Noise and Impact Assessment

Acoustic Logic

Appendix S

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Operational Noise and Vibration Impact Assessment

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1 EXECUTIVE SUMMARY

This noise and vibration impact assessment has been prepared to support a State Significant Development (SSD) Development Application (DA) submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Application (referred to as SSDA16_8175) follows the approval of a Stage 1 SSD DA (SSDA16_7534) in December 2016. The Stage 1 SSDA sets out a Concept Proposal for the redevelopment of the Western Sydney Stadium and future supporting uses. In summary, the Stage 1 Consent includes the following components:

- Concept Proposal for the Western Sydney Stadium, including building envelopes, a new 30,000 seat stadium, 500 surface car parking spaces, access, ancillary infrastructure and landscaping; and

- Detailed works for staged demolition and removal of the existing stadium and associated infrastructure and the Parramatta Swimming Centre.

This report presents an operational noise and vibration assessment for the Western Sydney Stadium Stage 2 submission with specific reference to Secretary's Environmental Assessment Requirement 13. The following noise sources have been addressed:

- Operational noise and vibration emissions associated with the services plant, car park and loading dock has been addressed in Section 4 of this report. The Stadium has the capacity to fully comply with noise emission requirements, which have been formulated in accordance with the NSW EPA Industrial Noise Policy.

- Demolition, excavation and construction noise has been addressed in a Demolition, Excavation and Construction Noise and Vibration Management Plan has been which has been submitted with this application SSDA16_8175.

- Operational noise as a result of sporting events and concerts has been modelled as per the requirements of SEAR 13 and the predicted noise levels have been presented. The predicted noise emissions are generally consistent with the Stage 1 Acoustic Report, with marginal increases in noise emissions for concert noise (2dB(A) L_{eq}) predicted as a result of proposal development. A regularly updated Noise Management Plan is recommended to be developed by the Western Sydney Stadium Trust in accordance with Section 6.5 of this report.

2 INTRODUCTION

This report has been prepared to address Secretary's Environmental Assessment Requirement 13. SEAR 13 is replicated below with the section of this report addressing each item nominated.

"Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction of the Western Sydney Stadium, which details, but is not limited to, the following:

· background noise levels determined in accordance with the NSW Industrial Noise Policy and measured at the most affected sensitive receiver locations;

Background noise levels and the resulting NSW Industrial Noise Policy noise emission criteria have been established and presented within the Stage 1 acoustic report prepared by AECOM with reference 60504744, dated 16 September 2016. The ultimate criteria for general noise emissions are replicated from the AECOM Stage 1 DA report and presented in Section 4.1 of this report.

· predicted noise levels using LAeq, 15minutes, LCeq, 15minutes, LAmax and LCmax noise descriptors;
· marked up orthophoto maps showing the predicted noise levels contours for various proposed activities;

Appendix One presents the SoundPLAN model of event and crowd operational noise emissions from the Stadium. This model includes the $L_{Aeq,15minute}$, $L_{Ceq,15minute}$, L_{Amax} and L_{Cmax} noise descriptors. These noise contour maps include orthophoto maps.

operational details (i.e. weekday and weekend game day/non-game day operation and event modes), including:
- the nature, scale and number of events and activities per year;
- the days and times at which each type of event/activity is proposed to occur;
- details and use of amplified sound equipment and pyrotechnics;
- impacts associated with event setup and breakdown activities and the delivery and removal of any ancillary plant and equipment required; and

Section 6 of this report details the operational details of game days and events with an assessment of noise emissions from these activities.

· a detailed assessment of measures to minimise and mitigate the construction and operational noise impacts on surrounding sensitive receivers and occupiers of land, including surrounding residential properties, educational establishments, places of worship, and fauna, particularly where noise from the operation of the Western Sydney Stadium exceeds the prevailing background noise level by greater than 5dB.

Relevant Policies and Guidelines:

· NSW Industrial Noise Policy (EPA)
· Interim Construction Noise Guideline (DECC)
· Assessing Vibration: A Technical Guideline 2006"

The primary noise emission source addressed within this report is Stadium Event noise emissions. General noise emissions from operation of the Stadium (mechanical and hydraulic services, car park

noise) have been addressed within the Stage 1 DA acoustic report prepared by AECOM with reference 60504744, dated 16 September 2016. A supplementary assessment of these noise sources is presented within this report in Section 4.

A detailed Demolition, Excavation and Construction Noise and Vibration Management Plan has been prepared by this office in accordance with Condition of Consent C2 of Application SSD 7534. A detailed assessment of noise and vibration from construction activities is presented within this report with reference 20170038.4/1302A/R1/TA which has been submitted with this application (referred to as SSDA16_8175).

3 OVERVIEW OF PROPOSED DEVELOPMENT

The application is for 'Stage 2' DA for the detailed design and construction of the stadium. This SSD DA seeks approval for the following components of the development:

- Detailed design of the stadium, public domain and car parking spaces;
- Construction and use of the 30,000 seat stadium including:
  - General Admission Facilities including bars, food and drink stalls, amenities and viewing areas
  - A function centre and kitchen facility
  - Associated Stadium facilities including player and coaching facilities, media and press conference rooms, security and stadium managers' facilities
  - Waste storage and loading dock
- Construction and embellishment of the public domain including:
  - Outdoor sporting and recreation facilities
  - Public plazas and entertainment areas; and
  - General landscaping works
- Provision of up to 500 car parking spaces with vehicle access to the development from O'Connell Street and internal roads for vehicular circulation
- Provision of signage zones, lighting and other ancillary stadium elements
- Pedestrian access and footpath upgrades along O'Connell Street
- Extension and augmentation of physical infrastructure / utilities as required

3.1 BACKGROUND

3.1.1 Stadia Strategy

The stadium is the first project to be delivered under the NSW Government's $1.6 billion Stadia Strategy, the largest investment in sporting infrastructure since the 2000 Olympics. The new Western Sydney Stadium will:

- Be able to cater for bigger crowds, provide an improved game day experience and bring major benefits to the Western Sydney economy;
- Generate approximately 1,200 jobs during construction and between 600 and 900 jobs once operational for sporting event days and major events;
- Cater for a range of sporting and community uses within the precinct.

3.1.2 Concept Proposal (SSDA 16_7534)

Infrastructure NSW (iNSW) on behalf of Venues NSW submitted a State Significant Development Application (SSDA) for the Stage 1 concept proposal and demolition of the existing stadium in July 2016. Consent for the Stage 1 SSDA was granted by the Minister for Planning on 7 December 2016 and includes:

- A maximum total GFA of approximately 60,000 m^2 (excluding the playing pitch) for the stadium development, including:
  - additional seating for approximately 10,000 more spectators in a seating bowl with 30,000 seats, including 27,000 general admission seats and 3,000 corporate seats
  - playing pitch
  - five levels of premium box/terrace, function/lounge offerings and a number of suite offerings
  - flood lighting, stadium video screens and other ancillary fittings
  - additional facilities for team, media, administration and amenity, including:

- police facility and security office;
- players changing rooms;
- ticket gates and ticket boxes;
- media interview rooms;
- green room;
- production suite and joint operation control room;
- event briefing rooms;
- hirers office and patron services offices;
- first aid facilities;
- loading docks for deliveries; and
- food, beverage and retail facilities.

- A maximum GFA of approximately 20,000 m^2 for future development of ancillary uses within the northern corner of the Site
- Transport, parking and accessibility
- Public domain elements
- Landscaping elements throughout the Site.

3.1.3 Design Excellence and Project Tender Phase

Since receiving the development consent for Stage 1, Venues NSW have appointed Lendlease as the contractor for the Stage 2 detailed design and the demolition and construction of the stadium. The tender process also served as a competitive design process in accordance with the Director General's Design Excellence Guidelines and Clause 7.10 of the *Parramatta Local Environmental Plan 2011*.

3.1.4 Site Establishment works Modification

A modification application (MOD 1) was made to the Stage 1 DA pursuant to Section 96(2) of the EP&A Act in February 2017. The modification seeks to expand the approved range of site preparation works to include piling and remediation/earthworks, as outlined below:

- Remediation works comprising the excavation and storage of contaminated materials and bulk excavation. Contaminated materials will be stored on site and capped below ground in accordance with the recommendations outlined in the Remedial Action Plan.
- Piling works which will comprise the driving and drilling of concrete piles to establish foundations for the construction of a stadium located within the Stage 1 building envelope.

The modification application is currently under assessment by the Department of Planning and Environment (DPE) and is awaiting determination.

3.2 SITE DESCRIPTION

The Western Sydney Stadium is located at 11-13 O'Connell Street, within the Parramatta Park on the north-eastern edge of the Parramatta CBD. It is bound to the south and west by the Parramatta Park and the Parramatta River, the Parramatta Leagues Club to the north and O'Connell Street to the east. The Site is located within the City of Parramatta local government area (LGA).

A locational context plan is provided at **Figure 1** below.

Figure 1 – Site context Plan

The site boundary is illustrated in **Figure 2** below.

Figure 2 – Site Aerial Plan

3.3 NEAREST POTENTIALLY AFFECTED RECEIVERS

A survey of nearest potentially affected sensitive commercial and residential receivers has been conducted and the following locations have been identified:

- O'Connell Street Residential Properties,
- Parramatta Leagues Club,
- Queens Road and Park Avenue Residential Properties,
- Lichen Place and Parkside Lane Residential Properties,
- Parramatta CBD Commercial Properties,
- St Patricks Cathedral,
- Our Lady of Mercy College, and
- Parramatta Park

4 GENERAL OPERATION NOISE (EXCLUDING EVENT NOISE)

The following general Stadium noise sources are assessed within this section:

- Car park noise emissions;
- Loading dock noise emissions; and
- Services noise emissions;

Noise as a result of increased traffic on public roads (O'Connell Street and Victoria Road) has been assessed in accordance with the NSW Road Noise Policy in Section 5.4 of the AECOM Stage 1 report 60504744, dated 16 September 2016. As the current proposal would not alter the expected number or character of vehicle movements, and the previous assessment found traffic noise emissions to be compliant, noise from increased traffic volumes is not addressed further within this report.

Assessment of noise emissions as a result of Stadium concert and sporting event noise is presented in Section 6. Section 4 exclusively addresses noise emissions from general Stadium operation (services plant, car parks and loading dock).

4.1 NOISE EMISSION CRITERIA

Rating background noise levels and the resultant noise emission criteria for the general operational noise sources associated within the Stadium has been developed and presented within the approved AECOM Stage 1 report 60504744, dated 16 September 2016. These assessment criteria have been developed based on the requirements of the NSW Environmental Protection Authority Industrial Noise Policy, and the project specific noise goals are summarised below:

Table 1 - Summary of Environmental Noise Emission Criteria for Residential Receivers

Location	Period	Intrusiveness criteria dB(A) $L_{eq\ (15\ min)}$	Amenity criteria dB(A) $L_{eq\ (period)}$
O'Connell Street Residential Properties (northeast)	Day (7am – 6pm)	59	60
	Evening (6pm – 10pm)	57	50
	Night (10pm – 7am)	52	45
Queens Road Residential Properties (west)	Day (7am – 6pm)	45	60
	Evening (6pm – 10pm)	44	45
	Night (10pm – 7am)	42	40
Lichen Place Residential Properties (south)	Day (7am – 6pm)	48	60
	Evening (6pm – 10pm)	47	45
	Night (10pm – 7am)	43	40

Table 2 - Summary of Environmental Noise Emission Criteria for Non-Residential Receivers

Location	Occupancy	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Our Lady of Mercy College	School Classroom	Noisiest 1-hour	35 (internal)
St Patricks Cathedral	Places of worship	When in use	40 (internal)
Parramatta Park	Passive recreation area	When in use	50
Old Kings Oval	Active recreation area	When in use	55
Parramatta Leagues	Commercial	When in use	65

Table 3 – Sleep Disturbance Criteria for Car Park and Loading Dock Operation Between 10pm and 7am

Location	Sleep Disturbance Screening Criteria (dB(A) L_1	Sleep Disturbance Awakening Reaction Criteria dB(A) L_{max}
O'Connell Street Residential Properties (northeast)	62	65 (external)
Queens Road Residential Properties (west)	52	65 (external)
Lichen Place Residential Properties (south)	53	65 (external)

4.2 NOISE EMISSION ASSESSMENT (CAR PARK, LOADING DOCK AND SERVICES PLANT)

The operational noise emissions as a result of car park, loading dock and services plant operation will be assessed below. The assessment of the following noise sources will be undertaken:

- Noise from the use of loading dock in the southwest corner of the stadium (truck manoeuvring and material handling) will be assessed with reference to the Industrial Noise Policy criteria presented in Section 4.1.
- Noise from the use of car parks (vehicle manoeuvring, cars starting, doors closing) will be assessed with reference to the Industrial Noise Policy.
- Noise from services plant will be assessed with reference to the Industrial Noise Policy.

4.2.1 Loading Dock & Car Parks

4.2.1.1 General Operation

As there are no specific details as to the operation of the loading dock at this stage of the project, typical operations from similar developments (including truck types, truck movements & numbers, etc) have been used to assess potential impacts on surrounding development.

Noise associated with the use of the loading dock and car park will likely consist of:

- Trucks moving into or out of the loading dock;
- Materials handling within the loading dock; and
- Cars manoeuvring and entering / exiting car parks

Noise generated on the proposed site will be assessed with reference to the EPA Industrial Noise Policy criteria presented in Section 4.1. Predictions will be made based on the following data/assumptions:

Table 4 – Loading Dock Noise Source Data

Noise Source	Noise Level (sound power level) dB(A) L_{eq}
Truck engine (semi-trailer driving at approx 5km/h)	105
Materials handling	90
Car manoeuvring (approx 10km/h)	82

- Relative position of noise source and noise receiver, taking into account distance attenuation, air absorption, adverse weather and noise screening (where appropriate).

- It is assumed it takes approximately one minute for a truck to manoeuvre into or out of the loading dock to O'Connell Street.

Operational noise levels as a result of the operation of the loading dock are predicted and assessed against relevant criteria from Section 4.1 below. Operational noise levels have been assessed against the EPA night period noise criteria for residential receivers as this period has the most stringent criteria for the assumed operating hours of the loading dock.

Table 5 – Noise Emissions - Loading Dock / Car Park - Night

Receiver Location	Noise Source	Predicted Noise Level – dB(A)$L_{eq(period)}$	Amenity Criteria Night dB(A)$L_{eq(9\ hour)}$	Intrusiveness Criteria Night dB(A)$L_{eq(15\ min)}$	Complies
O'Connell Street Residences	Truck manoeuvring to/from loading dock	30dB(A)L_{eq}	45dB(A)L_{eq}	47dB(A)L_{eq}	Yes
	Materials Handling within loading dock	<20dB(A)L_{eq}	45dB(A)L_{eq}	47dB(A)L_{eq}	Yes
	Cars manoeuvring; entering / exiting	40dB(A) L_{eq}	45dB(A) L_{eq}	47dB(A)L_{eq}	Yes
Queen Street Residences	Truck manoeuvring to/from loading dock	<20dB(A)L_{eq}	40dB(A)L_{eq}	42dB(A)L_{eq}	Yes
	Materials Handling within loading dock	<10dB(A)L_{eq}	40dB(A)L_{eq}	42dB(A)L_{eq}	Yes
	Cars manoeuvring; entering / exiting	<20dB(A)L_{eq}	40dB(A)L_{eq}	42dB(A)L_{eq}	Yes
Old Kings Oval	Truck manoeuvring to/from loading dock	49dB(A) L_{eq}	55dB(A) L_{eq}	N/A	Yes
	Materials Handling within loading dock	34dB(A) L_{eq}	55dB(A) L_{eq}	N/A	Yes
	Cars manoeuvring; entering / exiting	50dB(A)L_{eq}	55dB(A) L_{eq}	N/A	Yes

All operational noise associated with the use of the loading dock and car parks is predicted to comply at nearest affected receivers.

Compliance at the locations listed within the table above demonstrates compliance at all receivers.

4.2.1.2 Short Term Noise Events (Sleep Arousal)

As it is anticipated that the loading dock will potentially operate between the hours of 10pm and 7am an assessment of potential noise emissions from trucks arriving and operating during this period will be conducted. It is envisaged that the loudest typical short term noise event will be the discharge of the air pressure valve in a truck braking system, which has been measured by this office to typically generate a noise levels of 110dB(A)$L_{1(1min)}$.

It is also envisaged that the car park may be used by staff or patrons between the 10pm and the 7am period, and as such, an assessment of the impact of car doors shutting (which represents the loudest event associated with this activity) has been undertaken. Car doors slamming has been measured by the office to be 90dB(A) $L_{1(1min)}$.

All predictions take into account the relative position of noise source and noise receiver, distance attenuation, air absorption, adverse weather and noise screening (where appropriate).

Predicted noise levels are as follows:

Table 6 - Sleep Arousal Emergence Assessment

Receiver Location	Noise Source	Predicted Noise Level dB(A)$L_{1(1min)}$	Sleep Disturbance Screening Criteria dB(A) $L_{1(1min)}$	Awakening Reaction Test Required?
O'Connell Street Residences (northeast)	Brake Air release valve from truck within southwest loading dock	44	62	Compliant - No further assessment required
	Car door slamming northern car park	37	62	Compliant - No further assessment required
Queen Street Residences (west)	Brake Air release valve from truck within southwest loading dock	41	52	Compliant - No further assessment required
	Car door slamming northern / southern car park	<25	52	Compliant - No further assessment required
Lichen Place Residences (south)	Brake Air release valve from truck within southwest loading dock	38	53	Compliant - No further assessment required
	Car door slamming southern car park	<25	53	Compliant - No further assessment required

All short term noise events associated with the operation of the car parks and the loading dock are predicted to fully comply with the sleep disturbance screening criteria.

4.3 MECHANICAL SERVICES NOISE

Detailed acoustic design of mechanical plant cannot be undertaken at approval stage, as plant selections and locations are not finalised. A detailed assessment of services plant will be conducted upon selection of services plant and finalisation of equipment locations. However, an indicative assessment of primary plant items is presented below.

Primary noise emitting plant items will include:

- Cooling towers (located in Stadium perimeter plant deck);
- Air handling plant (air handling units, supply/exhaust/outside air fans);
- Chillers; and
- Emergency diesel generators.

With respect to the above, we note:

- Cooling towers
    - To ensure compliance with INP requirements during day, evening and night time:
        - All cooling towers are to have variable speed drives, to allow for reduced fan speed during periods of low load. Typically, a fan speed of no more than 50% would be expected at night time.
        - Acoustic screening around the cooling towers may be required (using FC sheet or similar).
- Emergency power back-up generators.
    - Proposed emergency generator will be located within a plant room on the Stadium perimeter.
    - In the event that the generator is located within a plant room, acoustic attenuators will be required to the plant room air inlet and air discharge (indicatively 1.8m long, 45% open area attenuators). Additionally, the exhaust gas discharge will require a muffler such that it creates a noise level of no more than 80dB(A) at 1m distance.
    - In the event that the generator comes with a proprietary acoustic enclosure, the length of attenuators can be reduced/removed.
    - Detailed acoustic performance of plant room (or any acoustic enclosure) to be finalised following final generator selection/location.
- Chillers
    - Chillers should be located in plant rooms with any external ventilation opening/louvre area minimised, and fitted with acoustic louvres/attenuators.
    - Light weight cladding to plant room walls and ceiling will potentially require internal plasterboard sheeting to ensure noise breakout through wall/roof are compliant with NSW INP requirements. Final plant room building shell design to be conducted following final chiller section and plant room location.

- Fans and air-handling units

    - Air handling units do not typically require substantial acoustic treatment to ensure compliant noise emissions at nearby properties.

    - Air handling unit exhaust and outside air ducting (both of which are typically ducted to outside) are to be acoustically reviewed following layout design by mechanical engineer/contractor to determine whether internal lining to this ductwork is required.

    - Major fans (typically with a sound power over 90dB(A) – such as kitchen exhaust, major toilet exhaust and major relief air fans) will require acoustic treatment. This treatment would include internal lining to any external ductwork. Potentially acoustic treatment of fan casing will also be required. Review of all external fans (including fans ducted to external locations) must be conducted once selected to ensure compliant noise emissions to external areas.

As detailed within this section, predicted noise levels from the operation of the Stadium loading dock, car park and services plant demonstrate that the Stadium has the capacity to fully comply with noise emission objectives.

Cumulative assessment of both services plant noise with other noise sources is recommended when conducting acoustic design of the services plant items. This is particularly important for services plant near the north-eastern property boundary, where there will be the addition of noise emissions from the northern car park to the receivers on O'Connell Street.

Full compliance with Industrial Noise Policy acoustic criteria as set out in Section 4.1 is achievable, with a detailed acoustic review of services plant item to be undertaken once plant is selected, and acoustic treatments similar to those outlined above are adopted.

5 DEMOLITION, EXCAVATION AND CONSTRUCTION NOISE & VIBRATION

A Demolition, Excavation and Construction Noise and Vibration Management Plan has been prepared by this office in accordance with Condition of Consent C2 of Application SSD 7534. A detailed assessment of noise and vibration from construction activities is presented within this report with reference 20170038.4/1302A/R1/TA which has been submitted with this application (referred to as SSDA16_8175).

6 STADIUM EVENT AND CROWD NOISE

The section of the report addresses noise emissions from concerts and sporting events to be held within the stadium. Specifically, this section presents:

- A discussion of applicable criteria
- The proposed indicative operational event schedule
- Applicable noise emission goals for events
- A SoundPLAN noise contour model of event noise
- Noise management strategies for events.

6.1 OPERATIONAL SCHEDULE

A complete description of the Stadium proposal is presented in Section 2 of this document. The proposed indicative events schedule as per the Western Sydney Stadium Project Brief is presented below:

Table 7 - Indicative Annual Events Schedule

	Telstra Premiership (3 clubs)	National Rugby Champs	Super Ruby	FFAA League	FFA Women's Leagues and Internati onal	Captain's runs	Concert	Total
Jan				2	1	3	1	**7**
Feb				2		2		**4**
March	4			2		6		**12**
Apr	4					4		**8**
May	4		1			4		**8**
Jun	4					5		**10**
Jul	4					4		**8**
Aug	4	1				5		**10**
Sep	4	1		2		4		**8**
Oct	3	1		2	1	6		**12**
Nov				2	1	3	1	**7**
Dec						3	1	**7**

6.2 DISCUSSION OF APPLICABLE NOISE EMISSION GOALS

Clause 90 of the *Protection of Environment Operations (POEO) (General) Regulation 1997* makes the EPA the responsible authority for environmental noise emissions from outdoor concerts, festivals and cinematic or theatrical events using sound amplification equipment with 200 or more people. Specifically, Clause 90(d) nominates the EPA as the regulatory body for the trust land within the meaning of *Parramatta Stadium Trust Act 1998.*

However, the *Protection of Environment Operations (POEO) (General) Regulation 1997* does not provide any clear noise emission goals for the concerts or sporting events. The difficulty in establishing noise emission goals for stadiums is noted within the EPA Noise Guide for Local Government which states:

> *"There are no hard and fast rules to apply when developing noise limits for these types of events, and what is appropriate will depend upon the particular circumstances. Typically, unless the venue is very remote, it is not possible to establish noise limits that prevent annoyance at every residence. However, noise limits can prevent the noise levels from being any higher than necessary.*

In the determination of noise emission goals for sporting events and concerts held within the Stadium, a study of similar facilities with comparable design and operational principles has been conducted. The study concluded that, with respect to acoustics, direct comparisons can be made between the current Western Sydney Stadium design and proposed operation, and that of Allianz Stadium.

The two stadiums are comparable in that:

- Both have a similar proposed crowd capacity (30, 000 for WSS and 42,000 for Allianz);
- The roof junction with the perimeter of the top seating tier on both stadiums have openings for ventilation and light (which is a source of operational noise emissions);
- WSS and Allianz have central open apertures over the pitch;
- Both stadiums and their respective potentially affected noise receivers are located in similar ambient acoustic environments; and
- The stadiums have almost identical operating principles, in that the stadiums will primarily be a venue for sporting events, with periodic concerts and other events.

Given the similarities, and the fact that Allianz has a history of operating successfully in proximity to residential properties, it is proposed that the Allianz Stadium noise management goals as presented within the Allianz Stadium Noise Management Plan (January 2017, prepared by ERM) be established as noise management levels for Western Sydney Stadium.

As a result, the following noise management levels have been developed for the surrounding residential properties:

Table 8 – Western Sydney Stadium Noise Emission Management Levels

Event	Compliance Location	Noise Source	Noise Management Level dB(A) L_{Amax}	Noise Management Level dB(A) L_{Cmax}
Sporting Event	Surrounding Residential Receivers	Amplification Equipment	60	N/A
Concerts & Sound Tests	Surrounding Residential Receivers	All	80	100

Non-residential sensitive receivers in the vicinity of the site, such as the Our Lady of Mercy College, will not normally be impacted by concert and sporting event noise given that concerts and sporting events are almost exclusively night-time or weekend events. However, the noise management controls and strategies detailed within this Section will maintain the acoustic amenity of these properties.

6.3 HOURS OF EVENTS

The following hours of operation are envisaged for the Stadium based on the Stage 1 DA documentation and similar facilities:

Table 9 – Expected Hours of Operation

Event / Activity	Hours of Operation	Comments	Number of Events
Concerts	12:00pm – 11:30pm	Extension of hours to midnight may be considered acceptable if concert delays are outside of the control of the WSS Trust.	Three concerts per calendar year as per the Western Sydney Stadium Project Brief
Sound tests	10:00am – 19:00pm	N/A	Sound tests associated with concerts should be restricted to the day of the proposed concert
Pyrotechnics	10:00am – 22:30pm	Extension of hours of fireworks to 12:15am may be considered to be acceptable on NYE given the cultural significance.	Separate applications should be submitted to the EPA for each event proposing the use of aerial pyrotechnics to be ignited or erupt above the roof line.
Sporting Events	10:00am – 22:00pm	Extension of hours to 22:30pm may be considered acceptable if delays are outside of the control of the WSS Trust.	Indicative number of sporting events is as per Table 7 of this report which has been sourced from the Western Sydney Stadium Project Brief

It is noted that the above hours of operation are indicative and would be developed in the preparation of the Noise Management Plan undertaken by the operator. See Section 6.5.1.

6.4 SOUNDPLAN MODELLING

A noise model of the Stadium and the surrounding properties has been developed to predict noise levels as a result of concerts and crowd noise. Noise predictions have been conducted using the SoundPlan noise modelling software. Noise propagation was determined using ISO 9613-2:1996 "Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation" noise propagation standard.

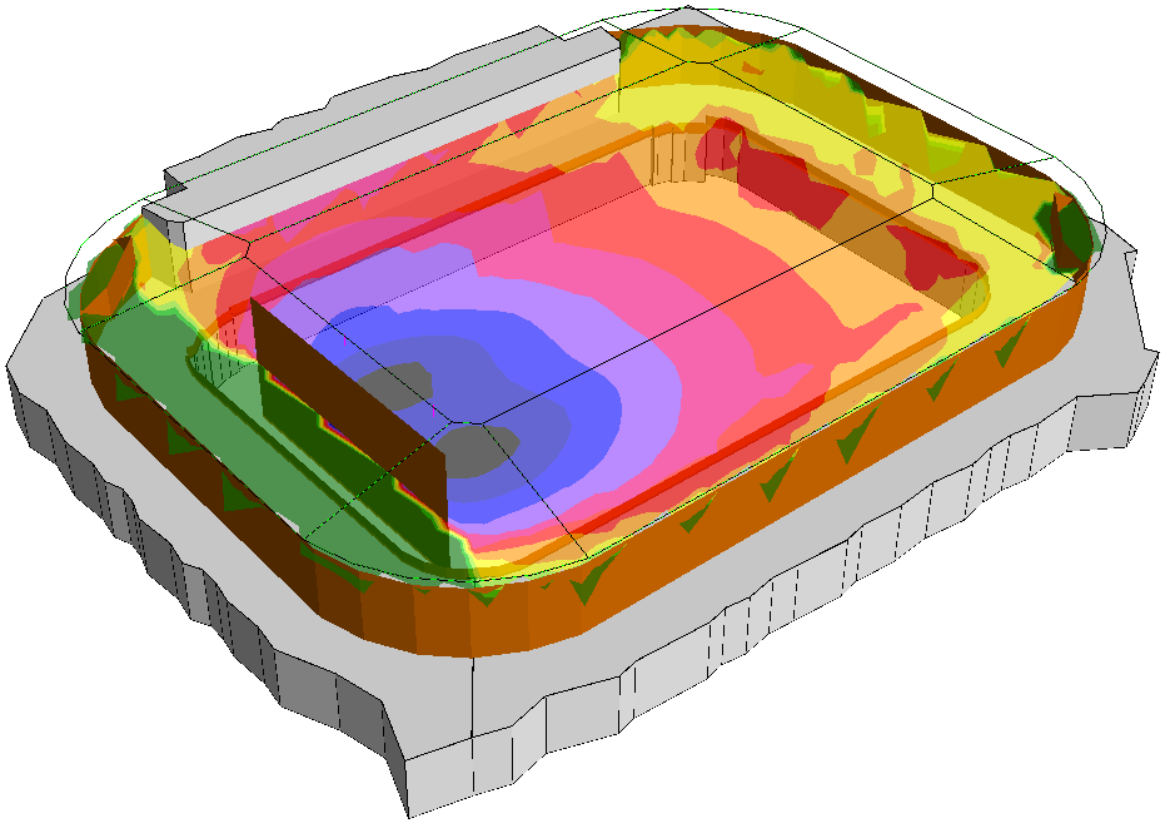


Figure 3 – SoundPLAN Western Sydney Stadium Noise Model

Source noise levels for concerts and crowd noise have been sourced from the Stage 1 AECOM acoustic report. The rock music noise model was simulated using two line arrays with sound power level sufficient to provide a sound pressure level between 95-105dB(A) L_{eq} across the seating area.

Crowd noise was simulated by normalising area sources across the seating area to achieve a sound pressure level of 94dB(A) L_{eq} at the source height (i.e. plane source height at 1.2m above seating FFL to achieve 94dB(A) L_{eq}.

As noted within the Stage 1 AECOM acoustic report, these are conservatively high levels which are unlikely to be sustained for more than 15 minutes and are representative of absolute worst case scenarios. Additionally, it a conservative assumption that these source noise levels will be maintained across the entire crowd area, and in a typical concert arrangement, noise levels will be lowered at the rear of the tiered seating area.

6.4.1 Noise Modelling Results and Discussion

Appendix One details the results of the noise modelling of concerts and sporting event crowds.

6.4.1.1 Sporting Event / Crowd Noise

Crowd noise is predicted to be 64dB(A) L_{eq} at the nearest receivers to the northeast of the stadium at 44 O'Connell Street (See Appendix One). This is consistent with the AECOM Stage 1 DA Acoustic report which also predicts 64dB(A) L_{eq} at the worst affect receivers. Additionally, as noted in the Stage 1 acoustic report, this predicted noise level of 64dB(A) L_{eq} is consistent with current sporting event noise emissions from the existing Pirtek Stadium.

The consistency between the current noise emissions for sporting events and predicted future emissions is expected, even with a proposed increase in crowd capacity from 22,000 to 30,000. This is due to the fact that nearest receivers of noise on O'Connell Street currently have a direct line of sight to the crowd in Pirtek Stadium western seating tier, where the new stadium design provides inherent screening with the northern seating tier and roof structure.

6.4.2 Concert Noise Emissions

The predicted noise emissions as a result of rock concerts are presented in Appendix One. As discussed in Section 6.4, these are conservative predictions representing a "worst case scenario" and typical concerts will emit lower noise levels.

The noise emission model predicts a noise level of 78dB(A) L_{eq} at the nearest receivers of noise on O'Connell Street. The Stage 1 AECOM Acoustic Report predicts 76dB(A) L_{eq} at the nearest receivers on O'Connell Street, which is 2dB(A) L_{eq} less than the current model. This is as expected, as noted within Section 5.3.1 of the Stage 1 Acoustic Report:

> *"It should be noted that at this concept stage of the stadium design no details regarding penetrations in the perimeter walls for ventilation or otherwise are available. Should penetrations to the perimeter walls or roof be introduced during later development of the design, noise emissions from the stadium may increase.*

As noted above, marginal increases in the predicted noise emissions from the original model were expected as the original model was based on a concept without detailed information regarding the required openings in the building shell.

6.5 COMPLIANCE WITH THE STAGE 1 ACOUSTIC REPORT

6.5.1 Noise Management Plan

As per the recommendations of the Stage 1 AECOM report, it is recommended that the Western Sydney Stadium Trust develop a Noise Management Plan which is regularly updated after measurements of concerts and events. The requirements of this Noise Management Plan have been outlined within the approved Stage 1 AECOM acoustic report and are replicated below. It is noted that the noise emission goals / management levels formulated in Table 8 of Section 6.2 should be adopted in the preparation of the Noise Management Plan and the noise mitigation strategies.

Preventative management

Requirements on limits to the days and times of events

Restrictions to the number of events per year will provide respite measures for residential receivers. Limiting the times of major event to daytime and / or evening hours when the community is least sensitive to noise will minimise the disturbance to the community and prevent sleep disturbance to surrounding residences.

Requirement for notice to consent authorities

Current NMP conditions require Venues NSW to notify consent authorities of details of upcoming events. These requirements include notification of:

- *Environmental Protection Authority; and*
- *Parramatta City Council's Development Services Unit*

It is recommended the notice to the consent authorities advise of:

- *a nature (description) and size of (expected crowd attending) an event;*
- *a date and time (duration) of the event, including preliminary practice sessions and/or rehearsals;*
- *Western Sydney Stadium (WSS) Hot Line (telephone number) for lodgement of noise complaints; and*
- *a name and telephone number of the Venue Manager, who will be responsible for compliance with noise limits.*

Notice to the community including residents and businesses

Similarly, current NMP conditions require Venues NSW to notify all residential premises within 1 kilometre of Parramatta Stadium and the residential premises listed in the NMP of any planned noisy events by a letterbox drop at least 60 days before the events.

It is recommended the notice to the residential and commercial premises advise of:

- *a nature (description) and size of (expected crowd attending) a major event;*
- *a date and time (duration) of the event, including preliminary practice sessions and/or rehearsals;*

- *A Hot Line (telephone number) for lodgement of noise complaints;*

- *the Noise Management Plan available on agency's website; and invite post-event feedback.*

Setup of sound amplification systems

An optimal setup of sound amplification systems should be sought in consultation with suitably qualified acoustic consultants in order to minimise noise impacts at potential worst affected receivers.

Sound systems may also include noise limiters to prevent exceedance of established noise limits at nearby receivers, or trigger levels as indication of exceedances of noise limits. The setting of these systems will require consultation with suitably qualified acoustic and AV consultants.

Reactive management

Noise monitoring requirements

Requirements for noise monitoring during noisy events should be outlined in the NMP, including:

- *Location of noise measurements*

- *Instrumentation*

- *Monitoring times*

- *Noise descriptors*

- *Personnel qualifications*

An outline to reporting requirements should also be included, outlining information required in the report, such as confirmation of conditions being met.

Complaints handling

During noisy events a hotline should be made available to the public for lodgement of noise complaints. The hotline should notify without delay the acoustical consultants carrying out measurements of noise, who should immediately follow complaints with noise measurements carried out at locations of complainants.

A register of all noise complaints received during noisy events should be maintained.

Review mechanism

Community feedback

Occupiers of the residential and commercial premises should be encouraged to express their opinion on the impact of noise emanating from noisy events held at WSS and provide suggestions on minimising the impact through letter box drops. The general public should similarly be encouraged through a website and in local newspapers.

Noise Management Plan publicly available

The NMP should be made publicly available on a website alongside information on upcoming noisy events.

Review of Noise Management Plan

A regular review and update the Noise Management Plan should be conducted taking into account:

- *complaints regarding noise*
- *results of the community consultation; and*
- *recommendations from the consent authorities and acoustical consultants engaged in monitoring of noise during the events.*

7 CONCLUSION

An operational noise and vibration assessment has been prepared for the Western Sydney Stadium Stage 2 submission with specific reference to Secretary's Environmental Assessment Requirement 13. The following noise sources have been addressed:

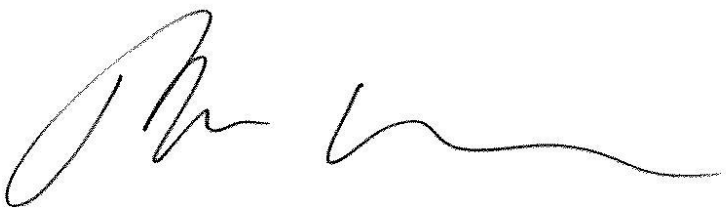
- Operational noise and vibration emissions associated with the services plant, car park and loading dock has been addressed in Section 4 of this report. The Stadium has the capacity to fully comply with noise emission requirements, which have been formulated in accordance with the NSW EPA Industrial Noise Policy.

- Demolition, excavation and construction noise has been addressed in a Demolition, Excavation and Construction Noise and Vibration Management Plan has been which has been submitted with this application SSDA16_8175.

- Operational noise as a result of sporting events and concerts has been modelled as per the requirements of SEAR 13 and the predicted noise levels have been presented. The predicted noise emissions are generally consistent with the Stage 1 Acoustic Report, with marginal increases in noise emissions for concert noise (2dB(A) L_{eq}) predicted as a result of proposal development. A regularly updated Noise Management Plan is recommended to be developed by the Western Sydney Stadium Trust in accordance with Section 6.5 of this report.

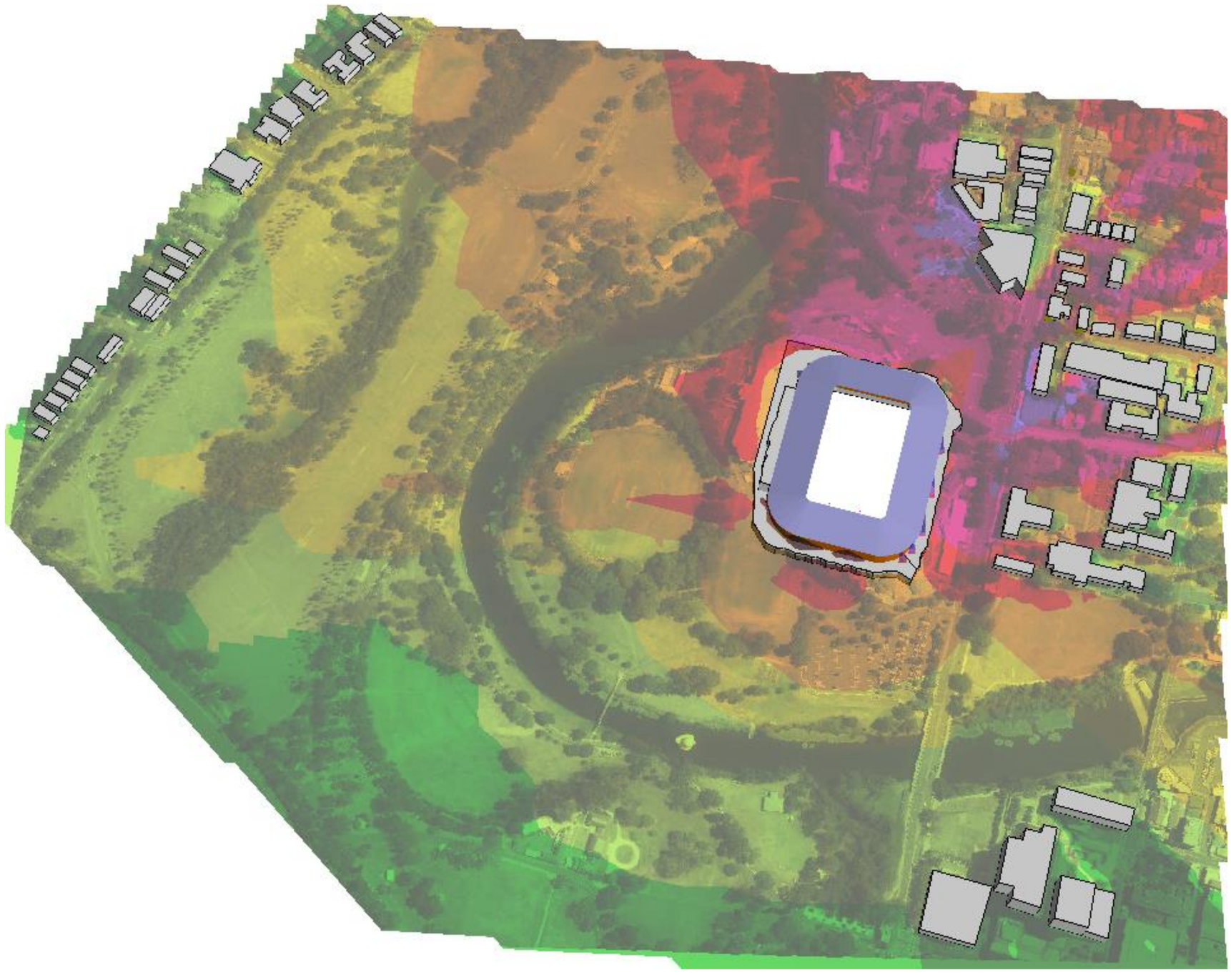
We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,



Thomas Aubusson MAAS

APPENDIX ONE – SOUNDPLAN NOISE CONTOURS



Western Sydney Stadium

Operational Noise Prediction

Rock Music Noise

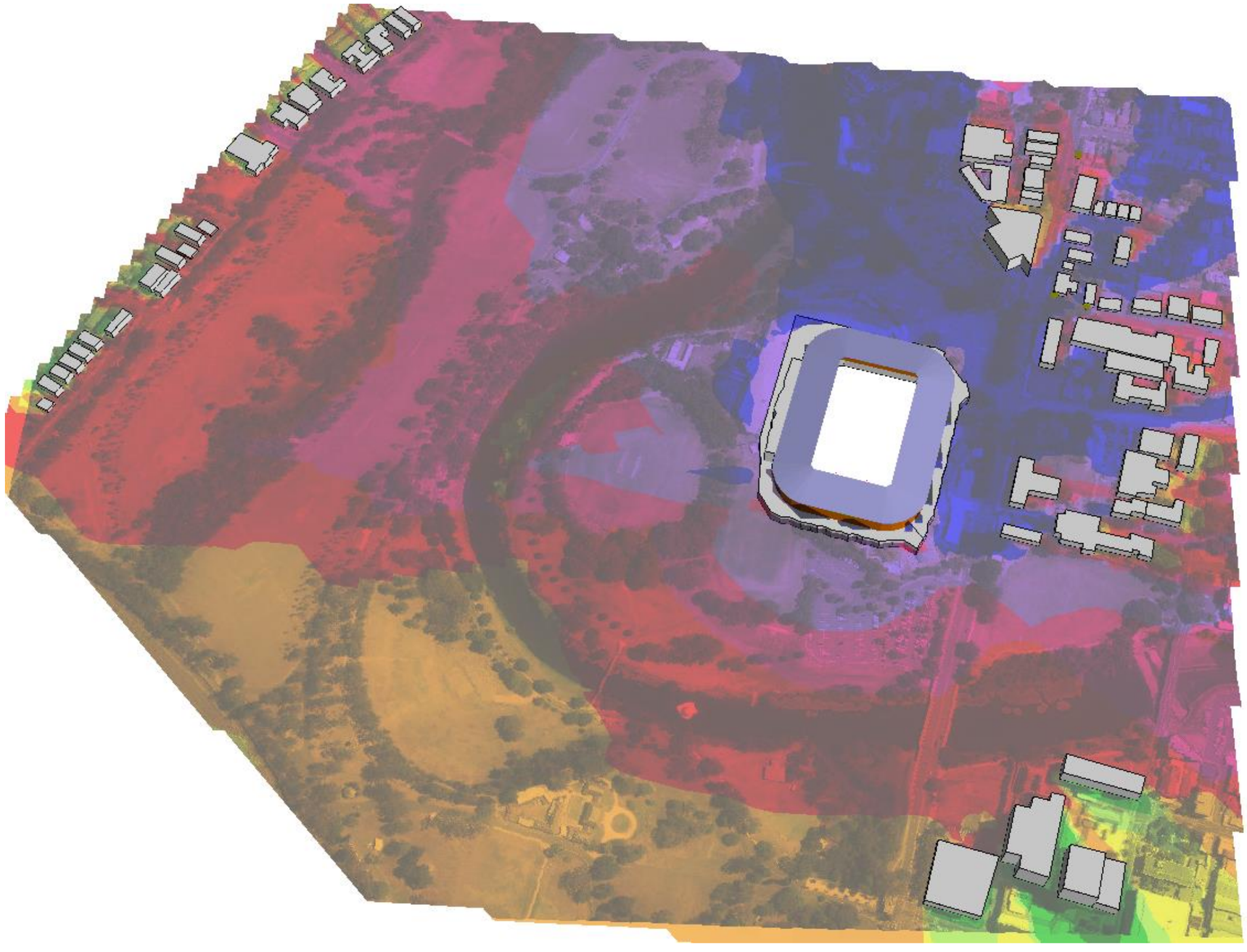
Noise Level

$L_{eq\ 15min}$
in dB(A)

< 61
61 - 64
64 - 67
67 - 70
70 - 73
73 - 76
76 - 79
79 - 82
82 - 85
85 - 88
88 - 91
>= 91

ACOUSTIC LOGIC

Western Sydney Stadium



Operational Noise Prediction

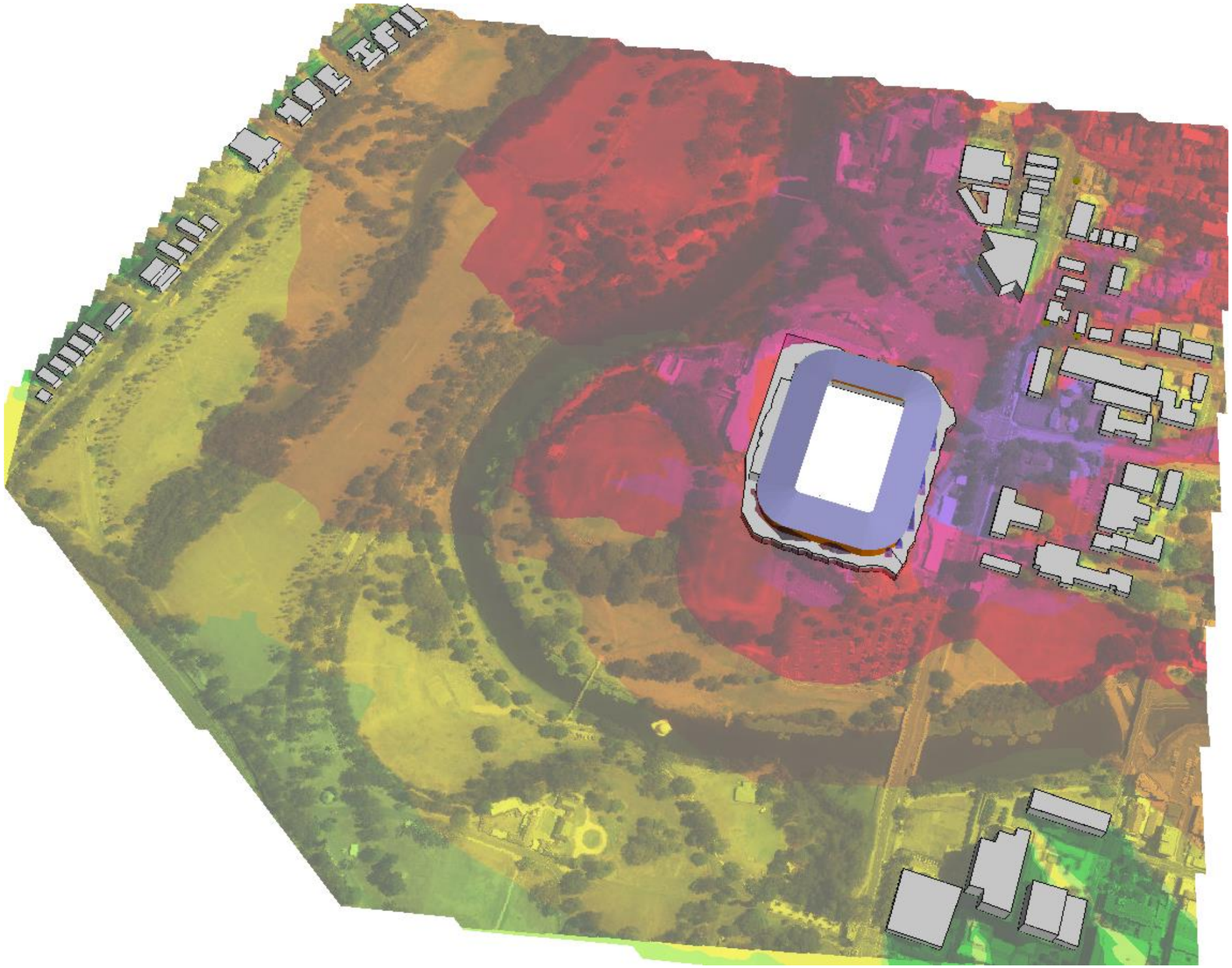
Rock Music Noise

Noise Level

L_{max}
in dB(A)

	< 61
	61 - 64
	64 - 67
	67 - 70
	70 - 73
	73 - 76
	76 - 79
	79 - 82
	82 - 85
	85 - 88
	88 - 91
	>= 91

ACOUSTIC LOGIC



Western Sydney Stadium

Operational Noise Prediction

Rock Music Noise

Noise Level
$L_{eq\ 15min}$
in dB(C)

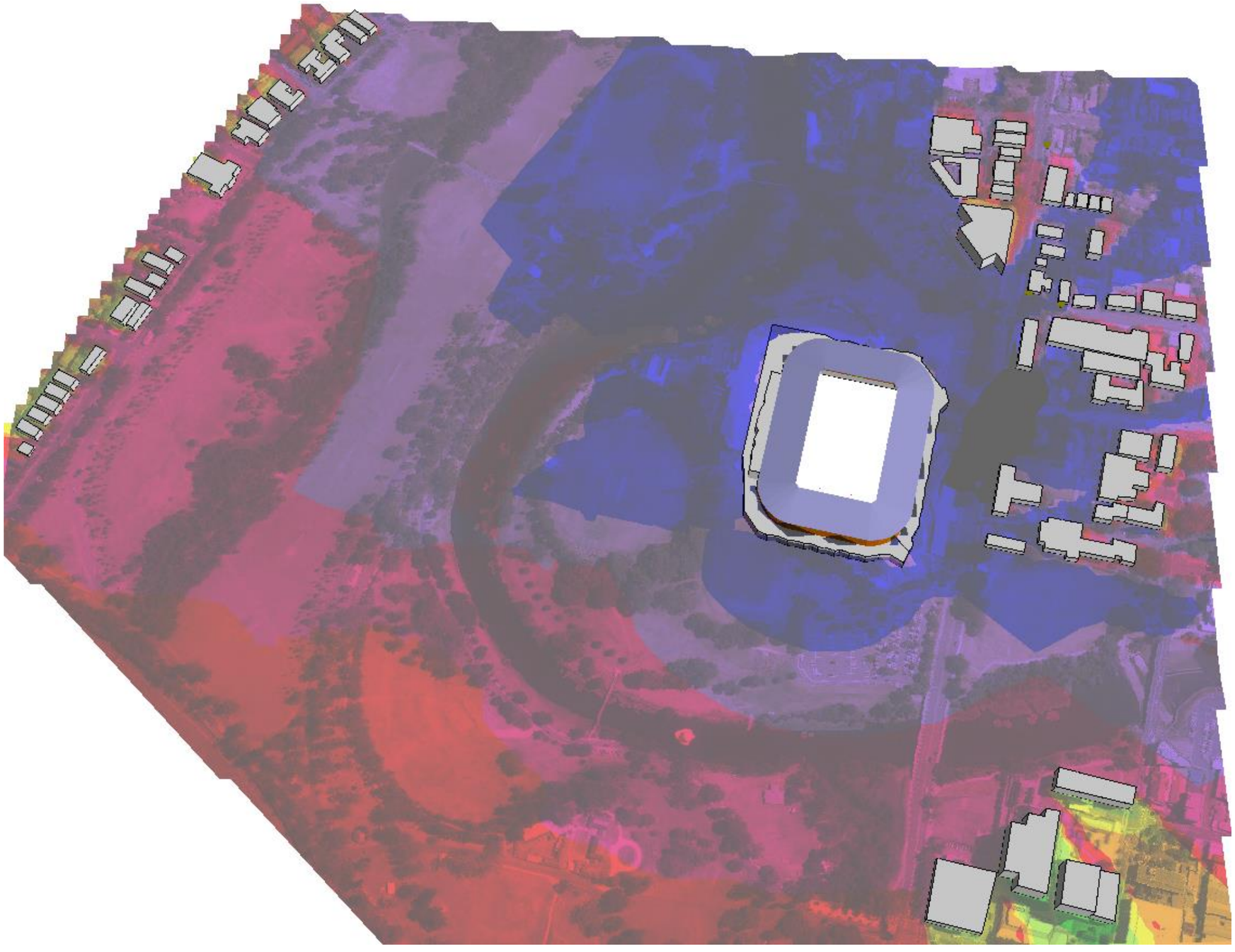
	< 80
80	- 83
83	- 86
86	- 89
89	- 92
92	- 95
95	- 98
98	- 101
101	- 104
104	- 107
107	- 110
	>= 110

ACOUSTIC LOGIC

Western Sydney Stadium

Operational Noise Prediction

Rock Music Noise



ACOUSTIC LOGIC

Western Sydney Stadium

Operational Noise Prediction

Crowd Noise

Noise Level
$L_{eq\ 15min}$
in dB(A)

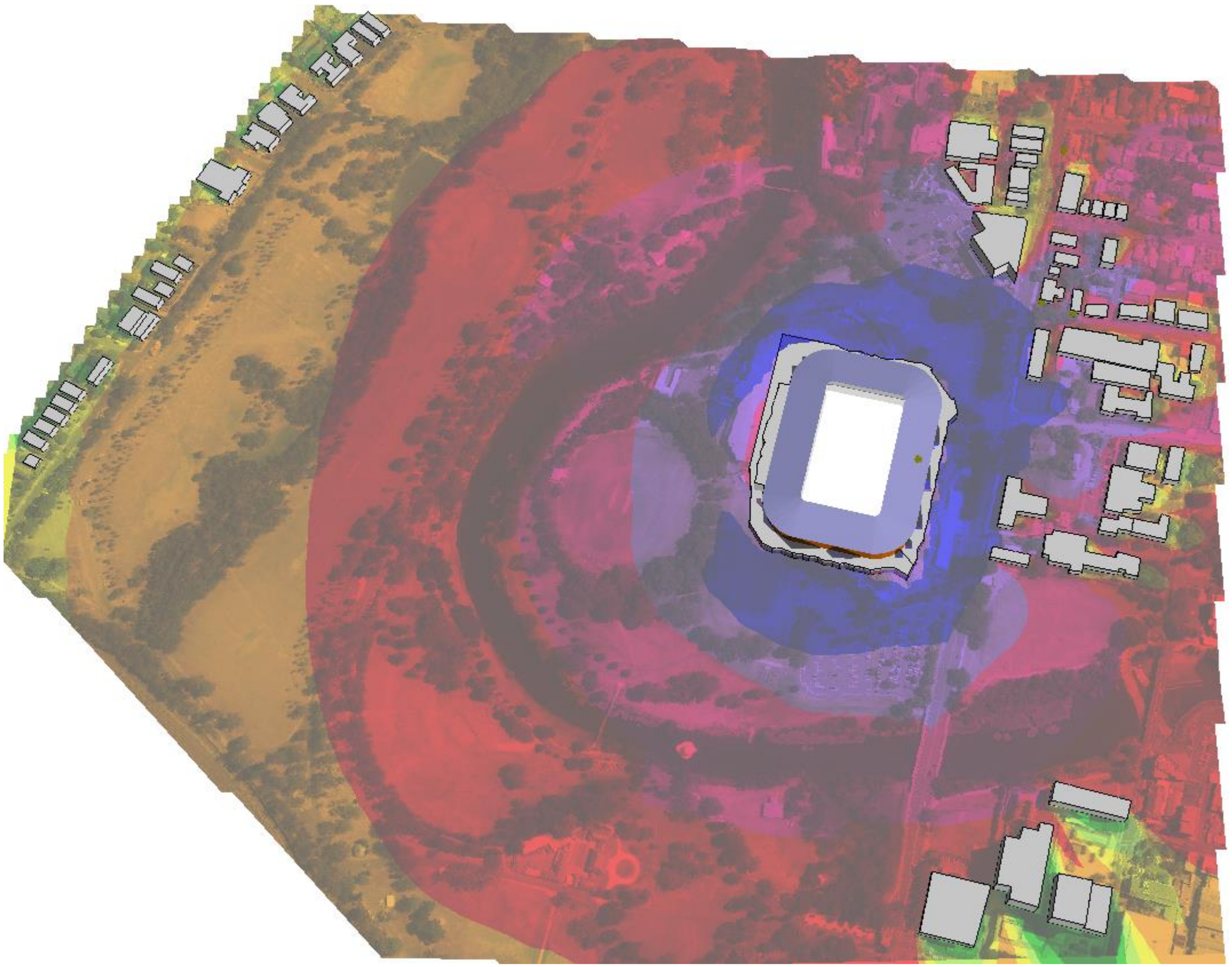
< 50
50 - 53
53 - 56
56 - 59
59 - 62
62 - 65
65 - 68
68 - 71
71 - 74
74 - 77
77 - 80
>= 80

ACOUSTIC LOGIC

Western Sydney Stadium

Operational Noise Prediction

Crowd Noise



Noise Level

L_{max}
in dB(A)

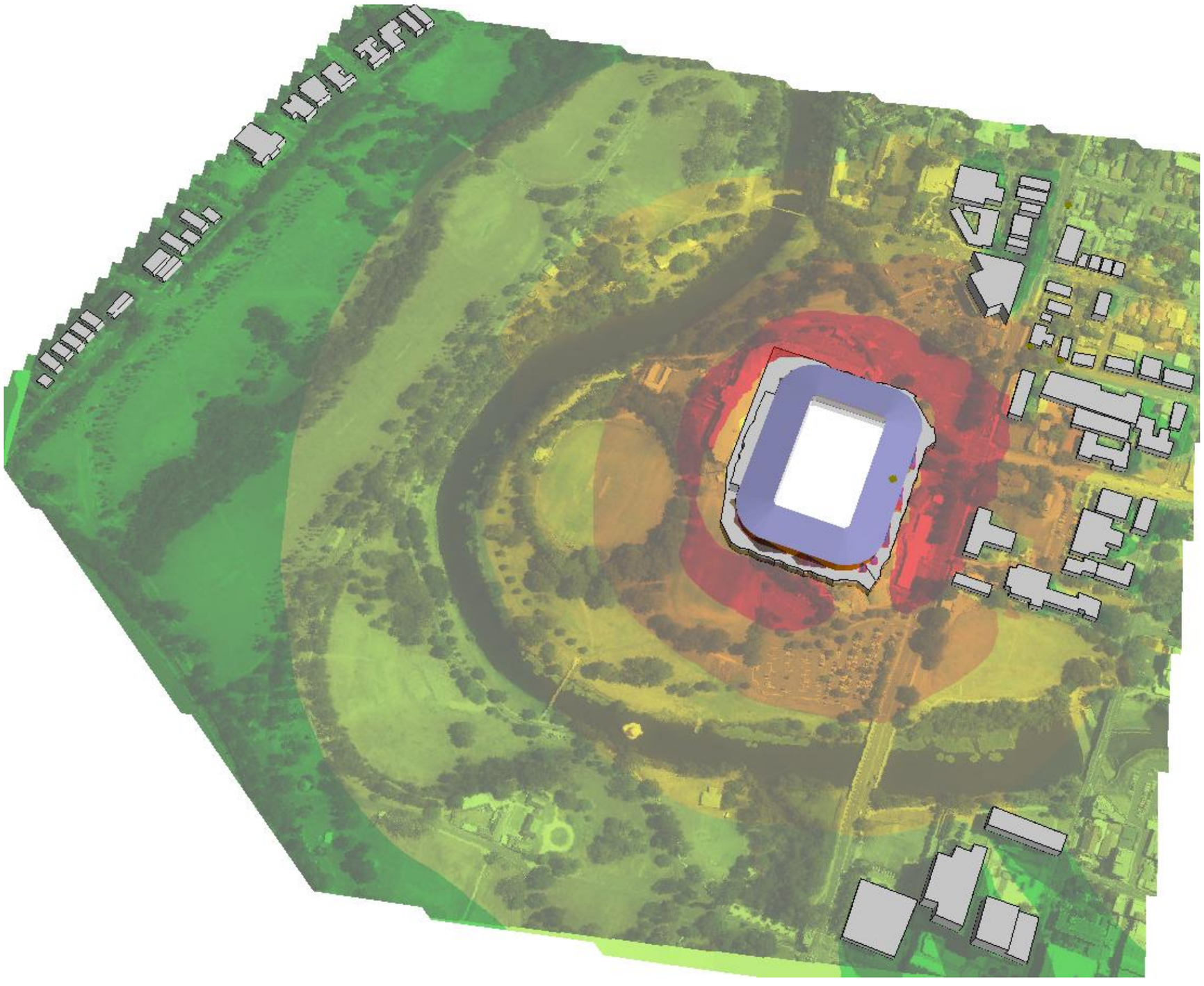
< 50
50 - 53
53 - 56
56 - 59
59 - 62
62 - 65
65 - 68
68 - 71
71 - 74
74 - 77
77 - 80
>= 80

ACOUSTIC LOGIC

Western Sydney Stadium

Operational Noise Prediction

Crowd Noise



Noise Level

$L_{eq\ 15min}$
in dB(C)

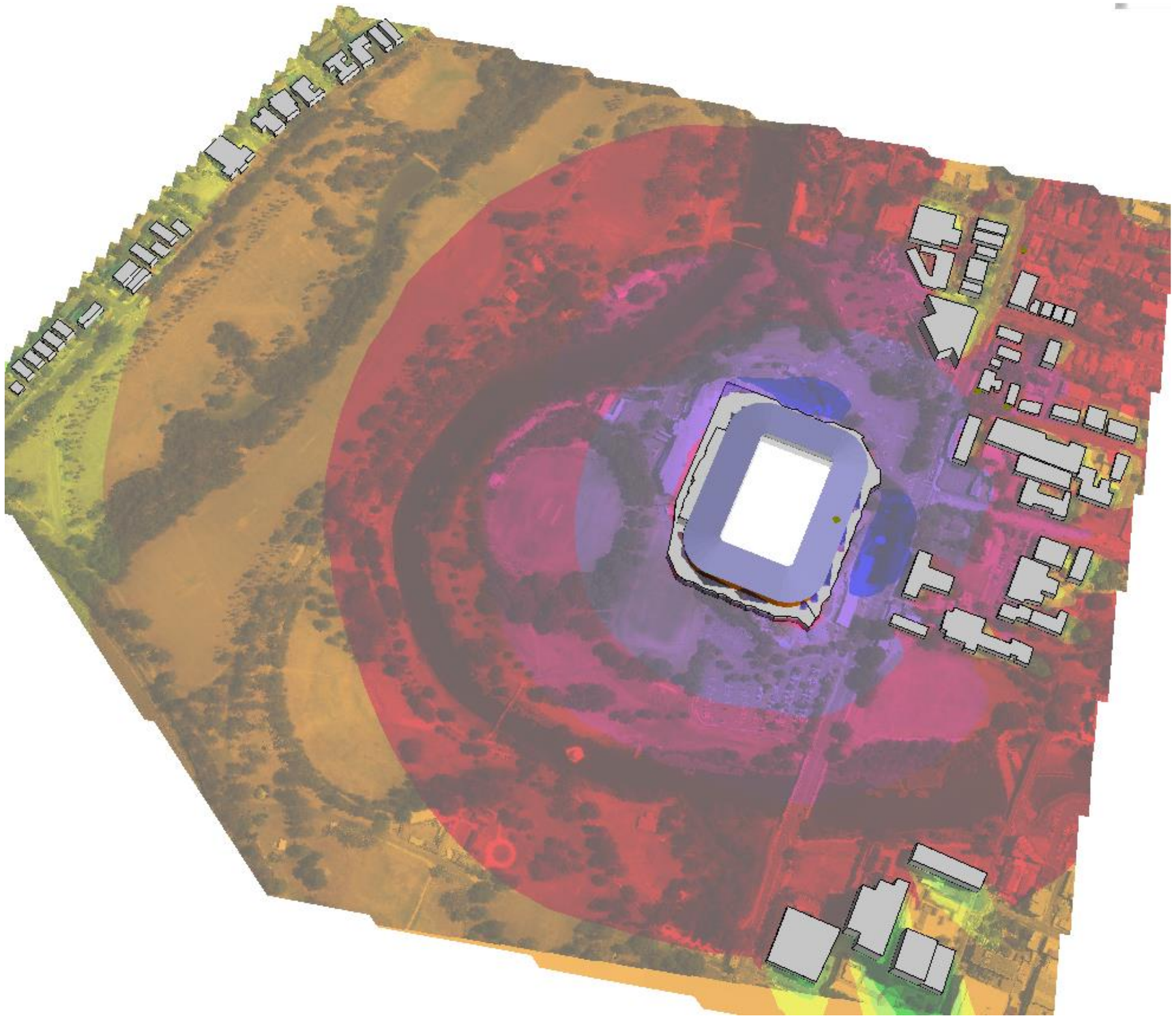
	< 70
70 -	73
73 -	76
76 -	79
79 -	82
82 -	85
85 -	88
88 -	91
91 -	94
94 -	97
97 -	100
>=	100

ACOUSTIC LOGIC

Western Sydney Stadium

Operational Noise Prediction

Crowd Noise



ACOUSTIC LOGIC