



Australian Turf Club Limited

ATC Winx Stand Development Noise and vibration assessment

October 2019

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Appendix A – Construction noise predicted levels

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Glossary of acoustic terms and abbreviations

Abbreviation	Definition
ATC	Australian Turf Club Limited
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{A90} descriptor.
dB	Decibel is the logarithmic unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dBA	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
$L_{Aeq}(\text{period})$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A90}(\text{period})$	The sound pressure level exceeded for 90% of the measurement period.
L_{Amax}	The maximum A-weighted sound level recorded during the measurement period.
L_{Cmax}	The maximum C-weighted sound level recorded during the measurement period.
$L_{Aeq}(15\text{hr})$	The L_{Aeq} noise level for the period 7 am to 10 pm.
$L_{Aeq}(9\text{hr})$	The L_{Aeq} noise level for the period 10 pm to 7 am.
$L_{Aeq}(1\text{hr})$	The highest hourly L_{Aeq} noise level during the day and night periods.
Noise sensitive receiver	An area or place potentially affected by noise including residential dwellings, schools, child care centres, places of worship, health care institutions and active or passive recreational areas.
Rating background level (RBL)	The overall single-figure background level representing each assessment period over the whole monitoring period.
RNP	Road Noise Policy (DECWW, 2011)
SEARs	Secretary's Environmental Assessment Requirements

1. Introduction

1.1 Overview

GHD has prepared a noise and vibration impact assessment (NVIA) for the proposed Winx Stand (“the Proposal”) at the existing ATC Royal Randwick Racecourse. This NVIA was prepared in support of an Environmental Impact Statement (EIS) for SSD 10285.

The objective of this acoustic assessment is to assess construction and operational noise emission from the redevelopment, and if required, recommend acoustic measures to ensure acceptable residential amenity.

1.2 Scope and limitations

GHD has undertaken the following works as part of this NVIA:

- Identification of surrounding sensitive receivers potentially impact by construction noise
- Determination of the noise criteria for the Proposal from previous reports and existing Conditions of Approval for the Spectator Precinct
- A quantitative assessment of construction noise and vibration
- Reviewing the potential noise impacts due to construction traffic generation
- An assessment of operational noise impacts
- Providing construction noise and vibration mitigation measures to minimise impacts on the community
- Prepare a noise and vibration impact assessment outlining results of the acoustic assessment and, where required, mitigation recommendations. The Acoustic Report will form part of the EIS and address the Secretary’s Environmental Assessment Requirements (SEARs) key issues in relation to noise

This report has been prepared with consideration to the following documents:

- *Interim Construction Noise Guideline* (DECCW, 2009) (ICNG)
- *Road Noise Policy* (DECCW, 2011) (RNP)
- *Assessing Vibration: a technical guideline* (EPA, 2006) (AVTG)
- *Industrial Noise Policy* (EPA, 2000) (INP)
- *Construction Noise and Vibration Guideline* (TfNSW, 2016) (CNVG)

This report: has been prepared by GHD for Australian Turf Club Limited and may only be used and relied on by Australian Turf Club Limited for the purpose agreed between GHD and the Australian Turf Club Limited as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Australian Turf Club Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

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1.3 Secretary's Environmental Assessment Requirements (SEARs)

The specific Secretary's Environmental Assessment Requirements (SEARs) addressed in this report are summarised in Table 1-1.

Table 1-1 SEARs

Assessment requirements	Section of the report
6. Noise and vibration The EIS shall include a noise and vibration assessment prepared in accordance with the relevant EPA guidelines. This assessment must detail construction and operational noise impacts on nearby noise sensitive receivers and outline proposed noise mitigation and monitoring procedures.	Construction Section 4 and 5 Operational Section 6 Mitigation Section 7

2. Existing environment

2.1 Project description

Royal Randwick Racecourse is located in the eastern suburbs of Sydney NSW, approximately 6 km from Sydney's CBD. It consists of the course proper (2224 m circumference) and the inner Kensington track (2100 m circumference). The site is on Crown Land, zoned RE1 – Public Recreation, leased to The Australian Turf Club and is bounded by Alison Road, Wansey Road, High Street & Doncaster Ave. Along these boundaries are a diverse range of neighbouring properties of varying heights, including the UNSW Sydney campus along with several commercial and residential properties.

The Australian Turf Club proposes to undertake the Winx Stand development on the Leger Lawn area of the Royal Randwick Racecourse. The location of the proposal is shown in Figure 2-1.



Figure 2-1 Proposal location

The development will involve the construction of the two storey multi-purpose facility at the southern end of the existing QEII Grandstand, in the Royal Randwick Spectator Precinct. The proposed facility is designed to significantly enhance the amenity for patrons attending race day events at RRR and provide a flexible space for non-race day events. The Winx Stand will comprise an approximate 3,546sqm footprint and a maximum building height of 18m. The proposed development is summarised as follows:

Construction of a two storey multi-purpose facility comprising:

- Multi-purpose hall at ground level of approximately 3,255sqmGFA.
- Multi-purpose hall at upper level of approximately 1,788sqm.
- Food and beverage facilities.
- Entry foyer and ancillary facilities.
- Building Identification Signage.
- 'Eat Street' (The Laneway) located between the new facility and the existing multi-deck car park and day stables

The dominant noise sources at this site would be road traffic noise from Anzac Parade and Alison Road. Future noise contributions to the ambient noise level would be from the Sydney Light Rail and associated stabling facility.

2.2 Sensitive receivers

Noise sensitive receivers are defined based on the type of occupancy and the activities performed in the land use and could include:

- residential dwellings
- educational institutes, libraries or childcare centres
- hospitals, surgery or other medical institutions
- places of worship
- passive and active recreational areas such as parks, sporting fields or golf courses
- community centres
- commercial or industrial premises

The following sensitive receivers and land uses have been identified for this assessment.

- Randwick TAFE College (to the north of the proposal)
- Residential receivers located along Alison Road (to the north and east of the proposal)
- Residential receivers located along Wansey Road (to the east of the proposal)
- University of New South Wales (to the south of the proposal)
- Residential receivers located along Doncaster Avenue (to the west of the proposal)

Representative sensitive receivers included for modelling and assessment purposes are detailed in Table 2-1. The location of the site including nearby sensitive receivers are shown in Figure 2-2.

Table 2-1 Sensitive receivers

Receiver ID	Receiver address	Receiver type
R01	170 Doncaster Avenue	Residential
R02	142 Doncaster Avenue	Residential
R03	68-92 Doncaster Avenue	Residential
R04	66 Doncaster Avenue	Residential
R05	36 Doncaster Avenue	Residential
R06	4-8 Doncaster Avenue	Residential
R07	University of New South Wales	Educational
R08	Randwick TAFE College	Educational
R09	22 Alison Road	Residential
R10	34-52 Alison Road	Residential
R11	54-76 Alison Road	Residential
R12	80 Alison Road	Residential
R13	88 Alison Road	Residential
R14	47 Wansey Road	Residential
R15	94-96 Alison Road	Residential
R16	2 Wansey Road	Residential
R17	39 Wansey Road	Residential
R18	19 Wansey Road	Residential
R19	102-106 Alison Road	Residential
R20	1 Wansey Road	Residential
R21	110 Alison Road	Residential

The location of the site, including nearby sensitive receivers considered for the assessment, is shown in Figure 2-2 below.



3. Criteria

3.1 Existing Conditions of Approval for Spectator Precinct

GHD understands that the spectator precinct (shown within the blue section in Figure 3-1 below) currently operates under an existing modified approval MP10_0097 Mod 2, dated 3 March 2014. The Conditions of Approval within this document provides noise limits for various activities across the precinct, based on the Acoustic Assessment prepared by ARUP, dated 15 November 2013.

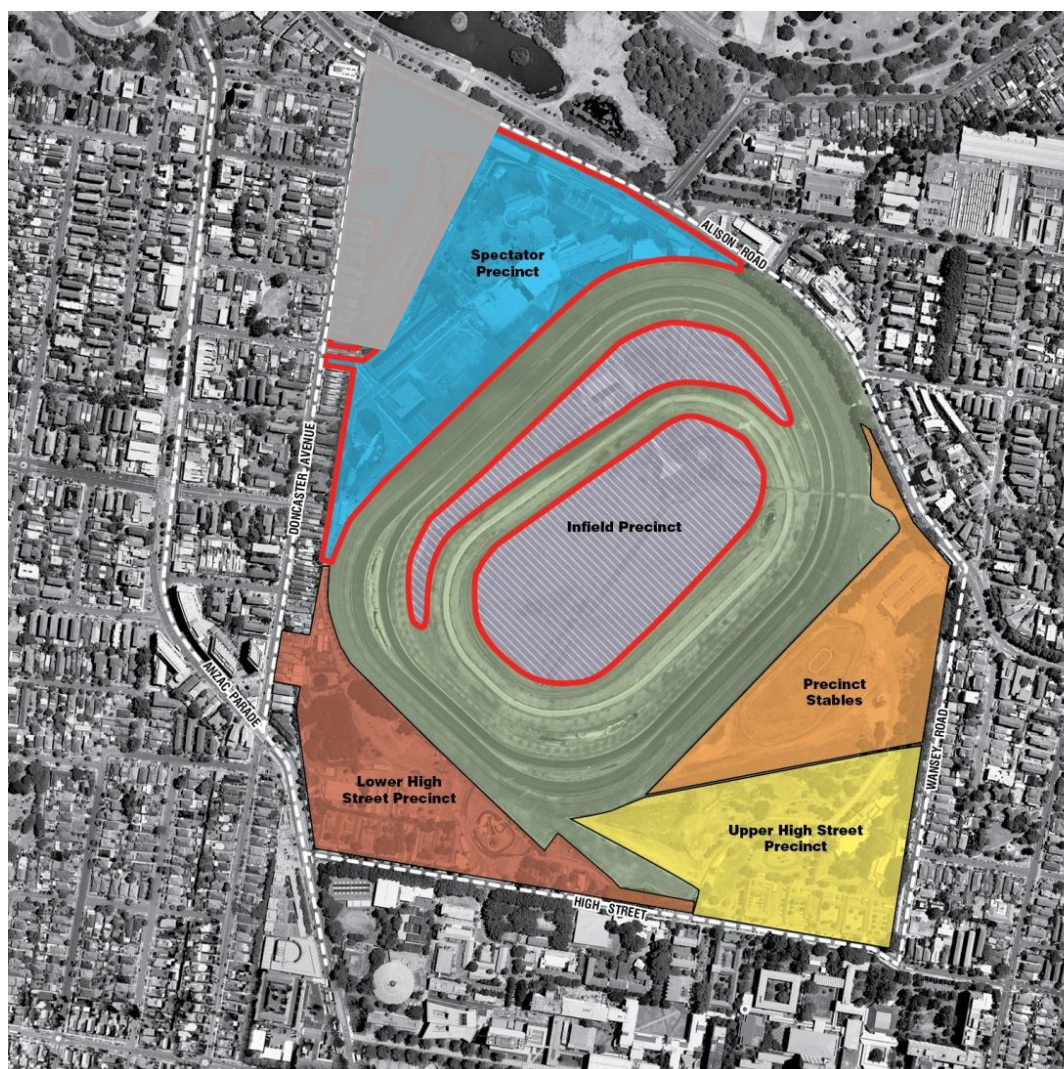


Figure 3-1 Location of existing precincts

It is proposed that the new facility, located within this spectator precinct, operates under these existing conditions. The function of the proposal is similar to the existing facilities on site and therefore it is considered appropriate to utilise existing noise emission criteria for use and operation of this facility. These are detailed below.

F10 Noise Limits

All non race day minor events being held pursuant to condition AS shall comply with the noise limits recommended by the Acoustic Assessment prepared by ARUP dated 15 November 2013 and submitted with MP10 0097 MOD 2, with the exception of amplified outdoor events which shall comply with the noise criteria as outlined:

<i>Norse Criteria for outdoor amplified events (excluding Level 4 terrace)</i>	
<i>Sunday to Thursdays:</i>	
<i>9:00 am to 6:00 pm</i>	<i>Maximum 60dB(A) $L_{A1, 5 \text{ min (Event)}}$ and 80 dB(A) $L_{C1, 5 \text{ min (Event)}}$ as measured at any residential premises</i>
<i>6:00 pm to 10:00 pm</i>	<i>Same as unamplified outdoor events and amplified indoor events as recommended by the Acoustic Assessment prepared by ARUP dated 15 November 2013</i>
<i>10:00 pm to 9:00 am</i>	<i>No outdoor amplified events permitted unless approved via a separate development consent</i>
<i>Fridays, Saturdays and Public Holidays:</i>	
<i>9:00 am to 8:00 pm</i>	<i>Maximum 60dB(A) $L_{A1, 5 \text{ min (Event)}}$ and 80 dB(A) $L_{C1, 5 \text{ min (Event)}}$ as measured at any residential premises</i>
<i>6:00 pm to 11:00 pm</i>	<i>Same as unamplified outdoor events and amplified indoor events as recommended by the Acoustic Assessment prepared by ARUP dated 15 November 2013</i>
<i>10:00 pm to 9:00 am</i>	<i>No outdoor amplified events permitted unless approved via a separate development consent</i>

F11 Noise Level Monitoring

Noise level recordings shall be undertaken for all outdoor amplified events with a compliance report prepared annually. Copies of the final document are to be made available the Department and Council and to the general public through those agencies. The summary report will set out:

- i. Compliance or non-compliance with noise and time limits;
- ii. The times and duration of any occasions where there were exceedances of the noise and time limits;
- iii. A table identifying the number of complaints, types of complaint and mitigation measures taken by the Australian Turf Club including any subsequent correspondence from the complainant.
- iv. Recommendations by the Australian Turf Club and/or its acoustic consultant on any proposed changes to conditioned controls - if required.

iv} What measures were implemented to ensure that the exceedance(s) did not reoccur

The report should summarise the noise monitoring results outlining in plain English the number of exceedances and the measures taken to manage these.

F12 Level 4 Outdoor Terrace

The following additional measures shall be imposed to minimise noise impacts:

- closure of the outdoor terraces by midnight every night;
- sound system compliance with relevant noise criteria; and
- all level 4 sound systems to incorporate RMS limiting.

F13 Operation Hours for Restaurant/Members Facility and Minor Non-Raceday Events

The following operating hours shall apply for the level 4 restaurant/members facility and for non race day events being held pursuant to condition A5:

- Level 4 Restaurant/members facility:
Mondays to Sundays 7:00 am to 2:00 am
- Level 4 Outdoor Terrace
Mondays to Sundays 7:00 am to 12:00 am
- Indoor Amplified Events
Monday to Sundays 7:00 am to 2:00 am
- Outdoor Unamplified events
Monday to Sundays 7:00 am to 12:00 am
- Outdoor Amplified events
Sundays to Thursday 9:00 am to 10:00 am
Fridays, Saturdays and Public Holidays 9:00 am to 11:00 pm

SCHEDULE 3

STATEMENT OF COMMITMENTS

Subject	Commitments	Timing
Acoustics	Noise from proposed mechanical plant will be controlled to meet the established INP criteria at the nearest noise sensitive receivers at 66A Doncaster Avenue.	During operation
	Any new sound system installed as part of the development will be designed using line array loudspeaker technology and directional sub-woofers that allow the sound to be directed digitally to the location where it is needed, and avoid unnecessary sound spill to other areas.	Prior to occupation
	Physical articulation on the back of the grandstands will be maximised where practical in the architectural design to scatter any reflected sound from the sound system. To prevent focusing of sound, the depth of articulation will vary.	Prior to issue of construction certificate
	Noise limits at affected residences similar to those approved for the Future Music Festival 2010 be adopted in order to set noise limits for all event types to be held at Randwick Racecourse (both race day and non-race day events). This noise limit is to apply to events held	

	<p><i>both on the infield and within the Theatre of the Horse. The proposed noise limit criteria are:</i></p> <p><i>< LA 1, 15min 70 dB(A)</i></p> <p><i>< LC90, 15min 90 dB(C)</i></p> <p><i>Noise levels are to be measured at affected residences with the sound level meter set to the 'fast' response setting over any 15 minute period during the event, including any bump in/out phases and sound checks</i></p>	
	<p><i>When background music is played through the installed sound system within the Grandstand or other buildings (on any level excluding level 4), the doors and windows must be closed after 11pm.</i></p> <p><i>Events using temporary hired sound systems with music for indoor events within the Grandstand or other buildings must have all windows and doors closed when sound systems are in use.</i></p> <p><i>The temporary stage orientation and location for events in the Theatre of the Horse is to be orientated to minimise impact on Location 1 and Doncaster Road properties behind it.</i></p> <p><i>Temporary hire PA systems and equipment shall be designed and operated in such a fashion as to minimise noise spill to the site boundaries at all times.</i></p> <p><i>Sound system levels shall be set and verified to comply with the nominated criteria.</i></p> <p><i>Noise measurement monitoring shall be undertaken for Amplified Outdoor Events when required as per the description in Section 7.3.2.2, including:</i></p> <ul style="list-style-type: none"> <i>o Outdoor Amplified Events:</i> <i>o Maximum of 60 dB(A) LA 1, 5min (Event) and 80 dB(C) LC1, 5min (Event) as measured at the most affected noise sensitive receiver (i.e. typically nearest residential boundary). Note that these limits are for the noise generated by the event only and shall be distinguished between noise from traffic and other sources when required. The limits apply for the entire duration of the event and associated sound checks, etc.</i> <i>o Event end time shall not exceed 23:00</i> <i>o Event limited to maximum duration of 12 hours in length (including sound checks on day of)</i> <i>o Each event allowed 1.0 hour sound check/ rehearsal during daytime hours on non-event day (09:00 - 18:00)</i> <i>o Maximum event capacity of 5000 patrons</i> 	<p><i>During minor events</i></p>

- o "Amplified events" is defined to mean all events using either installed sound systems or temporary hired sound systems for audio reproduction*
 - o Includes all amplified event types, including speech only, functions and music performances*
 - o Applies to events held anywhere outdoors, including Theatre of the Horse and Infield (but excludes background music on Level 4 terraces) Method of noise level compliance to be assessed by ATC taking into account duration and timing of event, location of event and planned sound system. At ATC discretion, noise monitoring to be undertaken by ATC staff or external consultant as required.*
- External event operators shall submit an Event Noise Management Plan to the ATC for all Amplified Outdoor Events.*
- Level 4 Operational Noise Management Plan (excludes other areas):*
- Level 4 (operating under a new liquor licence) will comply with the NSW OLGR standard noise conditions. Notwithstanding, the following procedures will be implemented to assist with the mitigation of noise from its operation on non-race day events:*
- o Closure of the outdoor terraces by 00:00 midnight every night.*
 - o Signage erected at points of egress informing patrons to respect the neighbours.*
 - o On nights where large numbers of patrons are expected, a security guard will be placed at the bottom of the central lift directing patrons and informing them to leave in a quiet and orderly manner*
 - o For large groups, transportation will be arranged prior to the group leaving the premises.*
 - o Sound system compliance with the OLGR criteria will be certified by a suitably qualified engineer within 30 days of the commencement of night time functions and re- testing will take place every 18 months.*
 - o All Level 4 sound systems will incorporate rms limiting."*

3.2 ARUP Acoustic Assessment

The Conditions of Approval in Section 3.1 above refers to noise criteria presented in the ARUP Acoustic Assessment for the spectator precinct, dated 15 November 2013. As previously discussed, the noise emission from the proposal will be assessed against the noise criteria presented in this report, as required under the Conditions of Approval.

A summary of this report is provided in the following sections.

3.2.1 Background noise monitoring

Long term noise monitoring was conducted by ARUP to establish relevant criteria for the assessment of noise from use and operation of the spectator precinct.

Noise monitoring was undertaken from 23 August 2010 to 31 August 2010, at locations representative of the nearest sensitive receivers. Figure 3-2 below has been extracted from the report showing the locations of the long term noise monitoring.

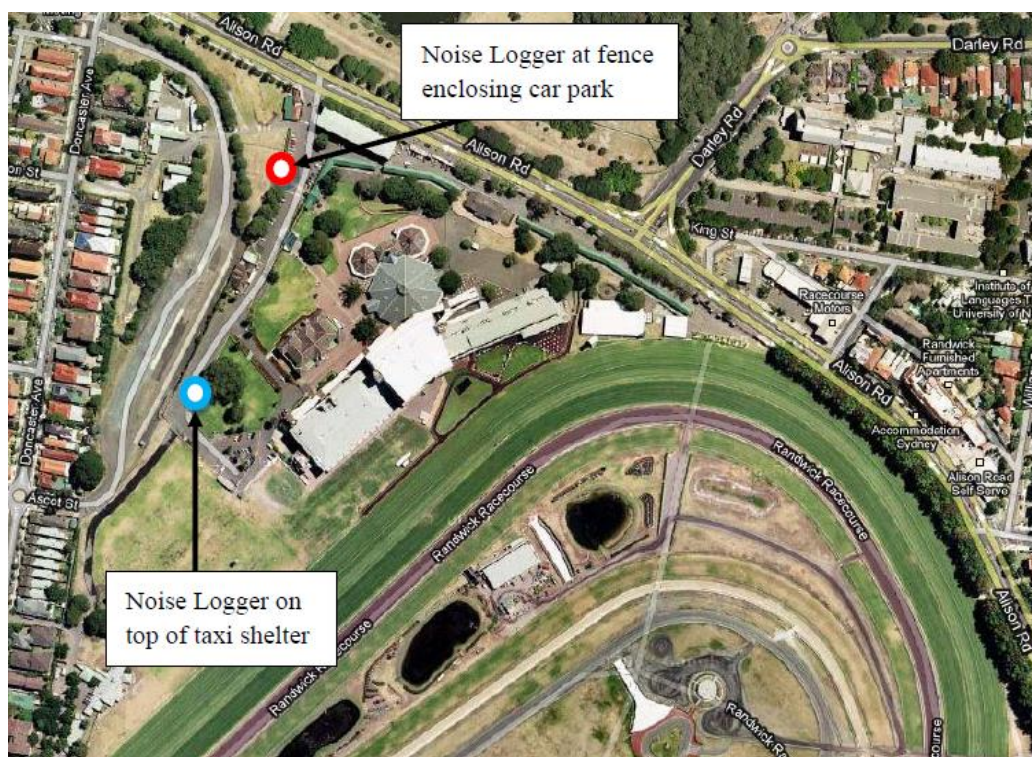


Figure 3-2 Long term noise monitoring locations (extract from ARUP acoustic report)

The results of the long term noise monitoring are presented below in Table 3-1.

Table 3-1 Long term noise monitoring results

Location	Time Period	Rating Background Level (RBL), L_{A90}	Ambient noise level, L_{Aeq}
Adjacent to 66A Doncaster Avenue	Day (7 am to 6 pm)	52	59
	Evening (6 pm to 10 pm)	52	58
	Night (10 pm to 7 am) ¹	42	56
On top of the taxi and non-raceday parking shelter between Doncaster Avenue and the Paddock Grandstand	Day (7 am to 6 pm)	49	58
	Evening (6 pm to 10 pm)	48	55
	Night (10 pm to 7 am) ¹	44	51

Note: 10 pm to 8 am on Sundays and Public Holidays

3.2.2 Operational noise emission criteria

The relevant noise criteria from the ARUP Acoustic Report have been presented in Table 3-2.

Note that the noise from internal activities within the spectator precinct was assessed against the requirements of the Environment Protection Authority's (EPA) *Industrial Noise Policy (2000)*. This EPA policy is intended for scheduled activities and not applicable to sporting events or function centres, however, it is proposed to use the criteria previously established for the site for consistency.

Table 3-2 Operational noise criteria

Location	Time Period	Intrusive criteria	Amenity criteria	Limiting criterion
All residential receivers	Day (7 am to 6 pm)	54	54	54
	Evening (6 pm to 10 pm)	53	45	45
	Night (10 pm to 7 am) ¹	49	41	41

Note: 10 pm to 8 am on Sundays and Public Holidays

3.2.3 Sleep disturbance criteria

The ARUP Acoustic Report did not provide criteria for the assessment of sleep disturbance for non-race day activities occurring after 10:00 pm. The latest EPA guidance on sleep disturbance is contained within the *Noise Policy for Industry* which is considered to provide a suitable framework for the assessment of sleep disturbance.

The EPA guidance for the assessment of sleep disturbance for short-term noise events. The EPA guidance defines the sleep disturbance criteria during the night time at a residential location as L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, which is greater. The proposal criteria for sleep disturbance is presented below in Table 3-3.

Table 3-3 Sleep disturbance criteria

Time period	RBL $L_{A90(15min)}$, dB(A)	Sleep disturbance criteria L_{AFmax} , dB(A)
Night time	42	57

3.3 Construction noise criteria

3.3.1 Proposed construction hours

Construction noise management levels for the Proposal are based on the *Interim Construction Noise Guideline (ICNG)* (DECCW, 2009). Construction works would be conducted during standard construction hours and certain out-of-hours periods.

The construction hours periods are presented below in Table 3-4.

Table 3-4 Construction hours

Construction hours	Monday to Friday	Saturday	Sunday/Public holiday
Standard hours	7 am to 6 pm	8 am to 1 pm	No work
Outside recommended standard hours	6 pm to 7 am	1 pm to 8 am	All times

Note is made that construction works will be restricted to noisy activities from 8:30 am daily due to track work, and from 11:30 am during barrier trials. No works are to be undertaken on race days.

The ICNG acknowledges that the following activities have justification to be undertaken outside the standard construction hours assuming all feasible and reasonable mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses:

- the delivery of oversized plant, equipment and materials that police or other authorities determine require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- maintenance and repair of public infrastructure where disruption to essential services or considerations of worker safety do not allow work within standard hours
- public infrastructure works that shorten the length of the Proposal and are supported by the affected community
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours
- works which maintain noise levels below the noise management levels outside of the recommended standard construction hours

Works required outside standard construction hours would be identified during construction planning and nearby residents would be notified before possession work is expected.

3.3.2 Construction noise management levels

Construction noise management levels for residential premises and other sensitive land uses are provided in the ICNG.

The method to determine the noise management levels for residential receivers in accordance with the ICNG is outlined in Table 3-5.

Table 3-5 Noise management levels for residential receivers

Time of day	Noise management level, $L_{Aeq}(15 \text{ min})$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dBA	<p>The noise affected level represents the point above which there may be some community reaction to noise.</p> <ul style="list-style-type: none"> where the predicted or measured $L_{Aeq}(15 \text{ min})$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level the proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly noise affected: 75 dBA	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <p>Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level.</p> <ul style="list-style-type: none"> If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided
Outside recommended standard hours	Noise affected: RBL + 5 dBA	<p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable measures have been applied and noise is more than 5 dBA above the noise affected level, the proponent should consult with the community</p>

Noise management levels for other sensitive land uses are provided in Table 3-6 and only apply when the properties are in use.

Table 3-6 Noise management levels for other sensitive land uses

Land use	Noise management level, $L_{Aeq}(15 \text{ min})$
Commercial premises	70 dB(A) (external)
Industrial premises	75 dB(A) (external)
Educational institutes	45 dB(A) (internal) / 55 dB(A) (external) ¹
Hospital wards and operating theatres	45 dB(A) (internal) / 55 dB(A) (external) ¹
Places of worship	45 dB(A) (internal) / 55 dB(A) (external) ¹
Active recreation areas	65 dB(A) (external)
Passive recreation areas	60 dB(A) (external)
Note: 1) A 10 dBA noise reduction is assumed from outside to inside the building for the educational facilities	

3.3.3 Sleep disturbance

The ICNG recommends that where construction works are planned to extend over two or more consecutive nights, the Proposal should consider maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL.

The EPA guidance for the assessment of sleep disturbance in Section 3.2.3 is considered appropriate for sleep disturbance during construction. .

3.3.4 Construction noise management levels

A summary of the Proposal construction noise management levels for each identified sensitive receiver type is provided in Table 3-7. As construction activities are not proposed during night time hours, a sleep disturbance assessment has not been undertaken.

Table 3-7 Proposal construction noise management levels

Receiver Type	Time of day	Management level, dB(A)
Residential	Recommended standard hours	Noise affected: 59
		Highly affected: 75
	Outside recommended standard hours ¹	Day: 54
		Evening: 53
		Night: 49
Commercial	When in use	70 (external)
Educational institutes		55 (external)
Hospital wards and operating theatres		55 (external)
Places of worship		55 (external)
Active recreation areas		65 (external)

Note 1: The *Noise Policy for Industry* (EPA, 2017) defines day, evening and night time periods as:

- Day: the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
- Evening: the period from 6 pm to 10 pm.
- Night: the remaining periods.

3.3.5 Construction traffic criteria

The *Road Noise Policy* (RNP) (DECCW, 2011) provides road traffic noise criteria for residential land uses affected by construction traffic on the public road network.

Section 3.4.1 of the RNP states that any increase in the total noise level at existing residences and other sensitive land uses affected by land use development traffic generation on existing roads should be limited to 2 dBA above current levels. This limit only applies when the noise level without the development is within 2 dBA or exceeds the road traffic noise criterion provided in the RNP.

This has been used to identify potential impacts as a result of noise produced by construction traffic. If road traffic noise increases as a result of construction works within 2 dBA of current levels then the objectives of the RNP are considered to be met and no specific mitigation measures would be required.

Where construction traffic increases the existing road traffic noise levels by more than 2 dBA then further assessment against the road traffic noise criteria in Table 3-8 is required.

Table 3-8 Road traffic noise criteria, dBA

Type of development	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 L _{Aeq} (15 hour)	55 L _{Aeq} (9 hour)
Existing residence affected by additional traffic on local roads generated by land use developments	55 L _{Aeq} (1 hour)	50 L _{Aeq} (1 hour)

3.4 Construction vibration criteria

3.4.1 Human comfort

Acceptable vibration levels for human comfort have been set with consideration to *Assessing Vibration: a technical guideline* (DEC, 2006) which is based on the guidelines contained in British Standard *BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*.

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3-9 for sensitive receivers.

Table 3-9 Human comfort intermittent vibration limits

Receiver type	Period	Intermittent vibration dose value (m/s ^{1.75})	
		Preferred value	Maximum value
Residential	Day (7 am and 10 pm)	0.2	0.4
	Night (10 pm and 7 am)	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8

Whilst the assessment of response to vibration in *BS 6472:1992* is based on vibration dose value and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of a peak value, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard, *BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration* and are shown below in Table 3-10.

Table 3-10 Guidance on effects of vibration levels for human comfort

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

3.4.2 Guidelines for general structures

The effects of transient vibration on structures is considered in *BS 7385 Part 2 – 1993 Evaluation and measurement for vibration in buildings*. The criteria provided in BS 7385 are presented in Table 3-11.

Table 3-11 Transient vibration guide values – minimal risk of cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above.

The guide values in Table 3-11 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings. Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at lower frequencies, then the guide values may need to be reduced by up to 50 per cent.

The predominant vibration for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers and excavators occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). However, a conservative vibration damage screening level per receiver type is given below:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

3.4.3 Guidelines for vibration sensitive structures

Heritage buildings and structures would be assessed using the guide values in Table 3-11. A heritage building or structure should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. If a heritage building or structure is found to be structurally unsound (following inspection) a more conservative cosmetic damage criterion of 2.5 mm/s peak component particle velocity (from DIN 4150) should be considered.

4. Construction noise assessment

4.1 Construction works program

The plant and equipment likely to be required throughout each proposed stage of construction have been used to predict the noise levels that would be expected during construction works. The predicted noise levels were assessed against the construction noise management levels identified in Section 3.2.

Construction scenarios have been created based on construction equipment operating simultaneously at any given time. All works are located within or adjacent to the Proposal site. It is unlikely that construction machinery would be operating at the same time (as the modelling assumes), but analysing the 'worse-case' scenario helps to identify where noise impacts could be a concern and assists in the formulation of mitigation areas.

4.1.1 Construction activities

The construction hours for the Proposal is as follows:

- Monday – Saturday: 8:30 am to 5:00 pm

Note is made that construction works will be restricted to noisy activities from 8:30 am daily due to track work, and from 11:30 am during barrier trials. No works are to be undertaken on race days.

The Proposal is anticipated to follow the following work methodology and staging provided in Table 4-1. Construction is proposed to be undertaken from September 2020 to October 2021. These construction scenarios have been modelled to determine the potential construction noise impacts on the environment.

Table 4-1 Construction staging

Construction scenario	Construction phase	Construction hours
CS01	Demolition of temporary day stalls	Standard hours Outside of standard hours
	Site establishment	
	Investigation works	
	Services diversions and relocations	
CS02	Excavation and earthworks	Standard hours Outside of standard hours
CS03	Piling and footing works	Standard hours Outside of standard hours
CS04	Structure works	Standard hours Outside of standard hours
CS05	Facade construction	Standard hours Outside of standard hours
CS06	Fit-out	Standard hours Outside of standard hours
CS07	Landscaping and civil works	Standard hours Outside of standard hours

4.1.2 Noise generating equipment

Plant and equipment needed for the Proposal would be determined during the construction planning phase. Typical equipment for the proposed activities has been assumed for this assessment. Other equipment may be used, however, it is anticipated that they would produce similar net noise emissions when used concurrently with the equipment listed.

The magnitude of off-site noise impacts associated with construction is dependent upon a number of factors:

- the intensity and location of construction activities
- the type of equipment used
- existing background noise levels
- intervening terrain and structures
- prevailing weather conditions

Construction machinery would likely move about the Proposal site altering the received noise for individual receivers. During any given period, the machinery items to be used would operate at maximum sound power levels for only brief stages. At other times, the machinery would produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one

time. Certain types of construction machinery would be present in the study area for only brief periods during construction. Therefore, noise predictions are considered conservative.

Table 4-2 below presents the number of construction equipment proposed for each construction scenario. The activity sound power level has been calculated based on the two noisiest plant to determine the worst-case noise impacts during construction. The activity noise levels have been used to predict the noise levels that would be expected during construction works.

Table 4-2 Construction scenarios sound power levels, dB(A)

Plant description	Sound power level	Construction scenario						
		CS01	CS02	CS03	CS04	CS05	CS06	CS07
Activity Sound Power Level, dB(A)		122	123	115	122	122	112	115
Concrete agitator truck	103		✓	✓	✓	✓		
Concrete pump truck	108		✓	✓	✓	✓		
Concrete saw (5 mins) ¹	122	✓	✓		✓	✓		
Crane (mobile)	104			✓	✓			
Excavator	107	✓	✓					✓
Hand tools (electric)	110	✓	✓	✓	✓	✓	✓	✓
Piling rig (bored)	111			✓				
Roller	113		✓	✓				✓
Truck (> 20 tonne)	107	✓	✓	✓	✓	✓	✓	✓
Forklift	106	✓	✓			✓	✓	✓

1) A 5 dB penalty has been added due to tonal annoyance in accordance with the NPI

4.2 Noise modelling inputs

Noise modelling was undertaken using SoundPlan Version 8.1. SoundPlan is a computer program for the calculation, assessment and prognosis of noise exposure. SoundPlan calculates environmental noise propagation according to *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'*.

The following noise modelling assumptions were made:

- Land within the Royal Randwick Racecourse was modelled assuming a mix of 75 per cent soft and 25 per cent hard ground with a ground absorption coefficient of 0.75
- Surrounding land was modelled assuming a mix of 25 per cent soft and 75 percent hard ground with a ground absorption coefficient of 0.25
- atmospheric absorption was based on an average temperature of 10°C and an average humidity of 70%
- atmospheric propagation conditions were modelled with noise enhancing wind conditions for noise propagation (downwind conditions) or an equivalently well-developed moderate ground based temperature inversions
- modelled scenarios take into account the shielding effect from surrounding buildings and structures on and adjacent to the site

- noise sources for each scenario are in some cases modelled at different locations. As such the noise modelling assesses the noise source at multiple locations and takes the maximum L_{Aeq} received noise level.

4.3 Construction noise impacts

A summary of the number of exceedances of the noise management levels for sensitive receivers is presented in Table 4-3 for residential receivers and Table 4-4 for non-residential receivers. Predicted noise levels from the construction scenarios outlined in are presented in Appendix A.

Exceedances of the construction noise management levels are typical for construction projects of this scale. The noise impacts would be limited to the construction period only and would not have lasting effects on the community. The maximum noise impacts would be expected during works at the platform level involving the use of a concrete saw. Impacted receivers would only experience the predicted worst case noise levels when construction works are located closest to the receiver. At other times, the receivers would experience levels below the worst case noise levels predicted as construction activities would move away from the receiver.

A summary of the results is presented below in for residential receivers and Table 4-4 for non-residential receivers.

Table 4-3 Residential receivers summary

	Construction scenario						
	CS01	CS02	CS03	CS04	CS05	CS06	CS07
Summary during standard construction hours							
Number of NAML exceedances	2	3	1	2	2	1	1
Highest noise level, dB(A)	70	71	63	70	70	60	63
Worst affected receiver	R03	R03	R03	R03	R03	R03	R03
Summary during outside standard construction hours (day)							
Number of NAML exceedances	13	14	2	13	13	2	2
Highest noise level, dB(A)	70	71	63	70	70	60	63
Worst affected receiver	R03	R03	R03	R03	R03	R03	R03

Table 4-4 Non-residential receiver summary

	Construction scenario						
	CS01	CS02	CS03	CS04	CS05	CS06	CS07
Educational institute							
Number of NAML exceedances	2	2	1	2	2	0	1
Highest noise level, dB(A)	54	55	47	54	54	44	47
Worst affected receiver	R08	R08	R08	R08	R08	R08	R08

4.4 Sleep disturbance impacts

No night works are scheduled in the construction works program, and as such no sleep disturbance impacts have been assessed. If any night works are to be scheduled during construction a sleep disturbance impacts assessment should be carried out.

4.5 Construction traffic impacts

The RNP recommends that “*any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding ‘without construction’ scenario.*” Construction of the Proposal would generate heavy vehicle movements associated with the transportation of construction machinery, equipment and materials to the site. Light vehicle movements would be associated

with employees and smaller deliveries. Access to the construction site would be from Ascot Street. The site access route road classifications are as follows:

- Anzac Parade
- Ascot Street

To increase road traffic noise by 2 dBA (a doubling in traffic roughly corresponds to a 3 dBA increase) a large increase in traffic volumes would be required along Anzac Parade. Due to the existing high traffic volumes along Anzac Parade, it is considered unlikely that construction traffic generation along these roads would cause construction traffic noise impacts. Therefore no further assessment is required along this route.

Access to the Proposal site would be Ascot Street and Alison Road. Ascot Street is a local road however and is unlikely to experience construction road traffic noise impacts due to the high existing road traffic volumes. Traffic flows should be managed in a way to reduce the impact to residential receivers in this area.

5. Construction vibration assessment

5.1 Assessment methodology

The methodology for the construction vibration assessment included:

- vibration from surface construction plant and equipment was predicted and assessed with consideration to *Assessing Vibration: a Technical Guideline*. British Standard BS 6472 – 1992, *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* and German Standard DIN 4150-3: 1999 *Structural Vibration – Part 3: Effects of vibration on structure*
- where vibration impacts are anticipated, appropriate construction noise and vibration mitigation measures were provided to minimise impacts from each construction phase

5.1.1 Vibration source levels

Typical vibration levels for vibration generating equipment are detailed in Table 5-1.

Table 5-1 Vibration generating equipment

Equipment	Peak particle velocity source level (mm/s)	Data reference
Roller	5 to 7 at 10 m	<i>Environmental Noise Management Manual</i> (RTA, 2001)
Excavator	2.5 at 8 m	Tynan, A.E. <i>Ground Vibration Damaging Effects to Buildings</i> , Australian Road Research Board 1973

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuates with distance. The magnitude and attenuation of ground vibration is dependent on the following:

- the efficiency of the energy transfer mechanism of the equipment (i.e. impulsive; reciprocating, rolling or rotating equipment)
- the frequency content
- the impact medium stiffness
- the type of wave (surface or body)
- the ground type and topography

5.1.2 Assessment of vibration impacts

Construction and demolition works have the potential to impact human comfort and / or cause structural damage to buildings. Potential vibration inducing activities identified during construction and demolition works include:

- piling, grinding and cutting will generate impulsive vibration emissions
- bulk earthworks, construction traffic movements and demolition works will be a source of intermittent or continuous vibration.

Safe working buffer distances to comply with the human comfort and cosmetic damage are listed in Table 5-2. The heritage structure buffer distance has been assumed to be twice as stringent as the residential structure distance.

Table 5-2 Vibration safe working buffer distances (metres)

Activity	Human comfort	Residential and light commercial structures	Heritage structure
Vibratory roller (7-13 tonnes)	100 m	30 m	15 m
Piling rig – Bored	N/A	4 m (nominal)	2 m (nominal)
Large hydraulic hammer	73 m	44 m	22 m

5.1.3 Construction vibration impacts

Structural damage impacts

Standard structures that are a part of the Royal Randwick Racecourse precinct are within 15 metres of the construction, specifically the multi-storey carpark and equine centre. Mitigation measures have been provided in Section 7 should vibratory rolling occur within 15 meters of the multi-storey car park, or hammering occur within 22 meters of the multi-storey car park.

The location of heritage items within the Randwick Racecourse should be identified prior to construction activities. If any of the works occur within the buffer zones presented above, mitigation measures provided in Section 7 should be implemented.

Human comfort impacts

The closest residential receiver is over 150 metres away from construction activities and as such no further assessment for human comfort impacts is required.



Figure 5-1 Vibration buffer zones

6. Operational impact assessment

6.1 Race day events

The proposed Leger Lawn Redevelopment will not result in an increase of approved patronage within the spectator precinct during race day events.

The use and operation of the facility during race day events is unlikely to result in an increase of overall noise emission from the site. The noise emission from the site is proposed to be managed under the existing Noise Management Plan for the spectator precinct.

As such, an assessment of noise emission from the use of the facility during race day events is not warranted.

6.2 Non race day events – outdoor amplified events

The proposed Leger Lawn Redevelopment does not propose to hold large outdoor amplified events, and as such, an assessment of noise emission from this type of usage is not required.

6.3 Non race day events

6.3.1 Proposed usage

The facility is proposed to be utilised for similar activities already being held on site. Typical activities will include:

- Private and corporate dinners
- Luncheons
- Cocktail parties and formals
- Functions
- Conferences and general meetings
- Exhibitions and expositions
- University and school exams

Noise from conferences and general meetings, exhibitions and exams within the proposed facility are unlikely to generate high levels of noise emission and do not require detailed noise modelling.

Noise from dinners, luncheons, and cocktail parties and functions have the potential to generate noise levels requiring assessment. Therefore, a noise assessment of several scenarios has been undertaken to determine these impacts and inform any mitigation or management measures to be implemented.

6.3.2 Noise modelling methodology

Noise modelling was undertaken using CadnaA 2019. CadnaA is a computer program for the calculation, assessment and prognosis of noise exposure. Environmental noise propagation in CadnaA was calculated using the ISO 9713-2 algorithm.

The following noise modelling assumptions were made to establish site specific conditions:

- Surrounding land was modelled assuming mixed ground (the surrounding area was a mix of concrete and asphalt, and grass) with a ground absorption coefficient of 0.5

- Modelled scenarios take into account the shielding effect from surrounding buildings and structures on and adjacent to the site
- Receivers were modelled at a height of 1.5 m (ground floor), and 4.5 (first floor)

The following meteorological conditions used in the model:

- Atmospheric air absorption was based on an average temperature of 10°C and an average humidity of 75 % (conservative)
- Atmospheric propagation conditions were modelled with moderate inversions from source to receiver (ISO 9613)

6.3.3 Operational scenarios

The assessment of noise emission from the proposal has been assessed against the relevant noise emission criteria. The resulting scenarios and assumptions for the assessment are as follows.

Scenario 1: Maximum operations – 7:00 am to 10:00 pm

This scenario represents the proposal at maximum capacity. The facility is at full capacity with live/amplified music played inside the function facility. The assumptions for the scenario are as follows:

- 2870 patrons in total across the facility, including:
 - 1850 patrons within the ground floor internal area
 - 1020 patrons across the first floor area, with an assumed 60 % of patrons within the indoor function space and 40 % of patrons within the outdoor deck area:
- The following sound power levels for patrons have been assumed:
 - It is assumed that 50% of patrons are talking at any given time with the following vocal efforts:
 - 70% talking with normal voices – Sound pressure level (SPL) @ 1 m – 62 dB(A) each
 - 20% talking with raised voices – SPL @ 1 m – 69 dB(A) each
 - 10% talking with loud voices – SPL @ 1 m – 76 dB(A) each
 - Ground floor glazing open to lawn area. All other glazing closed. Glazing assumed to be 6 mm standards glazing with sound transmission loss of R_w 26.
 - South western doors providing access between indoor and outdoor areas open 50 % of time to allow for ingress/egress
- Amplified music/live band playing inside indoor function space – SPL @ 10 m – 79 dB(A)
- Outdoor speakers (12 evenly distributed around perimeter at 2 metres high) – sound pressure level (SPL) 74 dB(A) at 1 metre

Based on the above assumptions, the following octave band sound levels have been used for modelling of scenario 1.

Table 6-1 Operational noise levels – Scenario 1

Noise source	Type	L _{Aeq} in octave bands [Hz], dB(A)									
		31.5	63	125	250	500	1000	2000	4000	8000	OA
Ground floor function room	Internal reverberant sound pressure level ¹	45	53	69	73	75	79	77	73	67	84
First floor function room	Internal reverberant sound pressure level ¹	47	55	72	75	77	80	78	75	69	85
First floor outdoor area	Sound Power Level ²	60 ³	65 ³	69	84	95	99	97	90	80	102

Note:

1) Inclusive of patron noise and live / amplified music

2) the sound power level has been evenly distributed across the outside area, being approximately 800 m²

3) No data is provided at these frequencies. Conservative assumptions have been made

Scenario 2: Operations with all patrons inside and external doors closed – 10 pm to 2 am

This scenario represents the proposal at a further reduced noise emission. The doors to between indoor and outdoor areas are closed with no patrons utilising the outside deck. The assumptions for the scenario are as follows:

- 2870 patrons in total across the facility, including:
 - 1850 patrons within the ground floor internal area
 - 1020 patrons within the first floor indoor area
- The following sound power levels for patrons have been assumed:
 - It is assumed that 50% of patrons are talking at any given time
 - 70% talking with normal voices – Sound pressure level (SPL) @ 1 m – 62 dB(A) each
 - 20% talking with raised voices – SPL @ 1 m – 69 dB(A) each
 - 10% talking with loud voices – SPL @ 1 m – 76 dB(A) each
 - All other glazing closed. Glazing assumed to be 6 mm standard glazing with R_w 26.
 - South western doors closed at all times. Ingress and egress using door separating internal areas and circulation areas at rear of facility
- Amplified music/live band playing inside indoor function space – SPL @ 10 m – 79 dB(A)

Based on the above assumptions, the following octave band sound levels have been used for modelling of scenario 1.

Table 6-2 Operational noise levels – Scenario 1

Noise source	Type	L _{Aeq} in octave bands [Hz], dB(A)									
		31.5	63	125	250	500	1000	2000	4000	8000	OA
Ground floor function room	Internal reverberant sound pressure level ¹	45	53	69	73	75	79	77	73	67	84
First floor function room	Internal reverberant sound pressure level ¹	50	58	75	78	80	83	81	78	72	88

Note:

1) Inclusive of patron noise and live / amplified music

6.3.4 Additional modelling inputs

In addition to the above operational scenarios, the following noise modelling inputs have been included in the assessment.

Existing operations in QEII function area

To assess possible cumulative noise impacts from the spectator precincts, the noise assessment has taken into account the possibility of simultaneous usage of the proposed facility and the existing function areas of the QEII building.

As these existing facilities vary in usage and capacity, a conservative internal reverberant sound pressure level of 100 dBA has been assumed for each of the areas, assumed with windows and doors open between the hours of 7 am and 10 pm. After 10 pm, it is assumed that windows and doors will be closed with a reduced noise level due to the sound transmission loss of the glass, assumed to be R_w 26. This has been included within the noise modelling to determine the cumulative noise impacts at each of the sensitive receivers.

Mechanical plant

The mechanical plant servicing the proposal facility is to be located within 2 areas, being the mezzanine floor level (between the ground and first floor levels) and the plant level (between first floor and roof levels).

The specific mechanical plant has not been selected at this stage of the project, however indicative plant location and sound power levels have been provided by the mechanical consultant for preliminary assessment. A summary of the preliminary design is provided:

Mezzanine plant room

This plant room is fully enclosed with an outside air louvre as detailed in Figure 6-1 below.

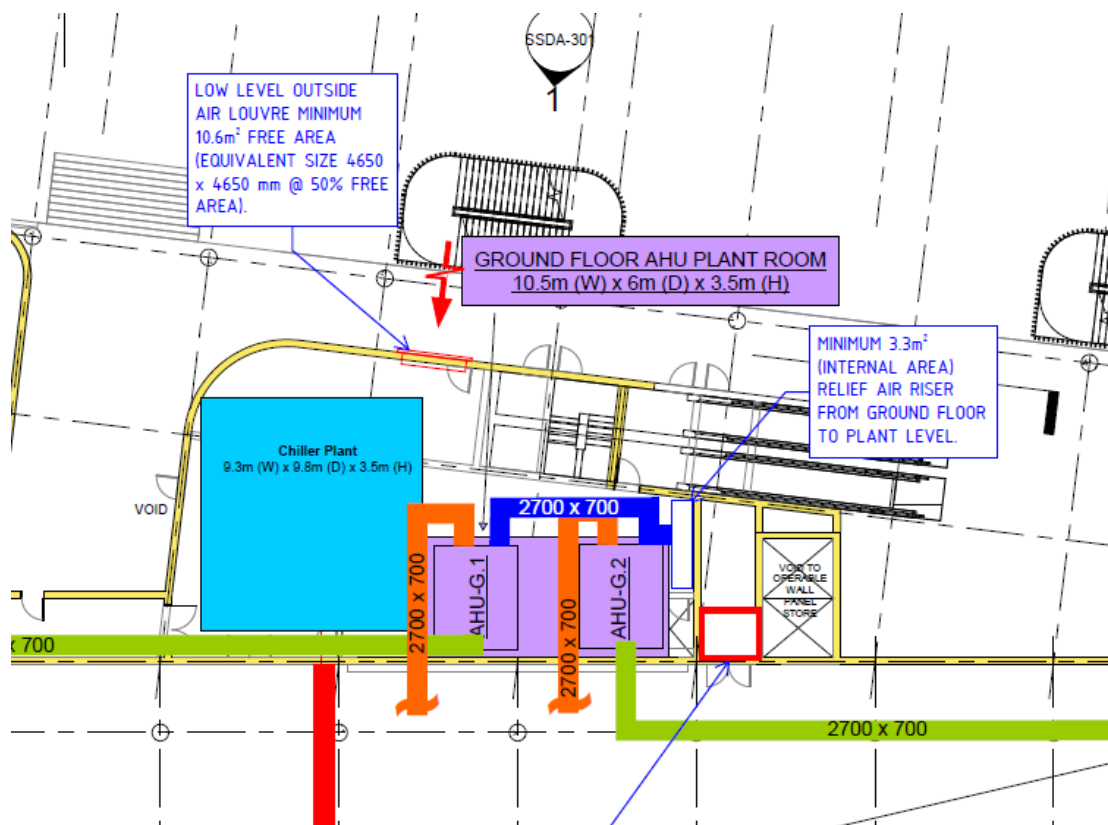


Figure 6-1 Mezzanine plant room layout

Chiller plant (2 off) – Sound power level (SWL) 85 dBA

Air handling units (AHU) (2 off) – SWL 92 dBA

Outdoor plant

This plant room is has an open roof with outside air louvres as detailed in Figure 6-2 below.

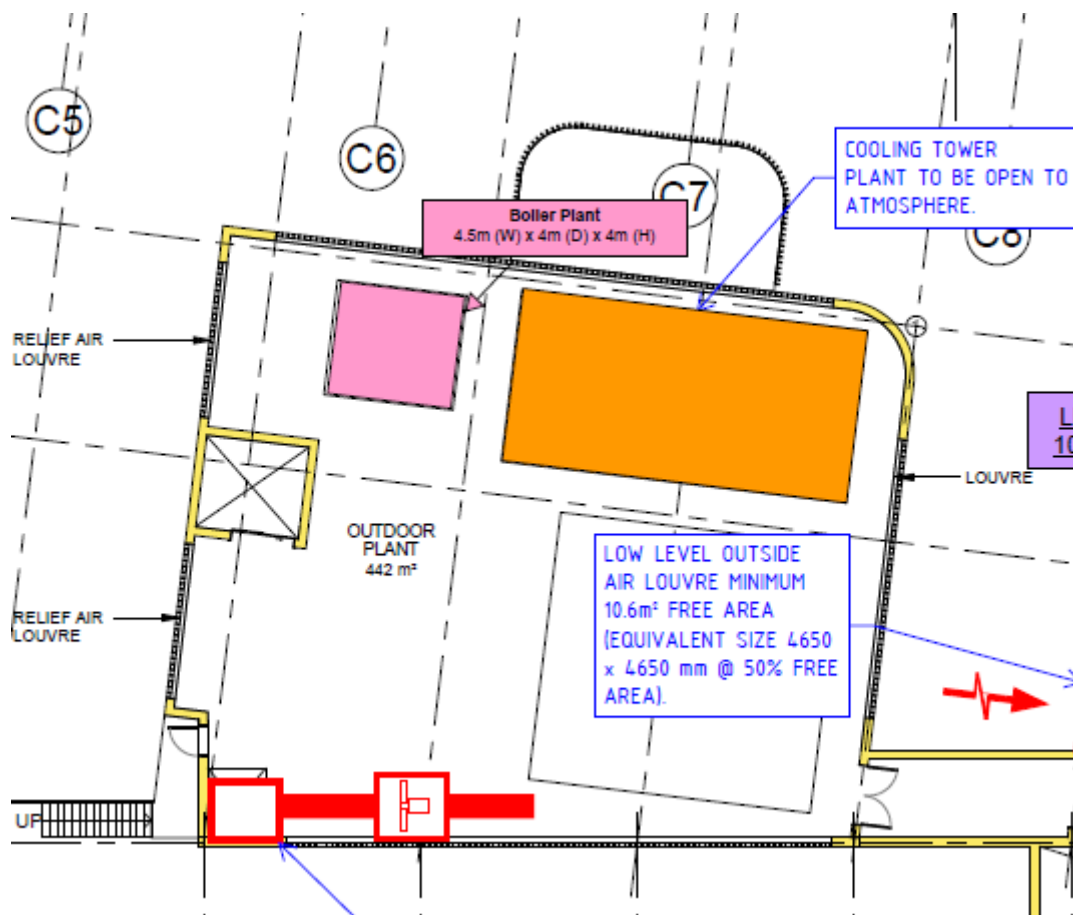


Figure 6-2 Outdoor plant area layout

Cooling towers (2 off) – SWL 91 dBA

Boilers (2 off) – 53 dBA

A detailed assessment should be undertaken at a later stage when the mechanical plant details have been finalised to determine whether any specific noise mitigation measures are required.

6.3.5 Predicted noise levels

Based on the above operational scenarios and additional assumptions, noise levels have been predicted and are detailed in Table 6-3 below.

Table 6-3 Noise assessment results – Scenario 1

Receiver ID	Scenario 1, dB(A) 7:00 am to 6 pm			
	Noise source	Contribution	Overall noise level	Criteria
R01	Ground floor function space	15	33	51 (day) 45 (evening)
	First floor function space	30		
	First floor outside areas	23		
	Mechanical plant	16		
	Existing operations in QEII building	26		
R02	Ground floor function space	21	37	
	First floor function space	35		
	First floor outside areas	26		
	Mechanical plant	19		
	Existing operations in QEII building	29		
R03	Ground floor function space	5	44	
	First floor function space	41		
	First floor outside areas	28		
	Mechanical plant	37		
	Existing operations in QEII building	36		
R04	Ground floor function space	1	37	
	First floor function space	25		
	First floor outside areas	16		
	Mechanical plant	35		
	Existing operations in QEII building	30		
R05	Ground floor function space	<0	45	
	First floor function space	20		
	First floor outside areas	17		
	Mechanical plant	44		
	Existing operations in QEII building	32		
R06	Ground floor function space	<0	43	
	First floor function space	18		
	First floor outside areas	19		
	Mechanical plant	42		
	Existing operations in QEII building	31		

Receiver ID	Scenario 1, dB(A) 7:00 am to 6 pm			
	Noise source	Contribution	Overall noise level	Criteria
R07	Ground floor function space	17	29	
	First floor function space	26		
	First floor outside areas	22		
	Mechanical plant	16		
	Existing operations in QEII building	22		
R08	Ground floor function space	19	30	
	First floor function space	25		
	First floor outside areas	20		
	Mechanical plant	28		
	Existing operations in QEII building	15		
R09	Ground floor function space	17	31	
	First floor function space	28		
	First floor outside areas	23		
	Mechanical plant	24		
	Existing operations in QEII building	22		
R10	Ground floor function space	21	31	
	First floor function space	28		
	First floor outside areas	24		
	Mechanical plant	23		
	Existing operations in QEII building	22		
R11	Ground floor function space	21	31	
	First floor function space	28		
	First floor outside areas	24		
	Mechanical plant	22		
	Existing operations in QEII building	21		
R12	Ground floor function space	21	31	
	First floor function space	28		
	First floor outside areas	23		
	Mechanical plant	21		
	Existing operations in QEII building	22		

Receiver ID	Scenario 1, dB(A) 7:00 am to 6 pm			
	Noise source	Contribution	Overall noise level	Criteria
R13	Ground floor function space	20	31	
	First floor function space	28		
	First floor outside areas	23		
	Mechanical plant	20		
	Existing operations in QEII building	22		
R14	Ground floor function space	9	24	
	First floor function space	22		
	First floor outside areas	15		
	Mechanical plant	17		
	Existing operations in QEII building	14		
R15	Ground floor function space	19	30	
	First floor function space	28		
	First floor outside areas	22		
	Mechanical plant	19		
	Existing operations in QEII building	23		
R16	Ground floor function space	11	27	
	First floor function space	25		
	First floor outside areas	19		
	Mechanical plant	17		
	Existing operations in QEII building	19		
R17	Ground floor function space	14	28	
	First floor function space	25		
	First floor outside areas	19		
	Mechanical plant	18		
	Existing operations in QEII building	20		
R18	Ground floor function space	17	28	
	First floor function space	26		
	First floor outside areas	19		
	Mechanical plant	14		
	Existing operations in QEII building	21		

Receiver ID	Scenario 1, dB(A) 7:00 am to 6 pm			
	Noise source	Contribution	Overall noise level	Criteria
R19	Ground floor function space	19	30	
	First floor function space	27		
	First floor outside areas	21		
	Mechanical plant	18		
	Existing operations in QEII building	22		
R20	Ground floor function space	17	29	
	First floor function space	26		
	First floor outside areas	20		
	Mechanical plant	15		
	Existing operations in QEII building	21		
R21	Ground floor function space	18	29	
	First floor function space	27		
	First floor outside areas	21		
	Mechanical plant	17		
	Existing operations in QEII building	22		

Table 6-4 Noise assessment results – Scenario 2

Receiver ID	Scenario 2, dB(A) 10:00 pm to 7:00 am			
	Noise source	Contribution	Overall noise level	Criteria
R01	Ground floor function space	22	28	41 (night)
	First floor function space	16		
	Mechanical plant	26		
	Existing operations in QEII building	16		
R02	Ground floor function space	25	31	
	First floor function space	20		
	Mechanical plant	29		
	Existing operations in QEII building	19		
R03	Ground floor function space	25	49	
	First floor function space	7		
	Mechanical plant	36		
	Existing operations in QEII building	37		
R04	Ground floor function space	14	37	
	First floor function space	1		
	Mechanical plant	30		
	Existing operations in QEII building	35		
R05	Ground floor function space	17	38	
	First floor function space	<0		
	Mechanical plant	32		
	Existing operations in QEII building	37		
R06	Ground floor function space	19	37	
	First floor function space	<0		
	Mechanical plant	31		
	Existing operations in QEII building	35		
R07	Ground floor function space	21	26	
	First floor function space	17		
	Mechanical plant	22		
	Existing operations in QEII building	16		
R08	Ground floor function space	20	27	
	First floor function space	18		

Receiver ID	Scenario 2, dB(A) 10:00 pm to 7:00 am			
	Noise source	Contribution	Overall noise level	Criteria
	Mechanical plant	15		
	Existing operations in QEII building	28		
R09	Ground floor function space	23	27	
	First floor function space	17		
	Mechanical plant	22		
	Existing operations in QEII building	24		
R10	Ground floor function space	24	28	
	First floor function space	21		
	Mechanical plant	22		
	Existing operations in QEII building	23		
R11	Ground floor function space	24	28	
	First floor function space	21		
	Mechanical plant	21		
	Existing operations in QEII building	22		
R12	Ground floor function space	23	27	
	First floor function space	20		
	Mechanical plant	22		
	Existing operations in QEII building	21		
R13	Ground floor function space	23	27	
	First floor function space	20		
	Mechanical plant	22		
	Existing operations in QEII building	20		
R14	Ground floor function space	13	19	
	First floor function space	11		
	Mechanical plant	14		
	Existing operations in QEII building	17		
R15	Ground floor function space	22	27	
	First floor function space	19		
	Mechanical plant	23		
	Existing operations in QEII building	19		

Receiver ID	Scenario 2, dB(A) 10:00 pm to 7:00 am			
	Noise source	Contribution	Overall noise level	Criteria
R16	Ground floor function space	17	23	
	First floor function space	12		
	Mechanical plant	19		
	Existing operations in QEII building	17		
R17	Ground floor function space	18	23	
	First floor function space	15		
	Mechanical plant	20		
	Existing operations in QEII building	18		
R18	Ground floor function space	19	24	
	First floor function space	16		
	Mechanical plant	21		
	Existing operations in QEII building	14		
R19	Ground floor function space	21	26	
	First floor function space	18		
	Mechanical plant	22		
	Existing operations in QEII building	18		
R20	Ground floor function space	20	25	
	First floor function space	17		
	Mechanical plant	21		
	Existing operations in QEII building	15		
R21	Ground floor function space	20	26	
	First floor function space	18		
	Mechanical plant	22		
	Existing operations in QEII building	17		

6.3.6 Sleep disturbance assessment

The assessment of sleep disturbance from the use and operation of the proposed facility is based on the following scenarios that represent maximum noise level events, and is assessed against the INP sleep disturbance criteria:

- SD1: Snare drum (or equivalent) inside function space – SWL 105 dB(A)
- SD2: Patron shouting in outdoor deck area – SWL 90 dB(A)

It is expected that maximum noise events from within the facility would be similar to this or less.

The results of the sleep disturbance noise assessment are presented in Table 6-5.

Table 6-5 Sleep disturbance assessment

Receiver ID	Receiver type	Criteria L_{AFmax} , dB(A)	Predicted max noise level at receiver L_{AFmax} , dB(A)		Compliance
			SD1	SD2	
R01	Residential	57	39	24	Yes
R02			42	28	Yes
R03			41	34	Yes
R04			28	16	Yes
R05			34	12	Yes
R06			35	9	Yes
R07			37	19	Yes
R08			37	14	Yes
R09			41	18	Yes
R10			41	17	Yes
R11			41	17	Yes
R12			40	17	Yes
R13			39	17	Yes
R14			29	10	Yes
R15			39	18	Yes
R16			34	15	Yes
R17			34	15	Yes
R18			35	16	Yes
R19			38	17	Yes
R20			36	16	Yes
R21			37	17	Yes

6.4 Discussion

The results of the operational noise assessment and sleep disturbance noise assessment indicate the following:

- The proposed operational scenarios are compliant with the existing conditions of approval for the spectator precinct, being the EPA's Industrial Noise Policy

Mitigation measures are presented in Section 7 to ensure compliance with the relevant noise criteria.

7. Mitigation recommendations

7.1 Construction mitigation measures

As discussed in Section 4, construction activities could cause adverse noise impact on surrounding sensitive receivers during one construction scenario. Mitigation measures detailed in Table 7-1 should be considered where reasonable and feasible to minimise noise construction noise impacts at sensitive receivers.

Table 7-1 Standard mitigation measures for construction noise and vibration

Action required	Details
Management measures	
Implement community consultation measures	Potentially impacted receivers would be notified of the works prior to commencement. Notification would include expected noise levels, duration of the works and a method of contact.
Site inductions	<p>All employees, contractors and subcontractors are to receive an environmental induction and an ATC Equine Online Induction. The inductions must at least include:</p> <ul style="list-style-type: none"> • all relevant project specific and standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/ unloading areas and procedures • construction traffic routes • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioural practices	<p>No unnecessary shouting or loud stereos/radios on site.</p> <p>No dropping of materials from height, throwing of metal items and slamming of doors.</p>
Attended vibration measurements	Attended vibration measurements are required at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic damage, should activities occur within the vibration buffer zones
Complaints handling	<p>Potentially impacted receivers would be provided with a community consultation telephone number. Upon receipt of noise or vibration complaints, the following would be recorded:</p> <ul style="list-style-type: none"> • Time and nature of complaint • Complaint response and close out actions • Correspondence • Monitoring results • Mitigation measures.
Source controls	
Construction hours and scheduling	Where feasible and reasonable, construction should be carried out during standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods
Construction respite periods	High noise and vibration generating activities may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.
Equipment selection	Use quieter and less vibration emitting construction methods where feasible and reasonable.

Action required	Details
Noise audits	<p>The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria listed in Table 4-2 of this report.</p> <p>Noise audits would be undertaken to verify equipment noise levels and compliance at the commencement of noise generating activities.</p>
Use and siting of plant	<p>Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided.</p> <p>The offset distance between noisy plant and adjacent sensitive receivers is to be maximised.</p> <p>Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.</p>
Plan worksites and activities to minimise noise and vibration	<p>Plan traffic flow, parking and loading/ unloading areas to minimise reversing movements within the site.</p>
Minimise disturbance arising from delivery of goods to construction sites	<p>Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers.</p> <p>Select site access points and roads as far as possible away from sensitive receivers.</p> <p>Dedicated loading/unloading areas to be shielded if close to sensitive receivers.</p> <p>Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.</p>

The Construction Noise Strategy (Transport for NSW, 2012) provides additional mitigation measures when the predicted noise levels exceed the construction noise management levels. These additional mitigation measures are provided in Table 7-2. Noise levels for each scenario are presented in Appendix A and should be used to determine the appropriate additional mitigation measures as per the table below, depending on the activity and the exceedance of the background noise level.

Noise levels are not predicted to be highly intrusive at any sensitive receiver during standard or Out of hours work (OOHW) period 1 construction hours.

Table 7-2 Additional mitigation measures – airborne construction noise

Criteria		L _{Aeq} (15 min) noise level above rating background level			
		0 to 10 dBA	10 to 20 dBA	20 to 30 dBA	>30 dBA
Time period		Noticeable	Clearly audible	Moderately intrusive	Highly intrusive
Standard	Weekday (7 am – 6 pm)	-	-	LB, M	LB, M
	Saturday (8 am – 1 pm)				
OOHW Period 1	Saturday (1 pm – 6 pm)	-	LB	M, LB	M, IB, LB, RO, PC, SN

Monitoring (M): Compliance noise monitoring

Individual Briefings (IB): Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the Proposal.

Letter box drops (LB): Letter box drops or media advertisements.

Phone Calls (PC): Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs.

Specific Notifications (SN): Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications.

Alternative accommodation (AA): Alternative accommodation options would be offered to residents.

Source: *Construction Noise Strategy (Rail Projects)*, (TfNSW, 2012)

7.2 Operational mitigation measures

The results of the noise assessment presented in Section 6 include the following operational procedure presented in Table 7-3 will need to be in place for the precinct to be compliant with the relevant noise emission criteria presented in Section 3.

In addition to these measures, all operations are to be conducted in accordance with the Conditions of Approval for the spectator precinct as detailed in Section 3.1.

Table 7-3 Operational procedure

Representative scenario	Time of day	Operations
Scenario 1	7 am to 10 pm	<ul style="list-style-type: none"> Maximum 800 patrons using first floor outdoor area Partitioning doors separating outside ground floor function area and the lawn can be open <p>LEVEL 1 OUTDOOR AREA</p> <ul style="list-style-type: none"> Between 7 am and 6 pm: <ul style="list-style-type: none"> Should amplified music/live band be playing on the first floor outdoor area, the sound pressure level measured on the south-eastern end must not exceed $L_{Aeq, 15 \text{ min}}$ 70 dBA Between 6 pm and 10 pm: <ul style="list-style-type: none"> Should amplified music/live band be playing on the first floor outdoor area, the sound pressure level measured on the south-eastern end must not exceed $L_{Aeq, 15 \text{ min}}$ 65 dBA Speakers may be set up on outdoor area for background music with $L_{Aeq, 15 \text{ min}}$ 74 dBA at 1 m Between 7 am and 6 pm, the south-east doors on level 1 can remain open <p>LEVEL 1 INDOOR AREA</p> <ul style="list-style-type: none"> Between 6 pm and 10 pm: <ul style="list-style-type: none"> Should amplified music/live band be playing inside the first floor function space (with an internal reverberant sound pressure level of $L_{Aeq, 15 \text{ min}}$ 95 dBA or greater), the south-east doors are required to remain closed except for ingress/egress. The installation of an RMS noise level indicator may be required to inform staff when this level

		<p>is exceeded and doors are required to be closed</p> <ul style="list-style-type: none"> Should the internal reverberant sound pressure level be less than $L_{Aeq, 15 \text{ min}}$ 95 dBA, the south-east doors can remain open
Scenario 2	10 pm to 2 am	<ul style="list-style-type: none"> No patrons using first floor outdoor area Amplified DJ/live band music played inside the function spaces only No music outdoors All first floor south-east glazing to remain closed Ingress and egress through internal doors between function rooms and rear circulation areas

The following additional mitigation measures are provided in order to ensure that compliance with the relevant acoustic criteria is maintained and the acoustic amenity of the nearby receivers is adequately protected:

- Glazing on the indoor function space is to be minimum 6 mm thick glass.
- The erection of clear signage at the entry/exit of the venue advising patrons that they must not generate excessive noise and leave the premises in a quiet and sensible manor to minimise any potential impacts on the surrounding amenity.
- Emptying glass bottles in bins is to be conducted during the day time hours only (7 am to 6 pm Monday to Saturday and 8 am to 6 pm on Sundays and Public Holidays). Glass bottles should be crushed prior to disposal, if possible

8. Conclusion

GHD has prepared a noise and vibration impact assessment (NVIA) for the proposed Leger Lawn Redevelopment ("the Proposal") at the existing ATC Royal Randwick Racecourse. This NVIA was prepared in support of an Environmental Impact Statement (EIS) for SSD 10285.

The objective of this acoustic assessment is to assess construction and operational noise emission from the redevelopment, and if required, recommend acoustic measures to ensure acceptable residential amenity.

Results of the noise assessment are detailed in Section 5 for construction and Section 6 for operation. Mitigation measures for both construction and operational activities are detailed in Section 7 and should be implemented to achieve relevant noise emission criteria.

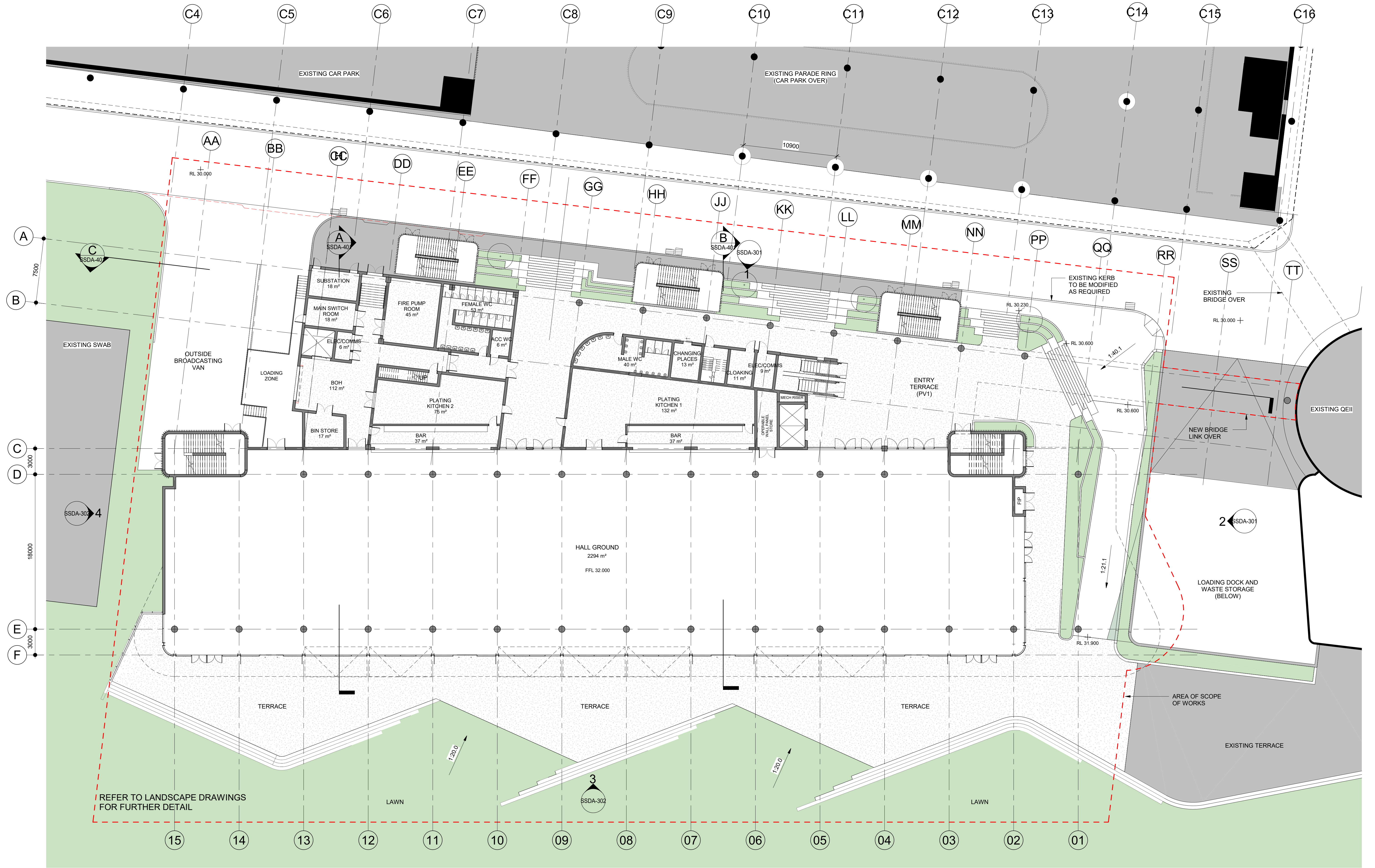
Based on the noise modelling assumptions and assessment of the operation of the proposed Leger Lawn Redevelopment, the development is predicted to comply with the relevant noise emission criteria presented in Section 3. With the mitigation measures presented in Section 7 implemented, the proposed facility should not adversely affect the acoustic amenity of the surrounding residential area.

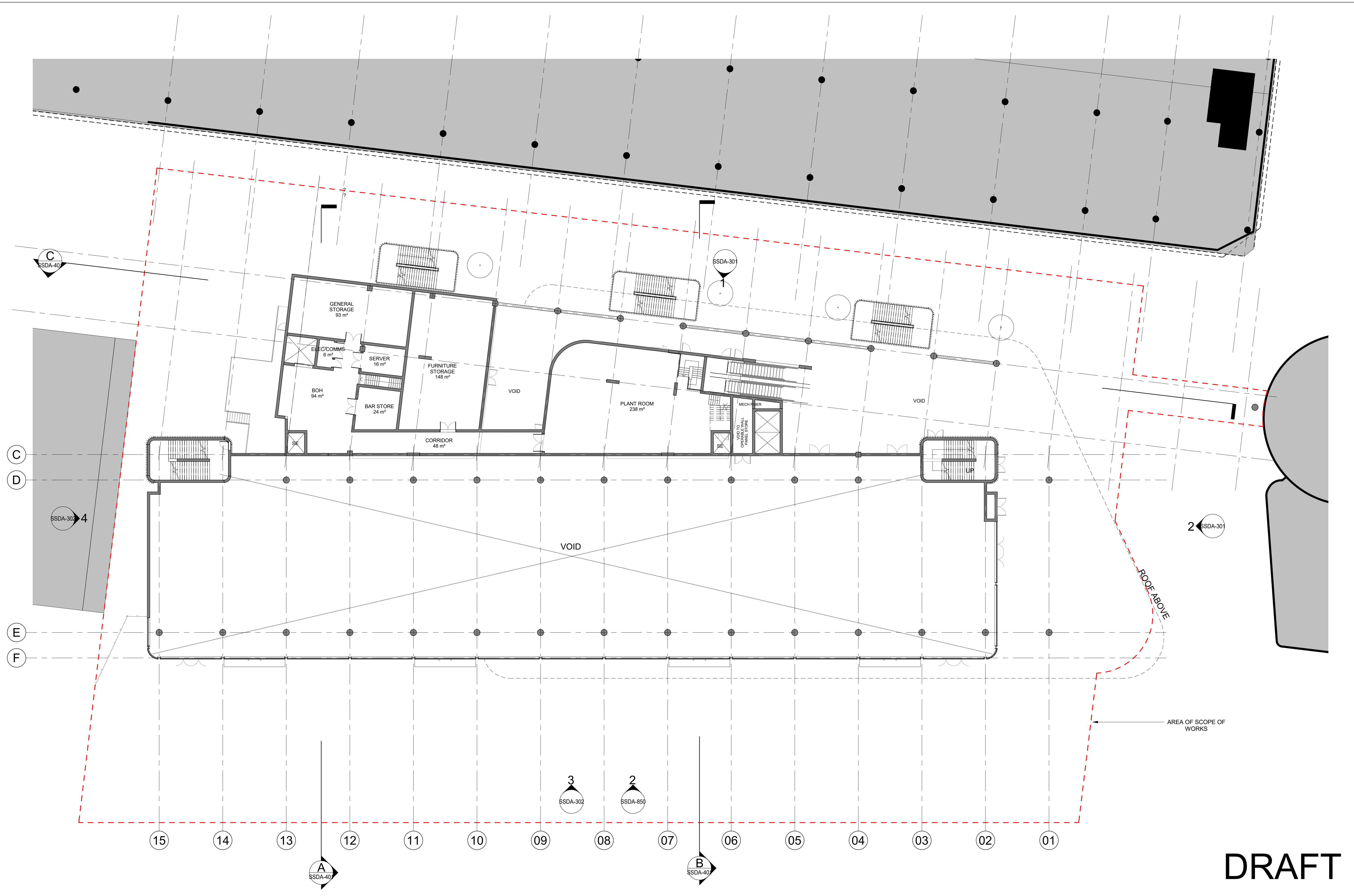
Appendices

Appendix A – Construction noise predicted levels

Receiver ID	CS1	CS2	CS3	CS4	CS5	CS6	CS7	Criteria	
								Standard hours	OOH
R01	54	55	47	54	54	44	47	59 (noise affected) 75 (highly noise affected)	54
R02	62	63	55	62	62	52	55		
R03	70	71	63	70	70	60	63		
R04	56	57	49	56	56	46	49		
R05	54	55	47	54	54	44	47		
R06	55	56	48	55	55	45	48		
R07	49	50	42	49	49	39	42	55	NA
R08	54	55	47	54	54	44	47		
R09	55	56	48	55	55	45	48	59 (noise affected) 75 (highly noise affected)	54
R10	54	55	47	54	54	44	47		
R11	53	54	46	53	53	43	46		
R12	53	54	46	53	53	43	46		
R13	53	54	46	53	53	43	46		
R14	52	53	45	52	52	42	45		
R15	51	52	44	51	51	41	44		
R16	48	49	41	48	48	38	41		
R17	49	50	42	49	49	39	42		
R18	48	49	41	48	48	38	41		
R19	45	46	38	45	45	35	38		
R20	47	48	40	47	47	37	40		
R21	47	48	40	47	47	37	40		

Appendix B – Architectural drawings



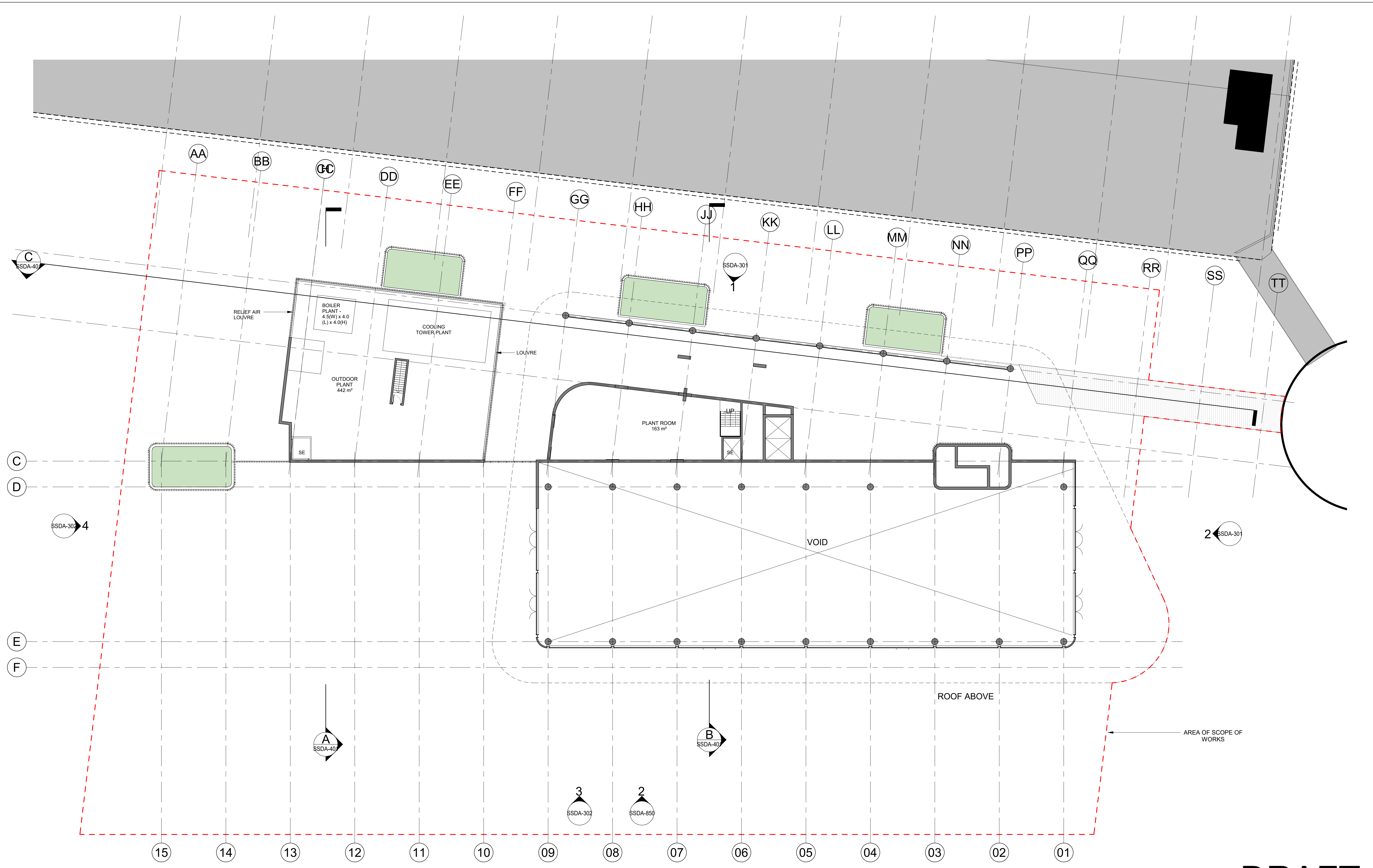


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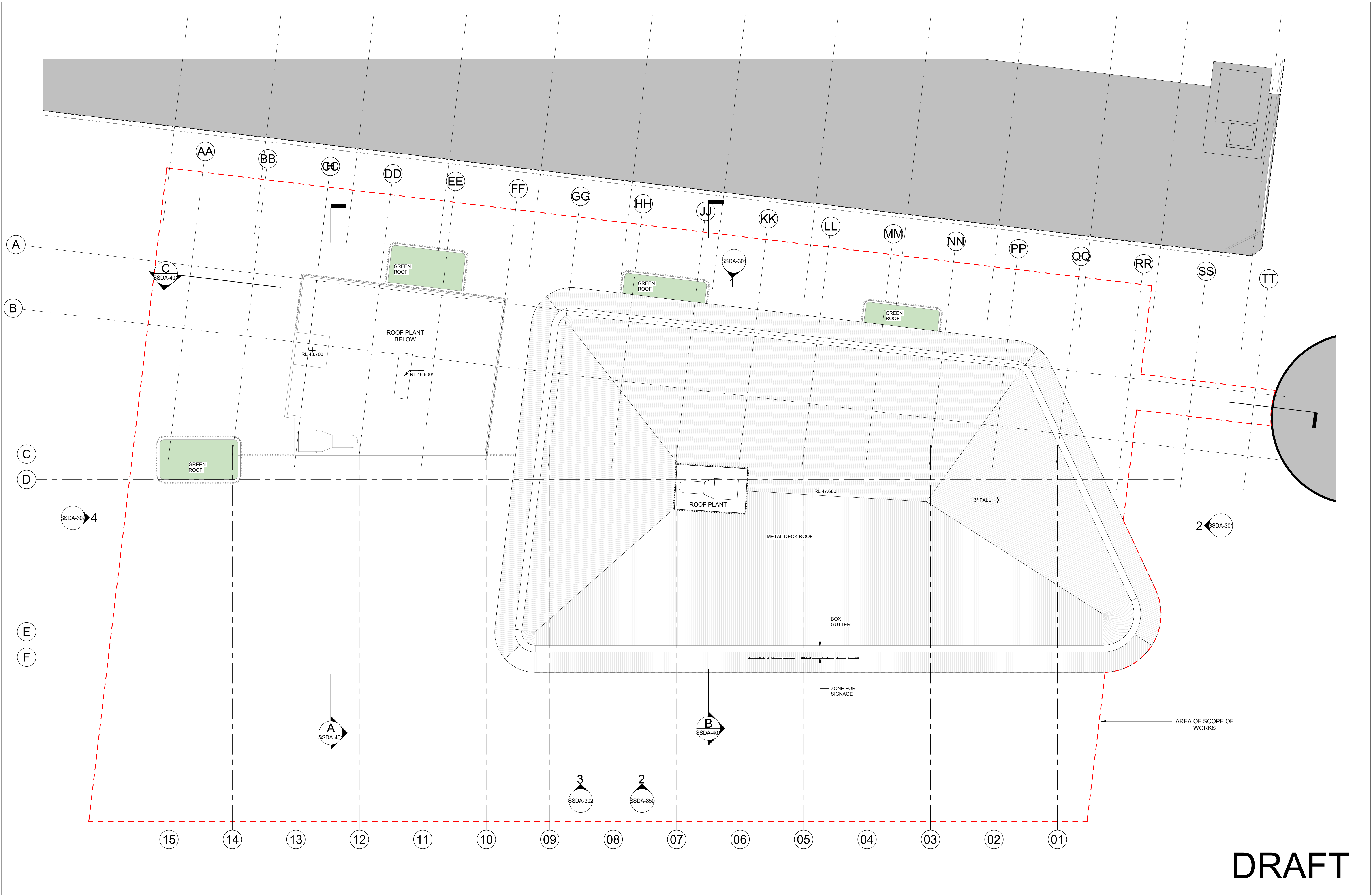


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21-SO1-34955311-

[1/https://projects.ghd.com/oc/sydney2/atcrrrlegerlawndevel/Delivery/Documents/2128150-REP_ATC Leger Lawn_Noise and Vibration.docx](https://projects.ghd.com/oc/sydney2/atcrrrlegerlawndevel/Delivery/Documents/2128150-REP_ATC Leger Lawn_Noise and Vibration.docx)

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	C Gordon	E Milton		E Smith		29/10/2019
1	C Gordon	E Milton		E Smith		30/10/2019
2	C Gordon	E Milton		E Smith		31/10/2019

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