GREAT GEORGE STREET DEVELOPMENTS LTD

GREAT GEORGE STREET, LIVERPOOL

NOISE ASSESSMENT FOR PLANNING PURPOSES

25 September 2018

AEC REPORT: P3191/R3a/PJK

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1.0 INTRODUCTION

1.1 Acoustic & Engineering Consultants Limited (AEC) has been instructed by Great George Street Developments Ltd to undertake a noise assessment relating to a proposed mixed-use residential and commercial development on Great George Street, Liverpool. The assessment is required for planning purposes.

1.2 AEC prepared a noise assessment (P3191/R01/PJK) for a proposed mixed-use residential and commercial development on the same site in 2015, which was granted planning permission. Due to a revised site layout, a new planning application is required.

1.3 This report presents the on-site noise levels measured in both 2015 and 2018 and provides outline guidance on the required sound insulation performance of the external envelope of the residential properties, including the glazing and ventilation strategy, and commercial units to meet the Local Authority's internal noise level limit requirements.

1.4 Acoustic terminology used throughout the report is described in brief in Appendix A.

2.0 SITE DESCRIPTION

2.1 A scheme to build 5 residential blocks, a hotel and an office block on Great George Street, Liverpool has been prepared by Brock Carmichael Architects. The proposed layout is identified on Figure 1.

2.2 The proposed height and occupancy of each block is provided below:

- Block 2a – 9 storey residential block, including townhouses and apartments, with commercial units on the ground floor;
- Block 2b – 8 storey hotel block, including ground floor front and back of house areas and a fitness suite on the first floor;
- Block 2c – 6 storey residential block, including townhouses and apartments;
- Block 3a – 13 storey apartment block with ground floor commercial units;
- Block 3b – 2 storey office block;
- Block 3c – 17 storey residential block with ground floor commercial units;
- Block 3d – 8 storey residential block with ground floor commercial units.

2.3 AEC understand that at least one of the commercial units will be used for planning use Class A3/A4, which includes restaurants, cafes and public houses.

2.4 Great George Street makes up the eastern boundary of the development site. Adjacent to the site on the opposite side of Great George Street are existing residential blocks, beyond which is Liverpool Protestant Cathedral.

2.5 To the south of the site is the junction of Great George Street and St James Street. Further to the south is Parliament Street which is a main route into Liverpool city centre.

2.6 St James Street runs to the south-west of Blocks 3c and 3d. Beyond St James Street is an empty plot, which being developed into a 12-storey residential block. Further to the south-west is the Constellations and Observatory event venue.

2.7 To the west of the site are local residential streets, including Duncan Street, Upper Pitt Street and Cookson Street. To the north is Block 1, which is currently under construction, and beyond which is Hardy Street and further residential properties.

3.0 NOISE MEASUREMENTS

3.1 As the main noise source during the original daytime and night-time noise surveys in 2015 was road traffic on the surrounding roads, it has been deemed that the measured noise levels would still be representative of the noise climate in the area.

3.2 However, because of the number of events spaces in the Baltic Triangle, to the south of the site, further night-time noise level measurements were undertaken on a Friday night in August 2018. Both the 2015 and 2018 measurements are presented below.

2015 Measurements (Daytime and Night-Time)

3.3 Daytime noise levels were measured by AEC on Friday 10 July 2015 between 1000 and 1330h. Night-time noise levels were measured on Tuesday 21 and Wednesday 22 July 2015 between 2300 and 0110h.

3.4 Free-field noise measurements were undertaken at 4 locations around the development site, identified as A to D on Figure 1. All measurements were undertaken in general accordance with BS7445-1: 2003 '*Description and measurement of environmental noise. Guide to quantities and procedures*.'

3.5 Full details of the noise surveys are presented in Appendix B with measured noise data presented in Tables B1 and B2, with a brief description provided below.

3.6 Locations A and C were chosen to represent the facades of the blocks overlooking Great George Street. Location A was towards the centre of the proposed development site and Location C was closer to the junction of Great George Street and St James Street. During the daytime period the measured noise levels of around 64dB$L_{Aeq,15min}$ and 68dB$L_{A10,15min}$ was similar at both locations.

3.7 Similarly, at night, there was little variation between the measured noise levels at both locations of 61dB$L_{Aeq,10min}$ and typical maximum noise levels ranging from 74 to 78dB$L_{Amax.}$

3.8 Due to building works on Duncan Street, it was not possible to measure on either Duncan Street or Upper Pitt Street, however, the daytime and night-time measurements obtained at Location B have been considered representative of the blocks facing away from Great George Street.

3.9 The ambient noise level at this location during the day was 55dB$L_{Aeq,15min}$ and 51dB$L_{Aeq,10min}$ at night. The main noise source during both periods was due to road traffic on Great George Street, however, there were occasional car pass-bys on Cookson Street and the night-time maximum noise level from this source was around 67dBL_{Amax}.

3.10 Location D was selected to represent the blocks overlooking St James Street. The daytime noise levels at this location were 64dB$L_{Aeq,15min}$ and 68dB$L_{A10,15min}$. At night, the amount of traffic reduced, and the night-time ambient noise level was around 57dB$L_{Aeq,10min}$ with maximum noise levels no greater than 77dBL_{Amax}.

3.11 The lowest background noise levels measured around the development site were 49dB$L_{A90,\ 15minutes}$ during the daytime period and 40dB$L_{A90,\ 10minutes}$ at night.

2018 Noise Measurements (Night-time only)

3.12 The night-time measurements for the 2015 assessment were undertaken during the week (Monday to Thursday), and therefore, to supplement these measurements, noise levels were measured during between 2300 and 0100h on Friday 13 August 2018.

3.13 Noise levels were measured at 5 locations around the development site, identified as A, C, D, E and F on Figure 1. All noise levels were measured under free-field conditions except for Location A, which was undertaken at 1m from the hoardings around the development site.

3.14 Full details of the noise surveys are presented in Appendix B with measured noise data presented in Table B3, with a brief description provided below.

3.15 As stated above the noise levels measured at Location A were under façade conditions and the ambient noise level due to road traffic on Great George Street was around 70dB$L_{Aeq,10min}$. Maximum noise levels due to vehicle movements ranged from 77 to 80dBL_{Amax}.

3.16 At Location C the ambient noise level ranged from 65 to 67dB$L_{Aeq,10min}$ and maximum noise levels were no greater than 79dBL_{Amax} due to road traffic on Great George Street and St James Street.

3.17 During the measurements at Location D the ambient noise level was affected by noise breaking out of 'Constellations and Observatory'. The ambient noise level without road traffic, only music noise, was 58dB$L_{Aeq,T}$ and the ambient noise level due to a combination of music and road traffic sources was 64dB$L_{Aeq,10min}$. Maximum noise levels due to road traffic was 74 to 76dBL_{Amax}.

3.18 Location E was selected to measure the noise levels affecting any habitable rooms facing Upper Peel Street. As the road traffic on Upper Peel Street is intermittent the ambient noise level at this location ranged from 47 to 51dB$L_{Aeq,\ 10min}$. Maximum noise levels due to car pass-bys were no greater than 70dBL_{Amax}.

3.19 Due to generator noise from the building site for Block A, noise levels were measured overlooking Great George Square to the north of the site on Grenville Street. The main noise source at this location was road traffic on Grenville Street and the ambient noise level ranged from 50 to 53dB$L_{Aeq,10min}$ and maximum noise levels were no greater than 73dBL_{Amax}.

4.0 BASIS OF ASSESSMENT

4.1 The site is proposed to be a mix of residential properties and commercial units and the scheme needs to be designed to achieve suitable internal noise level limits within the different spaces; the control of noise breaking into and out of the commercial units and noise from any building services plant associated with the development.

4.2 The assessment methodology for each aspect is presented separately below.

Residential Properties Including Hotel

Internal Noise Levels

4.3 Liverpool City Council issued the document '*Noise Control Requirements for Residential and other Developments on the City Centre*' in October 2000. The aim of this document was to provide guidance in relation to the noise insulation requirements for new residential developments in the city centre.

4.4 Paragraph 2.1 of Section 2 of this document states that, ideally, the following glazing would be installed:

"*double window having well sealed inner and outer panes in which, for a gap between the inner and outer pane of 200 mm, an inner pane thickness of 4 mm is satisfactory and for a gap of 100 mm an inner pane thickness of at least 6mm is required*. *Where it is not possible to achieve this specification (e.g. because the window reveals will not permit such a gap) then a reduced gap may be permitted or thermal double glazing having panes of 6mm and 10mm thickness and a minimum of a 12mm gap between*."

4.5 Paragraph 2.2 of the document states that, where windows need to be closed to maintain the sound insulation performance of the external envelope, mechanical ventilation would need to be provided. However, other methods of ventilation be considered assuming a detailed noise assessment has been undertaken.

4.6 It has previously been agreed with Ian Rushforth, Senior Enforcement Officer in the Environmental Protection Unit at LCC, that internal noise level limits within dwellings due to steady external noise sources, such as road traffic, should be controlled to meet the levels presented in BS 8233:2014 '*Guidance on sound insulation and noise reduction for buildings' and* World Health Organisation (WHO) document '*Guidelines for Community Noise*'.

4.7 Based on the guidance presented in BS8233 and WHO, the proposed noise levels to be achieved in habitable rooms non-distinct noise sources (such as transportation) are presented in Table 1, below.

4.8 At this stage, AEC has not been informed of any specific requirements for the hotel guest rooms in Block 3a, and therefore, the noise level limits presented in Table 1 have been used as the design aim for this block as well.

Table 1 – Internal Noise Level Limits within Habitable Rooms

Activity	Location	Noise Limit, dB		
		Daytime 0700 – 2300h	Night-Time 2300 – 0700h	
		$L_{Aeq,T}$	$L_{Aeq,T}$	L_{Amax}
Resting	Living Room	35	-	-
Dining	Dining Room/Area	40	-	-
Sleeping (daytime resting)	Bedroom	35	30	45

4.9 With regard to the maximum noise level limit of 45dBL_{Amax} during the night-time period, WHO guidelines state that, for a good night's sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dBL_{Amax} more than 10 to 15 times per night.

4.10 Based on this AEC would propose to design the façade in order that 45dBL_{Amax} is not typically exceeded during the night-time period 2300h to 0700h and any non-typical events such as a one-off emergency siren or noisy motorbike pass-by will be excluded in the assessment of the external envelope.

Ventilation

4.11 In addition to achieving the noise level limits identified in Table 1, continuous whole dwelling ventilation, which prevents the accumulation of moisture and other pollutants originating within a building in accordance with Approved Document F '*Ventilation*' (2010) of the Building Regulations (2010) also needs to be provided. This is typically achieved either via a partially opened window or by whole building ventilation through the provision of trickle ventilators or mechanical means.

4.12 Based on various sources including WHO, BS8233 and a study undertaken by Napier University in 2007, it is reasonable to assume that a window partially open (ajar) for background ventilation purposes will reduce external (free-field) to internal noise levels by at least 15dB.

4.13 Therefore, for background ventilation to be provided via a partially open window, external noise levels outside habitable rooms should not normally exceed 50dB$L_{Aeq,T}$ during the day, and 45dB$L_{Aeq,T}$ and 60dBL_{Amax} at night.

4.14 Based on discussions with Ian Rushforth it is understood that LCC allow for purge ventilation to be achieved via opening windows.

4.15 In addition, Ian confirmed that the control of overheating can be achieved using opening windows, provided that the thermal modelling demonstrates that windows only need to be open for less than 200 hours during the year.

Commercial Units

4.16 Based on the drawings provided by Brock Carmichael, commercial units are proposed on the ground floor of four of the residential blocks and Block 3b is proposed to house commercial units on the ground floor and offices on the first floor.

Internal Noise Levels

4.17 BS8233 provides suggested internal design ranges for different types of commercial units, including offices, and these are presented in Table 2, below.

Table 2 – Internal Ambient Noise Levels for Commercial Units

Unit	Design Range, dB$L_{Aeq,T}$
Store	50-55
Cafeteria	50-55
Restaurant	40-55
Open Plan Office	45-50
Library	40-50
Public House	40-45
Staff/Meeting Room, Training Room	35-45
Executive Office	35-40
Place of Worship, Counselling, Meditation, Relaxation	30-35

4.18 In addition to the above, guidance relating to office developments is provided in the British Council of Office (BCO) document '*Guide to Specification*' (2014).

4.19 To satisfy BCO guidance, internal noise levels are required to not exceed NR35$L_{Aeq,T}$ in meeting rooms; NR40$L_{Aeq,T}$ in open plan offices and 50dB$L_{Aeq,T}$ in toilet and circulation areas.

4.20 In addition to the ambient, L_{Aeq}, noise levels, to comply with BCO guidance, maximum (L_{Amax}), noise levels are suggested to be controlled to not exceed 55dB$L_{Amax,Fast}$ in open plan offices and 50dB$L_{Amax,Fast}$ in meeting rooms.

Noise Breaking-Out from Commercial Units

4.21 In order to reduce the potential for an adverse impact from noise breaking out of the commercial units, via the external envelope, it is proposed that ambient noise levels ($dBL_{Aeq,T}$) are controlled to not exceed the background noise levels at the nearest noise sensitive receptors. In relation to maximum noise levels, it is proposed that in units occupied by A3/A4 users that maximum noise levels are controlled to no greater than $NR30L_{max}$ during the daytime and $NR25L_{max}$ at night.

4.22 In addition to controlling noise breaking out to external noise receptors, noise levels from commercial activities would also need to be controlled to the flats above via the separating floor. It is recommended that noise from commercial units are controlled to not exceed $NR30L_{max}$ during the daytime and $NR25L_{max}$ at night.

Atmospheric Plant Noise Emissions

4.23 Following discussions with LCC, AEC has been informed that any items of plant should be assessed using BS4142: 2014 '*Methods for rating and assessing industrial and commercial sound*', and the 'rating' level should not exceed the existing background at the nearest noise sensitive residential property.

4.24 Paragraph 9.1 of BS4142 identifies that "*Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment locations, add a character corrections to the specific sound level to obtain the rating level.*"

5.0 ASSESSMENT OF PROPOSED DEVELOPMENT

External Noise Levels

5.1 As identified above, the main noise source which effects the site is traffic on the surrounding roads. Daytime ambient noise levels due to traffic on Great George Street and St James Street can be calculated using the shortened measurement procedure presented in the Department of Transport Welsh Office document '*Calculation of Road Traffic Noise'* (CRTN)

5.2 The shortened measurement procedure converts the arithmetic mean of the three consecutive values of hourly $L_{10,3hour}$ to a daytime $L_{10,18hour}$ by subtracting 1dB. This is then converted to a daytime $L_{Aeq,16hour}$ value by subtracting a further 2dB.

5.3 In relation to the noise levels measured at Location B, this was a combination of road traffic on both Cookson Street and Great George Street. Therefore, noise levels at this location will be lower when the development is built and noise from Great George Street is significantly reduced due to the screening from the proposed buildings. Based on this, it is anticipated that ambient noise levels from Cookson Street would be at least 3dB lower than those measured during the measurement period.

5.4 At night the ambient noise level was marginally higher at Locations A and C in 2018 than 2015 and therefore, the higher noise level has been used in our assessment. At both locations the highest maximum noise levels were similar and the highest measured maximum has been used in the assessment.

5.5 In relation to Location D, the ambient noise levels were higher in 2018 than 2015, however, there was a contribution to the noise levels from music noise associated with 'Constellations and Observatory'. As identified above, currently the site between the development and the event space is empty as there are building works being undertaken.

5.6 Once the building works have been completed, the development will be screened from Constellations and Observatory and noise levels are expected to reduce to around 61dB$L_{Aeq,T}$ which is similar to the ambient noise levels measured in 2015 from road traffic only. Maximum noise levels were also similar during both measurements.

5.7 At Locations E and F, the ambient noise level was due to intermittent road traffic on Upper Pitt Street and Grenville Street respectively, and the highest measured ambient noise levels have been used in the assessment. The highest maximum noise levels measured at both locations have also been used in our assessment.

5.8 It should be noted that at night, although noise levels may reduce after 0100h until about 0500h, the average noise levels measured over the two-hour period between 2300 and 0100h have been taken to be representative of the 8-hour period for all locations.

5.9 Based on the above, the daytime ambient and night-time ambient and maximum noise levels external to each block have been determined and are presented on Figures 2 and 3, respectively.

Assessment of Residential Ventilation and Glazing Requirements

5.10 As identified above, it is understood that LCC generally requires that habitable rooms in residential developments within Liverpool city centre are be provided mechanical ventilation and 10/TC/6mm glazing as a minimum.

5.11 A comparison of the external noise levels presented on Figures 2 and 3, with the allowable limits for rooms to be naturally ventilated via a partially open window (of 50dB$L_{Aeq,T}$ during the daytime and 45dB$L_{Aeq,T}$ and 60dBL_{Amax} at night) indicates that windows would need to be closed to all habitable rooms and ventilation provided by alternative means.

5.12 However, to the majority of rooms the external noise levels are low enough in order that the appropriate internal noise levels can be achieved with suitable acoustic trickle/wall vents. The sound insulation performance for these are provided in Tables 3 and 4, below.

5.13 In relation to the glazing requirements, it should be noted that the provision of 10/TC/6mm glazing may not be suitable in all locations, and therefore, calculations have been undertaken to determine the required sound insulation performance of the glazing to meet the internal noise level limits presented in BS8233 and WHO.

5.14 The calculations have been undertaken based on noise level spectrum data measured on-site, typical assumed rooms sizes and glazed areas of 95% to living rooms and 33% to bedrooms. The required sound insulation performance for the glazing is presented in Tables 3 and 4, below, for living rooms during the daytime and bedrooms at night, respectively. Example glazing build-ups are also presented in Tables 3 and 4.

Table 3 – Outline Requirements to Achieve Appropriate Internal Noise Levels in Living Rooms

Colour on Figure 2	Glazing Sound Insulation Performance	Ventilator Sound Insulation Performance	Example Glazing (TC – Thermal Cavity)
	36dBR_w and 29dBR_w + C_{tr}	38dB$D_{n,e,w}$	10mm Glass / TC / 4mm Glass
	31dBR_w and 25dBR_w + C_{tr}	33dB$D_{n,e,w}$	4mm Glass / TC / 4mm Glass (Standard Double Glazing)

Table 4 – Outline Requirements to Achieve Appropriate Internal Noise Levels in Bedrooms

Colour on Figure 3	Glazing Sound Insulation Performance	Ventilator (Sound Insulation Performance)	Example Glazing (TC – Thermal Cavity)
	38dBR_w and 32dBR_w + C_{tr}	Mechanical Ventilation	10mm Glass / TC / 6mm Glass
	38dBR_w and 32dBR_w + C_{tr}	41dB$D_{n,e,w}$	10mm Glass / TC / 6mm Glass
	36dBR_w and 29dBR_w + C_{tr}	38dB$D_{n,e,w}$	10mm Glass / TC / 4mm Glass
	31dBR_w and 25dBR_w + C_{tr}	38dB$D_{n,e,w}$	4mm Glass / TC / 4mm Glass (Standard Double Glazing)
	31dBR_w and 25dBR_w + C_{tr}	33dB$D_{n,e,w}$	4mm Glass / TC / 4mm Glass (Standard Double Glazing)

5.15 Prior to any glazing being installed, AEC must check full acoustic details of the glazing build-ups and ventilators selected. It should be noted that if the final glazing sizes are different from those used in our calculations the specifications presented in Tables 3 and 4 will need to be updated.

5.16 Windows can be openable for purge ventilation provided that they are effectively acoustically sealed when closed, and it is important that any frames and seals do not downgrade the sound insulation performance of the glazing.

5.17 All ventilation requirements have been based on the use of a single ventilator per room. If more than one unit is required, such as may be required to satisfy Building Control requirements, the performance of each unit might need to be increased.

External Envelope

5.18 To maintain the sound insulation performance of the external envelope, the remainder of the façade construction should have a sound insulation performance of at least 10dB higher than the glazing. Therefore, the external walls and roof of all elevations would need to achieve a sound insulation performance of at least 55dBR_w, which is not onerous.

Commercial Units

Noise Break-In

5.19 Based on the daytime ambient noise levels presented on Figure 2, the internal ambient noise levels presented in Table 2 would be achieved in all the commercial units with glazing achieving a sound insulation performance of 36dBR_w and 29dBR_w + C_{tr}. This level of performance can be achieved with 10mm Glass / Thermal Cavity / 4mm Glass.

5.20 It is anticipated that most units will be mechanically ventilated, however, it should be noted that the internal noise level limits for open-plan offices could be achieved within the offices on the first floor of Block B2 with windows partially open for ventilation purposes.

Noise Breakout Via Glazing

5.21 As stated above at least one of the commercial units is expected to be operated as a Class A3/A4 use and therefore, could have relatively high internal ambient and maximum noise levels.

5.22 Based on AEC's experience of noise levels in busy city centre public houses and restaurants playing low level background music, it is anticipated that typical ambient and maximum noise levels could be around 84dB$L_{Aeq,T}$ and 95dBL_{Amax}, and these levels have been used as a 'worst case' assessment of noise breaking out of the commercial units.

5.23 The nearest noise sensitive properties to commercial units will be the apartments in the adjacent blocks and on the floors above.

5.24 To meet AEC's suggested criteria of the ambient noise level breaking out of the commercial units not exceeding the existing background noise, ambient noise levels would need to be controlled to no greater than 49dB$L_{Aeq,T}$ external to the the nearest apartment during the daytime period.

5.25 The weakest element, acoustically, in the external envelope would typically be the glazing.

5.26 Calculations, based on the largest commercial unit having a glazed area of 80% on the largest facade, the assumed typical maximum noise level of 84dBL_{Amax} and the distance attenuation to the first-floor windows, indicate that the required noise level limits would be achieved with glazing achieving a sound insulation performance of 42dBR_w and 35dBR_w + C_{tr}. This level of performance can be achieved with 10mm Glass / Thermal Cavity / 8.8mm Glass. Doors to the unit would also need to be lobbied.

5.27 In relation to maximum noise level, as suggested in Section 4, noise from amplified music should be controlled to no greater than NR30 in living rooms during the daytime and NR25 in bedrooms at night. If the operator of a unit is likely to produce relatively high low frequency noise levels due to amplified music it may be appropriate to provide enhanced acoustic glazing to the adjacent residential properties. This will require development at the design stage.

5.28 It should be noted that the above is based on a likely 'worst case' operator. Where the operate generates significantly lower noise levels the glazing requirements would also be reduced. This will need to be developed at the design stage.

Noise Transfer to Adjacent Residential Areas

5.29 The noise levels from ground floor activities would not only need to be controlled externally, but there would also be a need to control noise to the residential areas above.

5.30 As a minimum the separating floor between the commercial unit and first floor residential areas would need to achieve an airborne sound insulation performance of 45dB$D_{nT,w}$ + C_{tr} in order to comply with Approved Document E of The Building Regulations.

5.31 However, a higher sound insulation performance will be required depending on the use of the commercial unit. If a unit is occupied by a pubic house or a restaurant the separating floor will need to achieve an airborne sound insulation performance around 65dB$D_{nT,w}$ + C_{tr} to achieve a noise level no greater than NR30L_{max} in the apartment rooms.

5.32 This level of performance can be achieved with a solid concrete floor slab and a plasterboard ceiling. This would need to be developed at the design stage.

Atmospheric Plant Noise Emissions

5.33 It is not yet known what plant is to be associated with this development or where it will be located. Therefore, as a full assessment cannot be undertaken at this stage.

5.34 Based on the background noise level measured around the site and LCC requirements, the atmospheric plant noise emissions emitted from the site should not exceed the limits presented in Table 5, below.

5.35 As identified above, the nearest noise sensitive properties to the plant will be the residential accommodation within the development itself.

Table 5 – Plant Noise Level Limits

Period	Plant Noise Limit, $dBL_{Aeq,T}$
Daytime (0700h to 2300h)	44
Night-time (2300h to 0700h)	35

5.36 The above noise limits assume that there is an acoustic character associated with the mechanical services plant (e.g. tonality or intermittency). If there is no acoustic character a 5dB increase can be applied to the levels presented in Table, 5.

6.0 SUMMARY AND CONCLUSIONS

6.1 Acoustic & Engineering Consultants Limited (AEC) has been instructed by Great George Street Developments Ltd to undertake a noise assessment relating to a proposed mixed-use residential and commercial development on Great George Street, Liverpool. The assessment is required for planning purposes.

6.2 AEC prepared a noise assessment (P3191/R01/PJK) for a proposed mixed-use residential and commercial development on the same site in 2015, which was granted planning permission. Due to a revised site layout, a new planning application is required.

6.3 A scheme to build 5 residential blocks, a hotel and an office block on Great George Street, Liverpool has been prepared by Brock Carmichael Architects.

6.4 Following a consultation with Ian Rushforth, an Environmental Health Officer at Liverpool City Council (LCC) it was confirmed that internal levels within the residential properties due to noise from the surrounding roads would need to be controlled to meet the levels presented in BS8233:2014 '*Guidance on sound insulation and noise reduction for buildings'* and World Health Organisation (WHO) document 'Guidelines for Community Noise'. The guidance presented in these documents have also been used as the design aim for the hotel.

6.5 In relation to noise breaking in to the commercial units, internal noise level limits have been proposed based on BS8233 and the British Council of Office (BCO) document '*Guide to Specification*'. AEC propose that noise breaking out of the commercial units is controlled such that the ambient noise level does not exceed the existing ambient noise levels and maximum noise levels are controlled to no greater than NR30 in living rooms during the day and NR25 in bedrooms at night.

6.6 The dominant noise source around the site was road traffic on Great George Street, St James Street, Grenville Street and Upper Pitt Street and the measured noise levels are summarised in Section 3.

6.7 Based on the measured noise levels affecting the proposed development site, windows to habitable rooms would need to remain closed to achieve appropriate internal noise levels and the sound insulation requirements of the building envelope and ventilation, to achieve the appropriate noise levels and are presented in Section 5.

6.8 Measures to control the potential impact of noise break out of the ground floor commercial units on the nearest noise sensitive properties and the first-floor apartments are also presented in Section 5. This will be developed at construction phase.

6.9 Total external noise level limits for all future mechanical and electrical plant serving the proposed development should be controlled to the levels presented in Table 5.

6.10 Based on the above, appropriate planning conditions can be applied to the proposed development to ensure internal noise levels compliant with LCC's requirements in the proposed accommodation are achieved, and that noise from any mechanical services plant is also appropriately controlled.

6.11 Therefore, based on this assessment, noise should not be considered a determining factor in relation to any planning permission being sought.

FIGURE 1 – Site Location Plan Identifying Monitoring Locations (A to F) and Block Numbers

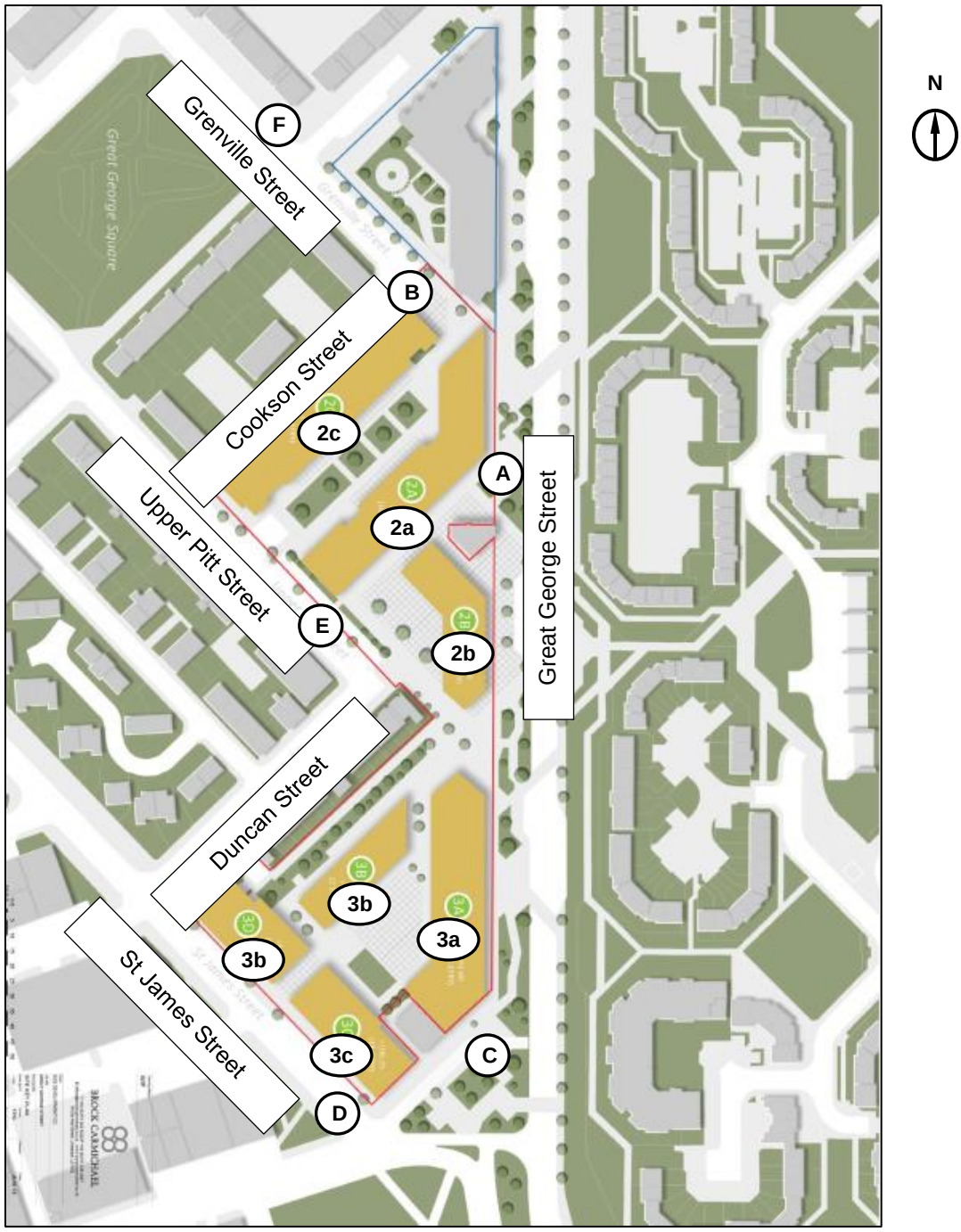


FIGURE 2 – Daytime External Noise Levels

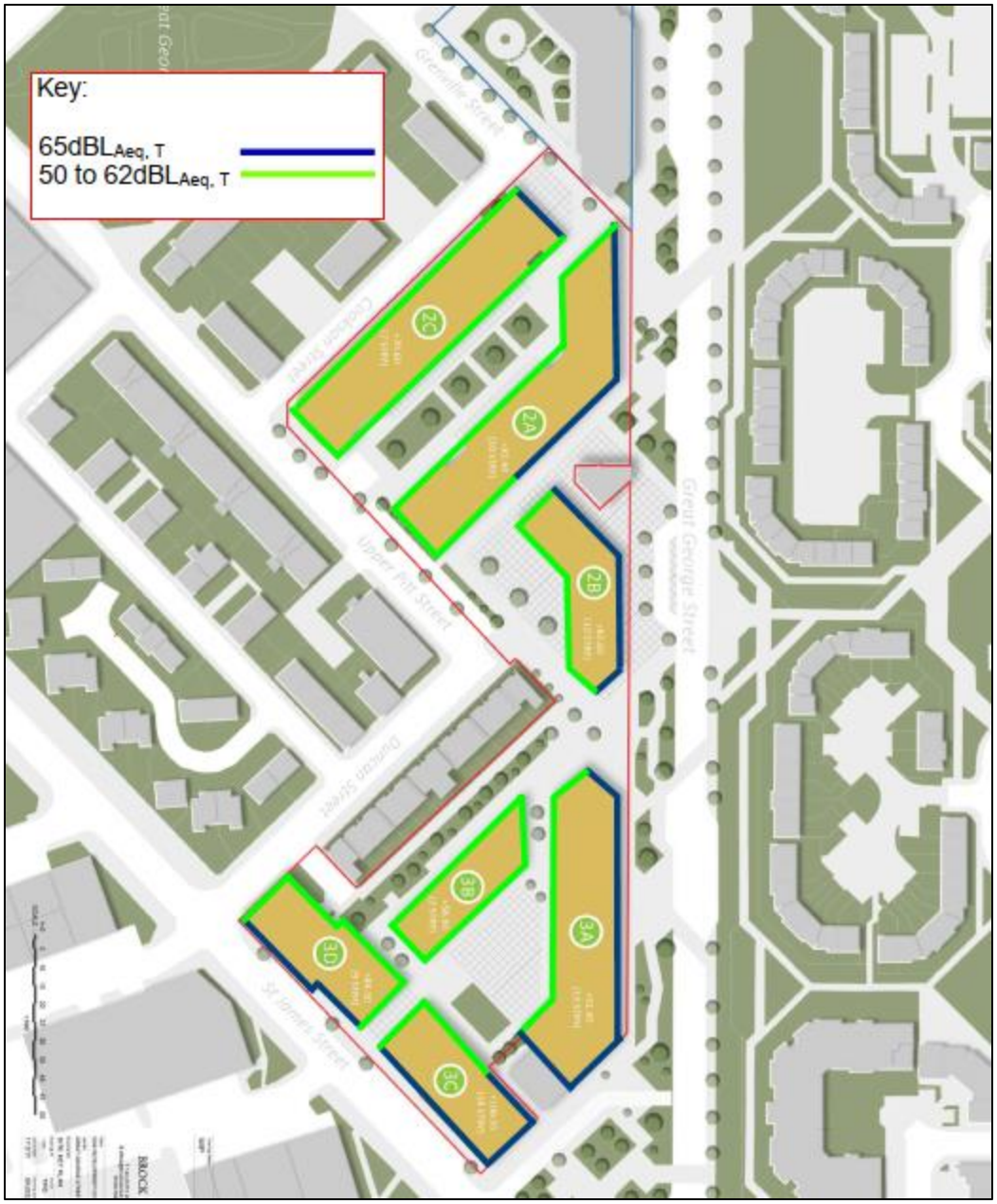
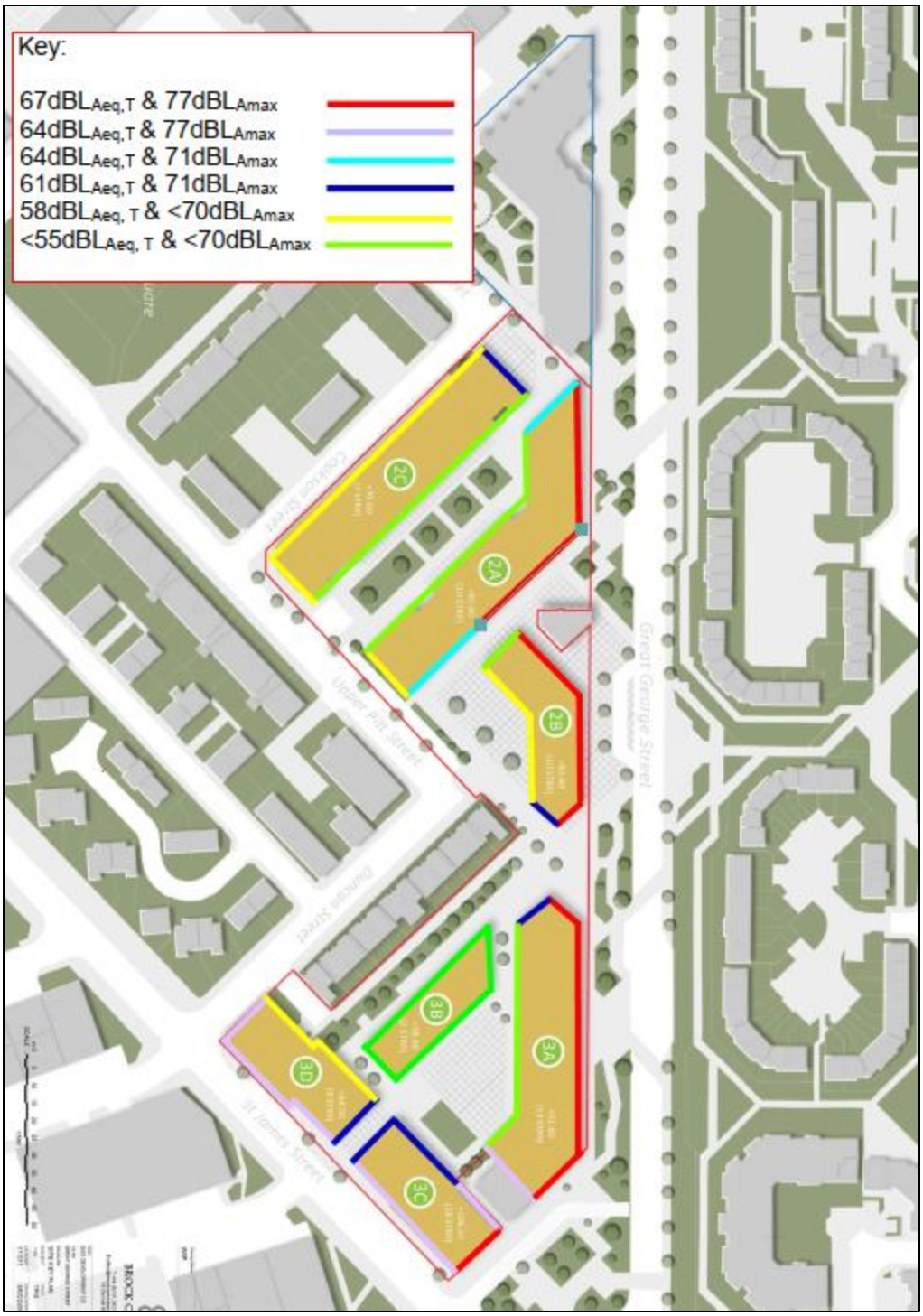


FIGURE 3 – Night-Time External Noise Levels



APPENDIX A – Acoustic Terminology in Brief

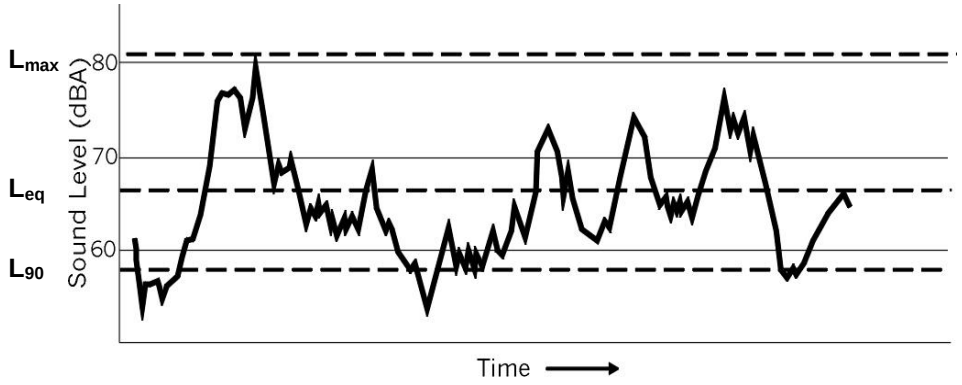
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air. The rate at which the pressure fluctuations occur determines the pitch or *frequency* of the sound. The frequency is expressed in Hertz *(Hz)*, that is, cycles per second. The human ear is sensitive to sounds from about 20 Hertz to 20,000 Hertz. Although sound can be of one discreet frequency - a 'pure tone' - most sound is made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same subjective way. This is the basis of the A-weighted sound pressure level *dBA,* normally used to assess the effect of noise on people. The dBA weighting emphasises or reduces the importance of certain frequencies within the audible range.

Sound Units

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as fifteen minutes or one hour, the statistically determined results being used to quantify various aspects of the sound.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of sound can be described by several different levels. The most common of these are described below. It should be noted that in many instances in the main body of text, the unit will be proceeded by a dB descriptor in the report e.g. $L_{Aeq,T}$ could be written $dBL_{Aeq,T,\ T}$



Example of Sound Level Varying With Time

$L_{Aeq,T}$ The equivalent continuous (A-weighted) sound level. It may be thought of as the "average" sound level over a given time, T. It is used for assessing noise from various sources: industrial and commercial premises, construction sites, railways and other intermittent noises and can be considered as the "ambient" noise level.

L_{A1} The (A-weighted) sound level exceeded for 1% of a measurement period. It is the value generally used to indicate a 'typical' maximum noise level.

$L_{A10,T}$ The (A-weighted) sound level exceeded for 10% of a measurement period. It is the value often used to describe traffic noise.

L_{A90}	The (A-weighted) sound level exceeded for 90% of a measurement period. It is the value often used to describe background noise.
L_{Amax}	The maximum (A-weighted) sound level measured during a given time. 'Fast' or 'Slow' meter response should be cited.
L_{AE}	The sound exposure level is a notional noise level and describes the average $L_{Aeq,T}$ noise level of an event over a given time period as if it occurred during a one second period. This allows the $L_{Aeq,T}$ to be determined over a time period with a number of distinct events.
Free-field Level	This refers to the sound level measured outside, away from reflecting surfaces.
Façade Level	This refers to the sound level measured outside, at 1m from a hard-reflecting surface, typically 3dB greater than the free-field level.
NR	Noise rating – a graphical method for assigning a single number rating to a noise spectrum and is often used to specify noise level limits for mechanical services.
R_w	Sound reduction index - single number rating used to describe the laboratory airborne sound insulation properties of a material or building element over a range of frequencies, typically 100-3150Hz.
R'_w	Apparent sound reduction index - Single number rating used to describe the sound reduction index of an on-site construction over a range of frequencies, typically 100-3150Hz.
$R_W + C_{tr}$	Single number rating used to describe the laboratory airborne sound insulation properties of a material or building element (normally windows) over a range of frequencies, typically 100-3150Hz, adjusted to adjusted by a spectrum adaptation to provide the reduction of traffic noise.
$D_{n,e,w}$	Element normalised normalised level difference. Single number rating used to describe the sound insulation performance of small elements

APPENDIX B – Noise Survey Details

Dates & Times of Survey	Daytime: Friday 10 July 2015, 1000 to 1400h Night-Time: Tuesday/Wednesday 21/22 July 2015, 2300 to 0100h Night-Time: Friday 10 August 2018, 2300 to 0115h
Personnel Present	2015 &2018 – Paul Knowles (AEC)
Equipment Used	2015 – B&K 2260 Real Time Analyser (AEC Kit 1) 2018 – B&K 2250 Real Time Analyser (AEC Kit 1)
Weather Conditions	2015 – Daytime 2015: Dry, 22°C, clear skies, calm 2015 – Night-Time: Dry, 15°C, clear skies, 2m/s westerly breeze 2018 – Night-Time: Dry, 20°C, clear skies, calm
Measurement Procedure	Ambient, background and maximum noise levels were measured at 6 locations, identified as Locations A to F on Figure 1 and described below. A - On the edge of the path, 12m from the edge of the carriageway of Great George Street. 2018 measurements were undertaken under façade conditions. B - 5m from the edge of the carriageway of Cookson Street. C - On the edge of the path, 12m from the edge of the carriageway of Great George Street. D - 5m from the edge of the carriageway of St James Street. E - 5m from the edge of the carriageway of Upper Pitt Street. F - 2m from the edge of the carriageway of Grenville Street All locations were selected to measure baseline noise levels, which were measured in terms of L_{Aeq}, L_{A10}, L_{A90} and L_{Amax} (fast response) typically over 5 to 15 minute periods. All the measurements were taken at a height of 1.5m above ground and all were free-field measurements, except for Location A in 2018 which was a façade measurement. The sound level analyser, which conforms to BS EN 61672-12003 *'Electro acoustics – sound level meters - Part1Specifications'* for Class 1 Type Z meters, was in calibration and check calibrated before and after the measurement periods using a Brüel & Kjær type 4231 (94dB) calibrator. There was no significant drift of calibration. Calibration certificates are available on request.
Measured Data	A summary of the results are presented in Tables B1, B2 and B3.

TABLE B1 – Measured Daytime Noise Levels in 2015

Location	Period, h	Noise Level, dB				Comments
		L_{Aeq}	L_{A10}	L_{A90}	$L_{Amax, F}$	
A	1001-1016	64.3	68.0	51.3	73.6	Road traffic on Great George Street
	1123-1138	64.0	67.8	51.1	74.8	
	1231-1246	63.6	67.2	49.0	73.3	
B	1018-1033	54.6	57.3	49.3	63.3	Road traffic on Great George Street and Cookson Street
	1144-1159	55.9	58.6	49.8	72.9	
	1247-1302	55.1	57.8	50.2	70.0	
C	1052-1102	62.5	66.4	53.6	74.5	Road traffic on Great George Street
	1306-1316	63.8	67.9	53.4	75.2	
D	1104-1114	64.9	69.3	56.3	78.6	Road traffic on Saint James Street
	1231-1246	63.6	67.2	49.0	73.3	
	1318-1333	63.8	68.2	55.1	74.1	

TABLE B2 – Measured Night-Time Noise Levels in 2015

Location	Period, h	Noise Level, dB			Comments
		L_{Aeq}	L_{A90}	$L_{Amax, F}$	
A	2305-2315	61.0	43.9	78.5	Road traffic on Great George Street
	2356-0006	62.7	42.2	75.1	
B	2317-2327	51.0	42.5	67.2	Road traffic on Great George Street and Cookson Street
	0008-0018	51.7	40.5	67.1	
C	2330-2340	61.8	46.6	75.9	Road traffic on Great George Street
	0022-0032	60.8	44.3	74.1	
	0057-0107	60.5	39.7	77.2	
D	2343-2353	58.8	44.0	76.6	Road traffic on Saint James Street
	0034-0044	54.6	40.2	72.6	
	0044-0054	57.3	42.9	73.6	

TABLE B3 – Measured Night-Time Noise Levels in 2018

Location	Period, h	Noise Level, dB			Comments
		L_{Aeq}	L_{A90}	$L_{Amax, F}$	
A	2305-2315	69.5	48.6	79.5	Ambient and maximum noise levels due to road traffic on Great George Street.
	0014-0024	68.5	48.4	76.7	
C	2319-2329	67.1	56.3	79.2	Ambient and maximum noise levels due to road traffic on Great George Street and St James Street.
	0027-0037	64.8	54.6	75.3	
D	2330-2340	62.9	54.3	74.1	Ambient due to road traffic on Road traffic on St James Street and music noise from Constellations and Observatory event space. Maximum noise levels due to road traffic.
	0038-0048	63.9	55.7	75.9	
	0048-0048*	58.0	54.2	61.7	Music noise from Constellations and Observatory event space, without road traffic.
E	2344-2354	50.7	43.6	69.5	Ambient and maximum noise levels due to road traffic on Upper Pitt Street.
	0051-0151	46.6	40.8	66.6	
F	2359-0009	49.8	42.5	66.8	Ambient and maximum noise levels due to road traffic on Grenville Street.
	0104-0114	69.5	48.6	79.5	

***Spot check**