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26 Stonehills, Welwyn Garden City

Assessment of Proposed Residential Development

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Appendices

1.0 Executive Summary

1.1 Sharps Gayler LLP (SGL) have been instructed to provide an acoustic assessment relating to a proposed development described as follows – "Proposed conversion of the first and second floors of the building together with an additional storey to provide residential accommodation (total of 27 dwellings); the retention of the ground floor for class A uses at 26 Stonehills, Welwyn Garden City, Hertfordshire, AL8 6NA."

1.2 The focus of this assessment is the impact of noise on the intended occupiers of the development.

1.3 The assessment has been undertaken by noise surveys at the site.

1.4 The assessment has been based on advice in BS8233:2014 and BS4142:2014, in conjunction with the World Health Organisation Guidelines.

1.5 Recommendations are made on mitigation measures necessary to ensure an acceptable noise environment for future residents against present international and national guidelines.

1.6 Measurements and calculations have shown that the internal criteria proposed should comfortably be achieved with the provision of the minimum standard of glazing set out.

1.7 The conclusions of the assessment are that the noise environment is such that the conversion to residential use can proceed in a way which provides an acceptable noise climate for future residents.

2.0 Introduction

2.1 Sharps Gayler LLP (SGL) has been commissioned to provide an acoustic assessment relating to a proposed residential development at 26 Stonehills, Welwyn Garden City. This report will assess the sound insulation requirements of the building external envelope necessary to achieve appropriate internal noise level criteria.

2.2 The building is currently occupied by a Debenhams department store at ground, first and second floor. It is proposed to convert the first and second floors of the building to residential apartments, and to add a third floor also containing residential apartments. The ground floor is to be retained for retail use.

2.3 The building is located in a largely commercial (retail) street in the Welwyn Garden City commercial centre. There are mainly retail buildings in the vicinity with associated car parks and servicing areas.

2.4 This report details the environmental noise survey undertaken to assess the existing noise climate at the site, including noise from general activity in the vicinity, and commercial activity at the adjacent service yard serving the existing retail use. This data forms the basis of assessing the acoustic requirements of the building, in order to achieve acceptable internal noise criteria for residential use.

3.0 Assessment Criteria

3.1 The nationally accepted design standards for residential premises are contained in BS 8233:2014. Table 4 of the standard contains the following design targets for residential dwellings, which are adopted in the assessment that follows:

BS8233:2014 Table 4 – Indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB LAeq, 16 hour	--
Dining	Dining room/area	40 dB LAeq, 16 hour	--
Sleeping (daytime resting)	Bedroom	35 dB LAeq, 16 hour	30 dB LAeq, 8hour

3.2 There is no longer an LAMAX standard for bedrooms In BS 8233. However, footnote 4 to Table 4 states that *"Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or LAmax,F depending on the character and number of events per night. Sporadic noise events could require separate values."* In this case, it is proposed that the previous BS 8233 internal standard (also referenced in World Health Organisation Guidelines for Community Noise) is applied. This is 45 dB LAMAX, inside bedrooms.

3.3 When assessing noise of an industrial/commercial nature, from premises (not traffic on the public highway), both BS8233:2014 (para 6.5.2) and BS4142:2014 (para 1.2 3)) require that the "rating level" of the noise is determined (the rating level is the noise emission level plus a correction for the character of the noise. Once the rating level has been determined, the glazing specification can be properly assessed (i.e. by comparing the rating level with the BS8233 guideline values for internal spaces).

3.4 In summary, the assessment has been undertaken by comparing the rating level (BS4142:2014) of sound from the commercial servicing areas with internal criteria from BS8233:2014. Glazing specifications have been developed on that basis. For the "front" elevations (i.e. those facing vehicular activity on Stonehills and Wigmores North), an assessment using BS8233:2014 guidance has been undertaken (i.e. for general traffic and vehicular activity noise).

4.0 Noise Survey

4.1 An environmental noise survey was carried out from 9th to 14th May 2019 to determine the existing noise levels at the site. Continuous measurements were made on the southern elevation of the building, exposed to delivery noise to the rear of the existing building and on the northern elevation exposed to more general activity noise on Stonehills and Wigmores North. These measurements were taken continuously over a 5 day period from a Thursday to a Tuesday, so included weekday and weekend periods. The microphone was fitted with an integrated wet weather kit and wind shield. These measurements were façade measurements. The measurement locations are shown in Appendix A.

4.2 All measurements were made in 15 minute periods and were made using a Norsonic 140 sound level meter. The meter used is of Class 1 type and were field checked for calibration before and after the measurements. No drift was noted.

4.3 The weather was good throughout the measurement period, and meteorological conditions are not believed to have affected the measurements in the long term. The meters allow simultaneous measurements of noise levels both in overall dBA values and frequency selective octave bands over predetermined time periods, using various measurement parameters. The Leq, and LMAX noise levels were recorded in overall dBA values together with octave band levels.

4.4 For information purposes it can be noted:

- dBA is the sound level in decibels (dB) measured by the sound level meter with the A-weighting.
- The A-weighting is a filter applied to the sound level meter to simulate the frequency response of the human ear, which is more sensitive to high frequency sound than low.
- Leq is the equivalent continuous noise level which is a method of averaging the varying noise level over the time period into a single figure value. The Leq has the same sound energy as the fluctuating level over that period.
- LMAX is the highest level within the measurement period.

5.0 Survey Results

5.1 The full data set is included in Appendix B. Design levels are summarised below.

Southern Elevation – Delivery Activity

5.2 For the northern elevation, these tables detail the highest measured daytime LAeq,1Hr and night-time LAeq, 15 mins (as per BS4142:2014) and the typical LAMAX levels at the measurement location. These are façade levels:

Established External Façade Levels – Southern Elevation

Day 0700-2300 hours	Night 2300-0700 hours	Night 2300-0700 hours
LAeq, 1 hour, dB	**LAeq, 15 mins, dB**	**LAMAX***
65	58	85

*90th percentile value for design purposes

5.3 The following typical octave band levels associated with the dBA levels above have been used to assess the sound insulation requirements of the building envelope. These are façade levels:

Octave Band Spectra – Delivery Yard

Period	Parameter	Octave band centre frequency Hz						
		63	125	250	500	1k	2k	4k
Day 0700-2300 hours	Leq	67	63	56	54	55	58	62
Night 2300-0700 hours	Leq	60	53	48	46	51	52	53
Night 2300-0700 hours	LMAX	75	75	73	73	76	79	81

5.4 Noise from deliveries and service yard activity is not impulsive or tonal, but does feature characteristics that are otherwise readily distinctive against the residual acoustic environment. In calculating performance of sound insulation, therefore, 3 dB has been added to all measured Leq levels to reflect the character (commercial deliveries) of the noise being considered (as per BS4142:2014). The resultant level is the Rating Level, LAr. The tables above include the 3 dB penalty where appropriate.

Northern Elevation – Wigmores North/Stonehills

5.5 For the northern elevation, these tables detail the measured daytime LAeq,16Hr, night time LAeq,8Hr and the typical LAMAX levels at the measurement location. These are façade levels:

Established External Façade Levels – Southern Elevation

Day 0700-2300 hours	Night 2300-0700 hours	Night 2300-0700 hours
LAeq, 16 hour, dB	**LAeq, 8 hour, dB**	**LAMAX, dB***
60	53	85

*90th percentile value for design purposes

5.6 The following typical octave band levels associated with the dBA levels above have been used to assess the sound insulation requirements of the building envelope. These are façade levels:

Octave Band Spectra – Southern Elevation

Period	Parameter	Octave band centre frequency Hz						
		63	125	250	500	1k	2k	4k
Day 0700-2300 hours	Leq	65	60	58	55	57	52	44
Night 2300-0700 hours	Leq	57	51	50	49	50	44	35
Night 2300-0700 hours	LMAX	82	80	75	70	75	78	81

6.0 Sound Insulation of the Building Envelope

6.1 The acoustic performance of the elements are expressed below in terms of Sound Reduction Index (R) in octave bands.

6.2 Specifications set out below include options to retain existing windows in the current locations and improve the sound insulation via an additional secondary pane installed internally. This has been assumed to be 6mm glass, separated by a 150mm (minimum) cavity. Secondly an option to replace all windows with new double-glazed units has been provided. This specification would apply to the new installations at third floor in any case.

Secondary Glazing

6.3 The sound reduction performance assumed in the calculations is the minimum performance expected from a 4mm glass-150mm cavity-6mm glass secondary glazed unit. It is assumed that the existing windows will be refurbished where necessary and provided with well-sealed frames, but allowance has been made for the fact that the windows will be refurbished and not replaced.

Window System Performance – Secondary Glazed System

	Octave band centre frequency Hz							
R dB	63	125	250	500	1k	2k	4k	Rw
4-150-6	21	26	32	42	53	49	48	41

Replacement Double-Glazing

6.4 The sound reduction performance assumed in the calculations is the minimum performance expected from a 10mm glass-12mm cavity-6mm glass sealed "acoustic" double-glazed unit.

Window System Performance – Double Glazed System

	Octave band centre frequency Hz							
R dB	63	125	250	500	1k	2k	4k	Rw
10-12-6	24	27	26	33	39	39	47	38

Internal Noise Levels

6.5 Calculations of the internal noise levels have been undertaken based on the glazing set out above (see Appendix C). The calculations allow for room and window size corrections and typical internal residential conditions with soft furnishings etc. The construction of the walls is assumed to be a traditional brick-cavity-block construction, plastered internally. The results below denote the worst-case from either scenario (i.e. retained windows and secondary glazing or replacement double-glazing), summarised as follows:

Calculated Internal Noise Levels for Future Residences – Southern (Service Yard) Elevation

Day 0700-2300 hours LAr(1Hr)		Night 2300-0700 hours LAr(15mins)		Night 2300-0700 hours LAMAX	
Result	Criterion	Result	Criterion	Result	Criterion
23	35	**22**	30	**43**	45

Calculated Internal Noise Levels for Future Residences – Northern (Wigmores North/Stonehills) Elevation

Day 0700-2300 hours LAr(1Hr)		Night 2300-0700 hours LAr(15mins)		Night 2300-0700 hours LAMAX	
Result	Criterion	Result	Criterion	Result	Criterion
22	35	**17**	30	**44**	45

6.6 It should be noted that these results assume that windows are closed and ventilation is supplied by a system with a DN,e,w greater than 39 dB. The calculations have assumed a Greenwood EA5000EAW.AC1 acoustic trickle vent.

Summary

6.7 It can be seen from the table above that the internal criteria can be met comfortably with the retained glazing and an additional secondary pane, or with the replacement double-glazing. The internal noise environment for future residents would be acceptable on that basis.

Ventilation

6.8 Ventilation, in accordance with Building Regulations, would need to be provided to residential units. This can be provided by way of passive vents such as the Greenwood EA5000EAW.AC1, meeting a minimum acoustic performance of 39 dB DN,e,w.

Internal Sound Transmission

6.9 The future occupiers of the ground floor retail elements are not known and some structural works will take place to close voids and provide a complete separating structure so it is not possible to test the current structure in-situ.

6.10 Retail use with residential apartments above is not, however, an uncommon scenario, and occurs in many mixed use developments. Internal sound insulation is a matter covered by the Building Regulations. Approved Document E (2015) sets out the requirements for separating structures (walls or floors) for residential purposes (45 dB $D_{nT.W}$ +C_{TR}). These are, in effect, legal requirements and so must be achieved (and verified through testing) in the construction.

6.11 The document advises that a higher standard of sound insulation may be required for spaces used for normal domestic purposes and communal or non-domestic purposes. It is normal practice in such situations to design sound insulation to and enhanced standard, normally 3 to 5 dB better than Building Regulations requirements, and it is considered that this would be appropriate in this case.

6.12 Such an enhanced requirement can be required by planning condition if felt necessary, although it is not necessary to condition the general requirements as they are mandatory under other legislation. Appropriate sound levels within the retail space can be controlled by way of tenancy agreements as appropriate.

7.0 Conclusions

7.1 A noise survey has been conducted; the noise climate at the site has been measured, including the influence of general noise in the area and commercial activity at the adjacent commercial servicing area.

7.2 Internal noise level criteria have been proposed in line with the standards set out in BS 8233:2014, BS4142:2014 and the World Health Organisation Guidelines. Calculations of internal noise levels have been undertaken, assuming retention of the existing and an additional internal secondary pane, or through replacement double-glazed units.

7.3 Measurements and calculations have shown that the internal criteria proposed should comfortably be achieved with the glazing system recommended. The assessment includes a "penalty" for the character of the noise being considered (i.e. commercial servicing noise).

7.4 Further ventilation to residential apartments will be provided via acoustically treated vents meeting a minimum performance of 39 dB DN,e,w.

7.5 The glazing and ventilation solutions will ensure acceptable internal noise levels for future residents and do not represent special design measures or non-standard construction methods.

7.6 Internal sound insulation between retail space and residential units above can be effectively ensured by meeting Building Regulations requirements, or better.

Appendix A: Site Location Plan

Site Location and Survey Positions

Appendix B: Noise Survey Results

Side of building

Start Date	Start time	LAeq 1hour	LAMAX	LA1	LA10	LA90
Thursday, May, 09, 2019	12:00	61.4	85.8	66.9	62.9	58.1
Thursday, May, 09, 2019	13:00	60.9	84.8	65.2	62.8	57.7
Thursday, May, 09, 2019	14:00	60.9	77.5	66.8	62.7	57.5
Thursday, May, 09, 2019	15:00	60.8	86.5	67.8	62.2	56.9
Thursday, May, 09, 2019	16:00	59.5	75.4	65.8	61.3	56.3
Thursday, May, 09, 2019	17:00	59.4	78.3	65.0	61.0	56.4
Thursday, May, 09, 2019	18:00	59.2	81.4	64.7	61.0	55.6
Thursday, May, 09, 2019	19:00	60.0	86.1	67.0	60.5	54.0
Thursday, May, 09, 2019	20:00	57.4	84.5	65.3	58.6	51.2
Thursday, May, 09, 2019	21:00	62.6	94.4	67.7	57.5	48.1
Thursday, May, 09, 2019	22:00	54.3	75.5	62.1	56.9	46.0
Thursday, May, 09, 2019	23:00	52.2	72.8	60.9	55.4	42.8
Friday, May, 10, 2019	00:00	51.6	66.3	60.1	55.1	41.6
Friday, May, 10, 2019	01:00	46.5	65.0	58.2	50.4	34.9
Friday, May, 10, 2019	02:00	44.1	61.9	56.2	47.3	34.6
Friday, May, 10, 2019	03:00	43.2	62.4	54.7	47.1	33.3
Friday, May, 10, 2019	04:00	47.4	74.3	57.9	51.0	34.8
Friday, May, 10, 2019	05:00	53.3	72.7	62.9	56.6	43.3
Friday, May, 10, 2019	06:00	55.2	73.0	63.4	58.5	46.3
Friday, May, 10, 2019	07:00	58.8	77.4	66.2	61.2	53.4
Friday, May, 10, 2019	08:00	66.2	83.9	78.0	68.8	56.2
Friday, May, 10, 2019	09:00	58.8	76.5	65.3	60.7	55.0
Friday, May, 10, 2019	10:00	58.9	84.4	64.0	60.1	54.7
Friday, May, 10, 2019	11:00	60.7	86.4	66.9	61.2	55.5
Friday, May, 10, 2019	12:00	59.4	76.7	66.9	61.4	55.5
Friday, May, 10, 2019	13:00	58.1	75.5	63.7	59.9	54.7
Friday, May, 10, 2019	14:00	57.9	73.4	63.1	59.8	55.1
Friday, May, 10, 2019	15:00	58.8	80.1	65.3	60.4	54.9
Friday, May, 10, 2019	16:00	59.2	80.4	67.6	60.6	55.3
Friday, May, 10, 2019	17:00	59.5	81.0	67.8	61.1	56.0
Friday, May, 10, 2019	18:00	59.1	75.4	65.5	61.3	55.5
Friday, May, 10, 2019	19:00	58.3	79.6	64.8	60.7	53.7
Friday, May, 10, 2019	20:00	57.4	83.7	64.6	59.5	52.0
Friday, May, 10, 2019	21:00	54.9	67.9	61.6	57.6	49.9
Friday, May, 10, 2019	22:00	53.7	67.5	60.8	56.7	47.5
Friday, May, 10, 2019	23:00	53.6	68.4	61.7	56.9	45.8
Saturday, May, 11, 2019	00:00	52.6	70.3	61.4	55.9	44.9
Saturday, May, 11, 2019	01:00	53.7	85.0	61.5	54.8	42.4
Saturday, May, 11, 2019	02:00	48.0	64.6	57.5	51.8	37.6
Saturday, May, 11, 2019	03:00	47.6	68.7	59.9	50.3	36.3
Saturday, May, 11, 2019	04:00	45.4	62.7	54.5	49.2	36.7
Saturday, May, 11, 2019	05:00	49.7	72.5	59.0	52.5	40.0
Saturday, May, 11, 2019	06:00	52.4	71.8	60.2	55.6	44.8
Saturday, May, 11, 2019	07:00	56.1	76.9	64.5	58.8	47.9
Saturday, May, 11, 2019	08:00	58.1	74.5	65.9	60.4	52.2
Saturday, May, 11, 2019	09:00	59.3	82.6	64.9	60.8	55.4
Saturday, May, 11, 2019	10:00	58.6	79.3	63.5	60.4	55.7
Saturday, May, 11, 2019	11:00	62.5	89.2	68.8	61.0	56.3
Saturday, May, 11, 2019	12:00	61.1	93.1	66.5	61.1	56.3

Start Date	Start time	LAeq 1hour	LAMAX	LA1	LA10	LA90
Saturday, May, 11, 2019	13:00	59.8	84.3	66.7	61.6	56.3
Saturday, May, 11, 2019	14:00	59.7	84.0	66.1	61.1	56.4
Saturday, May, 11, 2019	15:00	59.4	80.3	65.5	60.9	56.7
Saturday, May, 11, 2019	16:00	60.2	84.7	68.2	61.4	55.7
Saturday, May, 11, 2019	17:00	59.0	81.9	65.8	60.8	55.2
Saturday, May, 11, 2019	18:00	58.1	74.8	66.4	60.0	54.0
Saturday, May, 11, 2019	19:00	57.9	79.7	65.9	59.9	52.9
Saturday, May, 11, 2019	20:00	56.3	81.3	65.8	58.1	48.6
Saturday, May, 11, 2019	21:00	55.2	83.4	62.1	56.7	47.7
Saturday, May, 11, 2019	22:00	53.6	70.6	62.0	56.6	46.1
Saturday, May, 11, 2019	23:00	51.8	67.1	59.4	55.0	44.7
Sunday, May, 12, 2019	00:00	52.3	74.9	61.1	55.4	44.6
Sunday, May, 12, 2019	01:00	50.7	74.2	60.4	53.5	42.1
Sunday, May, 12, 2019	02:00	52.9	81.3	61.5	54.4	36.7
Sunday, May, 12, 2019	03:00	44.8	70.1	54.4	48.6	36.7
Sunday, May, 12, 2019	04:00	46.7	74.4	56.8	47.8	38.9
Sunday, May, 12, 2019	05:00	49.5	70.9	62.4	50.7	40.3
Sunday, May, 12, 2019	06:00	48.4	67.2	57.7	51.8	40.9
Sunday, May, 12, 2019	07:00	51.3	77.1	58.8	53.5	41.8
Sunday, May, 12, 2019	08:00	53.5	72.9	60.4	56.4	44.9
Sunday, May, 12, 2019	09:00	55.6	70.2	62.9	58.2	49.9
Sunday, May, 12, 2019	10:00	58.7	86.3	65.4	59.9	53.1
Sunday, May, 12, 2019	11:00	57.8	81.6	63.5	59.5	54.2
Sunday, May, 12, 2019	12:00	57.7	75.7	64.1	59.3	54.6
Sunday, May, 12, 2019	13:00	58.6	79.9	68.4	59.9	54.1
Sunday, May, 12, 2019	14:00	58.5	81.3	66.8	59.6	53.8
Sunday, May, 12, 2019	15:00	57.8	83.0	65.4	59.5	53.4
Sunday, May, 12, 2019	16:00	56.9	74.3	64.1	58.8	53.0
Sunday, May, 12, 2019	17:00	57.3	81.3	65.4	59.5	51.8
Sunday, May, 12, 2019	18:00	57.0	82.4	65.2	59.0	50.0
Sunday, May, 12, 2019	19:00	55.9	75.2	64.7	58.3	50.3
Sunday, May, 12, 2019	20:00	56.3	82.4	64.3	58.2	50.3
Sunday, May, 12, 2019	21:00	53.9	75.3	62.6	56.6	47.4
Sunday, May, 12, 2019	22:00	50.5	64.9	58.8	53.6	44.1
Sunday, May, 12, 2019	23:00	49.9	78.2	58.8	52.8	42.8
Monday, May, 13, 2019	00:00	45.7	61.9	56.4	49.7	36.1
Monday, May, 13, 2019	01:00	45.1	64.4	56.7	48.1	35.7
Monday, May, 13, 2019	02:00	45.3	68.1	58.2	46.6	35.8
Monday, May, 13, 2019	03:00	42.4	61.5	52.4	44.7	37.0
Monday, May, 13, 2019	04:00	48.3	75.9	59.1	51.5	39.5
Monday, May, 13, 2019	05:00	54.6	74.9	64.9	57.6	45.4
Monday, May, 13, 2019	06:00	55.3	75.2	62.3	58.3	49.1
Monday, May, 13, 2019	07:00	58.4	78.6	64.4	60.6	54.0
Monday, May, 13, 2019	08:00	60.0	83.4	67.6	61.2	55.3
Monday, May, 13, 2019	09:00	58.2	79.4	63.6	60.3	54.4
Monday, May, 13, 2019	10:00	58.2	85.0	64.0	60.0	54.3
Monday, May, 13, 2019	11:00	58.5	78.1	65.3	60.5	54.6
Monday, May, 13, 2019	12:00	58.8	79.4	66.1	60.6	55.0
Monday, May, 13, 2019	13:00	58.6	80.4	65.0	60.5	54.9
Monday, May, 13, 2019	14:00	58.3	77.1	65.2	60.1	55.2
Monday, May, 13, 2019	15:00	59.5	81.6	67.0	61.2	55.1

Start Date	Start time	LAeq 1hour	LAMAX	LA1	LA10	LA90
Monday, May, 13, 2019	16:00	62.4	90.8	68.7	61.0	55.5
Monday, May, 13, 2019	17:00	59.3	83.4	65.7	61.2	55.8
Monday, May, 13, 2019	18:00	59.3	79.2	66.2	61.3	54.9
Monday, May, 13, 2019	19:00	58.1	88.2	65.6	59.7	52.7
Monday, May, 13, 2019	20:00	55.1	75.2	62.3	57.5	48.7
Monday, May, 13, 2019	21:00	56.7	86.2	63.5	57.4	47.6
Monday, May, 13, 2019	22:00	52.1	72.3	60.1	55.0	45.1
Monday, May, 13, 2019	23:00	50.2	69.2	59.3	53.2	43.0
Tuesday, May, 14, 2019	00:00	49.0	71.6	59.5	51.3	39.0
Tuesday, May, 14, 2019	01:00	44.8	62.6	57.2	46.6	38.6
Tuesday, May, 14, 2019	02:00	47.0	70.5	58.5	49.1	38.6
Tuesday, May, 14, 2019	03:00	45.4	63.9	57.5	46.8	38.6
Tuesday, May, 14, 2019	04:00	48.4	64.3	59.1	51.9	39.6
Tuesday, May, 14, 2019	05:00	53.1	76.6	62.5	56.2	44.1
Tuesday, May, 14, 2019	06:00	59.9	79.5	68.4	63.1	49.7
Tuesday, May, 14, 2019	07:00	58.9	76.9	65.3	61.3	54.2
Tuesday, May, 14, 2019	08:00	59.6	76.8	65.9	61.5	56.1
Tuesday, May, 14, 2019	09:00	58.8	75.8	65.5	61.1	54.9
Tuesday, May, 14, 2019	10:00	60.5	81.9	68.3	62.5	55.6

Service yard

Start Date	Start time	LAeq 1hour	LAMAX	LA1	LA10	LA90
Thursday, May, 09, 2019	12:00	50.6	74.0	58.2	51.3	45.9
Thursday, May, 09, 2019	13:00	50.0	75.9	56.4	51.0	46.7
Thursday, May, 09, 2019	14:00	48.8	72.5	56.1	50.5	45.8
Thursday, May, 09, 2019	15:00	47.9	62.3	55.7	49.5	45.4
Thursday, May, 09, 2019	16:00	48.0	69.8	54.5	50.4	44.8
Thursday, May, 09, 2019	17:00	50.4	77.8	59.9	51.3	45.4
Thursday, May, 09, 2019	18:00	50.2	77.7	55.7	51.2	45.1
Thursday, May, 09, 2019	19:00	48.3	68.7	57.3	48.9	44.8
Thursday, May, 09, 2019	20:00	45.3	66.2	53.6	46.8	41.0
Thursday, May, 09, 2019	21:00	45.2	69.4	56.2	45.3	41.6
Thursday, May, 09, 2019	22:00	42.2	61.2	48.6	43.4	39.8
Thursday, May, 09, 2019	23:00	40.0	60.8	46.0	41.6	37.7
Friday, May, 10, 2019	00:00	41.4	57.4	51.3	43.3	37.5
Friday, May, 10, 2019	01:00	37.7	50.7	41.6	38.6	36.7
Friday, May, 10, 2019	02:00	38.4	57.4	46.1	39.2	36.6
Friday, May, 10, 2019	03:00	38.1	51.9	45.0	39.2	36.6
Friday, May, 10, 2019	04:00	48.6	73.7	62.1	47.1	36.8
Friday, May, 10, 2019	05:00	44.7	71.9	56.8	42.3	37.4
Friday, May, 10, 2019	06:00	54.6	85.0	65.8	54.9	38.8
Friday, May, 10, 2019	07:00	51.6	76.3	62.3	51.5	41.0
Friday, May, 10, 2019	08:00	50.9	82.7	60.4	52.0	42.1
Friday, May, 10, 2019	09:00	47.8	68.1	57.7	49.7	42.7
Friday, May, 10, 2019	10:00	52.4	80.1	64.2	53.7	43.0
Friday, May, 10, 2019	11:00	61.6	92.1	72.4	61.4	44.2
Friday, May, 10, 2019	12:00	48.2	69.1	59.8	47.8	44.2
Friday, May, 10, 2019	13:00	56.2	87.7	66.6	56.6	44.5
Friday, May, 10, 2019	14:00	59.5	88.3	70.3	61.4	44.4
Friday, May, 10, 2019	15:00	50.7	92.8	55.2	47.7	43.2

Start Date	Start time	LAeq 1hour	LAMAX	LA1	LA10	LA90
Friday, May, 10, 2019	16:00	49.1	74.9	58.7	48.7	42.9
Friday, May, 10, 2019	17:00	47.9	80.0	55.1	48.2	43.9
Friday, May, 10, 2019	18:00	47.7	64.5	55.3	49.8	45.0
Friday, May, 10, 2019	19:00	47.8	67.8	56.4	49.5	44.7
Friday, May, 10, 2019	20:00	46.4	66.9	53.8	48.6	42.8
Friday, May, 10, 2019	21:00	43.9	59.8	50.4	46.1	41.5
Friday, May, 10, 2019	22:00	43.4	64.2	49.5	44.5	40.6
Friday, May, 10, 2019	23:00	43.5	64.9	53.1	45.3	38.9
Saturday, May, 11, 2019	00:00	42.9	62.3	54.3	43.9	38.2
Saturday, May, 11, 2019	01:00	44.4	82.2	53.2	41.4	37.6
Saturday, May, 11, 2019	02:00	42.2	72.6	52.9	42.5	37.4
Saturday, May, 11, 2019	03:00	43.0	61.9	55.7	42.9	37.1
Saturday, May, 11, 2019	04:00	43.0	61.6	53.9	45.4	37.4
Saturday, May, 11, 2019	05:00	43.2	71.5	51.9	44.3	38.3
Saturday, May, 11, 2019	06:00	46.6	76.8	54.9	47.7	40.2
Saturday, May, 11, 2019	07:00	47.4	76.3	55.1	46.6	40.7
Saturday, May, 11, 2019	08:00	46.5	73.9	56.0	46.4	41.1
Saturday, May, 11, 2019	09:00	47.3	76.9	55.9	50.0	42.0
Saturday, May, 11, 2019	10:00	46.6	75.1	52.7	47.9	43.5
Saturday, May, 11, 2019	11:00	47.6	76.1	55.7	47.6	44.2
Saturday, May, 11, 2019	12:00	46.1	65.2	53.2	47.2	43.9
Saturday, May, 11, 2019	13:00	47.2	67.2	55.4	49.6	43.7
Saturday, May, 11, 2019	14:00	50.9	69.4	63.0	51.5	43.5
Saturday, May, 11, 2019	15:00	46.9	70.8	55.1	47.9	43.4
Saturday, May, 11, 2019	16:00	46.0	71.0	53.1	47.9	42.9
Saturday, May, 11, 2019	17:00	46.2	69.2	54.2	47.8	42.5
Saturday, May, 11, 2019	18:00	46.9	74.7	54.9	48.1	42.8
Saturday, May, 11, 2019	19:00	47.7	63.8	54.5	52.0	43.1
Saturday, May, 11, 2019	20:00	46.7	68.9	56.8	47.6	42.2
Saturday, May, 11, 2019	21:00	44.3	61.3	50.2	46.0	42.2
Saturday, May, 11, 2019	22:00	42.9	60.4	49.1	44.7	40.2
Saturday, May, 11, 2019	23:00	42.0	59.8	51.3	44.1	38.8
Sunday, May, 12, 2019	00:00	41.8	71.8	47.1	41.2	38.5
Sunday, May, 12, 2019	01:00	39.9	53.5	46.3	41.3	38.0
Sunday, May, 12, 2019	02:00	39.7	50.5	44.3	41.5	37.8
Sunday, May, 12, 2019	03:00	38.5	49.1	41.8	39.5	37.5
Sunday, May, 12, 2019	04:00	39.6	56.7	47.0	40.4	37.8
Sunday, May, 12, 2019	05:00	43.6	72.0	54.0	41.2	38.4
Sunday, May, 12, 2019	06:00	43.9	68.7	54.4	45.7	38.7
Sunday, May, 12, 2019	07:00	47.4	73.1	58.0	49.4	39.0
Sunday, May, 12, 2019	08:00	43.3	72.0	52.4	45.1	38.3
Sunday, May, 12, 2019	09:00	42.5	63.1	52.6	44.4	38.5
Sunday, May, 12, 2019	10:00	52.3	83.4	63.8	47.7	39.4
Sunday, May, 12, 2019	11:00	45.6	73.6	53.1	45.6	40.6
Sunday, May, 12, 2019	12:00	47.0	72.7	56.3	47.1	41.7
Sunday, May, 12, 2019	13:00	47.6	77.7	57.3	47.7	41.7
Sunday, May, 12, 2019	14:00	50.4	93.0	51.7	45.8	41.8
Sunday, May, 12, 2019	15:00	48.6	79.2	58.4	48.1	41.9
Sunday, May, 12, 2019	16:00	50.0	78.0	59.6	48.3	40.8
Sunday, May, 12, 2019	17:00	46.5	79.0	53.6	46.2	41.3
Sunday, May, 12, 2019	18:00	48.1	76.6	58.2	48.2	41.7

Start Date	Start time	LAeq 1hour	LAMAX	LA1	LA10	LA90
Sunday, May, 12, 2019	19:00	45.7	67.6	54.2	48.1	41.4
Sunday, May, 12, 2019	20:00	47.2	68.9	58.5	48.0	41.3
Sunday, May, 12, 2019	21:00	44.3	64.6	55.1	45.4	40.1
Sunday, May, 12, 2019	22:00	44.0	78.7	51.9	44.0	38.7
Sunday, May, 12, 2019	23:00	39.7	51.5	46.0	41.0	38.0
Monday, May, 13, 2019	00:00	38.8	50.7	43.0	39.9	37.7
Monday, May, 13, 2019	01:00	39.2	57.8	46.6	40.0	37.5
Monday, May, 13, 2019	02:00	43.5	63.2	57.5	40.5	37.4
Monday, May, 13, 2019	03:00	38.3	50.9	41.4	39.2	37.4
Monday, May, 13, 2019	04:00	47.6	70.1	62.3	46.8	37.9
Monday, May, 13, 2019	05:00	52.4	77.4	65.4	52.5	39.8
Monday, May, 13, 2019	06:00	47.7	73.0	60.2	45.8	40.2
Monday, May, 13, 2019	07:00	60.2	86.0	73.8	59.0	41.6
Monday, May, 13, 2019	08:00	50.9	82.3	62.7	49.5	41.0
Monday, May, 13, 2019	09:00	48.8	82.7	57.2	46.8	40.7
Monday, May, 13, 2019	10:00	52.5	77.8	65.4	50.3	41.9
Monday, May, 13, 2019	11:00	49.7	80.6	59.5	48.9	42.5
Monday, May, 13, 2019	12:00	50.2	80.3	58.0	50.2	44.2
Monday, May, 13, 2019	13:00	49.3	79.8	57.4	49.6	44.1
Monday, May, 13, 2019	14:00	49.3	79.1	56.3	49.1	43.9
Monday, May, 13, 2019	15:00	48.7	82.3	54.7	47.8	43.6
Monday, May, 13, 2019	16:00	47.4	71.3	56.7	49.7	43.4
Monday, May, 13, 2019	17:00	47.1	77.3	54.0	48.0	43.6
Monday, May, 13, 2019	18:00	47.7	74.8	57.0	48.5	43.5
Monday, May, 13, 2019	19:00	46.0	76.6	51.5	46.7	42.8
Monday, May, 13, 2019	20:00	44.1	62.1	52.9	46.0	39.9
Monday, May, 13, 2019	21:00	44.2	71.9	50.7	45.0	39.4
Monday, May, 13, 2019	22:00	40.7	59.8	47.8	42.7	38.2
Monday, May, 13, 2019	23:00	39.9	61.7	47.5	41.3	37.7
Tuesday, May, 14, 2019	00:00	39.1	49.9	46.3	40.5	37.4
Tuesday, May, 14, 2019	01:00	38.0	48.7	41.0	39.1	37.1
Tuesday, May, 14, 2019	02:00	39.1	53.1	45.9	40.5	37.2
Tuesday, May, 14, 2019	03:00	38.1	47.5	42.9	38.8	37.2
Tuesday, May, 14, 2019	04:00	43.7	73.6	49.8	41.0	37.6
Tuesday, May, 14, 2019	05:00	54.4	81.8	67.2	51.4	38.6
Tuesday, May, 14, 2019	06:00	46.2	64.0	55.4	49.4	41.1
Tuesday, May, 14, 2019	07:00	47.0	74.1	52.8	45.6	41.9
Tuesday, May, 14, 2019	08:00	47.0	69.8	56.2	49.3	41.9
Tuesday, May, 14, 2019	09:00	46.5	69.8	54.9	49.5	41.3
Tuesday, May, 14, 2019	10:00	47.6	69.8	56.6	49.0	43.5

Appendix C: Façade Sound Reduction Calculations

Project Stonehills, WGC Room Location **Living Room. Rear Façade - Service Yard**

Volume 64 m^3
Façade Area 8 m^2

DAYTIME

Element	Windows	63	125	250	500	1 k	2 k	4 k
		63	125	250	500	1 k	2 k	4 k
	LAr	67	63	56	54	55	58	62
	Correction	0	0	0	0	0	0	0
	10 log S	9	9	9	9	9	9	9
	-10 Log A	-13	-13	-13	-13	-13	-13	-13
SRI façade	4-150-6	-21	-26	-32	-42	-53	-49	-48
	A-weighting	-26	-16	-9	-3	0	1	1
	A- weighted	16	17	11	5	-2	6	11

Rev time =	0.5
Internal dBA=	21
Criterion	35

Project Stonehills, WGC Room Location **Bedroom. Rear Façade - Service Yard**

Volume 20 m^3
Facade Area 4 m^2

NIGHT

Element	Windows	63	125	250	500	1 k	2 k	4 k
		63	125	250	500	1 k	2 k	4 k
	LAr	60	53	48	46	51	52	53
	Correction	0	0	0	0	0	0	0
	10 log S	6	6	6	6	6	6	6
	-10 Log A	-8	-8	-8	-8	-8	-8	-8
SRI façade	4-150-6	-21	-26	-32	-42	-53	-49	-48
	A-weighting	-26	-16	-9	-3	0	1	1
	A- weighted	11	9	5	-1	-4	2	4

Rev time =	0.5
Internal dBA=	15
Criterion	30

Project Stonehills, WGC Room Location **Bedroom. Rear Façade - Service Yard**

Volume 20 m^3
Façade Area 4 m^2

NIGHT LMAX

Element	Windows	63	125	250	500	1 k	2 k	4 k
		63	125	250	500	1 k	2 k	4 k
	L_{MAX}	75	75	73	73	76	79	81
	Correction	0	0	0	0	0	0	0
	10 log S	6	6	6	6	6	6	6
	-10 Log A	-8	-8	-8	-8	-8	-8	-8
SRI façade	4-150-6	-21	-26	-32	-42	-53	-49	-48
	A-weighting	-26	-16	-9	-3	0	1	1
	A- weighted	26	31	30	26	21	29	32

Rev time =	0.5
Internal dBA=	37
Criterion	45

Project Stonehills, WGC Room Location **Living Room. <u>Front Façade</u> - Wigmores N/Stonehills**

Volume 64 m^3
Façade Area 8 m^2

DAYTIME

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
LAeq	65	60	58	55	57	52	44
Correction	0	0	0	0	0	0	0
10 log S	9	9	9	9	9	9	9
-10 Log A	-13	-13	-13	-13	-13	-13	-13
SRI façade 4-150-6	-21	-26	-32	-42	-53	-49	-48
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	14	14	13	6	0	0	-7

Rev time =	0.5
Internal dBA=	19
Criterion	35

Project Stonehills, WGC Room Location **Bedroom. <u>Front Façade</u> - Wigmores N/Stonehills**

Volume 20 m^3
Facade Area 4 m^2

NIGHT

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
LAeq	57	51	50	49	50	44	35
Correction	0	0	0	0	0	0	0
10 log S	6	6	6	6	6	6	6
-10 Log A	-8	-8	-8	-8	-8	-8	-8
SRI façade 4-150-6	-21	-26	-32	-42	-53	-49	-48
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	8	7	7	2	-5	-6	-14

Rev time =	0.5
Internal dBA=	13
Criterion	30

Project Stonehills, WGC Room Location **Bedroom. <u>Front Façade</u> - Wigmores N/Stonehills**

Volume 20 m^3
Façade Area 4 m^2

NIGHT LMAX

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
L_{MAX}	82	80	75	70	75	78	81
Correction	0	0	0	0	0	0	0
10 log S	6	6	6	6	6	6	6
-10 Log A	-8	-8	-8	-8	-8	-8	-8
SRI façade 4-150-6	-21	-26	-32	-42	-53	-49	-48
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	33	36	32	23	20	28	32

Rev time =	0.5
Internal dBA=	40
Criterion	45

Project Stonehills, WGC Room Location **Living Room. Rear Façade - Service Yard**

Volume 64 m^3
Façade Area 8 m^2

DAYTIME

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
LAr	67	63	56	54	55	58	62
Correction	0	0	0	0	0	0	0
10 log S	9	9	9	9	9	9	9
-10 Log A	-13	-13	-13	-13	-13	-13	-13
SRI façade 10-12-6	-24	-27	-26	-33	-39	-39	-47
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	13	16	17	14	12	16	12

Rev time =	0.5
Internal dBA=	23
Criterion	35

Project Stonehills, WGC Room Location **Bedroom. Rear Façade - Service Yard**

Volume 20 m^3
Facade Area 4 m^2

NIGHT

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
LAr	60	53	48	46	51	52	53
Correction	0	0	0	0	0	0	0
10 log S	6	6	6	6	6	6	6
-10 Log A	-8	-8	-8	-8	-8	-8	-8
SRI façade 10-12-6	-24	-27	-26	-33	-39	-39	-47
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	8	8	11	8	10	12	5

Rev time =	0.5
Internal dBA=	18
Criterion	30

Project Stonehills, WGC Room Location **Bedroom. Rear Façade - Service Yard**

Volume 20 m^3
Façade Area 4 m^2

NIGHT LMAX

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
L_{MAX}	75	75	73	73	76	79	81
Correction	0	0	0	0	0	0	0
10 log S	6	6	6	6	6	6	6
-10 Log A	-8	-8	-8	-8	-8	-8	-8
SRI façade 10-12-6	-24	-27	-26	-33	-39	-39	-47
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	23	30	36	35	35	39	33

Rev time =	0.5
Internal dBA=	43
Criterion	45

Project Stonehills, WGC Room Location **Living Room. <u>Front Façade</u> - Wigmores N/Stonehills**

Volume 64 m^3
Façade Area 8 m^2

DAYTIME

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
LAeq	65	60	58	55	57	52	44
Correction	0	0	0	0	0	0	0
10 log S	9	9	9	9	9	9	9
-10 Log A	-13	-13	-13	-13	-13	-13	-13
SRI façade 10-12-6	-24	-27	-26	-33	-39	-39	-47
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	11	13	19	15	14	10	-6

Rev time =	0.5
Internal dBA=	22
Criterion	35

Project Stonehills, WGC Room Location **Bedroom. <u>Front Façade</u> - Wigmores N/Stonehills**

Volume 20 m^3
Facade Area 4 m^2

NIGHT

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
LAeq	57	51	50	49	50	44	35
Correction	0	0	0	0	0	0	0
10 log S	6	6	6	6	6	6	6
-10 Log A	-8	-8	-8	-8	-8	-8	-8
SRI façade 10-12-6	-24	-27	-26	-33	-39	-39	-47
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	5	6	13	11	9	4	-13

Rev time =	0.5
Internal dBA=	17
Criterion	30

Project Stonehills, WGC Room Location **Bedroom. <u>Front Façade</u> - Wigmores N/Stonehills**

Volume 20 m^3
Façade Area 4 m^2

NIGHT LMAX

Element	Windows						
	63	125	250	500	1 k	2 k	4 k
L_{MAX}	82	80	75	70	75	78	81
Correction	0	0	0	0	0	0	0
10 log S	6	6	6	6	6	6	6
-10 Log A	-8	-8	-8	-8	-8	-8	-8
SRI façade 10-12-6	-24	-27	-26	-33	-39	-39	-47
A-weighting	-26	-16	-9	-3	0	1	1
A- weighted	30	35	38	32	34	38	33

Rev time =	0.5
Internal dBA=	44
Criterion	45