9.9 Acoustic Report

Part 3A Acoustic Report
Global Switch Sydney 2
Global Switch

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aurecon

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Contents

1. Introduction

1.1 Project Scope

This report details the acoustic assessment of the proposed Global Switch 2 development at 273 Pyrmont Street, Ultimo NSW. The proposed development consists of a data centre facility to be constructed adjacent the existing Global Switch 1 data centre. The two sites will have linked building services as well as access walkways and will operate as a single facility spread across two buildings.

The following report outlines acoustic recommendations as part of the development application process based on the Director General's Requirements MP 08_0222.

1.2 Site description

The proposed site is located at 273 Pyrmont Street, Ultimo NSW in a mixed use zone. The site bound by the Western Distributor to the north with Goldsbrough Apartments further north, existing Global Switch 1 facility to the west with residential townhouses along Harris Street, Light rail corridor and Sydney Convention and Exhibition Centre (SCEC) to the east and residential apartments to the south.

The Western Distributor is a high traffic road with daily traffic in excess of 75,000 vehicles peaking during the morning period and remaining constant throughout the day until the evening. It is the major noise source adjacent the site with a constant traffic hum audible 24 hours a day at the site. At ground level a shielding effect is provided by the elevated overpass, however reflected noise events are clearly distinguished from the Harris Street on-ramp due to the reflection from the underside of the viaduct especially during truck pass-bys. Constant at grade traffic along Harris Street (in excess of 30,000 vehicles daily) as well as intermittent traffic along Pyrmont Street provide other dominant noise sources.

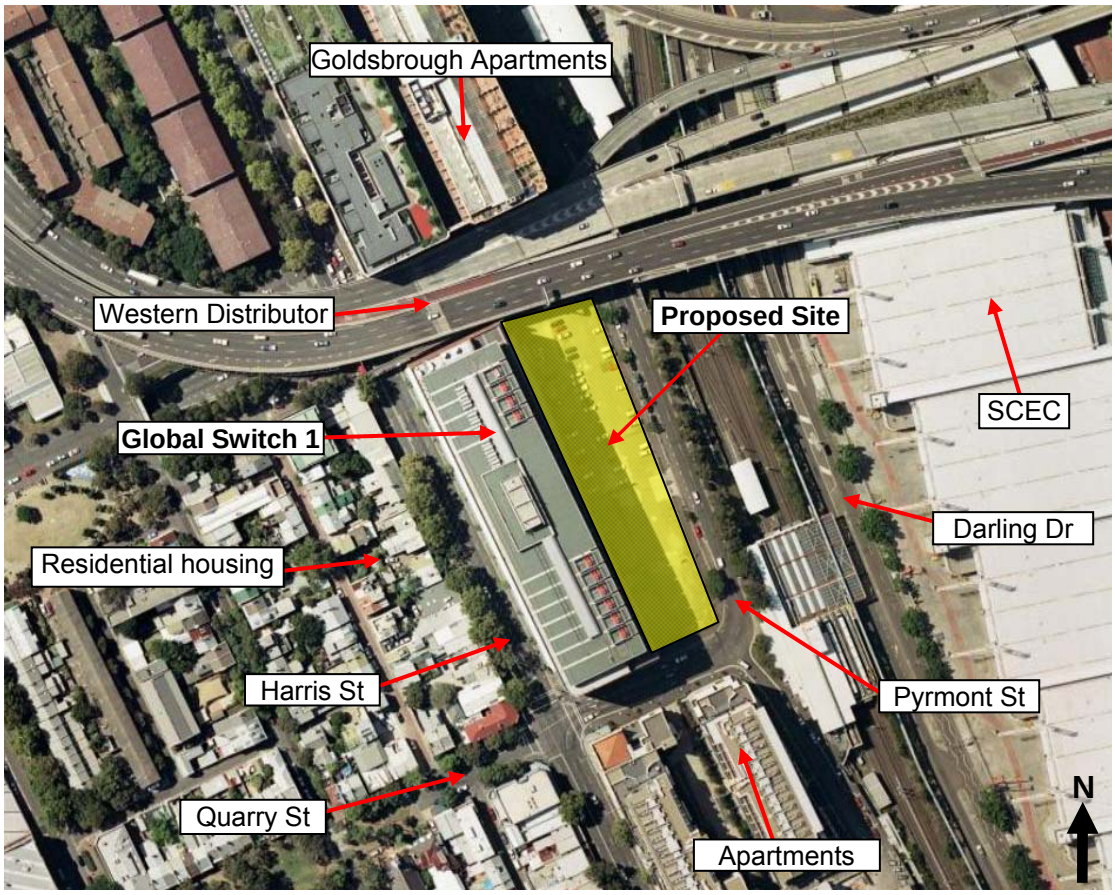


Figure 1 Site layout

1.3 Development details

The proposed Global Switch 2 development is to consist of five levels above ground with three basement levels with the building approximately 40 m tall relative to Pyrmont Street. A section view of the building is shown in Figure 2. The proposed development will also include the following elements:

- 17,000 m^2 of technical space found between Level 3 and Basement 2
- Cogeneration plant and top level plant rooms
  - 9 x 4 MW Gas engines (maximum all engines operating simultaneously)
  - 27 x 1,500 kW Diesel engines
  - Building services connections to Global Switch 1
  - 24 hour, 7 day a week operation
- Walk through access from Global Switch 1
- Metal clad Pyrmont Street façade
- Facility access from reception and waiting area access off Pyrmont Street

The overall building will be shorter than Global Switch 1 creating a cascade effect when the two building observed as a whole from the eastern side. An artist impression of the proposed development is shown in Figure 3.

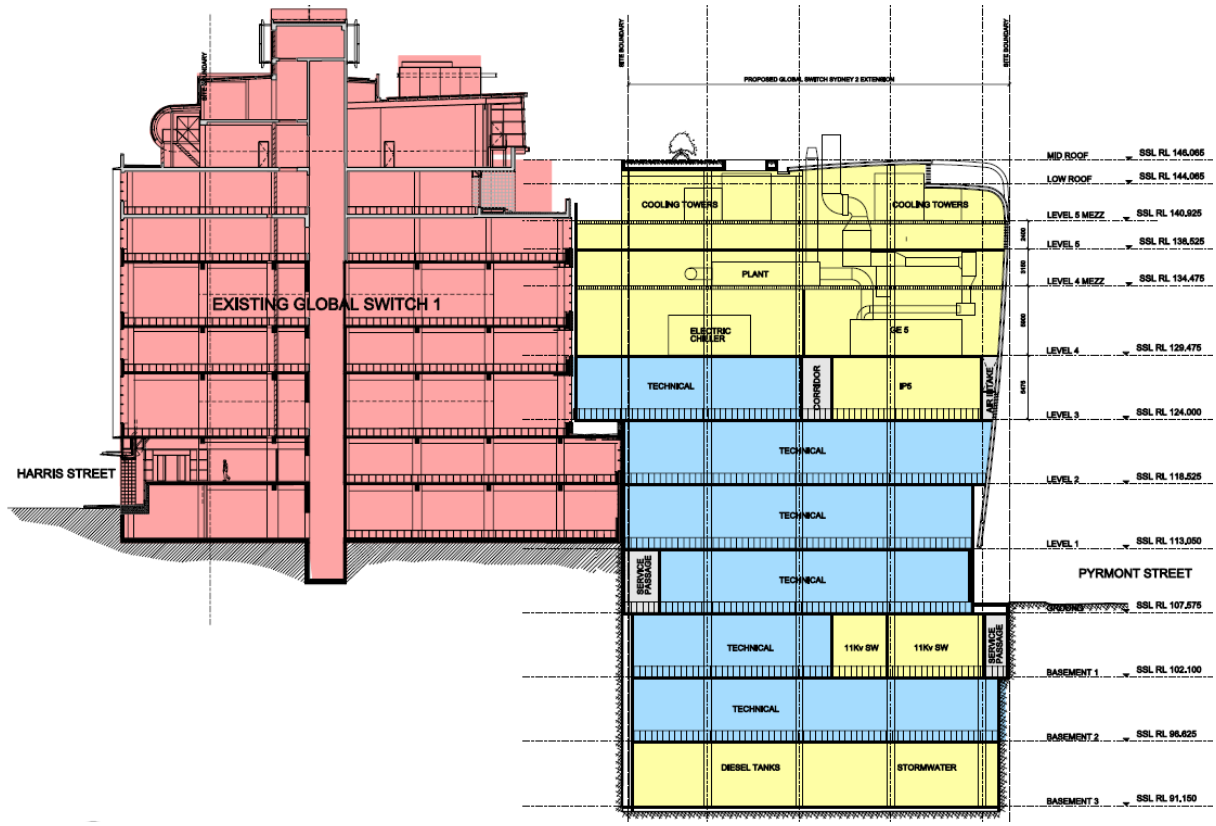


Figure 2 Section view of Global Switch 2

Figure 3 External computer render of Global Switch 2

2. References

- *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"*
- Deutz Power Systems, *TCG 2032 Specification sheet*, Deutz AG Deautz Power Systems
- *NSW Industrial Noise Policy*, EPA (NSW), January 2000

3. Noise criteria

3.1 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:

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

Note: Rating background level (RBL) being defined as the median value of the measured $L_{A90,\ 15\ minute}$ 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 1 below.

Table 1 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
Industrial Premises	All	When in use	70	75

The Acceptable noise level (ANL) from Table 1 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)

In areas of high road traffic, the noise may be high enough to make an industrial source effectively inaudible even though the L_{eq} noise level from the industrial source may exceed the recommended ANL. In such cases the amenity criterion for noise form the industrial noise becomes:

$$Amenity\ criterion = L_{Aeq,\ period\ (traffic)} - 10\ dB$$

This criterion may be applied only if all the following apply:

i) Traffic noise is identified as the dominant noise source at the site
ii) The existing traffics noise level is 10 dB or more above the ANL for the area
iii) It is highly unlikely the road traffic noise levels would decrease in the future

Modifying factor correction of +5 dB is applied to a noise source containing tonal characteristic (ie dominant audible pitch) and low frequency noise. Low frequency modifying factor is applied when the following criterion is satisfied:

$$L_{eq}\ dBA - L_{eq}\ dBC \geq 15\ dB$$

Only one of the above modifying factors is applied when a source emits a tonal noise that is within the low frequency range.

3.2 Sydney city

City of Sydney does not identify specific noise emission requirements associated with industrial noise. The criteria and guidance outlined in the *NSW Industrial noise policy* has been applied for the assessment of this proposed development.

4. Noise survey

A noise survey was conducted on the proposed site between Friday 4 December 2009 and Friday 11 December 2009 to determine the existing noise levels in the air. The noise survey consisted of a long term noise loggers being setup at two locations, with additional spot measurements being taken at various street level locations. The locations of the noise measurements are shown in Figure 4 below.

- Site 1 – North west corner of Global Switch 1 roof space
  - corresponds to receivers adjacent and at the height (and above) of the Western Distributor
- Site 2 – Street level (Site 2B is adjacent to Site B on footpath of Pyrmont St)
  - corresponds to all remaining street level receivers around surrounding the development site
- Site 3 – Street level at apartments on corner of Pyrmont and Quarry Streets
- Site 4 – Street level at Goldsbrough Apartments, 243 Pyrmont Street
- Site 5 – Street level on the corner of Harris and Quarry Streets

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 weather during the noise logging ranged from overcast to sunny periods. Intermittent rain occurred on Wednesday 9 December 2009, based on BOM measurements (at nearby Observatory Hill) the samples during the rain periods have been excluded. Some noise data during other monitoring periods have been identified to contain extraneous noise which can be identified by excessive L_{Amax}

levels and significantly heightened L_{Aeq} levels, hence those samples have also been excluded from analysis.

Results from the noise survey can be seen in Table 2, with Table 3 displaying the spot measurement results. Daily noise logging graphs are shown in Appendix A.

Noise logging at Site 1 shows a very regular daily noise pattern (as shown in Appendix A) associated with the traffic volume along the Western Distributor. The average L_{eq} levels are very consistent even during the weekend period when compared to the weekday levels. The traffic noise peaks at L_{eq} 68 dBA during the morning peak hour and remains at least L_{eq} 66 dBA until the evening hours. No real distinguishable peak is shown during the afternoon rush hour. The traffic noise levels are at their lowest between 3 am and 4 am.

Noise logging at Site 2 encountered a problem with logging only occurring for four days. However upon reviewing of the limited data it can be seen that there is a very regular pattern to the noise levels which is associated with the local traffic conditions. There is quite small variation in the ambient and background noise levels as the noise environment is dominated by the Western Distributor traffic volume. Along with the comparison to the data at Site 1 which also shows the same regular noise pattern, it is concluded that the four days of logging are sufficient to accurately determine the noise environment at street level adjacent to the proposed development site. This is inline with the NSW INP which states that:

"In areas where the background noise levels are affected significantly by nearby road traffic with regular daily pattern, three days' worth of valid data may be sufficient".

Other audible intermittent noise sources at this site consisted of light rail pass and monorail pass-bys, non regular traffic along Pyrmont Street and Darling Drive. During quieter periods at night, small hum from the Global Switch 1 rooftop plant was audible.

Site 3 contained similar noise sources to those observed at Site 2/2B. During one spot monitoring session a loud cricket or cicada was intermittently audible from and adjacent tree. Noise data during those times was discarded as it was not a regular noise sources subject to seasonal variations.

Site 4 noise levels were dominated by the Western Distributor on-ramp from Harris Street, with individual vehicle movements especially from heavy vehicles being very loud due to the reflection effects from the underside of the viaduct. Intermittent traffic along Pyrmont Street added to the ambient noise environment.

Site 5 noise levels were representative of the residential townhouses located on Harris Street. The noise measured was lower than at the other sites due to lower traffic noise exposure.

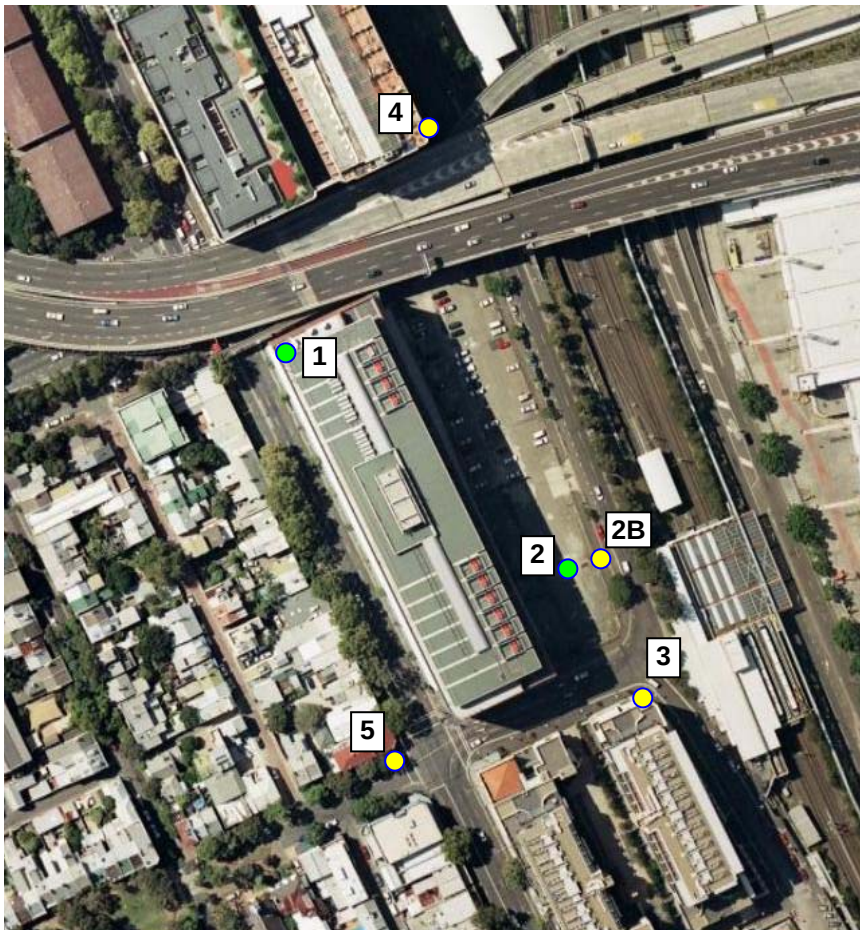


Figure 4 Noise measurement locations

Table 2 Noise survey results and residential receiver criteria

Location	Time of Day	Results		
		$L_{Aeq,\ 15min}$ (dBA)	RBL (dBA)	L_{10} (dBA)
Site 1	Day	67	65	68
	Evening	66	64	67
	Night	64	59	65
Site 2	Day	62	58	64
	Evening	62	57	63
	Night	59	53	61

Table 3 Noise spot measurement results

Location	Date	Time	L_{eq} (dBA)	L_{max} (dBA)	L_{10} (dBA)	L_{90} (dBA)
Site 1	04/12/2009	09:08	69	81	70	67
Site 3	04/12/2009	09:56	65	81	68	60
Site 2B	04/12/2009	10:23	65	80	68	60
Site 4	04/12/2009	10:39	70	80	73	65

Location	Date	Time	L_{eq} (dBA)	L_{max} (dBA)	L_{10} (dBA)	L_{90} (dBA)
Site 3	09/12/2009	23:50	61	76	64	54
Site 2B	10/12/2009	00:08	61	73	64	54
Site 4	10/12/2009	00:30	64	81	67	56
Site 5	10/12/2009	00:51	66	81	69	50
Site 3	10/12/2009	01:02	61	79	63	52
Site 3	11/12/2009	11:35	64	78	67	59
Site 1	11/12/2009	12:04	69	76	70	67

5. Assessment criteria

Taking into account the results of the conducted noise survey the assessment criteria have been calculated based on the *NSW Industrial noise policy*. The criteria have been split into three different receiver types associated with different incident noise environments and specific requirements:

- Residential at Western Distributor height or higher
- Residential at street level and below Western Distributor height
- Commercial

Given the 24 hour proposed operation of the development the driving criterion is 49 dBA for residential receivers at street level and below the Western Distributor height. The summary of the assessment criteria are shown in Table 4.

Table 4 Assessment criteria

Type of receiver	Indicative noise amenity area	Time of Day	Assessment criteria ($L_{eq,\ period}$ dBA)	Criterion Type
Residential at West. Dist height or higher	Urban	Day	57	Amenity
		Evening	56	Amenity (existing traffic)
		Night	54	Amenity (existing traffic)
Residential at street level and below West. Dist height	Urban	Day	52	Amenity
		Evening	52	Amenity (existing traffic)
		Night	**49**	Amenity (existing traffic)
Commercial (When in use)	All	Day	62	Amenity
		Evening	62	Amenity
		Night	58	Intrusive

6. Noise emissions

Noise emissions from the proposed development are predominantly associated with the roof top plant as well as the cogeneration plant located on Level 4. The following are considered major noise emitting equipment which will be operating at this development:

- Absorption and electric chillers
- 52 x Cooling Towers roof mounted
- Various diesel and water pumps
- Air handling plant (fans)

- 9 x 4 MW Gas engines
- 27 x 1,500 kW Diesel engines
- UPS systems
- 2 x 20 MVA 33/11 kV transformers

Currently industrial noise is predominantly audible from the mechanical plant located at Global Switch 1. The remainder of the industrial noise sources are masked by the constant traffic noise in the area. The total noise emissions have to comply with the criteria outlined in the *NSW Industrial Noise Policy* which are outlined in Table 4.

6.1 Roof top plant

The roof top plant will consist predominately of 57 cooling towers. The cooling towers incorporate intake and outlet attenuators minimising the noise emissions. Exhaust risers from the cogeneration plant below will also be discharged from the roof plant (see Section 6.2 below)

6.2 Cogeneration plant

The cogeneration plant is located on the fourth level of the development. The proposed layout consists of individual compartments for each gas engine, with the air intake path consisting of a Level 3 intake grille on the Pyrmont Street façade approximately 15 m above street level which then travels up a riser behind the façade up to Level 4 to provide sufficient air flow requirements. The exhaust gas is ducted and appropriately treated/filtered from the engine and travels up riser through the middle of the plant room with the exhaust outlet stack mouth located on the roof of the building. A summary of the system layout is shown in Figure 5 below.

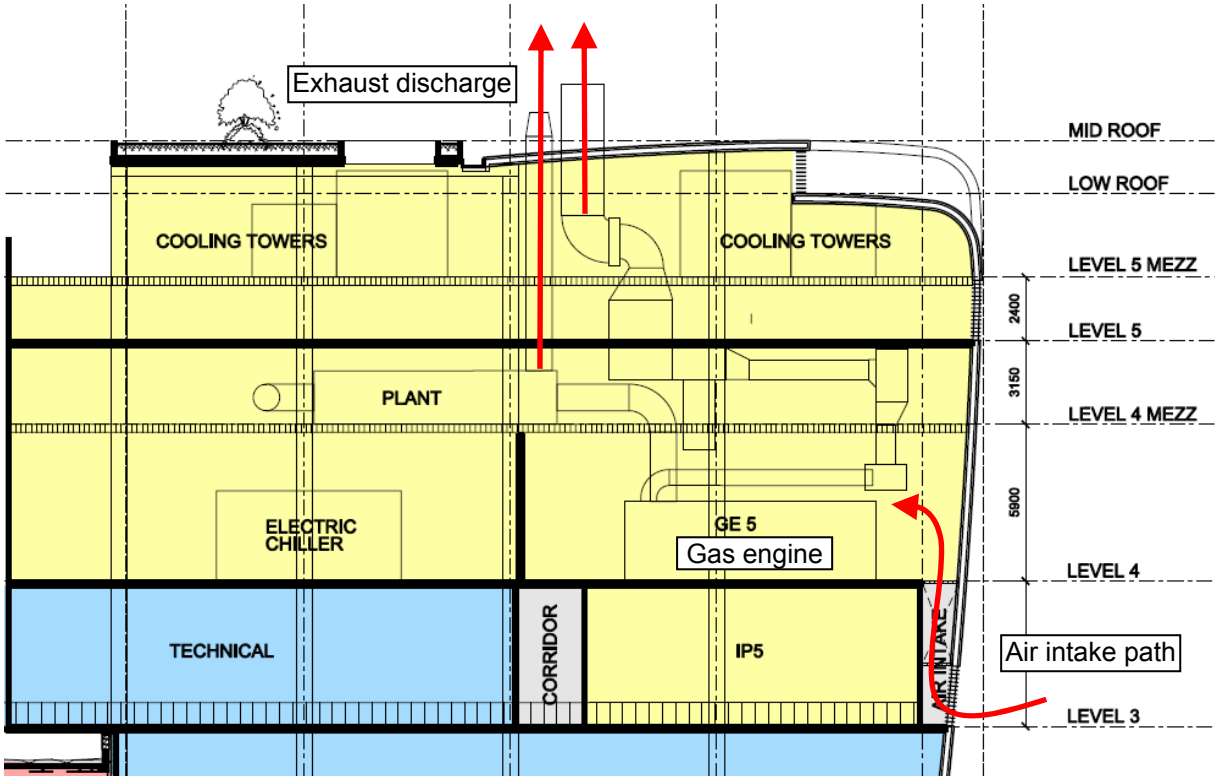


Figure 5 Cogeneration plant and layout

Indicative noise data has been provided for the Gas Engine based on the Deutz Power Systems TCG2032 Specification sheet which is shown in Table 5 below. Remaining noise emission data for

other cogeneration and plant room machinery is subject to more detailed specification which is not available at this stage.

Table 5 Deutz Power Systems TCG2032 V16 Sound emission data

TCG 2032 V16	Total (dBA)	Octave band centre frequency (Hz) sound pressure level (dBA)							
		63	125	250	500	1000	2000	4000	8000
Exhaust noise at 1m, 45° ± 2.5 dBA	122.5	129.7	123.0	120.2	120.2	116.4	114.4	112.0	108.2
Air-borne noise at 1m from side ± 1 dBA	106.2	93.2	102.3	102.7	97.9	99.0	99.4	98.3	99.8

Other equipment such as absorption and electric chillers along with auxiliary equipment are placed away from the external façade of the building, with the noise being controlled by the façade construction as well as floor and wall construction minimising noise break out to adjacent spaces.

6.3 Traffic noise

Minimal traffic noise is associated with this development. Additional traffic associated with the Global Switch 2 site is limited to intermittent deliveries and contractor access of Pyrmont Street. Given the existing high levels of both traffic volume and traffic noise, the addition of these vehicles will be negligible to the existing traffic noise levels at the site.

7. Sound insulation

7.1 Equipment position

Some noise emitting equipment such as pumps will be located in the below street level basement levels thus minimising any noise external noise emissions from these. Transformers will be located at street level in the Secure Service yard located of Pyrmont Street at the northern end of the site. 2 x 20 MVA 33/11 kV transformers will be positioned at this location, with acoustic barrier limiting noise break out to the street and to sensitive receivers. Given the increased ambient noise levels near the northern end of the site due to Harris Street on-ramp, it is expected that any audible noise emissions from the transformers will be masked by the existing traffic noise levels.

7.2 Façade

The specification of the façade will control noise emissions which are generated within the plant rooms especially from the diesel and gas engines. Proposed faced construction for the gas engine and diesel engine plant rooms are shown in Figure 6 below. Any aesthetic metal façade should be attached to the external face as labelled below.

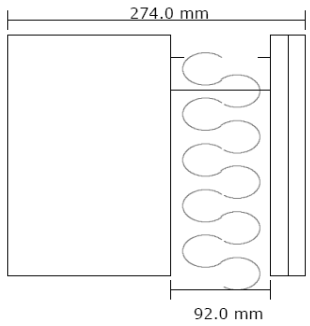
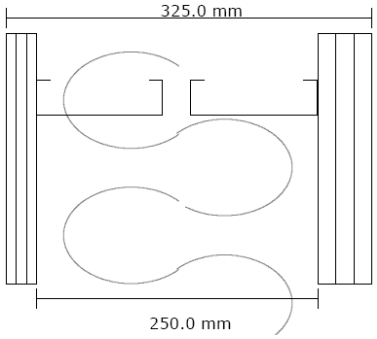
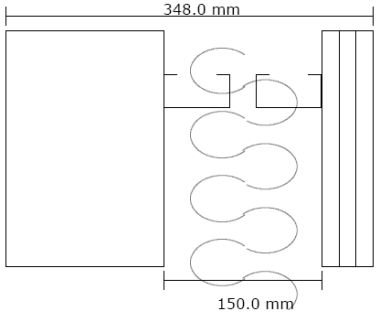
Option A	Option B	Option C
• 150 mm precast concrete (external face) • 92 mm steel stud, 75 mm fibre glass or glass wool insulation (ρ 32 kg/m^3) • 2 x 16 mm Fire rated plasterboard	• 3 x 9 mm compressed fibre cement or 1x 9 mm compressed fibre cement & 2 x 16 mm fire rated plasterboard (external face) • 250 mm double steel studs, 2 x 100 mm fibreglass or glass wool insulation (ρ 32 kg/m^3) • 3 x 16 mm Fire rated plasterboard	• 150 mm Hebel wall panels (external face) • 150 mm double steel stud, 100 mm fibreglass or glass wool insulation (ρ 32 kg/m^3) • 3 x 16 mm Fire rated plasterboard
		

Figure 6 Plant room façade options

7.3 Engine rooms

The engine rooms require acoustic lining within each room to reduce the reverberant noise level generated in these spaces. A reverberation time of approximately 0.5 seconds should be achieved through the installation of absorptive materials on the walls such as rock wool or fibreglass insulation panels.

7.4 Air intakes and exhausts

The air intake for the gas engines requires acoustically lined riser in combinations with an attenuator to limit the noise emissions levels from the gas engine room. A 3 m long low frequency attenuator is required to be installed in the intake system with the remainder of the duct to be lined with a minimum 50mm acoustic lining. The attenuator will need to meet the following dynamic insertion loss specification in the reverse flow configuration.

Table 6 Air intake attenuator dynamic insertion loss specification

Dynamic Insertion Loss (dB) in octave bands (Hz)							
63	125	250	500	1000	2000	4000	8000
22	31	47	53	54	43	26	17

Given that the air intakes will be at 90 degrees to the most affected residential receivers along Quarry Street, directivity effect of the intake orientation will further reduce the associated noise emissions at the receiver.

The exhaust systems will be ducted from the engines with the main engine compartment containing treatment options with the duct work travelling up a riser with the stack mouth located on the roof of the building. An industrial silencer with particular performance at low frequencies is required to control

the high noise content at the lower end of the spectrum which is usually mounted near the engine. A typical dynamic insertion loss for such a silencer is shown in Table 7.

Table 7 Exhaust system silencer dynamic insertion loss specification

Dynamic Insertion Loss (dB) in octave bands (Hz)							
63	125	250	500	1000	2000	4000	8000
30	33	36	39	35	32	28	24

A more detailed specification including the extent of additional internal acoustic lining, attenuators near exhaust outlet and detailed down duct noise analysis of the proposed system is to be developed during the detailed design stage of the project.

7.5 Roof plant

Noise emissions from the cooling towers will be controlled through equipment specification, with preliminary equipment selections incorporating inbuilt intake and outlet attenuators. Additional attenuation will be obtained from the physical barriers between sources and the receiver in the form of architectural features as well as from the building itself.

Further more detailed specification of the attenuation measures will be carried out by an Acoustic Engineer in conjunction with the Building Services Engineers during the design development stage of the project when more accurate specification of the required equipment will be known along with the specific sound power emission data and physical size of all of the proposed equipment. A SoundPLAN environmental noise model will be developed to confirm the proposed noise mitigation measures.

7.6 External traffic noise

The proposed development does not contain any noise sensitive spaces that are located along the perimeter of the building. External traffic noise from the Western Distributor will be attenuated through standard external construction such as 150 mm block work.

8. Summary

An environmental noise assessment has been carried out as part of the Part 3A submission for the proposed Global Switch 2 development at 273 Pyrmont Street, Ultimo NSW. The noise survey carried out on site showed very high traffic noise levels from the Western Distributor which dominated the existing noise environment during all periods of the day. The driving assessment criterion of L_{eq} 49 dBA during night time applicable to residential receivers at street level and below the Western Distributor height was developed as per the *NSW Industrial noise policy*.

The development will contain numerous major noise sources such as:

- Roof mounted cooling towers
- 4 MW Gas engines
- 1,500 kW Diesel engines
- UPS systems
- Transformers

All of these noise sources have the capacity to be operating 24 hours a day 7 days a week with the total noise emissions from the site needing to satisfy the aforementioned criteria. Noise attenuation measures are outlined in more detail in Section 7 and include:

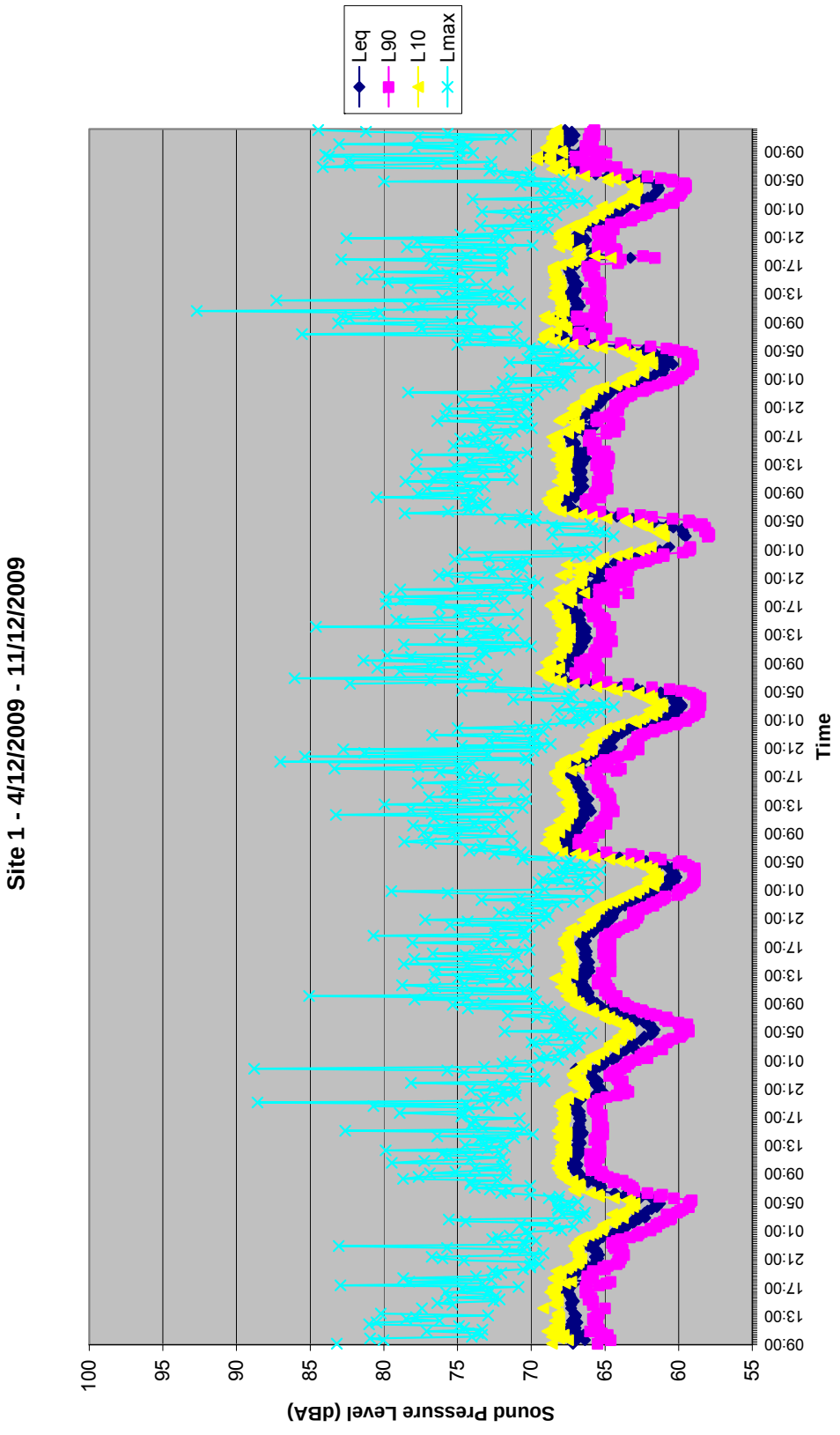
- Equipment specification
- Equipment arrangement, discharge and intake locations
- Incorporation of inlet and outlet attenuators to roof mounted cooling towers
- Engine and plant room acoustic wall and façade specifications controlling noise breakout
- Air intake and exhaust duct specification, plenums and in-duct sound attenuators for gas and diesel engines
- Acoustic barriers to transformers

Through the implementation of these attenuation measures, overall noise levels emitted from the site will satisfy the applicable criteria. A further more detailed review including a SoundPLAN environmental noise model of the specified 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 when more accurate specification of the required equipment will be known, along with the specific sound power emission data and physical size of all of the proposed equipment.

No specific noise insulation requirements are required outside of standard external construction to attenuate traffic noise from the viaduct due to no noise sensitive internal spaces being located along the perimeter of the development.

Appendix A
Noise survey results

Appendix A


Leq
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L10
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Sound Pressure Level (dBA)
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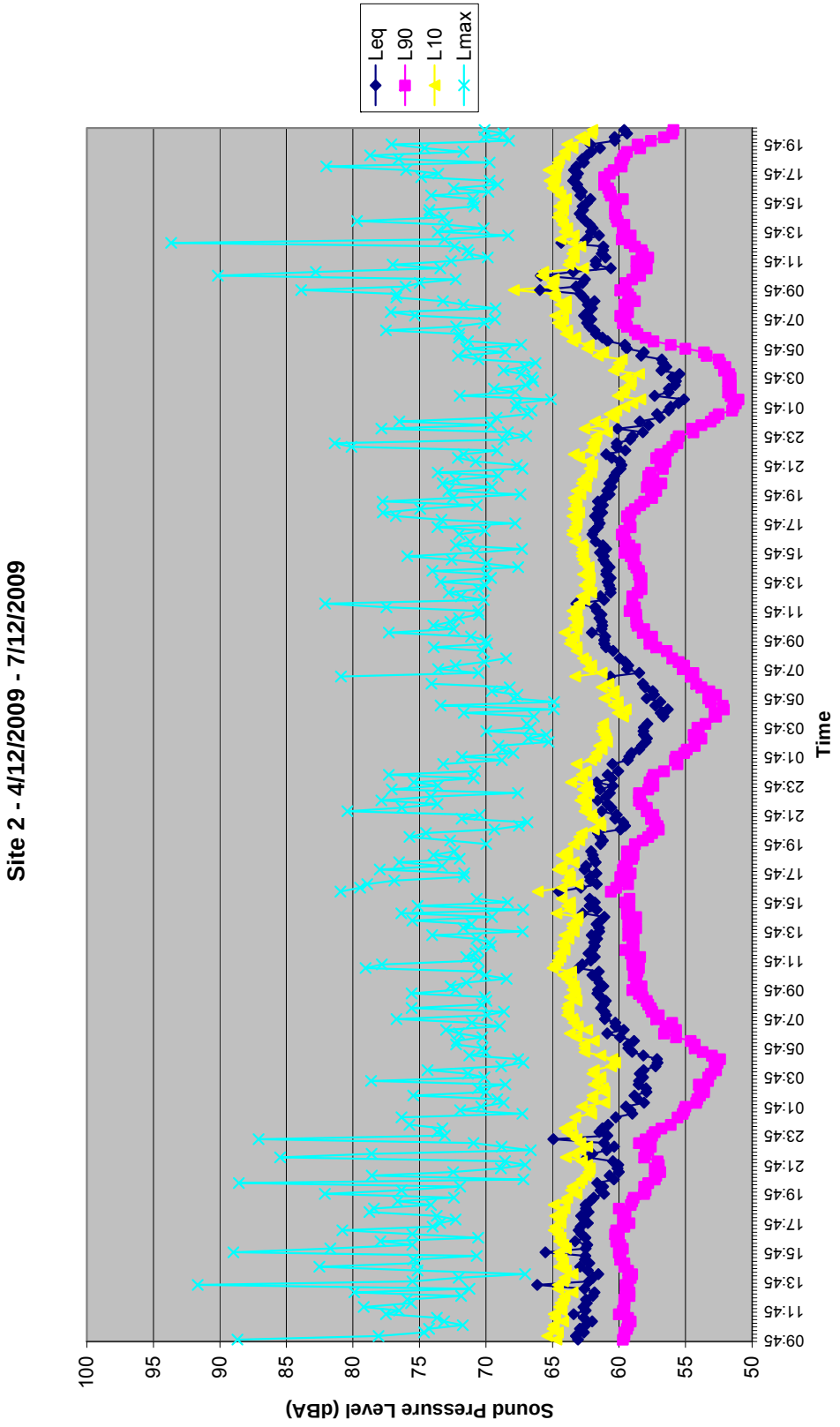
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