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# Air Conditioning Noise Assessment

Oran Park Public and High School  
390 South Circuit, Oran Park

REPORT No  
**6026-2.1R**

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**Prepared For:**  
Hindmarsh  
149 West Street  
Crows Nest NSW 2065

Attention: Mr Tommy Derek



## Revision History

| Report | Date       | Prepared     | Checked       | Comment                     |
|--------|------------|--------------|---------------|-----------------------------|
| Draft  | 06/05/2019 | William Wang | Stephen Gauld | By email, for client review |
| Final  | 08/05/2019 | William Wang | Stephen Gauld |                             |

Document R\6026-2.1R, 12 pages plus attachments

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## TABLE OF CONTENTS

|     |                                               |    |
|-----|-----------------------------------------------|----|
| 1.0 | CONSULTING BRIEF .....                        | 4  |
| 2.0 | PROJECT DESCRIPTION .....                     | 5  |
| 3.0 | NOISE EMISSION CRITERIA .....                 | 7  |
| 3.1 | Project Specific Noise Emission Criteria..... | 7  |
| 4.0 | AIR CONDITIONING NOISE EMISSION.....          | 8  |
| 4.1 | Mechanical Plant .....                        | 8  |
| 4.2 | Predicted Noise Levels.....                   | 10 |
| 5.0 | NOISE CONTROL RECOMMENDATIONS.....            | 11 |
| 5.1 | Privacy Screen to Condenser Units.....        | 11 |
| 5.2 | Acoustic Louvres .....                        | 11 |
| 5.3 | Construction Disclaimer.....                  | 11 |
| 6.0 | CONCLUSION .....                              | 12 |

## TABLES

|         |                                                 |    |
|---------|-------------------------------------------------|----|
| Table 1 | Condenser Unit $L_{eq}$ Sound Power Levels..... | 8  |
| Table 2 | Calculated $L_{eq}$ Noise Levels.....           | 10 |
| Table 3 | Acoustic Louvre Specification .....             | 11 |



## 1.0 CONSULTING BRIEF

Day Design Pty Ltd was engaged by Hindmarsh to carry out acoustic assessment for a proposed air conditioning system to serve the existing Oran Park Public School and the proposed new Oran Park High School to be constructed at 390 South Circuit, Oran Park, NSW. The scope of work is as follows:

- Review the architectural drawings.
- Inspect the proposed development site in Oran Park.
- Establish acceptable noise level criteria
- Quantify noise emissions from the air conditioning system serving the Schools
- Calculate the level of noise emission, taking into account building envelope transmission loss, screen walls, ground absorption and distance attenuation
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Provide recommendations for noise control (if necessary)
- Prepare an Air Conditioning Noise Assessment Report.





## 2.0 PROJECT DESCRIPTION

The existing Oran Park Public School currently has a capacity for 704 students. To facilitate the increase in capacity to 1,000 students, additions to the existing buildings are proposed.

The new Oran Park High School is proposed to be located on land located to the south of the existing Oran Park Public School. The proposed new High School will have capacity for 2,000 students.

The development site is located approximately 200 metres from the Oran Park Town Centre. Existing residences and undeveloped land zoned for residential purposes are located to the west and south across South Circuit and Holden Drive. Jack Brabham Reserve is located to the north of the existing Public School. A nature reserve is proposed directly to the east of the school site, with mixed use developments located further to the east.

Acceptable noise limits are derived from the EPA's Industrial Noise Policy for intrusive noise impacts from mechanical plant noise in each residential area.



Figure 1 : Location Plan – Oran Park Public and High School.



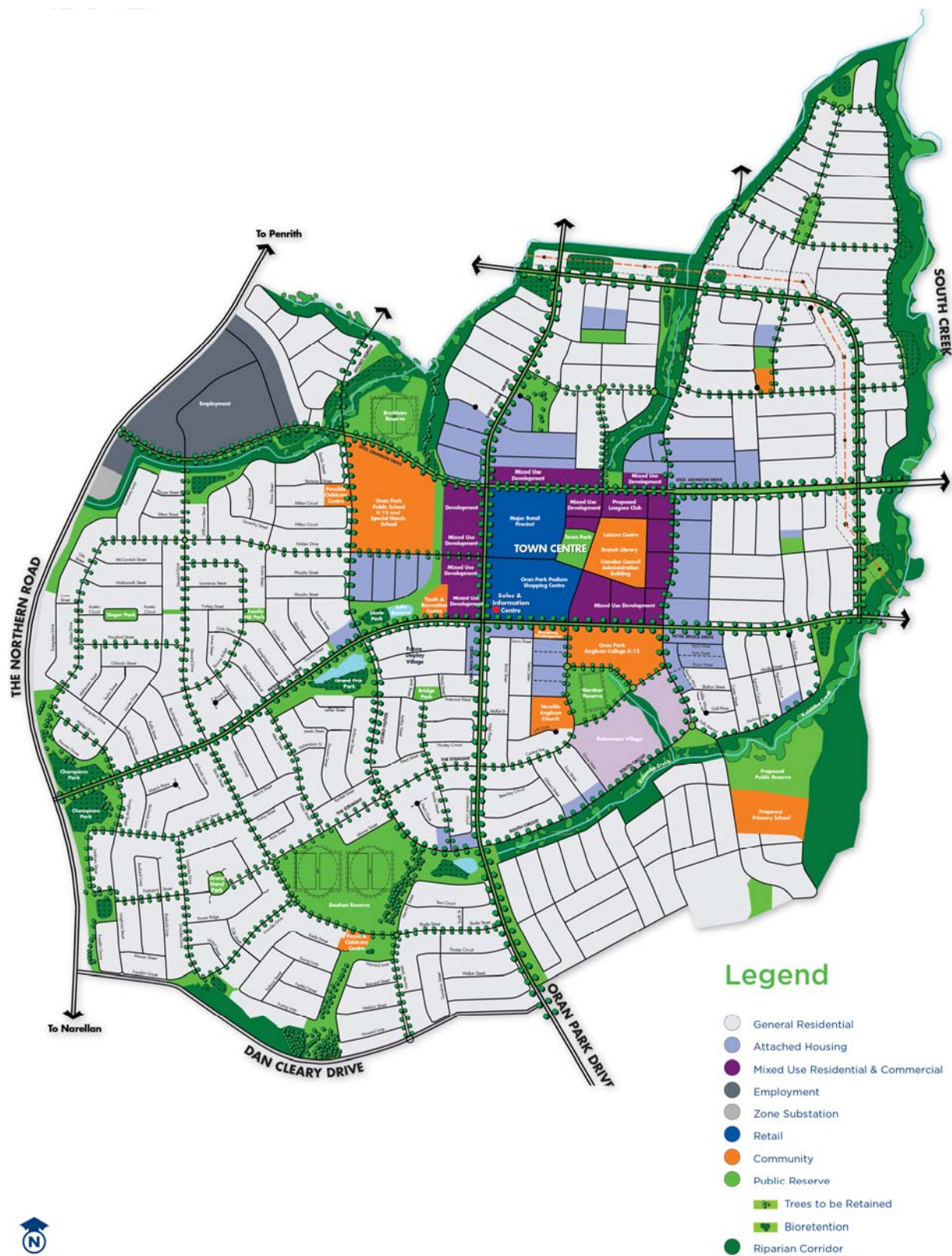


Figure 2 : Location Plan – Oran Park Master Plan



### 3.0 NOISE EMISSION CRITERIA

#### 3.1 Project Specific Noise Emission Criteria

The project specific noise criteria has previously been established in our original acoustic assessment report 6026-1.3R Rev C dated 14 September 2017. The most stringent noise criterion for mechanical plant noise was established as follows:

- **44 dBA** during the day.

These criteria apply at the most-affected point on or within the residential property boundary. For upper floors, the noise is assessed outside the nearest window.





#### 4.0 AIR CONDITIONING NOISE EMISSION

The main sources of noise from the condenser units serving the Public and High Schools are the fans attached to the outdoor condenser units. Calculations are based on the mechanical drawings provided by Hindmarsh attached as Appendix A.

##### 4.1 Mechanical Plant

The location and type of mechanical plant are shown on the mechanical drawings attached as Appendix A. The proposed new mechanical plant will typically only operate during day time hours when the School building may be in use.

A schedule of sound power noise levels from the condenser units is shown in Table 1.

**Table 1 Condenser Unit  $L_{eq}$  Sound Power Levels**

| Unit               | Description       | Sound Power Levels, dBA |
|--------------------|-------------------|-------------------------|
| <b>Building HA</b> |                   |                         |
| CU-HA-01           | Daikin RXYQ6AYM   | 77                      |
| CU-HA-02           | Daikin RXYQ8AYM   | 77                      |
| <b>Building HB</b> |                   |                         |
| CU-HB-01           | Daikin RXYQ20AYM  | 86                      |
| CU-HB-02           | Daikin RXYQ22AYMA | 82                      |
| CU-HB-03           | Daikin RXYQ24AYMA | 83                      |
| CU-HB-04           | Daikin RXYQ32AYMA | 84                      |
| CU-HB-05           | Daikin RXYQ26AYMA | 84                      |
| CU-HB-06           | Daikin RXYQ10AYM  | 78                      |
| <b>Building HC</b> |                   |                         |
| CU-HC-01           | Daikin RXYQ14AYM  | 81                      |
| CU-HC-02           | Daikin RXYQ18AYM  | 82                      |
| CU-HC-03           | Daikin RXYQ14AYM  | 81                      |
| CU-HC-04           | Daikin RXYQ18AYM  | 82                      |
| CU-HC-05           | Daikin RXYQ14AYM  | 81                      |
| CU-HC-06           | Daikin RXYQ14AYM  | 81                      |
| CU-HC-07           | Daikin RXYQ14AYM  | 81                      |
| CU-HC-08           | Daikin RXYQ20AYM  | 86                      |



**Table 1 Condenser Unit  $L_{eq}$  Sound Power Levels (continued)**

| Unit               | Description       | Sound Power Levels, dBA |
|--------------------|-------------------|-------------------------|
| <b>Building HC</b> |                   |                         |
| CU-HC-09           | Daikin RXYQ18AYM  | 82                      |
| CU-HC-10           | Daikin RXYQ20AYM  | 86                      |
| CU-HC-11           | Daikin RXYQ24AYMA | 83                      |
| CU-HC-12           | Daikin RXYQ28AYMA | 84                      |
| <b>Building HD</b> |                   |                         |
| CU-HD-01           | Daikin RXYQ18AYM  | 82                      |
| CU-HD-02           | Daikin RXYQ20AYM  | 86                      |
| CU-HD-03           | Daikin RXYQ12AYM  | 80                      |
| CU-HD-04           | Daikin RXYQ14AYM  | 81                      |
| CU-HD-05           | Daikin RXYQ16AYM  | 81                      |
| CU-HD-06           | Daikin RXYQ12AYM  | 80                      |
| CU-HD-07           | Daikin RXYQ18AYM  | 82                      |
| CU-HD-08           | Daikin RXYQ22AYMA | 82                      |
| CU-HD-09           | Daikin RXYQ18AYM  | 82                      |
| CU-HD-10           | Daikin RXYQ20AYM  | 86                      |
| CU-HD-11           | Daikin RXYQ18AYM  | 82                      |
| CU-HD-12           | Daikin RXYQ20AYM  | 86                      |
| CU-HD-13           | Daikin RXYQ8AYM   | 77                      |
| CU-HD-14           | Daikin RXYQ12AYM  | 80                      |
| CU-HD-15           | Daikin RXYQ26AYMA | 84                      |
| CU-HD-16           | Daikin RXYQ24AYMA | 83                      |
| CU-HD-17           | Daikin RXYQ14AYM  | 81                      |
| <b>Building PE</b> |                   |                         |
| CU-PE-01           | Daikin RXYMQ6AV4A | 76                      |



**Table 1 Condenser Unit  $L_{eq}$  Sound Power Levels (continued)**

| Unit               | Description       | Sound Power Levels, dBA |
|--------------------|-------------------|-------------------------|
| <b>Building PF</b> |                   |                         |
| CU-PF-01           | Daikin RXYQ16AYM  | 81                      |
| CU-PF-02           | Daikin RXYQ20AYM  | 86                      |
| CU-PF-03           | Daikin RXYQ12AYM  | 80                      |
| CU-PF-04           | Daikin RXYQ12AYM  | 80                      |
| <b>Building PG</b> |                   |                         |
| CU-PG-01           | Daikin RXYQ16AYM  | 81                      |
| CU-PG-02           | Daikin RXYQ14AYM  | 81                      |
| CU-PG-03           | Daikin RXYQ24AYMA | 83                      |
| CU-PG-04           | Daikin RXYQ28AYMA | 84                      |

Knowing the sound power level of a noise source, the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses, sound barriers, etc.

## 4.2 Predicted Noise Levels

Provided the recommendations in Section 5 are satisfactorily implemented, the level of noise emission from the condenser units serving the school buildings is calculated as shown in Table 2.

**Table 2 Calculated  $L_{eq}$  Noise Levels**

| Receptor Location                                      | Predicted Noise Level (dBA) | Noise Criterion (dBA) | Compliance (Yes/No) |
|--------------------------------------------------------|-----------------------------|-----------------------|---------------------|
| Holden Drive Residences<br>(South across Holden Drive) | 44                          | 44                    | Yes                 |
| South Circuit<br>(West across South Circuit)           | 44                          | 44                    | Yes                 |



## 5.0 NOISE CONTROL RECOMMENDATIONS

We recommend all of the following noise controls be implemented to meet the day time noise criterion.

### 5.1 Privacy Screen to Condenser Units

We recommend that the condenser units be screened using visual privacy louvres on all four sides to prevent line of sight to the condenser units from the street or school grounds.

The following condenser platforms are to have privacy screens:

- Plant Deck HB (Facing South Circuit)
- Plant Deck HB (Facing Podium Way)
- Plant Deck HC
- Plant Deck HD East (With CU-13 to 17)
- Plant Deck PG
- Plant Deck PF.

### 5.2 Acoustic Louvres

To reduce the level of noise emission from the condenser units on the rooftop, we recommend that acoustic louvres be installed on three sides to Plant Deck HD West (with CU-1 to 12). The fourth side facing north (towards the school) may be standard privacy louvres.

The acoustic louvres should be built to a height of 300 mm above the top of the condenser units.

**Table 3 Acoustic Louvre Specification**

| Description      | Insertion Loss (dB)<br>at Octave Band Centre Frequencies (Hz) |     |     |     |    |    |    |    |
|------------------|---------------------------------------------------------------|-----|-----|-----|----|----|----|----|
|                  | 63                                                            | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Acoustic Louvre* | 4                                                             | 7   | 9   | 13  | 14 | 12 | 12 | 8  |

\*Based on Fantech SBL1, 300mm deep

### 5.3 Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claim of expertise in other areas of building construction and therefore the recommended noise controls should be implemented into the building design in consultation with other specialists to ensure they meet the structural, fire, thermal or other aspects of building construction.

We encourage clients to check with us before using materials or equipment that are alternative to those specified in our Acoustical Report.

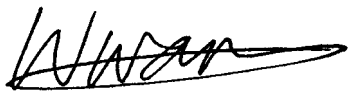


## 6.0 CONCLUSION

Day Design Pty Ltd was engaged Hindmarsh to provide acoustical advice for the proposed new air conditioning system serving the buildings of Oran Park Public and High School, located at 390 South Circuit, Oran Park, NSW.

Measurements and calculations show that the level of noise emitted by the use of the air conditioning system serving the buildings of Oran Park Public and High School will meet the acceptable noise level requirements of The EPA Noise Guide for Local Government as detailed in Section 4 of this report and will therefore be acceptable.

Recommendations to reduce construction noise and vibration are detailed in Section 5 of this report.



**William Wang**, BE (Mechatronics), MIEAust, MAAS  
Senior Acoustical Engineer  
for and on behalf of Day Design Pty Ltd

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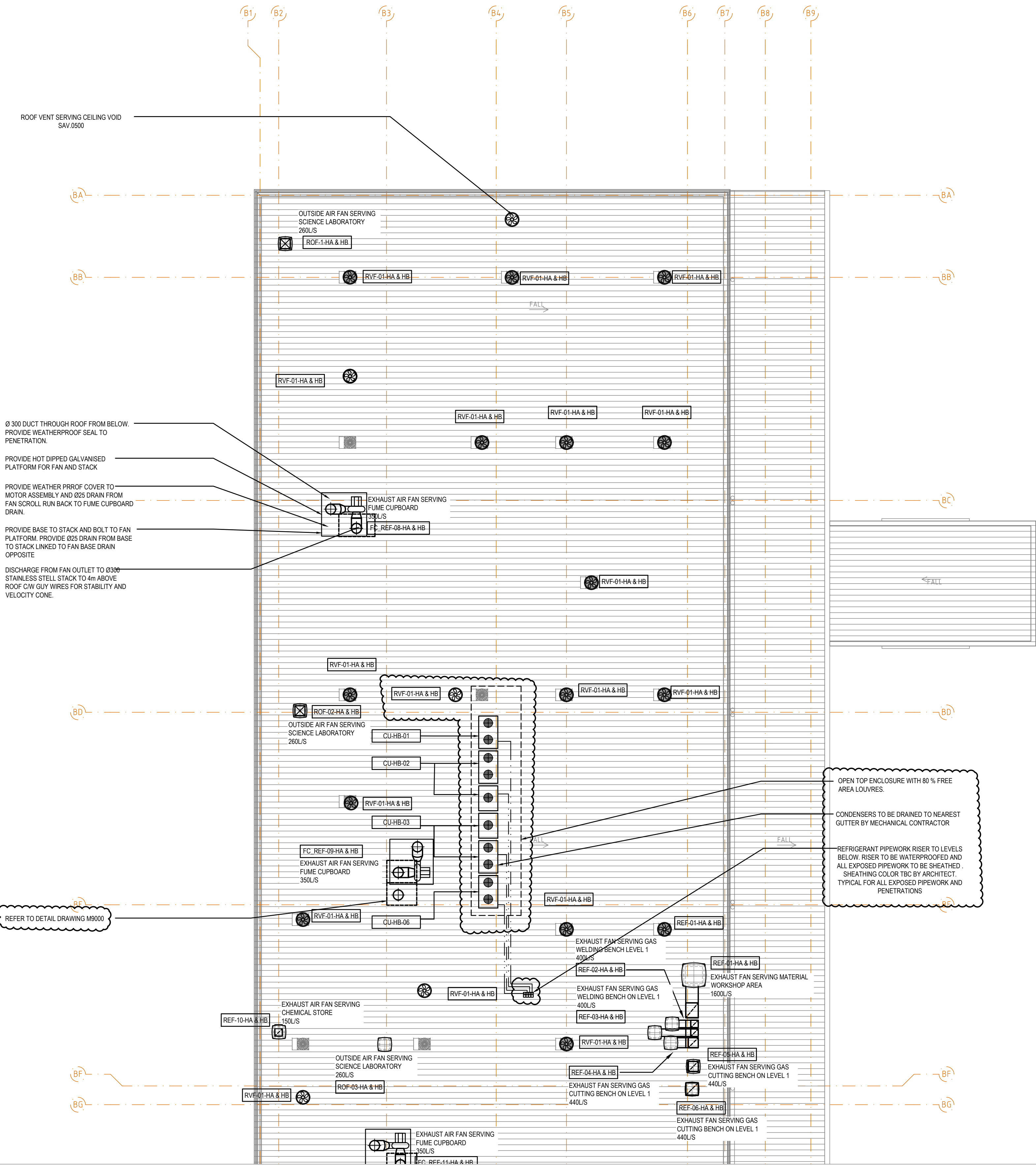
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## Attachments:

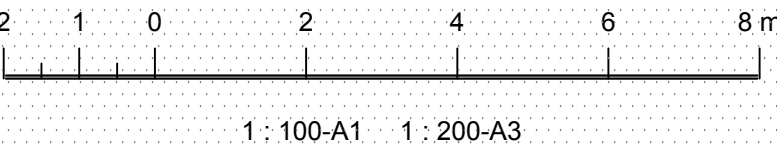
- Appendix A – Mechanical Drawings
- Appendix B – Rooftop Plant Layout
- AC108-1 to 4 – Glossary of Acoustical Terms







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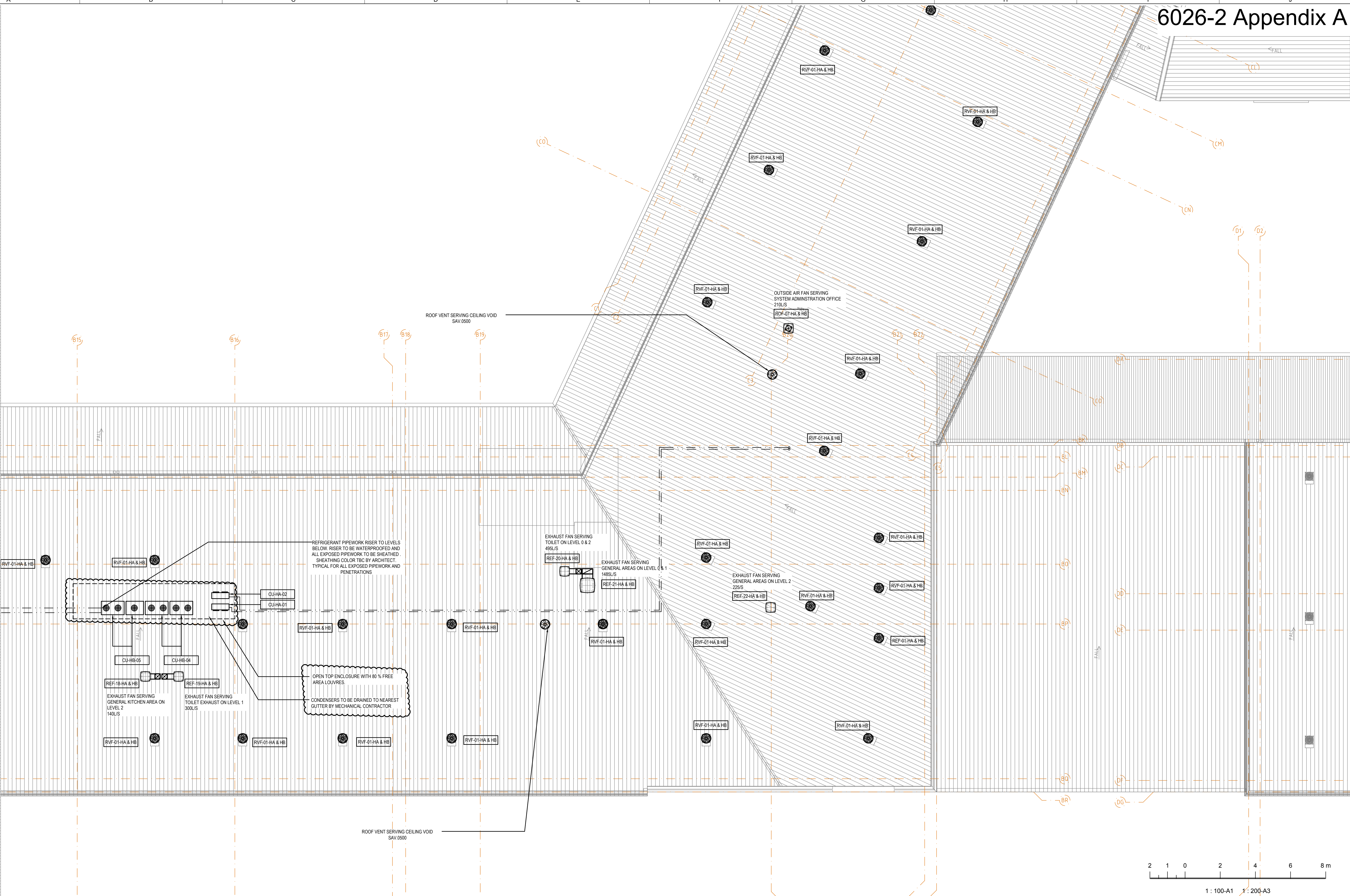
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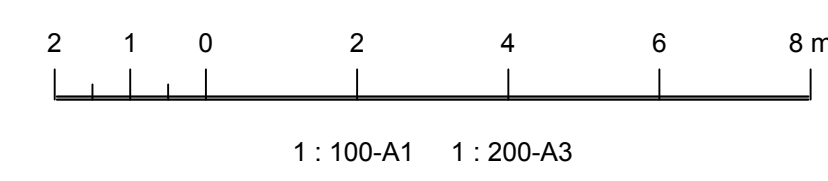
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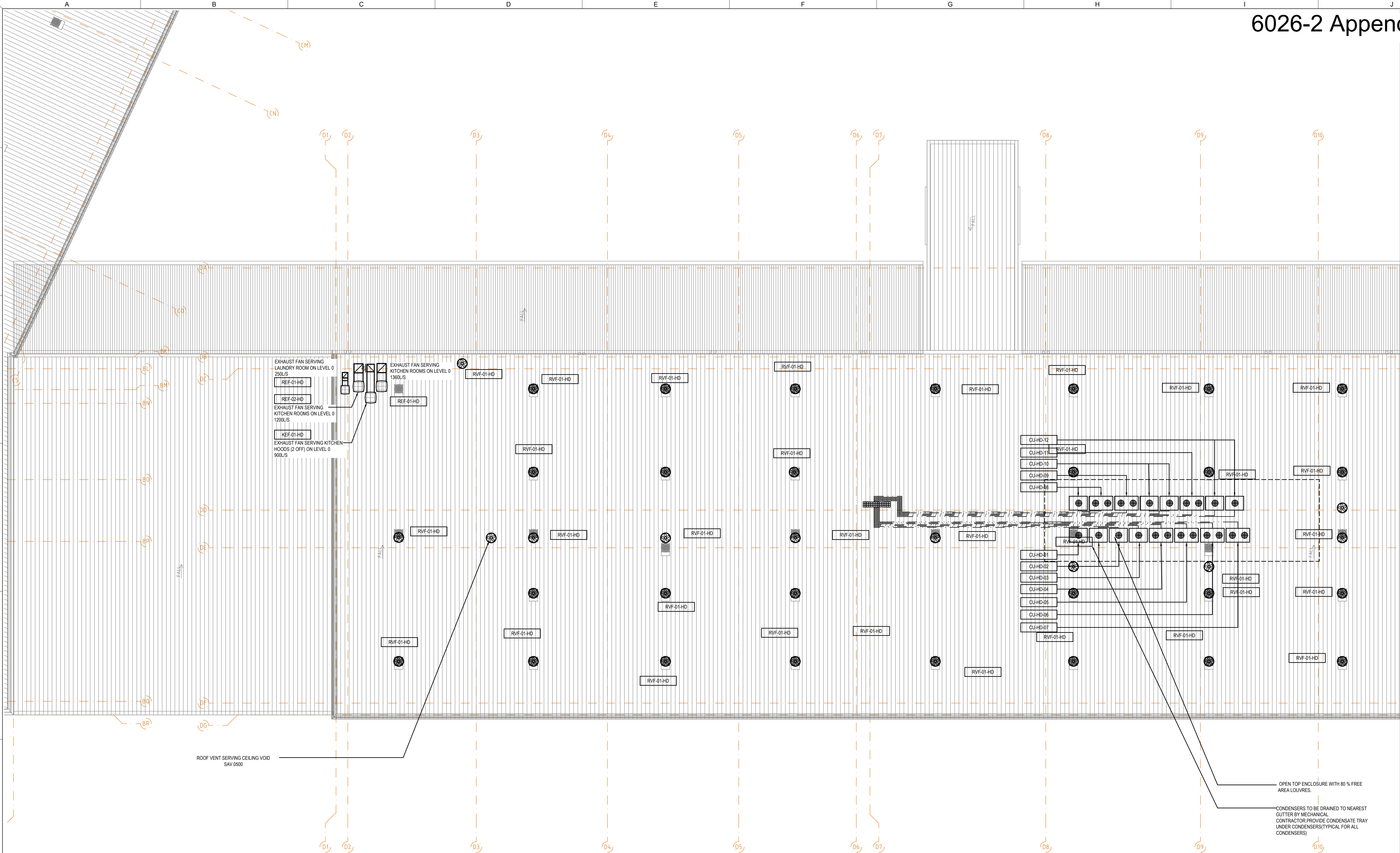




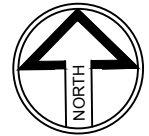
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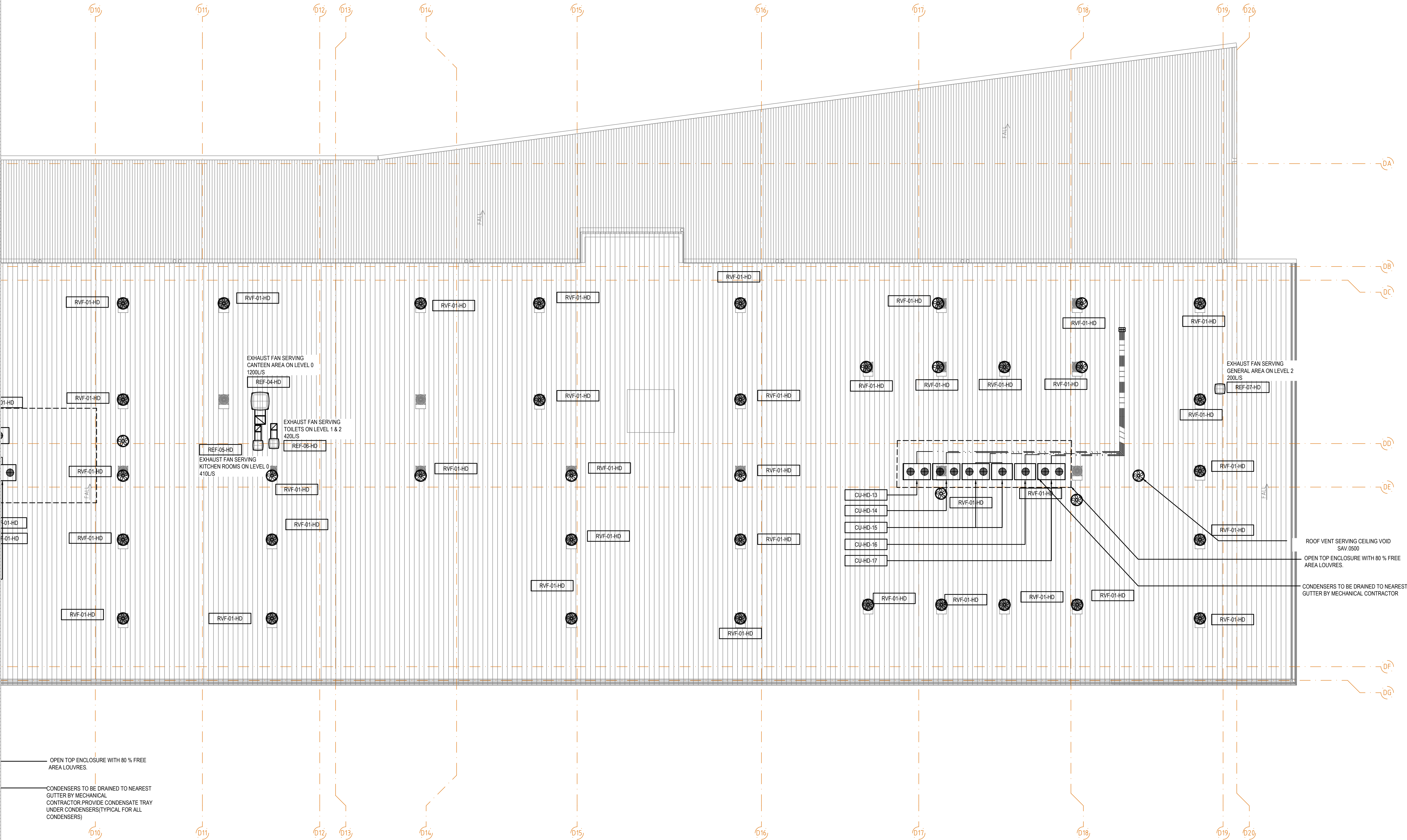
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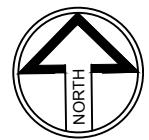


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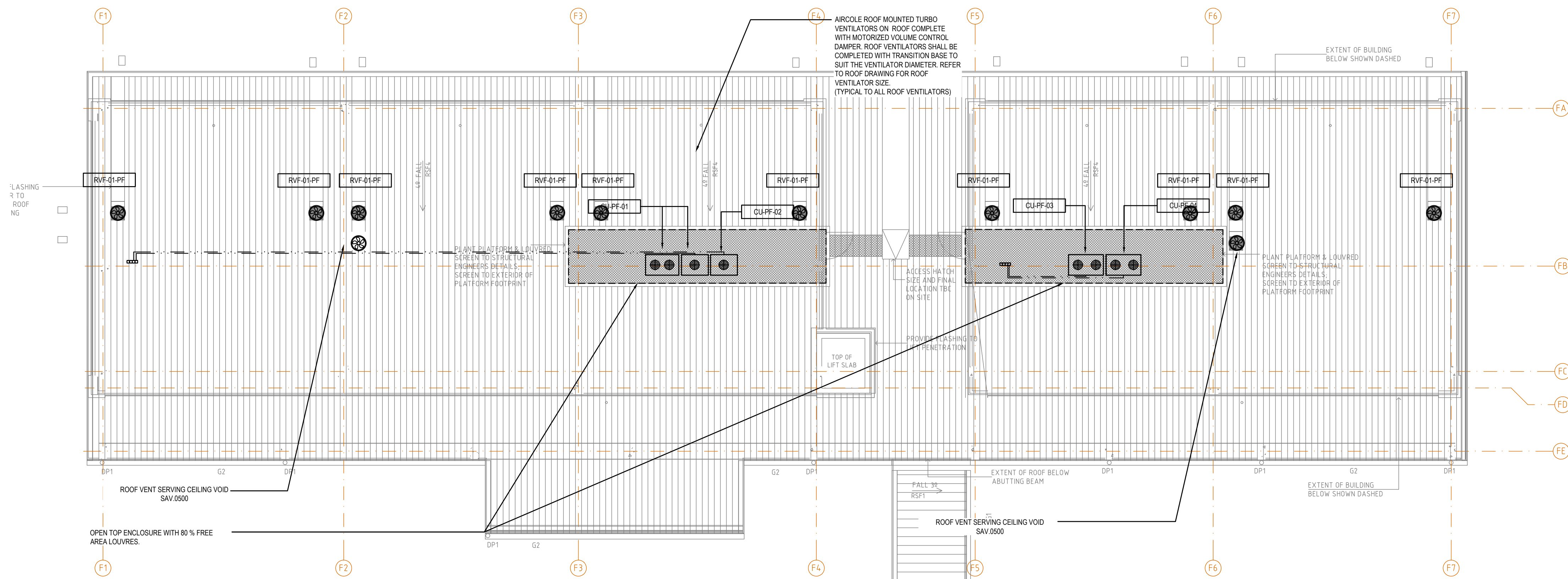
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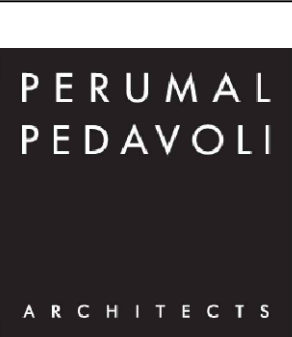


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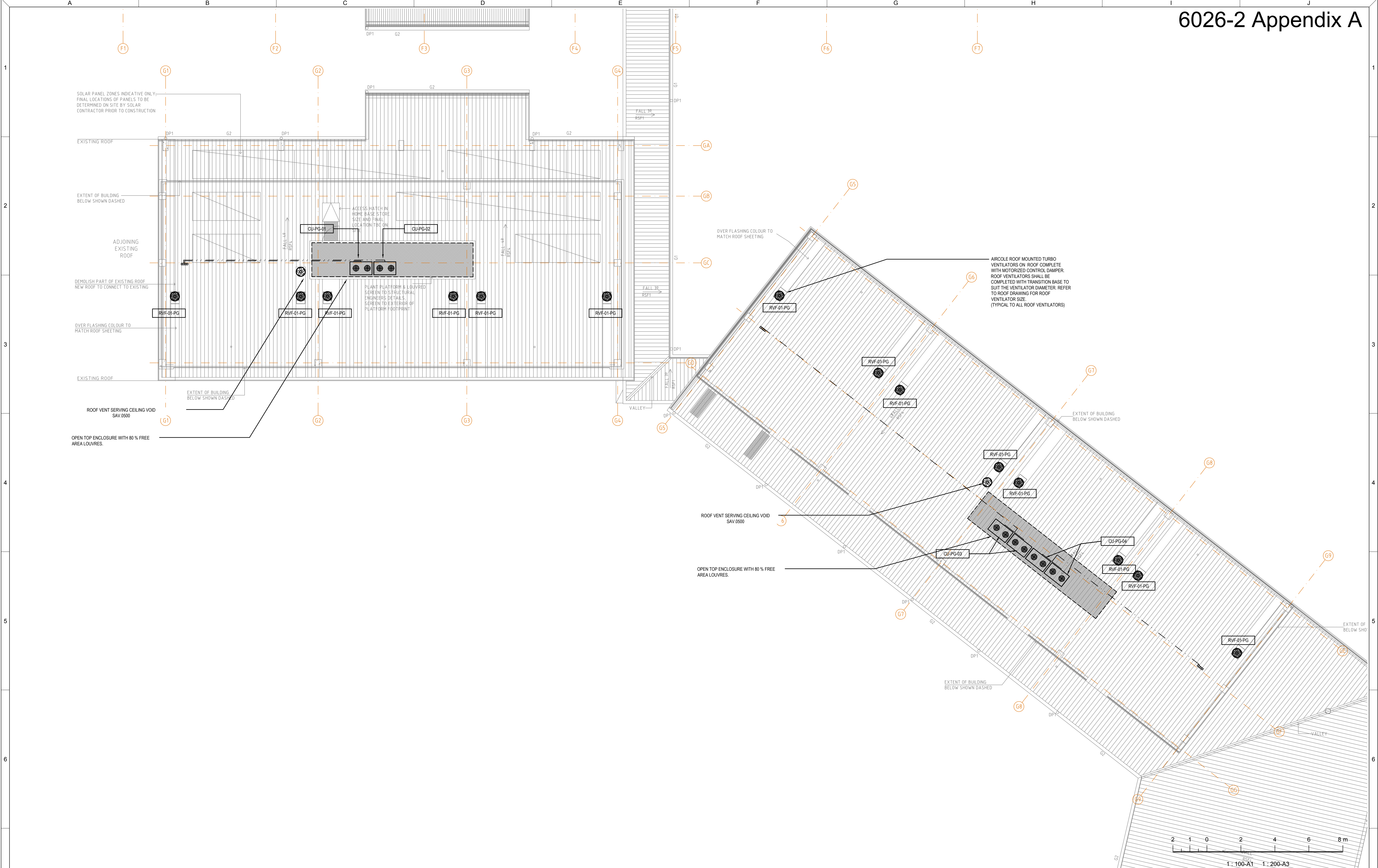
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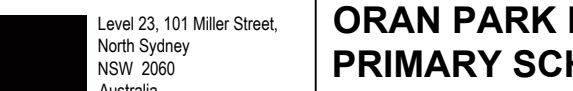
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| REVISIONS / AMENDMENTS |          |                           |          | REVISIONS / AMENDMENTS |      |             |          | CLIENT<br> | ARCHITECT<br> | CONSULTANT<br> <div>Level 23, 101 Miller Street,<br/>North Sydney<br/>NSW 2060<br/>Australia<br/>+61 (02) 9437 1000<br/>general@jhaengineers.com.au<br/>www.jhaservices.com</div> | PROJECT<br>ORAN PARK HIGH SCHOOL &<br>PRIMARY SCHOOL<br>SOUTH CIRCUIT & HOLDEN DRIVE<br>ORAN PARK NSW 2570 | TITLE<br>MECHANICAL SERVICES<br>BLOCK PG ROOF PLAN<br>MECHANICAL<br>VENTILATION LAYOUT | CONSTRUCTION ISSUE |             |            |   |  |   |  |   |  |   |  |
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| Rev                    | Date     | Description               | Verified | Rev                    | Date | Description | Verified |                                                                                                 |                                                                                                    |                                                                                                                                                                                                                                                                        |                                                                                                            |                                                                                        | DRAWN              | D.F.        | SCALE @ A1 |   |  |   |  |   |  |   |  |
| 1                      | 16.11.18 | CONSTRUCTION ISSUE        | T.K.     |                        |      |             |          |                                                                                                 |                                                                                                    |                                                                                                                                                                                                                                                                        |                                                                                                            |                                                                                        | CHECKED            | T.K.        | 1:100      |   |  |   |  |   |  |   |  |
| 2                      | 01.04.19 | FOR COORDINATION INCL. AC | R.C.     |                        |      |             |          |                                                                                                 |                                                                                                    |                                                                                                                                                                                                                                                                        |                                                                                                            |                                                                                        | APPROVED           | H.J.        |            |   |  |   |  |   |  |   |  |
|                        |          |                           |          |                        |      |             |          |                                                                                                 |                                                                                                    |                                                                                                                                                                                                                                                                        |                                                                                                            |                                                                                        | CREATED            | APR 2017    |            |   |  |   |  |   |  |   |  |
|                        |          |                           |          |                        |      |             |          |                                                                                                 |                                                                                                    |                                                                                                                                                                                                                                                                        |                                                                                                            |                                                                                        | JOB No.            | DRAWING No. | REV        |   |  |   |  |   |  |   |  |
|                        |          |                           |          |                        |      |             |          |                                                                                                 |                                                                                                    |                                                                                                                                                                                                                                                                        |                                                                                                            |                                                                                        | 180406             | M7102       | 2          |   |  |   |  |   |  |   |  |
| A                      |          |                           |          | B                      |      |             |          | C                                                                                               |                                                                                                    | D                                                                                                                                                                                                                                                                      |                                                                                                            | E                                                                                      |                    | F           |            | G |  | H |  | I |  | J |  |







**ACOUSTICAL** – Pertaining to the science of sound, including the generation, propagation, effects and control of both noise and vibration.

**AMBIENT NOISE** – The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including road traffic, factories, wind in the trees, birds, insects, animals, etc.

**AUDIBLE** – means that a sound can be heard. However, there are a wide range of audibility grades, varying from “barely audible” to “just audible”, “clearly audible” and “prominent”. Chapter 83 of the NSW Environment Protection Authority – Environmental Noise Control Manual (1985) states:

*“noise from a particular source might be offensive if it is clearly audible, distinct from the prevailing background noise and of a volume or character that a reasonable person would be conscious of the intrusion and find it annoying or disruptive”.*

It follows that the word “audible” in an environmental noise context means “clearly audible”.

**BACKGROUND NOISE LEVEL** – Silence does not exist in the natural or the built-environment, only varying degrees of noise. The Background Noise Level is the average minimum dBA level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by cicadas, lawnmowers, etc. It is quantified by the  $L_{A90}$  or the dBA noise level that is exceeded for 90 % of the measurement period (usually 15 minutes).

- **Assessment Background Level (ABL)** is the single figure background level representing each assessment period – day, evening and night (ie three assessment background levels are determined for each 24hr period of the monitoring period). Determination of the assessment background level is by calculating the tenth percentile (the lowest tenth percent value) of the background levels ( $L_{A90}$ ) for each period (refer: NSW Industrial Noise Policy, 2000).
- **Rating Background Level (RBL)** as specified by the Environment Protection Authority is the overall single figure ( $L_{A90}$ ) background noise level representing an assessment period (day, evening or night) over a monitoring period of (normally) three to seven days.

The RBL for an assessment period is the median of the daily lowest tenth percentile of  $L_{90}$  background noise levels.

If the measured background noise level is less than 30 dBA, then the Rating Background Level (RBL) is considered to be 30 dBA.

**DECIBEL** – The human ear has a vast sound-sensitivity range of over a thousand billion to one. The decibel is a logarithmic unit that allows this same range to be compressed into a somewhat more comprehensible range of 0 to 120 dB. The decibel is ten times the logarithm of the ratio of a sound level to a reference sound level. See also Sound Pressure Level and Sound Power Level.

Decibel noise levels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dBA, and another similar machine is placed beside it, the level will increase to 53 dBA, not 100 dBA. Ten similar machines placed side by side increase the sound level by 10 dBA, and one hundred machines increase the sound level by 20 dBA.

**dBA** – The human ear is less sensitive to low frequency sound than high frequency sound. We are most sensitive to high frequency sounds, such as a child’s scream. Sound level meters have an inbuilt weighting network, termed the dBA scale, that approximates the human loudness response at quiet sound levels (roughly approximates the 40 phon equal loudness contour).





However, the dBA sound level provides a poor indication of loudness for sounds that are dominated by low frequency components (below 250 Hz). If the difference between the “C” weighted and the “A” weighted sound level is 15 dB or more, then the NSW Industrial Noise Policy recommends a 5 dBA penalty be applied to the measured dBA level.

**dbc** – The dbc scale of a sound level meter is similar to the dBA scale defined above, except that at high sound intensity levels, the human ear frequency response is more linear. The dbc scale approximates the 100 phon equal loudness contour.

**EQUIVALENT CONTINUOUS NOISE LEVEL,  $L_{Aeq}$**  – Many noises, such as road traffic or construction noise, vary continually in level over a period of time. More sophisticated sound level meters have an integrating electronic device inbuilt, which average the A weighted sound pressure levels over a period of time and then display the energy average or  $L_{Aeq}$  sound level. Because the decibel scale is a logarithmic ratio the higher noise levels have far more sound energy, and therefore the  $L_{Aeq}$  level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closely to the  $L_{Aeq}$  noise level.

**FREE FIELD** – This is a sound field not subject to significant reflection of acoustical energy. A free field over a reflecting plane is usually outdoors with the noise source resting on hard flat ground, and not closer than 6 metres to any large flat object such as a fence or wall; or inside an anechoic chamber.

**FREQUENCY** – The number of oscillations or cycles of a wave motion per unit time, the SI unit being the Hertz, or one cycle per second.

**IMPACT ISOLATION CLASS (IIC)** – The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation.

**IMPACT SOUND INSULATION ( $L_{nT,w}$ )** – Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ( $L_{nT,w}$ ) is the sound pressure level at 500 Hz for a reference curve fitted to the measured octave band levels. Thus the lower  $L_{nT,w}$  the better the impact sound insulation.

**IMPULSE NOISE** – An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

**INTRUSIVE NOISE LEVEL,  $L_{Aeq}$**  – The level of noise from a factory, place of entertainment, etc. in NSW is assessed on the basis of the average maximum noise level, or the  $L_{Aeq}$  (15 min). This is the energy average A weighted noise level measured over any 15 minute period.

**LOUDNESS** – The degree to which a sound is audible to a listener is termed the loudness. The human ear perceives a 10 dBA noise level increase as a doubling of loudness and a 20 dBA noise increase as a quadrupling of the loudness.



**MAXIMUM NOISE LEVEL,  $L_{Amax}$**  – The rms maximum sound pressure level measured on the "A" scale of a sound level meter during a noise survey is the  $L_{Amax}$  noise level. It may be measured using either the Fast or Slow response time of the meter. This should be stated.

**NOISE RATING NUMBERS** – A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the dBA level minus five.

**NOISE** – Noise is unwanted sound. Sound is wave motion within matter, be it gaseous, liquid or solid. "Noise includes sound and vibration".

**NOISE REDUCTION COEFFICIENT** – See: "Sound Absorption Coefficient".

**OFFENSIVE NOISE** - (Reference: Dictionary of the Protection of the Environment Operations Act 1997). *"Offensive Noise means noise:*

- (a) *that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:*
  - (i) *is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or*
  - (ii) *interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
- (b) *that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."*

**PINK NOISE** – Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

**REVERBERATION TIME,  $T_{60}$**  – The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the  $T_{60}$ . The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

**SOUND ABSORPTION COEFFICIENT,  $\alpha$**  –  $\alpha$  Sound is absorbed in porous materials by the viscous conversion of sound energy to heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient,  $\alpha$ . An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average  $\alpha$  from 250 to 2000 Hz is termed the Noise Reduction Coefficient (NRC).

**SOUND ATTENUATION** – If an enclosure is placed around a machine, or a silencer is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 30 dBA, reduces the sound energy by one thousand times.

**SOUND EXPOSURE LEVEL (SEL)** – The total sound energy of a single noise event condensed into a one second duration or in other words it is an  $L_{eq}$  (1 sec).





**SOUND PRESSURE LEVEL,  $L_p$**  – The level of sound measured on a sound level meter and expressed in decibels, dB, dBA, dBC, etc.  $L_p = 20 \times \log (P/P_0) \dots \text{dB}$

where  $P$  is the rms sound pressure in Pascal and  $P_0$  is a reference sound pressure of 20  $\mu\text{Pa}$ .  
 $L_p$  varies with distance from a noise source.

**SOUND POWER LEVEL,  $L_w$**  – The Sound Power Level of a noise source is an absolute that does not vary with distance or with a different acoustic environment.

$$L_w = L_p + 10 \log A \dots \text{dB, re: } 1\text{pW},$$

where  $A$  is the measurement noise-emission area in square metres in a free field.

**SOUND TRANSMISSION CLASS (STC)** – An internationally standardised method of rating the sound transmission loss of partition walls to indicate the decibels of noise reduction of a human voice from one side to the other. (Refer: Australian Standard AS1276 – 1979)

**SOUND TRANSMISSION LOSS** – The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS1191 - 2002.

**STATISTICAL EXCEEDENCE SOUND LEVELS,  $L_{A90}$ ,  $L_{A10}$ ,  $L_{A1}$ , etc** – Noise which varies in level over a specific period of time (usually 15 minutes) may be quantified in terms of various statistical descriptors:

The  $L_{A90}$  is the dBA level exceeded for 90 % of the time. In NSW the  $L_{A90}$  is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

The  $L_{A10}$  is the dBA level that is exceeded for 10 % of the time. In NSW the  $L_{A10}$  measured over a period of 10 to 15 minutes. It was until recently used to describe the average maximum noise level, but has largely been replaced by the  $L_{Aeq}$  for describing level-varying noise.

The  $L_{A1}$  is the dBA level that is exceeded for 1 % of the time. In NSW the  $L_{A1}$  may be used for describing short-term noise levels such as could cause sleep arousal during the night.

**STEADY NOISE** – Noise, which varies in level by 6 dBA or less, over the period of interest with the time-weighting set to “Fast”, is considered to be “steady”. (Refer AS 1055.1 1997)

**WEIGHTED SOUND REDUCTION INDEX,  $R_w$**  – This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 to 3,150 Hertz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999).

Internal partition wall  $R_w + C$  ratings are frequency weighted to simulate insulation from human voice noise. The  $R_w + C$  is always similar in value to the STC rating value. External walls, doors and windows may be  $R_w + C_{tr}$  rated to simulate insulation from road traffic noise. This is normally a lower number than the STC rating value.

**WHITE NOISE** – White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.

