GABRIELS HEARNE FARRELL



# ENVIRONMENTAL ACOUSTICS

## DEVELOPMENT APPROVAL REPORT

### AUSTRALIAN HOCKEY CENTRE
### CURTIN UNIVERSITY, BENTLEY

13th November 2024

For

**HUNT ARCHITECTS**
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| Report Version | Author | Notes | Date |
|---|---|---|---|
| Initial Report | Michael Ferguson | | 13th November 2024 |

Gabriels Hearne Farrell Pty Ltd is a Member Firm of the Association of Australasian Acoustical Consultants. The report author is a full member of the Australian Acoustical Society.

# 1. INTRODUCTION

This report summarises the potential noise emissions from the proposed new Australian Hockey Centre, located at the Curtin University Campus in Bentley, Western Australia. This report is based upon the drawings received from the client on the 08th November, 2024. This report outlines the following:

- Demonstrates that the project team is aware of their Regulatory obligations with regards to noise emissions,
- Establishes the project specific Assigned Noise Level criteria in accordance with the Regulations,
- Identifies the relevant Noise Sources and the Assigned Nosie Levels applicable to each source,
- Identifies acoustic issues that will be addressed in detail during design and documentation stages, to ensure compliance with the Environmental Protection (Noise) Regulations (EPNR),
- Provides an initial assessment and recommendations to ensure compliance with the EPNR, including:
    - Noise emissions from sporting activities, including games, spectators, music, sirens, etc.
    - Special Events
    - Music breakout from Function Room
    - Proposed mechanical systems

## 1.1 Qualifications Of Consultant

The author of this report, Michael Ferguson, has been working for Gabriels Hearne Farrell Pty Ltd (formerly Gabriels Environmental Design Pty Ltd) since the beginning of 2010. He became a full member of the Australian Acoustical Society on the 22nd March, 2014. GHF is also a Member Firm of the Association of Australasian Acoustical Consultants.

# 2. PROJECT BACKGROUND

## 2.1 Project Context

The proposed development is a major upgrade of the existing hockey centre, with demolition of the existing stadium building and construction of a new stadium (adjacent to existing site), along with a new indoor sports centre. The number of proposed hockey pitches are increasing from two to four pitches total.

## 2.2 Proposed Operations

Trading hours are yet to be established by the client, however at this stage we have based our assumption on the proposed facilities being operation 7 days a week, from approximately 6am to 10pm, potentially later on weekend nights.

This is based off the use of the current facilities, with operational hours expected to be similar.

# 3. ENVIRONMENTAL NOISE EMISSIONS

Noise emissions generated by the use of the proposed facilities must comply with the Environmental Protection (Noise) Regulations, 1997 (as amended Dec 2013). The criteria for noise emissions from this development to neighbouring premises are called the Assigned Noise Levels, and vary depending on time of day, receiver location, duration of the noise source etc. The site specific criteria are set out in Section 3.1 of this report.

The neighbouring highly noise sensitive premises are:

- SwanCare Ningana, located approximately 340 metres to the east; and,
- The existing residences on Jarrah Rd, over 450 metres away (to the east).

Our current calculations and recommendations are based upon the above mentioned properties. Should this change in the future then this may have implications on the information contained within this report.


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The site specific Assigned Noise Level criteria takes into account the land zoning and traffic flows within 100m and 450m of the relevant receiver locations. This has been based on the land zoning information obtained from aerial imagery:

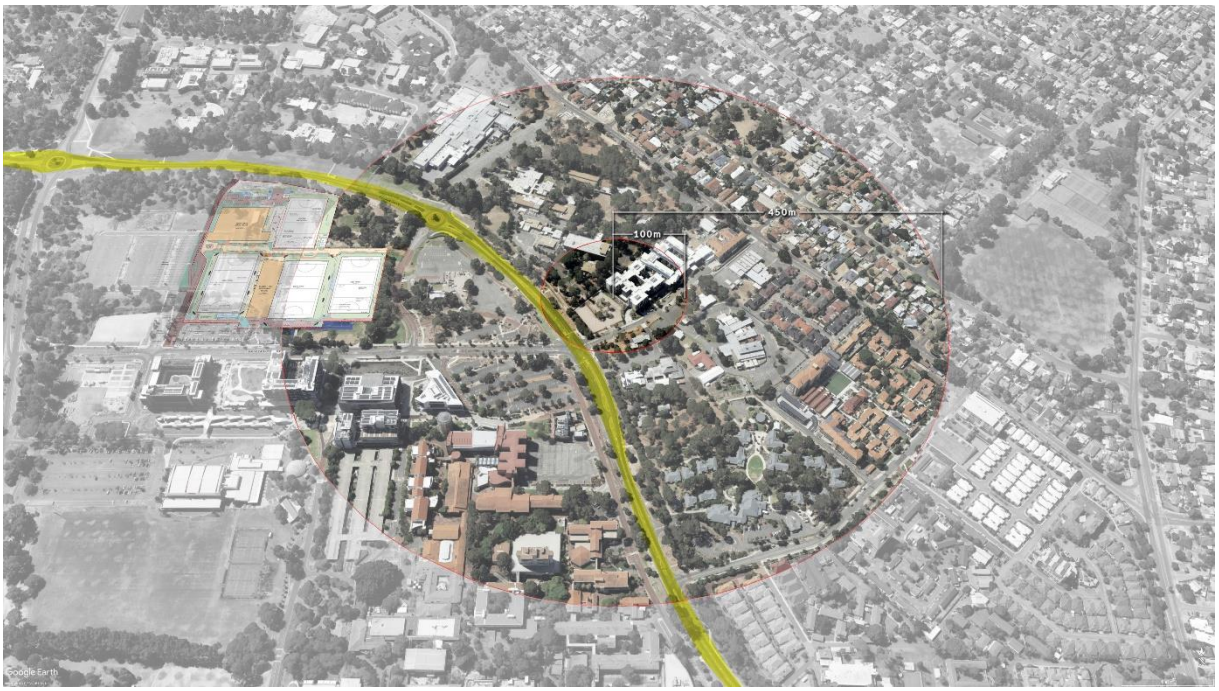


*Image 01 –Assigned Noise Level Circumferences*

Land Zoning Influencing Factor

There is negligible commercial properties within a 450m radius of the noise sensitive receivers. No Influencing Factor is applied for land zoning.

Transport Influencing Factor

Typically, the amount of traffic on nearby roads has an influencing factor on the assigned noise levels. For this development there is a secondary roads within 100m of the nearest noise sensitive premises, therefore a +2 dB Influencing Factor is applied.

## 3.1 Assigned Noise Levels

Based on the above, there is a + 1 dB Influencing Factor relevant to the residences surrounding area to the proposed development. On this basis, the regulatory Assigned Noise Level criteria to be applied to this development are:

| Type of premises receiving noise | Time of day | Assigned Noise Level (dB) | | |
|---|---|---|---|---|
| | | $L_{A10}$ | $L_{A1}$ | $L_{A\,max}$ |
| Noise sensitive premises; highly sensitive area (i.e. within 15m of a residential building) | 0700 to 1900 hours Monday to Saturday | 47 | 57 | 67 |
| | 0900 to 1900 hours Sunday and public holidays | 42 | 52 | 67 |
| | 1900 to 2200 hours all days | 42 | 52 | 57 |
| | 2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays. | 37 | 47 | 57 |
| Commercial Premises and all other land areas outside 15m from residences | All hours | 60 | 75 | 80 |

*Table 01 –Assigned Noise Levels*

The sound level parameters used for the various environmental noise criteria are described below, based on an assessment period of 15 minutes up to 4 hours:

**$L_{A10}$** is the 'A' weighted noise level which is not to be exceeded for more than 10% of the time, e.g. for more than 10 minutes in 100 minutes. This is the parameter relevant to most HVAC equipment, and emissions from other longer term noise sources that run for extended duration (such as crowd noise, etc.).

**$L_{A1}$** is the 'A' weighted noise level which is not to be exceeded for more than 1% of the time, e.g. for more than 1 minute in 100 minutes, or up to 24 minutes in 4 hours. This is the parameter relevant to noise sources that only occur occasionally, for short durations.

**$L_{Amax}$** is the 'A' weighted noise level for individual events which is not to be exceeded at any time.

### 3.2 Adjustments for Noise Character

Regulation 9(3) requires that the noise emission must be free of annoying characteristics, namely tonality (e.g. whining, droning), modulation (like a siren), and impulsiveness (e.g. thumping). Where noise emissions do exhibit the above noise characteristics, an adjustment is made to the measured/calculated noise level:

| | |
|---|---|
| *Tonality* | 5dB is added to the measured level |
| *Modulation* | 5dB is added to the measured level |
| *Impulsiveness* | 10dB is added to the measured level |

Where the noise emission is music the following adjustments to the measured noise levels apply:

| | |
|---|---|
| *Impulsiveness not present* | 10dB is added to the measurement level |
| *Impulsiveness present* | 15dB is added to the measurement level |

The above adjustments only apply where the noise character is audible and measurable the noise receiver.

Outdoor crowd noise and general hockey game noise is generally considered to be free from tonality and/or modulation and therefore has no penalties applied to it.

Please note that the noise transmission from the Australian Hockey Centre to the existing student accommodation buildings (St Catherine's College and Twin Dolphin Hall) may also technically be required to comply with the Environmental Protection (Noise) Regulations 1997 if the Hockey Centre ever becomes a separate Lot in the future. If compliance is required by the Local Authority this could be problematic as there is minimal that can be done about the potential noise emissions beyond management of sources.

Further to the above, potential noise emissions from the Australian Hockey Centre to the student accommodation may be appropriate to utilise the *Design Sound Levels* of Australian Standard 2107:2016. The *Design Sound Levels* are outlined in Table 2 below (these are internal noise level criteria).

| | Recommended Design Sound Level | |
|---|---|---|
| **Type of Space** | *Lower Range* | *Upper Range* |
| Living Areas | 30 dB(A) | 40 dB(A) |
| Sleeping Areas (night time) | 30 dB(A) | 35 dB(A) |

*Table 02 – Design Sound Levels for the accommodation rooms at St Catherine's College and Twin Dolphin Hall*

On the basis of external windows being closed, the resultant external noise level at the façades of the student accommodation buildings must not exceed the following levels, in order to comply with the above internal noise level criteria:

- Daytime – $L_{Aeq}$ 55 to 60 dB
- Night time (10pm to 7am) – $L_{Aeq}$ 50 to 55 dB


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# 4. NOISE SOURCES

All noise emissions from the proposed development are to be in full compliance with the requirements of the Environmental Protection (Noise) Regulations 1997. All noise generated by the various activities and building services must meet the Assigned Noise Levels at neighbouring premises, as determined by the Regulations. To note, with a sporting complex there are some exemptions to noise emissions based on "community noise", which are covered in more detail below where required.

Noise sources to be addressed include:

- Noise emissions from sporting activities, including games, spectators, music, sirens, etc.
- Special Events
- Music breakout from Function Room
- Proposed mechanical systems

Vehicle Movements

It should be noted that the parking area available for the hockey centre is open to the public. It is therefore our understanding that the main trafficable areas are considered 'road'. In accordance with clause 3 of the EPNR:

*1) Nothing in these regulations applies to the following noise emissions-*

*a) noise emissions from the propulsion and braking systems of motor vehicles operating on a road;*

Therefore propulsion and braking noise associated with vehicle movements has not been assessed.

Waste Collection & Site Cleaning

Waste collection and other similar works are covered by Regulation 14A of the EPNR. The regulation states that the collection of rubbish etc. is exempt from meeting the regulations, provided that:

*a) the works are carried out in the quietest reasonable and practicable manner; and*

*b) the equipment used to carry out the works is the quietest reasonably available; and*

*c) is carried out during day time hours, defined as 7am to 7pm Monday to Saturday, and 9am to 7pm Sundays and Public Holidays.*

## 4.1 Noise Level Data

The following noise level data was input into the noise model.

### *4.1.1 Hockey Activities*

The noise emissions from sporting activities are required to comply with the Environmental Protection (Noise) Regulations 1997, except for noise from spectators. As per Schedule 2 – Community Noise, Item 1, noise emitted from spectators at a dedicated sporting venue is deemed to be "community noise", which is exempt from complying with the Assigned Levels.

The noise from the hockey activities themselves shall comply with the Assigned Levels. This includes the noise from hockey sticks, the noise of balls hitting the backboard of the goals, on-field shouting, and sirens.

Noise Emissions from the Existing Hockey Pitch

On-site noise monitoring has been undertaken at the existing stadium hockey pitch at Curtin University, in order to ascertain the extent of noise emission associated with hockey training and matches. The noise monitoring was undertaken with a NATA calibrated sound level meter over a period of four days, from Thursday July 13th until Monday July 17th, 2023. The noise monitor was positioned 22 metres north of the existing pitch. The results of the noise monitoring are presented in Figure 1 on the following page.

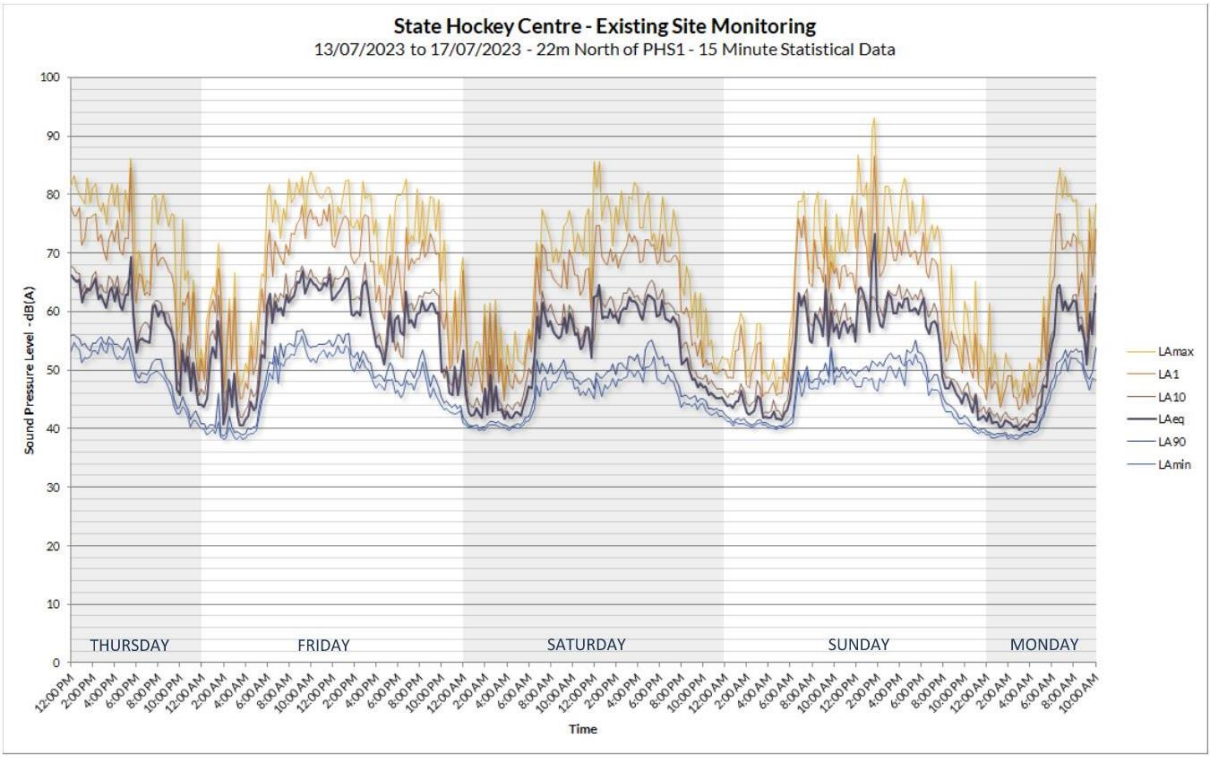
In addition to obtaining noise level data, the noise monitor also stored audio files to allow noise sources to be identified. Following our initial review of the noise monitor data, the following comments can be made:

- The loudest noise event associated with use of the hockey pitch is the hockey ball hitting the backboard within the goal (approximately $L_{Amax}$ 80 dB, 22 meters from the pitch). The next loudest noise was the hockey stick hitting the hockey ball, followed by the use of whistles by the referee. The noise level of players communicating with each other was not the dominant maximum noise level. These findings correlate well with international literature regarding hockey noise

emissions. Figure 2 on the following page provides an excerpt from the paper titled *"Max noise levels from Hockey Pitches"*, published in Volume 43 of the Proceedings of the Institute of Acoustics.

- The $L_{A10}$ noise levels were generally 60 to 64 dB, approximately 22 metres from the pitch during training and hockey matches.
- The $L_{Aeq}$ noise levels were generally 57 to 61 dB, approximately 22 metres from the pitch during training and hockey matches.






*Graph 01 – On-Site Noise Logging – 22 metres north of PHS1*

| Noise event in a real hockey match | Maximum sound power level, dB $L_{AFmax}$ | | |
|---|---|---|---|
| | Highest | Logarithmic average | Lowest |
| Hockey ball hitting perimeter board without mitigation | 119 | 116 | 111 |
| Stick hitting hockey ball | 105 | 103 | 86 |
| Whistle | 102 | 100 | 92 |
| Shouting | 102 | 98 | 83 |

*Figure 02 – Excerpt from Volume 43 of the Proceedings of the Institute of Acoustics (Sound Power Levels of maximum noise events)*

From the monitoring data above, as well as existing noise sources on file, the below noise spectrums were used in the acoustic modelling procedure:

| **Sound Power Level of Noise in Modelling** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **63Hz** | **125Hz** | **250Hz** | **500Hz** | **1kHz** | **2kHz** | **4kHz** | **dB(A)** |
| Typical Game – $L_{A10}$ | 101 | 100 | 95 | 99 | 99 | 95 | 93 | **103** |
| Backboard Impact - $L_{Amax}$ | 97 | 105 | 116 | 119 | 104 | 103 | 100 | **117** |
| Electronic Game Siren - $L_{Amax}$ | 100 | 96 | 100 | 104 | 106 | 107 | 101 | **111** |
| Music* – $L_{A1}$ | 117 | 120 | 116 | 109 | 107 | 106 | 95 | **113** |

*Table 03 - Noise Level of Noise Sources used in Modelling*

Note the above noise levels are sound Power noise levels, calibrated to the measured noise emissions at the monitoring location i.e. a sound Power level of 117 dB(A) for a backboard impact is approximately 80

dB(A) at the North tower. *Music noise levels were not recorded during the monitoring period, therefore an estimated noise level of approximately 75 dB(A) in the centre of the pitch was used.



Special Events

It is likely that there will be major events at the Australian Hockey Centre which will include use of temporary loud speakers in the external areas playing music at a higher volume (e.g. Grand Final Day, Hockey One games, Hockey World Cup, etc). Whilst this will not be a regular occurrence, the potential noise emissions from amplified music during special events will require consideration.

Loud amplified music within the external areas will not likely comply with the Assigned Levels at the nearest residences and Swancare Ningana aged care facility, especially given the relevant penalties that apply to music emissions under Regulation 9(3). It therefore may be necessary for the Stakeholders to obtain one of the following approvals from the Town of Victoria Park, to permit louder noise emissions for special events:

- Regulation 18 approval for one-off events; or,
- Regulation 19B approval for the overall venue, to permit multiple 'notifiable events' per year.

Note this report is not suitable for the above approvals. Typically this requires further modelling and preparation of a specific noise management plan, which is typically organised by the venue operator.

### *4.1.2 Music Emissions from Function Room*

Previous measurements of similar facilities has been undertaken where amplified music may be utilised. Based on these measurements we have run an assessment of the potential noise breakout, based on a potential sound pressure level at the inside face of the external walls / ceiling materials being approximately 90 dB(A).

Note whilst this noise level can be used as an approximate guideline for the venue i.e. it may be similar to a loud party or wedding venue, the results of the modelling can also be adjusted to indicate compliant levels based on this starting point. The spectrum used for this assessment is as follows:

| **Sound Pressure Level of Music in Function Room** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **63Hz** | **125Hz** | **250Hz** | **500Hz** | **1kHz** | **2kHz** | **4kHz** | **dB(A)** |
| At inside face of façade | 94 | 96 | 92 | 85 | 83 | 82 | 71 | **90** |

*Table 04 - Sound Pressure Level of Music at Inside Face of Building Envelope used in EPNR Assessment*

### *4.1.3 Mechanical Noise*

An assessment of the potential noise emissions from the potential external mechanical equipment has been undertaken. This assessment has been based off of the current mechanical documentation and noise level information. Whilst this may change in the future, this is unlikely to be of consequence to the potential noise emissions.

The noise level of the units used in the assessment are as follows:

| **Sound Power Level of Mechanical Units** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ***INDOOR BUILDING*** | | | | | | | | |
| | **63Hz** | **125Hz** | **250Hz** | **500Hz** | **1kHz** | **2kHz** | **4kHz** | **dB(A)** |
| Ground Cond (each) | 74 | 72 | 72 | 65 | 62 | 58 | 53 | **68** |
| TEF-I-GF-01A | 67 | 75 | 71 | 73 | 71 | 69 | 65 | **76** |
| GEF-I-GF-01 | 64 | 61 | 62 | 61 | 63 | 64 | 59 | **69** |
| Café fan | 55 | 56 | 62 | 62 | 64 | 62 | 54 | **68** |
| Upper Floor WC Exhaust | 82 | 79 | 72 | 73 | 71 | 73 | 68 | **78** |
| Staff exhaust | 57 | 56 | 61 | 60 | 58 | 57 | 51 | **63** |
| CU-I-RF-04a | 85 | 90 | 84 | 77 | 72 | 64 | 61 | **80** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CU-I-RF-04b | 91 | 81 | 81 | 75 | 71 | 64 | 57 | **77** |
| Comms Cond | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Comms Cond | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| TEF-I-RF-01A | 84 | 84 | 84 | 76 | 76 | 70 | 67 | **81** |
| GEF-I-RF-01 | 66 | 62 | 67 | 65 | 60 | 60 | 54 | **67** |
| CU-I-RF-05 | 90 | 91 | 87 | 81 | 75 | 69 | 64 | **83** |
| CU-I-RF-02 | 73 | 64 | 62 | 62 | 58 | 53 | 48 | **63** |
| Comms Cond | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| CU-I-RF-03 | 67 | 64 | 64 | 63 | 59 | 54 | 49 | **64** |
| CU-I-RF-01 | 90 | 91 | 87 | 81 | 75 | 69 | 64 | **83** |
| CU-I-RF-06 | 90 | 91 | 87 | 81 | 75 | 69 | 64 | **83** |
| ***STADIUM BUILDING*** | | | | | | | | |
| | **63Hz** | **125Hz** | **250Hz** | **500Hz** | **1kHz** | **2kHz** | **4kHz** | **dB(A)** |
| Ground AHU | 58 | 62 | 66 | 65 | 59 | 59 | 56 | **67** |
| GEF-S-GF-01 | 77 | 74 | 67 | 68 | 66 | 68 | 63 | **73** |
| Staff WC Exhaust | 68 | 65 | 66 | 65 | 67 | 68 | 63 | **73** |
| Staff Utility Exhaust | 76 | 73 | 66 | 67 | 65 | 67 | 62 | **72** |
| Staff Outside Air | 58 | 61 | 65 | 66 | 69 | 67 | 60 | **73** |
| CU-S-L1-14 | 78 | 79 | 78 | 71 | 67 | 59 | 55 | **74** |
| Elite Changerooms | 87 | 87 | 82 | 76 | 73 | 73 | 73 | **81** |
| Main Toilets | 73 | 76 | 71 | 71 | 68 | 68 | 66 | **75** |
| Bin Exhaust | 78 | 75 | 68 | 69 | 67 | 69 | 64 | **74** |
| CU-S-RF-05 | 87 | 90 | 85 | 80 | 74 | 69 | 62 | **82** |
| CU-S-RF-06 | 84 | 86 | 81 | 75 | 69 | 63 | 58 | **77** |
| TEF-S-RF-01 | 68 | 81 | 76 | 75 | 71 | 76 | 71 | **80** |
| TEF-S-RF-02 | 69 | 82 | 77 | 76 | 72 | 77 | 72 | **81** |
| TEF-S-RF-03 | 67 | 63 | 66 | 63 | 59 | 57 | 51 | **65** |
| CU-S-RF-10 | 90 | 91 | 87 | 81 | 75 | 69 | 64 | **83** |
| CU-S-RF-10 | 80 | 85 | 82 | 78 | 73 | 65 | 61 | **0** |
| Type D2 | 91 | 81 | 81 | 75 | 71 | 64 | 57 | **77** |
| Type B4 | 75 | 71 | 71 | 68 | 65 | 60 | 54 | **70** |
| Type A2 | 71 | 70 | 69 | 65 | 60 | 56 | 51 | **67** |
| Type B5 | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Split Condensing unit fans (x4) | 68 | 86 | 75 | 74 | 73 | 70 | 63 | **78** |
| EVAP-S-RF-01 | 68 | 68 | 65 | 63 | 64 | 66 | 62 | **71** |
| CU-S-L1-13 | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| CU-S-L1-15 | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| Type B5 | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Kitchen exhaust | 79 | 86 | 84 | 84 | 83 | 75 | 70 | **86** |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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Type B1 | 65 | 62 | 59 | 58 | 56 | 50 | 44 | **60** |
| Type B5 | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Type B5 | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Type B2 | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| Type B2 | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| Type D1 | 82 | 81 | 76 | 70 | 65 | 57 | 57 | **73** |
| Type C2 | 82 | 85 | 81 | 77 | 72 | 66 | 59 | **79** |
| TEF-S-RF-04A | 60 | 71 | 78 | 76 | 65 | 69 | 64 | **77** |
| GEF-S-RF-01 | 70 | 66 | 71 | 69 | 64 | 64 | 58 | **71** |
| Type D2 | 91 | 81 | 81 | 75 | 71 | 64 | 57 | **77** |
| Type D7 | 96 | 93 | 88 | 83 | 78 | 72 | 66 | **0** |
| Type D8 | 95 | 94 | 89 | 84 | 79 | 73 | 67 | **0** |
| Type C1 | 84 | 87 | 78 | 74 | 70 | 64 | 57 | **77** |
| TEF-S-RF-08 | 73 | 67 | 74 | 70 | 70 | 70 | 64 | **76** |
| Type B5 | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Type B5 | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Type B2 | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| Type B2 | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| Type B5 | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Type B5 | 72 | 69 | 67 | 63 | 59 | 54 | 49 | **65** |
| Type B2 | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| Type B2 | 68 | 69 | 70 | 61 | 58 | 51 | 49 | **65** |
| Type C5 | 96 | 92 | 88 | 85 | 80 | 74 | 68 | **86** |

*Table 05 - Sound Power Levels of Mechanical Units used in EPNR Assessment*

## 5. NOISE MODELLING PROCEDURE

The noise emissions from the proposed facility have been modelled using the *SoundPLAN 9.1* software with the *Concawe* algorithm. This software allows the input of topographical data, building heights and forms, meteorological conditions, and noise source data. The software produces noise contour plans, indicating the predicted noise level over a given area.

Note – the output noise levels from *SoundPLAN* are base noise levels not including adjustment for noise character. Adjustments as per the previous section of this report must then be applied.

### 5.1 Meteorological Conditions

The meteorological conditions used in the calculations were as follows (based on the requirements of the Department of Environment Regulation):

*Day-time Assessment*

- Temperature – 20°C
- Relative Humidity – 50%
- Wind – 4 m/s in all directions simultaneously
- Pasquil Stability Class - E

*Night-time Assessment*

- Temperature – 15°C
- Relative Humidity – 50%
- Wind – 3 m/s in all directions simultaneously
- Pasquil Stability Class - F

## 5.2 Topography and Building Form

The building form, height, and configuration were input into the noise model, based on the architectural drawings, site surveys and the contour information available in online systems.

All roads and carpark areas were input into the noise model as hard reflecting ground surface.

## 5.3 EPNR Noise Specific Criteria

Based on the proposed operations of the venue, the relevant EPNR criteria are shown in Table 06 below, against typical times of the activities. The most stringent Assigned Noise Level criteria applicable to these activities will form a basis of compliance. All noise sources are expected to be audible for a sufficient length of time applicable to the $L_{A10}$ criteria (as seen below).

| **Noise Emissions from All Long Term Sources** | | |
|---|---|---|
| | *Time of Day* | *Relevant Assigned Noise Level* |
| Daytime - Monday to Saturday | 7am to 7pm | $L_{A10}$ 47 dB(A) |
| Daytime - Sundays & Public Holidays | 9am to 7pm | $L_{A10}$ 42 dB(A) |
| Evening - All Days | 7pm to 10pm | $L_{A10}$ 42 dB(A) |
| Overnight - All Days | All other times from above | $L_{A10}$ 37 dB(A) |

*Table 06 –Noise Emissions and their Relevant Assigned Noise Levels – Long term sources*

It is generally expected that during normal operations that any music being played would not be for a period of more than 24 minutes within a four hour period. It is our understanding music is rarely played and is only for short periods during game warm-ups etc. Again, this assessment does not include music at special events, which would be covered by the relevant Regulation exemption and noise management plan. Based on the above, music has been assessed against an $L_{A1}$ criteria (as seen below).

| **Noise Emissions from Intermittent Music** | | |
|---|---|---|
| | *Time of Day* | *Relevant Assigned Noise Level* |
| Daytime - Monday to Saturday | 7am to 7pm | $L_{A10}$ 57 dB(A) |
| Daytime - Sundays & Public Holidays | 9am to 7pm | $L_{A10}$ 52 dB(A) |
| Evening - All Days | 7pm to 10pm | $L_{A10}$ 52 dB(A) |
| Overnight - All Days | All other times from above | $L_{A10}$ 47 dB(A) |

*Table 07 –Noise Emissions and their Relevant Assigned Noise Levels – Intermittent Music*

As some noise sources are only an instantaneous noise sources (e.g. ball impacts & sirens) these are typically assessed against the $L_{Amax}$ criteria, as follows:

| **Noise Emissions from Instantaneous Sources** | | |
|---|---|---|
| | *Time of Day* | *Relevant Assigned Noise Level* |
| Daytime - Monday to Saturday | 7am to 7pm | $L_{Amax}$ 67 dB(A) |
| Daytime - Sundays & Public Holidays | 9am to 7pm | $L_{Amax}$ 67 dB(A) |
| Evening - All Days | 7pm to 10pm | $L_{Amax}$ 57 dB(A) |
| Overnight - All Days | All other times from above | $L_{Amax}$ 57 dB(A) |

*Table 08 –Noise Emissions and their Relevant Assigned Noise Levels*

# 6. RESULTS OF ACOUSTIC MODELLING



## 6.1 Scenario 01 – Typical Hockey Noise

The existing site and hockey stadium noise emissions were initially modelled for the purposes of comparison to the Relevant Assigned Noise levels, as well as the potential changes to noise emissions with the proposed Stadium and additional playing pitches. It is understood that hockey games are likely to be a highly variable noise source, and therefore the modelling is best considered as a comparison to the existing conditions. It is also prudent to reiterate that the Sunday / Public Holiday daytime criteria is similar to the "evening" criteria mentioned in the tables below.

The results of the acoustic modelling can be seen in the contour plots appended to this report. The outcome of this modelling for the existing noise predictions are:

| **Noise Modelling Results – Existing** | | | | |
|---|---|---|---|---|
| | *Assigned Noise Levels (day / evening / night)* | *Predicted Noise at Swancare Ningana* | *Predicted Noise at Jarrah Road residences* | *Predicted Noise at Curtin College* |
| Typical Game – $L_{A10}$ | 47 / 42 / 37 | 45 dB(A) | 42 dB(A) | 54 dB(A) |
| Backboard Impact - $L_{Amax}$ | 67 / 57 / 57 | 60 dB(A) | 56 dB(A) | 71 dB(A) |
| Electronic Game Siren - $L_{Amax}$ | 67 / 57 / 57 | 48 dB(A) | 47 dB(A) | 59 dB(A) |
| Music – $L_{A1}$ | 57 / 52 / 47 | 54 dB(A) | 51 dB(A) | 65 dB(A) |

*Table 09 – Predicted Noise Level of Existing Facility*

As the main purposes of this assessment is for comparison purposes, no adjustments have been made to the above predicted noise levels. If the above levels are to be compared directly to the relevant Assigned Noise Levels then we would estimate a:

- 5 dB penalty for tonality to the electronic game siren
- 10 dB penalty for impulsiveness is to be applied to a backboard impact (at least for the adjacent college buildings, receivers further away impulsiveness is unlikely to be measurable)
- 10-15 dB penalty should be applied to the music noise emissions, depending on receiver location.

The adjusted noise levels including the above penalties (where likely to be measurable at the receiver locations are as follows:

| **Noise Modelling Results – Existing (including penalties)** | | | | |
|---|---|---|---|---|
| | *Assigned Noise Levels (day / evening / night)* | *Predicted Noise at Swancare Ningana* | *Predicted Noise at Jarrah Road residences* | *Predicted Noise at Curtin College* |
| Typical Game – $L_{A10}$ | 47 / 42 / 37 | 45 dB(A) | 42 dB(A) | 54 dB(A) |
| Backboard Impact - $L_{Amax}$ | 67 / 57 / 57 | 60 dB(A) | 56 dB(A) | 81 dB(A) |
| Electronic Game Siren - $L_{Amax}$ | 67 / 57 / 57 | 53 dB(A) | 52 dB(A) | 64 dB(A) |
| Music – $L_{A1}$ | 57 / 52 / 47 | 64 dB(A) | 61 dB(A) | 80 dB(A) |

*Table 10 – Predicted Noise Level of Existing Facility – Including Penalties*

As can be seen in the above table compliance with the Assigned Noise Levels for typical game activities is plausible at both the Swancare Ningana facility, as well as the Jarrah Road residences. However, as discussed with the project Architect and client, compliance with the Environmental Regulations at the adjacent College accommodation buildings is highly unlikely to be achieved if ever required to do so.

Noise Emissions from New Hockey Pitches

Detailed noise modelling of the potential noise emissions from the new hockey pitches has been undertaken for typical game noise as well as potential music emissions. These two scenarios were selected as a general comparison to the existing site conditions, however other scenarios can be modelled where required. We expect similar results to these scenarios across the board for all activities.

The results of the new stadium modelling can be seen in the appended contour plots, as well as the table below (not including any penalties):

| **Noise Modelling Results – Proposed** | | | | |
|---|---|---|---|---|
| | *Assigned Noise Levels (day / evening / night)* | *Predicted Noise at Swancare Ningana* | *Predicted Noise at Jarrah Road residences* | *Predicted Noise at Curtin College* |
| Typical Game – $L_{A10}$ | 47 / 42 / 37 | 47 dB(A) | 44 dB(A) | 57 dB(A) |
| Music – $L_{A1}$ | 57 / 52 / 47 | 53 dB(A) | 52 dB(A) | 66 dB(A) |

*Table 11 – Predicted Noise Level of Proposed Facility*

For the purposes of this assessment the following table shows the predicted increase in noise level in comparison to the existing conditions:

| **Noise Modelling Results – Predicted Difference to Existing** | | | |
|---|---|---|---|
| | *Predicted Noise at Swancare Ningana* | *Predicted Noise at Jarrah Road residences* | *Predicted Noise at Curtin College* |
| Typical Game – $L_{A10}$ | +2 dB(A) | +2 dB(A) | +3 dB(A) |
| Music – $L_{A1}$ | -1 dB(A) | +1 dB(A) | +1 dB(A) |

*Table 12 – Predicted Noise Level of Proposed Facility – In Comparison to Existing Facility*

For reference, the below should be seen as a useful approximation to keep in perspective the impact of changes in sound level.

| | |
|---|---|
| 1 dB difference | Almost imperceptible |
| 2 dB difference | Just perceptible |
| 3 dB difference | Noticeable |
| 5 dB difference | Clearly Noticeable |
| 10 dB difference | Twice (or half) as loud |

Potential Future Curtin Buildings

The current version of the site plan as of the 8th November 2024, indicates that there are some potential for future Curtin buildings to be located between the South of the new hockey pitches, and the North of University Boulevard. Details of these building are unknown at this early stage, however additional modelling was undertaken to determine the likely noise at the façade of these buildings should they ever be constructed.

Three 5 storey buildings were included in the acoustic model, in the locations currently shown on the overall site plan. The predicted noise from typical gameplay at the buildings is estimated to be 60-62 dB(A), depending on the final building heights and exact locations. To provide context, this noise level is estimated to be approximately 6 to 8 dB(A) louder than current levels experienced at the Curtin College building facades. Any future development on this land parcel should consider these noise emissions in the design of their building façades.

Modelling Summary

From the noise modelling of the existing and proposed facilities, it can be seen that compliance with the Relevant Assigned Noise levels is plausible at the Swancare and Jarrah Road residences (depending on the variability of the game being played, and / or the time of day), however compliance with the Environmental Regulations at the closest College Buildings is not likely to be achieved at any time of the day (if ever required to do so).


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In comparison to the existing noise emissions, there is minimal change at the majority of locations, except for the western College building. This particular building is now located closer to the hockey pitches, and is expected to receive similar noise emissions from the existing facilities that the Eastern College building does currently.

At this stage, it is our view that the noise emissions from the additional hockey pitches can be managed, to ensure that the amenity of the noise sensitive premises is maintained to similar levels as existing. The Stakeholders may need to consider the following noise management practices in order to reduce environmental noise emissions where practicable, including noise to the façade of the student accommodation:

- Install temporary damping materials (e.g. rubber matting) against the goal backboards for training occurring prior to 7am Monday to Saturday, and before 9am on Sundays and Public Holidays.
- Prior to 7am on Monday to Saturday (and prior to 9am on Sundays / PH) avoid using the southern goals of the proposed hockey pitches for goal shooting practice.
- Avoid use of whistles and the sirens prior to 7am Monday to Saturday and before 9am on Sundays.
- Siren and public address systems to be designed and configuration to limit environmental noise emissions. This is to be addressed by the AV consultant.

## 6.2 Scenario 02 – Music Breakout from Function Room

The second scenario undertaken was to predict the potential noise breakout from music being played within the function room. This is based upon the proposed roofing construction of Colorbond sheeting with compressed Anticon to the underside. Ceilings are semi-perforated acoustically absorbent materials (i.e. Autex cube arrangement with small gaps).

As mentioned above, the music in this scenario was run at 90 dB(A) at the inside face of the ceiling. The results of this modelling is indicating the following (not including any penalties):

| **Noise Modelling Results – Function Breakout** | | | | |
|---|---|---|---|---|
| | *Assigned Noise Levels (day / evening / night)* | *Predicted Noise at Swancare Ningana* | *Predicted Noise at Jarrah Road residences* | *Predicted Noise at Curtin College* |
| Music @ 90 dB(A) | 47 / 42 / 37 | 23 dB(A) | 21 dB(A) | 41 dB(A) |

*Table 13 – Predicted Noise Level of Proposed Facility*

Applying a +10 dB(A) penalty for music emissions, expected noise levels at the neighbouring noise sensitive receiver positions at Swancare and Jarrah Rd are expected to achieve compliance with the Regulations at all times of the day. Typical management practices of ensuring doors remain closed after 10pm is likely still required.

## 6.3 Scenario 03 – Mechanical Noise

The final scenario undertaken included all of the mechanical systems outlined in Section 4.1.3 of this report.

Based on this information, the results of the acoustic modelling are as follows (not including any penalties):

| **Noise Modelling Results – Mechanical Noise** | | | | |
|---|---|---|---|---|
| | *Assigned Noise Levels (day / evening / night)* | *Predicted Noise at Swancare Ningana* | *Predicted Noise at Jarrah Road residences* | *Predicted Noise at Curtin College* |
| Music @ 90 dB(A) | 47 / 42 / 37 | 31 dB(A) | 27 dB(A) | 47 dB(A) |

*Table 14 – Predicted Noise Level of Proposed Facility*

When applying a +5 dB penalty for tonality, the potential noise emissions are approximately 36 dB(A) and 32 dB(A) at the two noise sensitive locations. Therefore, compliance is achieved at all times of the day.


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## 7. CONCLUSION

This report summarises the project requirements in terms of compliance with the Environmental Protection (Noise) Regulations, 1997. This includes determination of the relevant site specific Assigned Noise Level criteria. A description of each noise source and applicable noise level criteria has been provided, including acknowledgment of relevant adjustments required for noise sources with particular characteristics.

Detailed acoustic modelling has been undertaken of the proposal using SoundPLAN v9.1 3D modelling software, with the outcome of this assessment being as such:

Noise Emissions from Hockey Activities

- Noise emissions from the existing facilities and proposed pitches has been measured, calibrated, and modelled. The results of this modelling is indicating that the predicted noise level are expected to be very similar to the existing conditions experienced by neighbours.
- Some nearby College buildings are likely to have increased noise levels where new hockey pitches are located closer than the existing turfs.

Noise Breakout from Function Room

- Calculations of potential music breakout from the function room in the Stadium Building is likely to achieve compliance at all times of the day.
- External doors should be kept closed after 10pm to limit noise breakout to neighbours.
- Any external music for functions (if provided) is not to exceed conversational level and must not be audible at the adjacent neighbouring residences.

Noise Emissions from Mechanical Sources

- A review of the potential noise emissions from the mechanical plant has been reviewed and compliance is expected to be achieved at all times of the day.

If you have any queries regarding this information please call the undersigned on 9474 5966.

Regards,

**Michael Ferguson**
Associate Director *B.IntArch(Hons)* *M.A.A.S.*

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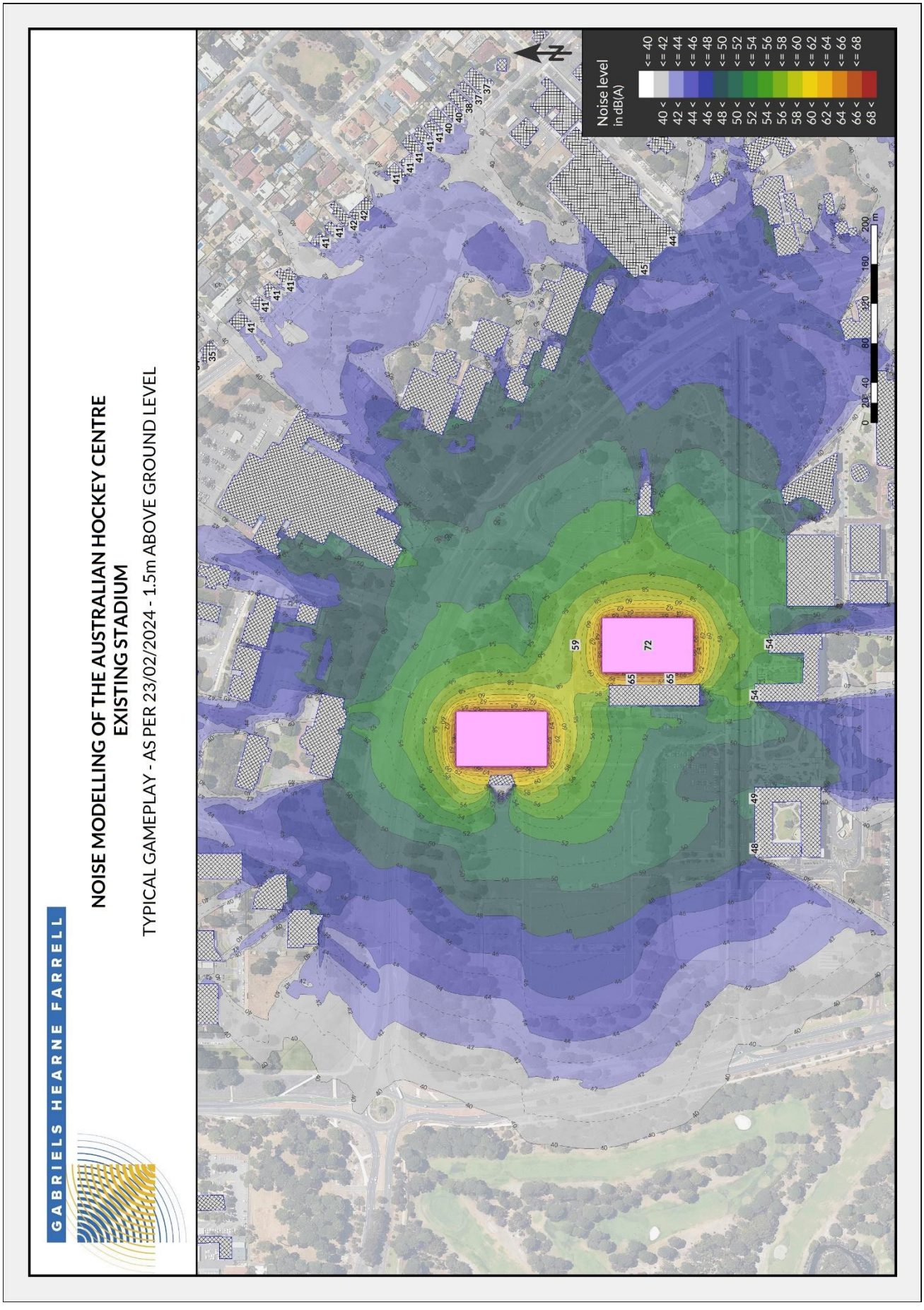



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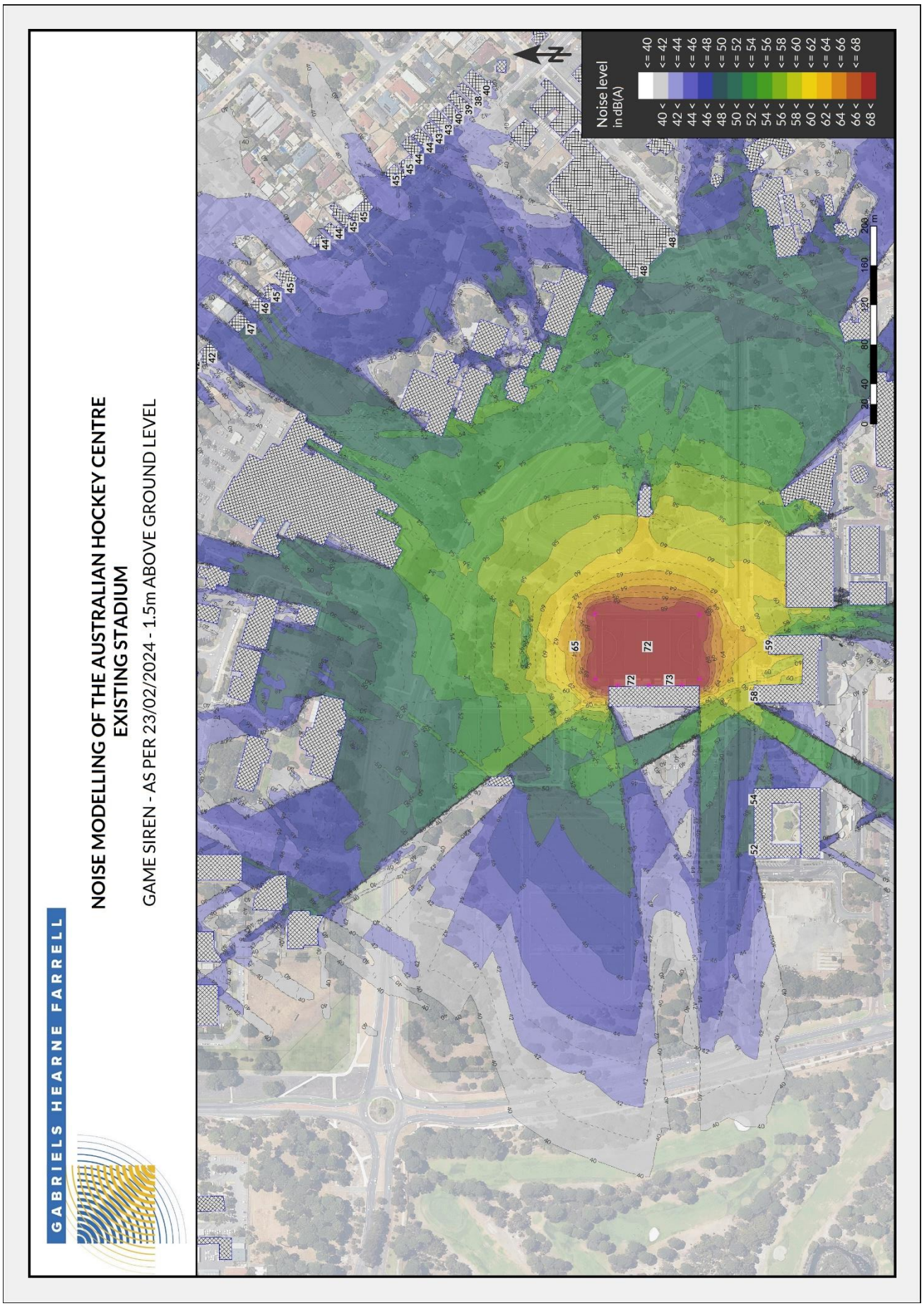



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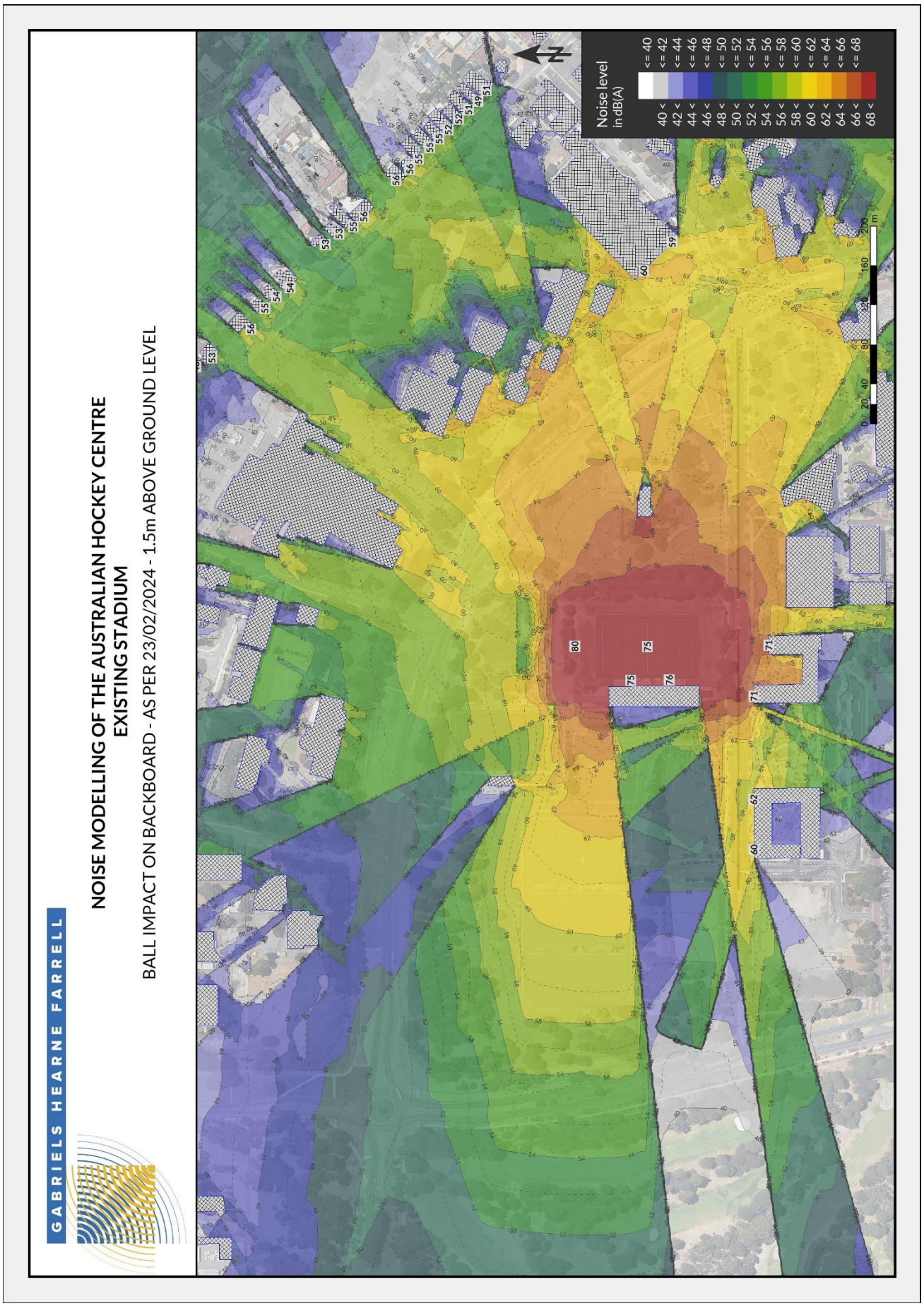



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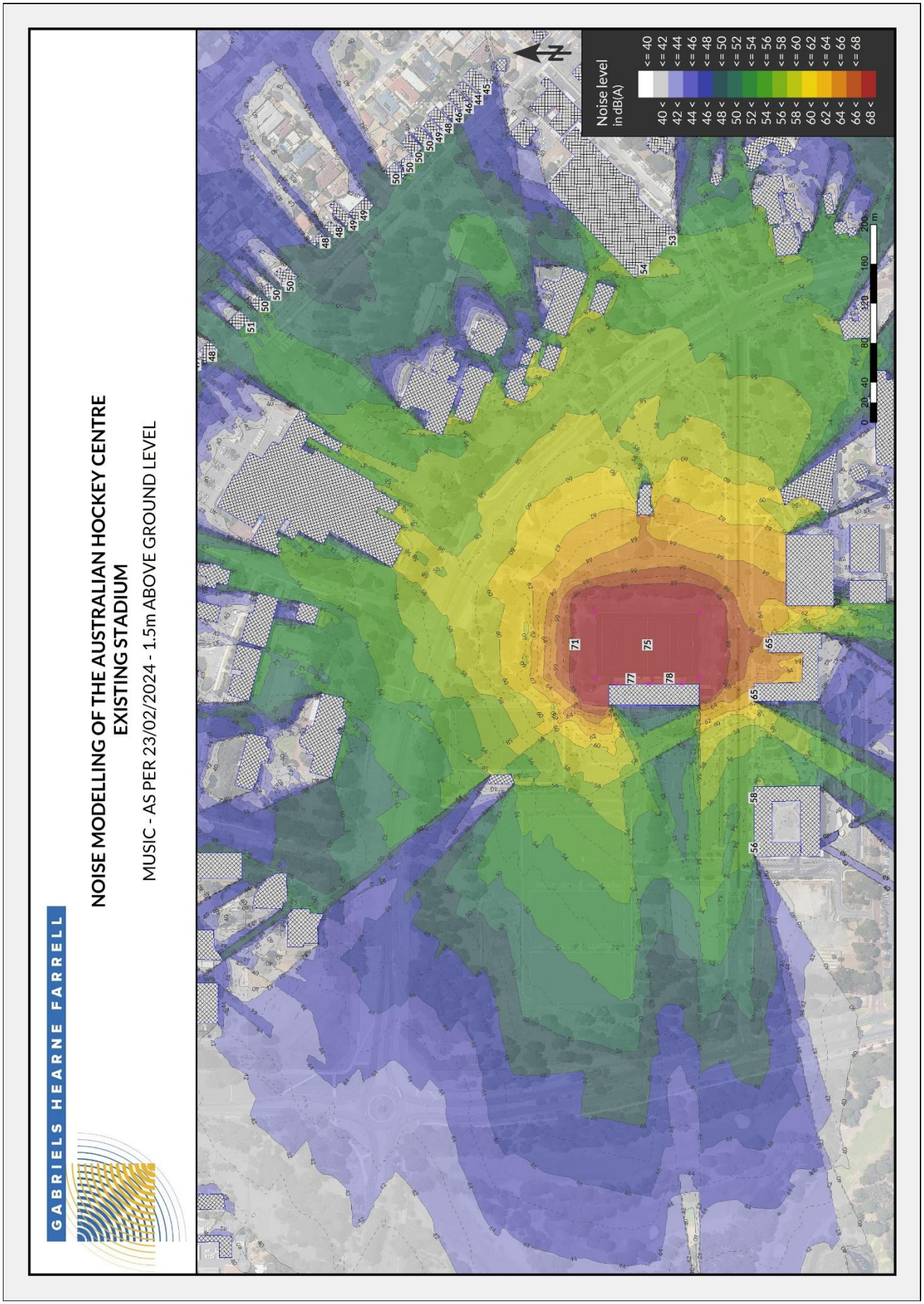



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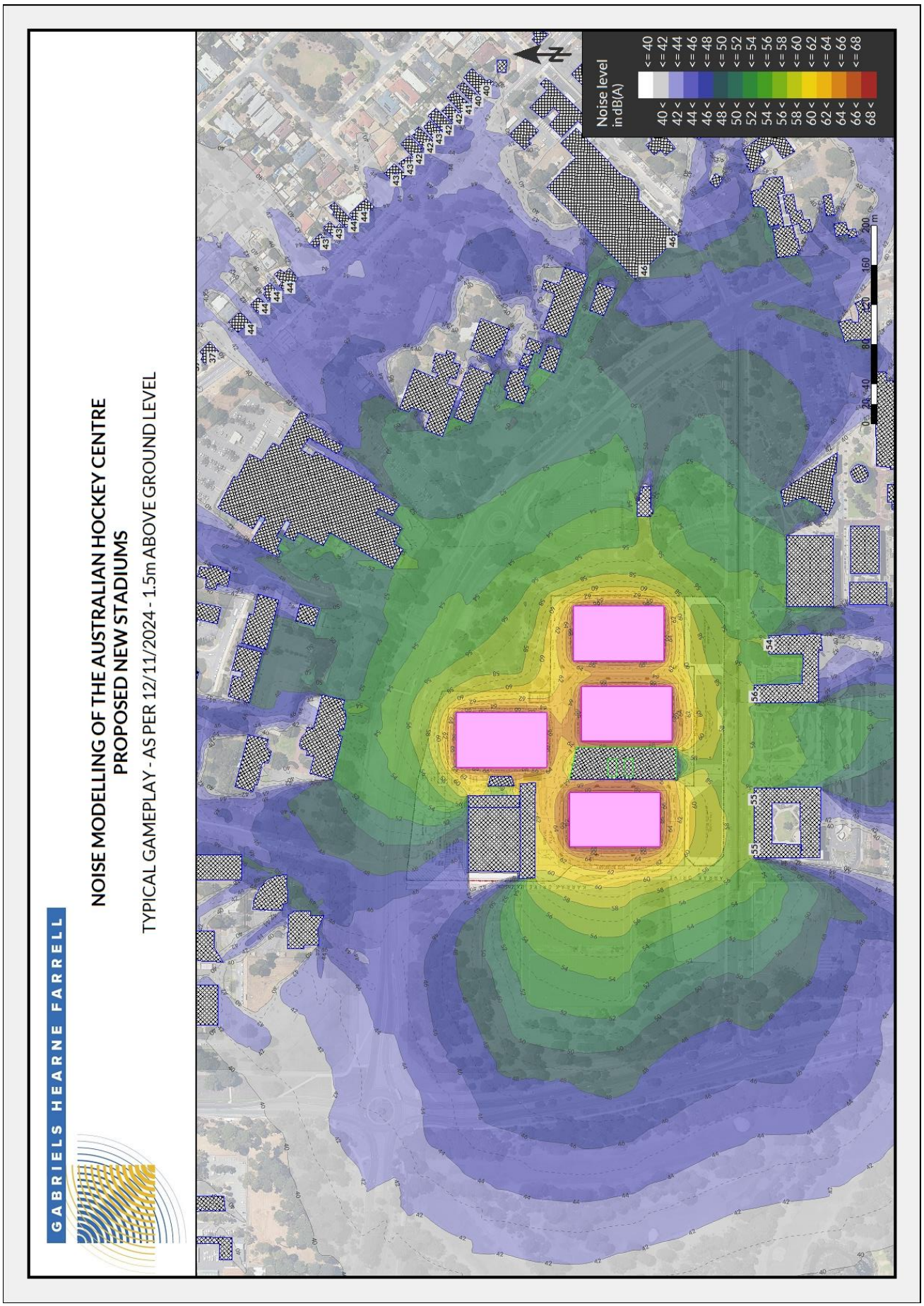



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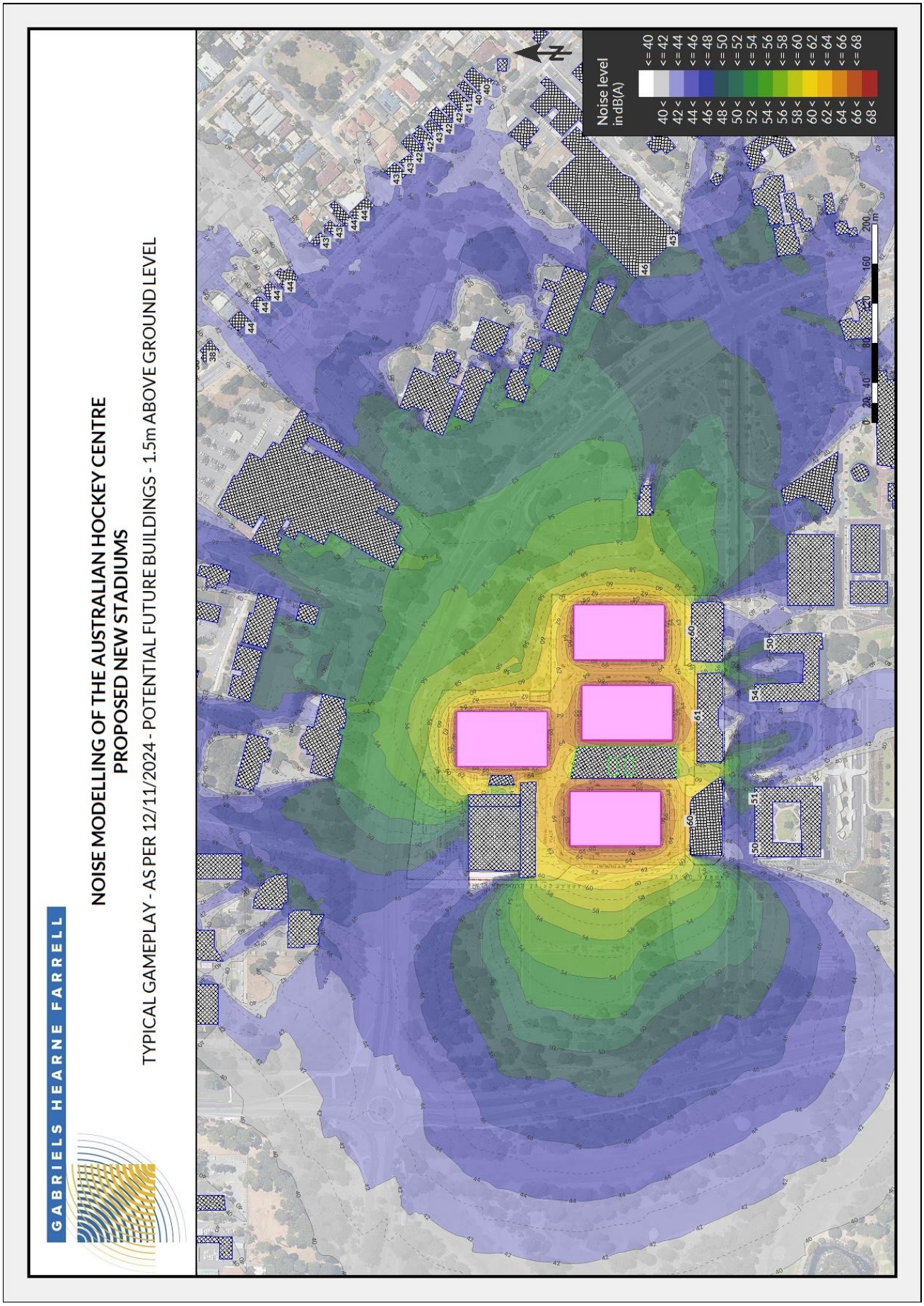



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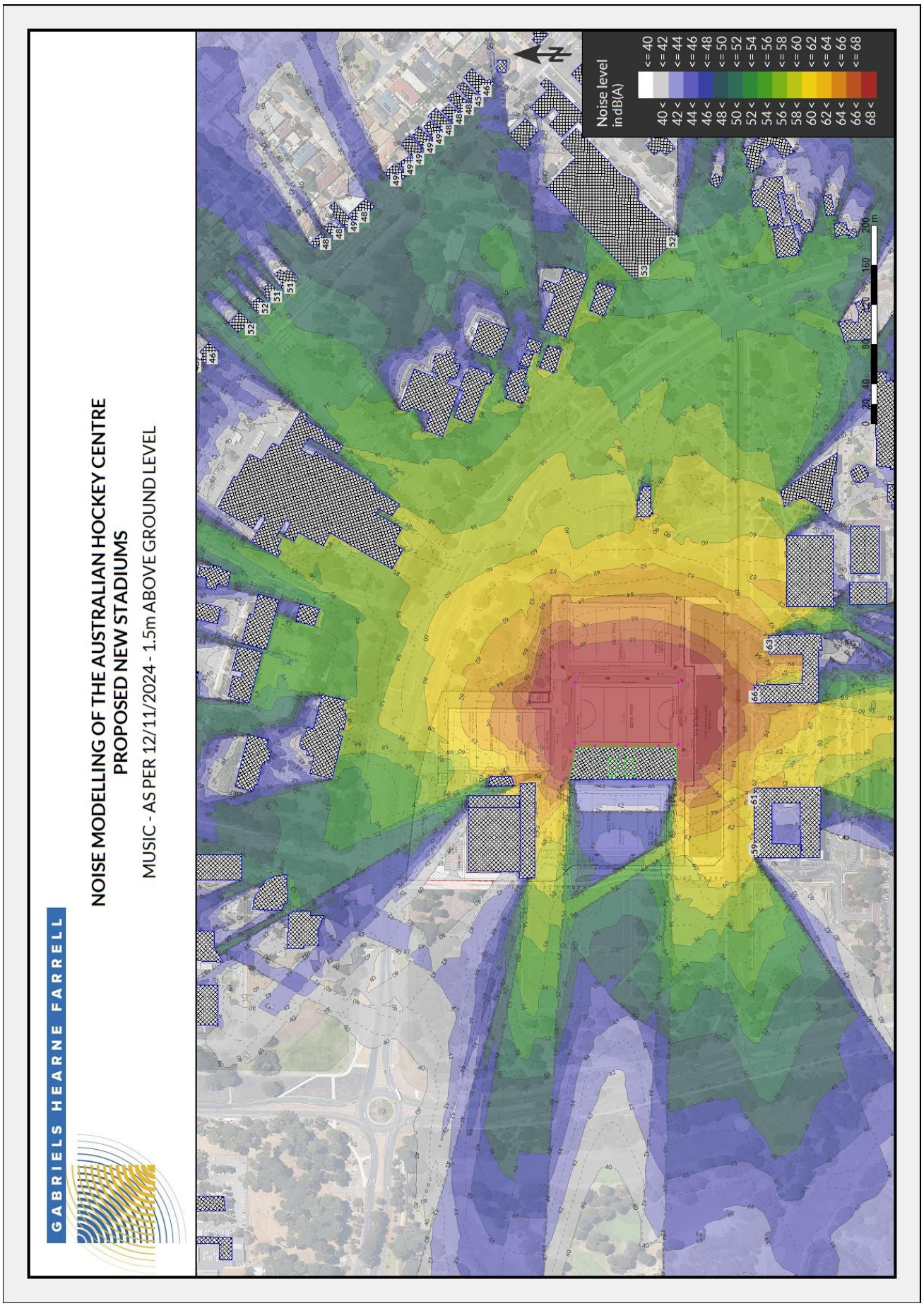



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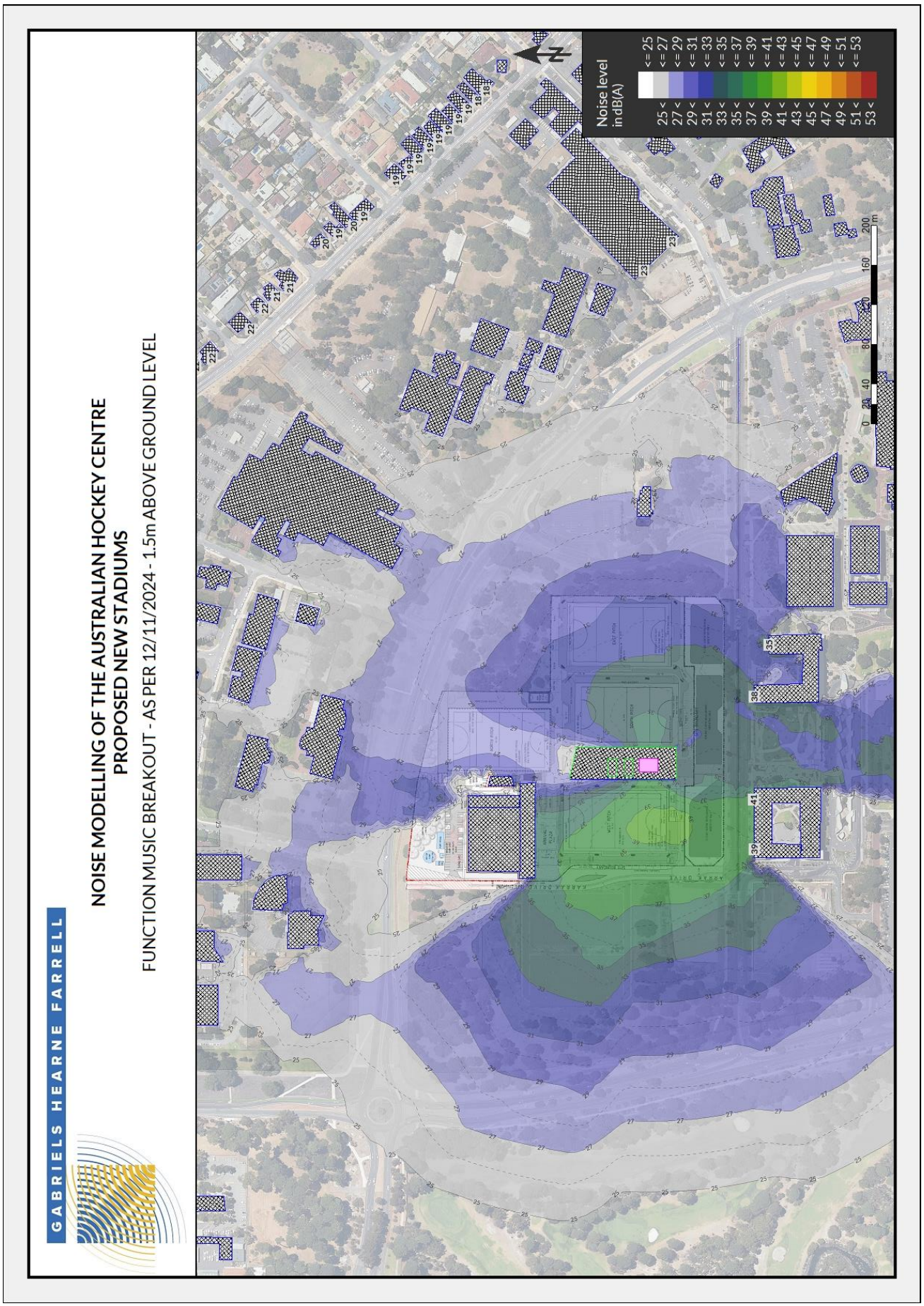



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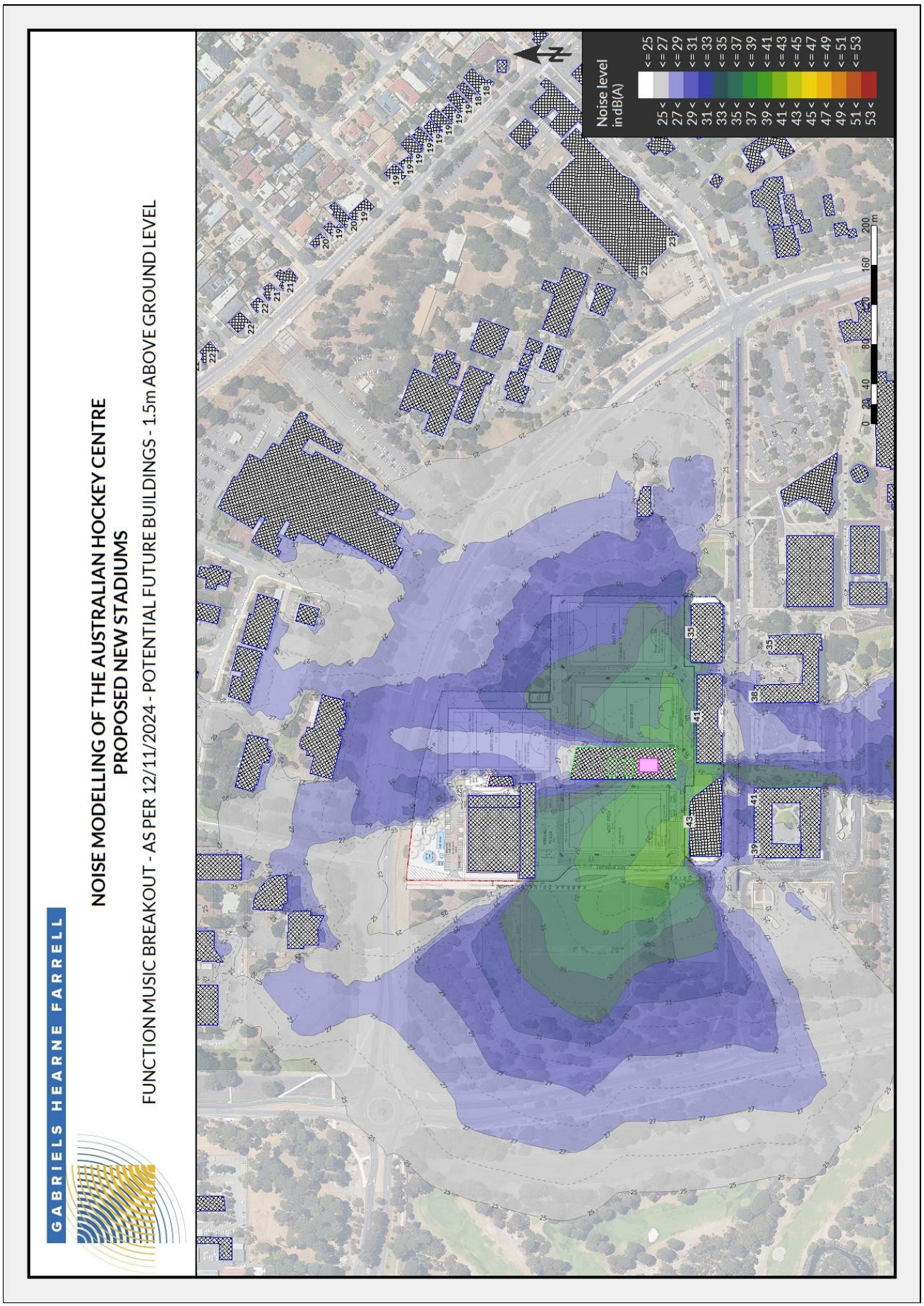



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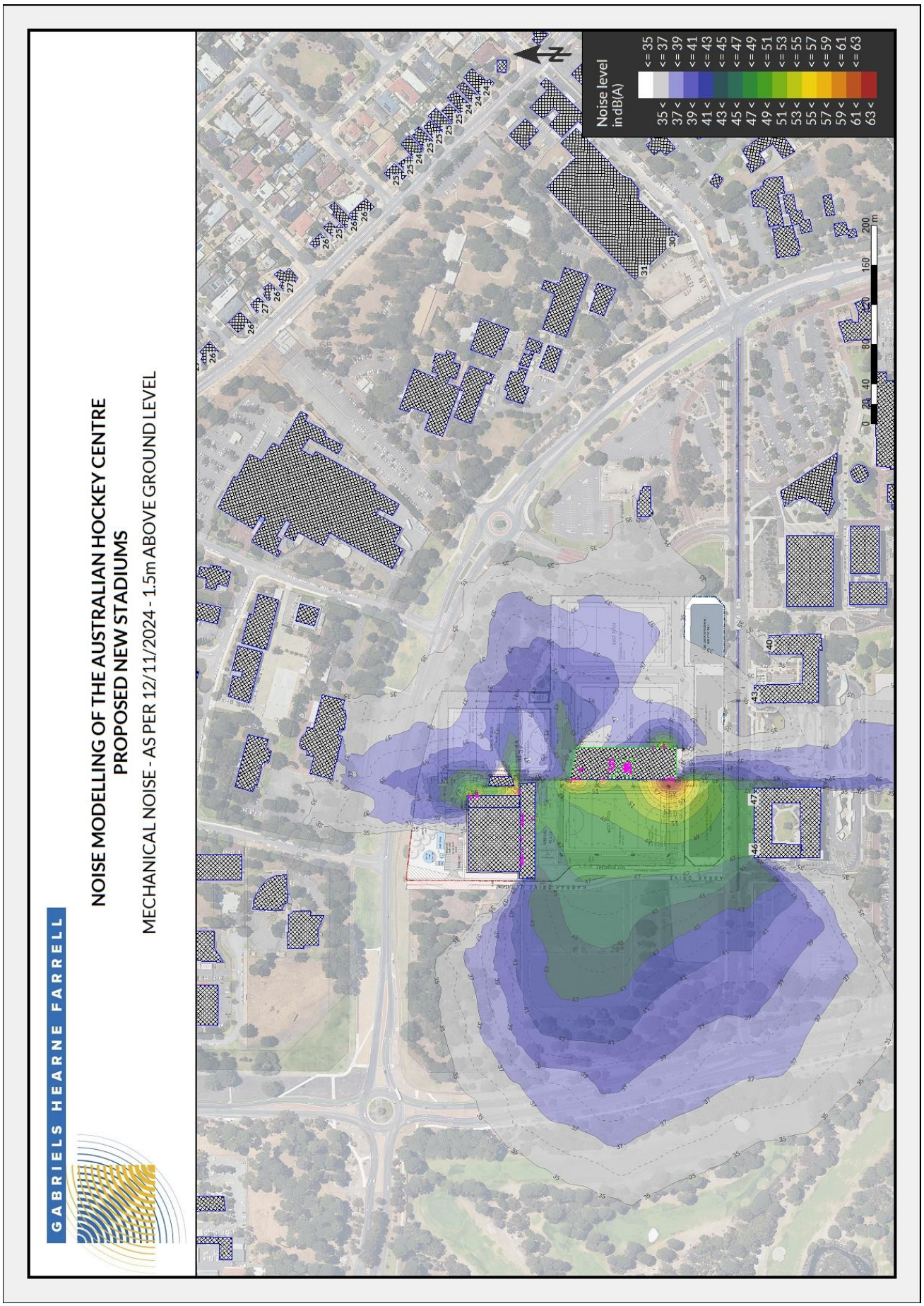



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