All Welcome_SSD_part01 10300 – Acoustic SEARs Report

Coffs Harbour City Council

2 Castle Street, Coffs Harbour, NSW

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1 INTRODUCTION

Pulse Acoustic Consultancy Pty Ltd (Pulse Acoustics) has been engaged by Coffs Harbour City Council (the client) to undertake an environmental impact acoustic assessment for the cultural and civic space project, namely, the “All Welcome” project.

This project is considered a state significant development, and as such, the Planning Secretary's Environmental Assessment Requirements (SEARs) have been issued for this project. This report addresses the relevant acoustic conditions included in the SEARs and forms part of the environmental impact statement for the project.

A list of acoustic terminology used in this report is included in Appendix A.

1.1 Site Location

The proposed development is located between Riding Lane and Gordon Street, Coffs Harbour (refer to Figure 1). A carpark is located west from the development, along Riding Lane. Also, the development is surrounded by commercial properties along the northern property boundary and across Gordon Street to the east. A place of worship is located along the southern property boundary (i.e. Coffs Harbour Uniting Church)

In consultation with the client, the following residences are identified as closest to the site (refer to Figure 2):

- 3 to 11 Duke Street, approximately 85 m from the project site
- Corner of Vernon Street and Gordon Street, approximately 70 m from the project site. This is currently occupied with retail and commercial premises. However, according to the client, this site is approved for a hotel development above the current premises.

Additionally, areas of passive and active recreation have been found in the vicinity of the project site, at approximately 125 m from the northern property boundary. These are the following:

- Rotary Park is identified as a passive recreation area. This is located along Coff Street, north of the intersection with Gordon Street.
- Fitzroy Oval and the Coffs Harbour War Memorial Olympic Pool are considered as active recreation areas. These are also located along Coff Street, south of the intersection with Gordon Street.

Figure 1 Site location

Figure 2 Site location with respect to nearest residential receivers

1.2 Project Description

The proposed development comprises the following new premises (also refer to floor layouts provided in Appendix C of this report):

- Basement Level: car park spaces, end of trip facilities, plant rooms
- Ground Level: library spaces, museum areas, exhibition areas, art galleries, reception, cafes, retail stores, amenities, storage spaces, lift lobby, back-of-house areas (waste storage, switch room, etc), loading dock
- Level 1: exhibition areas, meeting rooms, open office areas (including Makerspace and Digital Studio), enclosed private offices, lounge rooms, library spaces, amenities, storage rooms, lift lobby, plant rooms, back-of-house areas
- Level 2: library spaces, amenities, storage rooms, lift lobby, plant rooms, comms room
- Level 3: enclosed private offices (mayor offices, administration offices, councillor offices), open office areas, public meeting rooms, multi-purpose chamber, external event space, corridors, amenities, reception areas, storage rooms, lift lobby
- Levels 4 and 5: terrace areas, open office areas, enclosed private offices, amenities, lift lobbies, comms room
- Level 6: roof plant room

It is also noted that the café located at Ground Level will operate as a licensed premise. The café will also operate a small bar on the External Event Space (Level 3).

Areas where a public address system (PA system) will be installed externally, have not been confirmed at this stage. However areas which are being considered are the following:

- Internal Street at Ground Level
- External Event Space in Level 3

Patron capacity for the development is as follows:

- Ground Level Café: Maximum of 90 patrons
- Level 3 External Areas: Maximum of 150 patrons

Finally, it is noted that the development will operate under the following times during weekday and weekends: 6:00 am till 12:00am.

1.3 Planning Secretary's Environmental Assessment Requirements (SEARs)

The Planning Secretary’s Environmental Assessment Requirements (SEARs) for the Coffs Harbour Cultural and Civic Space; were issued on 10 May 2019. The project is classified as a state significant development (SSD), and nominated by NSW Planning & Environment as SSD 10300.

The sections of the SEARs which are relevant to the acoustic assessment are the following:

5. Environmental Amenity

The Environmental Impact Statement (EIS) should include:

- *An assessment of amenity impacts, including solar access, acoustic impacts, visual privacy, view loss, overshadowing, reflectivity from building facades and wind impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.*

9. Noise and Vibration

The EIS shall identify and provide an acoustic assessment of the main noise and vibration generating sources during construction and operation (air-conditioning or other mechanical plant and equipment and other potential noise impacts from the use of the building) and outline measures to minimise and mitigate the potential noise impacts on sensitive receiver locations.

Relevant Policies and Guidelines:

- *Noise Policy for Industry 2017 (EPA)*
- *Interim Construction Noise Guideline (DECC)*
- *Assessing Vibration: A Technical Guideline 2006*
- *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning, 2008)*

23. Construction, Environment Management Plan

The EIS shall include:

A draft Construction, Environment Management Plan and Site Management Plan for the proposed works, including the following:

- *Assessment of any asbestos and other hazardous materials likely to be encountered during any demolition and site preparation works*
- *Community consultation, notification and complaints handling*
- *Impacts of construction on adjoining development and proposed measures to mitigate construction impacts*
- *Noise and vibration impacts during demolition, site preparation, bulk earthworks, construction and construction related work*
- *Water quality management for the site*
- *Dust control measures*
- *Potential air quality, odour and waste impacts during the construction of the development and appropriate mitigation measures*
- *Identification, handling, transport and disposal of any asbestos waste, lead-based paint and PCBs that may be encountered during demolition, site preparation and construction.*

These requirements are addressed as follows in this report:

- Section 5 of the SEARs is generally addressed throughout this report
- Section 6 of the SEARs requires an operational acoustic assessment and an assessment of construction noise and vibration. The operational assessment is addressed in Section 3, and the assessment of construction activities are discussed in Section 6 of this report.

- Please note the document titled "*Development Near Rail Corridors and Busy Roads – Interim Guideline"* addresses criteria and assessment procedures for residential buildings, places of worship, hospitals, educational establishments and child care centres. The subject development does not comprise any of the aforementioned premises, therefore this guideline is not applicable to the project
- Section 23 reiterates the condition which requires an assessment of construction noise and vibration impacts. As mentioned above, this is discussed in Section 6.

2 EXISTING ACOUSTIC ENVIRONMENT

2.1 Unattended Noise Survey

2.1.1 Methodology and Instrumentation

An unattended noise survey was conducted between 19 May and 26 May 2019, at the locations shown in Figure 3. This survey was conducted in order to measure the existing ambient noise level.

Location 1 was selected to measure noise level emissions from the car park along Riding Lane and to obtain typical ambient noise levels in the vicinity of the project site. *Location 2* was selected to measure ambient noise levels near the residences along Duke Street.

Instrumentation for the survey comprised the following:

- For Location 1: one Svan 971 noise logger, serial number 74365. Logger was set up along the northern property boundary, facing the carpark along Riding Lane
- For Location 2: one Svan 971 noise logger, serial number 39005. Logger was deployed along the property boundary separating the residences at No. 9 and No. 11 Duke Street.

Calibration of the loggers was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dB. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Charts presenting summaries of the measured daily noise data are attached in Appendix B. The charts present each 24 hour period and show the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15 minute periods. This data has been filtered to remove periods affected during adverse weather conditions based on weather information obtained from Coffs Harbour Airport (ID number 059151).

Figure 3 Logger locations

2.1.2 Noise Descriptors and Terminology

Environmental noise constantly varies in level with time. Therefore, it is necessary to measure environmental noise in terms of quantifiable time periods with statistical descriptors. Typically environmental noise is measured over 15 minute periods and relevant statistical descriptors of the fluctuating noise are determined to quantify the measured level.

Noise (or sound) consists of minute fluctuations in atmospheric pressure capable of detection by human hearing. Noise levels are expressed in terms of decibels, abbreviated as dB or dBA, the "A" indicating that the noise levels have been frequency weighted to approximate the characteristics of normal human hearing. Because noise is measured using a logarithmic scale, 'normal' arithmetic does not apply, e.g. adding two sound sources of equal value result in an increase of 3dB (i.e. 60 dBA plus 60 dBA results in 63 dBA). A change of 1 dB or 2 dB in the sound level is difficult for most people to detect, whilst a 3 dB – 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change roughly corresponds to a doubling or halving in loudness.

The most relevant environmental noise descriptors are the L_{Aeq}, L_{A1}, L_{A10} and L_{A90} noise levels. The L_{Aeq} noise level represents the "equivalent energy average noise level". This parameter is derived by integrating the noise level measured over the measurement period. It represents the level that the fluctuating noise with the same acoustic energy would be if it were constant over the measured time period.

The L_{A1}, L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample period. These levels can be considered as the maximum noise level, the average repeatable maximum and average repeatable minimum noise levels, respectively.

Specific acoustic terminology is used in this assessment report. An explanation of common acoustic terms is included in Appendix A.

2.1.3 Measurement Results

2.1.3.1 External Noise Intrusion

The noise measurements obtained at *Location* 1 has been used to assess the external noise intrusion into the development. This information has been processed into the time periods discussed in the NSW Road Noise Policy (NSW RNP). The results are presented in Table 1 below.

Table 1 Measured L_{Aeq} noise levels for assessment of noise intrusion – Location 1

Period	Measured Noise Level (dBA)	
	Day time/Night time Periods	Maximum 1 hour levels
Daytime: 7:00 am – 10:00 pm,	59	62
Night time: 10:00pm – 7:00 am	59	64

The $L_{Aeq(15hour)}$ and $L_{Aeq(9hour)}$ descriptors represent the logarithmic average noise energy during the measurement period. The "15 hour" represents the daytime period between 7:00 am to 10:00 pm and the "9 hour" represents the night-time period between 10:00 pm to 7:00 am.

2.1.3.2 Background Noise Levels

The noise levels measured at *Location 1* and *Location 2* have been used to assess the noise impact of the development into the nearest noise affected receivers identified in Section 1.1. Hence the time periods used are in accordance with those recommended in the NSW Noise Policy for Industry (NSW NPI). The measurement results are presented in Table 2 and Table 3 below, in accordance with the operational times discussed in Section 1.2.

Table 2 Measured ambient noise levels in accordance with the NSW NPI

Measurement Location	Daytime[1] 7:00 am to 6:00 pm		Evening[1] 6:00 pm to 10:00 pm		Night-time[1] 10:00 pm to 7:00 am	
	L_{A90}[2]	L_{Aeq}[3]	L_{A90}[2]	L_{Aeq}[3]	L_{A90}[2]	L_{Aeq}[3]
Location 1 (within project site)	50	60	42	57	38	58
Location 2 (9-11 Duke Street)	43	56	40	44	35	43

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am

Note 2: The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 3: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

Table 3 Measured noise levels for morning and nigh time shoulder periods

Measurement Location	Night Time Shoulder Period Monday to Saturday 6:00am to 7:00am L_{A90} (dBA)	Night Time Shoulder Period Sunday 6:00am to 8:00am L_{A90} (dBA)	Night Time Shoulder Period Monday to Sunday 10:00pm to 12:00am L_{A90} (dBA)
Location 1 (within project site)	55	52	41
Location 2 (9-11 Duke Street)	45	45	38

2.2 Attended Noise Survey

Attended noise measurements were conducted to determine noise emissions from a typical late night event. These measurements were undertaken on 26 May 2019.

The attended noise measurements were conducted using a Brüel & Kjær Type 2250 sound level meters (serial numbers 3006332) Calibration of the sound level meter was checked prior to and following the measurements using a Brüel & Kjær Type 4231 sound calibrator (serial number 3009148). The calibrator emitted a calibration tone of 94 dB at 1 KHz. The drift in calibration did not exceed ±0.5 dB. All equipment carries appropriate and current NATA (or manufacturer) calibration certificates.

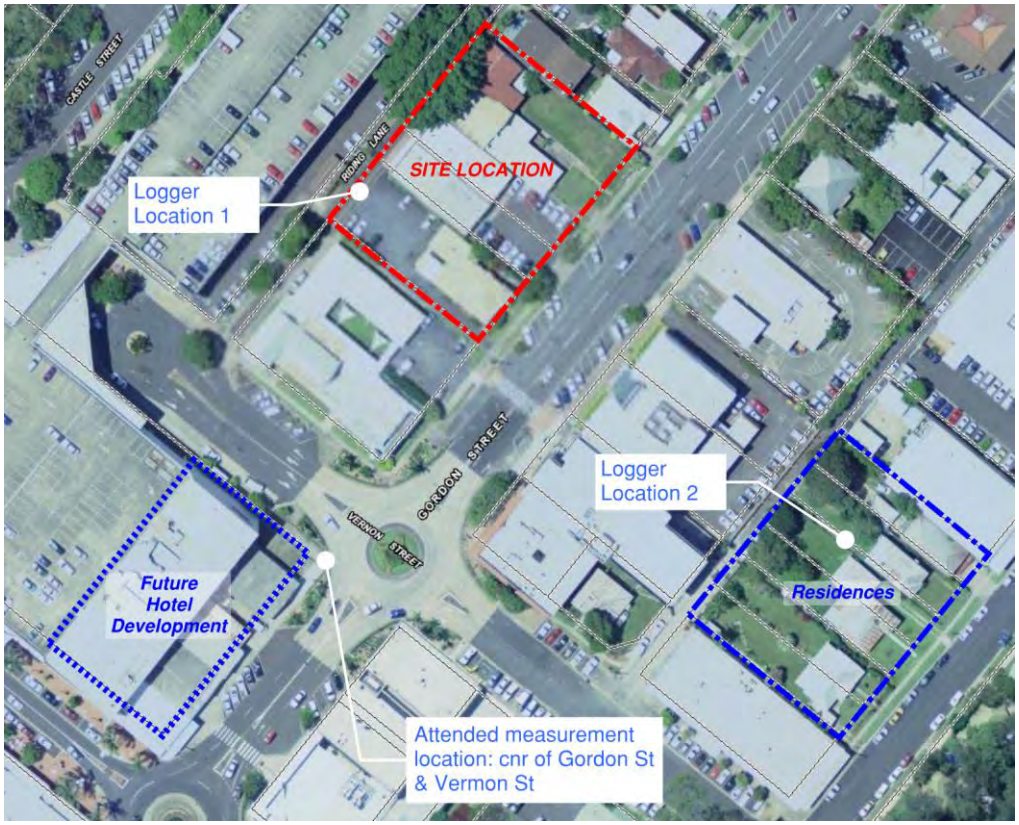
The locations where attended measurements were conducted are shown in Figure 4. Based on these locations, measurement results are summarised in Table 4.

Table 4 Measured L_{90} Background Spectra and overall L_{Aeq} noise levels

Date	Time	Location	L_{90} Spectrum in Octave Band Centre Frequencies, Hz									Overall L_{A90} dB	Overall L_{Aeq} dB
			31.5	63	125	250	500	1000	2000	4000	8000		
26 May 2019	2:42pm	Logger Location 1 (within project site)	61	58	54	49	47	46	43	37	26	51	61
26 May 2019	2:57pm	Logger Location 2 (9 – 11 Duke Street)	52	50	45	41	38	36	35	35	23	44	56
26 May 2019	3:12pm	Corner of Gordon Street & Vermon Street	59	58	54	51	48	49	47	46	35	55	62

Note 1: Measured background noise levels mostly influenced by noise emissions from mechanical services at the sports club

Figure 4 Locations for attended noise measurements



3 OPERATIONAL ACOUSTIC CRITERIA

3.1 NSW Noise Policy for Industry

In NSW, the control of noise emissions is the responsibility of Local Governments and the NSW Environment Protection Authority (NSW EPA).

Consequently, the NSW EPA has prepared a document titled *Noise Policy for Industry* (NSW NPI) which provides a framework and process for determining external noise criteria and subsequent assessments. The NSW NPI criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residents and other noise sensitive receivers in the short term; and
- Maintaining noise level amenity of particular land uses for residents and sensitive receivers in other land uses.

3.1.1 Intrusive Noise Impacts (Residential Receivers)

The NSW NPI states that the noise from any single source should not intrude greatly above the prevailing background noise level. Industrial noises are generally considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (L_{Aeq}), measured over a 15 minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dBA. This is often termed the Intrusiveness Criterion.

The 'Rating Background Level' (RBL) is the background noise level to be used for assessment purposes and is determined by the methods given in the NSW NPI. Using the rating background noise level approach results in the intrusiveness criterion being met for 90% of the time. Adjustments are to be applied to the level of noise produced by the source that is received at the assessment point where the noise source contains annoying characteristics such as tonality or impulsiveness.

3.1.2 Protecting Noise Amenity (All Receivers)

To limit continuing increase in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW NPI. That is, the ambient L_{Aeq} noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the 'Background Creep' or Amenity Criterion.

The amenity assessment is based on noise criteria specified for a particular land use and corresponding sensitivity to noise. The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. These criteria relate only to other continuous industrial-type noise and do not include road, rail or community noise. If the existing (measured) industrial-type noise level approaches the criterion value, then the NSW NPI sets maximum noise emission levels from new sources with the objective of ensuring that the cumulative levels do not significantly exceed the criterion.

3.1.3 Area Classification

According to the NSW Planning Portal (via the ePlanning Spatial Viewer), the project site and nearest residential receivers are located within a zone classified as B3 (refer to Figure 5). According to the Coffs Harbour Local Environmental Plan 2013, Zone B3 is considered a Commercial Core. Therefore, these residential receivers cannot be considered as rural residences.

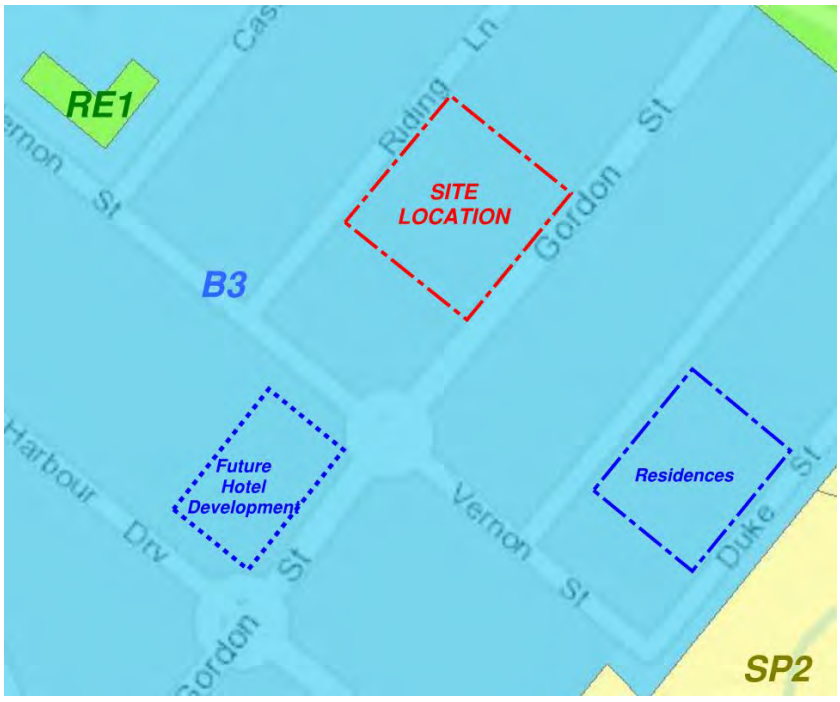
Based on Table 2.3 of the NSW NPI, suburban and urban residences typically have the following background noise levels:

- Suburban residences: daytime RBL lower than 45 dBA, evening RBL lower than 40 dBA, night time RBL lower than 35 dBA
- Urban residences: daytime RBL higher than 45 dBA, evening RBL higher than 40 dBA, night time RBL higher than 35 dBA

Therefore, based on the information listed above and the measured noise levels summarised in Table 2, the nearest affected residential developments are classified as follows:

- Residences along Duke Street: suburban residential
- Future hotel development in corner of Gordon Street and Vernon Street: within urban residential zone

Figure 5 Extract from zoning map obtained through ePlanning Spatial Viewer



The NSW NPI characterises the “suburban residential” noise environment as an area with an acoustical environment which shows the following:

- An area that has local traffic with characteristically intermittent traffic flows or some limited commerce or industry.
- Evening ambient noise levels defined by the natural environment and human activity.

For “urban residential” noise environment, the NSW NPI defines the following:

- Is dominated by “urban hum” or industrial noise source
- Has through traffic with characteristically heavy and continuous traffic flows during peak periods
- Is near commercial or industrial districts
- Has any combination of the above

…where “urban hum” means the aggregate unidentifiable sound of man and mostly due to traffic-related sound sources.

Consequently, for residential and non-residential receivers in an urban area, the recommended amenity criteria are shown in Table 5 below.

Table 5 NSW NPI – Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level ($L_{Aeq, period}$)[2]
Residence	Suburban	Day	55
		Evening	45
		Night	40
Hotel Development	Urban	Day	65
		Evening	55
		Night	50
Commercial premises	All	When in use	65
Places of worship	All	When in use (internal)	40
		When in use (external)	50 [3]
Areas for passive recreation (Rotary Park)	All	When in use	50
Areas for active recreation (Fitzroy Oval, Olympic Pool)	All	When in use	55

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am

Note 2: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

Note 3: External noise level criterion estimated from internal noise level criterion assuming a 10 dB noise level difference for open windows

3.1.4 Project Trigger Noise Levels

The intrusive and amenity criteria for industrial noise emissions derived from the measured data are presented in Table 6. These criteria are nominated for the purpose of determining the operational noise limits for mechanical plant associated with the commercial components of the development to potentially affected noise sensitive receivers.

For each assessment period, the lower (i.e. the more stringent) of the amenity or intrusive criteria are adopted. These are shown in bold text in Table 6.

3.1.5 Emergency Plant

For emergency plant, such as stand-by generators, which only operate occasionally (such as emergencies and maintenance operations), the NSW NPI allows for modifying factors that can be subtracted from the predicted noise levels. These modifying factors should be applied prior to assessing against the external noise level criteria. These duration modifying factors are summarised in Table 7 below.

Table 6 External noise level criteria in accordance with the NSW NPI

Location	Time of Day	Project Amenity Noise Level, $L_{Aeq, period}$ [1] (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [2] (dBA)	Measured $L_{Aeq, period}$ Noise Level (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)	Amenity $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA) [4]
Residences (Suburban, along Duke Street)	Day	50	43	56	**48**	53
	Evening	40	40	44	45	**43**
	6:00am-7:00am Monday to Saturday	-	45	-	**50**	-
	6:00am-8:00am Sunday	-	45	-	**50**	-
	10:00pm-12:00am Monday to Sunday	-	38	-	**43**	-
Hotel (Corner of Gordon Street & Vernon Street)	Day	60	50	60	**55**	63
	Evening	50	42	57	**47**	53
	6:00am-7:00am Monday to Saturday	-	55	-	**60**	-
	6:00am-8:00am Sunday	-	52	-	**57**	-
	10:00pm-12:00am Monday to Sunday	-	41	-	**46**	-
Commercial premises	When in use	60	N/A	60	-	**63**
Places of worship	When in use (external)	45	N/A	60	-	**53**
Passive recreation areas	When in use	45	N/A	60	-	**53**
Active recreation areas	When in use	50	N/A	60	-	**53**

Note 1: Project Amenity Noise Levels corresponding to "Urban" areas, equivalent to the Recommended Amenity Noise Levels (Table 5) minus 5 dBA

Note 2: L_{A90} Background Noise or Rating Background Level

Note 3: Project Noise Trigger Levels are shown in bold

Note 4: This is based on the assumption that the existing noise levels are unlikely to decrease in the future

Table 7 Modifying factors for duration

Allowable Duration of Noise (one event in any 24 hour period)	Allowable Exceedance at Receiver for the Period of Noise Event	
	Daytime and Evening (7am – 10pm)	Night time (10pm – 7am)
1 to 2.5 hours	2	Nil
15 minutes to 1 hour	5	Nil
6 minutes to 15 minutes	7	2
1.5 minutes to 6 minutes	15	5
Less than 1.5 minutes	20	10

Note: Where the duration of the noise event is smaller than the duration of the project trigger noise level (PNTL), that is, less than 15 minutes, the allowable adjusted project noise trigger level (APNTL) is derived as follows:

$$APNTL = 10\log((10^{\frac{PNTL}{10}}\ x\ (\frac{900 - duration}{900})) + (10^{\frac{PNTL+allowable\ exceedance\ in\ table\ above}{10}}\ x\ duration))$$

3.2 Sleep Disturbance

The sleep arousal criterion, obtained from the NSW Road Noise Policy (NSW RNP), provides an assessment criterion for the expected quality of sleep of the resident during the night.

An accurate representation of sleep disturbance impacts on a community from a noise source is particularly difficult to quantify mainly due to differing responses of individuals to sleep disturbance – this is found even within a single subject monitored at different stages of a single night's sleep or during different periods of sleep.

In addition the differing grades of sleep state make a definitive definition difficult, and even where sleep disturbance is not noted by the subject, factors such as heart rate, mood and performance can still be negatively affected.

An assessment of sleep disturbance should consider the maximum noise level or $L_{A1(1\ minute)}$, and the extent to which the maximum noise level exceeds the background level and the number of times this may happen during the night-time period. Factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur;
- Time of day (normally between 10.00pm and 7.00am); and
- Whether there are times of day when there is a clear change in the existing noise environment (such as during early morning shoulder periods).

Currently the information relating to sleep disturbance impacts indicates that:

- Maximum internal noise levels below 50–55 dBA are unlikely to cause an awakening from a sleep state.
- One or two noise events per night with maximum internal noise levels of 65–70 dBA are not likely to affect health and wellbeing significantly.

As a result, the adopted sleep disturbance criterion for the project is an internal noise level of 50 - 55 dB L_{Amax}. This criterion is applicable for noise emissions generated by short term events occurring during the night time period. Therefore, allowing for a 10 dB noise reduction for open windows**, it is proposed that the noise screening criterion for sleep arousal should be 60 - 65 dB L_{Amax} external noise level at residential properties**.

3.3 Patron Noise

3.3.1 Liquor & Gaming NSW

As discussed in Section 1.2, it is noted that the café at Ground Level and small bar on the External Event Space in Level 3) are considered as licensed premises.

Therefore patron noise emissions to outdoors and which are related to the use of the licensed premises, should be assessed in accordance with the typical conditions legislated for licensed premises.

Section 79 of the Liquor Act 2007 provides mechanisms for complaints to be made when the amenity of local areas is disturbed by the use of licensed premises and registered clubs (including disturbances caused by patrons). These complaints are addressed by the Director of Liquor and Gaming, and in the process may impose temporary or permanent noise conditions on the licensed venue. Typical noise conditions that are imposed upon licensed premises are as follows:

> *The L_{A10}* noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8k Hz inclusive) by more than 5 dB between 07:00 am and 12:00 midnight at the boundary of any affected residence.*
>
> *The L_{A10}* noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8k Hz inclusive) between 12:00 midnight and 07:00 am at the boundary of any affected residence.*
>
> *Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 07:00 am.*
>
> ** For the purposes of this condition, the L_{A10} can be taken as the average maximum deflection of the noise emission from the licensed premises.*
>
> *This is a minimum standard. In some instances the Director may specify a time earlier than midnight in respect of the above condition.*
>
> *Interior noise levels which still exceed safe hearing levels are in no way supported or condoned by the Director.*

These criteria are applicable to noise emissions from patron activities related to the use of the bar in Level 3 (excluding noise from mechanical services). Octave band spectral criteria for each assessment period has been summarised in Table 8 below.

Table 8 Liquor & Gaming NSW – L_{10} Criteria for residences along Duke Street

Time Period	Parameter	Octave Band Centre Frequency, Hz									Overall dBA
		31.5	63	125	250	500	1000	2000	4000	8000	
6:00am – 7:00am Monday to Saturday	Measured L_{A90} [1]	54	52	47	43	40	38	37	37	25	46
6:00am – 8:00am Sunday	**L_{A10}**	**54**	**52**	**47**	**43**	**40**	**38**	**37**	**37**	**25**	**46**
7:00am – 6:00pm Monday to Saturday	Measured L_{A90} [1]	52	50	45	41	38	36	35	35	23	44
8:00am – 6:00pm Sunday (day time period)	**L_{A10}**	**57**	**55**	**50**	**46**	**43**	**41**	**40**	**40**	**28**	**49**
6:00pm – 10:00pm (evening period)	Measured L_{A90} [1]	49	47	42	38	35	33	32	32	20	41
	L_{A10}	**54**	**52**	**47**	**43**	**40**	**38**	**37**	**37**	**25**	**46**
10:00pm – 12:00am	Measured L_{A90} [1]	47	45	40	36	33	31	30	30	18	39
	L_{A10}	**52**	**50**	**45**	**41**	**38**	**36**	**35**	**35**	**23**	**44**

Note 1: Measured L_{A90} spectrum has been adjusted to match overall RBL for corresponding period

Note 2: Shoulder period spectrum has been has been selected from typical daytime spectrum since measured RBLs and L_{Aeq} noise levels approximate those if the daytime period rather than the night time period

Table 9 Liquor & Gaming NSW – L_{10} Criteria for hotel development

Time Period	Parameter	Octave Band Centre Frequency, Hz									Overall dBA
		31.5	63	125	250	500	1000	2000	4000	8000	
6:00am – 7:00am Monday to Saturday	Measured L_{A90} [1]	59	58	54	51	48	49	47	46	35	55
	L_{A10}	**59**	**58**	**54**	**51**	**48**	**49**	**47**	**46**	**35**	**55**
6:00am – 8:00am Sunday	Measured L_{A90} [1]	56	55	51	48	45	46	44	43	32	52
	L_{A10}	**56**	**55**	**51**	**48**	**45**	**46**	**44**	**43**	**32**	**52**
7:00am – 6:00pm Monday to Saturday	Measured L_{A90} [1]	54	53	49	46	43	44	42	41	30	50
8:00am – 6:00pm Sunday (day time period)	**L_{A10}**	**59**	**58**	**54**	**51**	**48**	**49**	**47**	**46**	**35**	**55**
6:00pm – 10:00pm (evening period)	Measured L_{A90} [1]	46	45	41	38	35	36	34	33	22	42
	L_{A10}	**51**	**50**	**46**	**43**	**40**	**41**	**39**	**38**	**27**	**47**
10:00pm – 12:00am	Measured L_{A90} [1]	45	44	40	37	34	35	33	32	21	41
	L_{A10}	**50**	**49**	**45**	**42**	**39**	**40**	**38**	**37**	**26**	**46**

Note 1: Measured L_{A90} spectrum has been adjusted to match overall RBL for corresponding period

Note 2: Shoulder period spectrum has been has been selected from typical daytime spectrum since measured RBLs and L_{Aeq} noise levels approximate those if the daytime period rather than the night time period

3.3.2 Outdoor Events

It is advised that noise emissions from outdoor events should comply with the following criteria:

- Intrusiveness criteria discussed in Section 3.1
- Sleep disturbance criteria discussed in Section 3.2 for the shoulder time periods of 6:00am to 7:00am; and 10:00pm to 12:00am
- Criteria for licensed premises where applicable, as discussed in Section 3.3.1

It is also recommended that the criteria mentioned above should also be considered in determining the performance requirements for outdoor PA systems used in these events. Hence, the assessment should consider the aggregate noise level from noise emissions generated by the PA system and patrons.

3.4 Noise Impact on Local Roads

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy (NSW RNP) states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

3.5 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"*. (AVTG) This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources (refer to Table 10).
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 11).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 12).

Table 10 Continuous vibration acceleration criteria (m/s^2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 11 Impulsive vibration acceleration criteria (m/s^2) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 12 Intermittent vibration impacts criteria (m/s$^{1.75}$) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

4 CONSTRUCTION NOISE & VIBRATION CRITERIA

4.1 Construction Noise Criteria

4.1.1 Interim Construction Noise Guideline

Noise criteria for construction and demolition activities are discussed in the *Interim Construction Noise Guideline* (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all “feasible” and “reasonable” work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for residential receivers have been reproduced from the guideline and are listed in Table 13 below. These are also applicable to the future hotel development in the corner of Vernon Street and Gordon Street.

Specific non-residential receivers in the vicinity of the proposed construction site, and their recommended ‘management levels’, are presented in Table 14.

Based on the measured background noise levels summarised in Section 2, the NMLs to be used in this assessment are listed in Table 15.

Construction hours are provided by the client and are as follows:

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm

Proposed construction hours only fall under the recommended standard hours outlined in the ICNG.

Table 13 NMLs for quantitative assessment at residences (from ICNG)

Time of Day	Noise Management Level $L_{Aeq(15minute)}$[1,2]	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15minute)}$ 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	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1 *Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

Note 2 *The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).*

Table 14 NMLs for quantitative assessment at non-residential receivers

Land Use	$L_{Aeq(15minute)}$ Construction NML
Commercial premises	70
Places of worship	Internal noise level: 45 dBA External noise level: 55 dBA [1]
Passive recreation areas	60
Active recreation areas	65

Note 1: External noise level criterion estimated from internal noise level criterion assuming a 10 dB noise level difference for open windows

Table 15 NMLs as basis for the acoustic assessment

Receiver Types	NML, dB $L_{Aeq(15minute)}$	
	Standard Hours **Monday to Friday:** **7 am to 6 pm** **Saturday:** **8 am to 1 pm**	**Outside Standard Hours** **Monday to Friday:** **6 pm to 7 pm** **Saturday:** **7 am to 8 am** **1 pm to 5 pm**
Residences along Duke Street	53	-
Future hotel development (when operational)	60	-
Commercial premises	70	70
Places of worship	55 (external)	55 (external)
Passive recreation areas	60	60
Active recreation areas	65	65

As confirmed by the client no construction will occur outside of standard hours, this means a sleep disturbance assessment for construction noise is not required.

4.2 Construction Traffic Noise Criteria

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy (NSW RNP) states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

4.3 Vibration Criteria

Effects of ground borne vibration on buildings may be segregated into the following four categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 3.5.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 4.3.1.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 4.3.1.

- Effects on scientific and medical equipment – where vibration can have an impact on the functionality of scientific and medical equipment. Refer to discussion on Section 4.3.2

4.3.1 Vibration Criteria – Building Contents and Structure

The vibration effects on the building itself are assessed against international standards as follows:

- For transient vibration: British Standard BS 7385: Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration"* (BSI 1993); and
- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 *"Effects of Vibration on Structure"* (DIN 1999).

4.3.1.1 Standard BS 7385 Part 2 - 1993

For transient vibration, as discussed in standard BS 7385 Part 2-1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised in Table 16 and illustrated in Figure 6.

Table 16 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure 6	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	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

Standard BS 7385 Part 2 – 1993 states that the values in Table 16 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 16 may need to be reduced by up to 50% (refer to Line 3 in Figure 6).

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 16, and major damage to a building structure may occur at values greater than four times the tabulated values. Therefore for reinforced structures (Line 1), and accounting for dynamic loading, the following trigger levels are determined:

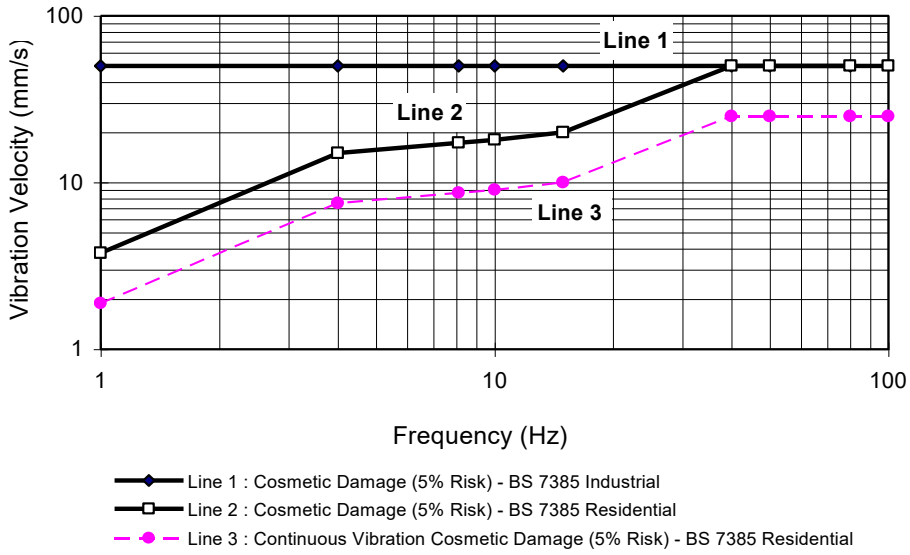
- For cosmetic damage, this is likely to occur at 25 mm/s at 4 Hz and above
- For minor damage, this is likely to occur at 50 mm/s at 4 Hz and above
- For major damage, this is likely to occur at 100 mm/s at 4 Hz and above

According to standard BS ISO 1866:2010, cosmetic, minor and major damage are defined as follows:

- Cosmetic: The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction
- Minor: The formation of large cracks or loosening and falling of plaster or drywall surfaces, or cracks through bricks/concrete blocks
- Major: The damage to structural elements of the structure, cracks in support columns, loosening of joints, splaying of masonry cracks, etc

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 16 should not be reduced for fatigue considerations.

Figure 6 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage



4.3.1.2 Standard DIN 4150 Part 3 - 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 17. The criteria are frequency dependent and specific to particular categories of structures.

Table 17 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

Type of Structure	Peak Component Particle Velocity, mm/s Vibration at the foundation at a frequency of			
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]	Vibration of horizontal plane of highest floor at all frequencies
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
Note 1: For frequencies above 100Hz, at least the values specified in this column shall be applied.				

4.3.2 Scientific and Medical Equipment

Some scientific equipment (e.g. electron microscopes and microelectronics manufacturing equipment) can require more stringent objectives than those applicable to human comfort.

Where it has been identified that vibration sensitive scientific and/or medical instruments are likely to be in use at the nearest existing hospital buildings, objectives for the satisfactory operation of the instrument should be sourced from manufacturer's data.

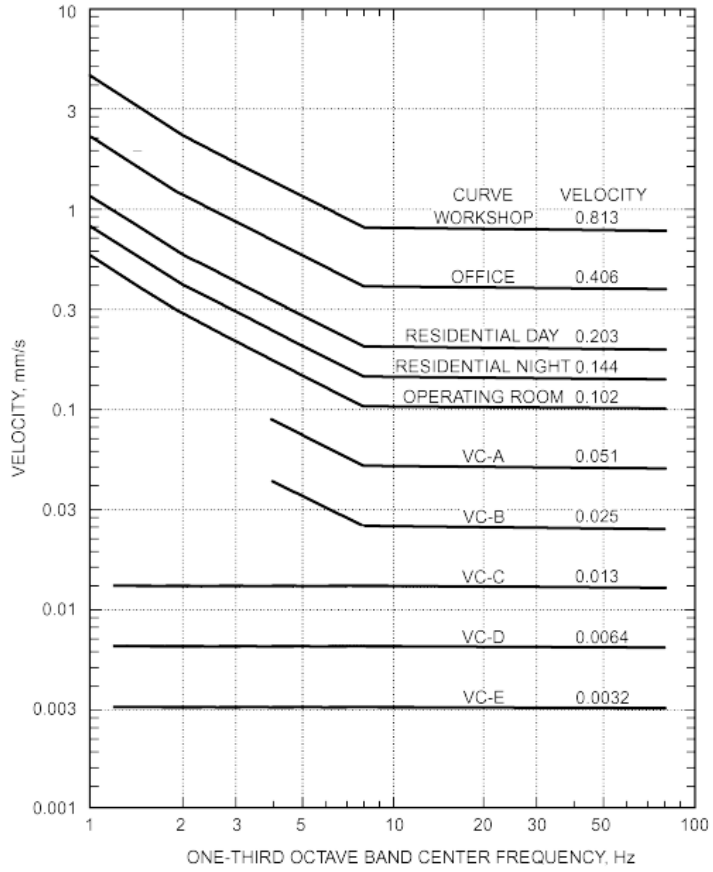
Where manufacturer's data is not available, generic vibration criterion (VC) curves may be adopted as vibration goals. These generic VC curves are presented below in Table 18 and Figure 7.

Table 18 Criteria for vibration sensitive equipment

Equipment	Curve
Bench microscopes up to 100× magnification; laboratory robots	0.102 mm/s
Bench microscopes up to 400× magnification; optical and other precision balances; coordinate measuring machines; metrology laboratories; optical comparators; microelectronics manufacturing equipment; proximity and projection aligners, etc.	0.051 mm/s VC-A
Microsurgery, eye surgery, neurosurgery; bench microscopes at magnification greater than 400×; optical equipment on isolation tables; microelectronic manufacturing equipment, such as inspection and lithography equipment (including steppers) to 3 mm line widths	0.025 mm/s VC-B
Electron microscopes up to 30 000× magnification; microtomes; magnetic resonance imagers; microelectronics manufacturing equipment, such as lithography and inspection equipment to 1 mm detail size	0.013 mm/s VC-C
Electron microscopes at magnification greater than 30 000×; mass spectrometers; cell implant equipment; microelectronics manufacturing equipment, such as aligners, steppers, and other critical equipment for photolithography with line widths of 1/2 µm; includes electron beam systems	0.0054 mm/s VC-D

Equipment	Curve
Non-isolated laser and optical research systems; microelectronics manufacturing equipment, such as aligners, steppers, and other critical equipment for photolithography with line widths of 1/4 µm; includes electron beam systems	0.0032 mm/s VC-E

Figure 7 Criteria for vibration sensitive equipment (ASHRAE 2007, HVAC Applications, Chapter 47 *"Sound and Vibration Control"*)



4.4 Ground-Borne Noise Criteria

Ground-borne noise is noise generated by vibration transmitted through the ground into a structure. The following ground-borne limits for residences are only applicable when ground-borne noise levels are higher than airborne noise levels. The ground-borne noise levels are for evening and night-time periods only, as the objectives are to protect the amenity and sleep of people when they are at home.

- Evening (6 pm to 10 pm) - Internal: $L_{Aeq\ (15\ min)}$ 40 dB(A)
- Night-time (10 pm to 7 am) - Internal: $L_{Aeq\ (15\ min)}$ 35 dB(A)

Mitigation options to deal with ground-borne noise may include extensive community consultation to determine the acceptable level of disruption and the provision of respite accommodation in some circumstances, not just restriction of work hours.

It is noted that no construction works are currently proposed for the evening and night-time periods, therefore, an assessment of ground-borne is not currently required for this development.

5 OPERATIONAL ACOUSTIC ASSESSMENT

5.1 Plant Rooms

External noise emissions from plant rooms should be acoustically treated in order to achieve compliance with the external noise level criteria discussed in Section 3.1.

Hence, plant rooms should be treated, in-principle, as follows:

- Plant room external walls should achieve a minimum weighted sound reduction index of 45 - 50 dB Rw. Plant rooms should not be accessible from outside the building. Consequently, ornamental louvres are not recommended in these plant rooms, however acoustic louvres can be considered depending on the noise emission from mechanical plant items.
- All plant room walls and roofs should be internally lined with insulation which achieves a minimum NRC rating of 0.8. Insulation should have a perforated metal facing with more than 20 % perforated area, or woven cloth facing.
- Plant room floor should comprise a 200 mm thick concrete slab with 2,400 kg/m^3 minimum density. For plan rooms located immediately below internal spaces, ceiling constructions should comprise a concrete slab as recommended for the floor construction.
- All plant room construction should be fully sealed (air tight), fully closed and free of gaps
- All door accessing plant rooms should be acoustically treated in order to achieve a minimum sound insulation performance of Rw 30.

It is advised that the conceptual measures listed above should be investigated and developed further during detailed design stages of the project

5.2 Building Services – External Noise Emissions

Acoustic treatment should be implemented for external noise emissions by mechanical plant in order to achieve the external noise level criteria discussed in Section 3.1. This treatment should be especially considered for plant items located in the roof plant room.

In order to achieve the recommended external noise level criteria, the following in principle measures will need to be considered during the detailed design stage:

- Within a plantroom, the following treatments are recommended:
    - All external air intakes and exhausts should be fully ducted to the relevant plant item (i.e. AHU, FCU or fan). These ducted components should include internally lined ductwork (typically with minimum 50 mm insulation), whose extent should be recommended at a detailed design stage. Wherever possible these intakes and exhausts should aim away from nearest affected receivers.
    - Only relief air paths should have openings through the external plant room walls provided that these include acoustic louvres. It is also recommended that these air openings be installed in the plant room roof.
- Install internally lined return air / outside air mixed boxes behind AHUs.
- Install silencers or internally lined ductwork on external air inlets or outlets, especially for fans.
- Implement variable speed drive units whenever possible.

- In the open roof compartment where cooling towers will be located, the walls should be constructed from acoustic louvres (i.e. ornamental louvres might not provide sufficient attenuation). Wall heights should extend as a minimum to the top of the cooling towers (height to be confirmed at a detailed design stage).
- The use of "quiet" or low noise cooling towers. Preliminary assessment of noise emissions by cooling tower indicate that acoustic louvers will need to be installed around these plant items. Louver performance and extent of treatment to be further developed during detailed design stages of the project.
- Limit the number of operating mechanical plant items (including cooling towers), or reduce operational loads between 6 pm and 7 am.

Finally it is advised that the conceptual measures listed above should be investigated and developed further during detailed design stages of the project.

5.3 Stand-By Generator

It is understood the stand-by generator will be installed in the roof of the new building, as shown in Appendix C.

Based on this information the following performance requirements are recommended in order to satisfy the NSW NPI criteria by considering modification factors for duration (refer to Section 3.1):

- The aggregate sound pressure level contribution at 7 m from the generator plant room (under free field conditions) should not exceed 70 dBA.
- Overall noise contributions from the stand-by generator should achieve the external noise level criteria discussed in Section 3.1, by accounting for modifying factors for duration of maintenance operations.

The aggregate sound pressure level from the generator plant room should include (but not be limited to) the noise contributions generated by the exhaust system, air inlet, air outlets; as well as the noise break-out from the plant room walls, doors and roof.

In order to achieve these performance requirements and the NSW NPI criteria by considering modification factors for duration, the following conceptual treatment is recommended for consideration during detailed design:

- Stand-by generator should be contained within an acoustic enclosure or a purpose built plant room (typically comprising masonry constructions).
- Air intake and air discharge paths should comprise rectangular silencers. These should be selected in order to achieve the recommended performance requirements
- The exhaust system should include mufflers which should be selected in order to achieve the recommended performance requirements. The exhaust outlet should be aimed upwards and vertically.
- If the generator is to be contained within a plant room, the following is advised for consideration:
    - Plant room walls should achieve, as a minimum, a sound insulation performance of Rw 50. It is advised these walls comprise a masonry construction.
    - Plant room doors should be acoustic proprietary doors which achieve a minimum sound insulation performance of Rw 35 – 40. Door should include acoustic rubber seals in the bottom threshold, door frame and meeting stile. Doors should also include a solid timber core.

    - Plant room roof should achieve a minimum sound insulation performance of Rw 50 – 55. It is advised this comprises a concrete slab.
- Stand-by generator should be resiliently mounted

Additionally, the following operational procedures for maintenance operations are advised to be considered in conjunction with the conceptual measures mentioned above:

- Maintenance operations should only be conducted between 7 am and 6 pm.
- Each maintenance operation should only be undertaken for a maximum period of 1 hour.
- Only one maintenance operation can be conducted in any 24 hour period.

Finally it is recommended that the acoustic treatment for the generator plant room should also consider the noise and vibration impact onto the new building, especially in regards to office areas in the floor level (i.e. Level 5). This is currently not part of the assessment scope.

All conceptual recommendations discussed in this Section should be further investigated and developed during detailed design stages of the project.

5.4 Patron Noise Assessment

5.4.1 Liquor & Gaming NSW

5.4.1.1 Ground Level – Cafe

Patron Noise levels from the café have been predicted to the nearest affected receivers i.e. the future hotel development on the corner of Gordon Street and Vernon Street and the residential dwellings at 3-11 Duke Street. The Noise levels are assessed against the Liquor and Gaming criteria established in Section 3.3.10.

Table 19 below shows compliance with the NSW Liquor and Gaming criteria is achieved at the residences located along Duke Street closest to the proposed Civic and Cultural Centre.

Table 20 below shows compliance with the NSW Liquor and Gaming criteria is achieved at the location of the proposed hotel development on the corner of Gordon Street and Vernon Street.

Table 19 Estimated L_{10} noise levels at the Duke Street residences from the cafe

Parameter	Octave Band Centre Frequency, Hz								Overall dBA
	63	125	250	500	1000	2000	4000	8000	
Receiver 1: Duke Street Residences									
Daytime Period (90 patrons with 45 talking)									
Predicted L10 Noise Levels	13	19	31	36	32	28	22	5	**39**
L&G NSW criterion [2]	55	50	46	43	41	40	40	28	**49**
Frequency exceedances	0	0	0	0	0	0	0	0	-
Evening Period (90 patrons with 45 talking)									
Predicted L10 Noise Levels	13	19	31	36	32	28	22	5	**39**
L&G NSW criterion [2]	52	47	43	40	38	37	37	25	**46**
Frequency exceedances	0	0	0	0	0	0	0	0	-
10:00pm to 12:00am Shoulder Period (90 patrons with 45 talking)									
Predicted L10 Noise Levels	13	19	31	36	32	28	22	5	**39**
L&G NSW criterion [2]	50	45	41	38	36	35	35	23	**44**
Frequency exceedances	0	0	0	0	0	0	0	0	-
6:00am-7:00am Monday to Saturday (90 patrons with 45 talking)									
Predicted L10 Noise Levels	13	19	31	36	32	28	22	5	**39**
L&G NSW criterion [2]	52	47	43	40	38	37	37	25	**46**
Frequency exceedances	0	0	0	0	0	0	0	0	
6:00am – 8:00am Sunday (90 patrons with 45 talking)									
Predicted L10 Noise Levels	13	19	31	36	32	28	22	5	**39**
L&G NSW criterion [2]	52	47	43	40	38	37	37	25	**46**
Frequency exceedances	0	0	0	0	0	0	0	0	

Note 1: Criterion derived from the minimum criteria corresponding to the day and evening shoulder period
Note 2. Criterion derived from the minimum criteria corresponding to the day, evening, and night time shoulder period

Table 20 Estimated L_{10} noise levels at the hotel development from the cafe

Parameter	Octave Band Centre Frequency, Hz								Overall dBA
	63	125	250	500	1000	2000	4000	8000	
Receiver 2: Hotel Development Corner Gordon and Vernon Street									
Daytime Period (90 patrons with 45 talking)									
Predicted L10 Noise Levels	0	3	17	24	21	18	11	0	**27**
L&G NSW criterion [2]	58	54	51	48	49	47	46	35	**55**
Frequency exceedances	0	0	0	0	0	0	0	0	-
Evening Period (90 patrons with 45 talking)									
Predicted L10 Noise Levels	0	3	17	24	21	18	11	0	**27**
L&G NSW criterion [2]	50	46	43	40	41	39	38	27	**47**
Frequency exceedances	0	0	0	0	0	0	0	0	-

Parameter	Octave Band Centre Frequency, Hz								Overall dBA
	63	125	250	500	1000	2000	4000	8000	
10:00pm to 12:00am Shoulder Period (90 patrons with 45 talking)									
Predicted L10 Noise Levels	0	3	17	24	21	18	11	0	**27**
L&G NSW criterion [2]	49	45	42	39	40	38	37	26	**46**
Frequency exceedances	0	0	0	0	0	0	0	0	-
6:00am-7:00am Monday to Saturday (90 patrons with 45 talking)									
Predicted L10 Noise Levels	0	3	17	24	21	18	11	0	**27**
L&G NSW criterion [2]	58	54	51	48	49	47	46	35	**55**
Frequency exceedances	0	0	0	0	0	0	0	0	
6:00am – 8:00am Sunday (90 patrons with 45 talking)									
Predicted L10 Noise Levels	0	3	17	24	21	18	11	0	**27**
L&G NSW criterion [2]	55	51	48	45	46	44	43	32	**52**
Frequency exceedances	0	0	0	0	0	0	0	0	

Note 1: Criterion derived from the minimum criteria corresponding to the day and evening shoulder period
Note 2. Criterion derived from the minimum criteria corresponding to the day, evening, and night time shoulder period

5.4.1.2 Level 3 – External Event Space

Patron noise from the level 3 external entertainment area has been predicted to the nearest affected residences, i.e. Duke Street residences and the proposed hotel development on the corner of Gordon Street and Vernon Street. The predicted noise level octave band spectra at the residential receivers has been assessed against the Liquor and Gaming criteria.

Table 21 shows that compliance with the NSW Liquor and Gaming criteria is achieved at the residences along Duke Street for patron noise emission from the open top level 3 entrainment area.

Table 22 shows compliance with the NSW Liquor and Gaming criteria is achieved at the proposed hotel development for patron noise emission from the open top level 3 entertainment area.

Table 21 Estimated L_{10} noise levels at the Duke Street residences from the level 3 entrainment area

Parameter	Octave Band Centre Frequency, Hz								Overall dBA
	63	125	250	500	1000	2000	4000	8000	
Receiver 1: Duke Street Residences									
Daytime Period (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	13	15	12	9	0	0	**19**
L&G NSW criterion [2]	55	50	46	43	41	40	40	28	**49**
Frequency exceedances	0	0	0	0	0	0	0	0	-
Evening Period (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	13	15	12	9	0	0	**19**
L&G NSW criterion [2]	52	47	43	40	38	37	37	25	**46**
Frequency exceedances	0	0	0	0	0	0	0	0	-
10:00pm to 12:00am Shoulder Period (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	13	15	12	9	0	0	**19**
L&G NSW criterion [2]	50	45	41	38	36	35	35	23	**44**
Frequency exceedances	0	0	0	0	0	0	0	0	-
6:00am-7:00am Monday to Saturday (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	13	15	12	9	0	0	**19**
L&G NSW criterion [2]	52	47	43	40	38	37	37	25	**46**
Frequency exceedances	0	0	0	0	0	0	0	0	
6:00am – 8:00am Sunday (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	13	15	12	9	0	0	**19**
L&G NSW criterion [2]	52	47	43	40	38	37	37	25	**46**
Frequency exceedances	0	0	0	0	0	0	0	0	

Note 1: Criterion derived from the minimum criteria corresponding to the day and evening shoulder period
Note 2. Criterion derived from the minimum criteria corresponding to the day, evening, and night time shoulder period

Table 22 Estimated L_{10} noise levels at the hotel development from the level 3 entrainment area

Parameter	Octave Band Centre Frequency, Hz								Overall dBA
	63	125	250	500	1000	2000	4000	8000	
Receiver 2: Hotel Development									
Daytime Period (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	0	8	5	1	0	0	**10**
L&G NSW criterion [2]	58	54	51	48	49	47	46	35	**55**
Frequency exceedances	0	0	0	0	0	0	0	0	-
Evening Period (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	0	8	5	1	0	0	**10**
L&G NSW criterion [2]	50	46	43	40	41	39	38	27	**47**

Parameter	Octave Band Centre Frequency, Hz								Overall dBA
	63	125	250	500	1000	2000	4000	8000	
Frequency exceedances	0	0	0	0	0	0	0	0	-
10:00pm to 12:00am Shoulder Period (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	0	8	5	1	0	0	**10**
L&G NSW criterion [2]	49	45	42	39	40	38	37	26	**46**
Frequency exceedances	0	0	0	0	0	0	0	0	-
6:00am-7:00am Monday to Saturday (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	0	8	5	1	0	0	**10**
L&G NSW criterion [2]	58	54	51	48	49	47	46	35	**55**
Frequency exceedances	0	0	0	0	0	0	0	0	
6:00am – 8:00am Sunday (150 patrons with 75 talking)									
Predicted L10 Noise Levels	0	0	0	8	5	1	0	0	**10**
L&G NSW criterion [2]	55	51	48	45	46	44	43	32	**52**
Frequency exceedances	0	0	0	0	0	0	0	0	

Note 1: Criterion derived from the minimum criteria corresponding to the day and evening shoulder period
Note 2. Criterion derived from the minimum criteria corresponding to the day, evening, and night time shoulder period

5.4.2 Intrusiveness Assessment

The cumulative noise levels from patrons utilising the Coffs Harbour Cultural and Civic centre at the nearest receivers are assessed against the NSW NPI Intrusiveness criteria, especially for noise emissions from the internal street and Level 3 external areas.

Hence Table 23 below summarises the intrusiveness assessment based on the criterion discussed in Section 3.1. From this table it is noted that compliance is achieved at the nearest affected residential receivers (Duke Street and the Hotel Development).

Table 23 Intrusiveness assessment of cumulative patron noise at the nearest affected receivers

Parameter	Residential Receivers	
Daytime Period (7am to 6pm)	**Res 1: Duke Street Residence**	**Res 2: Hotel Development**
Predicted Noise Levels	39	37
NSW NPI Intrusiveness criterion	48	55
Compliance	Yes	Yes
Evening Period (6pm to 10pm)	**Res 1: Duke Street Residence**	**Res 2: Hotel Development**
Predicted Noise Levels	39	37
NSW NPI Intrusiveness criterion	45	47
Compliance	Yes	Yes
10:00pm to 12:00am Shoulder Period	**Res 1: Duke Street Residence**	**Res 2: Hotel Development**
Predicted Noise Levels	39	37
NSW NPI Intrusiveness criterion	43	46
Compliance	Yes	Yes
6:00 am – 7:00 am Shoulder Period Monday to Saturday	**Res 1: Duke Street Residence**	**Res 2: Hotel Development**
Predicted Noise Levels	39	37
NSW NPI Intrusiveness criterion	50	60
Compliance	Yes	Yes
6:00 am – 8:00am Shoulder Period Sunday	**Res 1: Duke Street Residence**	**Res 2: Hotel Development**
Predicted Noise Levels	39	37
NSW NPI Intrusiveness criterion	50	57
Compliance	Yes	Yes

5.4.3 Sleep Disturbance Assessment

The cumulative noise levels from patrons utilising the Coffs Harbour Cultural and Civic centre at the nearest receivers are assessed against the sleep disturbance criteria (Section 3.2), refer to Table 24 below.

Table 24 shows compliance with the sleep arousal criteria is achieved at the nearest affected residences.

Table 24 Estimated maximum noise levels at residential receivers

Receiver	Predicted Noise Level (dBA)	Compliance
Receiver 1: Duke Street Residences	42	**Yes**
Receiver 2: Hotel Development	40	**Yes**

5.5 Public Address (PA) System – Noise Emission Requirements

As discussed in Section 1.2, it is understood that PA systems will be installed externally; however external areas to be served by the PA systems have not been confirmed at this stage. Nevertheless, it is expected that the Internal Street at Ground Level, and External Event Space in Level 3, are being considered.

In order to maintain compliance with intrusiveness and sleep arousal criteria, it is advised that the aggregate noise emissions from all PA systems in the development should be calibrated to achieve the maximum allowable noise levels, in octave bands, as outlined in Table 25 below.

Table 25 Maximum allowable noise level contribution from the PA system

Parameter	Octave Band Centre Frequency, Hz								Overall dBA
	63	125	250	500	1000	2000	4000	8000	
Maximum allowable noise level of the PA system - Duke Street residences	50	45	41	33	34	34	35	23	**41**
Maximum allowable noise level of the PA system – Hotel Development	49	45	42	38	40	38	37	26	**45**

5.6 Loading Dock

Noise emission from the loading dock is assessed against the sleep disturbance criteria established in Section 3.2 and only considers the impact from short term events such as van/truck door slamming, truck braking, truck entering loading dock, truck idling in loading dock and truck reversing into loading dock. Predictions in this section assume that the loading dock door remains open during operation.

The loading dock only takes deliveries between 9:30 am and 4:30 pm so no assessment against sleep disturbance is required.

5.6.1 NSW NPI Assessment

Based on information provided in the Ason Group *Transport Assessment Report* (Ref: 0914r01, dated 5/06/2019) approximately 5 van vehicles and 1 truck will utilise the loading dock between 9:30 am and 4:30 pm every day. Noise levels have been calculated for a 15 minute period based on 5 vehicle events associated with a single truck delivery taking place (worst case scenario) inside the loading dock. The 5 vehicle events include truck reversing (arriving), truck braking, truck door slam, truck idling and truck moving (departing). These events have been calculated for a cumulative 15 minute period and are assessed against the NSW NPI project noise trigger levels established in Section 3.1.4, refer to Table 26 below.

Table 26 Intrusiveness assessment of cumulative loading dock noise at nearest affected residences

Parameter	Residential Receivers	
Daytime Period (7am to 6pm)	**Res 1: Duke Street Residence**	**Res 2: Hotel Development**
Predicted Noise Levels	24	45
NSW NPI criterion	48	55
Compliance	Yes	Yes

Parameter	Residential Receivers	
Evening Period (6pm to 10pm)	Res 1: Duke Street Residence	Res 2: Hotel Development
Predicted Noise Levels	24	45
NSW NPI criterion	43	47
Compliance	Yes	Yes

Table 26 shows compliance with the NSW NPI intrusiveness criteria is achieved for the proposed operational period of the loading dock between 9:30 am and 4:30 pm.

5.6.2 Loading Dock Traffic Requirements

The maximum allowable truck and van events per during a 15 minute time period have been predicted based on the NSW NPI Intrusiveness assessment and traffic volume increase of less than 60%. The maximum allowable vehicle events related to the use of the loading dock are as follows:

- Maximum of 4 deliveries (8 vehicle movements, arriving and departing) in and out of the loading dock every 15 minutes during the day time period.
- Maximum of 1 delivery (2 vehicle movements, arriving and departing) in and out of the loading dock, every 15 minutes during the evening period.

5.7 Car Park Noise Emissions

The carpark is fully enclosed within a basement level. Therefore noise emissions from the carpark are screened from the nearest affected receivers.

Consequently, impact from carpark noise emissions is considered to be negligible.

5.8 Noise Impact on Local Roads

Regarding vehicular traffic movements related to the development; it is noted that vehicle numbers on surrounding roads would need to increase by around 60% from existing traffic flows, for a 2 dB increase in road traffic noise to occur.

Report titled *"Transport Assessment Report – Proposed Multi-Purpose Development – The Cultural and Civic Space Project, 23-31 Gordon Street, Coffs Harbour"* (dated 5 June 2019, issued by Ason Group), summarises the traffic generated by the development according to zones. These summaries are reproduced in Figure 8 and Figure 9 below.

Based on this information, it is noted that traffic generated by the development does not exceed 60% of the existing traffic flows. Therefore, it is unlikely that traffic noise levels will increase by 2 dB, and as a result, the noise impact on local roads is considered to be negligible.

Figure 8 Traffic generation summaries (extract from traffic report by Ason Group)

Table 15: Traffic Distribution Per Zone – Year of Opening

Zone	Period	Traffic Volumes	Existing Zone Traffic	Percentage of Net Traffic to Existing Traffic
1	AM	39 in, 2 out	1,126	3.5%
	PM	16 in, 29 out	1,156	3.7%
2	AM	37 in, 2 out	1,036	3.6%
	PM	24 in, 14 out	1,060	3.5%
3	AM	1 in, 1 out	450	0.4%
	PM	1 in, 8 out	348	2.5%
4	AM	0 in, 0 out	305	0%
	PM	0 in, 1 out	256	0.4%

Table 16: Traffic Distribution Per Zone – 10 Year Horizon Scenario

Zone	Period	Traffic Volumes	Existing Zone Traffic	Percentage of Net Traffic to Existing Traffic
1	AM	61 in, 3 out	1,126	5.4%
	PM	31 in, 54 out	1,156	6.8%
2	AM	58 in, 3 out	1,036	5.6%
	PM	46 in, 25 out	1,060	6.3%
3	AM	1 in, 2 out	450	0.7%
	PM	2 in, 15 out	348	4.7%
4	AM	0 in, 0 out	305	0%
	PM	0 in, 2 out	256	0.8%

Figure 9 Development traffic flows

Figure 25: Development Traffic Flows – AM Peak

Figure 26: Development Traffic Flows – PM Peak

6 CONSTRUCTION NOISE & VIBRATION ASSESSMENT

The construction and vibration assessment has been completed based on the indicative construction program provided on 17 July 2019, see Appendix D.

6.1 Construction Noise Assessment

Based on this indicative construction program and previous project experience, construction and demolition tasks have been assumed for our assessment. These are summarised in Table 27 below, along with the equipment likely to be used in each task and their sound levels.

Table 27 Summary of predicted sound power levels

Tasks	Equipment	Sound Power Levels (dBA re 1pW)	Aggregate Sound Power Level per Task (dBA re 1pW)
Slab and Pavement Removal	Bulldozer	116	124
	Excavator	110	
	Concrete Breaker	121	
	Concrete Cutter	116	
	Front end loader	112	
	Dump truck	109	
	Water cart	107	
Excavation works	Excavator	110	117
	Dump truck	109	
	Front end loader	112	
	Skid steer	110	
	Compactor	107	
Piling	Concrete pump	103	115
	Concrete truck	107	
	Piling rig	113	
	Welder	101	
Structure Assembly	Dump truck	109	120
	Concrete saw	119	
	Skid steer	110	
	Power hand tools	109	
	Welder	101	
	Concrete pump truck	110	
	Concrete agitator truck	108	
External façade works	Welder	101	114
	Saw cutter	109	
	Dump truck	109	
	Power hand tools	109	
Landscaping	Power hand tools	109	114
	Skid Steer	110	

Tasks	Equipment	Sound Power Levels (dBA re 1pW)	Aggregate Sound Power Level per Task (dBA re 1pW)
	Saw cutter	109	
	Dump Truck	109	

For the purpose of this assessment, the nearest affected receivers on which our assessment is conducted, are listed in Table 28 below. Based on the equipment sound power levels given in Table 27, noise levels have been predicted at these nearest affected properties for each construction scenario (where each construction scenario comprises two or more construction tasks). These predicted noise levels are summarised in Table 29.

The noise level predictions have been conducted using a 3D computational model developed using iNoise 2018 acoustic modelling software. The noise model takes into account reflections and shielding by adjacent buildings, attenuation due to distance, atmospheric conditions, ground elevations within the project site as well as existing terrain elevations outside the project site.

Table 28 Receiver IDs for assessment purposes

Receiver ID	Noise Sensitive Locations	Type
Com01	35 Gordon Street – Medical Offices	Commercial
Com02	30 Gordon Street Offices & Retail	Commercial
Com03	28 Gordon Street Offices	Commercial
Com04	32 Gordon Street Offices & Retail	Commercial
Rec01	Fitzroy Oval and Coffs Harbour War Memorial Olympic Swimming pool	Recreational
Re01	Duke Street Residences	Residential
Re02	Hotel Development	Residential
Com05	City Council Chambers	Commercial
Wshp01	21 Gordon Street - Uniting Church	Place of Worship

The predicted noise levels have been assessed against the criteria discussed in Section 4. The outcomes of this assessment are summarised in Table 30 for non-residential receivers and Table 31 for residential receivers.

Table 29 Predicted noise levels at receivers (based on indicative program)

Scenario	Dates	Tasks	Aggregate Sound Power Level per Scenario (dBA re 1pW)	Predicted Noise Levels, dBA									
				Com01	Com02	Com03	Com04	Rec01	Rec02	Re01	Re02	Com05	Wshp01
1	May – Jun 2020	Concrete slab and pavement removal	124	84	80	81	79	65	55	65	≥ 75	70	90
2	Jun – Jul 2020	Piling and excavation works	119	82	76	76	76	57	49	65	71	72	83
3	Oct 2020 – Jan 2021	Structure assembly	120	81	78	78	77	57	50	61	73	70	83
4	Mar – May 2022	External fitout works and landscaping	117	81	74	74	74	55	47	62	69	68	85

Table 30 Summary of assessment outcomes and exceedances at non-residential receivers based on the ICNG criteria

Scenario	Parameter	Assessment Outcome							
		Com01	Com02	Com03	Com04	Rec01	Rec02	Com05	Wrshp01
1	*Predicted Noise Levels, dBA*	*84*	*80*	*81*	*79*	*65*	*55*	*70*	*90*
	Monday – Saturday (Standard Hours)	Exccedance	Exccedance	Exccedance	Exccedance	Compliance	Compliance	Compliance	Exccedance
	Exceedance over NML, dB	14 dB	10 dB	11 dB	9 dB				35 dB
2	*Predicted Noise Levels, dBA*	*82*	*76*	*76*	*76*	*57*	*49*	*72*	*83*
	Monday – Saturday (Standard Hours)	Exccedance	Exccedance	Exccedance	Exccedance	Compliance	Compliance	Exceedance	Exceedance
	Exceedance over NML, dB	12 dB	6 dB	6 dB	6 dB			2 dB	28 dB
3	*Predicted Noise Levels, dBA*	*81*	*78*	*78*	*77*	*57*	*50*	*70*	*83*
	Monday – Saturday (Standard Hours)	Exceedance	Exceedance	Exceedance	Exceedance	Compliance	Compliance	Compliance	Exceedance
	Exceedance over NML, dB	11 dB	3 dB	3 dB	2 dB				28 dB
4	*Predicted Noise Levels, dBA*	*81*	*74*	*74*	*74*	*55*	*47*	*68*	*85*
	Monday – Saturday (Standard Hours)	Exceedance	Exceedance	Exceedance	Exceedance	Compliance	Compliance	Compliance	Exceedance
	Exceedance over NML, dB	11	4	4	4				30 dB

Table 31 Summary of assessment outcomes and exceedances at residential receivers based on the ICNG criteria

Scenario	Parameter	Assessment Outcome	
		Re01	Re02
1	*Predicted Noise Levels, dBA*	*65*	*≥ 75*
	Monday – Saturday (Standard Hours)	Noise affected	Highly noise affected
	Exceedance over NML, dB	12	≥ 15
2	*Predicted Noise Levels, dBA*	*65*	*71*
	Monday – Saturday (Standard Hours)	Noise affected	Noise affected
	Exceedance over NML, dB	12	11
3	*Predicted Noise Levels, dBA*	*61*	*73*
	Monday – Saturday (Standard Hours)	Noise affected	Noise affected
	Exceedance over NML, dB	8	13
4	*Predicted Noise Levels, dBA*	*62*	*69*
	Monday – Saturday (Standard Hours)	Noise affected	Noise affected
	Exceedance over NML, dB	9	9

Please note that the noise predictions consider a worst case scenario where:

- All listed plant items operate simultaneously
- Noise sources have been located as close as possible to nearest affected receivers

Consequently, from the assessment of these predicted noise levels, the following is noted:

- Scenario 3 shows the least noise impact to affected non-residential receivers, with three both recreational receivers and one commercial receiver complying.
- Scenario 3 shows the lowest exceedances for residential receivers along Duke Street. While scenario 4 shows the lowest exceedances for the future hotel development receiver.
- Scenarios 1 and 2 show the highest noise impact to nearest affected receivers, with nearest residential premises either being highly noise affected or noise affected (depending on the proximity of the noise sources to the receivers)

Therefore, based on these findings, the conceptual management procedures discussed in Section 6.4 are recommended.

6.2 Construction Traffic Noise Assessment

The construction traffic noise assessment is based on vehicle volumes provided in the *Construction Traffic Management Plan* by Ason Group (Ref: 0914r02v1), dated 17/06/2019.

6.2.1 Construction Traffic Event Assessment

The number of trucks required to access the site during the construction of the development is summarised in Figure 10 below

Figure 10 Truck movements related to each stage of construction as provided in the Construction Traffic Management Plan.

Table 4: Truck Movement Overview

Stage	Excavation	General Construction	Concrete Pours	External Finishes	Kerb / Footpath Works
Truck Frequency (Movements Per Day)	66	66	66	60	40
Largest Vehicle Size	Truck & Dog	Truck & Dog	Truck & Dog	MRV	AV

From Figure 10 it is determined that for the peak number of truck movements (66 per day) it is estimated that 2 truck movements over a 15 minute period is the worst case scenario and thus used as our scenario for assessing construction traffic events related to the use of the site.

Based on the information provided in the Construction Traffic Management Report it's understood that trucks will not remain on site or at a nearby depot location. Truck movements related to the site are expected to be short term arrival and departure events for offloading and on loading.

Since the proposed construction hours are the standard construction hours (7:00 am – 6:00 pm Monday - Friday and 8:00 am to 1:00 pm Saturday) outlined in the ICNG its expected traffic events related to the site will only occur during standard construction hours.

Vehicle noise events related to the use of the construction site have been predicted to the nearest affected receivers as per Table 28. Cumulative vehicle noise events of a truck reversing (arriving), truck braking, truck door slamming, truck dumping, truck idling and truck moving (departing) have been averaged for a 15 minute period and are assessed against the ICNG NML criteria established in Section 4, see Table 32 below.

Table 32 Assessment of construction traffic noise at nearest affected receivers

Receiver	Predicted Noise Level (dBA)	NML Criterion	Compliance
Com01: 35 Gordon Street	64	70	**Yes**
Com02: 30 Gordon Street	56	70	**Yes**
Com03:28 Gordon Street	54	70	**Yes**
Com04: 32 Gordon Street	57	70	**Yes**
Rec01:Oval and Swimming Pool	34	65	**Yes**
Re01: Duke Street Residences	48	53	**Yes**
Re02: Hotel Development	49	60	**Yes**
Com05: City Council Chambers	40	70	**Yes**
Wshp01: Uniting Church	56	55	**Yes – Marginal Compliance**

Compliance with the ICNG NML criteria is achieved for the proposed construction hours.

6.2.2 Construction Traffic Impact on Existing Traffic

Regarding vehicular traffic movements related to construction activities; it is noted that vehicle numbers on surrounding roads would need to increase by around 60% from existing traffic flows, for a 2 dB increase in road traffic noise to occur.

The Construction Traffic Management Plan forecasts a site peak of 109 vehicles per hour during the morning when workers arrive or afternoon when workers leave. Compared to the existing traffic volumes provided in Figure 8 and the existing peak hour traffic levels provided in Figure 15 and Figure 16 of the Transport Assessment Report, construction traffic volumes do not exceed the existing traffic volumes by more than 60%. Therefore it is unlikely traffic related to the construction site do not increase existing road levels by more than 2 dB.

6.3 Vibration Assessment

In order to maintain compliance with the human comfort vibration criteria discussed in Section 4.3, it is recommended that the indicative safe distances listed in Table 33 should be maintained. These indicative safe distances should be validated prior to the start of construction works by undertaking measurements of vibration levels generated by construction and demolition equipment to be used on site.

Since the criteria for scientific or medical equipment (should any of these exist close to the site) can be more stringent than those required for human comfort, vibration validating measurements should be conducted at each site to determine the vibration level and potential impact onto this sensitive equipment.

Additionally any vibration levels should be assessed in accordance with the criteria discussed in Section 4.3. This information should also be included as part of the construction noise and vibration management plan (CNVMP).

6.4 Noise and Vibration Management Procedures

The contractor should consider developing a construction noise and vibration management plan (CNVMP) in order to implement mitigation measures to manage the noise and vibration impact onto the potentially affected receivers.

The following sub-sections discuss the issues and measures that can be considered as part of this CNVMP.

Table 33 Recommended indicative safe working distances for vibration intensive plant

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	Human Comfort (AVTG)
Vibratory roller	< 50 kN (Typically 1 – 2 tonnes)	5	15 – 20
	< 100 kN (Typically 2 – 4 tonnes)	6	20
	< 200 kN (Typically 4 – 6 tonnes)	12	40
	< 300 kN (Typically 7 – 13 tonnes)	15	100
	> 300 kN (Typically more than 13 tonnes)	20	100
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2	7
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7	23
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22	73
Vibratory pile driver	Sheet piles	2 – 20	20
Jackhammer	Hand held	1	Avoid contact with structure and steel reinforcements

6.4.1 Noise Mitigation Measures

A detailed construction program should be provided which should include the following:

- Schedule of construction activities (classified into scenarios if applicable)
- List of construction equipment per activity
- Location of construction equipment
- Duration of construction activities, as well as proposed construction hours

This construction program should be issued in order to assist on the prediction of the noise impact and to develop mitigation measures that can ameliorate this impact. A 3D computer noise model can be produced to conduct the noise level predictions and undertake the relevant assessment. The outcomes of this assessment should be discussed in the CNVMP.

The contractor should, where reasonable and feasible, apply best practice noise mitigation measures. These measures include the following:

- Maximising the offset distance between plant items and nearby noise sensitive receivers.
- Preventing noisy plant working simultaneously and adjacent to sensitive receivers.
- Minimising consecutive works in the same site area.
- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.

In order to minimise noise impacts during the works, the contractor should take all reasonable and feasible measures to attenuate the noise impact. Hence it is advised that on-site monitoring be conducted in order to attest this impact and propose mitigation measures as construction activities develop.

The contractor should also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers.

The contractor should apply all feasible and reasonable work practices to meet the NMLs and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and the contact details for the proposal.

A potential approach would be to schedule a respite period after continuous construction activity, or undertaking high noise generating works to less sensitive times.

Finally, undertake an assessment of road traffic noise generated by light and heavy vehicle movements which are associated with the development construction. For this purpose, request a traffic study report to determine the relevant traffic flows and assess the predicted road traffic noise levels in accordance with the criteria discussed in Section 4.2.

6.4.2 Vibration Mitigation Measures

The following vibration mitigation measures are recommended to be considered as part of a CNVMP:

- Any vibration generating plant and equipment is to be located in areas within the site in order to lower the vibration impacts.

- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Identify other vibration sensitive structures such as tunnels, gas pipelines, fibre optic cables, Sydney Water retention basins. Specific vibration goals should be determined on a case-by-case basis by an acoustic consultant which is to be engaged by the construction contractor.
- Identify heritage structures as well as vibration sensitive premises (such as those containing scientific and surgery equipment). Safe working distances from vibration generating equipment should be established in order to achieve compliance with the criteria discussed in Section 4.3.

  Hence, it is advised to conduct attended measurements of vibration generating plant at commencement of works in order to confirm compliance with vibration criteria discussed in Section 4.3. Measurements should be conducted at the nearest affected property boundary. If possible, measurements will also be used to validate the safe working distances advised in Table 33 and to establish safe working distances suitable to the project.
- Use lower vibration generating items of construction plant and equipment, that is, smaller capacity plant.
- Minimise conducting vibration generating works consecutively in the same area (if applicable).
- Schedule a minimum respite period prior to long continuous activities.
- Use only dampened rock breakers and/or “city” rock breakers to minimise the impacts associated with rock breaking works.

6.4.3 Miscellaneous Measures

Deliveries should be undertaken, where possible, during standard construction hours and no more than 1 truck delivery every 15 minutes.

Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site, and monitor the profiles in use

It is advised that mobile plant and trucks operating on site for a significant portion of the project are to have reversing alarm noise emissions minimised. This is to be implemented subject to recognising the need to maintain occupational safety standards

No public address system should be used on site.

A complaint response procedure should be implemented. Information to be gathered as part of this process should include location of complainant, time/s of occurrence of alleged noise or vibration impacts (including nature of impact particularly with respect to vibration), perceived source, prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint. All resident complaints will be responded to in the required timeframe and action taken recorded.

7 CONCLUSIONS

Pulse Acoustics has been engaged by Coffs Harbour City Council (the client) to undertake an acoustic assessment in order to address the conditions stated in the Planning Secretary's Environmental Assessment Requirements (SEARs).

The following sub-sections summarise the outcomes of this assessment.

7.1 Operational Acoustic Assessment

7.1.1 Plant Rooms

External noise emissions from plant rooms should be acoustically treated in order to achieve compliance with the external noise level criteria discussed in Section 3.1.

Conceptual recommendations are provided in Section 5.1 for consideration and further investigation. These treatments include recommended wall constructions, roof and floor slab constructions, internal lining to plant room walls and ceilings, and acoustically sealed doors that achieve a Rw 30 sound insulation performance

7.1.2 External Noise Emissions

Acoustic treatment should be implemented for external noise emissions by mechanical plant items in order to achieve the external noise level criteria discussed in Section 3.1. This treatment should be especially considered for plant items located in the roof plant room.

Conceptual recommendations are provided in Section 5.2 for consideration and further investigation. These recommendations include the following:

- Internally lined ductwork for external air intake and exhaust paths, including internally lined return air / outside air mixed boxes behind AHUs.
- Acoustic louvres for relief air paths through plant room walls
- Silencers
- Implementation of variable speed drive units whenever possible.
- Acoustic louvres for cooling towers
- Limit the number of operating mechanical plant items (including cooling towers), or reduce operational loads between 6 pm and 7 am.

7.1.3 Stand-by Generator

Performance requirements have been provided for the generator plant room, which consists of complying with an aggregate noise level of 70 dBA at 7 m from the plant room under free field conditions, and to comply with the external noise level criteria discussed in Section 3.1, by accounting for modifying factors for duration of maintenance operations

Consequently, conceptual recommendations and requirements have been provided for further investigation and consideration during detailed design stages. Such conceptual recommendations include:

- Stand-by generator to be installed within an acoustic enclosure or masonry plant room
- Rectangular silencers for the air intake and air discharge paths,

- Mufflers for the exhaust system,
- Resilient vibration mounts

These conceptual measures should be considered in conjunction with recommended operational procedures for maintenance operations which limit the time when these operations can be conducted (between 7:00 am and 6:00 pm), the duration (maximum of 1 hour), and the frequency (maximum of one event in any 24 hour period).

7.1.4 Patron Noise Assessment

It has been determined that patron noise levels from both the ground level café and level 3 entertainment area have been predicted to comply with the NSW Liquor and Gaming Criteria (outlined in Section 3.3) at the nearest affected residential receivers, refer to Section 5.4.

Noise levels have also been predicted to the nearest residences based on the general patron use of the Coffs Harbour Cultural and Civic centre and have been assessed against the NSW NPI Intrusiveness criteria (refer to Section 3.1) and the sleep disturbance criteria (refer to Section 3.2). Compliance has been shown for both the intrusiveness and sleep disturbance criteria at all residential receivers.

The maximum allowable noise levels for the proposed personal announcement (PA) system to be used in the Coffs Harbour Cultural and Civic centre have been calculated at the nearest residential receivers. The maximum overall noise levels are as follows:

- Duke Street residences: 41 dBA
- Hotel development: 45 dBA

Refer to Table 25 in Section 5.5 for the maximum allowed PA noise levels at residences in octave band spectra.

7.1.5 Loading Dock

An assessment of noise emission from loading dock events against the NSW NPI project noise trigger levels (refer to Section 3) has been conducted with compliance being determined for the scenario of a single truck delivery within the proposed loading dock hours of operation, between 9:30 am and 4:30 pm.

Requirements with regards to the operation of the loading dock have been established in Section 5.6 and are as follows:

- Maximum of 4 deliveries (8 vehicle movements, arriving and departing) in and out of the loading dock every 15 minutes during the day time period.
- Maximum of 1 delivery (2 vehicle movements, arriving and departing) in and out of the loading dock, every 15 minutes during the evening period.

7.1.6 Car Park Noise Emissions

Since car park is located within a basement level, impact from carpark noise emissions is considered to be negligible.

7.1.7 Noise Impact on Local Roads

It has been found that traffic generated by the development does not exceed 60% of the existing traffic flows. Therefore, it is unlikely that traffic noise levels will increase by 2 dB, and as a result, the noise impact on local roads is considered to be negligible.

7.2 Construction Noise & Vibration Assessment

The indicative construction noise and vibration assessment has determined that some residential, commercial, recreational and municipal receivers will be impacted by the construction and demolition activities. The impact ranges from noise affected to highly noise affected.

As a result, conceptual management procedures have been advised in Section 6.4 which should be considered and further developed into a detailed construction noise and vibration plan (CNVMP).

Also, noise generated by road traffic related to the use of the construction site has been assessed and found to comply with the Interim Construction Noise Guideline (ICNG) NML criteria established in Section 4, for the proposed construction hours. It has also been determined that road noise along Gordon Street is unlikely to increase by 2 dB during peak construction traffic times.

Finally the CNVMP should also consider vibration impact onto the nearest affected locations. Hence vibration mitigation measures have been discussed in Section 6.4.2, which includes the validation of safe working distances prior to starting vibration intensive tasks.

7.3 Final Remarks

Based on the findings from the acoustic assessment, it is our opinion that the proposed development is capable of achieving the acoustic conditions discussed in the Planning Secretary's Environmental Assessment Requirements, provided the conceptual recommendations discussed herein are implemented and developed further as the project design evolves in detailed design stages.

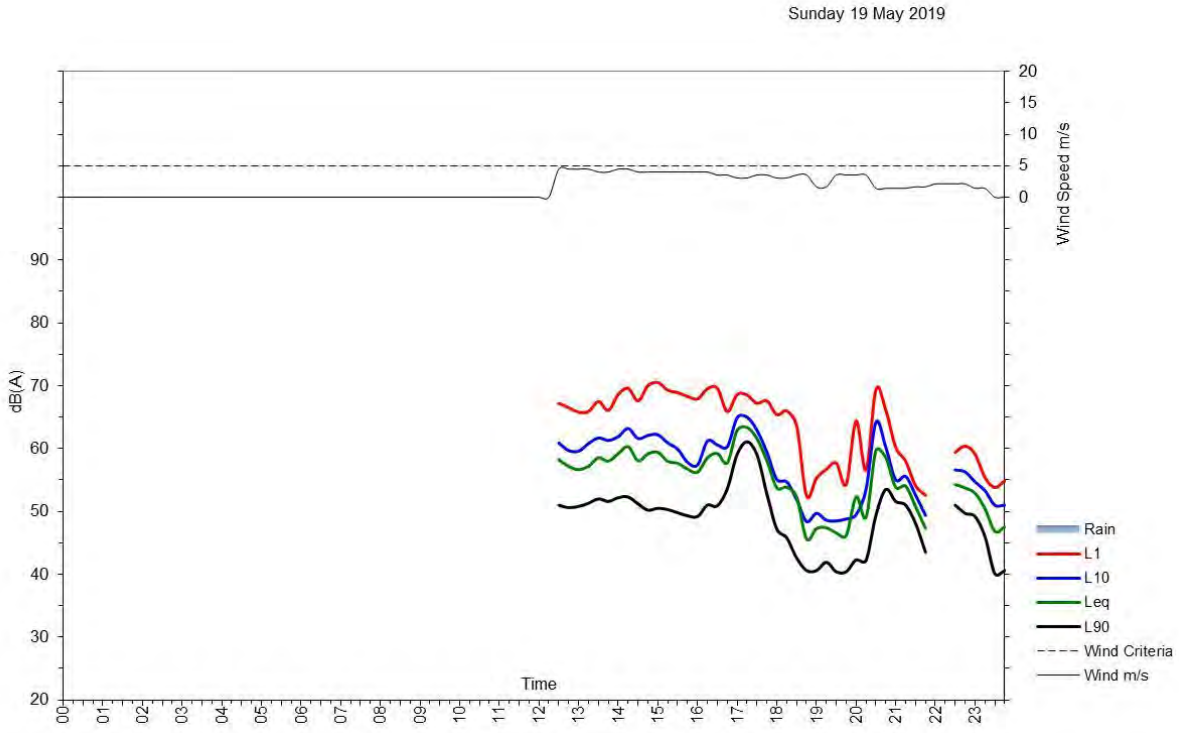
APPENDIX A: ACOUSTIC GLOSSARY

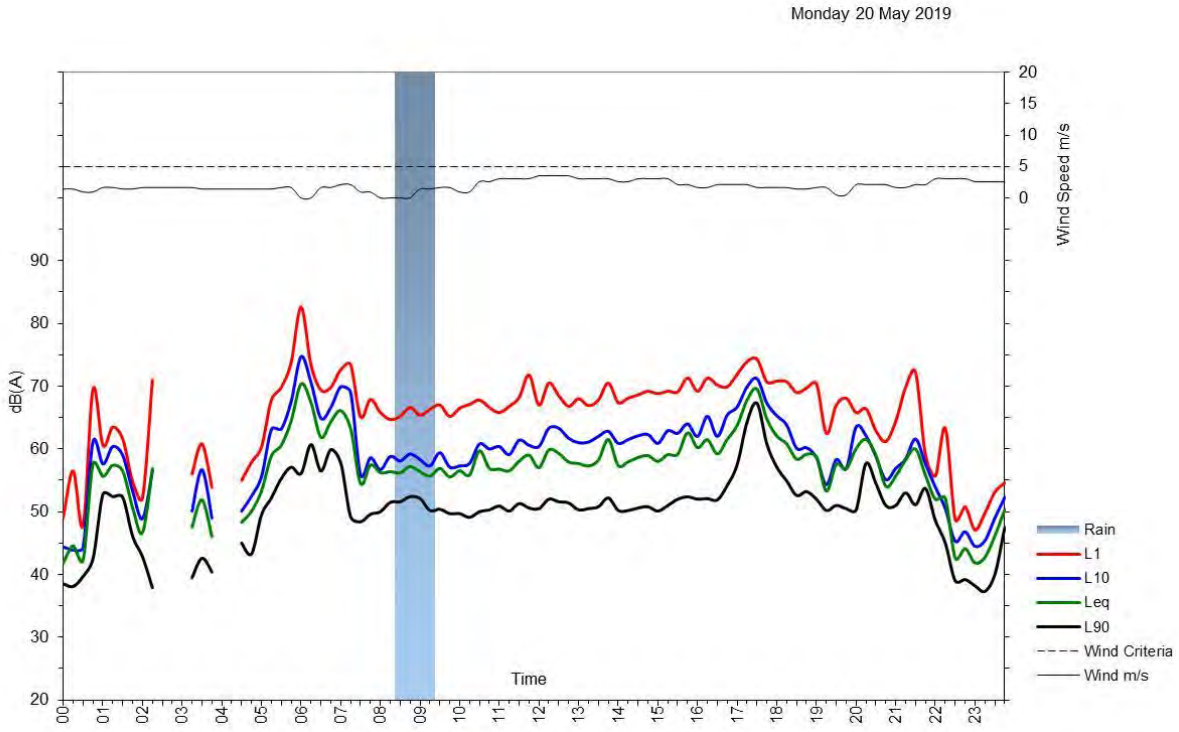
The following is a brief description of the acoustic terminology used in this report.

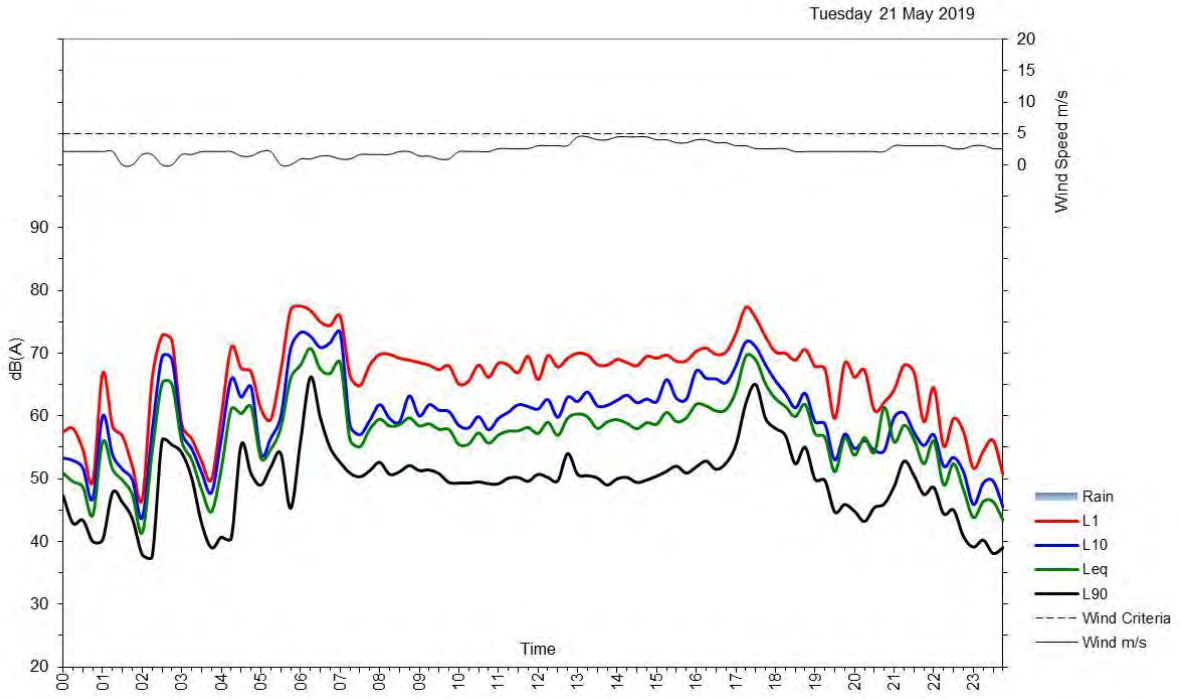
Ambient Sound	The totally encompassing sound in a given situation at a given time usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictates a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0dB the faintest sound we can hear 30dB a quiet library or in a quiet location in the country 45dB typical office space. Ambience in the city at night 60dB Martin Place at lunch time 70dB the sound of a car passing on the street 80dB loud music played at home 90dB the sound of a truck passing on the street 100dB the sound of a rock band 115dB limit of sound permitted in industry 120dB deafening
dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
L_{max}	The maximum sound pressure level measured over a given period.
L_{min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.

APPENDIX B: NOISE LOGGER SUMMARY

Logger Location 1: Within Project Site



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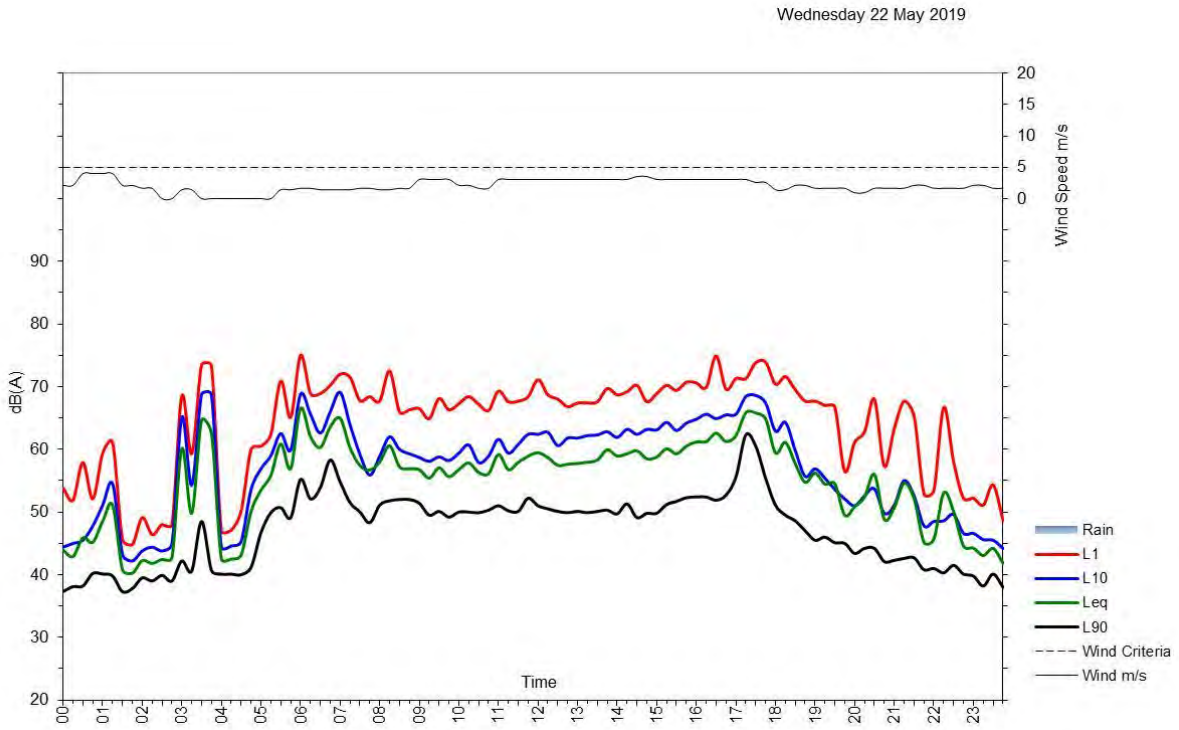
Wind Speed m/s
Time
Rain
L1
L10
Leq
L90
Wind Criteria
Wind m/s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Time
Rain
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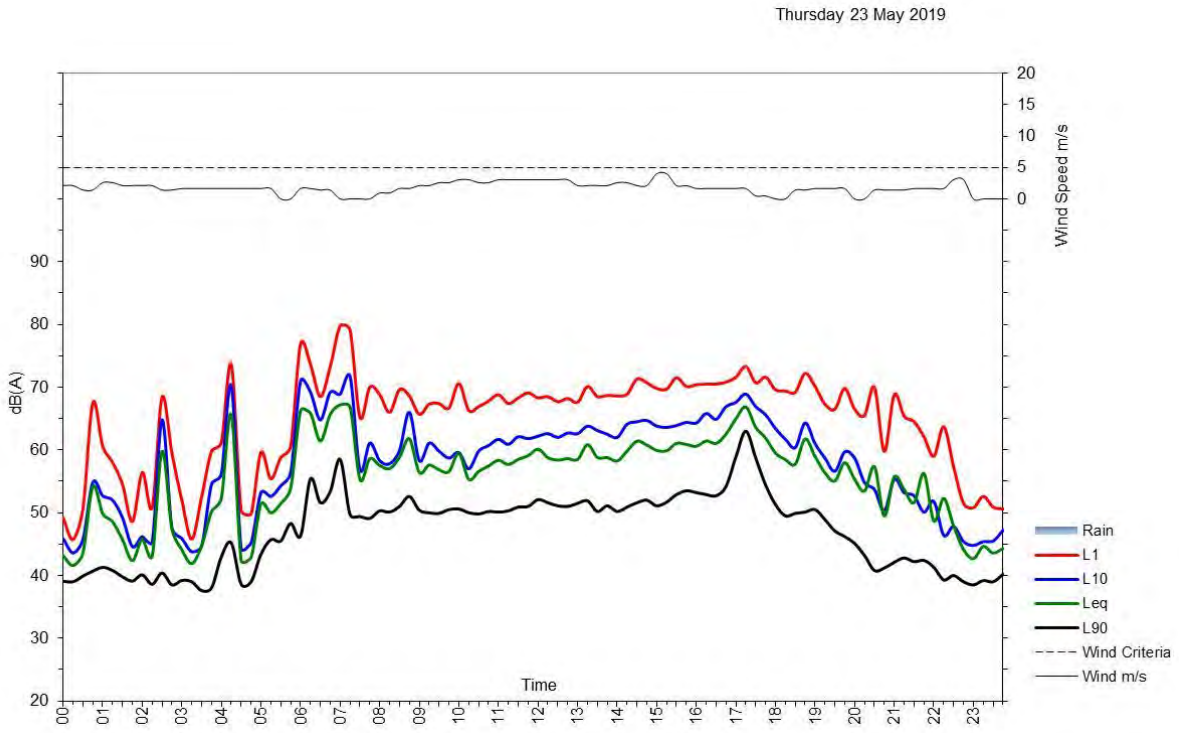
L10
Leq
L90
Wind Criteria
Wind m/s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Rain
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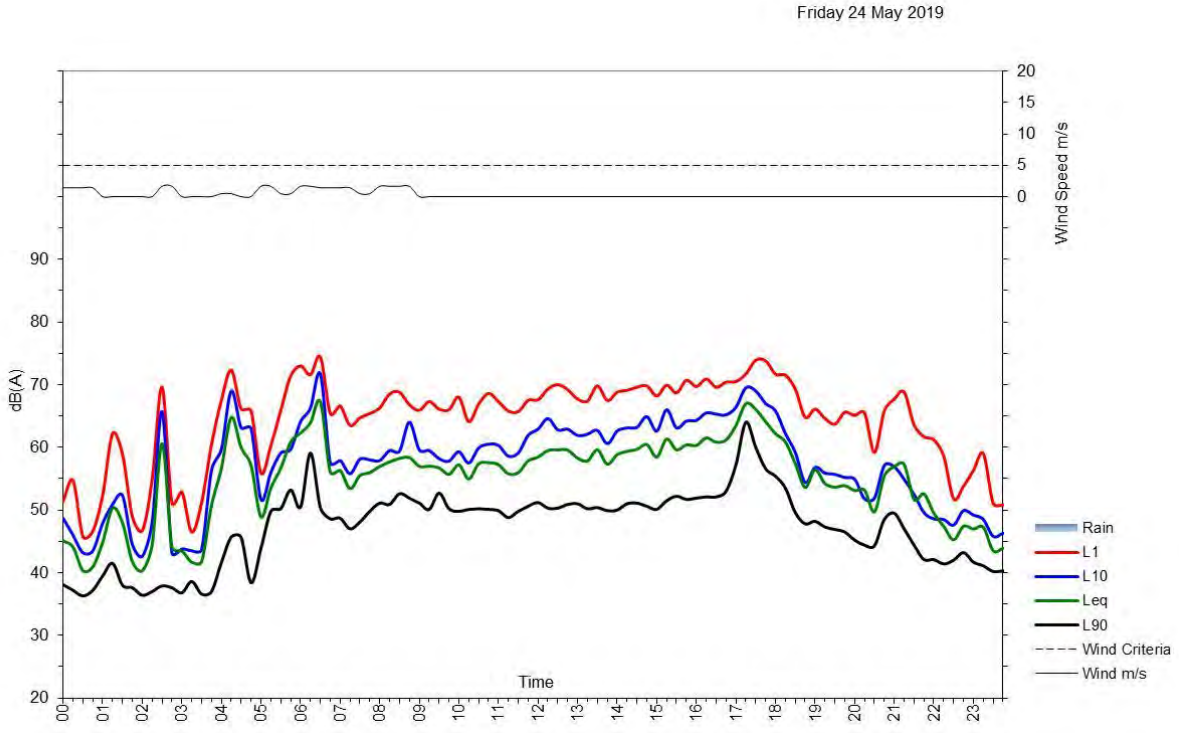
Leq
L90
Wind Criteria
Wind m/s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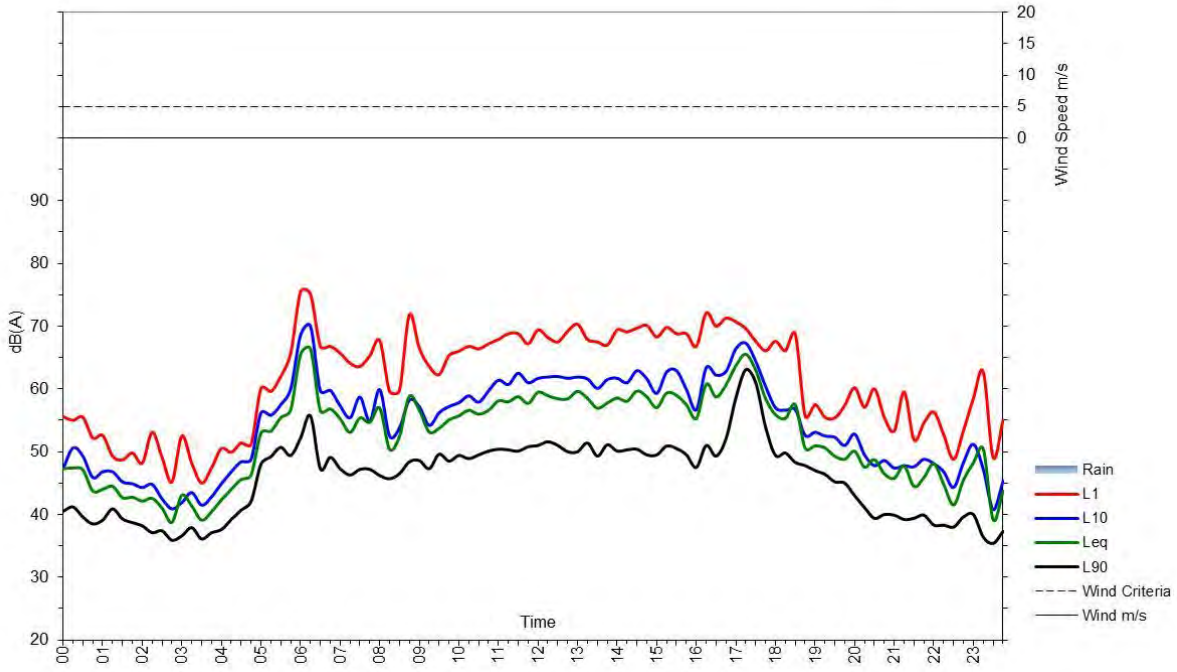
Saturday 25 May 2019



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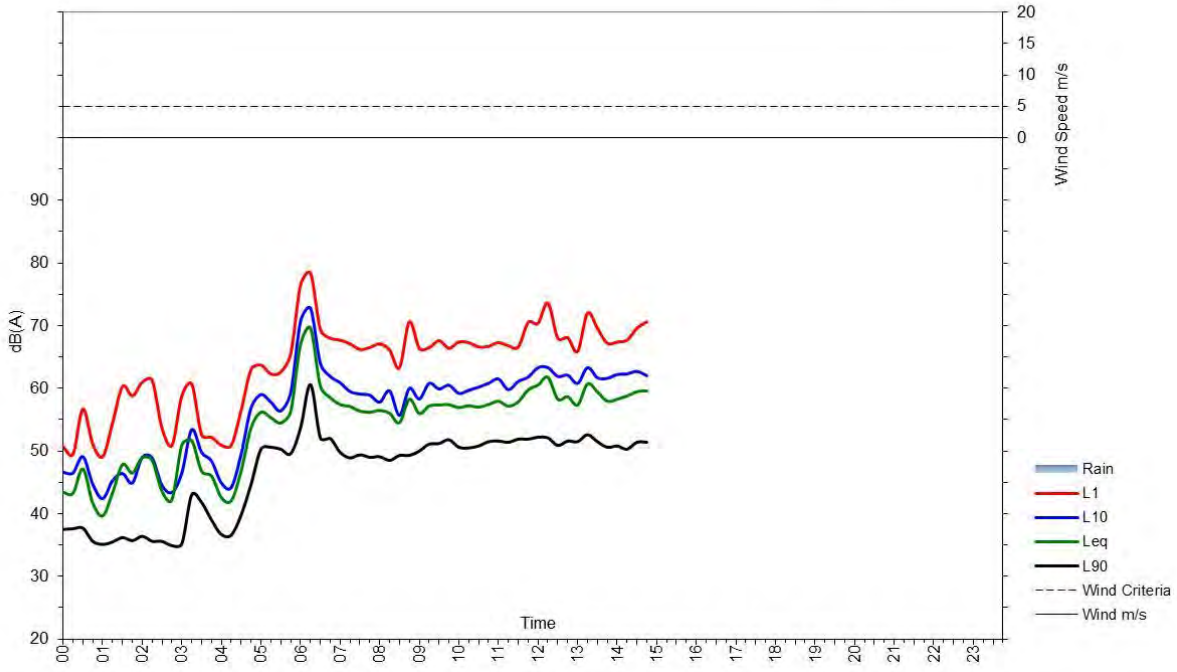
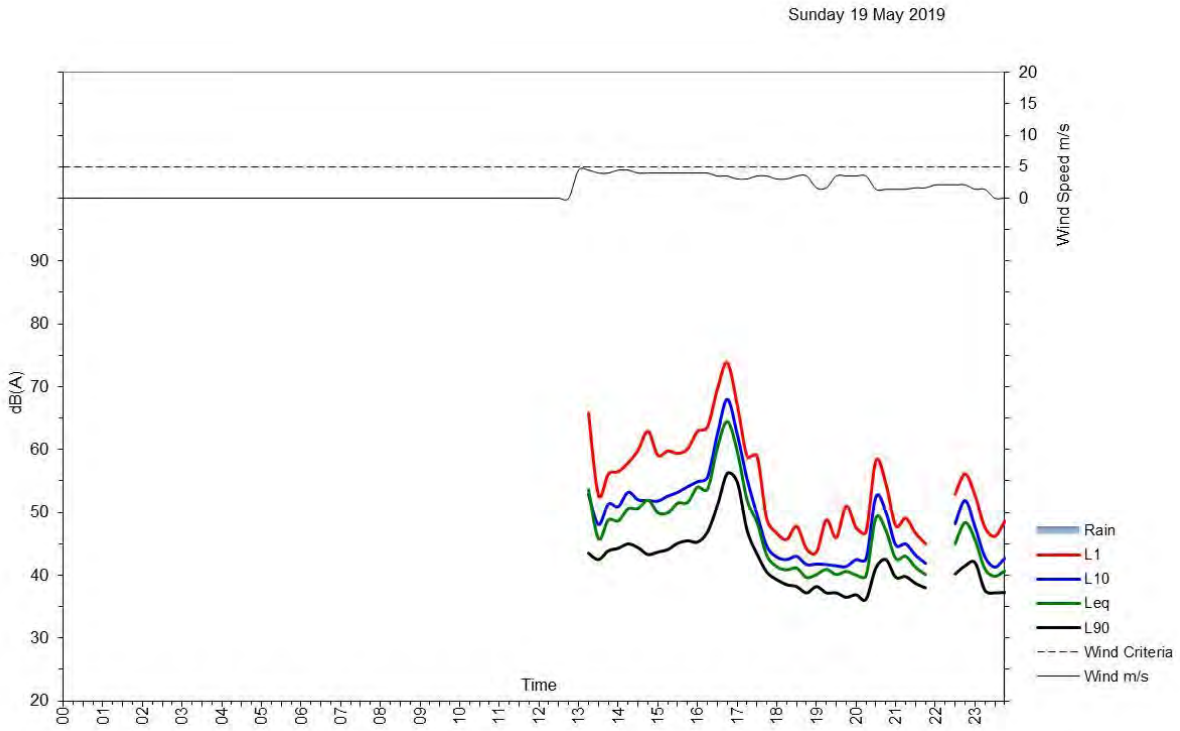
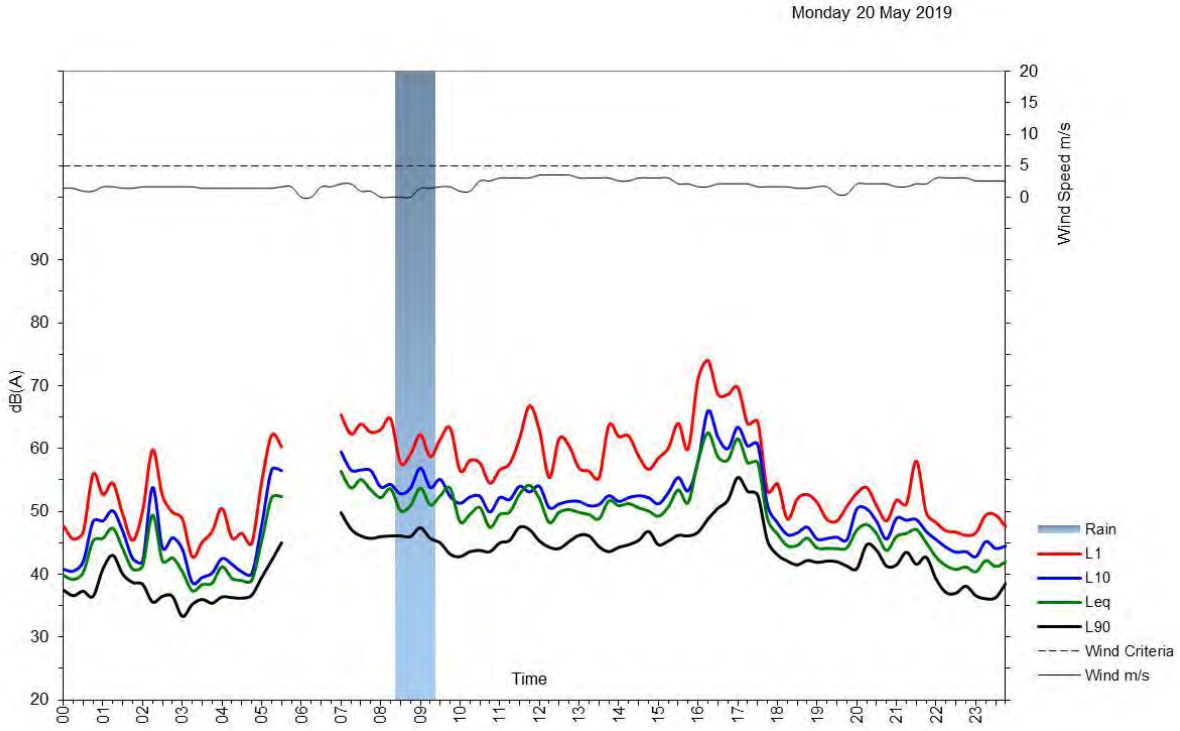
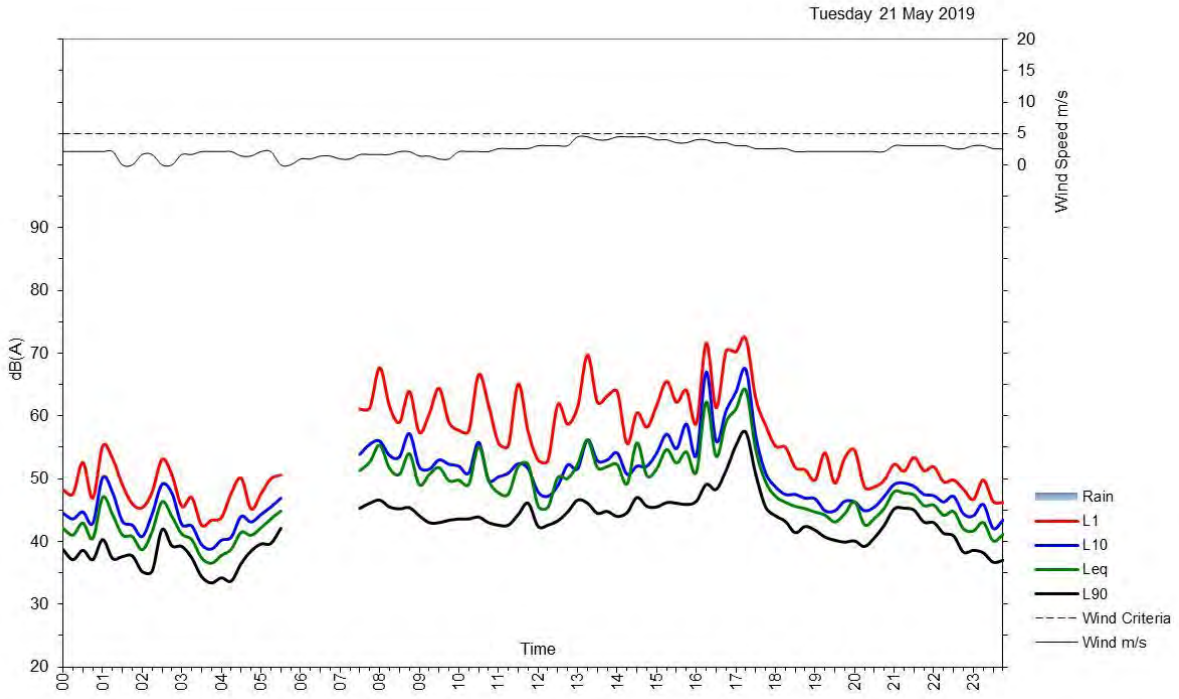


Logger Location 2: Along Property Boundary Between No. 9 and No. 11 Duke Street



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Time
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L1
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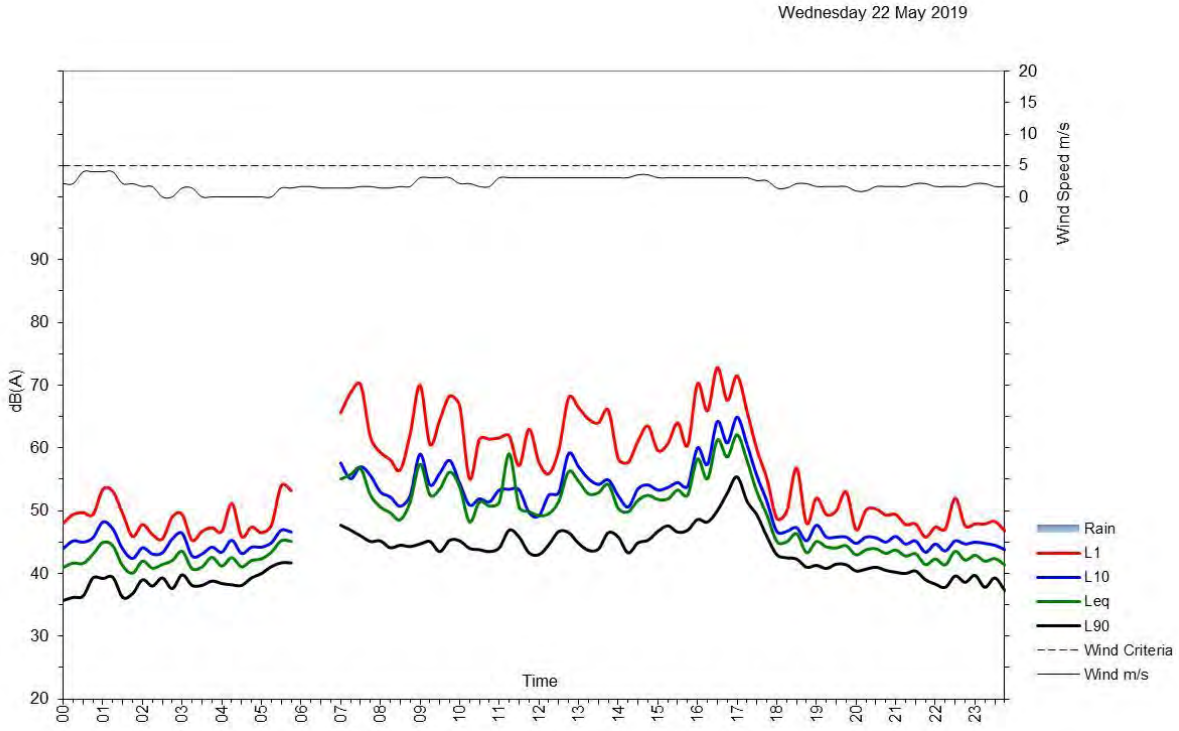
L90
Wind Criteria
Wind m/s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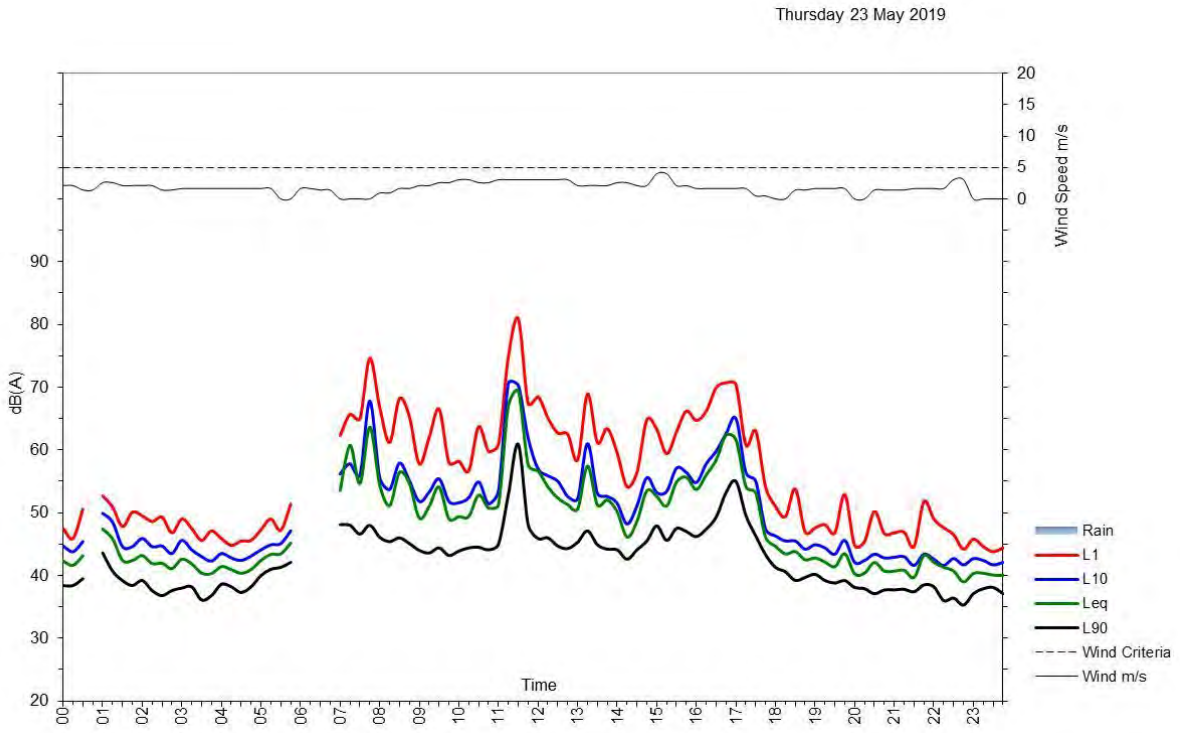
Wind m/s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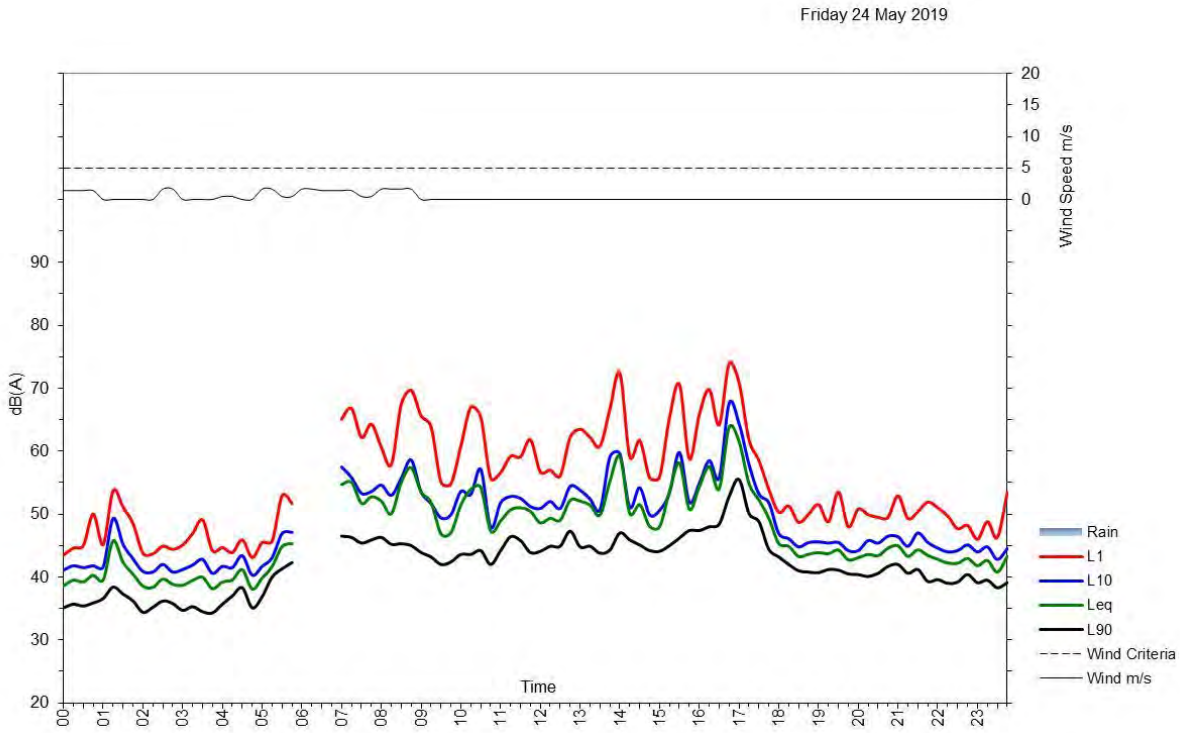
Wind m/s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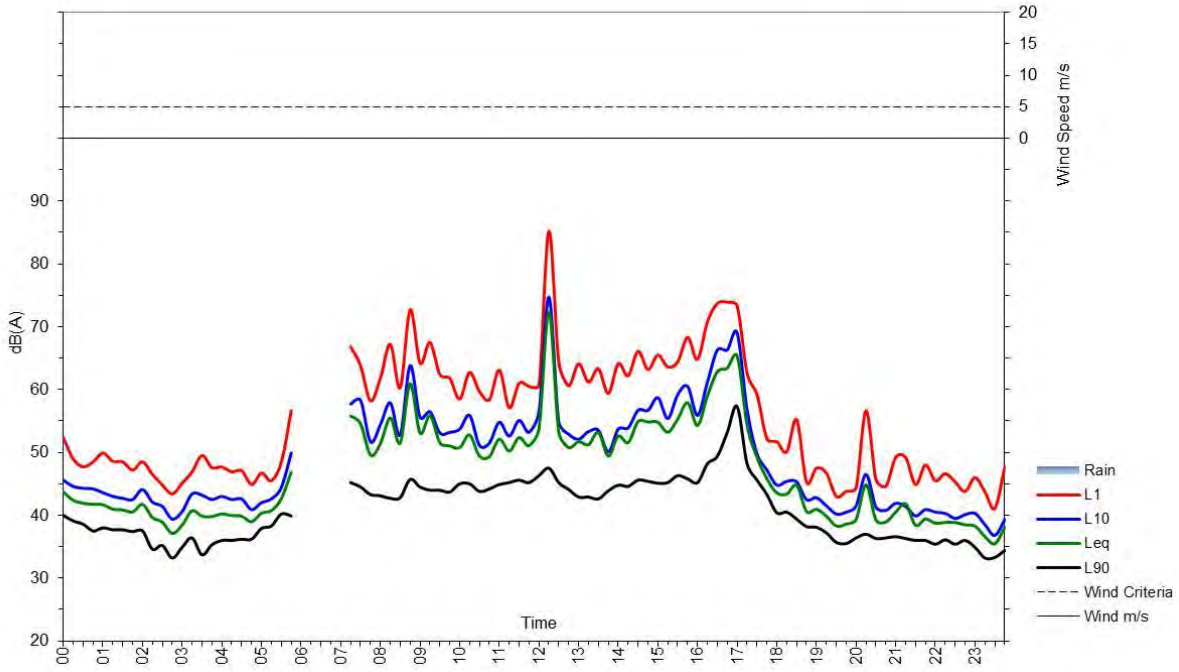

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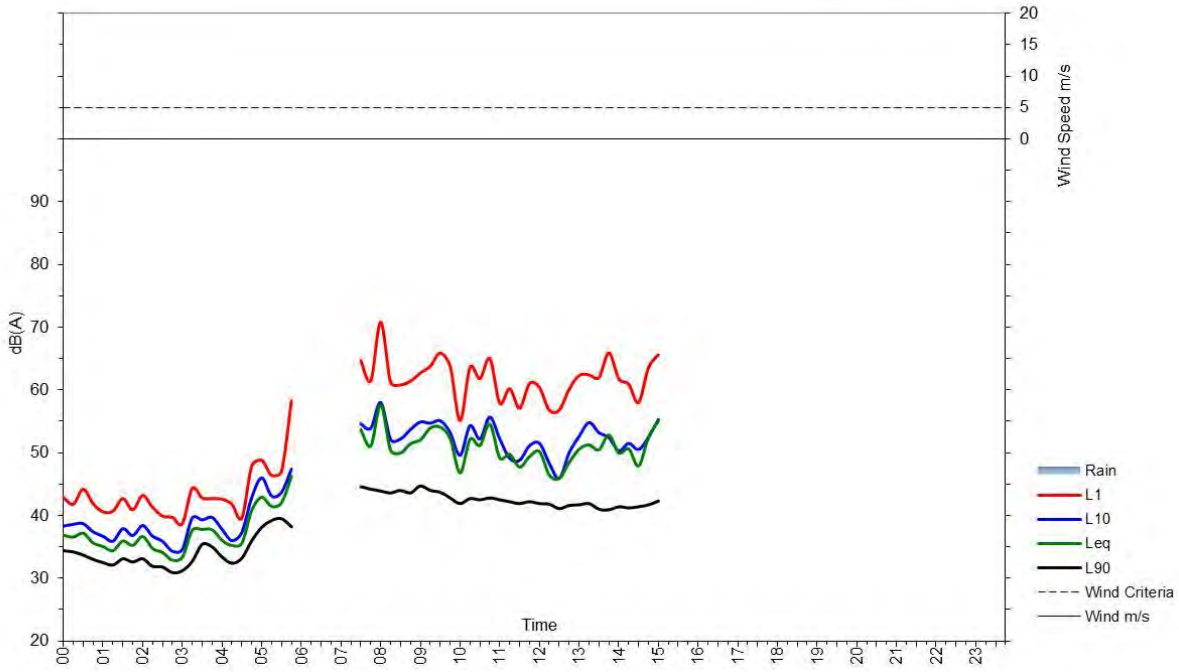
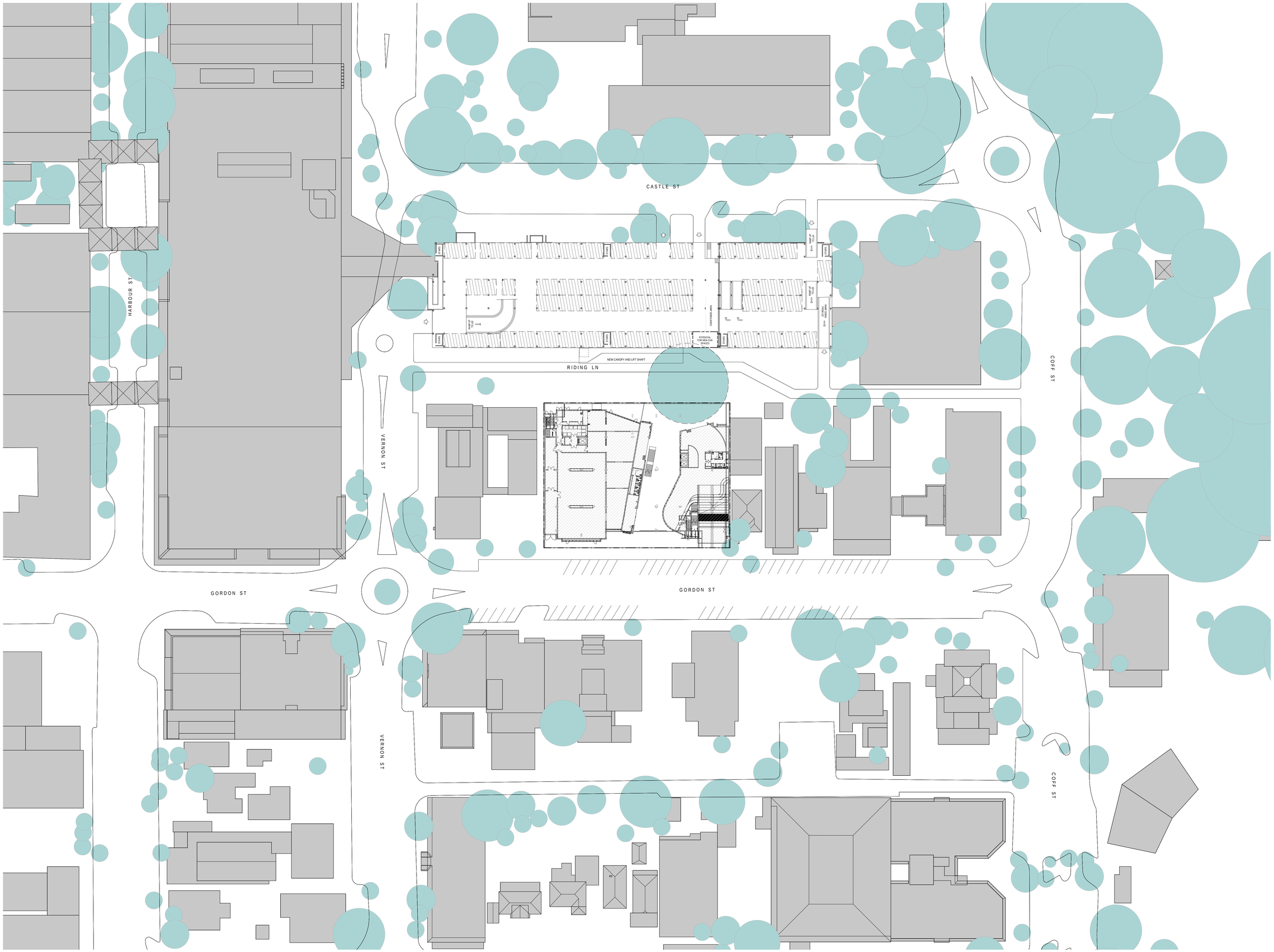


APPENDIX C: FLOOR LAYOUT DRAWINGS



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SITE ROOF PLAN

AR-A10-XX-02 | ISSUE 1

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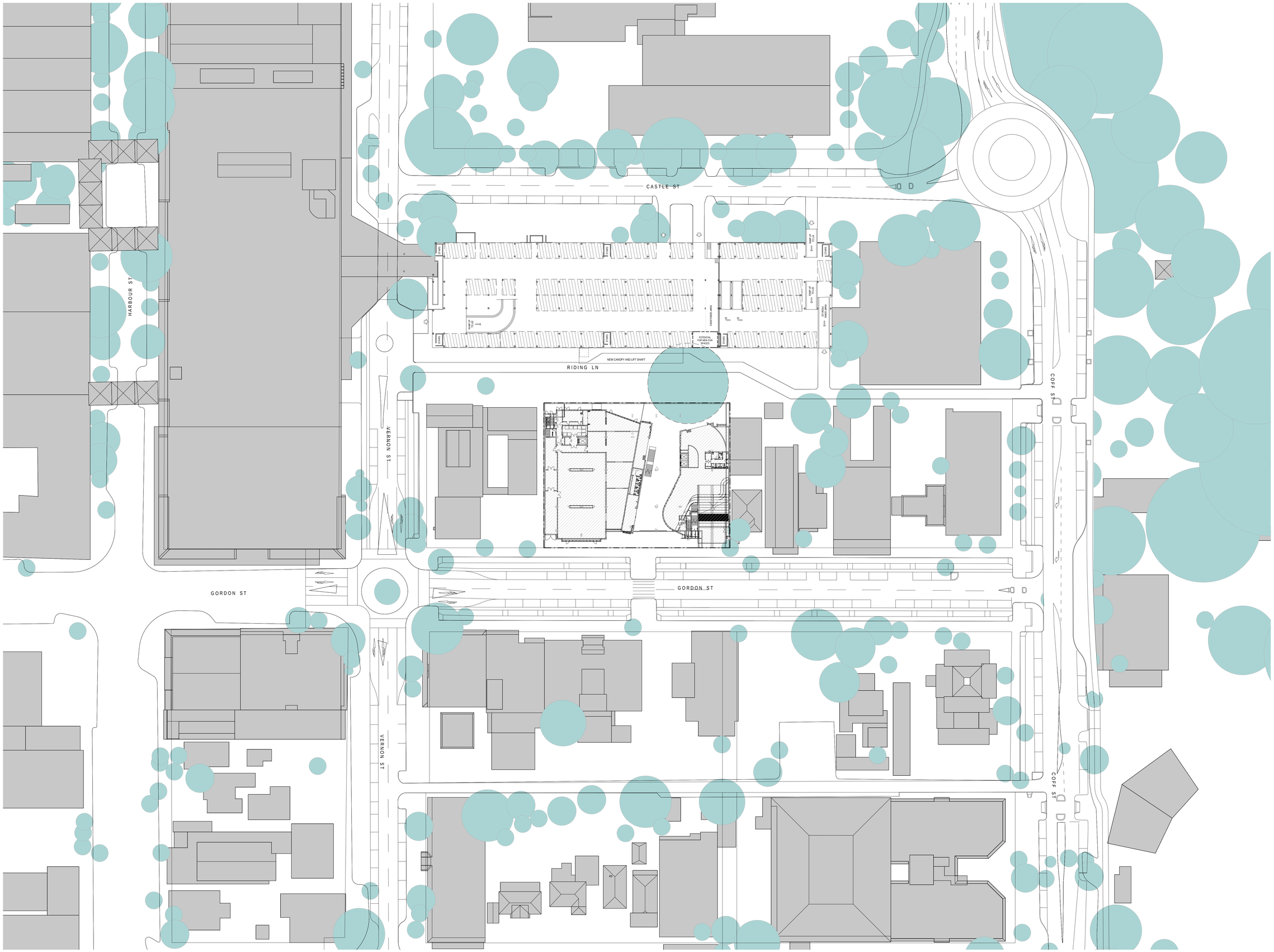

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LOCATION PLAN - PRECINCT STAGE 2

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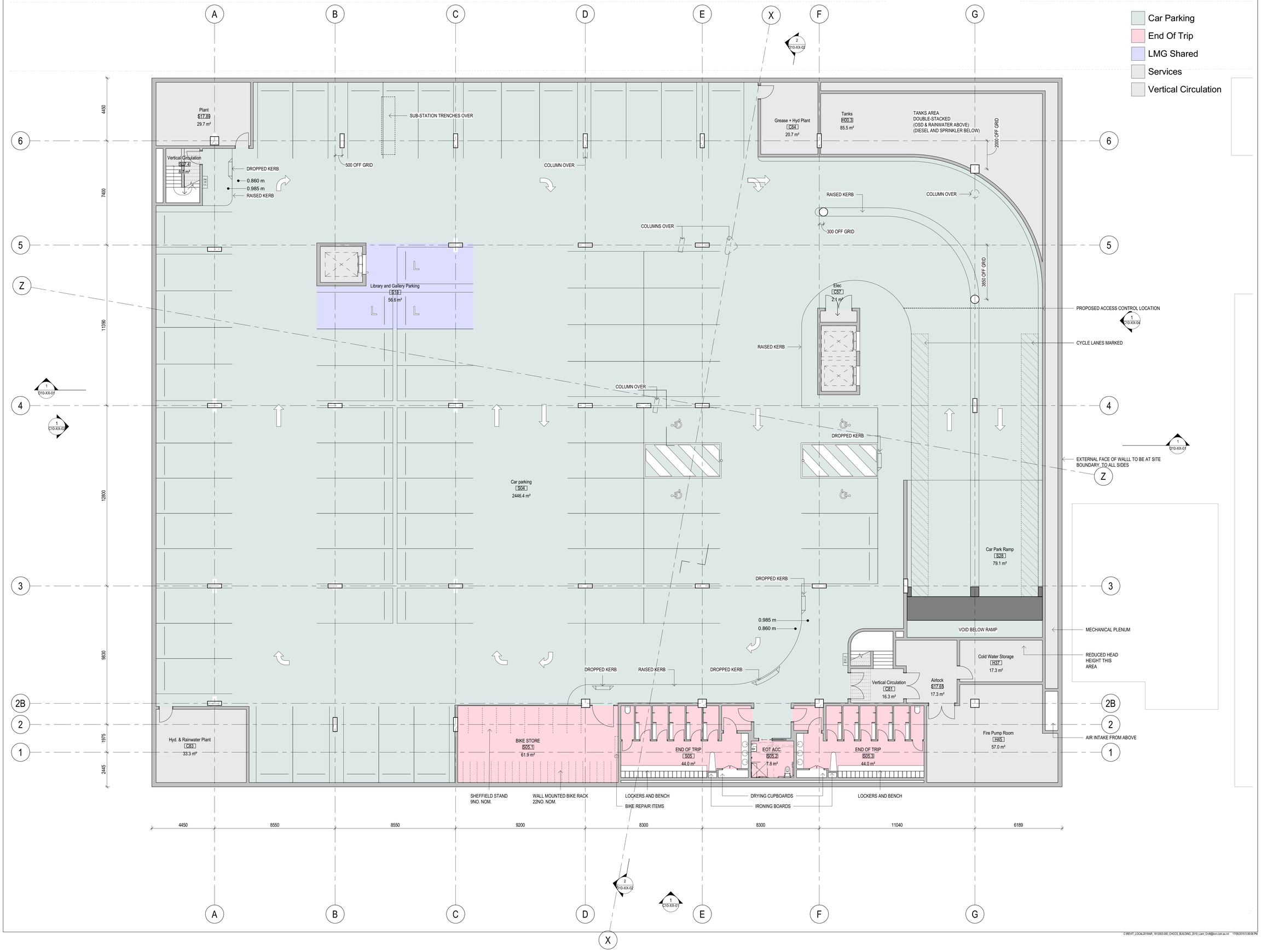

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BASEMENT LEVEL FLOOR PLAN

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GROUND LEVEL FLOOR PLAN

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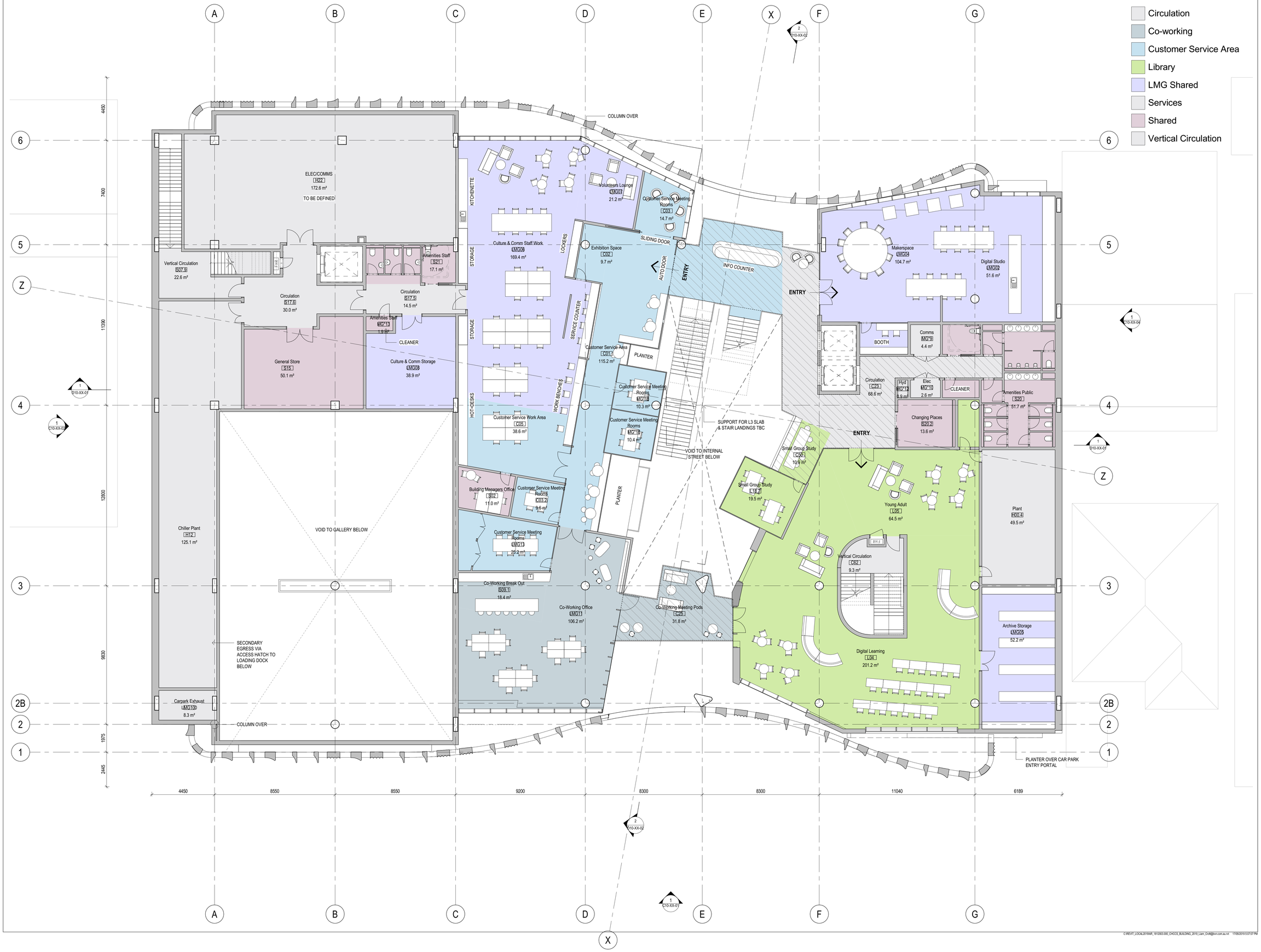

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STATUS
PRELIMINARY SCHEMATIC DESIGN

DRAWING
LEVEL 01 FLOOR PLAN

AR-B10-01-00 ISSUE 4

Circulation
Library
LMG Shared
Services
Vertical Circulation

Non-Print Material
L08
75.8 m²

Quiet Reading
C45
80.8 m²

HYD

Vertical Circulation
S07.2
12.9 m²

Comms
S17.70
6.0 m²

ELEC

Circulation
S17
734.8 m²

Returns Processing
L23
49.5 m²

Service Desk
L12.1
64.5 m²

Work & Processing Area
L21
50.3 m²

Outreach
L22
54.6 m²

Culture & Comm Staff Work
LMG8
39.5 m²

Collections Maintenance
L02
Redundant Room

Stack Area
L01
Redundant Room

Seating
L17
106.7 m²

COLUMN OVER

BALLASTED CONCRETE ROOF BELOW

ROOF TO L1 SPACES BELOW

Circulation
S07.17
100.7 m²

Library Outdoor Space
C86
33.5 m²

Group Study
L19
15.0 m²

Informal Gathering Spaces
L15.1
Redundant Room

Library Outdoor Space
C28
26.7 m²

Seating
C85
43.3 m²

Local History
L20
120.4 m²

Digitisation
LMG9
15.6 m²

Plant
LMG69
30.1 m²

Elec
LMG64
1.9 m²

Comms
LMG63
4.8 m²

Hydraulic
LMG65
2.8 m²

Multi-Function Devices
L14
3.8 m²

Public Computers
L13.1
108.9 m²

Public Computers
L13.1
108.9 m²

Multi-Function Devices
LMG67
6.0 m²

Vertical Circulation
S07.13
10.6 m²

FIRE

Quiet Reading
L16
92.7 m²

BALLASTED CONCRETE ROOF BELOW

4450 8550 8550 9200 8300 8300 11040 6189

4450 7400 11390 12860 9830 1975 2445

A B C D X E F G

6 5 Z 4 3 2B 2 1

1 D10-XX-07
1 C10-XX-02
2 D10-XX-02
1 C10-XX-01
1 C10-XX-04
1 D10-XX-01

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PROJECT

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COFFS HARBOUR, NSW
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LEVEL 02 FLOOR PLAN

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LEVEL 03 FLOOR PLAN

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