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159-161 Iverson Road, London

Environmental Noise Assessment Report

20 November 2013

James Tomalin

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Planning Application *20 November 2013*

James Tomalin

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Environmental Noise Assessment Report

Introduction

Aulos Acoustics has been appointed to review the environmental noise exposure of the application site including planning and noise assessment in accordance with local planning requirements.

The proposal includes a commercial unit and residential units to be built between Iverson Road and the railway to the north, in West Hampstead, London NW6.

The development proposal comprises the replacement of the existing light industrial space (currently Iverson Tyres) and 19 residential units, comprising 15 market apartments and 4 affordable units. A four to six storey development is proposed on the site, situated at 159-161 Iverson Road West Hampstead, within the London Borough of Camden

The properties will be exposed to railway noise, road traffic noise and building services and servicing noise generated by commercial premises. The level of noise is sufficient to require environmental noise survey and assessment in accordance with local planning policy.

The investigation was undertaken on behalf of the applicant.

The following report addresses the relevant aspects of the environmental noise climate and the requirements for the control of sound, as determined by national, regional and local planning policy.

Information Used

Full reference has been made to the documents, drawings and photographs forming the planning application package.

Where direct reference is required the specific document has been identified.

LB Camden planning policy regarding noise remains is defined in the Local Development Framework 2010-2025.

The overarching national planning requirements for noise are as directed by the National Planning Policy Framework and Noise Policy Statement for England and Explanatory Note.

The London Plan and Mayor's Ambient Noise Strategy require strategic and specific consideration of noise as it affects existing and future residents.

Planning Framework

The policy framework under which the application site needs to be assessed is defined in the following documents:

National Planning Policy Framework

National planning policy regarding noise is now limited and may best be described as a general aim to improve or maintain levels of amenity, in conjunction with consideration of other pollution and a sustainable approach.

The National Planning Policy Framework makes clear reference to the Noise Policy Statement for England and Explanatory Note as the basis of current and future policy.

These allow for two important changes:-

1. The explicit inclusion of the principles of sustainable development in noise policy
2. The application and use of different bands of Observed Adverse Effect Levels (OAEL)

The Noise Policy Statement for England states:-

> The first aim of the Noise Policy Statement for England
>
> **Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.**
>
> 2.23 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development (paragraph 1.8).
>
> The second aim of the Noise Policy Statement for England
>
> **Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.**
>
> 2.24 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.
>
> The third aim of the Noise Policy Statement for England
>
> **Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.**
>
> 2.25 This aim seeks, where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development (paragraph 1.8), recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

The NNPF / NPSE approach is, in summary, to avoid exceeding Significant OAEL values (Aim 1), to mitigate and minimise adverse effects by reasonable measures to noise between Lowest and Significant OAEL values (Aim 2) and to improve health and quality of life affected by noise (Aim 3) where possible. Wherever feasible, practical and sustainable, both current and future

noise impact should be reduced as far as may be technically feasible with the ideal goal being No Observed Effect Level.

The approach allows for higher noise levels than may have applied in the recent past, as a range of design is encouraged and adverse effects are not excluded, rather than the application of unsustainable and impractical single-value, upper limits.

NB_1: Observed adverse effect level is the sound pressure level below above which the stated magnitude of effect will be noted.

No specific criteria are defined for different noise sources and no compiled reference exists for comparison. The ongoing development and review of acoustic design standards means design criteria corresponding to each OEL are not well defined.

For the basis of comparison here for railway noise, road traffic noise and steady/continuous equipment noise, the following OEL criteria shall apply inside residential property:-

Significant OAEL	LAeq,T 45dB(A) daytime	LAeq,T 35dB(A) night-time
	(BS8233:1999 Reasonable, WHO 2000, WHO Noise Criteria 12)	
Lowest OAEL	LAeq,T 35dB(A) daytime	LAeq,T 30dB(A) night-time
	(BS8233:1999 Reasonable range, WHO 2000 and others)	
No Observed Effect Level	LAeq,T <=35dB(A) daytime	LAeq,T <=30dB(A) night-time (BS8233:1999 Good)

Sleep and rest conditions appropriate to the time of the day for the majority of the population are the “effect” addressed.

In addition, no observed effect will occur at night during sleep for typical levels of individual event noise of LAmax,FAST 45dB(A), where this level is not exceeded for more than 10% of the night-time events, to minimise sleep disturbance. The effect in this case is the slight changes to sleep pattern without full awakening that may occur and their possible adverse effect on health.

External noise standards are better defined with community annoyance criteria of BS8233:1999 applicable, where limiting the proportion of people stating they are “moderately” or “seriously”, or worse, by community noise to a reasonable value, is the “effect” in question. The equivalent criteria are:-

Significant OAEL	LAeq,T 60dB(A) daytime (BS8233:1999 Seriously annoyed), i.e. proportion seriously annoyed is significant or unreasonable above this level
Lowest OAEL	LAeq,T 55dB(A) daytime (BS8233:1999 Moderately annoyed), i.e. proportion moderately annoyed may increase beyond reasonable standards
No Observed Effect Level	LAeq,T 50dB(A) daytime (BS8233:1999 Slightly annoyed or Not annoyed, “desirable”), i.e. proportion moderately annoyed is small and seriously annoyed is negligible

Regional Policy – The London Plan

At present, the regional policy remains as stated in The London Plan and Mayor’s Ambient Noise Strategy, which aim to improve conditions overall.

The approach of the NPPF/NPSE is similar and more objectively defined.

Largely, local policy accords with the regional planning requirements for noise, although it is stringent in relation to the national policy and strategy.

Local Policy

London Borough of Camden (LBC) has maintained a stringent approach to noise and vibration over a considerable period of time, with highly defined criteria and approach.

Recent policy has focussed on the whether ambient noise levels outside are either too high for sensitive development or require attenuation. Such an approach is similar to that previously used by PPG24 Planning & Noise (withdrawn), although LBC policy is more refined.

The current planning policies of London Borough of Camden ["LBC"] are defined in the Local Development Framework 2010-2025 (1)["LDF"]. The relevant specific policies are understood to be:

- DP28. Noise and vibration

The relevant core strategic policies are understood to be:

- CS14. Promoting high quality places and conserving our heritage
- CS16 – Improving Camden's health and well-being.

DP28 states the following:

Policy	Statement
DP28. Noise and vibration	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.

Table 1 – LB Camden Planning Policy

The reasoned justification and detail of the policy section then defines a series of Noise & Vibration Thresholds on which planning decisions shall be based. These are reproduced in Appendix E.2.

Table A defines the thresholds above which planning permission will not be granted.

Table B defines the thresholds above which noise attenuation measures are required.

These threshold values do not accord with previous national planning policy, as set out in PPG24, in the following manner:

a) Separate evening and daytime periods are used to divide the 16 hour day of PPG24

b) Evening values are more stringent as such large fall in evening noise may not occur for the prevailing road or rail noise source

c) All values are more stringent by virtue of a 3dB façade reflection where none applies in PPG24

In effect, LB Camden defines a refusal position where noise levels are at or below the former NEC D boundary. The criteria are those defined in the previous Local Plan and SPG relating to noise. The Camden Noise Strategy 2002 stated:

> **16.26 There are three time periods in the standard, rather than the two time periods in PPG24, because of the considerable density of the rail and road network and the wide range of tourism and entertainment facilities in the Borough. These factors combine to make the area particularly susceptible to road and rail noise during the evening period, when local residents are entitled to expect reasonable peace and quiet in their own homes.**

No time period variations were permitted under PPG24, which stated in Annex 1:

> **7.** Traditionally, different indices have been used to describe noise from different sources, and limits have been set over different time periods. This has caused confusion, and this PPG follows the move towards consistency advocated in BS 7445: 1991 by expressing all noise in terms of $L_{Aeq,T}$. The recommended time periods are 07.00-23.00 and 23.00-07.00.

By contrast, the Table B values adopt an approach which at least clarifies the point where attenuation is expected, without defining a basis for the approach. These place the threshold values in NEC B, although again the different periods skew comparison with PPG24.

With respect to current national requirements, the day, evening and night approach is not unreasonable and seems suitable for a dense urban environment with significant evening activity. It remains arguable whether such an approach is sustainable, however, in the context of wider policy requirements.

It should be noted few, if any, other London Borough's adopt a complete evening strategy for ambient noise affecting sensitive properties. The regional or national ambient noise strategy provides no substantive support for such an approach.

Further information is defined in the Camden Planning Guidance 6 Amenity ["CPG6"] under section 6 Noise & Vibration. The CPG6 is general guidance regarding design approach and demonstration of the design. It retains reference to former (withdrawn) Planning Policy Guidance PPG24. The advice is comparable to that contained in BS8233:1999.

Most urban and many suburban environments experience extended periods of road and/or railway noise, with residential areas tending to experience later road traffic noise peaks than employment areas due to people returning home from further afield. The benefits to residents of highly-developed transport infrastructure generally outweigh the potential adverse effects. Benefits include greater employment flexibility and choice, as well as wider options for leisure, entertainment and training/education.

In general, these apply specific and onerous limits which reflect the "No Observed Effect Level" and represent a "Good" or better standard in relation to noise ingress to bedrooms particularly.

Whilst the approach is a desirable goal, in line with Aim 3 of the Noise Policy Statement for England, the author does not consider they represent a sustainable objective as required under the NPPF and addressed by Aim 1 and Aim 2 of the NPSE.

Criteria

The criteria for assessment of noise for external noise affecting the building envelope and controlling noise ingress to residential property shall be as defined in Appendix E (Table A and B)

The criteria for assessment of mechanical equipment noise affecting residential property shall be as defined in Appendix E (Table E).

The criteria for the assessment of vibration magnitude shall be as defined in Appendix E (Table C) although, except where these are superseded by assessment requirements in British Standards.

Building Envelope Design Criteria

The criteria for design of the building envelope sound insulation (including any ventilation paths) shall be as defined in BS8233:1999 for the Reasonable Design Target Range. The design aim shall be for “Reasonable” to “Good” standards of internal noise due to environmental sources, except in where individual noise events are assessed where the stated “Reasonable” maximum noise level limit shall apply.

Daytime design shall refer to Living Rooms and night-time design shall refer to Bedrooms, as these are the reasonable, primary domestic uses for the relevant periods. For the avoidance of doubt, night-time refers to the period 23.00-07.00 hours.

The highest, internal ambient noise level at night in bedrooms shall be LAeq,8hour 35dB(A) and shall allow for design uncertainty of 2-3dB. There is no fixed, minimum ambient noise level, but the aim shall be to ensure a reasonably consistent internal environment exists within habitable rooms, which tends to require noise levels within 5-10dB of the maximum noise level.

Quieter ambient noise levels can be expected to increase the obtrusiveness of certain noises (such as neighbour noise and barking dogs), the adverse effects of isolation from the external environment and the audibility of internal services, such as boilers or dishwashers.

For these reasons, it is not recommended the design cause very low internal transportation or other intruding noise levels, however desirable this may seem. A general lower target of LAeq,8h 20-25dB is applied in our approach.

The exception to the lower limit is where typical individual noise events may otherwise exceed the night-time noise limit of LAmax,FAST 45dB. This limit takes precedence in the design due to the known effects on sleep quality and disturbance and potential health effects of such disturbance. Typical individual noise events are generally taken to be the loudest 90-95th percentile of measured LAmax,FAST. Design to maximum noise levels may result in lower ambient noise levels than would otherwise be desirable.

Extraneous events are excluded (e.g. emergency sirens) except where such events might form a predictable or expected noise source (e.g. if flat is opposite a fire station).

The above are in general accordance with the requirements of the National Planning Policy Framework and ambient noise strategies for England and London.

Environmental Noise Survey

An environmental noise survey was completed between 13:00 hours 30 October 2013 and 13:00 hours 3 November 2013. The installation and removal periods for the meter are excluded from these times.

The survey was conducted in accordance with the requirements of BS7445:1 for establishing environmental noise exposure.

Continuous Monitoring

The noise climate was monitored continuously over the survey period from Position M, as indicated in Figure 13P282/1.

The microphone was fixed 4.2m above local site ground level on the north boundary, in a position unaffected by façade reflection. Ground level north of the position was 2.3m below the microphone. The microphone had a full and uninterrupted view of the nearest railway and an open view of Iverson Road.

Sound pressure level parameters measured and reported are Lmax, Leq and L90. More detailed parameters were measured, but are not reported for clarity. All parameters were measured in linear and A-weighted modes and with Fast and Slow time weightings. Frequency spectra were measured in octave bands, but are not reported.

A second fixed monitoring position was not considered viable due to security concerns.

Weather Conditions

Weather conditions during the survey period were erratic. Forecast conditions were for light rain at the start of the survey and dry periods and minor rainfall thereafter till the following week. Wind speeds were predicted as low till the following week.

Actual weather resulted in heavy rainfall at times, winds above normal limitations at times and persistently damp conditions with wet roads and tracks.

Similarly, the surveyor only returned to site after delay on 6 November following rainfall on 4 and 5 November. The weather forecast was for a dry morning and afternoon, with rain beginning in the mid afternoon. Actual weather was heavy showers before arrival in the morning and persistent showers thereafter.

In normal circumstances, the survey would have been aborted in full, but time constraints did not permit a repeat survey before planning application submission.

The results of measurements at Position M are presented here for the period up till 3 November 2013. No adjustment has been made to the results for weather conditions.

Uncertainty is expected to be high, although the effect will tend to be to report higher noise levels than actually exist during normal, compliant conditions.

The earlier periods are more representative (30 October to 1 November).

Some evening and night-time fireworks will have affected results at times. Some of these are clear from the time history results, but no adjustment is made under current conditions.

The results are considered to be a worst-case representation of the noise climate and are addressed as such below.

Manual Measurement

The site was attended during 30th October and 6th November 2013.

As discussed above, it was not feasible to measure on the selected day (6/11/13) at the selected sample positions on Iverson Road and the northern boundary. Weather conditions were far from suitable.

No noise emissions were noted from the warehouse / depot buildings to the west.

No construction site noise was noted from the open site to the east (163 Iverson Road).

Road traffic noise was observed to be relatively low with light to moderate traffic moving sporadically past the site. Most vehicles were light; cars and small goods vehicles. A few medium goods vehicles passed. No large goods vehicles were noted. Some public service vehicles were noted including taxis and smaller buses.

Equipment & Calibration

The measurement equipment used was as follows:

Reference	Type	**S/N**	**Manufacturer**	**Description**
GRAS01				Environmental microphone
NOR118	118	31349	Norsonic	Integrating-averaging sound level meter
NREV	NorReview 4.0.102	-	Norsonic	Data analysis & reporting software
NXFR	NorXfer 4.6.0.5	-	Norsonic	Data transfer software

Table 2 – Survey Equipment

All sound level meters are precision grade and have current, traceable calibration certificates, which are available on request.

Results

The results of the environmental noise survey are detailed in Appendix C for each of the measurement positions.

Continuous Monitoring

The planning process requires demonstration of the noise exposure of an application site for residential development, based on three periods. The typical noise exposure level is defined as the mean of the continuous equivalent sound pressure level ($L_{Aeq,T}$) where the period T is each successive day, evening or night.

There is also a requirement to consider the background noise level (LA90), where this may be affected by fixed mechanical equipment or building services noise.

Appendix C.1 reports the results of the continuous measurements at Position M for the primary parameters: $L_{Aeq,T}$, $L_{Amax(FAST)}$, L_{A90}.

Appendix C.2 reports the analysis of the measured data, including the average noise exposure calculations for each day and over the whole survey period.

Appendix C.3 reports the analysis of the data for the measured and calculated maximum noise level results, including comparison to night-time results.

Analysis

The basic noise exposure analysis of the results are presented in Appendix C.4 including the assessment of:-

- daily and average noise exposure levels
- minimum background noise levels for day, evening and night

Noise Climate

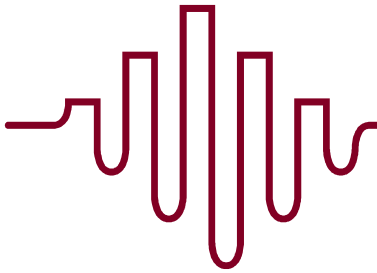
The environmental noise climate is determined by regular and frequent railway traffic and by road traffic on Iverson Road to a degree. Some contribution from sporadic works by Iverson Tyres was noted.

Further contribution from the surrounding area was audible, including from the B510 west End Lane and, distantly, from other railways to the south.

Building services equipment operating in the service yard of Iverson Tyres was an audible source on Iverson Road, but not beyond 10-15m. Some activity noise within the tyre workshop was audible at times, but was not obtrusive.

Commercial servicing by goods vehicles is not a significant a source of noise. All goods vehicles seen were small and medium vehicles.

With the exception of the railway, noise exposure is not subjectively obtrusive, in general, with road speeds remaining relatively low and most larger vehicles not approaching the nearest



boundaries directly. The pavement and parking on the north edge of Iverson Road form an effective buffer space between the site and the loudest vehicles, limiting direct exposure to noise.

The pattern of movement on Iverson Road is of moderate flow and sporadic, possibly with some cyclical elements due to local traffic management at and near the West End Lane junction.

The railway is relatively busy and is now understood to be operating fully following a long period of restricted activity due to engineering works and re-development of Thameslink.

The nearest tracks are understood to operate as one relief line and one management siding. Occasional trains are expected on these nearest tracks as demand requires. The through movements of trains on the relief track are expected to be few, based on previous investigations, and are likely to occur only during busy periods.

Freight is known to use all of the tracks north of the site, however, the general traffic is light in comparison to many lines. One freight train was noted on the far "Up" track (London-bound) during 30 October visit, but was not clearly audible. It is understood other routes through the Hampstead and Kilburn area can be expected to bear most of the freight traffic needs.

Background Noise Levels & Limits

The underlying background noise levels remain relatively high with the typical night-time minima being L_{90} 40dB(A). There is pre-existing building services noise audible at the site, which is normal for an urban environment.

Daytime and evening background noise is generally much higher in the core of the day, although the start and end of the full daytime period is similar. Typical minimum background noise levels over the eight days were:

Time	Min LA90,1h	
Day-Evening-Night 24-hour	33.3	dB(A)
Daytime 07:00-23:00	40.6	dB(A)
Daytime 07:00-19:00	40.6	dB(A)
Evening 19:00-23:00	41.5	
Night-time 23:00-07:00	33.3	

Table 3 – Minimum Background Noise Level

NB: the night-time minimum is abnormally low for the area. There is some indication engineering works or emergency railway works may have affected ambient noise levels on 1 November. This is being investigated. The minimum for other nights is LA90 38dB.

The above would imply the maximum background noise level criteria due to all sources of mechanical equipment noise at 1m from the nearest residential windows would be as follows:

Time	Min LA90,1h	
Day-Evening-Night 24-hour	28	dB(A)
Daytime 07:00-23:00	36	dB(A)
Daytime 07:00-19:00	36	dB(A)
Evening 19:00-23:00	37	dB(A)
Night-time 23:00-07:00	28	dB(A)

Table 4 – Mechanical Equipment Noise Limits

These are 5dB(A) below background noise level to ensure the LB Camden criterion is achieved.

A further 5dB(A) penalty may need to be applied in the event of acoustic features, particularly intermittency or tonal or tone-like content, as described in Appendix E.

Moderation of the above noise limits may be feasible for certain days, if operation does not occur at weekends, for example.

Ambient Noise Levels & Exposure

The ambient noise levels are moderate and normal for the central urban environment, located away from major transportation routes. These results are reported in Appendix C.

The highest noise exposure of the site would be as follows for the north boundary (Position M).

- Daytime 07.00-23.00 hours Leq,16 hours 60.5 dB(A) free-field
- Daytime 07.00-19.00hours Leq,12 hours 60.6 dB(A) free-field
- Evening 19.00-23.00 hours Leq,4 hours 60.2 dB(A) free-field
- Night-time 23.00-07.00 hours Leq,8 hours 53.3 dB(A) free-field

These are representative of noise levels for the most exposed position facing the railway.

Noise exposure is generally quieter than the above across the remainder of the site till close to Iverson Road.

As previously discussed, the above represent a worst-case due to the effects of precipitation on noise from road surfaces, particularly, and railways and of wind on measurement accuracy.

Based on previous measurement on Iverson Road and at similar locations, the expected daytime road traffic noise level may be in the range LAeq,16h 60-65dB. As the basis for design the following levels are assumed at the southern boundary within 2m of the carriageway edge:-

- Daytime 07.00-23.00 hours — Leq,16 hours 60-65 dB(A) free-field
- Daytime 07.00-19.00hours — Leq,12 hours 65 dB(A) free-field
- Evening 19.00-23.00 hours — Leq,4 hours 60 dB(A) free-field
- Night-time 23.00-07.00 hours — Leq,8 hours 55 dB(A) free-field

Maximum Noise Levels

Consideration should be given to the A-weighted maximum sound pressure levels at night. These characterize the effects of individual noise events, such as car movements. Advice has considered Fast time-weighted results to represent Human reaction as a worst case. The parameter is referred to as $L_{Amax,FAST}$.

Under PPG 24 guidance (based on extensive research into the reaction of people to such events), if the $L_{Amax,SLOW}$ exceeded 82dB several times in any night-time hour then the night-time noise exposure was deemed to be loud enough to require specific mitigation of the noise in design. Similar guidance is given in current guidance, including WHO 2000 and BS8233:1999.

The results are reported in Appendix C.2 for the continuous monitoring LAmax,FAST and show few night-time exceedance of the 82dB limits for most nights and no period where an excess occurs more than twice in an hour.

Event noise levels at night are likely to be highest at the northern boundary, where no regular exceedance of 82dB(A) is expected.

The total period where LAmax,FAST exceeds 82dB(A) is, at most, 1 ½ minutes in any night-time period. Annoyance due to individual noise events is expected to be reasonable with or without open windows.

In general, sleep disturbance; the critical issue at night; tends to correlate with LAmax,FAST, which describes a quicker “reaction time” of the measurement equipment. Consequently, Fast time-weighted levels tend to be higher for clear noise events.

Appendix C.3 shows the LAmax,FAST results also. These are much higher during the day than at night, which is expected to be due to the nature of train and car movements in the vicinity of the site.

Typical night-time maximum noise levels at Position M are LAmax,FAST 55-64dB(A), which represents the loudest 5% of events but excludes the loudest 1%.

Night-time maxima remain critical to the design, but the number of potentially disruptive events is relatively low and the levels measured are relatively low.

The maximum noise levels at the southern boundary are expected to be up to 10dB(A) higher than the night-time ambient noise level, typically. For the purposes of design, the maximum noise level there is taken to be LAmax,FAST 65dB.

Other Noise Sources

No other significant noise sources were noted.

All servicing vehicles and commercial activity are included within the measurements and no data has been excluded for reasons of weather, extraneous peaks or otherwise.

Implications of Assessment

The Position M results reflect the noise levels expected at the residential facades well. These facades are elevated from the roadside and railway by a significant separation. Such separation allows the most obtrusive noise to be attenuated.

The Position M results are taken to represent the north elevation with a 3dB correction for uncertainty. The southern elevation shall be represented by the assumed day, evening and night-time noise levels with a -3dB correction for vertical separation and 3dB correction for uncertainty.

The flank-elevation noise exposure shall be determined by calculation, but is expected to be 3-5dB less than the north and/or south elevations. The roof is expected to experience noise exposure at least 10dB below the highest noise levels elsewhere.

LB Camden Assessment

The following table provides the general assessment of site noise exposure against the criteria for planning policy DP28:-

Window	**Daytime Leq,12h 07.00-19.00 h**			**Evening Leq,4h 07.00-19.00 h**			**Night-time Leq,8h 23.00-07.00 h**		
Elevation:	**North**	**South**	**Roof**	**North**	**South**	**Roof**	**West**	**South**	
Source Noise Level	61	65	65	60	60	60	53	55	55
Uncertainty	+3	+3	+3	+3	+3	+3	+3	+3	+3
Separation	0	-3	-10	0	-3	-10	0	-3	-10
Facade	+3	+3	+3	+3	+3	+3	+3	+3	+3
Façade Noise Level	67	68	61	66	63	56	59	58	51
Table A Limit	74	72	72	74	72	72	66	66	66
Status	**Achieved**			**Achieved**			**Achieved**		
Table B Limit	65	62	62	60	57	57	55	52	52
Status	*+2dB*	*+6dB*	*Achieved*	*+6dB*	*+6dB*	*Achieved*	*+4dB*	+6dB	*Achieved*
Outcome	*Additional attenuation required for elevations*			*Additional attenuation required for elevations*			*Additional attenuation required for elevations*		

Table 5 – Review of Noise Exposure to LB Camden DP28 Requirements

Additional attenuation is expected to be required for the building envelope elevations. The roof is sufficient separate that sound insulation over and above the normal construction performance is not expected to be necessary.

Further assessment is required.

Noise Criteria Inside

The primary noise criteria are discussed under the Planning Policy section and are reiterated below and shall apply inside residential property:-

Significant OAEL	LAeq,T 45dB(A) daytime	LAeq,T 35dB(A) night-time
Lowest OAEL	LAeq,T 35dB(A) daytime	LAeq,T 30dB(A) night-time
No Observed Effect Level	LAeq,T <=35dB(A) daytime	LAeq,T <=30dB(A) night-time

Sleep and rest conditions appropriate to the time of the day for the majority of the population are the "effect" addressed during the night and with communication and intelligibility the main effects during the day.

In addition, no observed effect will occur at night during sleep for typical levels of individual event noise of LAmax,FAST 45dB(A), where this level is not exceeded for more than 10% of the night-time events, to minimise sleep disturbance. The effect in this case is the slight changes to sleep pattern without full awakening that may occur and their possible adverse effect on health.

On the north elevation, where railway noise determines the noise climate LAmax,FAST 45dB(A) should not be exceeded for more than 5% of the night-time events, due to the regular and similar nature of the train movements.

These represent a reasonable range of conditions to ensure the building design remains practical and sustainable.

Demonstration of Feasibility

Based on the general assessment methods of BS8233:1999, the sound level difference from outside to inside is expected to be as follows:

- Open Window -15dB(A)
- Closed Thermal Double Glazed Window -25dB(A)
- Closed High Mass Window -30dB(A)

The implied internal noise levels during the day and night are as follows:

Window	**Daytime Leq,16h 07.00-23.00 h**			**Night-time Leq,8h 23.00-07.00 h**		
Site:	**North**	**South**	**Roof**	**North**	**South**	**Roof**
Elevation Noise Level	67	68	61	59	58	51
Open	52	53	46	44	43	36

Closed Thermal	42	43	36	34	33	26
Closed High Mass	37	38	31	29	28	21
Key	*Not feasible*	*Not feasible*	*Feasible*			
	Excluded	*Potential for Improvement*	*Included*			

Table 4 – Feasibility of Basic Design Period Noise Levels

The noise levels of individual events at night are taken to be Lmax,FAST 67-68dB(A) at both main elevations and with a -10B correction for the noise levels affecting the roof.

The implied internal noise levels during the day and night are as follows:

Window	***Night-time Lmax,FAST***		
Site:	***North***	***South***	***Roof***
Source Noise Level	*67*	*68*	*58*
Open	*52*	*53*	*43*
Closed Thermal	*42*	*43*	*33*
Closed High Mass	*37*	*38*	*28*
Key	*Not feasible*	*Not feasible*	*Feasible*
	Excluded	*Potential for Improvement*	*Included*

Table 5 – Feasibility of Basic Design Individual Event Noise Levels

The provision of a building with open windows as the sole means of ventilation is not feasible, as the future residents would have no means of respite during the noisiest periods in moderate or high noise exposure areas.

For most circumstances, the use of windows equivalent in sound insulation to standard thermal double glazing would provide an adequate basis for noise control. Closed High Mass double or triple glazed windows would be required on the most-affected, loudest facades or where large areas of glazing or curtain walling are needed.

Some amelioration of requirements will occur with height, but the benefits are likely to be limited and may allow only the east and west elevations to achieve a greater proportion of natural ventilation.

The control of individual event noise at night to bedrooms is expected to require such Closed High Mass double or triple glazed windows where the bedroom overlooks the railway and Iverson Road.

Again, higher areas of glazing / curtain walling would require higher, relative sound insulation performance.

The above would constrain the use of openable windows as the sole means of ventilation and is likely to preclude natural ventilation without an effective alternative.

Other means of ventilation will be required to provide future residents with an effective means of noise control during the noisiest periods, whilst maintaining appropriate fresh air and extract air provision. The options for such treatment may include high free area attenuated openings or acoustic louvres, direct mechanical room ventilators or whole-dwelling mechanical ventilators. All will require a specific attenuation performance with the latter the most straightforward for including noise control.

The current design allows for whole-flat balanced ventilation and heat recovery systems, which will be sufficient to meet the acoustic requirements provided there are no window trickle ventilators or additional unducted wall ventilation openings to outside.

Within the constraints of a modern building design, the effective control of noise intrusion is feasible during both the day and night; provided the design allows future residents to control noise ingress effectively in the most exposed areas. To achieve such a goal would require sealed thermal double glazing of high quality and high mass in conjunction with an alternative means of ventilation to openable windows or unattenuated natural ventilation.

Development & Detailed Design

Detailed design will be required both to demonstrate the effectiveness of the sound insulation scheme and to optimise the use of high performance windows, non-vision areas and ventilators.

Such full design measures are not included for assessment at this stage.

Detailed calculations would be completed at design stage to determine the performance of all elements of the building envelope.

To illustrate the implications of such calculations, reference shall be made to Appendix D. Worst case sound transmission calculations are included as calculations 13P282 C1 and C2 for the North and South Elevations of the application site, respectively.

Calculation 13P282 C1 shows that the proposed elevation design allows the reasonable to good internal noise levels to be achieved on the North Elevation, as a worst case, with relatively standard construction and dimensions. With the provision of a high standard of window / external door, a “Good” standard [ref:BS8233:1999] is achievable in Bedrooms at night and all Significant Observed Adverse Effects are avoided under the NPPF / NPSE requirements.

Calculation 13P282 C2 shows that the proposed elevation design allows the reasonable to good internal noise levels to be achieved on the South Elevation, as a worst case, with relatively standard construction and dimensions. With the provision of a high standard of window / external door for both Bedrooms and Living Rooms, a “Good” standard [ref:BS8233:1999] is achievable in Bedrooms at night and Living Rooms during the day. All Significant Observed Adverse Effects are avoided under the NPPF / NPSE requirements.

The scheme allows for nominal acoustic ventilators, i.e. windows closed and alternative mechanical ventilation system with the exclusion of direct ventilation grilles and vents to outside.

It is recognised, though, that there are marked variations between different rooms and elevations. There are also variations in incident noise conditions, such as the degree of

screening afforded by balconies. The results of this calculation provide no significant margin against these variations, although a basic degree of Uncertainty has been applied against changes in source noise level.

The results achieve the required noise targets, with a small margin for design and construction variation.

The use of higher mass thermal double or triple glazed systems would be advisable for inclusion as a general allowance at this stage. The sound insulation performance target is Rw37-40dB for windows and external doors on the North and South elevations and flank elevations. Some degree of reduction may be feasible for Living Rooms on the North elevations, where Rw 33-37dB windows / external doors may suffice.

NB: Rw = Weighted Sound Reduction Index; a laboratory-tested performance of the complete window / door system including frames, seals, glass units and other components but not the adjoining walls. Glass performance alone is not an approved means of selection.

The higher performance windows are expected to comprise glazing units with at least one 10mm or similar mass pane and one 6mm or similar mass pane. The use of laminated panes and/or gas-filled cavities is presumed, as these tend to minimise the need for deep glazing modules. A high quality unit, including frames, seals and other components, may achieve the performance more easily. Medium quality build is likely to result in a requirement to increase glazing module depth and the number of panes / laminated layers.

Walls and other non-vision components of the building envelope shall achieve a minimum Weighted Sound Reduction Index of Rw 45dB. A composite, framed, lightweight wall panel may achieve this with sufficient mass (e.g. 20kg/sq.m either side of frame) boards on inside and outside, with non-rigid, part-fill insulation and a cavity of approximately 250mm.

Traditional masonry or insulated concrete construction is expected to achieve at least the performance level and, potentially, far exceed it.

The roof shall have a similar sound insulation performance and a minimum Rw 40dB performance is recommended. In addition, the provision of a high-mass or green roof system is likely to preclude the need for additional rain noise protection. The aim should be to achieve a mass of 150kg/sq.m or provide addition sound insulation to the roof surface and soffit to protect against rain impact noise.

On the basis such measures are included then it is expected the rooms will achieve the local and national planning policy requirements, with internal noise being below the Lowest Observed Adverse Effect Level in most cases. The proposed scheme is expected to avoid Significant Observed Adverse Effects.

No Effect Level is the most common condition with a “Good” standard of internal noise.

Both calculations are confirmation that openable windows are unlikely to be an effective means of ventilation. Any alternative ventilation system whether natural or of balanced mechanical ventilation must achieve a minimum sound insulation performance as well as meeting ventilation requirements of The Building Regulations and The Code for Sustainable Homes.

Some moderation of the requirement may be possible for the other elevations.

Detailed design development is required to optimise the sound insulation performance of the building envelope and ensure the cost-effective use of different wall, window and ventilation systems. This is particularly due to the significant variations in noise exposure expected around the buildings and with height.

Design Measures Included

The design aims to maximise separation between the noisiest sections of road and railway and the residential facades.

With noise sources on both sides of the building being of similar level, fewer options exist for changing location and outlook. The general layout places most bedroom windows on the North, West and East elevations, as well as inner elevations.

These are generally quieter or less obtrusive than the South elevation where road traffic noise is the main component of the noise climate at night.

It is deemed preferable to maintain bedrooms on the North elevation, where railway traffic is less annoying, quieter and less prolonged than road traffic. This enables the use of the Living Room frontages to remain active and more desirable spaces, as most domestic activity in these areas will not be adversely-affected or interrupted by outside noise.

A consistent standard of sound insulation is to be provided throughout the building and applied at a high quality.

All habitable spaces overlooking the noisiest routes, or with an oblique view of them, will require attenuated ventilation as an alternative to openable windows. The internal elevations may have a reduced requirement, but should be included in such a scheme. No direct ventilation openings (e.g. trickle vents) are to be provided and windows remain openable should residents require it.

The layout and orientation of the buildings is generally positive acoustically, with emphasis placed on protecting many of the most sensitive rooms from direct exposure to noise.

Noise From Commercial Uses

The proposed ground floor commercial B1 use is limited to one defined area.

Noise emissions due to activity is not expected to be an issue of concern as the use is self-contained within the building and there are limited ancillary areas, such as bin stores.

The basic airborne sound insulation between the commercial, including ancillary space, and the flats above should exceed the prevailing requirements of The Building Regulations by at least 5dB to provide for compatible neighbouring uses. The sound shall be incorporated in the property owner scheme and any operator shall add to this as required.

Where a noisy operator occupies the space, additional sound insulation may be required.

There are no specific proposals for operator at this time. It would not be practical, necessary, effective or sustainable to apply higher standards of sound insulation to address such unknown or atypical uses.

The degree of protection will extend beyond airborne sound insulation and include: impact protection of walls, columns and floors; noise-vibration control of mechanical, hydraulic and other equipment; noise-vibration control of doors and motorised openings and lifts; sound absorption control in spaces.

There may be a need for control of open doors for noisy uses, but it is noted the buildings directly opposite the site are not residential. The residential buildings are offset to a degree and separated by the full width of Iverson Road.

In general, it is expected that any use generating a noise level of greater than LAeq,1h 70-75dB will require additional sound insulation to inside and outside. All uses will require additional acoustic treatment to some degree to protect from specific activities, such as impacts and mechanical equipment.

Building Services

Noise limits will remain a requirement for all building services equipment, with a typical limit being 5dB(A) below background noise level when assessed according to BS4142:1997 to enable the installation of other equipment outside the commercial use.

Further attenuation of 5dB(A) may be required where there are acoustic features, which may attract attention, within the definition of BS4142. The noise limits for building services equipment at 1m from the nearest current and future residential windows are stated previously.

The cumulative effect of noise shall be taken into account.

Mechanical Noise & Vibration

Any mechanical building services equipment serving the development shall have noise and vibration control equipment to limit:-

- Airborne noise to the reasonable target noise levels;
- Structure-borne noise to inaudibility where practicable; and
- Vibration to imperceptible magnitudes.

The means of achieving these objectives are within current design capabilities for control equipment for, say, building services equipment.

Noise limits on equipment are as previously stated.

Outside Amenity Areas

Private amenity areas are limited to balconies which the author considers to be spaces of elective use, where the exposure to noise is an accepted circumstance.

With effective use of balcony deck and balustrade screening noise exposure while seated can be expected to be approximately LAeq,≥1h+ 55dB on the most exposed elevations. Such levels would decrease as height above ground level increased with effective treatment of projecting soffits.

Given the presence of full and Juliet balconies on the nearby and adjacent residential buildings and the common use of balconies and terraces in urban development, the future occupants' expectations should be fulfilled by the moderate noise level.

The above noise level would not be expected to represent a Significant Observed Adverse Effect in the context of an elective space in an urban area.

The remaining open or communal amenity areas are effectively screened from direct exposure to railway and road traffic noise. Daytime noise levels are expected to be below LAeq,16h 55dB and may well be below LAeq,16h 50dB in the east ground level area adjacent to the residential entrance provided a retaining wall or solid fence are retained on the northern boundary and ground level remains below the top of the embankment, as at present.

Ground-borne Vibration

No perceptible vibration was noted on site due to railway traffic at ground level or when standing on retaining masonry wall in poor condition.

Train movements on two of the furthest four tracks were noted during the site visits, including one freight movement.

No movements occurred on the nearest relief track and siding.

There is a moderate expectation of ground-borne vibration from railway movement sufficient to be perceptible in the completed building. Due to the nature of the building sub-structure proposed, it is recommended further detailed investigation is deferred until measurements can be made at pile locations in dedicated monitoring pits or on "temporary" piles.

The same approach was used for 163 Iverson Road and involves:-

1. Measurement of ground-borne vibration in accordance with BS6472 at commencement of enabling groundworks on site at two monitoring locations
2. Analysis and assessment of ground-borne vibration in accordance with BS6472 and LB Camden criteria to determine if perceptible vibration is acceptable in residential units at all floors.
3. Where assessment shows control of ground-borne vibration is required to comply with requirements of BS6472 and LB Camden criteria, develop a control scheme to include building isolation and separation of structure, fabric and services from ground. Submit report of vibration control scheme to LB Camden for review and approval.
4. Implement control scheme in full as agreed during construction.

Item 1 would need to take place on implementation or at least when enabling works on site allow the digging of test pits or setting of test piles.

Item 2 and 3 would need to occur at the earliest stage possible due to the cost and design implications of such control measures on structural and architectural requirements.

Item 4 would need to be an integral element of the construction process and not seen as an adjunct to it.

The above approach was previously agreed in principle to enable full operation of the railway and provision of suitable test areas on site. The latter remains the critical focus in this case, although there are indications the nearest tracks are not being used as fully as anticipated or advised during investigation of 163 Iverson Road.

The footprint of the proposed scheme is located over a low quality commercial building constructed in an entirely different manner to that proposed. To obtain accurate and representative results, vibration measurements should be made at the main structural bearing positions in full contact with the ground.

This is not practical currently without moving or disrupting an operating business.

It is recommended any planning permission include conditions to ensure the vibration survey and assessment are undertaken at an early stage for approval and that any required control scheme is approved and implemented.

Future Railway Noise

The above assessment includes current railway and road traffic noise levels.

The expectation for 15-20 year growth is not substantial, particularly as the Thameslink and Midlands Mainline rolling stock is modernised and road vehicle volumes are understood to be relatively static at present.

The expectation is of a worst-case increase in road traffic noise levels of LAeq 2dB(A) and in railway traffic noise levels of 1dB(A).

Maximum noise levels would not be expected to change to any measurable degree, although road vehicles will continue the trend towards quieter models and engines (e.g. higher proportion of electric cars.

A 2dB(A) change in the noise exposure used in the above assessment would be substantial, but the internal ambient noise climate would be expected to remain “Good” and no Significant Effects would arise.

Benefits to Neighbours

The proposed scheme provides a further barrier screening effect in conjunction with the consented scheme at 163 Iverson Road.

The latter scheme still allowed railway noise propagation at the western end of the site and limited the benefit attainable to existing flats further east.

The proposed scheme will effectively obscure line of sight to the railway for most if not all of the residents, in conjunction with the 163 Iverson Road scheme and the Network Rail signalling control building and other properties.

Whilst not a complete and continuous barrier, the effective noise reduction will be significant as the most open view of the railway, at the end of the embankment, will be obscured.

Overall, it is estimated that the nearest, existing residential properties on the south side of Iverson Road will benefit from reductions in train movement noise of approximately 10dB(A) from ground level up to around 8-10m above ground level. Reductions will decrease above that height, but wherever the view of the nearest mainline tracks is obscured at least 5dB reduction in train movement noise can be expected.

The greatest effect will be apparent for fast and freight trains using the relief track (the nearest track), where it is currently clearly visible as the embankment falls to the west.

Conclusions

Aulos Acoustics has completed an investigation of the environmental noise exposure expected at the application site of 159-161 Iverson Road, London.

Environmental Noise Survey

A noise survey was completed to determine the noise climate affecting the proposed residential properties. The application site is widely affected by railway noise due to its proximity to the Midland Mainline operating through West Hampstead Thameslink station. Both fast and stopping trains result in frequent railway movements.

The survey was affected by inconsistent weather conditions, including rain and wind. The results are considered to be higher than would otherwise be the case, although railway noise may not be so badly affected as road traffic noise.

As a result of the poor conditions, it was not possible to complete manual sample measurements around the site. Road traffic noise levels have been estimated on the basis of measurements at similar sites and taking into account published sources noise level progression for London.

The results have a degree of uncertainty greater than that normally expected for survey results. The contribution of the weather conditions to noise level is expected to be some 3dB (estimated).

It is recommended an environmental noise survey be repeated in more consistent conditions later to confirm noise levels and limit over-design of the building envelope sound insulation.

Noise Exposure Assessment

Noise exposure has been assessed against the LB Camden criteria of development policy *DP28. Noise and vibration* and the outcomes are as follows:

The noise exposure is insufficient to require refusal of the application on noise grounds as levels do not exceed the Table A threshold values of DP28.

The Table B threshold values describe the levels above which attenuation measures would be expected by the Council.

The noise exposure results indicate some attenuation is required to control noise exposure, although this is to a moderate degree.

Criteria

The criteria recommended in BS8233:1999 *Sound insulation and noise reduction for buildings- Code of practice* have also been taken into account, applying the reasonable design target range. The upper "Reasonable" boundary of the range may be considered as the onset of Significant Observed Adverse Effects, as described in the Noise Policy Statement for England, which is referenced in the NPPF.

The design approach shall avoid internal noise levels that are either too quiet or inconsistent within a property, to limit the adverse effects of low ambient noise levels, including increased intelligibility / audibility of neighbour noise, isolation from environment and perceptions of poor sound insulation.

Natural Ventilation Feasibility

A feasibility assessment has been undertaken to determine if openable windows and natural ventilation are suitable as the sole means of ventilation. It is concluded that an alternative means of full ventilation is required to provide an effective choice between open windows and noise intrusion. The exclusion of direct grilles and vents in walls, doors and windows is also confirmed as a requirement.

The current scheme would be expected to require moderate to high mass windows systems and a whole-flat balanced mechanical ventilation system.

Current Proposed Noise Mitigation

The design includes for reasonable measures to minimize noise exposure including:

- Application site for development is not immediately adjacent to busiest sections of mainline railway as two low impact tracks provide separation
- Large proportion of rooms on screened elevations or with a restricted view of the railway
- Provision of alternative ventilation system to openable windows
- Communal amenity area at low level where the effect of screening and topography are greatest and view of railhead is obscured
- Private amenity spaces are located away from railway or benefit from building screening in most instances
- Use of building and façade features to provide for localized screening and dispersion effect from facades

Further attenuation measures have been determined and recommended in the report. These include the following on the most exposed elevations:

- Specific provision for maintaining an alternative ventilation system to each habitable room to provide alternative to open windows, when desired by occupants
- Elimination of unattenuated background or trickle ventilation to each habitable room
- Provision for improved, medium performance window sound insulation

- Provision of increased airborne sound insulation for the B1 Use to provide substantive basis for future occupants
- Limits for building services noise emissions
- Optimise screening of balconies, rooftop amenity space and access by providing solid screen to perimeter 1.2-1.5m high to enable an obscured sound transfer path when seated, where applicable
- Provision for solid screening to north boundaries of ground level communal amenity space to optimize attenuation from railway

In general, medium attenuation (Rw 35-40dB) performance windows and ventilation system will be required for the most exposed habitable rooms. This equates to thermal double or triple glazing with heavier glass than is standard and a central ventilation system for each flat or house.

Future Noise Exposure

The future change in noise exposure levels would not be expected to alter the conclusions of the assessment or lead to Significant Observed Adverse Effects. The internal noise climate would remain “Good” with respect to BS8233:1999.

Ground-borne Vibration

The railway may not be operating fully at the nearest lines, but, critically, the site supports an operating business occupying the footprint of the proposed scheme.

The effect on noise exposure is expected to be small, but vibration exposure may be determined by these nearest lines.

Consequently, it is recommended provision is made within planning conditions, if permission is granted, for deferred survey, assessment and design of ground-borne vibration. The alternative approach was discussed and agreed with LB Camden for 163 Iverson Road consented scheme and adopted in the planning permission.

The approach to ground-borne vibration would include for:-

1. Measurement of ground-borne vibration in accordance with BS6472 at commencement of enabling groundworks on site at two monitoring locations
2. Analysis and assessment of ground-borne vibration in accordance with BS6472 and LB Camden criteria to determine if perceptible vibration is acceptable in residential units at all floors.
3. Where assessment shows control of ground-borne vibration is required to comply with requirements of BS6472 and LB Camden criteria, develop a control scheme to include building isolation and separation of structure, fabric and services from ground. Submit report of vibration control scheme to LB Camden for review and approval.
1. Implement control scheme in full as agreed during construction.

It is critical such an approach begins as soon as test sites can be prepared.

Benefits to Neighbours

Exposure to railway noise would be reduced at the houses and flats on the south side of Iverson Road as the building acts as a significant screen and completes the barrier effect of 163 Iverson Road and the Network Rail facilities.

The effect of maximum noise levels of individual train movements would be clearly and noticeably improved.

Such improvements to the noise climate of existing residents are expected to be substantial and noticeable and are strongly encouraged under local, regional and national planning policy and ambient noise policy and strategy.

Outcome

The proposed scheme would ensure future residential amenity would be optimised.

The internal noise climate would avoid Significant Observed Adverse Effects and would be expected to result in “Good” standard of acoustic comfort in most cases.

The proposal includes several design measures and key aspects, such as window sound insulation and the provision of mechanical ventilation, have been confirmed.

Criteria and noise limits for noise emissions have been confirmed.

The approach to ground-borne vibration has been considered and the approach adopted on the adjacent consented scheme is recommended.

The benefits of the property are primarily in the completion of the barrier effect between the railway and existing flats to the south and south-east of the site. These are expected to result in substantial and noticeable improvements to train movement noise levels.

The proposed development and design is capable of achieving a reasonable internal and external noise climate for future residents with moderate attenuation provided. There is expected to be material benefit to the existing residents as noise exposure to railway noise is reduced noticeably.

James Tomalin MIOA

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Term	Description	
Sound	Physical oscillation of air or other material which is normally detected by the ear as a complex, time-varying and detailed description of the environment around the listener. Interpretation and subjective filtering of sound by the brain results in comprehension, emotional response and physical reactions to sound. Sound can also be detected by touch when transmitted in a solid medium and be perceived as motion at very low frequencies (i.e. vibration).	
Noise	Generally defined as unwanted sound, which as a highly subjective description is subject to wide interpretation. Some describe noise as harsh or dissonant conditions, but such descriptions tend to be value-based and will vary from person to person.	
Ambient Noise	The noise climate heard over a period of time due to all normal sources, in the absence of extraneous or atypical sounds. Used to describe noise in the absence of the introduced sound, generally.	
Ambient Noise Level	Describes the average noise level of the ambient noise over a stated period of time, e.g. hourly noise	
	Parameter: A-weighted Continuous Equivalent Sound Pressure Level determined over the time period T. Expressed in decibels / A-weighted decibels	$L_{eq,T}$ or $L_{Aeq,T}$ dB(A) or dB
Note:	Used in the reports generically to represent both current noise climate and noise level of vehicle noise to encourage direct comparison	
Leq,T	the notionally-steady sound level having the same acoustic energy as the time varying sound pressure level over the same period	
Background Noise	The underlying noise climate in the absence of an introduced or extraneous noise. Describes the quieter periods in the noise climate.	
Background Noise Level	Describes the “average minimum” level of the background noise climate over a stated period of time	
	Parameter: A-weighted Statistical Index 90% Sound Pressure. The quietest decile of the sound pressure levels or level exceeded for 90% of the time period, T Expressed in decibels / A-weighted decibels	$L_{90,T}$ or $L_{A90,T}$ dB(A) or dB
Acoustic screening	Physical barrier to sound formed by fence, wall, building or other structure, which has the effect of reducing the sound transmitted.	
Individual Event Noise	The noise of a distinctive event with the varying noise climate, usually a transient activity, such as a vehicle pass-by, aircraft flyover or similar, rather than an isolated impulsive noise.	
Event Noise Level	Highest noise level during the event as measured under particular conditions of time-weighting	
	Parameter: A-weighted Maximum Sound Pressure Level with FAST or SLOW time weighting Expressed in decibels / A-weighted decibels	$L_{Amax,FAST}$ or $L_{Amax,F}$ $L_{Amax,SLOW}$ or $L_{Amax,S}$ dB(A) or dB
Event Frequency	The number of times an individual event of a similar type occurs in the time period under consideration. Important descriptor as the impact of Individual Event Noise is dependent on changes in both level and event frequency.	
Time Weighting	The sampling rate at which a sound level meter measures the time-varying sound pressure level: originally described how fast the needle moved on analogue meters. Ensures the measurements respond to the type of noise source accurately and are representative. FAST = 125ms sampling rate = 480 samples / minute SLOW = 1s sampling rate = 60 samples / minute	

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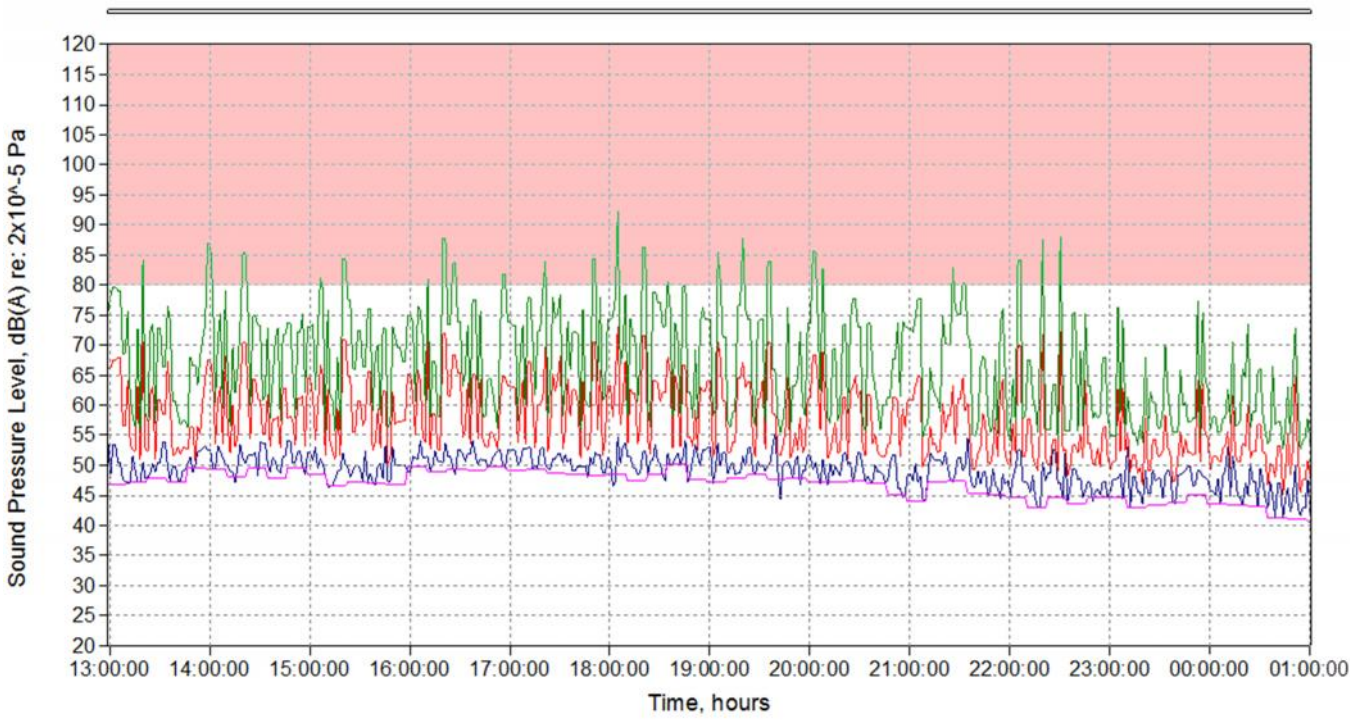
	LA90, 15min
	LA90,1 min
	Highest LAmax,FAST 1 min
	LAeq, 1 min

30 October 2013 PM



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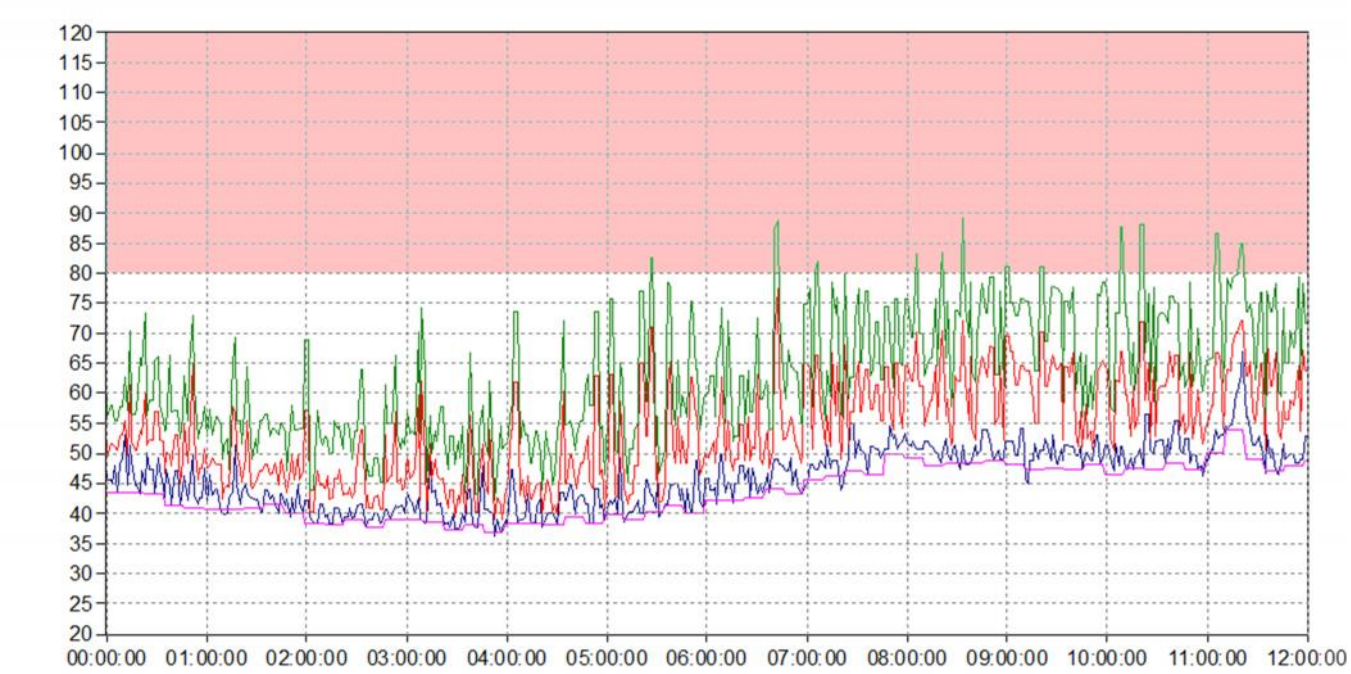

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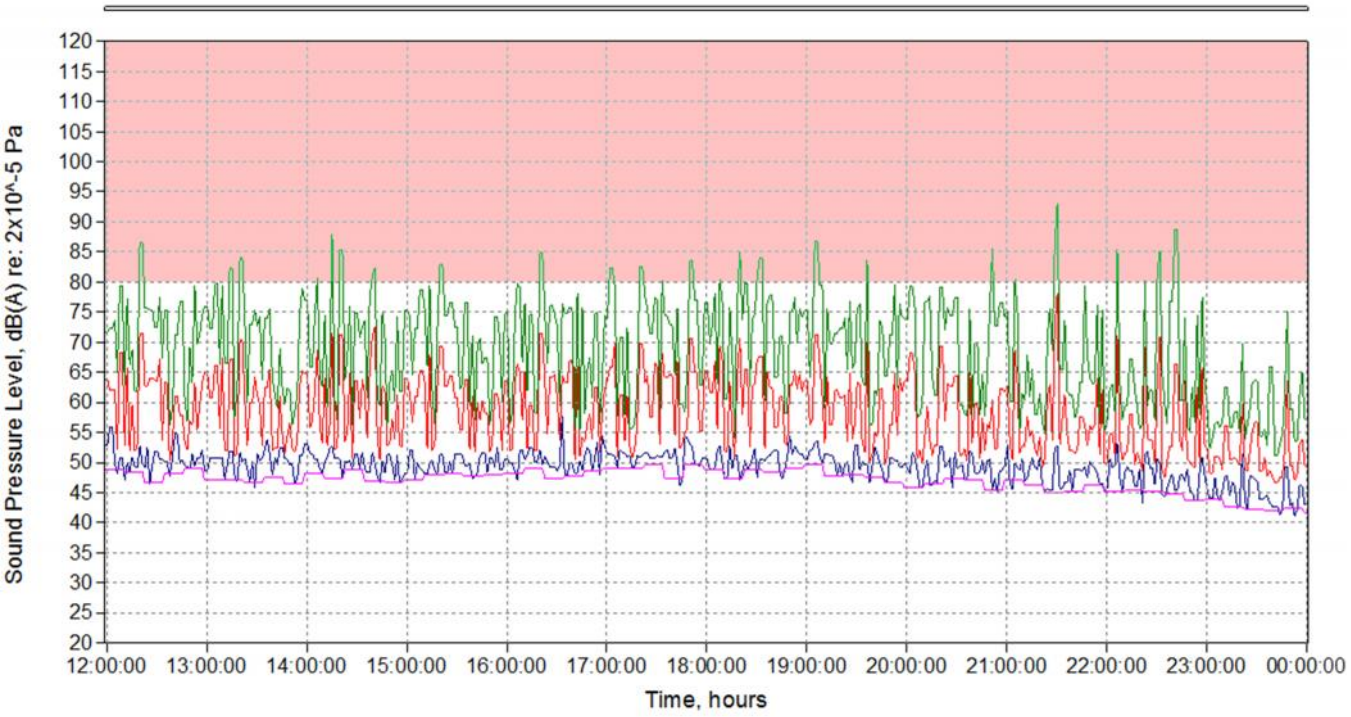

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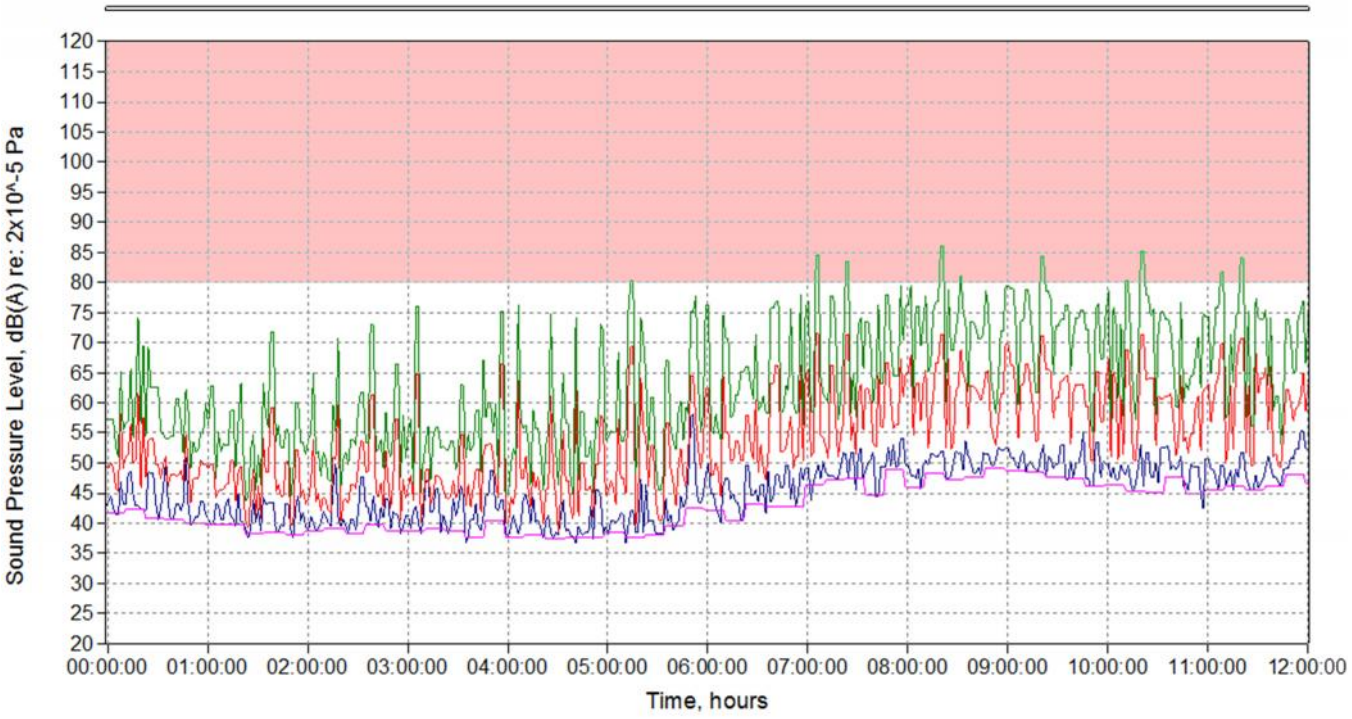

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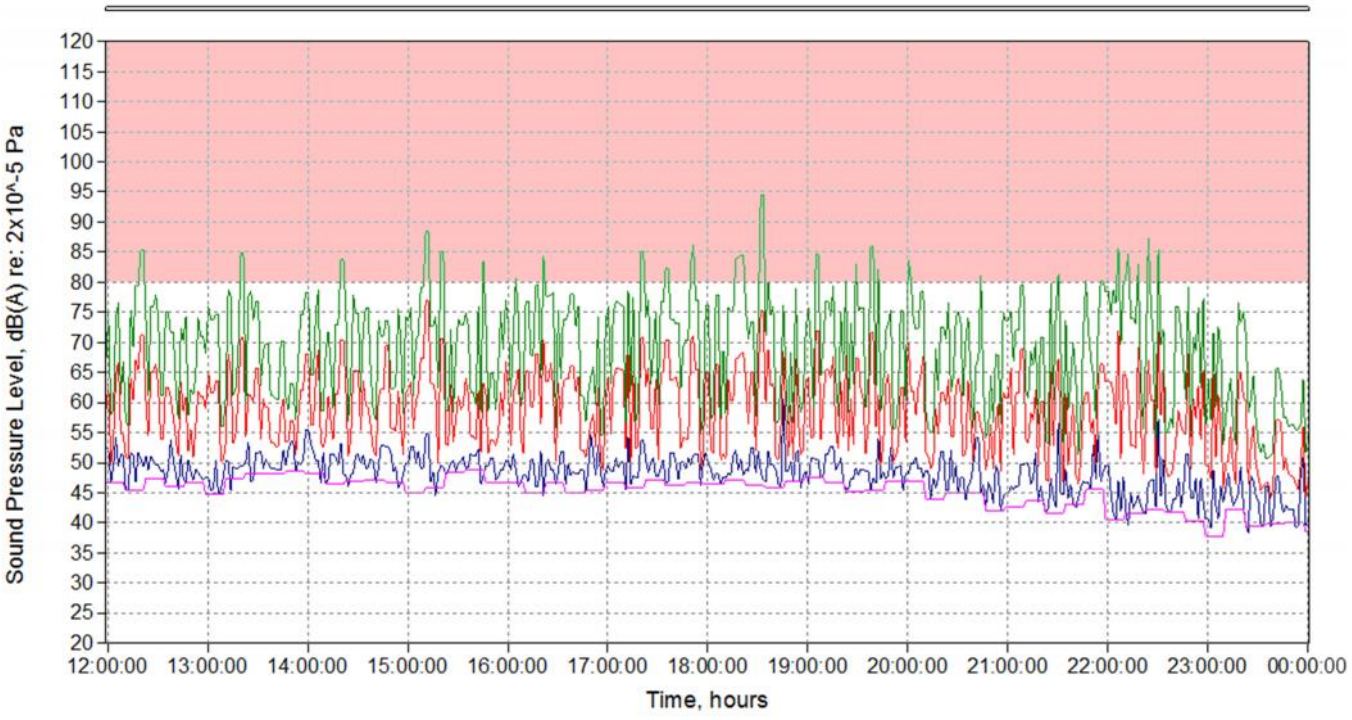

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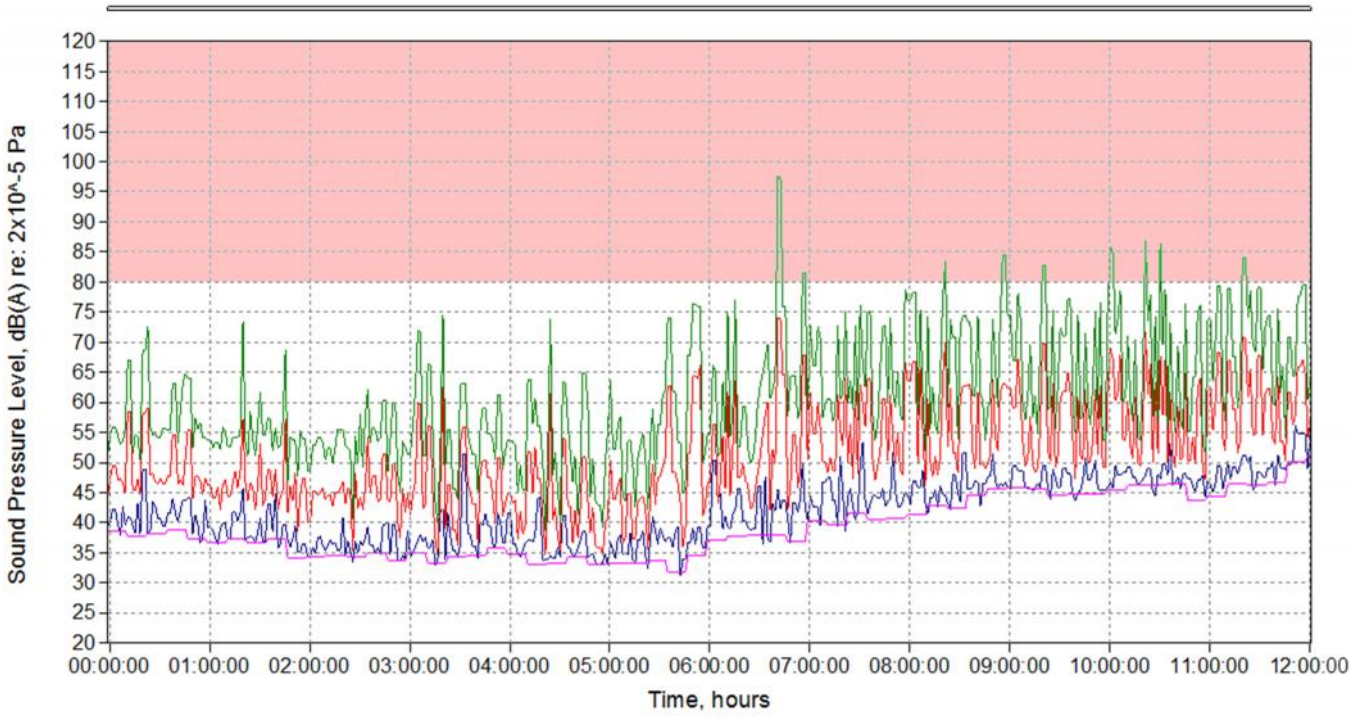

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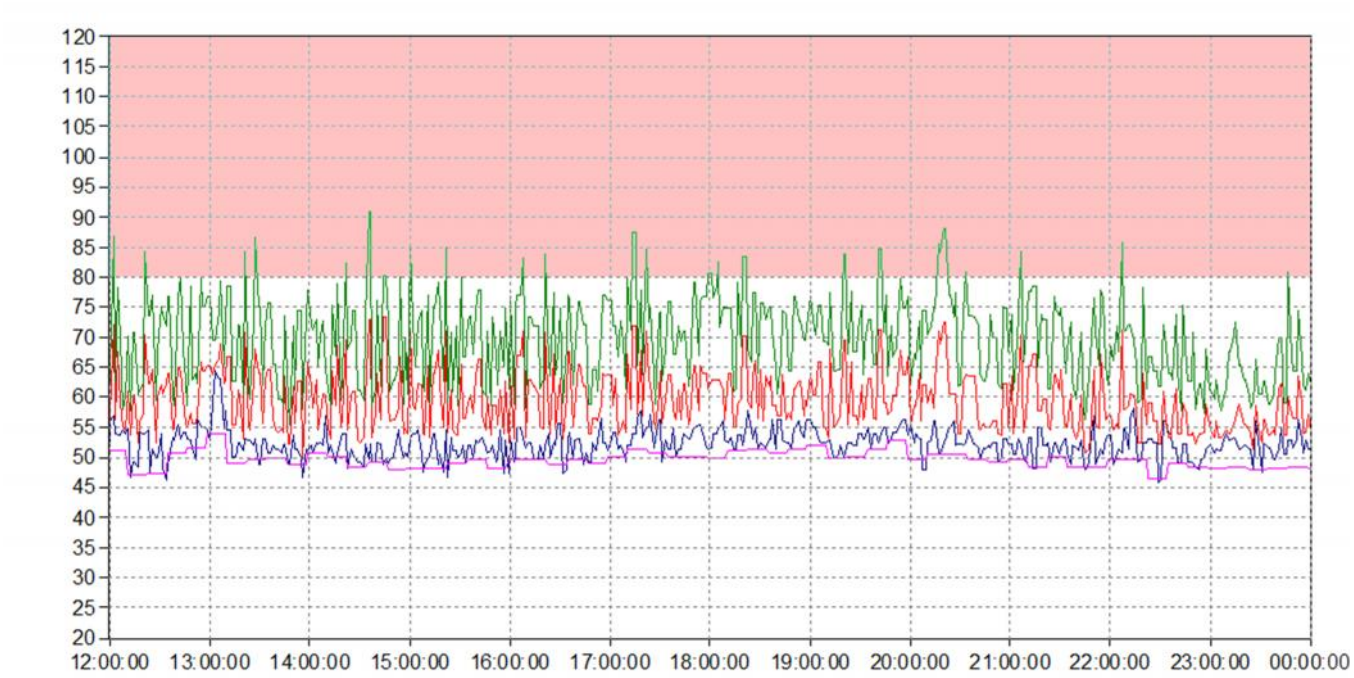
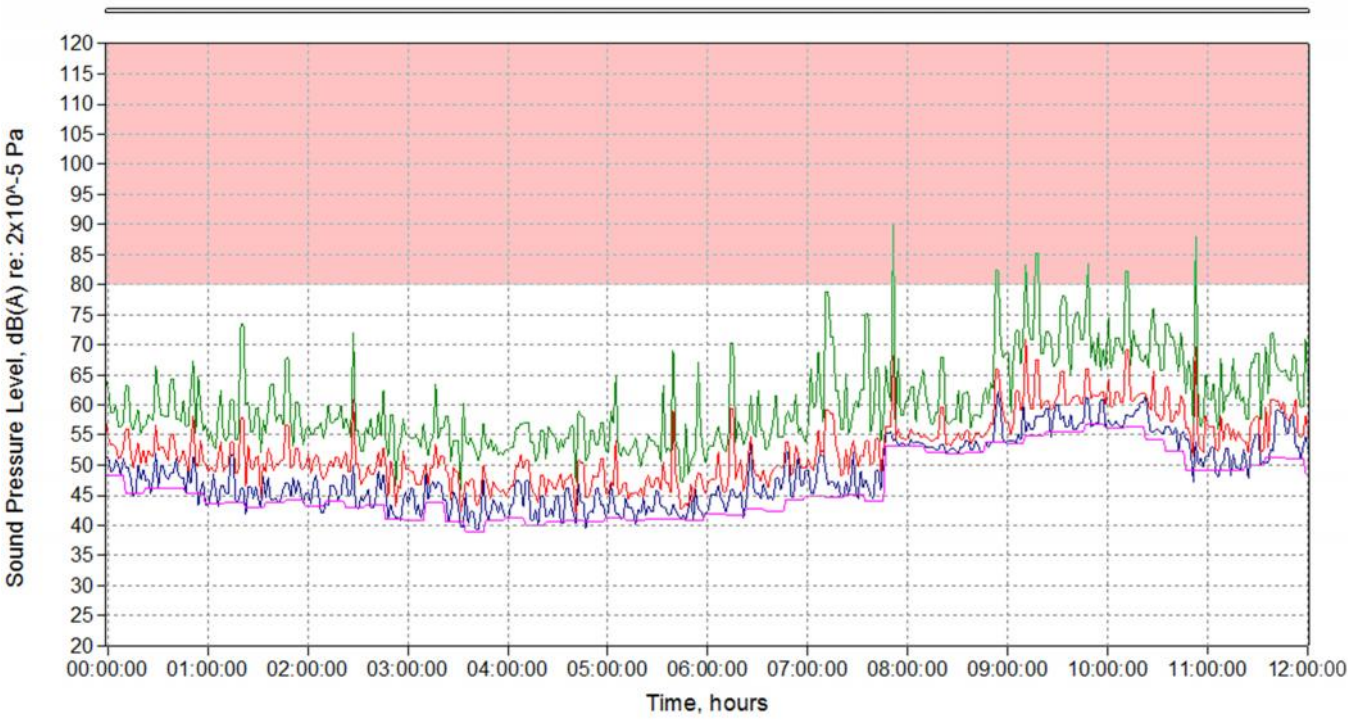


03 November 2013 AM



Appendix C.2 – Position M Period Analysis

Date	Period	Duration	LAeq	LA10	LA50	LA90	LAFmax	
30/10/2013	00:00-00:00	10:17:30	60	58	52	47	96	12:49:43
31/10/2013	00:00-00:00	24:00	60	58	50	42	93	21:31:28
01/11/2013	00:00-00:00	24:00	60	58	49	41	95	18:32:58
02/11/2013	00:00-00:00	24:00	59	58	51	38	98	06:42:28
03/11/2013	00:00-00:00	24:00	56	59	51	43	90	07:52:13
30/10/2013	07:00-19:00	05:17:30	61	58	52	48	96	12:49:43
31/10/2013	07:00-19:00	12:00	61	61	52	48	89	08:33:58
01/11/2013	07:00-19:00	12:00	61	59	52	47	95	18:32:58
02/11/2013	07:00-19:00	12:00	61	60	52	46	91	14:36:43
03/11/2013	07:00-19:00	12:00	59	61	55	49	90	07:52:13
30/10/2013	07:00-19:00	09:17:30	60	58	52	47	96	12:49:43
31/10/2013	07:00-19:00	16:00	61	60	52	47	93	21:31:28
01/11/2013	07:00-19:00	16:00	61	60	51	46	95	18:32:58
02/11/2013	07:00-19:00	16:00	61	60	53	47	91	14:36:43
03/11/2013	07:00-19:00	16:00	59	61	55	49	90	07:52:13
30/10/2013	07:00-19:00	04:00:00	59	57	51	46	88	22:31:43
31/10/2013	07:00-19:00	04:00:00	61	57	51	46	93	21:31:28
01/11/2013	07:00-19:00	04:00:00	61	60	49	43	87	22:25:13
02/11/2013	07:00-19:00	04:00:00	60	60	54	50	88	20:21:28
30/10/2013	07:00-19:00	08:00:00	55	53	44	39	89	06:42:58
31/10/2013	07:00-19:00	08:00:00	53	53	44	39	80	05:15:43
01/11/2013	07:00-19:00	08:00:00	53	51	41	35	98	06:42:28
02/11/2013	07:00-19:00	08:00:00	51	54	47	42	81	23:47:28

Position M – Period Averages

	Time	Period	LAeq	LA10	LA50	LA90
	00:00-00:00	24	58.9	58.2	50.4	41.2
	07:00-19:00	12	60.6	60.2	53.0	47.7
	07:00-23:00	16	60.5	60.1	52.9	47.5
	19:00-23:00	4	60.2	58.6	51.6	46.7
	23:00-07:00	8	53.3	52.7	44.8	39.3

Position M - Maximum Noise Level Analysis

Date	Period	Duration	LAmax		1%	5%	10%	50%	90%	Mean
30/10/2013	00:00-00:00	10:17:30	96	12:49:43	72.9	63.2	57.9	51.7	47.1	59.4
31/10/2013	00:00-00:00	24:00	93	21:31:28	73.1	62.6	58.0	50.5	41.9	59.8
01/11/2013	00:00-00:00	24:00	95	18:32:58	73.0	63.7	57.8	49.7	41.1	59.6
02/11/2013	00:00-00:00	24:00	98	06:42:28	72.4	62.3	58.5	51.1	37.8	58.9
03/11/2013	00:00-00:00	24:00	90	07:52:13	64.6	61.3	59.1	50.8	43.0	56.6
30/10/2013	07:00-19:00	05:17:30	96	12:49:43	72.8	65.9	58.9	52.4	48.4	59.9
31/10/2013	07:00-19:00	12:00	89	08:33:58	74.1	67.1	60.7	52.3	48.2	61.3
01/11/2013	07:00-19:00	12:00	95	18:32:58	73.9	66.8	59.7	51.6	46.9	60.9
02/11/2013	07:00-19:00	12:00	91	14:36:43	73.2	65.0	59.8	52.5	46.5	60.4
03/11/2013	07:00-19:00	12:00	90	07:52:13	67.1	62.5	61.4	55.1	49.4	59.3
30/10/2013	07:00-19:00	09:17:30	96	12:49:43	73.1	63.8	58.2	51.9	47.5	59.7
31/10/2013	07:00-19:00	16:00	93	21:31:28	74.1	65.9	60.1	52.0	47.6	61.0
01/11/2013	07:00-19:00	16:00	95	18:32:58	73.9	66.4	59.9	51.2	46.0	61.0
02/11/2013	07:00-19:00	16:00	91	14:36:43	73.2	64.6	59.9	53.1	47.1	60.4
03/11/2013	07:00-19:00	16:00	90	07:52:13	67.1	62.5	61.4	55.1	49.4	59.3
30/10/2013	07:00-19:00	04:00:00	88	22:31:43	73.3	61.3	56.9	51.0	45.9	59.3
31/10/2013	07:00-19:00	04:00:00	93	21:31:28	73.5	62.4	57.3	50.8	46.0	60.0
01/11/2013	07:00-19:00	04:00:00	87	22:25:13	74.5	65.8	60.2	49.8	43.5	61.3
02/11/2013	07:00-19:00	04:00:00	88	20:21:28	73.5	63.4	60.2	54.1	49.9	60.5
30/10/2013	07:00-19:00	08:00:00	89	06:42:58	63.2	55.4	52.8	44.5	39.3	55.7
31/10/2013	07:00-19:00	08:00:00	80	05:15:43	63.9	55.2	52.5	44.1	39.1	52.8
01/11/2013	07:00-19:00	08:00:00	98	06:42:28	63.6	54.3	50.9	41.1	34.7	51.4
02/11/2013	07:00-19:00	08:00:00	81	23:47:28	59.9	55.6	54.0	47.5	41.9	51.0

Position M – Maximum Lp Averages

Night-time					Nominal averages					
Position	Period	Duration	LAmax	Time max	1%	5%	10%	50%	90%	Mean
M	23:00-07:00	08:00	88.8	06:42:58	63.2	55.4	52.8	44.5	39.3	55.7

Number of Events LAmax >82dB at Night

Date	LAmax,F	LAmax,S	
30-Oct	0.3%	0.2%	
31-Oct	0.0%	0.0%	
01-Nov	0.1%	0.1%	
02-Nov	0.0%	0.0%	
Samples	6	4	
Sample period	00:00:15	00:00:15	hh:mm:ss
Duration	00:01:30	00:01:00	hh:mm:ss

Appendix C.4 – Noise Exposure Level Analysis

Position M – Period Averages

	Time	Period	LAeq	LA10	LA50	LA90
	00:00-00:00	24	58.9	58.2	50.4	41.2
	07:00-19:00	12	60.6	60.2	53.0	47.7
	07:00-23:00	16	60.5	60.1	52.9	47.5
	19:00-23:00	4	60.2	58.6	51.6	46.7
	23:00-07:00	8	53.3	52.7	44.8	39.3

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Job # 13P282
Project 159 Iverson Road
Elevation North **Level** First
Calculation Sound Insulation & intru BS8233
Engineer James Tomalin

Reference				13P282 C1	11/11/13
Rev					

Frequency, Hz			dB(A)	125	250	500	1000	2000	4000	8000	dB(A)
Source Noise Levels			**Measured**	*Typical Spectrum will vary with position and height*							**Calculated**
LAeq,16hour	Daytime	L1	61.0	58.3	57.6	57.7	57.2	52.3	48.8	46.7	61.0
LAeq,8hour	Night-time	L2	53.0	50.0	49.1	48.5	46.2	41.6	46.0	47.2	53.0
LAmax,night 95%	Night-time	L3	55.0	51.7	48.9	49.2	46.5	43.0	49.2	50.3	55.0
LAmax,night 99%	Night-time	L4	64.0	60.7	57.9	58.2	55.5	52.0	58.2	59.3	64.0
Building Element Sound Insulation											
R_{ew}	Framed system	Specification Type A		30	34	38	43	46			
R_{wi}	10-16-6 unit	Specificaton Type D		24	24	27	34	33			
	10-16-6 unit+ heavy	Specificaton Type D2		28	30	36	42	39			
	6-16-6 unit	Specificaton Type E		19	19	22	29	28			
$D_{n,e}$	Attenuated ventilator	Specification Type G		35	35	35	38	35			
R_{rr}	Projected Area	Not applicable									
Room Sound Absorption, A											
A living				16	12	14	16	17			
A bed				14	9	10	11	12			

Dimensions		Bedroom	Living Room	
Term	**Derivation**			
S_f	Façade area (including window)	10	26.25	sq.m
Sr	Roof area (exposed side)	0	0	sq.m
S_{wi}	Window area	2	10	sq.m
S_{ew}	S_f-S_{wi}	8	16.25	sq.m
S_{rr}	Area of ceiling	0	0	sq.m
S	S_f+S_{rr}	10	26.25	sq.m
Vn	*Number of vents serving room*	0	0	
A_0	Given in BS EN 20140-10			sq.m

Bedroom			**Ref**	**Octave Band Centre Frequency**				
				125	**250**	**500**	**1000**	**2000**
$D_{n,e}$	adjusted for number of							
t e			B					
R_{wi}		Specificaton Type D		24	24	27	34	33
t wi			C	0.00080	0.00080	0.00040	0.00008	0.00010
R_{ew}		Specification Type A		30	34	38	43	46
t ew			D	0.00080	0.00032	0.00013	0.00004	0.00002
R_{rr}								
t rr			E					
10 $\log_{10}$(B+C+D+E)			**F**	**-28.0**	**-29.5**	**-32.8**	**-39.2**	**-39.2**
A (furnished)				14	9	10	11	12
10 log ($^{S}/_{A}$)			G	-1.5	0.5	0.0	-0.4	-0.8
Level Difference,	**(F+G)**		**T1**	**-29.4**	**-29.1**	**-32.8**	**-39.6**	**-40.0**
Corrections?	**Allow uncertainty**			**3.0**	**3.0**	**3.0**	**3.0**	**3.0**

Living Room			**Ref**	**Octave Band Centre Frequency**				
				125	**250**	**500**	**1000**	**2000**
$D_{n,e}$	adjusted re number vents							
t e			B					
R_{wi}		Specificaton Type E		19	19	22	29	28
t wi			C	0.00480	0.00480	0.00240	0.00048	0.00060
R_{ew}		Specification Type A		30	34	38	43	46
t ew			D	0.00062	0.00025	0.00010	0.00003	0.00002
R_{rr}								
t rr			E					
10 $\log_{10}$(B+C+D+E)			**F**	**-22.7**	**-23.0**	**-26.0**	**-32.9**	**-32.1**
A (furnished)				16	12	14	16	17
10 log ($^{S}/_{A}$)			G	2.2	3.4	2.7	2.2	1.9
Level Difference,	**(F+G)**		**T2**	**-20.5**	**-19.6**	**-23.3**	**-30.8**	**-30.2**
Corrections?	**Allow uncertainty 3dB & separation -7dB**			**-4.0**	**-4.0**	**-4.0**	**-4.0**	**-4.0**
	Not on north elevation							

Internal Noise Levels	Target shall be Living Rooms Leq,T 40-45dBA daytime, Bedrooms Leq,T 30-35dBA & Lmax,FAST < 45dBA night-time									
Bedroom	**With ventilation**	**Ref**	**Octave Band Centre Frequency**							
			125	**250**	**500**	**1000**	**2000**	**dB(A)**		**NPSE RATING**
LAeq,16hour	Daytime	L1+T1	32	32	28	21	15	28.4	OK	No Effect Level
LAeq,8hour	Night-time	L2+T1	24	23	19	10	5	19.1	OK	No Effect Level
LAmax,night	Night-time	L3+T1	34	32	28	19	15	28.6	OK	> Lowest OAEL

Living Room	**With ventilation**	**Ref**	**Octave Band Centre Frequency**							
			125	**250**	**500**	**1000**	**2000**	**dB(A)**		
LAeq,16hour	Daytime	L1+T2	38	38	34	26	22	34.7	OK	No Effect Level
LAeq,8hour	Night-time	L2+T2	29	30	25	15	11	25.5	OK	No Effect Level
LAmax,night 99% ile	Night-time	L3+T2	40	38	35	25	22	35	OK	> Lowest OAEL

Outcome
Based on the above, with a change to windows (and external doors) of Rw35-40dB range performance the Bedrooms will attain a "Good" standard BS8233:1999 and achieve No Effect Level under Noise Policy Statement for England.
Living Rooms will be able to achieve a similar quality with the provision of Rw30-35 windows and external doors.
The internal noise climate will be consistent and above interference levels in general, although Bedrooms at night may seem very quiet particularly between railway activity.

Requirement
The above outcome requires the provision of a ducted and attenuated whole-flat balanced ventilation / ventilation & heat recovery system and exclusion of direct / open vents in windows and walls. Detailed design review will be required.

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Job # 13P282
Project 159 Iverson Road
Elevation South **Level** First
Calculation Sound Insulation & intru BS8233
Engineer James Tomalin

Reference			13P282 C2	11/11/13
Rev				

Frequency, Hz			dB(A)	125	250	500	1000	2000	4000	8000	dB(A)
Source Noise Levels			**Measured**	*Typical Spectrum will vary with position and height*							**Calculated**
LAeq,16hour	Daytime	L1	65.0	67.3	64.1	62.1	60.1	57.1	49.9	49.0	65.0
LAeq,8hour	Night-time	L2	55.0	57.0	54.0	52.5	49.0	46.0	44.5	43.0	55.0
LAmax,night 95%	Night-time	L3									
LAmax,night 99%	Night-time	L4	65.0	65.1	61.1	60.1	58.1	56.1	57.3	58.4	65.0
Building Element Sound Insulation											
R_{ew}	Framed system	Specification Type A		30	34	38	43	46			
R_{wi}	10-16-6 unit	Specificaton Type D		24	24	27	34	33			
	10-16-6 unit+ heavy	Specificaton Type D2		28	30	36	42	39			
	6-16-6 unit	Specificaton Type E		19	19	22	29	28			
$D_{n,e}$	Attenuated ventilator	Specification Type G		35	35	35	38	35			
R_{rr}	Projected Area	Not applicable									
Room Sound Absorption, A											
A living				16	12	14	16	17			
A bed				14	9	10	11	12			

Dimensions		**Bedroom**	**Living Room**	
Term	**Derivation**			
S_f	Façade area (including window)	15	27.5	sq.m
Sr	Roof area (exposed side)	0	0	sq.m
S_{wi}	Window area	5	8.4	sq.m
S_{ew}	S_f-S_{wi}	10	19.1	sq.m
S_{rr}	Area of ceiling	0	0	sq.m
S	S_f+S_{rr}	15	27.5	sq.m
Vn	*Number of vents serving room*			
A_0	Given in BS EN 20140-10			sq.m

Bedroom			**Ref**	**Octave Band Centre Frequency**				
				125	**250**	**500**	**1000**	**2000**
$D_{n,e}$	adjusted for number of							
t e			B					
R_{wi}		Specificaton Type D		24	24	27	34	33
t wi			C	0.00133	0.00133	0.00067	0.00013	0.00017
R_{ew}		Specification Type A		30	34	38	43	46
t ew			D	0.00067	0.00027	0.00011	0.00003	0.00002
R_{rr}								
t rr			E					
10 $\log_{10}$(B+C+D+E)			F	**-27.0**	**-28.0**	**-31.1**	**-37.8**	**-37.4**
A (furnished)				14	9	10	11	12
10 log ($^{S}/_{A}$)			G	0.3	2.2	1.8	1.3	1.0
Level Difference,	**(F+G)**		**T1**	**-26.7**	**-25.8**	**-29.4**	**-36.4**	**-36.4**
Corrections?	**Allow uncertainty & separation**			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Living Room			**Ref**	**Octave Band Centre Frequency**				
				125	**250**	**500**	**1000**	**2000**
$D_{n,e}$	adjusted re number vents							
t e			B					
R_{wi}		Specificaton Type D		24	24	27	34	33
t wi			C	0.00122	0.00122	0.00061	0.00012	0.00015
R_{ew}		Specification Type A		30	34	38	43	46
t ew			D	0.00069	0.00028	0.00011	0.00003	0.00002
R_{rr}								
t rr			E					
10 $\log_{10}$(B+C+D+E)			F	**-27.2**	**-28.3**	**-31.4**	**-38.1**	**-37.7**
A (furnished)				16	12	14	16	17
10 log ($^{S}/_{A}$)			G	2.4	3.6	2.9	2.4	2.1
Level Difference,	**(F+G)**		**T2**	**-24.8**	**-24.7**	**-28.5**	**-35.7**	**-35.6**
Corrections?	**Allow uncertainty 3dB & separation -3dB**			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	Not on north elevation							

Internal Noise Levels	Target shall be Living Rooms Leq,T 40-45dBA daytime, Bedrooms Leq,T 30-35dBA & Lmax,FAST < 45dBA night-time									
Bedroom	**With ventilation**	**Ref**	**Octave Band Centre Frequency**							
			125	**250**	**500**	**1000**	**2000**	**dB(A)**		**NPSE RATING**
LAeq,16hour	Daytime	L1+T1	41	38	33	24	21	33.9	OK	No effect level
LAeq,8hour	Night-time	L2+T1	30	28	23	13	10	23.9	OK	No effect level
LAmax,night	Night-time	L3+T1	38	35	31	22	20	31.6	OK	No effect level

Living Room	**With ventilation**	**Ref**	**Octave Band Centre Frequency**							
			125	**250**	**500**	**1000**	**2000**	**dB(A)**		
LAeq,16hour	Daytime	L1+T2	40	36	31	22	19	32	OK	No effect level
LAeq,8hour	Night-time	L2+T2	30	26	21	11	8	21.9	OK	No effect level
LAmax,night	Night-time	L3+T2	38	33	29	20	18	29.8	OK	Lowest OAEL

Outcome

Based on the above, with a change to windows (and external doors) of Rw35-40dB range performance the Bedrooms will attain a "Good" standard BS8233:1999 and achieve No Effect Level under Noise Policy Statement for England.

Living Rooms will be able to achieve a similar quality with the provision of Rw35-40dB windows and external doors also.

The internal noise climate will be consistent and above interference levels in general, although Bedrooms at night may seem very quiet particularly between road activity.

Requirement

The above outcome requires the provision of a ducted and attenuated whole-flat balanced ventilation / ventilation & heat recovery system and exclusion of direct / open vents in windows and walls. Detailed design review will be required.

Figure 13P282/1 – Site Measurement Plan

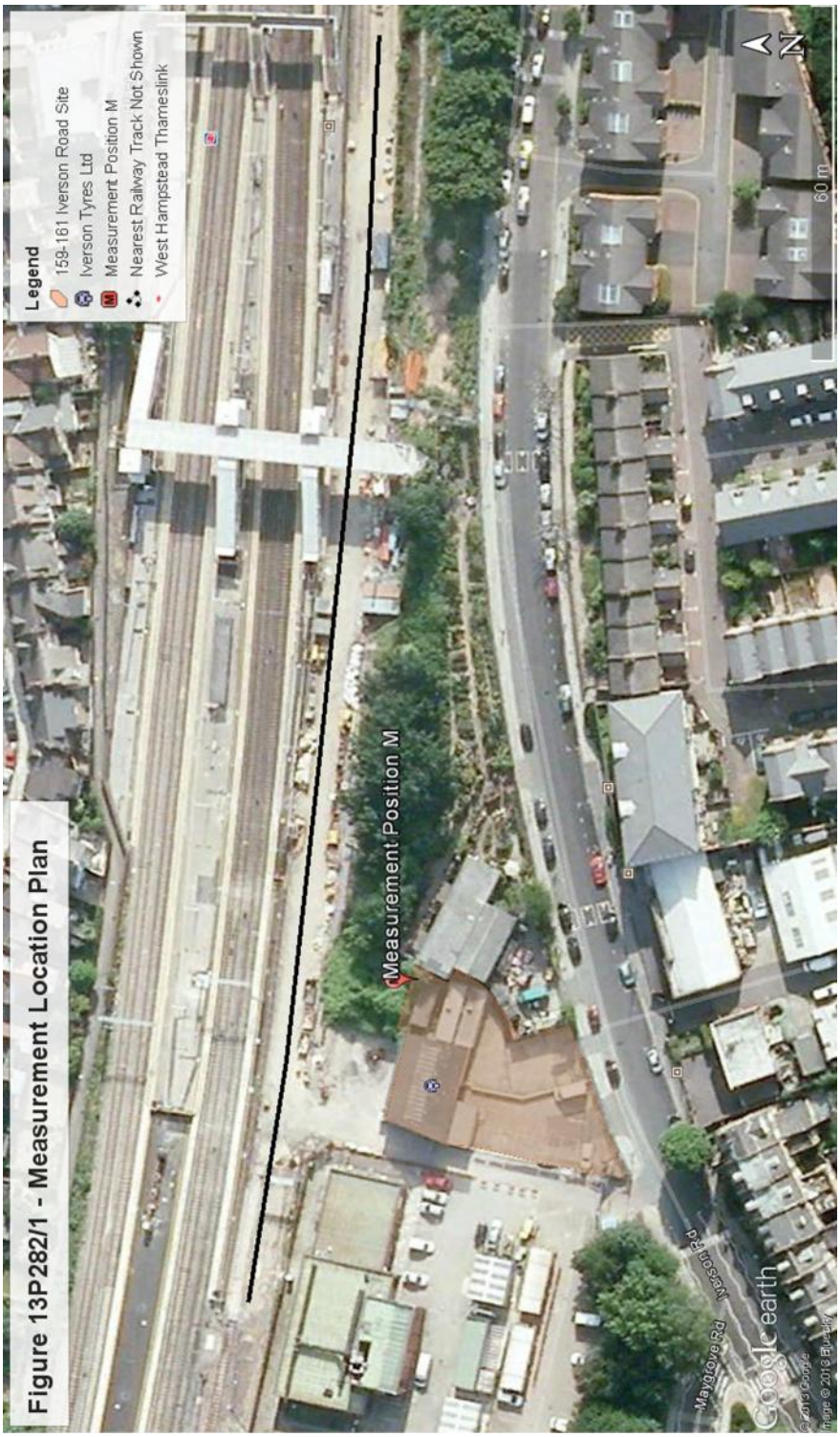

Table A: Noise levels on residential sites adjoining railways and roads at which planning permission will not be granted

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	74 dB L_{Aeq} 12h	72 dB L_{Aeq} 12h
Noise at 1 metre external to a sensitive façade	Evening	1900-2300	74 dB L_{Aeq} 4h	72 dB L_{Aeq} 4h
Noise at 1 metre external to a sensitive façade	Night	2300-0700	66 dB L_{Aeq} 8h	66 dB L_{Aeq} 8h

Table B: Noise levels on residential streets 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	65 dB L_{Aeq} 12h	62 dB L_{Aeq} 12h
Noise at 1 metre external to a sensitive façade	Evening	1900-2300	60 dB L_{Aeq} 4h	57 dB L_{Aeq} 4h
Noise at 1 metre external to a sensitive façade	Night	2300-0700	55 dB L_{Aeq} 1h	52 dB L_{Aeq} 1h
Individual noise events several times an hour	Night	2300-0700	>82 dB L_{Amax} (S time weighting)	>82 dB L_{AMAX} (S time weighting)

Table C: 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

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