 Walker Street and 77-81 Berry Street, North Sydney NSW. The proposed development consists of two commercial buildings to be constructed over two adjacent blocks. One of the buildings is to be hotel with the other containing office space. The following report outlines acoustic recommendations as part of the development application process based on the Director General's Requirements MP 08_0238.

2. References

- <http://ecouncil.northsydney.nsw.gov.au/eservice/mapping/mapDisplay.jsp>
- North Sydney Development Control Plan 2002, North Sydney Council, as amended 30 October 2008
- NSW Industrial Noise Policy, EPA (NSW), January 2000
- Environmental criteria for road traffic noise, EPA (NSW), May 1999
- AS 1055:1997 "Acoustics - Description and measurement of environmental noise - General procedures"
- AS 2107:2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors"

3. Development details

3.1 Site layout

The development site is located in the central business district of the North Sydney Council and is shown in Figure 1 below. The development is partially on a commercial zone and "Deferred" area. The immediate surrounding areas are all commercial zones. A high rise commercial and residential building is located at the northern end of the "Deferred" area.

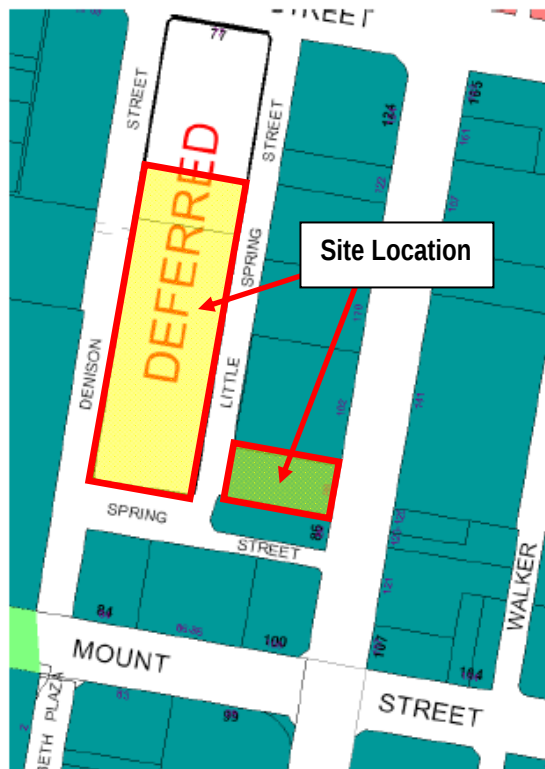


Figure 1 North Sydney Council Zoning

3.2 Development description

The development consist of two buildings, a 33 level hotel building at 88 Walker Street and a 37 level commercial building at the southern end of the 77 – 81 Berry Street block. The proposed site plan is shown in Figure 2 below.

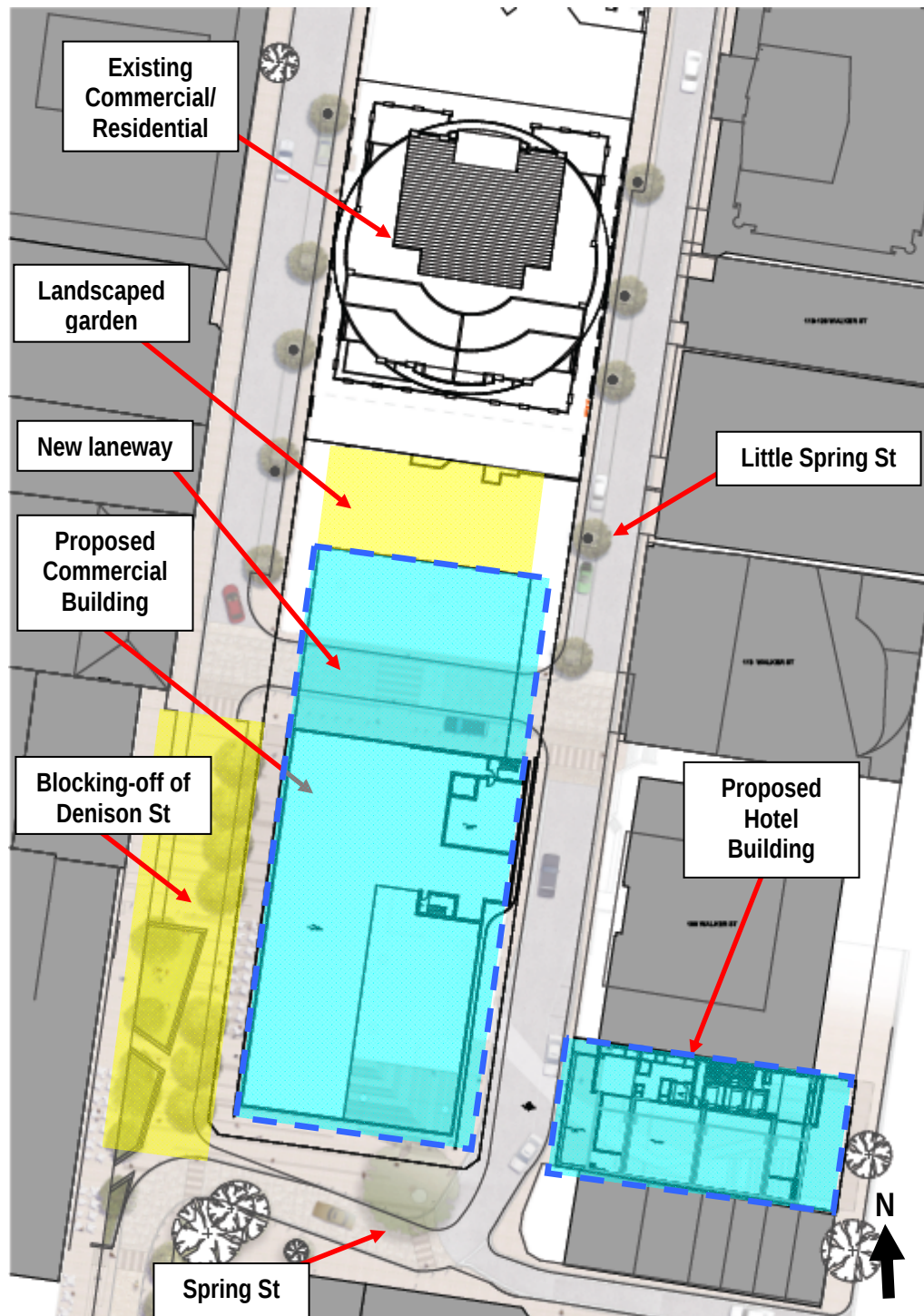


Figure 2 Proposed development site plan

The two buildings will be connected via an underground service link tunnel and an access bridge above Little Spring Street. A section of Denison Street would also be blocked-off to vehicular traffic (north of Spring Street) with a new laneway introduced to replace the vehicular access to the northern end of Denison Street. This would also require changing the traffic direction to two-way for a portion of Little Spring Street (currently one way only in southern direction). The commercial building will also

overhang above the new laneway. A landscaped garden is proposed for the Level 2 rooftop of the northern side of the commercial building. Three major plant room locations are proposed for both commercial and hotel buildings. These are a basement plant room, low level plant rooms (level 5 for commercial building and level 6 for hotel building) as well as top floor plant rooms. Figure 3 and Figure 4 provide section and elevation views of the proposed development.

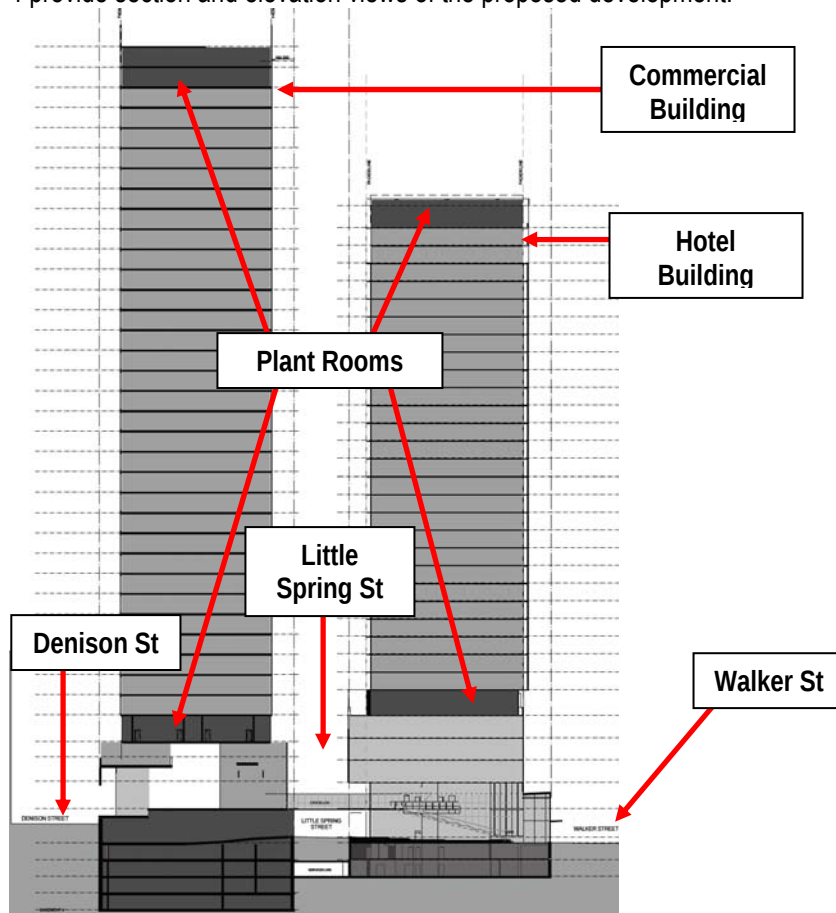


Figure 3 Section view of both proposed buildings

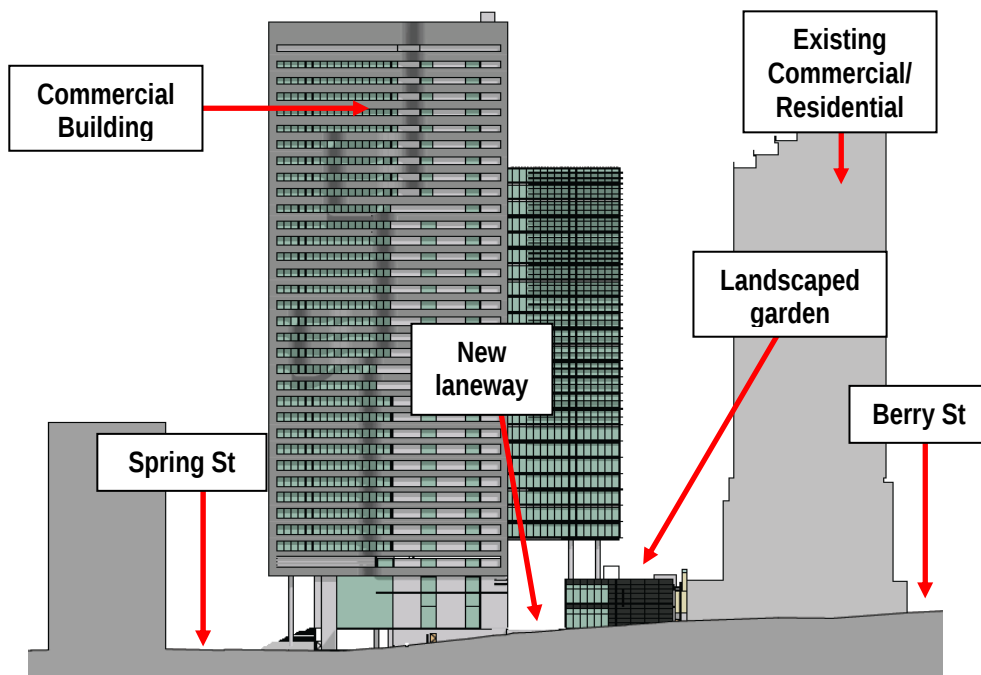


Figure 4 Eastern elevation view of the proposed commercial building

4. Noise criteria

4.1 North Sydney Development Control Plan

The *North Sydney Development Control Plan 2002* outlines specific noise criteria for allowable noise emissions from developments. These are outlined in Table 1 below.

Table 1 North Sydney Development Control Plan noise emission criteria

Period	Allowable noise $L_{Aeq, 1 \text{ hour}}$ (dBA)
Weekday	
Day	55
Evening	45
Night	40
Weekend	
Day	50
Evening	45
Night	40
OR in any case do not exceed	
Day	$\leq \text{Existing } L_{A90, 1 \text{ hour}} + 5 \text{ dBA}$
Evening	$\leq \text{Existing } L_{A90, 1 \text{ hour}} + 5 \text{ dBA}$
Night	$\leq \text{Existing } L_{A90, 1 \text{ hour}}$

Times of day are defined as:

- Weekday
 - Day 7 am – 6 pm
 - Evening 6 pm – 10 pm
 - Night 10 pm – 7 am
- Weekend
 - Day 8 am – 7 pm
 - Evening 7 pm – 10 pm
 - Night 10 pm – 8 am

The following guidelines are also provided:

- Incorporate noise reduction measures on plant and machinery.
- Use design features or planning that will reduce noise.
- Incorporate adequate measures for tonal, low frequency, impulsive, or intermittent noise.
- Comply with *NSW Industrial Noise Policy 2000* in particular the modification required for acceptable noise level (ANL)

4.2 NSW Industrial noise policy

The recommended noise levels emitted from industrial sources are outlined in the *NSW Industrial Noise Policy*. Intrusiveness and amenity criteria are determined based on type of receiver and existing ambient and background noise environment. The **intrusiveness criterion** is based on the existing background noise and is summarised by the following equation:

$$L_{Aeq, 15 \text{ minute}} \leq \text{rating background level} + 5 \text{ dB}$$

Note: Rating background level (RBL) being defined as the median value of the measured $L_{A90, 15 \text{ minute}}$ for the assessment period

The **amenity criterion** is based on the ambient noise level of the receiver. Recommended noise levels from industrial noise sources for the type of receivers encounter during this assessment are shown in Table 2 below.

Table 2 Recommended Noise Levels from Industrial Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Commercial Premises	All	When in use	65	70

The Acceptable noise level (ANL) from Table 2 is compared to the ambient noise level from which amenity criterion is determined by set of conditions outlined in the Industrial Noise Policy.

The design criterion is taken to be the lower of the intrusive criterion and amenity criterion

Times of day are defined as:

- Day – 7 am to 6 pm (8 am to 6 pm Sundays and public holidays)
- Evening – 6 pm to 10 pm
- Night – 10 pm to 7 am (10 pm to 8 am Sundays and public holidays)

4.3 Traffic noise

The traffic noise criteria are outlined in *Environmental criteria for road traffic noise* which are shown in Table 3. These criteria apply to traffic noise generated due to the development including the change of the traffic conditions in the area.

Table 3 Traffic noise criteria

Type of development	Criteria		
	Day (7 am – 10 pm)	Night (10 pm – 7 am)	Where criteria already exceeded
Land use development with potential to create additional traffic on local roads	$L_{Aeq, 1 \text{ hour}}$ 55 dBA	$L_{Aeq, 1 \text{ hour}}$ 50 dBA	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

4.4 Aircraft noise

The proposed development site is located outside the ANEF curves for any nearby airports; therefore assessment with respect to aircraft noise intrusion is not required.

5. Noise survey

A noise survey was conducted on the site between Thursday 19 February 2009 and Monday 22 February 2009 to determine the existing noise levels at the site. The noise survey consisted of a long term noise logger being setup on the roof of 88 Walker Street, with additional spot measurements being taken at various street level locations.

Both the long term noise logging and spot measurements were carried in accordance with AS 1055:1997 *"Acoustics - Description and measurement of environmental noise - General procedures"*. The noise logger consisted of a Larson and Davis LXT Type 1 sound level meter which was set to 'A' frequency weighting, 'F' time weighting and 15 minute sample intervals at the site.

Spot measurements were carried using a Larson and Davis 831 Type 1 sound level meter which was set to 'A' frequency weighting, 'F' time weighting. The measurement period was sufficiently long for the L_{Aeq} to stabilise but generally consisted of 10 to 15 minutes at each location. A Larson and Davis CAL200 was utilised to calibrate both sound level meters before and after each measurement. The locations of the noise measurements are shown in Figure 5 below. The weather during the noise logging ranged from overcast to sunny periods. Intermittent rain occurred on Saturday 21 February 2009, based on BOM measurements (at nearby Observatory Hill) the samples during the rain periods have been excluded. Loud thunder (without rain) was also heard during the evening of Friday 20 February 2009. The noise data during these period shows can be identified by excessive L_{Amax} levels hence those samples have also been excluded from analysis.

Results from the noise survey can be seen in Table 4, with Table 5 displaying the spot measurement results. Daily noise logging graphs are shown in Appendix A.



- Site 1 – Roof Level 88 Walker St – Noise logging location
- Site 2 – Roof Level 88 Walker St
- Site 3 – Street level Walker St
- Site 4 – Street level Spring St
- Site 5 – Street level Denison St
- Site 6 – Street level Little Spring St

Figure 5 Noise survey locations

Table 4 Noise logging results

Time	Existing Sound Pressure Levels (dBA)				
	L _{Amax}	L _{A10}	L _{Aeq}	L _{A90}	RBL
Day	96	66	66	63	66
Evening	88	64	63	61	63
Night	91	62	61	59	59

Table 5 Spot measurement results

Location	Date	Time	Sound Pressure Level (dBA)				
			L _{Amax}	L _{A10}	L _{A90}	L _{Aeq}	Logger L _{Aeq}
Site 1	19/02/08	14:08	68	68	67	67	67
Site 2	19/02/08	14:13	69	65	64	64	67
Site 3	19/02/08	14:25	83	72	64	69	67
Site 4	19/02/08	14:44	82	69	63	66	67
Site 5	19/02/08	14:56	83	66	63	65	67
Site 3	23/02/08	09:56	88	74	64	71	67
Site 4	23/02/08	10:11	83	69	63	67	67
Site 6	23/02/08	10:28	76	71	70	71	67
Site 5	23/02/08	10:33	77	67	63	65	67
Site 2	23/02/08	10:59	68	65	64	64	67
Site 1	23/02/08	11:05	72	68	66	67	67

The noise environment on top of the roof at 88 Walker Street (Site 1 and 2) was dominated by rooftop HVAC equipment from the various surrounding buildings. This is evident from relatively consistent noise levels throughout the day period.

Spot measurements at Site 2 were lower due to decreased proximity to nearby roof plant rooms however the ambient noise was still dominated by HVAC noise from adjacent buildings.

Spot measurements at Sites 3, 4 and 5 were dominated by traffic noise from the adjacent street. Whenever the traffic level decreased a background “hum” was audible from the various surrounding plant rooms as well as car park intake and exhaust outlets

Site 6 noise was dominated by a return air outlet from an adjacent car park. This dominated the noise environment at this monitoring location to such an extent that passing traffic did not register as a significant event.

Appendix B shows the octave band levels from the spot measurements carried out at various locations during the noise survey. It can be observed that the frequency content is very similar at all of the positions around the site which is consistent with HVAC noise that was audible throughout the survey.

6. Assessment criteria

6.1 Noise emissions

The *North Sydney Development Control Plan 2002* noise emission criteria outlined in Table 1 are designed for the residential suburban areas of the council and not the central business district where the development site is located. Given that the existing background noise levels already significantly exceed these noise emission criteria it is unrealistic and impractical to design a commercial development to satisfy these noise levels. The assessment criteria are based on the *NSW Industrial noise policy* amenity criteria as these provided the lowest criteria when based on the carried out noise survey results.

Table 6 Assessment noise emission criteria

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L _{Aeq} Noise Level (dBA)	Criteria
Residence	Urban	Day	56	Amenity
		Evening	53	Amenity
		Night	51	Amenity
Commercial Premises (when in use)	All	Day	57	Amenity
		Evening	61	Amenity
		Night	63	Amenity

6.2 Internal noise criteria

Indoor background noise criteria for various types of occupancy and activities are based on AS 2107:2000 "Acoustics – Recommended design sound levels and reverberation times for building interiors" which provides guideline values for internal sound pressure levels for various types of occupancy and activities. Table 7 provides the internal noise criteria for the various types of spaces expected within the development

Table 7 Assessment internal noise criteria

Type of occupancy/activity	Recommended design Sound Level L _{eq} (dBA)	
	Satisfactory	Maximum
Office building		
Board and conference room	30	40
Cafeterias	45	50
General office areas	40	45
Private offices	35	40
Reception areas	40	45
Rest rooms and tea rooms	40	45
Undercover car parks	55	65
Hotels		
Bars and lounges	45	50
Conference areas (without sound reinforcement)		
- Up to 50 people	35	40
- 50 – 250 people	30	35
Conference areas (with sound reinforcement)	35	45
Dining rooms	40	45
Foyers and recreation areas	45	50

Type of occupancy/activity	Recommended design Sound Level L_{eq} (dBA)	
	Satisfactory	Maximum
Sleeping areas		
- near minor roads	30	35
- near major roads	35	40

6.3 Traffic noise

Due to the high background noise levels in the area, additional traffic noise levels need to satisfy the following criterion:

$$\text{New traffic noise } L_{Aeq, 1\text{hour}} \leq \text{Existing } L_{A90, 1\text{hour}} + 2 \text{ dBA}$$

This actual traffic noise criteria based on the noise survey results are showed in Table 8 below.

Table 8 Assessment traffic noise criteria

Period	Allowable noise $L_{Aeq, 1\text{ hour}}$ (dBA)
Day	68
Evening	65
Night	63

7. Noise emission

7.1 HVAC noise

The major noise sources from the development will be HVAC equipment such as:

- Water-cooled chillers
- Cooling Towers
- Chilled water pumps
- Air handling plants (fans)
- Generators
- Transformers
- Kitchen exhaust fan, Car park exhaust fan, etc

These noise sources are similar to the current noise environment in the area. Three plant rooms in each of the buildings will contain the equipment. These are a basement plant rooms, low level plant rooms (level 5 for commercial building and level 6 for hotel building) and top level plant rooms. The noise emissions have to comply with the criteria outlined in the *NSW Industrial Noise Policy* which are outlined in Table 6. Control of the HVAC noise will be through the following measures:

- Equipment specification
- Equipment arrangement, discharge and intake locations
- Acoustic enclosures and barriers
- Duct specification, plenums and in-duct sound attenuators
- Acoustic louvers

Specification of the attenuation measures should be carried out by an Acoustic Engineer in conjunction with the Building Services Engineers during the design development stage of the project.

7.2 Traffic noise

Generally traffic levels in the vicinity of the development sites will either increase by an insignificant amount or decrease in volume as outlined in *Traffic and Parking Impacts* report issued by Halcrow. Table 9 summarises the sections of road where the greatest increase in traffic volumes and the corresponding change in traffic noise emissions will occur.

Table 9 Significant traffic volumes increases

Road	Section	Existing Weekday Traffic (veh/hr)		Forecast Weekday Traffic (veh/hr)		Change in traffic volume (%) and noise (dBA)	
		AM Peak	PM Peak	AM Peak	PM Peak	AM	PM
Mount St	West of Walker St	62	156	100	216	61% +2 dBA	38% +1 dBA
Little Spring St	North of Spring St	161	291	352	205	119% +3 dBA	-30% -2 dBA
Denison St	North of Spring St	366	163	N/A	N/A	N/A	N/A
Proposed Laneway	West of Little Spring St	N/A	N/A	376	133	N/A	N/A

As can be seen from the table above, most of the traffic noise increases satisfy the criteria of *Existing* $L_{A90, 1hour} + 2 \text{ dBA}$.

It can be also seen that traffic volumes from the closed-off section of Denison St (north of Spring St) will be directly transferred to the new Proposed Laneway. The increase in the traffic noise along Little Spring St is also due to the closure of the Denison St section. Despite the fact that future noise levels are likely to slightly exceed the traffic noise criteria. This noise level will predominantly be experienced by commercial receivers who will not be severely impacted (if at all). Existing residential receivers are located further away, and the incident traffic noise level experienced by these properties will be below the existing background noise level during the AM peak time.

Existing residential properties will be shielded from the traffic noise generated by the Proposed Laneway. Any audible noise levels from this Laneway will be below the existing background noise.

Overall increases in traffic noise due to the proposed development are deemed to be minor and comply with the required criteria generating minimal additional impacts.

7.3 Landscaped garden area

The outdoor landscaped area is to be predominately used during weekday business hours with limited usage expected on Saturday. The noise generated in this space is likely to be in the vicinity of $L_{Aeq} 70 \text{ dBA}$ at 1 m during peak periods (assumed to be weekday lunch time). The closest residential receivers are located approximately seven levels (approximately 20 m) above the outdoor area. The propagated noise level at the residences will be significantly below the allowable daytime emission criteria of $L_{Aeq} 56 \text{ dBA}$. Given that the generated noise will be in the speech frequencies with minimal low frequency noise therefore noise intrusion can be assumed as negligible into the residential spaces.

8. Sound insulation

Noise levels inside the buildings should comply with the criteria outlined in Table 7. Based on the noise survey results, incident noise levels on the façade can be predicted and appropriate glazing and construction can be specified. The development is located in a high ambient noise level area, with a steady background noise during all periods of the day.

8.1 Façade and glazing

The façade is to consist generally of a glazed curtain wall. The glazed sections will be aluminium framed with the commercial building containing stand off screens at various levels and extents as architectural features. The hotel building northern facade is to contain a metal clad concrete wall. Any standard construction (eg 150 mm) will provide sufficient sound insulation to control external noise break in. Remaining hotel walls will be glazed with minimal spandrels or glazing frames.

Given that the noise levels are relatively consistent across the various sides of the development and at the various heights at which noise measurements were carried out. Glazing recommendations are constant for all orientations and heights of the buildings. Indicative glazing recommendations are outlined in Table 10 below. Detailed design of the glazing will be conducted during design development stages of the project to identify and special requirements as to the internal spaces that will be located along the building perimeter.

Table 10 Indicative glazing recommendations

Building	Internal space	Type	Glazing
Commercial	Open plan office, reception areas, rest and team rooms	Single glazed	10 mm float or 8.38 mm laminated
		Double glazed	6 mm / 12 mm air gap / 6 mm float glass
	Boardroom, meeting rooms, private office	Single glazed	16.76 mm laminated
		Double glazed	6 mm / 12 mm air gap / 8 mm float glass
Hotel	Bars, lounges, foyer, recreation areas, dinning rooms	Single glazed	10 mm float or 8.38 mm laminated
		Double glazed	6 mm / 12 mm air gap / 6 mm float glass
	Sleeping areas, conference areas	Single glazed	16.76 mm laminated
		Double glazed	6 mm / 12 mm air gap / 8 mm float glass

9. Summary

An environmental noise assessment has been carried out as part the development application process for the proposed development at 88 Walker Street and 77-81 Berry Street, North Sydney NSW. The noise survey results showed high background noise levels dominated by HVAC equipment and traffic noise which is consistent for a central business district area. To meet recommended indoor noise levels the façade and glazing need to be carefully designed. Section 8.1 outlines the expected acoustic requirements of the façade elements.

Noise emitted from the site has to be controlled to meet the criteria outlined in the North Sydney Development Control Plan as well as the NSW Industrial Noise Policy. Assessment noise criteria are

outlined in Section 6 based on existing noise levels. It is anticipated that noise control measures will need to be included in the design stage of the project such as:

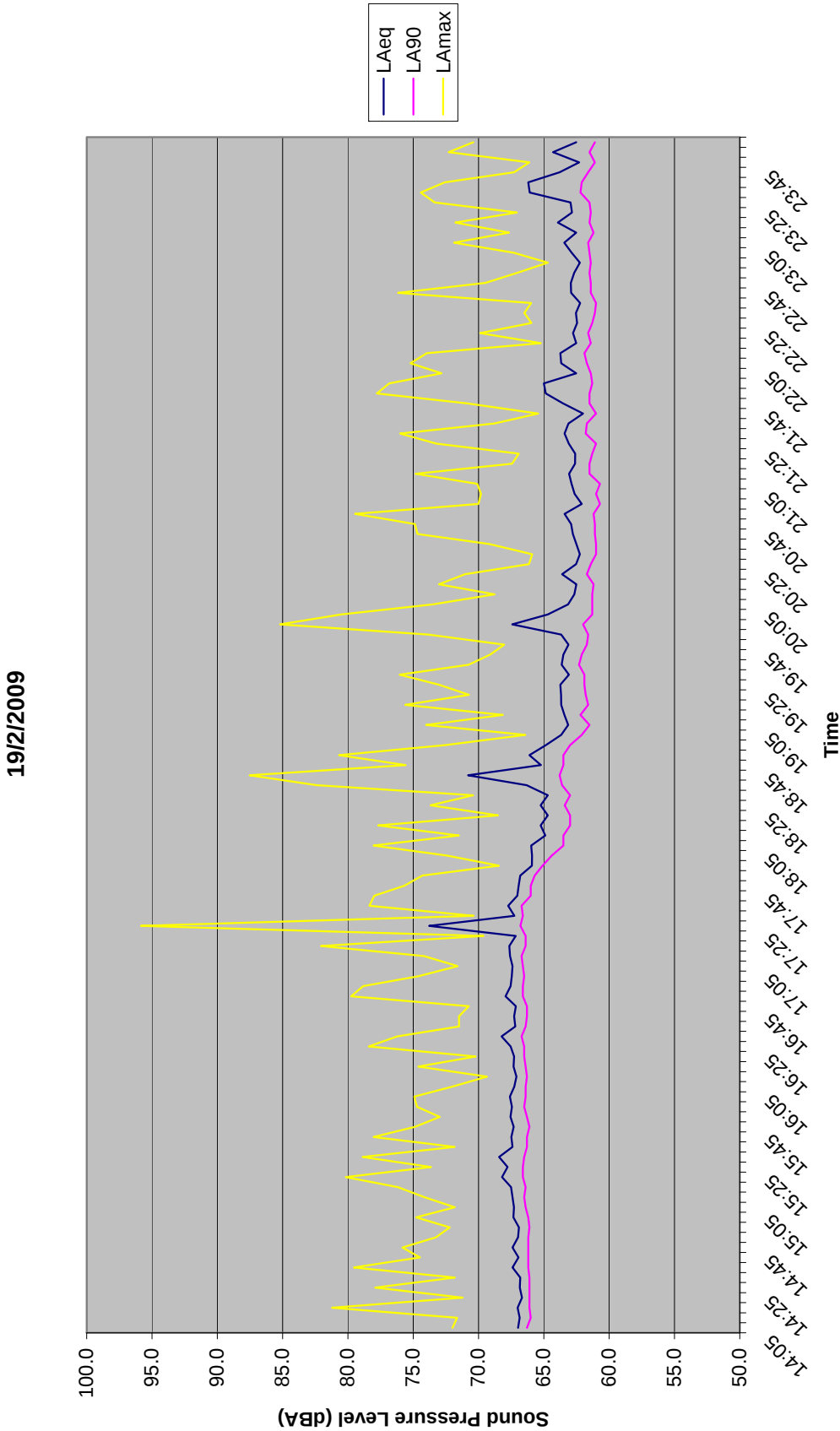
- Careful selection of equipment (ie select a low or quiet noise equipment).
- Orientation of outdoor noisy equipment/machine and noise sensitive receivers to avoid creating a layout with noise sources directed towards neighbouring receivers
- Installation of noise control measures (eg acoustic barriers, silencers, acoustic louvers and acoustic enclosures, etc) such to minimise impact on the nearby receivers

Appendix A

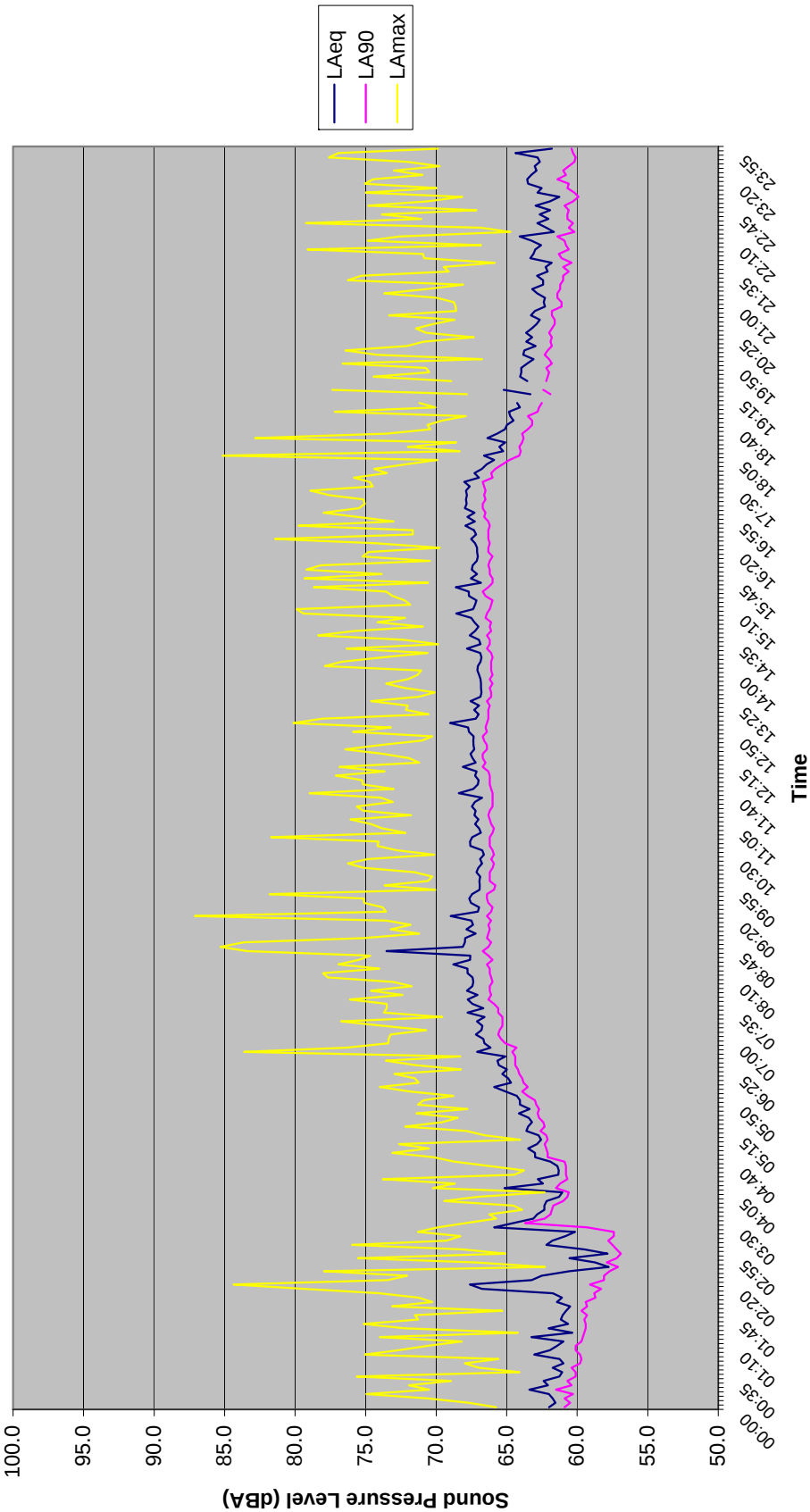
Daily noise survey results

Appendix A

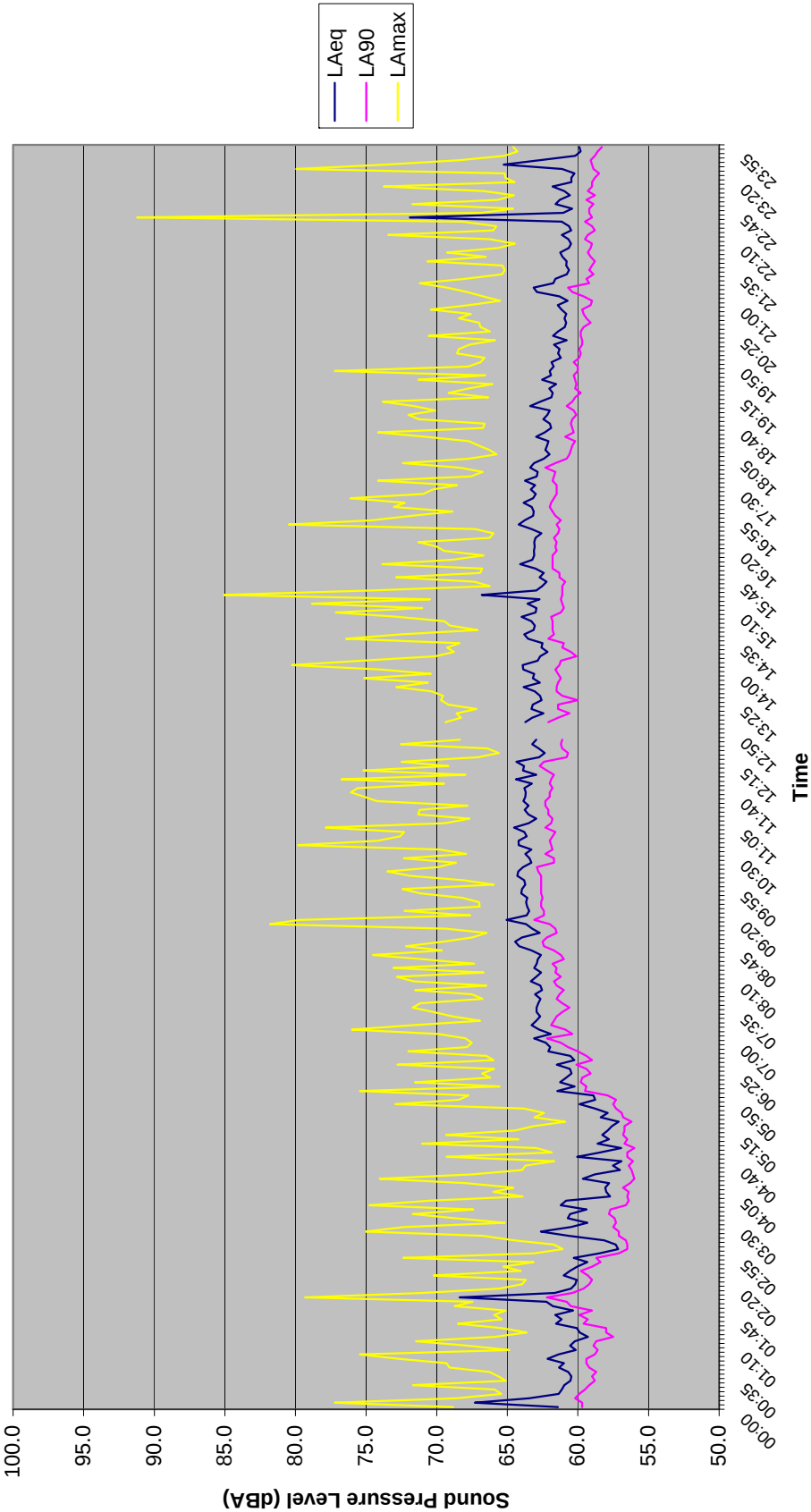
Noise survey results from Site 1 on the roof top of 88 Walker St, North Sydney



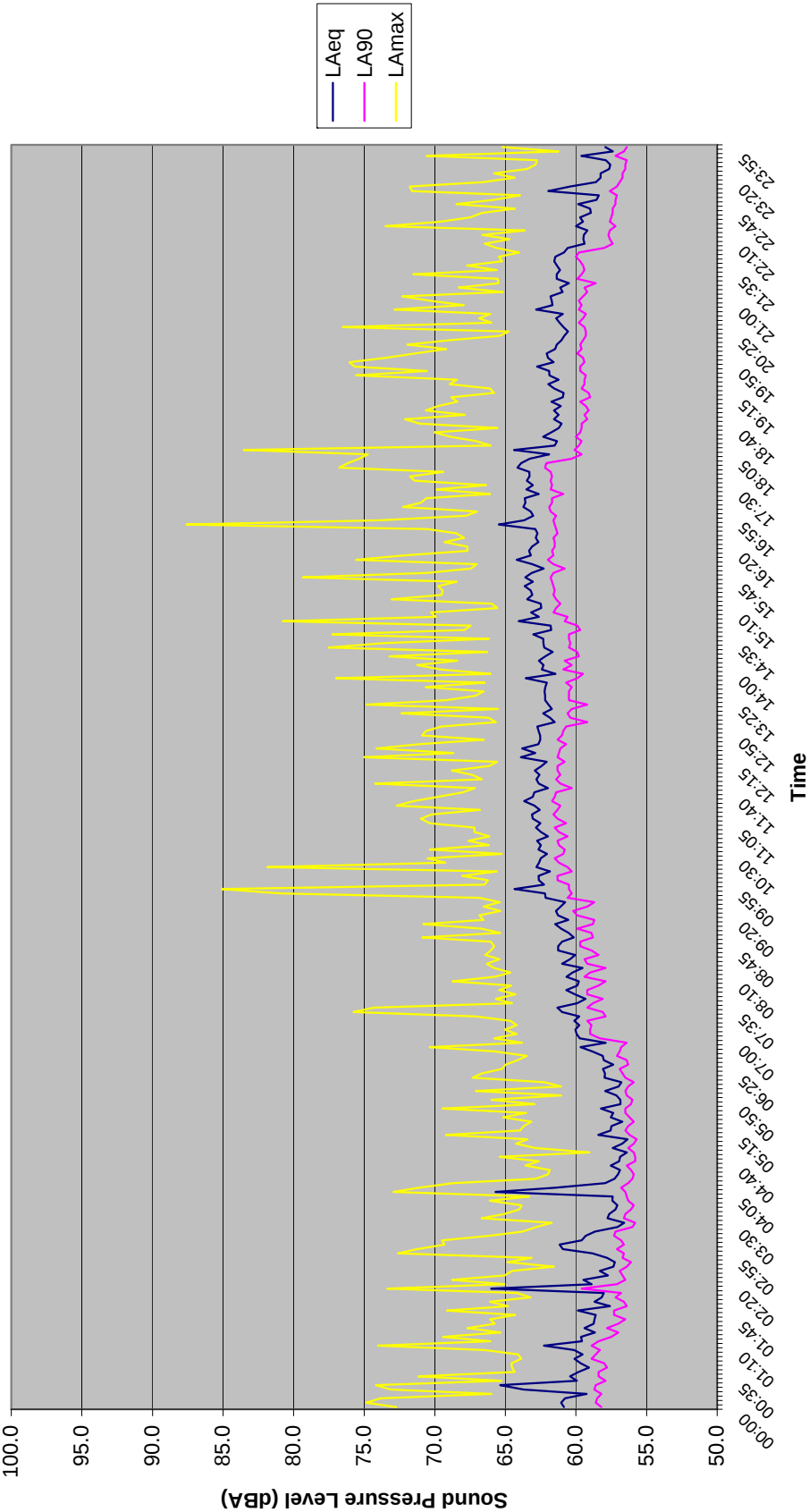
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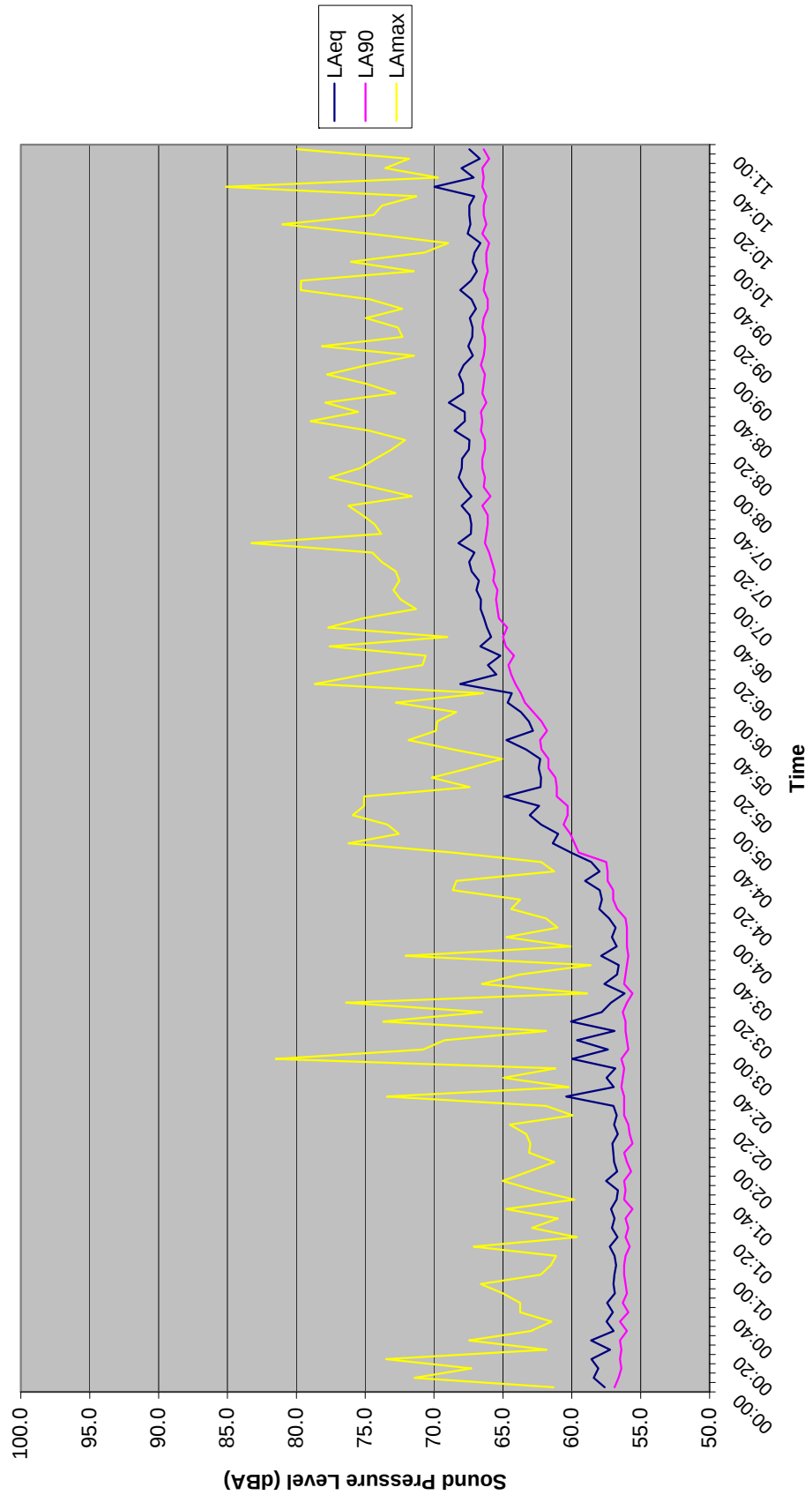
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Appendix B

Octave band levels from noise survey spot measurements

Appendix B

Octave band levels from spot noise measurements

