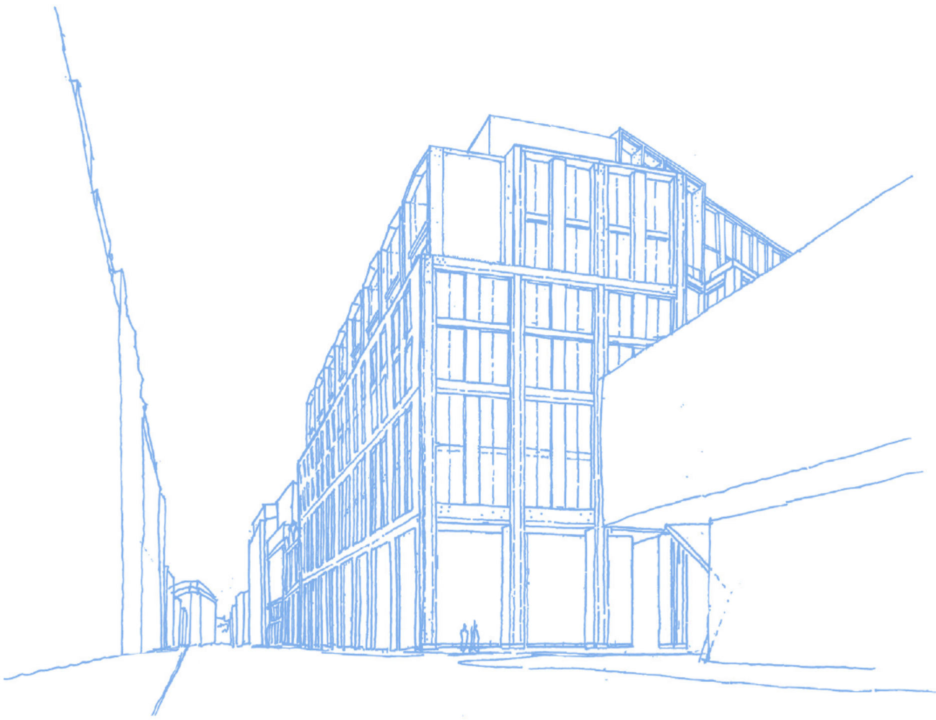
Prepared by REC
On behalf of Royal London Mutual Insurance Society

Noise Impact Assessment

Castlewood House & Medius House, WC1A



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EXECUTIVE SUMMARY

Resource and Environmental Consultants Limited has been commissioned by Royal London Mutual Insurance Society to undertake a Noise Impact Assessment for a proposed Mixed-use development on land located at Castlewood House and Medius House on New Oxford Street in Camden, London.

Noise Survey

A series of Noise Surveys have been completed in order to measure the impact of existing road traffic noise upon the proposed mixed-use development as a result of New Oxford Street and Earnshaw Street to provide baseline information on which to define proposed plant noise limit criteria.

Noise Impact Assessment

The Noise Impact Assessment has identified that the key noise source impacting upon the development is from road traffic using New Oxford Street to the north of the Site and Earnshaw Street to the west. Measurements concluded that the daytime and night-time noise levels were 68dB and 59dB respectively with reference to the surrounding roads with the lowest background sound levels resulting to 57dB and 54dB for the daytime and night-time respectively. Accordingly appropriate consideration has been given towards the mitigation measures required to ensure a commensurate level of protection against noise for future tenants and residents as well as defining appropriate limitations on plant noise emissions.

Proposed Mitigation Measures

Castlewood House

Appropriate mitigation measures have been proposed in order to reduce the impacts of noise from road traffic on internal office areas including the use of higher specification glazing and alternative ventilation.

Medius House

Appropriate mitigation measures have been proposed in order to reduce the impacts of noise from road traffic on internal habitable areas including the use of higher specification glazing and alternative ventilation.

Proposed Plant

Provided the emission levels are met as prescribed in Section 4.3, noise associated with the proposed plant should not impact on the surrounding noise sensitive receptors.

Subject to the incorporation of the identified mitigation measures, it is considered that in principle, the Site is suitable for the promotion of the desired mixed-use development.

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1. INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Limited has been commissioned by Royal London Mutual Insurance Society to undertake a Noise Impact Assessment for a proposed Mixed-use development on land located at Castlewood House and Medius House on New Oxford Street in Camden, London, to be referred to hereafter as '*the Site*'.

This assessment has been undertaken to identify key noise sources in the vicinity of the Site which may have the potential to impact upon the proposed noise-sensitive development.

All acronyms used within this report are defined in the Glossary presented in Appendix II.

1.2 Site Description

The site comprises two buildings: Castlewood House (77-91 New Oxford Street) and Medius House (63-69 New Oxford Street), which cover a total of 0.3 hectares.

Castlewood House is an existing office (Class B1) building providing 12,848sqm GEA of commercial floorspace over nine storeys. The existing post-war building is predominantly a brown brick facade above a single storey stone plinth. It is solely office use, from lower ground floor (looking out into the sunken courtyards to the rear of the building) to level 08, with the main entrance accessed from New Oxford Street.

Medius House comprises 675sqm GEA of retail (Class A1) at ground floor level and 1,578sqm GEA of office (Class B1) floorspace over five upper floors. The existing interwar building of five storeys, steps up to six storeys at the junction with Dyott Street. Although of a plainer and heavier architectural style, it shares the rusticated brickwork of its neighbour.

Proposals include for the demolition of the existing building, at Castlewood House, and construction of a replacement ten storey mixed use building, plus ground and two basement levels, including the provision of retail (Class A1 and/or A3) and office (Class B1) floor space. Proposals for Medius House include a change of use and two-floor extension comprising external alterations to Medius House including partial demolition, retention of the existing façade and two floor extension to provide 20 affordable housing units (Class C3), together with associated highway improvements, public realm, landscaping, vehicular and cycle parking, bin storage and other associated works.

The key noise source impacting upon the Site is vehicles using New Oxford Street to the north of the Site.

The Site location is shown in Figure 1 of Appendix III.

1.3 Report Structure

This report has been produced to show how noise sources surrounding the proposed development can be attenuated to a sufficient level in order to meet the criteria noise levels detailed in Section 2 of this report. Section 3 presents the Baseline Noise Survey conducted on Site and Section 4 presents the Noise Impact Assessment which considers the effectiveness of standard thermal double glazing in controlling external to internal noise levels. Section 5 considers the specification for a variety of upgraded glazing units to control noise levels to meet the adopted internal criteria.

1.4 Limitations

The limitations of this report are presented in Appendix I.

1.5 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

2. ASSESSMENT CRITERIA

2.1 National Planning Practice Guidance

Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.
-

In line with the Explanatory Note of the Noise Policy Statement for England dated March 2010, this would include identifying whether the overall effect of the noise exposure is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

The Observed Effect Levels are as follows:

- Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
- Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
- No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.

Table 1 summarises the noise exposure hierarchy, based on the likely average response.

Table 1 Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum

Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.

These factors include:

- The source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night;
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise; and
- The spectral content of the noise and the general character of the noise. The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.

More specific factors to consider when relevant:

- where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations; and
- If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

2.2 Calculation of Road Traffic Noise 1988

The Calculation of Road Traffic Noise (CRTN) memorandum, produced by the Department of Transport for the Welsh Office, describes the procedures for calculating noise from road traffic. Section III of this memorandum details the shortened measurement procedure whereby measurements of the L_{10} parameter are made over any three consecutive hours between 10:00 and 17:00. From the arithmetic average of the three 1-hour values, the $L_{10,18hr}$ noise level is derived before derivation of the $L_{Aeq,16hr}$ value.

2.3 Transport Research Laboratory – Converting the UK Traffic Noise Index $L_{A10,18hr}$ to EU Noise Indices for Noise Mapping 2002

This document provides a method for converting the $L_{A10,18hr}$ level to the L_{night} level using the following formula, applicable to non-motorway roads;

$$L_{night} = 0.90 \times L_{A10,18hr} - 3.77dB$$

2.4 British Standard BS8233: 2014: 'Guidance on Sound Insulation and Noise Reduction for Buildings'

Noise Criteria Limits

The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including dwellings, as shown in Table 2.

Table 2 BS8233 Recommended Internal Noise Levels

Criterion	Typical Situation	Design $L_{Aeq,T}$ (dB)
Suitable resting / sleeping conditions	Living Room	35
	Bedroom	30
	Offices	40
For a reasonable standard in bedrooms at night, individual noise events (measured with fast time weighting) should not normally exceed 45dB L_{Amax}		

BS8233 goes on to recommend noise levels for gardens. According to BS8233;

"It is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors might be warranted".

BS8233 goes on to say:

"In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited".

Ventilation Requirements

Where a partially open window cannot be relied upon to provide an adequate level of facade sound insulation performance, it is necessary to consider alternative ventilation for habitable rooms. Section 8.4.5.4 within BS8233 states:

"The Building Regulations' supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.

Alternatively, acoustic ventilation units (see 7.7.2 below) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."

Section 7.7.2 states:

"If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

2.5 World Health Organisation's (WHO) 'Guidelines for Community Noise'

The WHO 'Guidelines for Community Noise' offers advice with regard to setting noise criteria applicable to sleep disturbance. Section 4.2.3 specifies:

'If the noise is not continuous, L_{Amax} or SEL are used to indicate the probability of noise-induced awakenings. Effects have been observed at individual L_{Amax} exposures of 45dB or less. Consequently, it is important to limit the number of noise events with a L_{Amax} exceeding 45dB.'

The guidelines go on to state:

'At night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} and 60dB L_{Amax}, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15dB.'

The sound insulation performance value of 15dB for a façade containing a partially open window accords with the guidance offered in BS8233:2014.

The guidelines reference a study by Vallet & Vernet, 1991, which concluded that:

'For a good sleep, it is believed than indoor sound pressure levels should not exceed approximately 45 dB $L_{AF,max}$ more than 10-15 times per night.'

Accordingly this assessment has utilised the 10th highest measured maximum noise level from the night-time period and allows for an assessment of a typical maximum noise level in determining façade sound insulation performance.

2.6 British Standard BS4142: 2014: 'Methods for rating and assessing industrial and commercial sound'

This standard describes methods for rating and assessing sound of an industrial or commercial nature which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and / or commercial premises; and,

- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from processes or premises, such as that from forklift trucks, or that from train or ship movements on or around an industrial or commercial Site.

The procedure detailed in the standard compares the measured or predicted noise level 'the specific noise level' from any of the above detailed noise sources with the background sound level at a residential dwelling. The measured background sound level at a receptor should be reliable and should not necessarily ascertain a lowest measured background sound level, but rather to quantify what is typical.'

The specific noise level also acknowledges the following reference time intervals depending upon whether the noise source operates during daytime or night-time periods:

- Daytime (07:00 – 23:00): 1 hr; and,
- Night-time (23:00 – 07:00): 15 minutes.

There are a number of 'penalties' which can be attributed to the specific sound level depending upon the 'acoustic features' of the sound level under investigation as follows. These penalties vary in their weighting depending upon the severity of the acoustic feature, as follows:

Tonality

- +2dB: where the tonality is just perceptible;
- +4dB: where the tonality is clearly perceptible; and,
- +6dB: where the tonality is highly perceptible.

Impulsivity

- +3dB: where the impulsivity is just perceptible;
- +6dB: where the impulsivity is clearly perceptible; and,
- +9dB: where the impulsivity is highly perceptible.

Intermittency

- +3dB: where the intermittency is readily distinctive against the acoustic environment.

In addition to the above acoustic features, there is a penalty for 'other sound characteristics' of +3dB where a sound exhibits characteristics that are neither tonal nor impulsive, though are readily distinctive against the acoustic environment.

BS4142 goes on to state that the rating level is equal to the specific sound level if there are no such features present or expected to be present.

Assessment of the rating level relative to the background noise level can yield the following commentary:

- Typically the greater this difference (between the rating level and the background sound level), the greater the magnitude of impact;
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;

- A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and,
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

With the above in mind, it is common that a Local Planning Authority will specify their own criteria for the rating level relative to the background sound level and, where this is the case, this criterion usually takes precedence over a simple comparison of the rating level against the background sound level.

2.7 The London Plan (2016)

The London Plan, published by the Greater London Authority, sets out the Mayor's policies for ambient noise and noise pollution in Section 7.15 of the chapter, 'Living spaces and places'.

With reference to planning decisions,

Development proposals should seek to manage noise by:

- Avoiding significant adverse noise impacts on health and quality of life as a result of new development;
- Mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens on existing businesses;
- Improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquillity);
- Separating new noise sensitive development from major noise sources (such as road, rail, air transport and some types of industrial development) through the use of distance, screening or internal layout – in preference to sole reliance on sound insulation;
- Where it is not possible to achieve separation of noise sensitive development and noise sources, without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through the application of good acoustic design principles;
- Having particular regard to the impact of aviation noise on noise sensitive development;
- Promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver.'

2.8 Camden Council's Development Policy Adoption Version 2010 – Policy DP28 – Noise and Vibration (DP28)

The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for:
a) Development likely to generate noise pollution; or
b) Development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided.

Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted.

The Council will only grant permission for plant or machinery if it can be operated without cause harm to amenity and does not exceed our noise thresholds.

The Council will seek to minimise the impact on local amenity from the demolition and construction phases of development. Where these phases are likely to cause harm, conditions and planning obligations may be used to minimise the impact.

The following Tables are provided:

Table 3 Noise levels on residential sites adjoining railways and roads at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1 metre external to a sensitive façade	Day	0700 – 1900	74dB $L_{Aeq'}$ 12h	72dB $L_{Aeq'}$ 12h
Noise at 1 metre external to a sensitive façade	Evening	1900 – 2300	74dB $L_{Aeq'}$ 4h	72dB $L_{Aeq'}$ 4h
Noise at 1 metre external to a sensitive façade	Night	2300 - 0700	66dB $L_{Aeq'}$ 8h	66dB $L_{Aeq'}$ 8h

Table 4 Noise levels on residential sites adjoining railways and roads at and above which attenuation measures will be required

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1 metre external to a sensitive façade	Day	0700 – 1900	65dB $L_{Aeq'}$ 12h	62dB $L_{Aeq'}$ 12h
Noise at 1 metre external to a sensitive façade	Evening	1900 – 2300	60dB $L_{Aeq'}$ 4h	57dB $L_{Aeq'}$ 4h
Noise at 1 metre external to a sensitive façade	Night	2300 – 0700	55dB $L_{Aeq'}$ 1h	52dB $L_{Aeq'}$ 1h
Individual noise events several times an hour	Night	2300 - 0700	>82dB L_{Amax} (S time weighting)	>82dB L_{Amax} (S time weighting)

Table 5 Vibration levels on residential sites adjoining railways and roads at which planning permission will not be granted

Vibration description and location of measurement	Period	Time	Vibration Levels
Vibration inside critical areas such as a hospital operating theatre	Day, evening and night	0000 – 2400	0.1 VDV ms-1.75
Vibration inside dwellings	Day and evening	0700 – 2300	0.2 to 0.4 VDV ms-1.75
Vibration inside dwellings	Night	2300 – 0700	0.13 VDV ms-1.75
Vibration inside offices	Day, evening and night	0000 – 2400	0.4 VDV ms-1.75

Vibration inside workshops	Day, evening and night	0000 – 2400	0.8 VDV ms-1.75
Where dwellings may be affected by ground-borne regenerated noise internally from, for example, railways or underground trains within tunnels, noise levels within the rooms should not be greater than 35dB(A)max			

Table 6 Noise levels from plant and machinery at which planning permission will not be granted

Vibration description and location of measurement	Period	Time	Vibration Levels
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000 – 2400	5dB (A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000 – 2400	10dB(A) < LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000 – 2400	10dB(A) < LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000 – 2400	55dB L_{Aeq}

2.9 Camden Local Plan – Proposed Submission 2016 – Policy A4

Policy A4 of the draft Camden Local Plan replicates that in the DP28 Policy of the Camden Council's Development Policy.

2.10 Local Authority Guidance and Criteria – Camden Council's Environmental Health Department

REC have contacted Camden Council on Monday 20th June 2016 in order to agree the methodology for the noise survey and the appropriate noise criteria for this assessment which were proposed as follows:

- REC will look to achieve the lowest practicable noise levels in outdoor amenity areas where applicable, in accordance with BS8233: 2014;
- The maximum permissible average daytime noise level in living rooms and bedrooms shall not exceed 35dB $L_{Aeq,16hr}$ (BS8233:2014);
- The maximum permissible average night-time noise level in bedrooms shall not exceed 30dB $L_{Aeq,8hr}$ (BS8233:2014);
- The maximum permissible instantaneous noise level in bedrooms shall not exceed 45dB $L_{Amax,fast}$ criteria (WHO); and
- The maximum permissible average noise level in offices shall not exceed 40dB $L_{Aeq,16hr}$ (BS8233:2014).

At the time of preparing this report, no response was forthcoming from Camden Council. However, the adopted criteria are considered robust and in line with current guidance and will be adhered to in the assessment.

3. BASELINE NOISE SURVEY

3.1 Road Traffic Noise Survey – New Oxford Street

REC has conducted a Road Traffic Noise Survey in order to measure the level of noise generated by vehicles using New Oxford Street and Earnshaw Street. The survey was carried out over the following time period in accordance with the shortened procedure given in CRTN:

- Wednesday 22nd June 2016 between 11:35 and 14:35.

The following noise measurement position was chosen for the Road Traffic Noise Survey:

- Noise Measurement Position 1 (NMP1): Located on the western façade of Castlewood House towards New Oxford Street. The microphone was positioned out of the first floor window on the stairwell at the side of the building as all windows were sealed at Castlewood House fronting onto New Oxford Street. This location was chosen to capture the noise of vehicle pass-bys using New Oxford Street and Earnshaw Street, and consisted predominately of vehicle pass-bys on these roads.

The location of NMP1 can be seen in Figure 1 of Appendix III.

A summary of the measured sound pressure levels from the Road Traffic Noise Survey are presented in Table 7.

Table 7 Summary of Measured Sound Pressure Level

Measurement Position	Measurement Period	Measured Sound Pressure Level, free-field (dB)			
		$L_{Aeq,T}$	$L_{Amax,fast1}$	$L_{A90,T}$	$L_{A10,T}$
NMP1	22/06/2016 11:35 – 12:35	73	93[1]	68	74
	22/06/2016 12:35 – 13:35	73		67	73
	22/06/2016 13:35 – 14:35	74		68	74
[1] 10th highest $L_{Amax,fast}$ measured during the entire 3-hour period					

3.2 Background and Ambient Noise Survey

REC have carried out a noise measurement on the roof of Castlewood House in order to measure the prevailing background and ambient sound levels over a five day period covering weekend and weekdays. The survey was carried out over the following time period:

- 13:00 Friday 17th June 2016 to 11:00 Wednesday 22nd June 2016.

The following noise measurement position was chosen for the Background and Ambient Noise Survey:

- Noise Measurement Position 2 (NMP2): Located on the roof of Castlewood House towards the southern boundary. The microphone was positioned 1.5m above the roof level in a free-field position. Noise sources at this location consisted predominately of road traffic on the surrounding roads when the roof plant was not operational.

The location of NMP2 can be seen in Figure 1 of Appendix III

A summary of the measured sound pressure levels from the Background Sound Survey are presented in Table 8.

Table 8 Summary of Measured Noise Levels for NMP2

Date	Period	Measured Sound Pressure Level, free-field (dB)	
		$L_{Aeq,T}$	$L_{A90,T}$
Friday 17th June 2016	Daytime	62	59
	Night-time	62	56
Saturday 18th June 2016	Daytime	63	58
	Night-time	61	56
Sunday 19th June 2016	Daytime	61	57
	Night-time	62	57
Monday 20th June 2016	Daytime	63	57
	Night-time	60	54
Tuesday 21st June 2016	Daytime	63	58
	Night-time	60	55

The following equipment was used for the Noise Surveys.

Table 9 Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
NMP1 and NMP2	Sound Level Meter	01dB-Metravib Black Solo	65771	19th October 2017
	Pre-amplifier	01dB-Metravib PRE 21 S	16539	
	Microphone	01dB Metravib MCE212	175280	
	Calibrator	01dB-Metravib CAL-21	34634218	19th October 2016

The sound level meter was field-calibrated on Site prior to and after noise measurements were taken. No significant drift was witnessed. Calibration certificates are available upon request.

The weather conditions during the Noise Surveys were conducive towards the measurement of environmental noise, being fine and dry with wind speeds of less than 5.0m/s.

3.3 Underground Train Vibration Survey

During the site visit, the basements of Castlewood House and Medius House were accessed in order to determine any impacts of vibration from the London underground tube network. During this time no discernible vibration was apparent and with the criteria stipulated within BS6472-1:2008 based on human perception, by virtue it is considered that vibration would not be a cause of concern. Furthermore, due to no noise or vibration being evident from the London underground tube network, it would not be possible to associate the vibration levels with the tube network.

4. NOISE IMPACT ASSESSMENT

4.1 Road Traffic Noise

In order to accurately predict the levels of noise across the Site, it has been necessary to construct a noise model which accounts for New Oxford Street and Earnshaw Street for the daytime and night-time period.

For the purposes of this assessment, REC has used noise modelling software, CadnaA, to determine the impact of noise from road traffic. The measured noise level of the 3-hour road traffic measurement of New Oxford Street carried out in the baseline survey has been calibrated into the model in order to assess the impacts of road traffic using New Oxford Street upon the development. To inform a worst case assessment, Earnshaw Street has adopted the noise level measured of the free flowing traffic on New Oxford Street as during the noise survey, road vehicles on Earnshaw Street moved intermittently through the traffic light sequence.

The following inputs have been included in the model:

- Google maps aerial view of the Site;
- Site elevations have been taken as existing;
- A reflection order of 2 has been used in all calculations; and,
- Noise levels generated using ISO 9613-1 and ISO 9613-2 "*Acoustics – Attenuation of sound during propagation outdoors*" as incorporated into CadnaA software.

For the purposes of this assessment, the daytime and night-time average ($L_{eq,T}$) noise levels have been calculated based on the shortened measurement procedure detailed in CRTN. The respective daytime and night-time noise levels have been derived using the following calculations:

1. Calculation of the $L_{A10,18hr}$ noise level by using the following formula:

$$L_{10,18hr} = L_{10,3hr} – 1dB$$

2. Calculation of the $L_{Aeq,16hr}$ noise level by using the following formula:

$$L_{eq,16hr} = L_{10,18hr} – 2dB$$

3. Calculation of the night-time $L_{Aeq,8hr}$ noise level by using the following formula:

$$L_{night}\ (L_{eq,8hr}) = 0.90 \times L_{10,18hr} – 3.77dB$$

4. A reduction of 3dB has been included to produce a free-field measurement.

Table 10 displays the calculated daytime average and night-time average and maximum noise levels.

Table 10 Calculation of Daytime and Night-time Road Traffic Noise Levels

Measurement Position	Period	Calculated L_{Aeq} (dB)	10th Highest Measured $L_{Amax,fast}$ (dB)
NMP1	Daytime (07:00 – 23:00)	68	N/A

	Night-time (23:00 – 07:00)	59	90[1]
[1] 10th highest $L_{Amax,fast}$ from three 1-hour periods			

Based on the information provided by ARUP, the appointed transport consultant for this project, it is not anticipated the development will result in a change of AADT flows of more than 100, produce over 25 HDV movements per day or significantly affect average speeds on the local road network. As such, it is considered highly unlikely that the additional traffic will increase noise levels to a level considered to adversely affect surrounding noise sensitive receptors. Accordingly, the noise impact from proposed development traffic on existing receptors has not be assessed.

4.1.1 Internal Amenity Areas – Castlewood House

Figure 2 of Appendix III shows the daytime 3D noise map and details colour coded façade noise levels of Castlewood House. Pink facades exceed the internal criteria of 40dB with standard double glazing and opening windows, Light Green facades exceed the internal criteria of 40dB with opening windows and Dark Green facades meet the criteria of 40dB with opening windows.

BS8233:2014 suggest that a glazing unit with configuration 6mm glass/12mm air space/6mm glass affords sound insulation performance in the order of 33dB with windows closed however this is for a pink noise spectrum. The same unit, weighted for road traffic noise using the '+C_{tr}' correction, has a sound insulation performance value of approximately 30dB and so this value has been used to calculate internal noise levels with windows closed. Similarly, BS8233:2014 suggests that the sound reduction index of a partially open window will attenuate noise by approximately 15dB.

Table 11 details the calculated daytime internal noise levels for all floor levels in exceedence with standard thermal double glazing (Pink façade). The exceedences range from 2dB at the first floor and 1dB at the second floor.

Table 11 Calculation of Daytime Internal Noise Levels with Standard Thermal Double Glazing – Castlewood House

Section	Floor	Calculated External Noise Level at Façade, $L_{Aeq,16hour}$ (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dB)	Calculated Internal Noise Level, $L_{Aeq,16hour}$ (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
North Facade	1F	72	30	42	40	+2
	2F	71	30	41	40	+1

Exceedences have been shown in Table 11 therefore, the following section considers appropriate mitigation measures of which include for upgraded glazing and alternative ventilation to opening windows. It should be noted that the predicted worst case façade levels meet the 72dB and 66dB daytime and night-time criteria respectively as stipulated within DP28, thus planning permission can be granted.

4.1.2 Internal Amenity Areas – Medius House

Figures 3 and 4 of Appendix III show the daytime and night-time 3D noise map and detail colour coded façade noise levels for Medius House. Pink facades exceed the internal criteria of 35dB daytime and 30dB night-time with standard double glazing and opening windows, Light Green facades exceed the internal criteria of 35dB daytime and 30dB night-time with opening windows and Dark Green facades meet the criteria of 35dB daytime and 30dB night-time with opening windows.

Table 12 and Table 13 detail the calculated daytime and night-time internal noise levels respectively for all floor levels in exceedence with standard thermal double glazing (Pink façade). Figure 3 of Appendix III details the façade labelling. The exceedences range from 7dB at the first floor to 1dB at the fifth floor.

Table 12 Calculation of Daytime Internal Noise Levels with Standard Thermal Double Glazing – Medius House

Section	Floor	Calculated External Noise Level at Façade, $L_{Aeq,16hour}$ (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dB)	Calculated Internal Noise Level, $L_{Aeq,16hour}$ (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
A	1F	69	30	39	35	+4
	2F	68	30	38	35	+3
	3F	68	30	38	35	+3
	4F	67	30	37	35	+2
	5F	66	30	36	35	+1
B	1F	72	30	42	35	+7
	2F	71	30	41	35	+6
	3F	71	30	41	35	+6
	4F	70	30	40	35	+5
	5F	69	30	39	35	+4
	6F	68	30	38	35	+3
C	1F	72	30	42	35	+7
	2F	71	30	41	35	+6
	3F	71	30	41	35	+6
	4F	70	30	40	35	+5
	5F	69	30	39	35	+4
D	1F	72	30	42	35	+7

	2F	71	30	41	35	+6
	3F	71	30	41	35	+6
	4F	70	30	40	35	+5
	5F	69	30	39	35	+4

Table 13 Calculation of Night-time Internal Noise Levels with Standard Thermal Double Glazing – Medius House

Section	Floor	Calculated External Noise Level at Façade, $L_{Aeq,8hour}$ (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dB)	Calculated Internal Noise Level, $L_{Aeq,8hour}$ (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
B	1F	63	30	33	30	+3
	2F	62	30	32	30	+2
	3F	61	30	31	30	+1
	4F	61	30	31	30	+1
C	1F	63	30	33	30	+3
	2F	62	30	32	30	+2
	3F	61	30	31	30	+1
	4F	61	30	31	30	+1
D	1F	63	30	33	30	+3
	2F	62	30	32	30	+2
	3F	61	30	31	30	+1
	4F	61	30	31	30	+1

Exceedences have been shown in both Table 12 and Table 13 therefore, the following section considers appropriate mitigation measures of which include upgraded glazing and alternative ventilation to opening windows. It should be noted that the predicted worst case façade levels meet the 72dB and 66dB daytime and night-time criteria respectively as stipulated within DP28, thus planning permission can be granted.

4.2 Night-time Maximum Noise Levels – Medius House

As a worst case scenario the 10th highest $L_{Amax,fast}$ from the daytime period measured during the Road Traffic Noise Survey has been used to represent the L_{Amax} during the night-time period. The measured level of 90dB $L_{Amax,fast}$ has been modelled at each floor level ranging from 90dB at the first floor to 81dB at the sixth floor. As maximum noise levels are not generally made up of low frequency content as seen with road traffic, it is considered that the broadband rating of 33dB can be adopted to attenuate noise. With standard thermal double glazing reducing noise levels by 33dB, the criteria of 45dB $L_{Amax,fast}$ is exceeded by a maximum of 12dB which is higher than that of the exceedence due to the average daytime and night-time noise level. Table 14 details the facades in exceedence with standard double glazing with any further required mitigation considered in the following section.

Table 14 Calculation of Night-time Maximum Internal Noise Levels with Standard Thermal Double Glazing – Medius House

Section	Floor	Calculated External Noise Level at Façade, $L_{Aeq,16hour}$ (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dB)	Calculated Internal Noise Level, $L_{Aeq,16hour}$ (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
A	1F	88	33	55	45	+10
	2F	86	33	53	45	+8
	3F	85	33	52	45	+7
	4F	83	33	50	45	+5
	5F	82	33	49	45	+4
B	1F	90	33	57	45	+12
	2F	88	33	55	45	+10
	3F	85	33	52	45	+7
	4F	84	33	51	45	+6
	5F	82	33	49	45	+4
	6F	81	33	48	45	+3
C	1F	90	33	57	45	+12
	2F	88	33	55	45	+10
	3F	85	33	52	45	+7
	4F	84	33	51	45	+6
	5F	82	33	49	45	+4
D	1F	90	33	57	45	+12
	2F	88	33	55	45	+10
	3F	85	33	52	45	+7
	4F	84	33	51	45	+6
	5F	82	33	49	45	+4

4.3 Proposed Fixed Plant Items

There is the potential for fixed plant items associated with the development to impact upon the closest proposed receptors of which constitute the office space on the top floor of Castlewood House and the residential dwellings on the top floor of Medius House. Should the criteria be met at these closest receptors, those receptors beyond the assessed will meet also, including the Matilda apartments.

At the time of producing this report the precise details of any mechanical and electrical plant were unknown and so it is appropriate to set plant noise emission limits which are based upon the measured background noise level and any criteria specified in BS4142:2014.

Table 15 calculates the plant noise emission limits for the daytime and Night-time periods based on the adopted criteria stipulated within Camden Council's Development Policy, DP28 of $L_{A,r}$ = L_{A90} -5. The average background sound levels from Table 8 have been adopted.

Table 15 Calculation of Plant Noise Emission Limits

Period	Lowest Average Measured Background Sound Level $L_{A90,t}$ (dB)	BS4142:2014 Criteria (dB)	Calculated Plant Noise Emission Limit at the I $L_{A,r}$ (dB)
Daytime (07:00 – 23:00)	57	$L_{A,r}$ = $L_{A90,t}$ -5	53
Night-time (23:00 – 07:00)	54		49

In order to calculate the maximum sound power level of the fixed plant units of which will be in place on the roof of Castlewood House and Medius House, the prospective fixed plant items, as provided by GDM, have been modelled in the following way:

- Castlewood House – 10 Dry Air Coolers all in operation with a source height of 1m in their prospective positions according to the roof level site plans. A 1.2m sealed guard rail on the roof boundary has been included.
- Medius House – 2 Smoke Extract Fans all in operation with a source height of 1m in their prospective positions according to the roof level site plans. A 1.5m sealed barrier around the extracts has been included.

In accordance with the above, the maximum Sound Power Level of a single unit is as follows:

- Dry Air Cooler – 81dB SWL; and
- Smoke Extract Fan – 75dB SWL.

Proposed plant locations and respective closest receptors are shown in Figure 5 of Appendix III.

It should be noted there is the potential for an emergency tenant generator to be incorporated within the development however, this would be used for emergency use only and therefore has not been assessed.

5. MITIGATION

5.1 Road Traffic Noise

5.1.1 Internal Amenity Areas – Castlewood House

The previous section indicated that standard thermal double glazing will not be sufficient for certain floors on the northern facade for offices in Castlewood House. Therefore, Table 16 details higher specification glazing examples for each exceedance.

Table 16 Upgraded Glazing Specifications

Exceedance of Criteria (dB)	Required Performance of Glazing Unit $R_w + C_{tr}$ (dB)	Typical Glazing Configuration (glass / air space / glass)
+1	31	4 / 12 / 8 or 4 / 6 / 10
+2	32	6 / 12 / 10 or 4 / 10 / 6.4A
Note: Sound reduction performance of a stand-alone glazing unit is approximately 30dB R_w. The required sound reduction performance, weighted for the road traffic noise spectrum, is obtained by adding the excess to the stand-alone performance value. A denotes acoustic laminate glass		

With a partially open window, the internal noise levels for a vast majority of floor levels of Castlewood House will exceed the internal target criteria for offices as shown in Figure 2 of Appendix III. Accordingly it is necessary to consider an alternative ventilation scheme which does not require the opening of windows. One such scheme could be the inclusion of trickle ventilators for all office windows on facades in order to supply background ventilation whilst not compromising the façade performance.

In each case the chosen trickle ventilator will need to match the glazing performance in the open position.

As has been shown, internal noise levels for Castlewood House can be suitably controlled through façade design, i.e. glazing specification and alternative ventilation, and is therefore not deemed constraining.

5.1.2 Internal Amenity Areas – Medius House

The previous section indicated that standard thermal double glazing will not be sufficient for certain floors on certain facades for habitable rooms in Medius House for both daytime and night-time average noise levels as well as night-time maximum noise levels. Therefore, Table 17 details higher specification glazing for each exceedance. As the daytime average noise levels exceed the night-time average noise levels, it is deemed that all mitigation required to meet daytime internal noise levels will also mitigate night-time noise levels sufficiently.

Table 17 Upgraded Glazing Specifications for Average Calculated Noise Levels ($L_{Aeq,T}$)

Exceedance of Daytime Criteria Road Traffic – $R_w + C_{tr}$ / Corresponding exceedance for Night-time Max's R_w (dB)	Required Performance of Glazing Unit Road Traffic – $R_w + C_{tr}$ / Corresponding R_w Performance for Night-time Max's – (dB)	Typical Glazing Configuration (glass / air space / glass)
+1 / +1	31 / 34	4 / 12 / 8 or 6 / 12 / 8
+2 / +2	32 / 35	6 / 12 / 10 or 4 / 10 / 6.4A
+3 / +3	33 / 36	10 / 12 / 12 or 4 / 15 / 6.4A
+4 / +4	34 / 37	12 / 16 / 6 or 4 / 8 / 8.4A
+5 / +5	35 / 38	12 / 20 / 6 or 4 / 16 / 8.8A
+6 / +7	36 / 40	6 / 15 / 8.4A or 6 / 12 / 8.8A
+7 / +8	37 / 41	6 / 12 / 10.8A or 6 / 16 / 10.4A
+8 / +10	38 / 43	8 / 20 / 8.4A or 8 / 16 / 10.4A
+9 / +12	39 / 45	8.8A /20 / 10.8A or 10.4A / 20 / 8.8A

Note: Sound reduction performance of a stand-alone glazing unit is approximately 30dB $R_w + C_{tr}$. The required sound reduction performance, weighted for the road traffic noise spectrum, is obtained by adding the excess to the stand-alone performance value.
A denotes acoustic laminate glass

With a partially open window, the internal noise levels for a vast majority of habitable rooms across the Site will exceed the internal target criteria. Accordingly it is necessary to consider an alternative ventilation scheme which does not require the opening of windows.

It is understood that in order to comply with suitable Air Quality criteria, facades overlooking New Oxford Street to the north will require filtered mechanical ventilation and high specification of window tightness. As using a trickle ventilator will compromise the specified window tightness, it is advised that the mechanical ventilation is used throughout the rooms in exceedence of the noise criteria with a partially open window, as shown as Light Green in Figures 3 and 4.

Internal noise levels can be suitably controlled through façade design, i.e. glazing specification and alternative ventilation, and is therefore not deemed constraining.

6. CONCLUSION

REC Limited have been commissioned by Royal London Mutual Insurance Society to undertake a Noise Impact Assessment for a proposed Mixed-use development on land located at Castlewood House and Medius House off New Oxford Street in Camden, London.

This assessment has been undertaken to identify key noise sources in the vicinity of the Site which may have the potential to impact upon the proposed mixed-use development.

A series of Noise Surveys have been completed in order to measure the impact of noise upon the proposed development as a result of road traffic on New Oxford Street and Earnshaw Street as well as defining proposed plant noise limit criteria.

The Noise Impact Assessment has identified that the key noise source impacting upon the development is from road traffic using New Oxford Street to the north of the Site and Earnshaw Street to the west. Accordingly appropriate recommendations regarding mitigation measures have been specified in order to reduce these impacts for any proposed internal habitable areas.

Castlewood House

Appropriate mitigation measures have been proposed in order to reduce the impacts of road traffic on internal office areas including the use of higher specification glazing and alternative ventilation.

Medius House

Appropriate mitigation measures have been proposed in order to reduce the impacts of road traffic on internal habitable areas including, higher specification glazing and alternative ventilation.

Proposed Plant

Providing the emission levels are met as prescribed in Section 4.3, noise associated with the proposed plant should not impact on the surrounding noise sensitive receptors.

Subject to the incorporation of the identified recommendations and mitigation measures, it is considered that in principle, internal noise levels can be suitably controlled across the Site.

APPENDIX I LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Limited and the Client as indicated in Section 1.2.

2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

3. REC cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.

APPENDIX II GLOSSARY OF ACOUSTICAL TERMINOLOGY

Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1 Typical Sound Pressure Levels

Sound Pressure Level dB(A)	Location
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Table A2 Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.
Tonality	Tonality of a noise source is determined by a single third octave band being greater than the adjacent octave bands by a set number of decibels.
Impulsivity	A sound that lasts for a short period of time and includes frequencies over a large portion of the acoustic spectrum, such as a hammer blow or hand clap.
Intermittency	Sound occurring at irregular intervals; not continuous or steady
Pink Noise Spectrum	A random broadband signal which has equal power per percentage bandwidth and therefore has a flat, i.e. horizontal, frequency spectrum when plotted on a logarithmic frequency scale.

APPENDIX III FIGURES

Figure 1 – site Location & Noise Measurement Positions

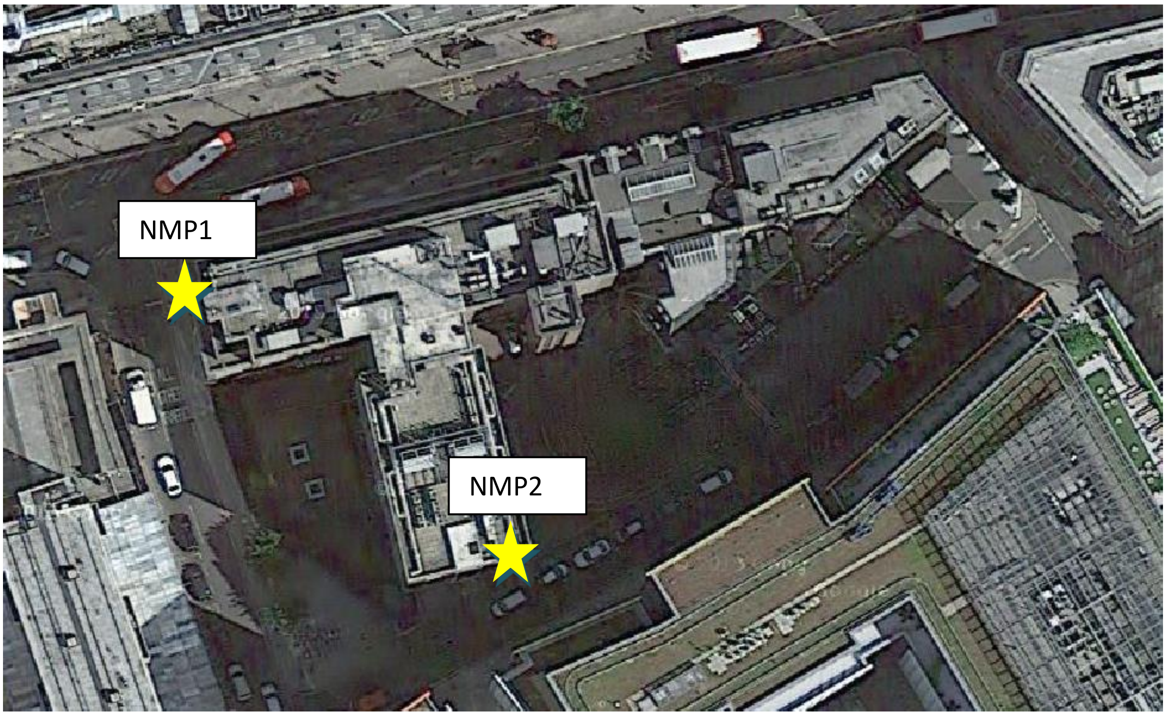
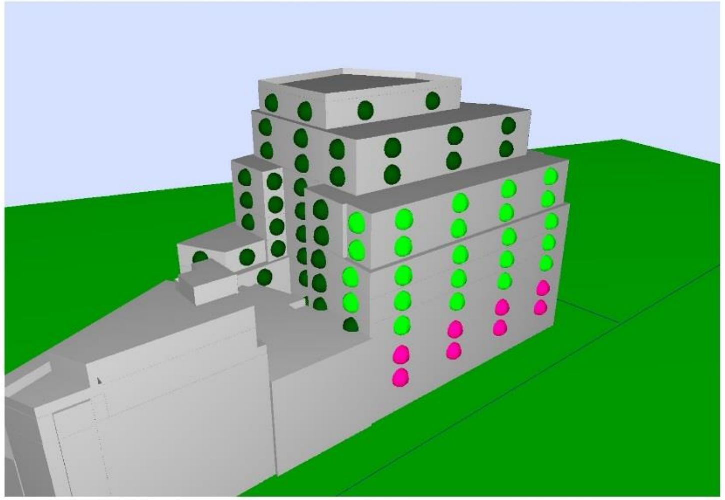
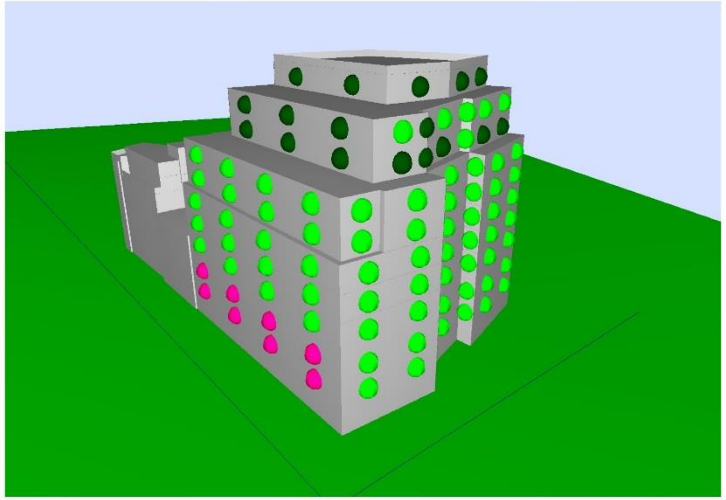


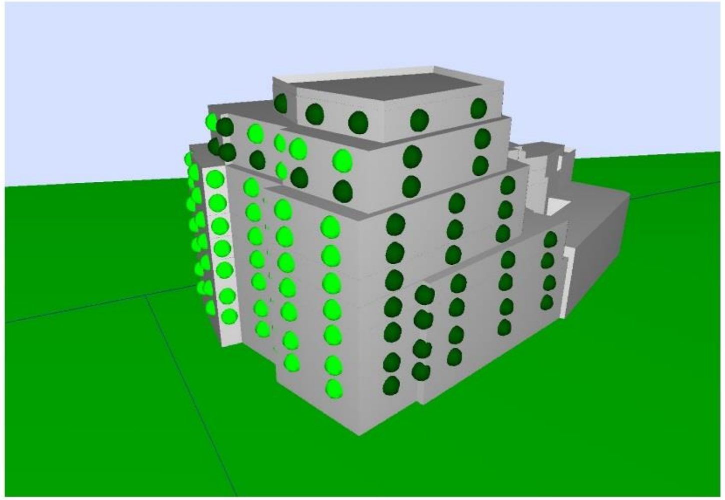
Figure 2 - Daytime 3D Facades – Castlewood House

View from the North East

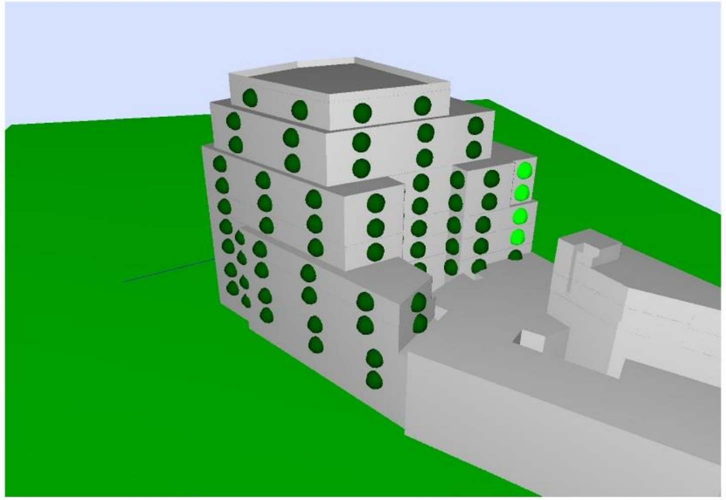


View from the North West





View from the South East



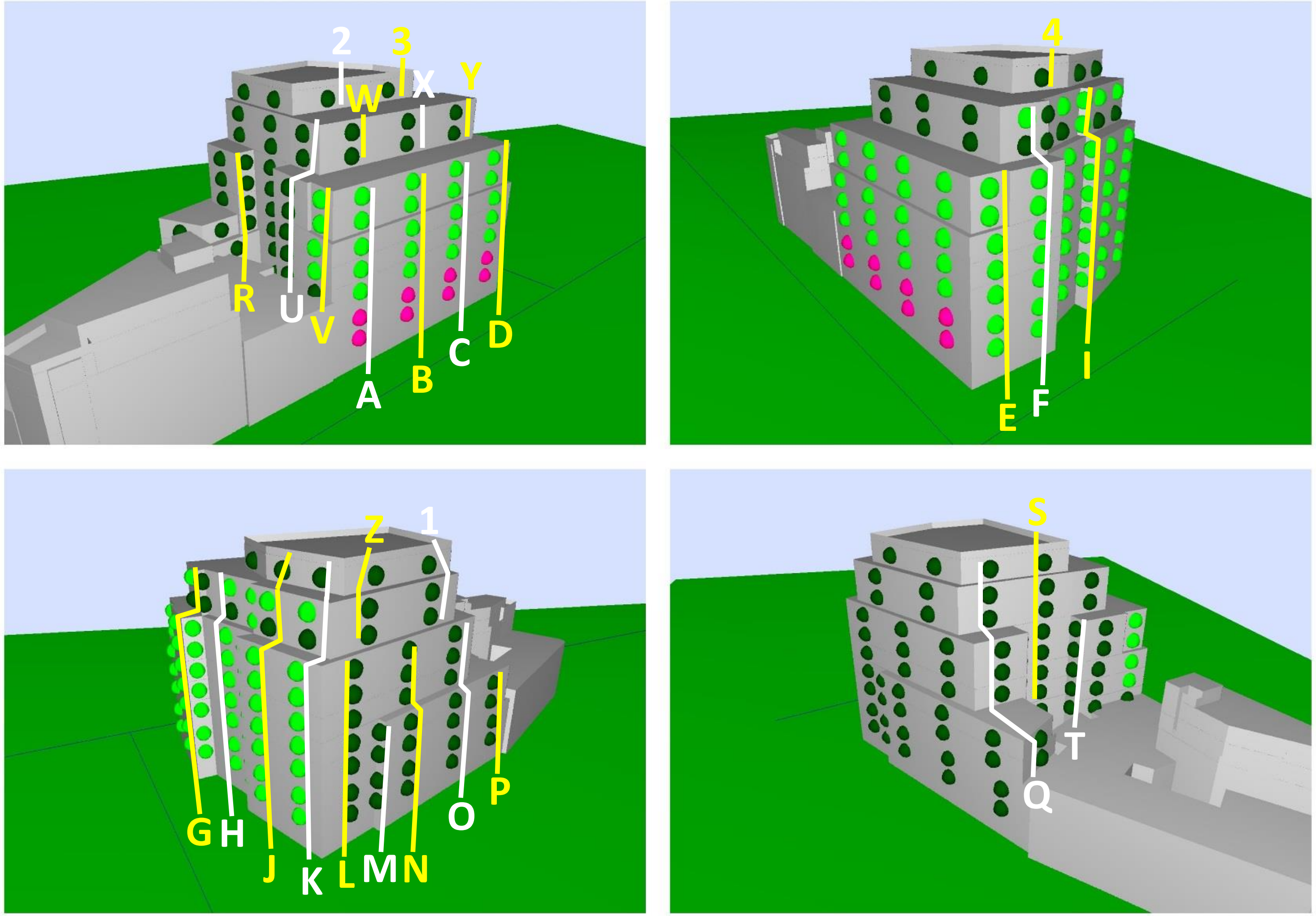
View from the South West

Key:

- >70dB – Upgraded Glazing and Alternative Ventilation Required
- <70dB – Alternative Ventilation Required
- <55dB – No Mitigation Required

Figure 3 – Daytime 3D Facades – Castlewood House with Labels

View from the North East | **View from the North West**



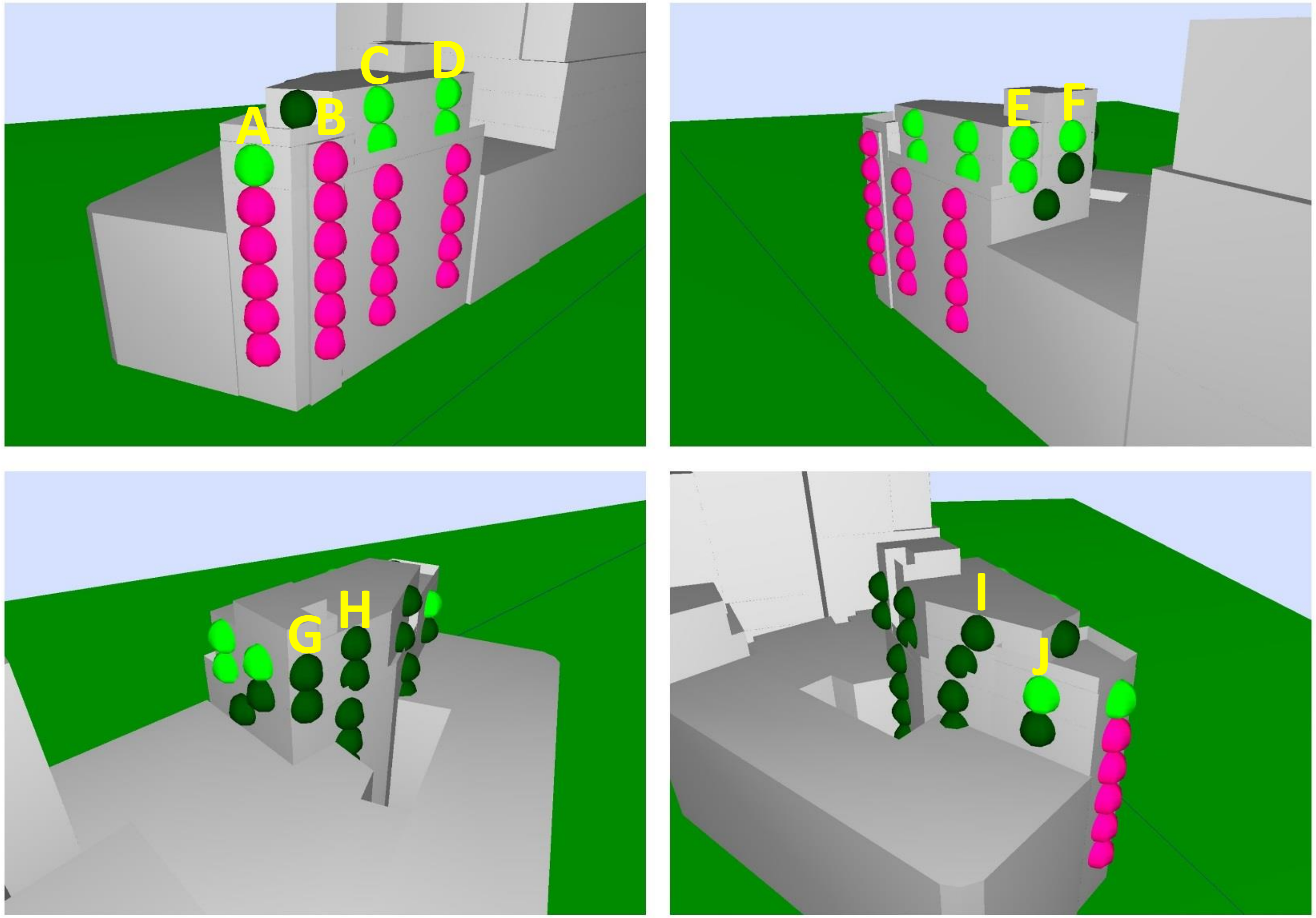
View from the South East | **View from the South West**

Key:

- >70dB – Upgraded Glazing and Alternative Ventilation Required
- <70dB – Alternative Ventilation Required
- <55dB – No Mitigation Required

Figure 3 – Daytime 3D Facades – Medius House

View from the North East | **View from the North West**



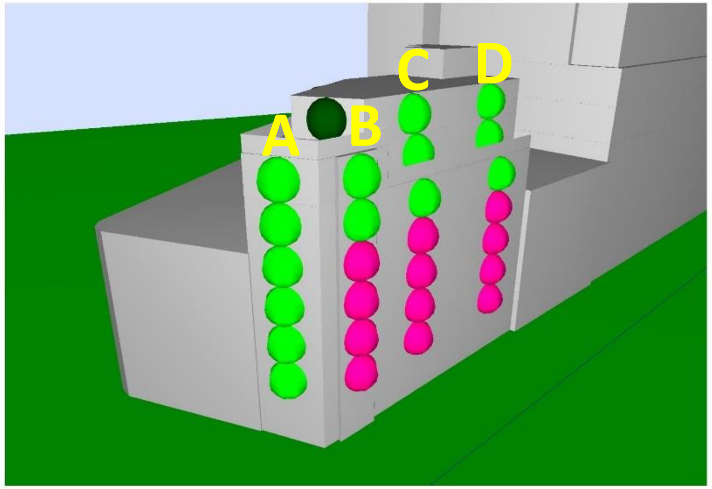
View from the South East | **View from the South West**

Key:

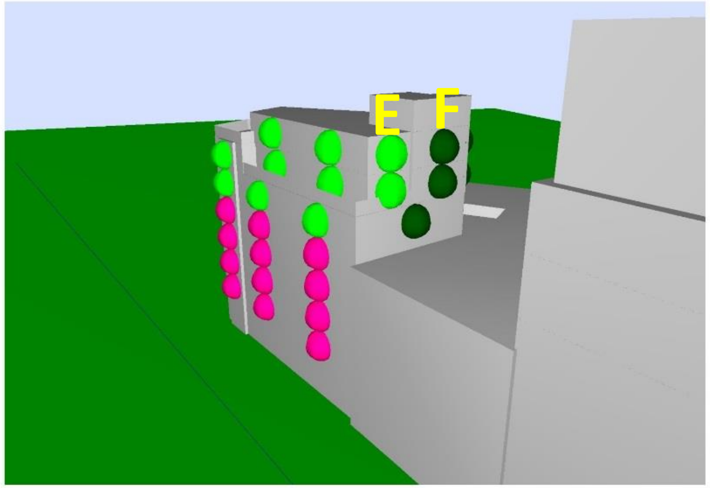
- Pink: >70dB – Upgraded Glazing and Alternative Ventilation Required
- Light green: <70dB – Alternative Ventilation Required
- Dark green: <55dB – No Mitigation Required

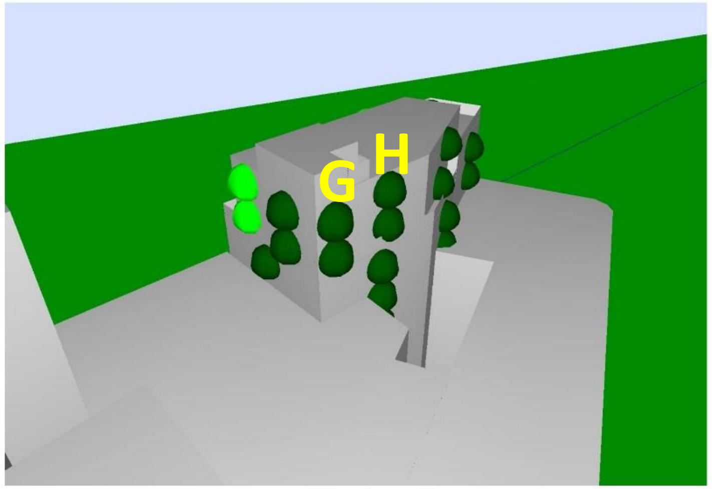
Figure 4 – Night-time 3D Facades – Medius House

View from the North East

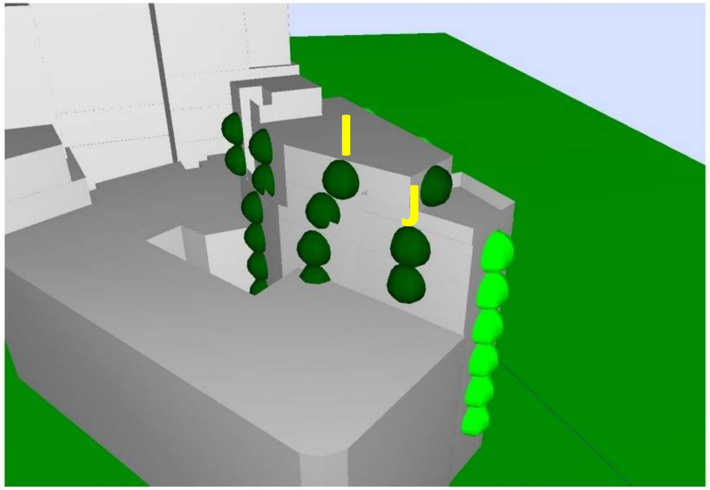


View from the North West





View from the South East



View from the South West

Key:

>70dB – Upgraded Glazing and Alternative Ventilation Required

<70dB – Alternative Ventilation Required

<55dB – No Mitigation Required

Figure 5 – Plant Locations and Closest Receptors

Key:

- Proposed Plant
- Castlewood House Receptors (10F)
- Medius House Receptors (7F)
- Matilda Apartments

APPENDIX IV TABLES OF RESULTS

Table A1 Calculation of Daytime Internal Noise Levels with Standard Thermal Double Glazing – Castlewood House

Section	Floor	Calculated External Noise Level at Façade, $L_{Aeq,16hour}$ (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dB)	Calculated Internal Noise Level, $L_{Aeq,16hour}$ (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
A	1F	72	30	42	40	+2
	2F	71	30	41	40	+1
	3F	70	30	40	40	0
	4F	69	30	39	40	-1
	5F	68	30	38	40	-2
	6F	64	30	34	40	-6
	7F	63	30	33	40	-7
B	1F	72	30	42	40	+2
	2F	71	30	41	40	+1
	3F	70	30	40	40	0
	4F	69	30	39	40	-1
	5F	68	30	38	40	-2
	6F	64	30	34	40	-6
	7F	63	30	33	40	-7
C	1F	72	30	42	40	+2
	2F	71	30	41	40	+1
	3F	70	30	40	40	0
	4F	69	30	39	40	-1
	5F	68	30	38	40	-2
	6F	64	30	34	40	-6
	7F	63	30	33	40	-7
D	1F	72	30	42	40	+2
	2F	71	30	41	40	+1
	3F	70	30	40	40	0

	4F	69	30	39	40	-1
	5F	68	30	38	40	-2
	6F	64	30	34	40	-6
	7F	63	30	33	40	-7
E	1F	70	30	40	40	0
	2F	69	30	39	40	-1
	3F	68	30	38	40	-2
	4F	67	30	37	40	-3
	5F	66	30	36	40	-4
	6F	61	30	31	40	-9
	7F	61	30	31	40	-9
F	1F	69	30	39	40	-1
	2F	68	30	38	40	-2
	3F	67	30	37	40	-3
	4F	66	30	36	40	-4
	5F	65	30	35	40	-5
	6F	65	30	35	40	-5
	7F	64	30	34	40	-6
	8F	52	30	22	40	-18
	9F	57	30	27	40	-13
G	1F	65	30	35	40	-5
	2F	64	30	34	40	-6
	3F	63	30	33	40	-7
	4F	62	30	32	40	-8
	5F	62	30	32	40	-8
	6F	61	30	31	40	-9
	7F	60	30	30	40	-10
	8F	53	30	23	40	-17

	9F	55	30	25	40	-15
H	1F	66	30	36	40	-4
	2F	65	30	35	40	-5
	3F	65	30	35	40	-5
	4F	64	30	34	40	-6
	5F	63	30	33	40	-7
	6F	62	30	32	40	-8
	7F	62	30	32	40	-8
	8F	55	30	25	40	-15
	9F	57	30	27	40	-13
I	1F	66	30	36	40	-4
	2F	65	30	35	40	-5
	3F	65	30	35	40	-5
	4F	64	30	34	40	-6
	5F	63	30	33	40	-7
	6F	63	30	33	40	-7
	7F	62	30	32	40	-8
	8F	56	30	26	40	-14
	9F	57	30	27	40	-13
J	1F	66	30	36	40	-4
	2F	65	30	35	40	-5
	3F	64	30	34	40	-6
	4F	64	30	34	40	-6
	5F	63	30	33	40	-7
	6F	63	30	33	40	-7
	7F	62	30	32	40	-8
	8F	52	30	22	40	-18
	9F	57	30	27	40	-13

	10F	49	30	19	40	-21
K	1F	65	30	35	40	-5
	2F	64	30	34	40	-6
	3F	64	30	34	40	-6
	4F	63	30	33	40	-7
	5F	62	30	32	40	-8
	6F	62	30	32	40	-8
	7F	61	30	31	40	-9
	8F	51	30	21	40	-19
	9F	56	30	26	40	-14
	10F	46	30	16	40	-24
L	1F	55	30	25	40	-15
	2F	55	30	25	40	-15
	3F	55	30	25	40	-15
	4F	54	30	24	40	-16
	5F	51	30	21	40	-19
	6F	51	30	21	40	-19
	7F	50	30	20	40	-20
M	1F	54	30	24	40	-16
	2F	54	30	24	40	-16
	3F	53	30	23	40	-17
	4F	53	30	23	40	-17
N	1F	52	30	22	40	-18
	2F	51	30	21	40	-19
	3F	51	30	21	40	-19
	4F	51	30	21	40	-19
	5F	45	30	15	40	-25
	6F	48	30	18	40	-22

	7F	48	30	18	40	-22
O	1F	49	30	19	40	-21
	2F	49	30	19	40	-21
	3F	49	30	19	40	-21
	4F	49	30	19	40	-21
	5F	43	30	13	40	-27
	6F	45	30	15	40	-25
	7F	46	30	16	40	-24
P	1F	47	30	17	40	-23
	2F	47	30	17	40	-23
	3F	48	30	18	40	-22
	4F	47	30	17	40	-23
Q	3F	40	30	10	40	-30
	4F	41	30	11	40	-29
	5F	41	30	11	40	-29
	6F	42	30	12	40	-28
	7F	42	30	12	40	-28
	8F	41	30	11	40	-29
	9F	43	30	13	40	-27
	10F	43	30	13	40	-27
R	1F	39	30	9	40	-31
	2F	39	30	9	40	-31
	3F	41	30	11	40	-29
	4F	41	30	11	40	-29
	5F	42	30	12	40	-28
	6F	43	30	13	40	-27
	7F	43	30	13	40	-27
S	1F	40	30	10	40	-30

	2F	40	30	10	40	-30
	3F	40	30	10	40	-30
	4F	41	30	11	40	-29
	5F	42	30	12	40	-28
	6F	43	30	13	40	-27
	7F	44	30	14	40	-26
	8F	45	30	15	40	-25
	9F	46	30	16	40	-24
	10F	48	30	18	40	-22
T	1F	40	30	10	40	-30
	2F	40	30	10	40	-30
	3F	40	30	10	40	-30
	4F	40	30	10	40	-30
	5F	41	30	11	40	-29
	6F	40	30	10	40	-30
	7F	40	30	10	40	-30
U	3F	44	30	14	40	-26
	4F	46	30	16	40	-24
	5F	49	30	19	40	-21
	6F	52	30	22	40	-18
	7F	55	30	25	40	-15
	8F	48	30	18	40	-22
	9F	52	30	22	40	-18
V	3F	49	30	19	40	-21
	4F	57	30	27	40	-13
	5F	59	30	29	40	-11
	6F	60	30	30	40	-10
	7F	60	30	30	40	-10

W	8F	47	30	17	40	-23
	9F	54	30	24	40	-16
X	8F	47	30	17	40	-23
	9F	51	30	21	40	-19
Y	8F	47	30	17	40	-23
	9F	52	30	22	40	-18
Z	8F	45	30	15	40	-25
	9F	47	30	17	40	-23
	10F	42	30	12	40	-28
1	8F	43	30	13	40	-27
	9F	45	30	15	40	-25
	10F	41	30	11	40	-29
2	10F	41	30	11	40	-29
3	10F	42	30	12	40	-28
4	10F	47	30	17	40	-23

Table A2 - Calculation of Daytime Internal Noise Levels with Standard Thermal Double Glazing – Medius House

Section	Floor	Calculated External Noise Level at Façade, $L_{Aeq,16hour}$ (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dB)	Calculated Internal Noise Level, $L_{Aeq,16hour}$ (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
A	1F	69	30	39	35	+4
	2F	68	30	38	35	+3
	3F	68	30	38	35	+3
	4F	67	30	37	35	+2
	5F	66	30	36	35	+1
	6F	65	30	35	35	0
	7F	49	30	19	35	-16
B	1F	72	30	42	35	+7
	2F	71	30	41	35	+6
	3F	71	30	41	35	+6
	4F	70	30	40	35	+5
	5F	69	30	39	35	+4
	6F	68	30	38	35	+3
C	1F	72	30	42	35	+7
	2F	71	30	41	35	+6
	3F	71	30	41	35	+6
	4F	70	30	40	35	+5
	5F	69	30	39	35	+4
	6F	55	30	25	35	-10
	7F	63	30	33	35	-2
D	1F	72	30	42	35	+7
	2F	71	30	41	35	+6
	3F	71	30	41	35	+6

	4F	70	30	40	35	+5
	5F	69	30	39	35	+4
	6F	56	30	26	35	-9
	7F	64	30	34	35	-1
E	5F	50	30	20	35	-15
	6F	58	30	28	35	-7
	7F	58	30	28	35	-7
F	6F	49	30	19	35	-16
	7F	51	30	21	35	-14
G	6F	41	30	11	35	-24
	7F	41	30	11	35	-24
H	1F	41	30	11	35	-24
	2F	41	30	11	35	-24
	3F	41	30	11	35	-24
	4F	41	30	11	35	-24
	5F	41	30	11	35	-24
	6F	41	30	11	35	-24
	7F	41	30	11	35	-24
I	5F	42	30	12	35	-23
	6F	41	30	11	35	-24
	7F	44	30	14	35	-21
J	5F	45	30	15	35	-20
	6F	52	30	22	35	-13

Table A3 - Calculation of Night-time Internal Noise Levels with Standard Thermal Double Glazing – Medius House

Section	Floor	Calculated External Noise Level at Façade, $L_{Aeq,16hour}$ (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dB)	Calculated Internal Noise Level, $L_{Aeq,16hour}$ (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
A	1F	69	30	39	35	+4
	2F	68	30	38	35	+3
	3F	68	30	38	35	+3
	4F	67	30	37	35	+2
	5F	66	30	36	35	+1
	6F	65	30	35	35	0
	7F	49	30	19	35	-16
B	1F	72	30	42	35	+7
	2F	71	30	41	35	+6
	3F	71	30	41	35	+6
	4F	70	30	40	35	+5
	5F	69	30	39	35	+4
	6F	68	30	38	35	+3
C	1F	72	30	42	35	+7
	2F	71	30	41	35	+6
	3F	71	30	41	35	+6
	4F	70	30	40	35	+5
	5F	69	30	39	35	+4
	6F	55	30	25	35	-10
	7F	63	30	33	35	-2
D	1F	72	30	42	35	+7
	2F	71	30	41	35	+6
	3F	71	30	41	35	+6
	4F	70	30	40	35	+5

	5F	69	30	39	35	+4
	6F	56	30	26	35	-9
	7F	64	30	34	35	-1
E	5F	50	30	20	35	-15
	6F	58	30	28	35	-7
	7F	58	30	28	35	-7
F	6F	49	30	19	35	-16
	7F	51	30	21	35	-14
G	6F	41	30	11	35	-24
	7F	41	30	11	35	-24
H	1F	41	30	11	35	-24
	2F	41	30	11	35	-24
	3F	41	30	11	35	-24
	4F	41	30	11	35	-24
	5F	41	30	11	35	-24
	6F	41	30	11	35	-24
	7F	41	30	11	35	-24
I	5F	42	30	12	35	-23
	6F	41	30	11	35	-24
	7F	44	30	14	35	-21
J	5F	45	30	15	35	-20
	6F	52	30	22	35	-13