Digital Realty Trust

Digital Realty SYD11

DA Acoustic Assessment Report

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Job number 249780-00

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Grid Noise Map

1 Introduction

Arup has been commissioned to conduct an acoustic assessment of the proposed Digital Realty SYD11 development at Erskine Business Park, Penrith.

This document:

- Quantifies the existing acoustic environment
- Establishes noise emission criteria from relevant local and state guidance
- Assesses noise impacts from mechanical and electrical services for compliance with project specific design targets

A glossary of the acoustic terminology used in this document is presented in Appendix A.

1.1 Site Description

The subject site is located within Erskine Business Park, Penrith. The immediate area is predominantly zoned as industrial with residential receivers approximately 750 m to the north. The subject site neighbours an existing data centre immediately to the north.

Figure 1 is extracted from the NSW Department of Planning website and shows the location of the subject site in relation to its surroundings.

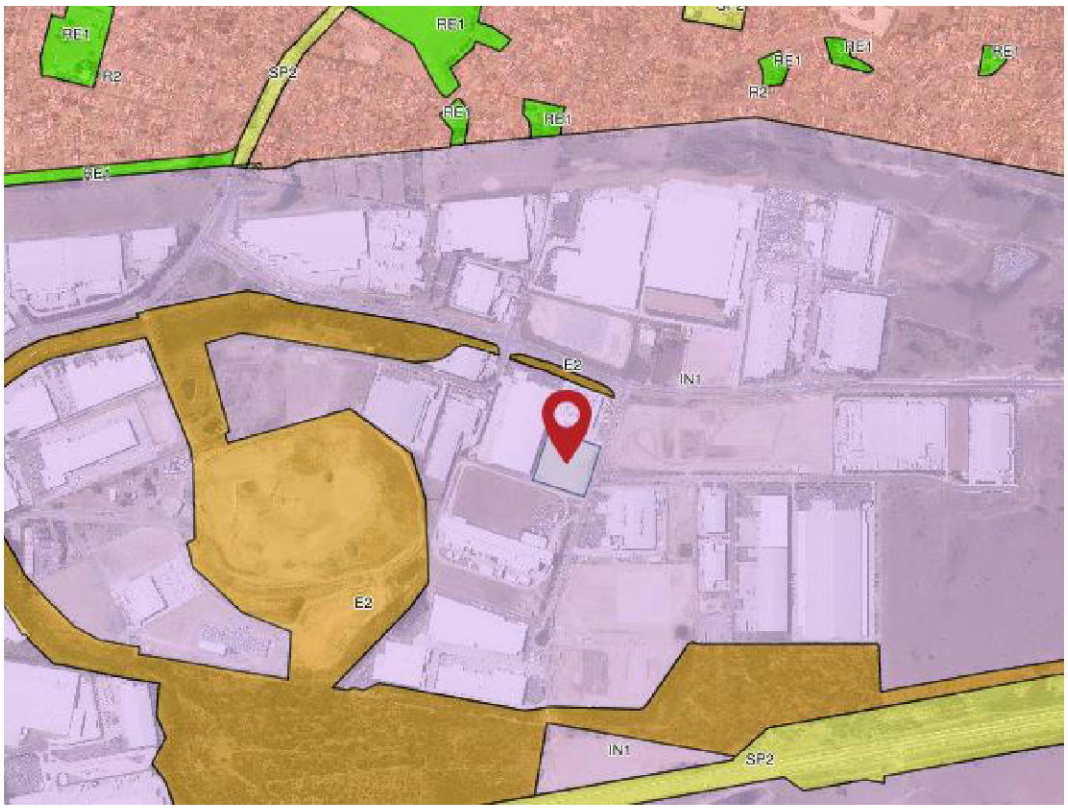


Figure 1 Location of Subject Site

2 Existing Acoustic Environment

2.1 Noise Survey

A noise survey was conducted on the site and at nearby residential receivers to the north of the development. The following sections summarise measured noise levels. Figure 2 shows measurement locations and the location.

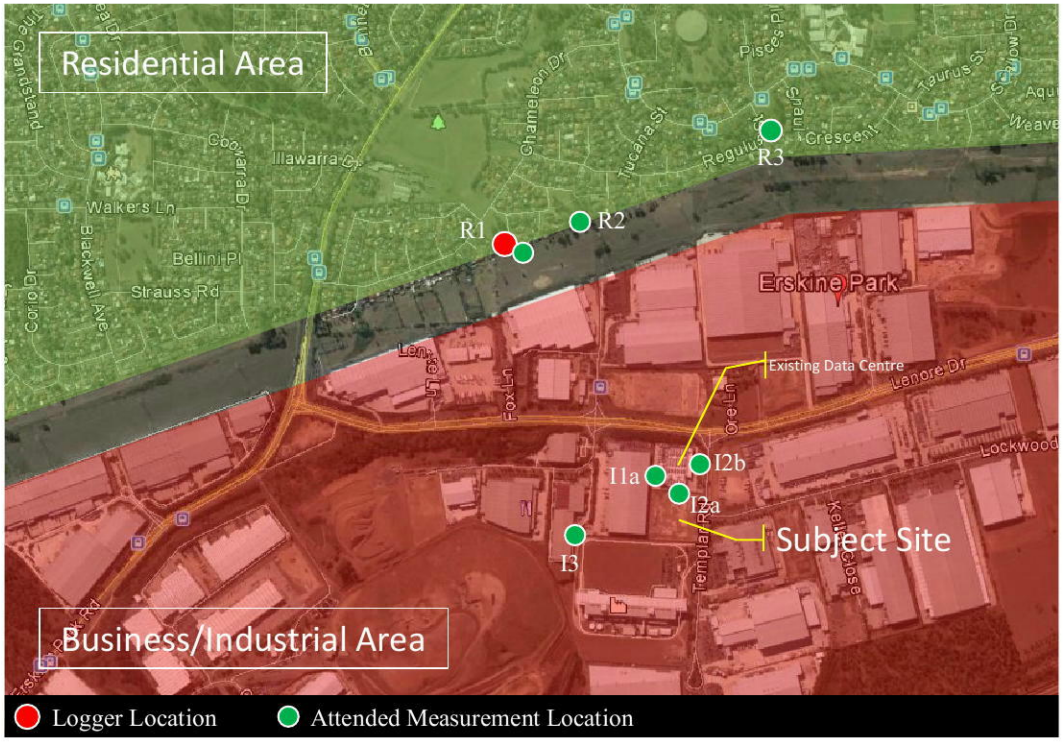


Figure 2: Measurement locations

2.2 Long-term Monitoring

Long-term noise monitoring was conducted from 7 June to 11 June 2016 at Location R1 shown in Figure 2. Broadband band L_{Aeq}, L_{A10} and L_{A90} indices were recorded at 15 minute intervals with a 'fast' time weighting.

Meteorological conditions were monitored during the survey period. No rainfall was observed. Measured data was removed as required to account for the influence of any extraneous noise events. Calibration of the equipment was checked prior and subsequent to monitoring with no significant drift being observed.

A representative average 24 hour graph of long term measured levels is presented in Figure 3 for reference. Measured results have been processed to derive day, evening and night time periods as defined in the NSW industrial Noise Policy (see Section 3.2) and are presented in Table 1.

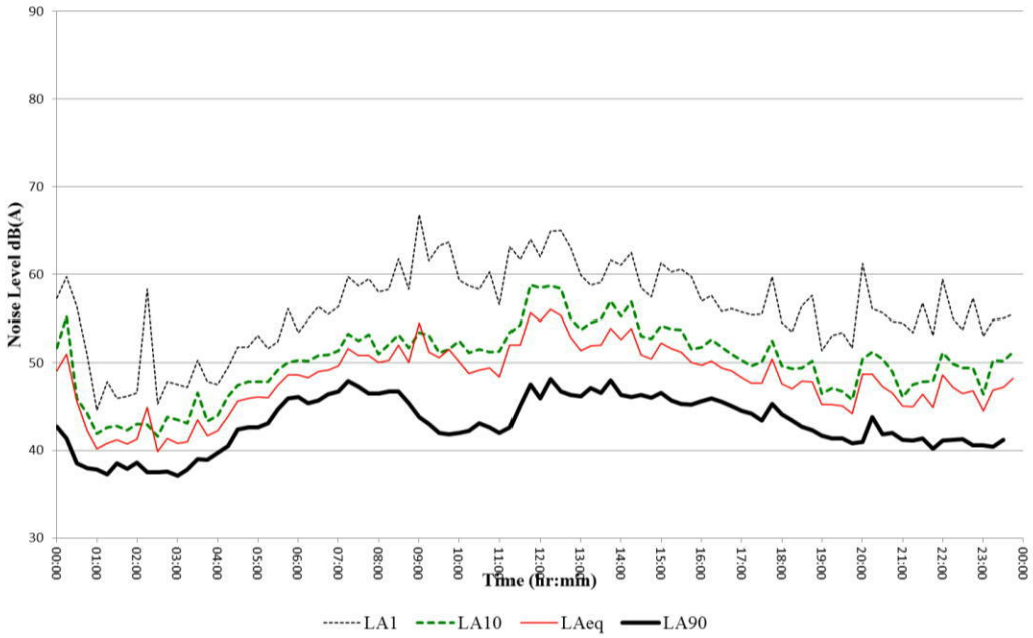


Figure 3: 24hr average measured noise levels at R1

Table 1: INP processed results of Long-term Noise Monitoring

Location	Time Period	dB $L_{Aeq,15mins}$	RBL, dB $L_{A90,15mins}$
R1	Day	52	40
	Evening	47	40
	Night	46	38

2.3 Attended Short-term Measurement

Attended short-term noise measurements were conducted at various locations across the site and at residential receivers. Results and locations of attended noise measurements are summarised in Table 2.

Table 2: Results of Attended Short-term Noise Measurements

Location	Descriptions	Time	Measured Noise Level, dB $L_{Aeq,15mins}$	Measured Noise Level, dB $L_{A90,15mins}$
R1	5 Tipani Close	7 June 2016 13:00 – 13:15	53	49 [1]
		15 June 2016 11:45 - 12:00	42	37
R2	6 Ballyleaney Pl.	15 June 2016 14:35 – 14:50	47	43
R3	Park on Regulus St.	15 June 2016 15:10 – 15:25	52	40

[1] Noise from the truck depot to the north was observed to be constant and significant. Noise from a helicopter passby was also observed.

Location	Descriptions	Time	Measured Noise Level, dB $L_{Aeq,15mins}$	Measured Noise Level, dB $L_{A90,15mins}$
I1a	Rear of Existing Data Centre (close to Shenker)	15 June 2016 12:40 – 12:55	53	50
I2a	South of Existing Data Centre	15 June 2016 13:00 – 13:15	53	50
I2b	Front of Existing Data Centre (close to Templar Road)	15 June 2016 13:15 – 13:30	57	48
I3	4 Tyrone Place	15 June 2016 15:36 – 15:51	61	48

3 Assessment Criteria

3.1 Penrith Development Control Plan 2014

The following relevant noise control requirements are specified in the Part C12 of Penrith Development Control Plan 2014:

- *The development complies with the relevant State Government authority or agency standards and guidelines for noise, as well as relevant Australian Standards;*
- *The development is not intrusive (as defined in the EPA's Industrial Noise Policy);*
- *The development does not adversely impact on the amenity of the area or cause sleep disturbance.*

3.2 NSW Industrial Noise Policy

The objective of the INP is to protect sensitive receivers, such as residences, from noise generated by industrial noise sources. In this context, 'industrial' refers to the source of the noise (e.g. plant) rather than the nature of the premises.

The assessment of noise emission under the INP is based on the calculation of a noise limit at a receiver position, taking into account the land-use in the surrounding area and the existing background noise level.

Compliance is achieved if the adjusted L_{Aeq} noise level at any sensitive receivers affected by noise from the facility is below the noise limit. The adjusted L_{Aeq} is determined by applying corrections for such noise characteristics as duration, intermittency, tonality, and impulsiveness.

The INP separates the 24 hour day into three different time periods – day, evening and night. These time periods are detailed below in Table 3.

Table 3 Standard INP time periods

Period	Day of Week	Time period
Day	Monday-Saturday Sunday, Public Holidays	7:00 am-6:00 pm 8:00 am-6:00 pm
Evening	Monday-Sunday	6:00 pm -10:00 pm
Night	Monday-Saturday Sunday, Public Holidays	10:00 pm -7:00 am 10:00 pm -8:00 am

The INP states that background noise levels should be determined over the "days and times of operation of the project". When setting criteria, only the measured data from the hours of operation of the project should be included.

The INP provides guidance on acceptable noise levels from the introduction of new industrial noise sources to an area. The assessment procedure for industrial noise sources has two components:

- Controlling intrusive noise impacts in the short term for residences; and
- Protecting noise level amenity for particular land uses such as residences, recreation areas, commercial offices and industrial premises.

Both of these components result in noise criteria that should not be exceeded in order to avoid any adverse noise impacts on the affected areas. Both criteria have been taken into account when assessing the noise impact of building services noise source(s) associated with the project, and where the intrusiveness and the amenity criterion differ, the most stringent of the noise criteria has been adopted as the 'project-specific' noise criterion.

3.2.1 General Operation

The project specific noise criteria at noise sensitive receivers are summarised in Table 4 below. These take into account zoning of the surrounding area as shown in Figure 1 and the measured noise levels presented in Table 1 and Table 2

Table 4: Project Specific Noise Levels at Noise Sensitive Receivers

Receiver Type	Time Period	Intrusive Criteria, dB $L_{Aeq, 15mins}$	Amenity Criteria, dB $L_{Aeq,Period}$	Project Specific Noise Criterion dB $L_{Aeq,Period}$
Residential	Day	45	52	45
	Evening	45	37	37
	Night	43	36	36
Industrial	When in use	-	70-75[1]	70

[1] Discussed further in Section 3.2.2

All levels noted for the residential buildings in Table 4 above are applicable at the most-affected point on or within the residential property boundary.

3.2.2 Emergency Equipment

There are 15 emergency generators proposed for the development. It is common practice to relax assessment criteria for emergency equipment in light of operation being limited to emergency situations and periodic testing and maintenance.

For residential receivers, the recommended criterion for emergency noise impacts is 10 dBA above the RBL (5 dB above the intrusiveness criterion). This equates to the following limits:

Daytime / Evening: RBL + 10dB(A) = 55 dB(A)

Night-time: RBL + 10 dB(A) = 53 dB(A)

The INP provides also range of 'satisfactory' to 'maximum' noise levels for assessment of industrial noise impacts for different land uses. For industrial premises, the maximum acceptable noise level is 75 dB(A). This criterion is adopted as the assessment criterion for generator noise impacts at industrial receivers.

3.3 Sleep Disturbance

The INP does not specifically address sleep disturbance from high noise level events. Research on sleep disturbance is reviewed in the NSW Road Noise Policy. From the research, the EPA recognises that the sleep disturbance criterion of an $L_{A1\ (1\ minute)}$ not exceeding the $L_{A90,(15\ minute)}$ 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.

Based on the measured night-time RBL presented in Table 1 the sleep disturbance criterion relevant to this development is:

$$38 + 15 = 53\ dBL_{A1\ (1\ minute)}$$

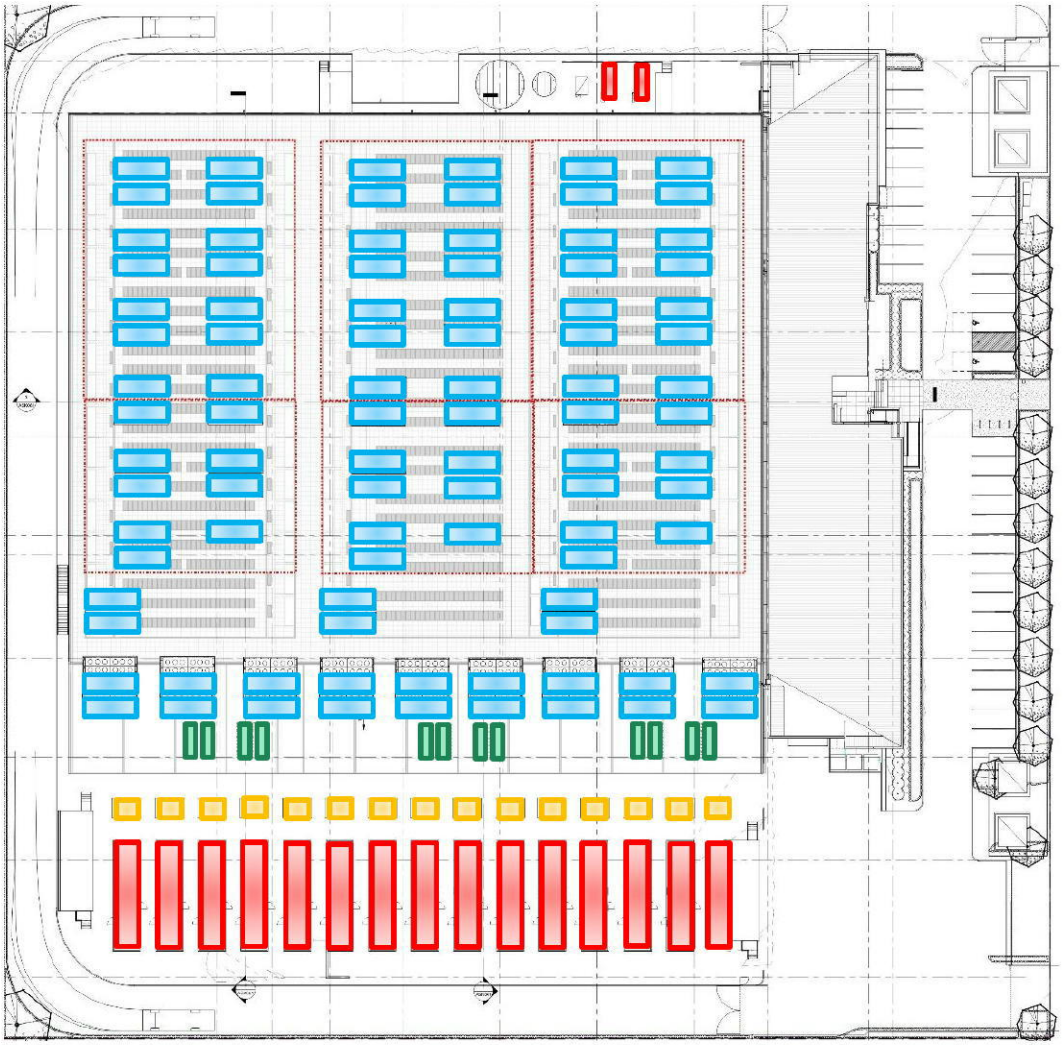
This level will be used as a screening criterion for sleep disturbance at residential receivers to the north.

4 Noise Impact Assessment

4.1 Plant and Equipment

Figure 4 shows the proposed layout of ground floor and first floor acoustically significant plant and equipment.

Figure 4: Proposed plant and equipment layout



= Generator
= Transformer
= Condenser units
= Air Handling Units

Table 5: Plant and equipment quantities

Item	Quantity
Generators	17[1]
Transformers	15
Condenser Units	372
Air Handling Units	8

[1] 15 generators aligning the southern boundary and 2 PBB generators aligning the northern boundary.

The corresponding sound power spectrum for each item of plant and equipment is provided in Table 6. These have been derived based on manufacturers data and empirical calculations and are based on the current stage of development. This information will be reviewed as the design progresses.

Table 6: Plant and equipment sound power spectra

Item of Plant	**Octave Band Centre Frequency (Hz) Sound Power Level – dB re: 1pW**								**Overall dB(A)**
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Condenser Unit (3 x fans)									
100%	85	92	88	88	86	84	77	72	96
80%	80	82	82	82	80	76	70	64	89
75%[1]	*80*	*83*	*79*	*78*	*76*	*72*	*66*	*60*	*81*
70%[1]	*78*	*81*	*77*	*76*	*74*	*70*	*63*	*57*	*78*
Main Generator Set									
Intake / Discharge	105	101	85	55	50	47	55	73	86
Exhaust Flue	81	84	80	83	85	86	78	69	90
PBB Diesel Generators									
All	94	96	92	88	86	82	78	73	91
Transformer									
-	82	84	79	79	73	68	63	56	80
Office Plant									
Condenser	80	87	83	83	81	79	72	67	86
AHU	80	87	83	83	81	79	72	67	86

[1] Values have been interpolated from manufacturer supplied data

It should be noted that operating noise levels for condenser units operating at 70-75% duty have been interpolated from manufacturer supplied data. This has been done to inform the design process when assessing noise mitigation options. Figure 5 presents a graph of manufacturer supplied and interpolated sound power spectra for reference.

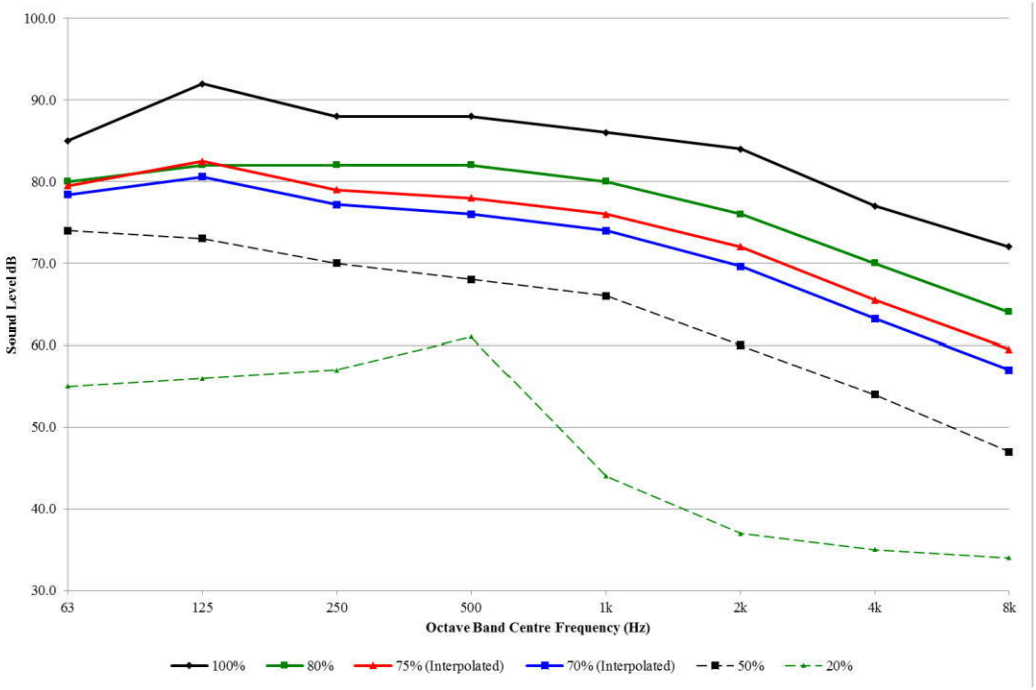


Figure 5: Manufacturer supplied and interpolated sound power spectra for MCL 165 condenser units

4.2 Methodology

The SoundPLAN acoustic modelling suite was used to predict industrial noise impacts. The model for the site and surrounding areas has been established based on aerial imagery and site survey. The acoustic model uses ISO 9613 for industrial noise propagation and takes into account shielding, absorption and weather conditions.

Figure 6 provides an isometric view of the model showing the location the development in relation to neighbouring structures and nearby receiver locations.

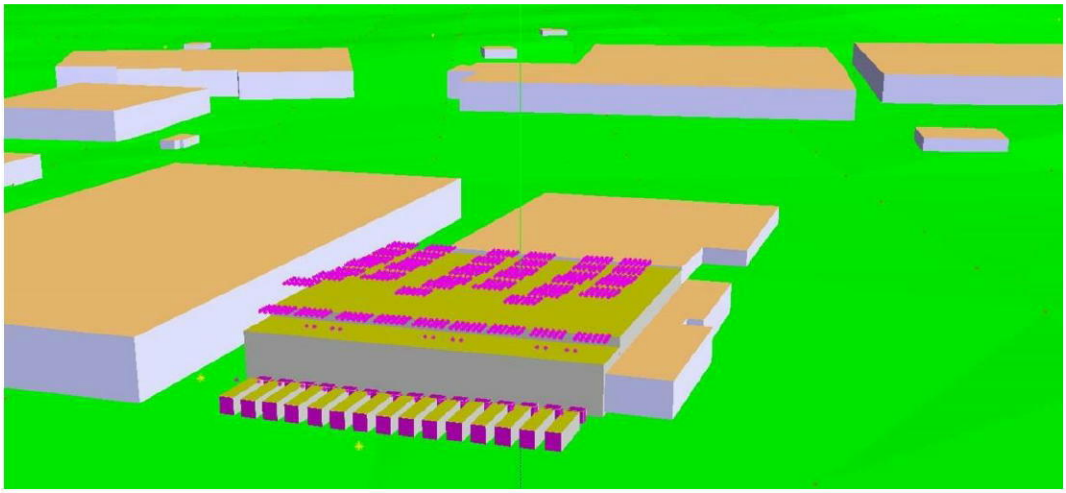


Figure 6: Isometric view of SoundPLAN model for the site

4.3 Predicted Noise Levels

Table 7 provides a summary of highest predicted noise levels at the nearest affected receiver locations for various equipment combinations. Comparison against the most stringent limiting assessment criterion is provided to demonstrate compliance. Grid noise maps are presented in Appendix B.

Table 7: Predicted noise levels at worst affected receiver location

Receiver	Equipment	Predicted Level dB(A)	Limiting Criterion dB(A)	Compliance		
				Day	Evening	Night
Site Boundary North	Generators Only	65	75	✓	✓	✓
	Condensers 100%	64	70	✓	✓	✓
	All plant (100%)	68	75	✓	✓	✓
Site Boundary South	Generators Only	66	75	✓	✓	✓
	Condensers 100%	66	70	✓	✓	✓
	All plant (100%)	69	75	✓	✓	✓
Site Boundary South West Corner	Generators Only	66	75	✓	✓	✓
	Condensers 100%	68	70	✓	✓	✓
	All plant (100%)	69	75	✓	✓	✓
Residential (R2)	Generators Only	21	53 (Night)	✓	✓	✓
	Condensers 100% 80% 75% 70%	 43 36 33 31	 45 (Day) 37 (Evening) 36 (Night)	 ✓ ✓ ✓ ✓	 × ✓ ✓ ✓	 × ✓ ✓
	All plant (100%)	43	55 (Day / Evening) 53 (Night)	✓	✓	✓

A summary of the data presented in Table 7 follows:

- For the nearest affected points on the site boundary of neighbouring industrial premises, all condenser units operating at 100% comply with operational criteria and generator sets comply with emergency criteria. All plant operating at 100% duty comply with emergency criteria.
- For residential receivers, all condenser units operating at 100% duty comply with daytime criteria at the nearest affected residential receivers to the north, however evening and night-time criteria are exceeded.
- All condensers operating at maximum 80% duty comply with evening and night-time criteria at residential receivers to the north.

- Generator noise impact to residential receivers to the north is negligible.

For all predictions, it should be noted that margins for compliance are tight and that industrial noise impacts will be reliant on manufacturer quoted levels and extrapolated data being achieved on site.

4.4 Recommendations

Based on the predictions, the following is recommended:

- Condenser units be operated at a reduced number or capacity (i.e. maximum 80% duty) during evening and night-time periods.
- Given noise impact from generators to residential receivers to the north is negligible, consideration should be given to testing generator sets outside of hours to minimise adversely impacting neighbouring industrial premises.

It is understood that the CRAC unit supplier has confirmed that they can achieve full cooling capacity at an ambient temperature of 43 C with the condenser fans turned down to 80%. Analysis of the weather file confirms that this set back mode is suitable for the period evening and night-time period (i.e. 6pm-7am).

The above recommendations will need to be coordinated with the project team to determine feasibility and with manufacturers to confirm extrapolated sound power spectra at reduced loads.

5 Conclusions

An assessment has been undertaken of potential industrial noise impacts associated with the proposed Digital Realty SYD11 development. Noise emission criteria have been set based on site survey and relevant local and state guidance. Provided the recommendations made in this report are implemented, it is recommended that the proposed development be approved with regard to acoustics.

Appendix A

Glossary

Assessment Background Level (ABL)

A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background LA90 noise levels – i.e. the measured background noise is above the ABL 90% of the time.

Ambient Noise Level

The noise level in a space measured in the absence of the noise being investigated. For example, if a fan located on a city building is being investigated, the ambient noise level is the noise level without the fan running. This would include sources such as traffic, birds, people talking and other nearby fans.

Decibel

The decibel scale is a logarithmic scale which is used to measure sound and vibration levels. Human hearing is not linear, which allows hearing over a large range of sound pressure levels. Therefore a logarithmic scale, the decibel (dB) scale, is used to describe sound levels.

dB(A)

dB(A) is a single-number sound pressure level that includes a frequency weighting to reflect the subjective loudness level.

The frequency of a sound affects its perceived loudness. Human hearing is less sensitive at low and very high frequencies, the A- weighting is used to account for this effect. An A-weighted decibel level is written as dB(A).

An increase of approximately 10 dB corresponds to a subjective doubling of the loudness of a noise. The minimum increase or decrease in noise level that can be noticed is typically 2 to 3 dB. Some typical dB(A) levels are shown below.

Noise Level dB(A)	Example
130	Human threshold of pain
120	Jet aircraft take-off at 100 m
110	Chain saw at 1 m
100	Inside nightclub
90	Heavy trucks at 5 m
80	Kerbside of busy street
70	Loud stereo in living room

Noise Level dB(A)	Example
60	Office or restaurant with people present
50	Domestic fan heater at 1m
40	Living room (without TV, stereo, etc)
30	Background noise in a theatre
20	Remote rural area on still night
10	Acoustic laboratory test chamber
0	Threshold of hearing

L_1

The L_1 statistical level is often used to represent the maximum level of a sound level that varies with time.

Mathematically, the L_1 level is the sound level exceeded for 1% of the measurement duration. As an example, 87 dB $L_{A1,15min}$ is a sound level of 87 dB(A) or higher for 1% of the 15 minute measurement period.

L_{10}

The L_{10} statistical level is often used as the "average maximum" level of a sound level that varies with time.

Mathematically, the L_{10} level is the sound level exceeded for 10% of the measurement duration. L_{10} is often used for road traffic noise assessment. As an example, 63 dB $L_{A10,18hr}$ is a sound level of 63 dB(A) or higher for 10% of the 18 hour measurement period.

L_{90}

The L_{90} statistical level is often used as the "average minimum" or "background" level of a sound level that varies with time.

Mathematically, L_{90} is the sound level exceeded for 90% of the measurement duration. As an example, 45 dB $L_{A90,15min}$ is a sound level of 45 dB(A) or higher for 90% of the 15 minute measurement period.

L_{eq}

The 'equivalent continuous sound level', L_{eq}, is used to describe the level of a time-varying sound or vibration measurement.

L_{eq} is often used as the "average" level for a measurement where the level is fluctuating over time. Mathematically, it is the energy-average level over a period of time. When the dB(A) weighting is applied, the level is denoted dB L_{Aeq}. Often

the measurement duration is quoted, thus $L_{Aeq,15\ min}$ represents the dB(A) weighted energy-average level of a 15 minute measurement.

L_{max}

The L_{max} statistical level can be used to describe the "absolute maximum" level of a sound or vibration level that varies with time.

Mathematically, L_{max} is the highest value recorded during the measurement period. As an example, 94 dB L_{Amax} is a highest value of 94 dB(A) during the measurement period.

Since L_{max} is often caused by an instantaneous event, L_{max} levels often vary significantly between measurements.

Frequency

Frequency is the number of cycles per second of a sound or vibration wave. In musical terms, frequency is described as "pitch". Sounds towards the lower end of the human hearing frequency range are perceived as "bass" and sounds with a higher frequency are perceived as "high pitched".

Rating Background Level (RBL)

A single-number figure used to characterise the background noise levels from a complete noise survey. The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period, and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey.

Sound Power and Sound Pressure

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level (L_p) varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located.

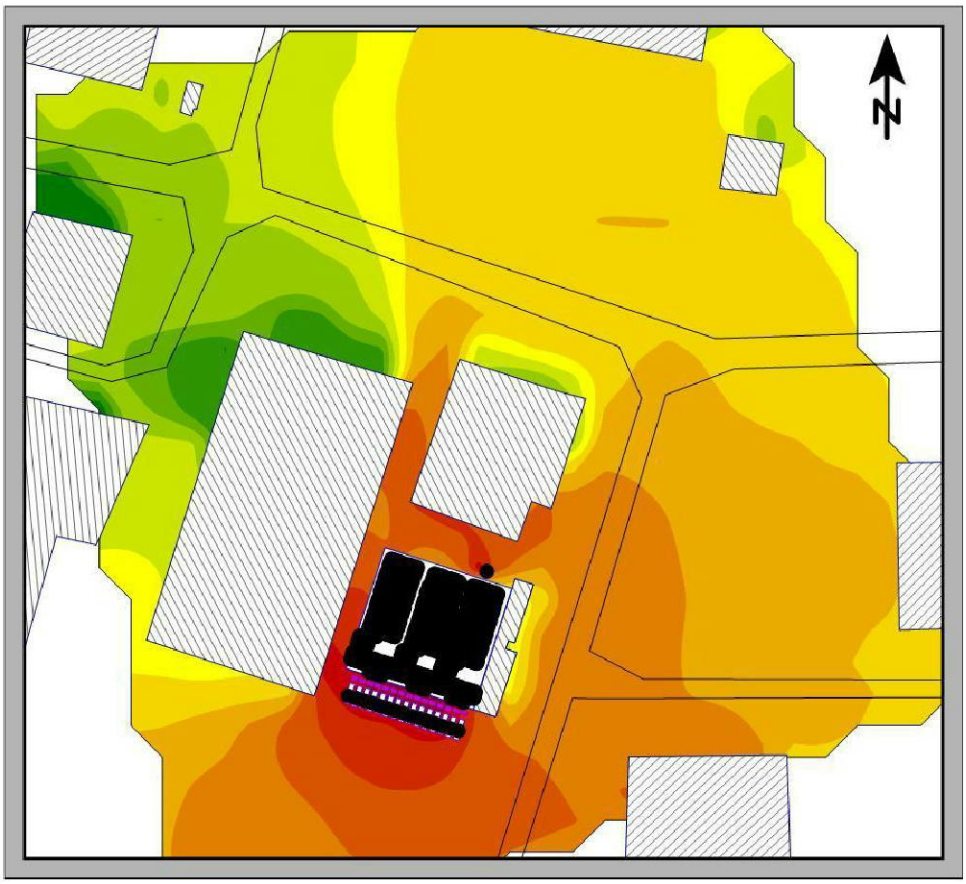
Appendix B

Grid Noise Map

DLR SYD11

Project No.

Grid Noise Map (Industrial) 75 dBA generators, PBB and AHU, Condensers 100%, Result No. 69



Main building
Industrial building

Levels LrD
in dB(A)

< 40
40 - 43
43 - 46
46 - 49
49 - 52
52 - 55
55 - 58
58 - 61
61 - 64
64 - 67
67 - 70
70 - 73
73 - 76
>= 76

Length scale 1:3195

0 35 70 140 210 28

Date: 15/11/2016
Project engineer: