Acoustic Associates Sussex Ltd

Planning Application Noise Impact Assessment

Site: **Former Masonic Hall and Old Telephone Exchange site**
Client: **Inland Homes Ltd**

Report by: George Orton BEng(Hons) MIOA

Date: 24/09/2020
Project: J2878
Issue 2

Acoustic Associates

ANC THE ASSOCIATION OF NOISE CONSULTANTS

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Sound Insulation Testing - Acoustic Design of Buildings - BS4142 - PPG24 - Schools Acoustics BB93 - Vibration - Expert Witness Testimony - Noise at Work - Air Tightness Testing - Auditorium Acoustics

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Tables and Figures

1 Introduction

Acoustic Associates have been appointed to undertake an acoustic assessment of the proposed Former Masonic Hall and Old Telephone Exchange site development. The assessment will be submitted as part of a planning application.

The development description is detailed in the next section.

The purpose of this assessment is to assess noise levels affecting the proposed noise sensitive receptors (NSRs). The following has been assessed:

- Noise from existing environmental and commercial sources close to proposed development
- Noise from proposed commercial sources that form part of the proposed development

Noise levels have been measured close to where the proposed re-development will take place (Prior to Covid-19 Lockdown measures being implemented).

Noise propagation around the proposed development has been predicted using the computer program IMMI (Wolfel).

Based on the Local Authority's planning guidance noise levels have been assessed in terms of and following the guidelines of the documents listed below:

- BS4142 (2014+A1:2019) Method for rating industrial noise affecting mixed residential and industrial areas
- World Health Organisation (WHO) - Guidelines for Community Noise 1999
- BS8233 (Sound insulation and noise reduction for buildings) 2014
- ProPG: Planning & Noise (Professional Practice Guidance on Planning & Noise) 2017

Noise mitigation measures have been recommended and if they are implemented correctly the internal noise levels will achieve the guideline values detailed in ProPG, WHO and BS8233.

Achieving these criteria will result in a good acoustic environment inside the proposed dwellings.

It is considered that the planning application would not be refused on noise grounds so long as the mitigation measures are completed by the developer prior to occupation of the building.

2 Context and Noise Criteria

2.1 Planning Application Details

Details pertinent to the planning application can be found below:

- Applicant – Inland Homes Ltd.
- LPA - Spelthorne Borough Council
- Site - Former Masonic Hall and Old Telephone Exchange site
- Address - Former Masonic Hall and Old Telephone Exchange site, Elmsleigh Road, Staines
- Site Area - 0.53ha

2.2 Development Description

Demolition of the Former Masonic Hall and redevelopment of the site to provide 206 dwellings comprising two buildings of 13 and 15 storeys in height, provided together with car and cycle parking, hard and soft landscaping and other associated works.

2.3 Existing Site Description

The development will be built on a site that previously housed a Masonic hall and a telephone exchange site.

All of the existing buildings will be demolished to make way for the mixed use development. At the time of the initial noise survey the Masonic Hall had not been demolished.

Elmsleigh road encompasses the development site. The road is used to access the rear of the various retail establishments that surround the site. The access is required for deliveries, refuse collection and for parking at Tothill multi-storey.

There is also a service ramp that runs along the northern boundary from Elmsleigh Road to an upper level of the Elmsleigh shopping center. The service ramp is not open to the public but is used by delivery vehicles serving the shopping center

To the west of the site (around 45m from boundary) is the A308 Thames Street dual carriageway road.

2.4 Spelthorne Borough Council Planning Guidance

Spelthorne Borough Council Policy EN11: “Development and noise” has been copied below:

Policy EN11: Development and Noise

The Council will seek to minimise the adverse impact of noise by:

a) requiring developments that generate unacceptable noise levels to include measures to reduce noise to an acceptable level,

b) requiring appropriate noise attenuation measures where this can overcome unacceptable impacts on residential and other noise sensitive development proposed in areas with high noise levels. Development will otherwise be refused,

and in the case of development close to Heathrow by:

c) refusing new residential development where aircraft noise levels are at or exceed 66Leq; except in the case of the one-for-one replacement of dwellings

d) requiring appropriate attenuation measures for development between 60 and 65Leq

This noise impact assessment assesses the existing noise levels and details mitigation measures to reduce noise ingress to an acceptable level. To quantify what is “acceptable” various guidance documents have been referred to.

Based upon Spelthorne Borough Council planning guidance (on website) it is recommended in this case that appropriate criteria are provided by (the versions below are the most recent as opposed to the now superseded versions detailed on the Spelthorne website):

- BS4142 (2014+A1:2019) Method for rating industrial noise affecting mixed residential and industrial areas
- BS8233 (Sound insulation and noise reduction for buildings) 2014
- World Health Organisation (WHO) - Guidelines for Community Noise 1999

Reference is also made to the 2017 ProPG “Planning & Noise Document” (Introduced to aid assessment subsequent to the withdrawal of the PPG24 document)

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2.5 National Planning Policy Framework 2019

The National Planning Policy Framework (2019) defines the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so.

The document recommends: *preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.*

Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- *Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;*

Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

The Framework states that the planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution. It does not, however, provide any specific formal guidelines.

2.6 BS8233 Noise Criteria

Table 5 of BS8233 provides the following guideline values:

Activity	Location	Time period of day	
		07:00-23:00	23:00-07:00
Resting	Living Rooms	35dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hour}$	30dB $L_{Aeq,8hour}$

Table 1: BS8233 Criteria

With regard to external amenity areas BS8233 (7.7.3.2 Design criteria for external noise) states the following:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB LAeq,T, with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments. However, it is also recognized 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, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

2.7 WHO Internal Noise Criteria

The target internal levels are based on guidelines laid out by the World Health Organisation (WHO) and are as follows:

Room Type	Target Maximum Internal Level - L_{Aeq} dB (A)
Living rooms	35 (Daytime only)
Bedrooms	30 (Night)
Room Type	**Maximum Internal Level – L_{Amax} dB(A)**
Bedrooms	45 (not more than 10-15 times per Night)

The target maximum internal noise level for a bedroom during the night time corresponds to the threshold of sleep disturbance. WHO state that the noise level outside a bedroom window would be less than 45dB(A) this assumes that an open window provides 15dB attenuation.

2.8 WHO External Noise Criteria

With regard to outdoor amenity areas WHO states the following:

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB(A) on balconies, terraces and in outdoor living areas.

To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 50dB(A) on balconies, terraces and in outdoor living areas.

2.9 BS4142(2014+A1:2019): Method for rating and assessing industrial and commercial sound

This document provides a means of assessing the impact of industrial or commercial sound upon nearby noise-sensitive receptors, including residential properties.

It does this by comparing the Rating Level of the noise from the industrial or commercial source with the pre-existent L_{90} background noise level affecting the same noise-sensitive premises. The Standard provides guidance that:

a) Typically, the greater the difference, the greater the magnitude of the impact.

b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.

d) 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 or a significant adverse impact. Where the rating level does not exceed the background noise level, this is an indication of the specific sound source having a low impact, depending on the context.

2.10 Proposed Plant Machinery

It is understood that 40no. air source heat pumps will be installed on the roof of the development (20no. on each tower)

The unit below has been proposed:

- 40no. Mitsubishi - CAHV-P500YA-HPB
  - Sound Pressure at 1m = 59dBA
  - Sound power level = 70.7dBA

The datasheet summary can be found in the appendix of the report.

2.11 ProPG –Planning and Noise: new residential development

The following has been copied from the Association of Noise Consultants' (ANC) website:

Over recent years, we have seen the introduction of the Noise Policy Statement for England, as well as substantial changes in national planning policy. But these developments have not been accompanied by detailed technical acoustic advice.

The lack of detailed guidance can lead to inconsistent application of policy, that may in turn result in unsatisfactory development and affect quality of life.

To fill that gap and facilitate efficient and consistent decision-making in the development control process, the Institute of Acoustics, the Association of Noise Consultants and the CIEH have joined to produce a Professional Practice Guidance (ProPG) focussing on noise sensitive development.

The following extract has been taken (Figure 2, Page 13) from the ProPG document:

ACTIVITY	LOCATION	07:00 – 23:00 HRS	23:00 – 07:00 HRS
Resting	Living room	35 dB $L_{Aeq,16\,hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16\,hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16\,hr}$	30 dB $L_{Aeq,8\,hr}$ 45 dB $L_{Amax,F}$ (Note 4)

NOTE 1 The Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The internal L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the internal L_{Aeq} target levels recommended in the Table.

NOTE 3 These internal L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

NOTE 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded, subject to the further advice in Note 7.

NOTE 6 Attention is drawn to the requirements of the Building Regulations.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form **(see Section 3.D)**.

Figure 2. ProPG Internal Noise Level Guidelines (additions to BS8233:2014 shown in blue)

Figure 1: ProPG Guidance

3 Environmental Noise Survey Baseline Conditions and Results

3.1 Summary and Covid-19 Note

A noise survey was completed from the 25th February to the 8th of March 2020. Noise levels were measured, at two separate locations, continuously, for the whole duration of the survey.

The survey finished prior to the initial Covid-19 announcements that impacted traffic flow levels on many roads (Secretary of State for Health announcement on 16th March 2020). Traffic flow levels were significantly affected after the Covid-19 Lockdown statement issued by the Prime Minister on the 23rd March 2020)

3.2 Survey Details

- Survey carried out by: George Orton BEng (Hons) MIOA
- Equipment used: Rion NL18 - Type 1 Sound Level Meter
  Castle Mirus Type 1 Sound Level Meter
- Weather conditions: Variable (mostly dry); Wind: variable direction
  Generally less than 5ms^{-2} in the sheltered locations

Meters were calibrated before and after commencing the noise measurements (@94dB no drift).

3.3 Baseline Conditions

A survey was completed, close to the western site boundary of the proposed development, with line of sight to the A308 road (see appendix for survey positions). The microphone was approximately 4.5m from the ground and away from reflective surfaces i.e. free-field level.

A survey was also completed, close to the centre of the proposed development, with line of sight to the elevated vehicle access ramp (see appendix for survey positions). The microphone was also in a free-field position

All noise levels in the report, including those predicted by the noise model, will be free-field unless stated otherwise.

3.4 Survey Results Summary

The survey data has been used to calculate the $L_{Aeq,16/8hr}$ for the day time period and night time period.

The highest L_{Aeq1Hr} values for the day and night time period have also been calculated. The results tables for all days can be seen in the appendix and a summary can be seen below

Position	Free-field Level - dBA			
	Daytime 07:00-23:00		Night Time 23:00-07:00	
	Average $L_{Aeq,16hr}$	Highest $L_{Aeq,1hr}$	Average $L_{Aeq,8hr}$	Highest $L_{Aeq,1hr}$
P1	56	60	51	57
	55	60	50	61

Table 2: Survey Noise Level Summary

3.5 Background Sound Levels

The Position 1 survey was set to 5 minutes to allow a more in depth review of LAmax noise levels. The meter at Positon 2 allows for the $L_{Aeq/max}$ to be set to 5 minutes and the L_{A90} (Background sound) to be set at 15 minutes (BS4142 states that the background sound level measurement duration should not be less than 15 minutes).

The graphical results can be seen below:

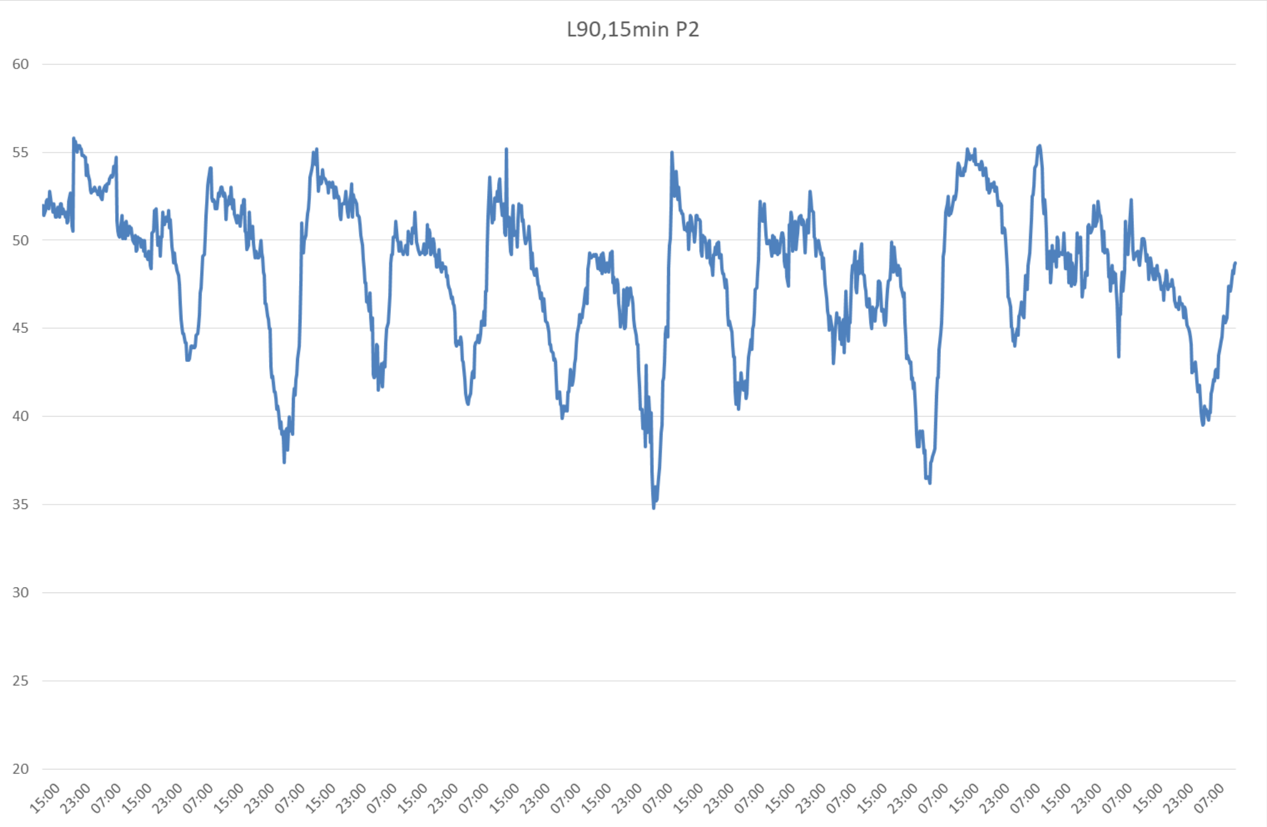

Figure 2: Background Sound Levels

The survey $L_{A90,15min}$ values have also been rounded to the nearest whole number. The mode value (most commonly occurring) was calculated separately for the day and night time values:

- Daytime $L_{A90,15min}$ mode value = 49dBA
- Night time $L_{A90,15min}$ mode value = 45dBA

3.6 Discussion of Results

The steady noise levels affecting the site are fairly low. For the majority of the time the steady rumble of traffic on the A308 is the main noise source.

At night time the worst case 1hr noise levels are significantly higher than the 8hr night time period sound level on that day. The worst case night time hour is nearly always between 06:00-07:00hrs.

CCTV footage (use for traffic count) was reviewed to show delivery lorry and refuse lorry activity at this time of day.

4 Computer Noise Model

In order to see how noise varies at different positions around the proposed development it is possible to produce a noise contour map.

A computer noise model has been completed using the computer package IMMI. The survey data and drawings of the proposed development have been used to complete the noise models. IMMI faithfully implements the propagation method of ISO-9613:1996; Acoustics – Attenuation of sound during propagation outdoors.

4.1 Existing Noise Model Methodology

Existing Buildings (to be demolished) and nearby buildings were added to the model with the appropriate heights.

Reception points were added to the model at plan/height positions corresponding to the unattended noise survey positions. Reception points (RPs) predict the noise level at a discreet position within the noise model space.

The A308 was added to the “Survey” noise model as a line source. The line source day/night time sound powers were set based on traffic count information for the road. With just this road the level at the P1 survey reception point (RP) was 1dB lower than as measured.

Elmsleigh Road and the service ramp road were added (Service ramp added as a line source starting at ground level heading to the elevated position above the shopping Centre)

These roads were added based on an equation that used noise readings from HGVs and small vans as well as traffic flow data for the roads. Details of the calculation can be found in the appendix.

Rooftop plant was then added at positions around the site where plant could be seen. The sound power data for a large heat pump was used for the individual point sources (Sound power 83//80dBA Day/Night).

The substation was added as a point source that created a noise level of 54dBA at the fence (measured on site).

With the above noise sources the predicted levels matched the survey levels for positions 1 and 2 (Survey model can be seen in the appendix of the report).

4.2 Existing Noise Model Methodology Worst Case Hour

For the worst case hour survey model the Ramp source was adjusted. For the daytime a 6dB increase was used (assuming ¼ of all day time traffic used the ramp in the worst hour). For the night time a 9dB increase was used (assuming all of the night time traffic used the ramp in the worst hour).

The Elmsleigh road source was then adjusted until the level at P1 and P2 matched the survey worst hour levels. This method has been chosen as it spreads the delivery noise sources around Elmsleigh road. This is deemed to be the best way to proceed given the large number of loading areas around the site. With fewer loading areas adding point sources may have been a better way to proceed.

4.3 Proposed Development Noise Model

The existing (to be demolished) buildings were removed from the model. The proposed building was added along with reception points around the development.

New reception points were added at 1st, 3rd and top floor levels to simplify the noise assessments (lower floors will generally be worst case in terms of vehicle noise as they are closer to Elmsleigh Road and the ramp. The top floor has been added due to the proximity to the rooftop plant

The first model included all noise sources. The road noise source was then switched off to allow the prediction of commercial noise levels around the whole site.

4.4 Proposed Development Plant Noise Model

Point sources were added for all of the 40no. Rooftop air source heat pumps. Sound power levels for the day were as detailed in the datasheet. For the night time a 3dB reduction was implemented (Due to reduced heating requirements at night time). The noise model plot was completed with all other sources switched on.

4.5 Proposed Development Combined Noise levels

All sources were switched on and plots were completed for the day/night periods as well as for the day/night worst case hour. The combined noise level for the 16/8hr periods can be seen below

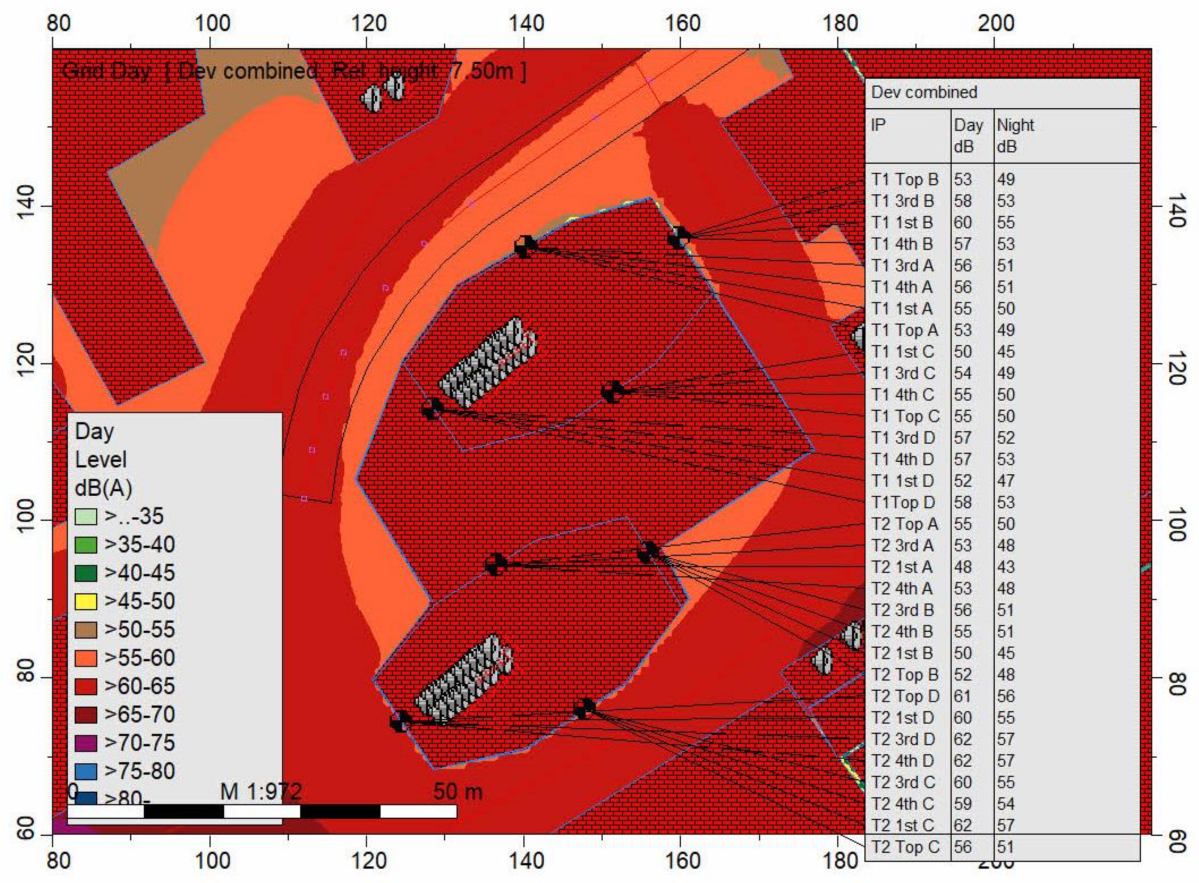

Figure 3: Model Predicted Noise Levels

For the lounge areas 2dB will be subtracted from the model predictions due to the balcony areas protecting the windows to the room

5 BS4142 Assessment – Proposed Plant closed to Proposed Dwellings

5.1 Background Sound Level

The survey data modal values have been used to estimate the daytime and night time background sound levels:

- Background Sound Daytime = 49dBA
- Background Sound Night time = 45dBA

5.2 Rating Level

It is important to differentiate between noise rating level and specific noise level. Certain acoustic features can increase the likelihood of complaint. In this case the noise created by the rooftop plant will be low in comparison to the existing residual noise level. For this reason no correction will be added:

5.3 Assessment

The assessment table has been detailed below (summary for best and worst case reception points):

Day/Night	Rp	Noise Rating	Background	Rating - Background
Day	T2 Top A	45	49	-4
Day	T1 1st B	23	49	-26
Night	T2 Top A	42	45	-3
Night	T1 1st B	20	45	-25

Table 3: Bs4142 Assessment

The BS4142 standard provides guidance that:

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 or a significant adverse impact. Where the rating level does not exceed the background noise level, this is an indication of the specific sound source having a low impact, depending on the context.

Even when considering the worst case (top floor windows) the rating level is lower than the background sound level. This indicates that the resulting impact should be low.

5.4 Uncertainty

Where possible the calculations have erred on the side of caution to predict the worst case. It should also be noted that any small (up to 3dB) unfavorable uncertainties would not affect the outcome of the assessment (i.e. rating still equal to or lower than background).

6 Noise Mitigation Measures

6.1 Noise Criteria

6.1.1 Continuous Noise Levels

The BS8233 2014 and WHO noise criteria will be used to specify the noise mitigation measures for all habitable rooms. The maximum internal noise level for each area is as follows:

- Bedrooms 30dBA at Night
- Lounges 35dBA in Day

6.1.2 Road Noise Maximum Noise Levels

For LAmax events the ProPG noise LAmax criterion will be used to specify the noise mitigation measures for bedrooms only:

For a reasonable standard in noise sensitive rooms at night (e.g. bedrooms) individual noise events should not normally exceed 45dB LAFmax more than 10 times a night.

6.1.3 Continuous Noise Levels Worst Case Hour

In many cases the 16hr/8hr noise limits detailed above are used to form an assessment. In this case the worst case 1hour levels are up to 11dB higher than the associated period noise level average. It is proposed that a reasonable standard is achieved for the worst case hour noise levels:

- Worst Case Hour: Bedrooms 35dBA at Night
- Worst Case Hour: Lounges 40dBA in the Day

6.2 Location Specific Sound Reduction (SRI)

6.2.1 Continuous Noise $L_{Aeq,T}$

The sound reduction of the building envelope (SRI) quantifies how well the building fabric will attenuate noise created outside of the building. The required sound reduction (SRI) has initially been calculated so that the worst case hour noise level criteria can be achieved. For the most affected areas if the worst case hour criteria are achieved the day/night period targets will also be easily achieved. For areas facing away from the ramp and Elmsleigh road the sound reduction required is higher for the steady noise level criteria.

6.2.2 L_{AMax}

For the worst case areas the SRI has to be 6dB higher in order to achieve the worst case hour criteria. Usually the L_{Amax} criteria are achieved when the night time period targets are exceeded by around 2dB. For the less affected areas, where the sound reduction is based on the night time period level, 2dB will be added to ensure the L_{Amax} criteria are achieved.

A summary of the required sound reduction can be seen below

RP	Lounge		Bedrooms	
	RP	SRI	RP	SRI
Worst Case	67	27	67	32
Second Worst	65	25	65	30
Best Case	44	9	42	14

Table 4: Required Sound Reduction

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6.3 Glazing/Ventilation

6.3.1 Glazing

It is understood that double glazing would be preferred for this scheme. Based on the predicted noise levels some areas (see below) will require enhanced acoustic double glazing.

6.3.2 Ventilation Strategy

It is understood that either continuous MEV extract fans will be installed to achieve the correct level of "Whole Dwelling" ventilation. Therefore there will be the need for trickle ventilators to allow the ingress of fresh air. As with the glazing an enhanced specification would be required for the most affected areas.

6.3.3 Basic Solution

A calculation (following BS8233 rigorous method) has been completed to predict the sound insulation of the building envelope if basic windows and ventilators are fitted:

- Lounge Façade Sound Reduction = 22dB
  - Basic Glazing (Frame and Glass) - Rw+Ctr 26dB (Based on Velfac 4/16/4)
  - 2x Basic Trickle Vents - $D_{n,ew}$ 29dB (Based on Velfac standard vent – 2dB)
- Bedroom Façade Sound Reduction = 26dB
  - Basic Glazing (Frame and Glass) - Rw+Ctr 26dB (Based on Velfac 4/16/4)
  - 1x Basic Trickle Vent - $D_{n,ew}$ 29dB (Based on Velfac standard vent – 2dB)

6.3.4 Enhanced Solution

A calculation (following BS8233 rigorous method) has been completed to predict the sound insulation of the building envelope for areas that require a higher performance than as detailed above.

- Lounge Façade Sound Reduction = 27dB
  - Basic Glazing (Frame and Glass) - Rw+Ctr 31dB (Rw=35)
    (Based on Velfac 6/16/4)
  - 2x Acoustic Trickle Vents - $D_{n,ew}$ 33dB (Based on a Simon Rw vent)
- Bedroom Façade Sound Reduction = 32dB
  - Basic Glazing (Frame and Glass) - Rw+Ctr31 (Rw=36)
    (Based on Velfac 4/14/6.8)
  - 1x Acoustic Trickle Vent - $D_{n,ew}$ 36dB (Based on Velfac standard vent – 2dB)

6.3.5 Mitigation Strategy

The areas that require the enhanced specifications have been detailed below:

Strategy	Tower	Facade	Floor
Enhanced	T1	A	1to4
Enhanced	T1	B	1to4
Enhanced	T1	C	4
Enhanced	T1	D	4
Enhanced	T2	A	4
Enhanced	T2	C	1to3
Enhanced	T2	D	1to3
Basic	All other areas not detailed above		

Table 5: Mitigation Table

The plan showing the areas above can be seen below:

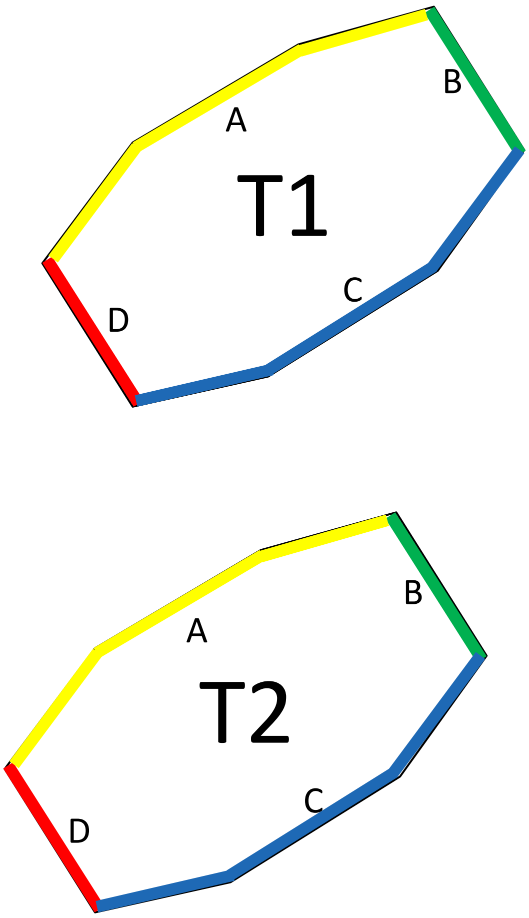


Figure 4: Mitigation Plan

7 Conclusion

Noise levels that will affect the proposed development have been measured and assessed prior to the Covid-19 lockdown.

7.1 Assessments

7.1.1 Internal Noise Criteria

The model has been used to predict that, for the worst case areas, an SRI of 32dB will be required if the internal noise criteria are to be achieved (WHO/BS8233 and ProPg for L_{Amax}).

This would be relatively easy to achieve with a slightly uprated glazing and ventilator specification. A mitigation strategy has been completed that show the areas that require enhanced glazing and trickle vents.

With the stated sound reduction level reasonable standard is also achieved when considering the worst case 1hr noise levels which typically occur between 06:00-07:00hrs as vehicles access the nearby commercial properties.

7.1.2 BS4142 (2014+A1:2019)

For the proposed rooftop air source heat pumps the predicted noise rating level is lower than the representative background sound level which indicates there should be low impact.

7.2 Conclusion

Noise mitigation measures have been recommended and if they are implemented correctly the internal noise levels will achieve the guideline values detailed in ProPG, WHO and BS8233. To enable a robust assessment worst case 1hr values have also been reviewed

Achieving these criteria will result in a good acoustic environment inside the proposed dwellings.

It is considered that the planning application would not be refused on noise grounds so long as the mitigation measures are completed by the developer prior to occupation of the building.

8 Appendix

8.1 Site and Survey Location

Figure 5: Site/Survey Plan

8.2 Sound Survey

The survey data has been used to calculate the 16hr day time and the 8hr night time period noise levels:

8.2.1 P1 West

Day	Date 20	Free-field dBA	
		$L_{Aeq,07:00-23:00hrs}$	$L_{Aeq,23:00-07:00hrs}$
Tue	25-Feb	55.5	50.4
Wed	26-Feb	55.2	51.1
Thu	27-Feb	56.0	49.9
Fri	28-Feb	56.7	53.3
Sat	29-Feb	57.4	48.2
Sun	01-Mar	55.1	50.7
Mon	02-Mar	55.2	50.7
Tue	03-Mar	54.9	50.3
Wed	04-Mar	54.6	49.4
Thu	05-Mar	57.5	51.7
Fri	06-Mar	55.5	51.2

Table 6: P1 Survey

8.2.2 P2 Centre

Day	Date 20	Free-field dBA	
		$L_{Aeq,07:00-23:00hrs}$	$L_{Aeq,23:00-07:00hrs}$
Tue	25-Feb	54.4	49.9
Wed	26-Feb	54.7	45.6
Thu	27-Feb	55.4	50.3
Fri	28-Feb	54.7	47.2
Sat	29-Feb	56.3	46.0
Sun	01-Mar	53.9	49.4
Mon	02-Mar	55.1	47.8
Tue	03-Mar	54.3	51.7
Wed	04-Mar	52.7	51.6
Thu	05-Mar	56.5	51.5
Fri	06-Mar	54.6	51.8
Sat	07-Mar	54.3	52.5

Table 7: P2 Survey

8.3 Noise Models

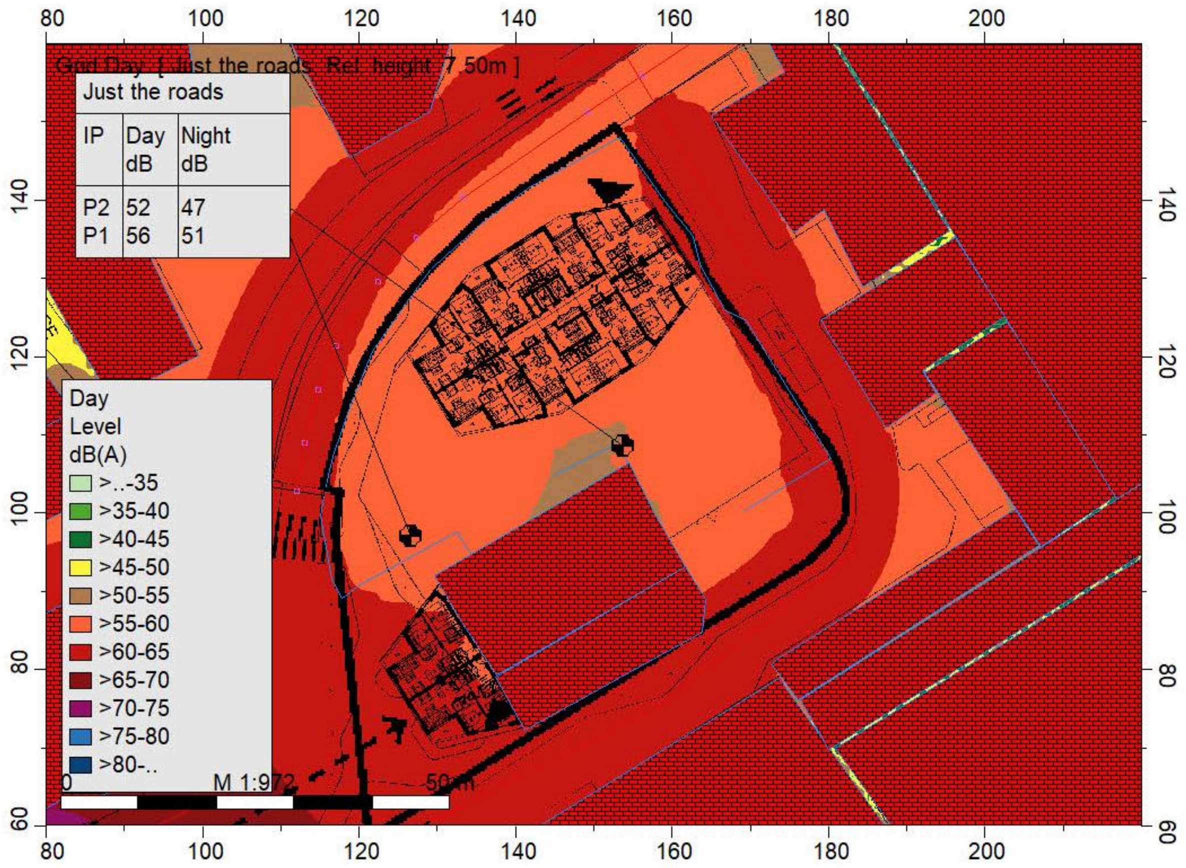


Figure 6: Survey Noise Model Traffic Only

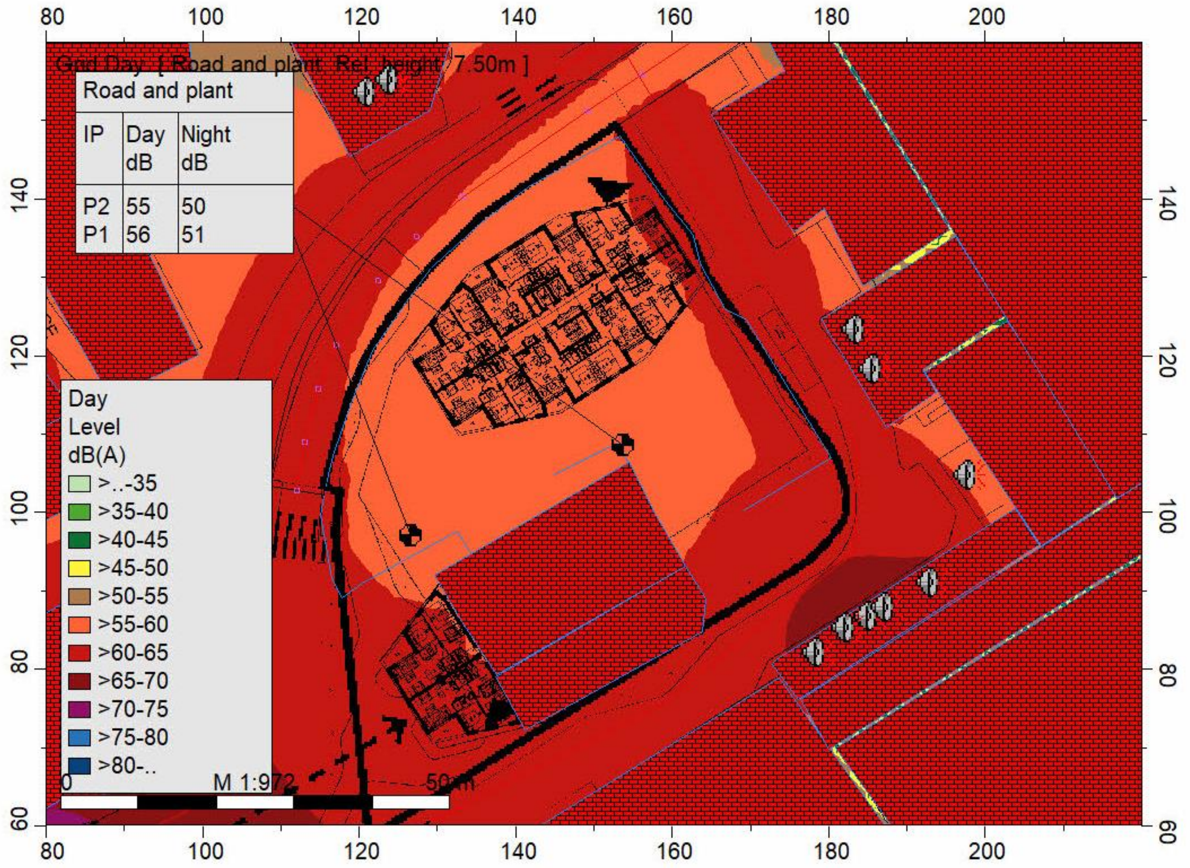
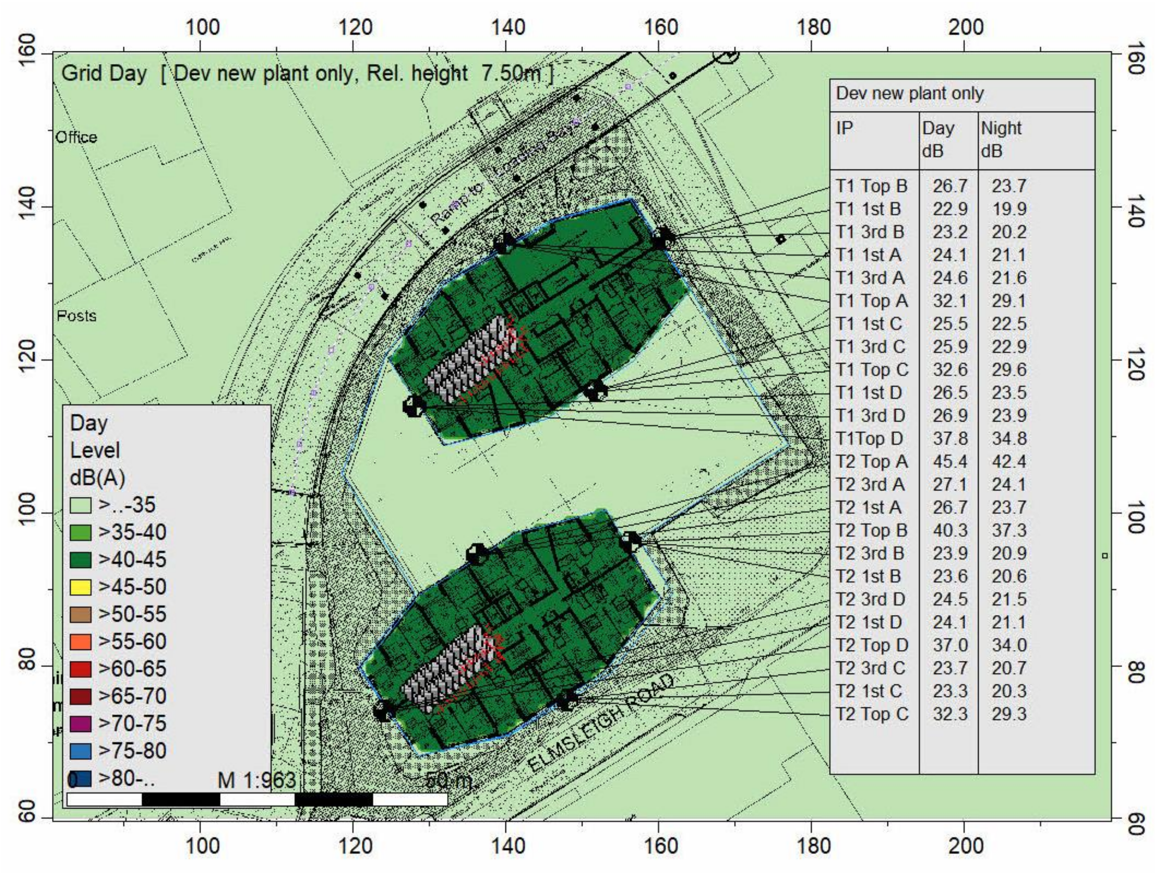


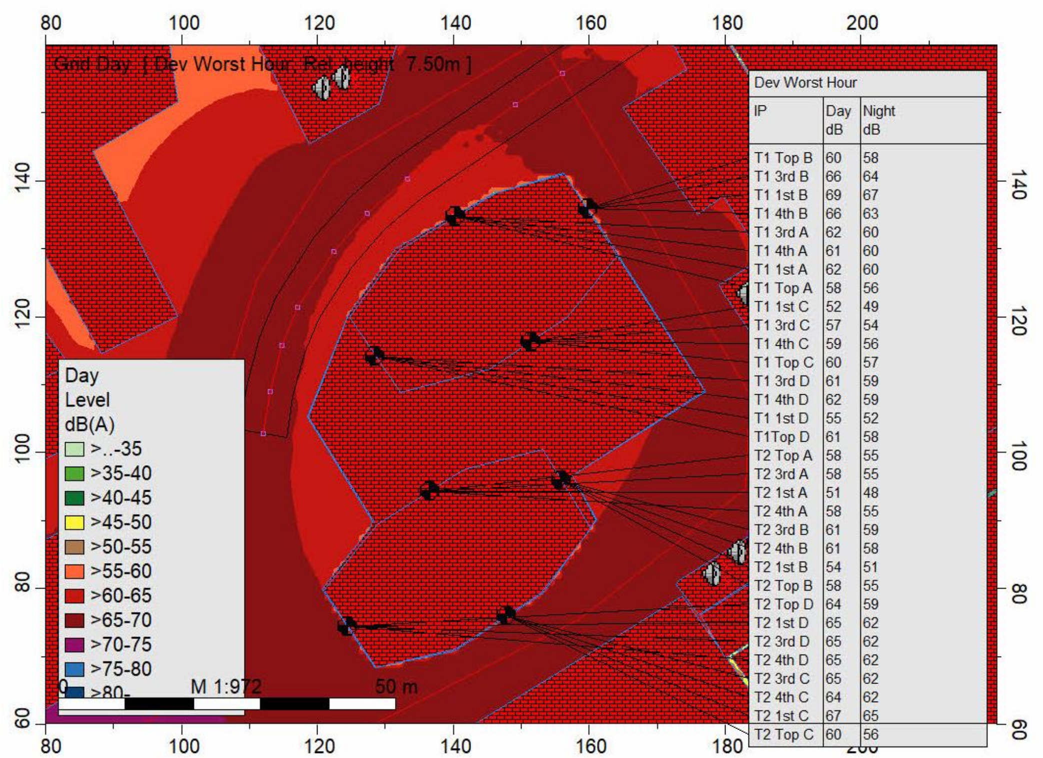
Figure 7: Survey Noise Model

Acoustic Associates



IP	Day dB	Night dB
T1 Top B	26.7	23.7
T1 1st B	22.9	19.9
T1 3rd B	23.2	20.2
T1 1st A	24.1	21.1
T1 3rd A	24.6	21.6
T1 Top A	32.1	29.1
T1 1st C	25.5	22.5
T1 3rd C	25.9	22.9
T1 Top C	32.6	29.6
T1 1st D	26.5	23.5
T1 3rd D	26.9	23.9
T1Top D	37.8	34.8
T2 Top A	45.4	42.4
T2 3rd A	27.1	24.1
T2 1st A	26.7	23.7
T2 Top B	40.3	37.3
T2 3rd B	23.9	20.9
T2 1st B	23.6	20.6
T2 3rd D	24.5	21.5
T2 1st D	24.1	21.1
T2 Top D	37.0	34.0
T2 3rd C	23.7	20.7
T2 1st C	23.3	20.3
T2 Top C	32.3	29.3

Figure 8: Proposed Plant Noise Model



IP	Day dB	Night dB
T1 Top B	60	58
T1 3rd B	66	64
T1 1st B	69	67
T1 4th B	66	63
T1 3rd A	62	60
T1 4th A	61	60
T1 1st A	62	60
T1 Top A	58	56
T1 1st C	52	49
T1 3rd C	57	54
T1 4th C	59	56
T1 Top C	60	57
T1 3rd D	61	59
T1 4th D	62	59
T1 1st D	55	52
T1Top D	61	58
T2 Top A	58	55
T2 3rd A	58	55
T2 1st A	51	48
T2 4th A	58	55
T2 3rd B	61	59
T2 4th B	61	58
T2 1st B	54	51
T2 Top B	58	55
T2 Top D	64	59
T2 1st D	65	62
T2 3rd D	65	62
T2 4th D	65	62
T2 3rd C	65	62
T2 4th C	64	62
T2 1st C	67	65
T2 Top C	60	56

Figure 9: Combined Noise Model Worst Case Hour

T1 1st B		60.355		55.442
T1 1st C		49.622		45.166
T1 1st D		51.632		46.681
T1 1st A		55.125		50.404
T1 3rd B		58.074		53.309
T1 3rd C		53.78		49.147
T1 3rd D		56.98		52.023
T1 3rd A		55.824		51.427
T2 1st B		49.914		45.463
T2 1st C		61.564		56.561
T2 1st D		60.428		55.436
T2 1st A		47.988		43.386
T2 3rd B		55.778		51.011
T2 3rd C		59.671		54.677
T2 3rd D		61.708		56.72
T2 3rd A		52.767		47.983
T2 Top A		54.946		50.315
T2 Top C		55.981		50.791
T2 Top B		52.336		47.51
T2 Top D		60.902		55.922
T1 Top C		55.073		50.27
T1 Top A		53.382		49.01
T1 Top B		52.99		48.646
T1Top D		57.841		52.926
T1 4th A		55.668		51.269
T1 4th B		57.449		52.851
T1 4th C		54.784		50.117
T1 4th D		57.479		52.526
T2 4th A		53.013		48.219
T2 4th B		55.439		50.678
T2 4th C		59.194		54.172
T2 4th D		61.795		56.807
T2 5th C		58.874		53.825
T2 5th D		61.61		56.623
T2 5th A		53.322		48.499
T2 5th B		55.099		50.335
T1 5th C		55.036		50.341
T1 5th D		58.012		53.046
T1 5th A		56.158		51.673
T1 5th B		56.783		52.234

Figure 10: Model Prediction All Sources

T1 1st B	22.924		19.924
T1 1st C	25.48		22.48
T1 1st D	26.451		23.451
T1 1st A	24.14		21.14
T1 3rd B	23.178		20.178
T1 3rd C	25.879		22.879
T1 3rd D	26.927		23.927
T1 3rd A	24.646		21.646
T2 1st B	23.619		20.619
T2 1st C	23.284		20.284
T2 1st D	24.074		21.074
T2 1st A	26.694		23.694
T2 3rd B	23.881		20.881
T2 3rd C	23.716		20.716
T2 3rd D	24.491		21.491
T2 3rd A	27.071		24.071
T2 Top A	45.376		42.376
T2 Top C	32.271		29.271
T2 Top B	40.252		37.252
T2 Top D	36.99		33.99
T1 Top C	32.647		29.647
T1 Top A	32.144		29.144
T1 Top B	26.749		23.749
T1Top D	37.809		34.809

Figure 11: Model Predictions New Plant

8.4 Service Ramp and Elmsleigh Road Calculations

The steady noise levels of the above roads were estimated based on the traffic flow data below (it should be noted that for the day/night period the estimations resulted in a noise level that matched the survey data. For the worst case hour the noise sources required additional adjustments (increase in noise level) for the survey data to be matched):

Road Link	AADT 2-way	HGV (%)	Speeds (if available)
Elmsleigh Road North	762	1.4%	
Service ramp	115	23.6%	
Elmsleigh Road East	689	1.5%	

Figure 12: Traffic Flow Data

To simplify matters one Elmsleigh Road source was added to the model with the worst case vehicle count.

8.4.1 Elmsleigh Road Calculation

The calculation of road line source sound power is detailed below. A basic equation has been used to predict the noise level due to HGV and van traffic. The equation uses data collected at other sites. The traffic flow data and HGV% has also been used. The night time reduction has been calculated so that the predicted noise level at night is 5dB lower than the day (This was the case both survey positions). The sound power of the road was calculated using the model with a reception point at a set distance corresponding to the vehicle pass by measurements (at 6m for the car/van example and at 8m for the HGV example)

56 car/van passbys at 6m			6 HGV passbys at 8m			
Highest SEL = 75			Highest SEL = 83			
LAeq,Hour = SEL - 10LogT +10LogN			LAeq,Hour = SEL - 10LogT +10LogN			
N Day	566		N Day	92		
N Night	91		N Night	15		
LAeq,day	54.9		LAeq,day	55.0		
LAeq,Hour night	50.0		LAeq,Hou	50.2		
LwA,Day	65.9		LwA,Day	67.2		
LwA,Night	61.0		LwA,Night	62.4		

8.4.2 Service Ramp Calculation

56 car/van passbys at 6m			6 HGV passbys at 8m		
Highest SEL = 75			Highest SEL = 83		
LAeq,Hour = SEL - 10LogT +10LogN			LAeq,Hour = SEL - 10LogT +10Lo		
N Day	76		N Day	24	
N Night	13		N Night	4	
LAeq,day	46.2		LAeq,day	49.2	
LAeq,Hour night	41.5		LAeq,Hou	44.4	
LwA,Day	57.2		LwA,Day	61.4	
LwA,Night	52.5		LwA,Nigh	56.6	

8.5 SRI Calculations

Non Frequency Dependent Variables		
Term	**Derivation**	**Value**
Ao	Given in BS EN 20140-10 = 10 (m^2)	10
Sf	Total Facade Area (m^2)	12
Swi	Window Area (m^2)	6
Sew	External Wall Area (m^2)	6
Srr	Ceiling Area (m^2)	0.00001
S	Total Area sound enters the room (m^2)	12

Key for Table Below	
Rwi	Sound Reduction of Window (Octave)
Rew	Sound Reduction Index of External Wall (Octave)
Rrr	Sound Reduction Index of Roof/Ceiling (Octave)
A	Equivalent Absorbtion Area of Rx Room
Dn,e	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	**Description**	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	Free-Field External Noise Level	59	62	62	57	54	49
Dn,e	2 x 29 dB Vent	31	29	23	28	28	34
Rwi	Velfac 4/16/4	20	18.9	28.5	37.5	38.7	34.9
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	No Roof	100	100	100	100	100	100
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	10.00	13.00	15.00	15.00	14.00	14.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	59	62	62	57	54	49
Ao/S . 10^(-Dn,e/10)	0.0006619	0.001049	0.004177	0.001320744	0.001320744	0.000331756
Swi/S . 10^(-Rwi/10)	0.005	0.006441	0.000706	8.8914E-05	6.74481E-05	0.000161797
Sew/S . 10^(-Rew/10)	3.972E-05	6.29E-05	1.99E-05	3.15479E-06	0.0000005	1.58114E-07
Srr/S . 10^(-Rrr/10)	8.333E-17	8.33E-17	8.33E-17	8.33333E-17	8.33333E-17	8.33333E-17
10log10(S/A)+3	3.7918125	2.652379	2.0309	2.03089987	2.330532104	2.330532104
Leq,2	40.351823	43.43375	40.93528	30.53174695	27.75659291	18.26525942
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**24.251823**	**34.83375**	**37.73528**	**30.53174695**	**28.95659291**	**19.26525942**

Prediced Building Envelope SRI	22

Velfac 4/16/4

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10}\left(\frac{S}{A}\right) + 3$$

Figure 13: Lounge SRI 22dB Calculation

Acoustic Associates

Non Frequency Dependent Variables		
Term	Derivation	Value
Ao	Given in BS EN 20140-10 = 10 (m^2)	10
Sf	Total Facade Area (m^2)	12
Swi	Window Area (m^2)	6
Sew	External Wall Area (m^2)	6
Srr	Ceiling Area (m^2)	0.00001
S	Total Area sound enters the room (m^2)	12

Key for Table Below	
Rwi	Sound Reduction of Window (Octave)
Rew	Sound Reduction Index of External Wall (Octave)
Rrr	Sound Reduction Index of Roof/Ceiling (Octave)
A	Equivalent Absorbtion Area of Rx Room
Dn,e	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	59	62	62	57	54	49
Dn,e	2xSimon Frame Vent 33dB	37	33	32	28	29	34
Rwi	Velfac 6/14/4	23	23	32.8	38.5	38.5	37.9
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	No Roof	100	100	100	100	100	100
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	10.00	13.00	15.00	15.00	14.00	14.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
Leq,ff	59	62	62	57	54	49
Ao/S . 10^(-Dn,e/10)	0.0001663	0.000418	0.000526	0.001320744	0.001049105	0.000331756
Swi/S . 10^(-Rwi/10)	0.0025059	0.002506	0.000262	7.06269E-05	7.06269E-05	8.10905E-05
Sew/S . 10^(-Rew/10)	3.972E-05	6.29E-05	1.99E-05	3.15479E-06	0.0000005	1.58114E-07
Srr/S . 10^(-Rrr/10)	8.333E-17	8.33E-17	8.33E-17	8.33333E-17	8.33333E-17	8.33333E-17
10log10(S/A)+3	3.7918125	2.652379	2.0309	2.03089987	2.330532104	2.330532104
Leq,2	37.124588	39.40406	33.10559	30.475166	26.82360947	17.49008093
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**21.024588**	**30.80406**	**29.90559**	**30.475166**	**28.02360947**	**18.49008093**

Prediced Building Envelope SRI	**27**

Velfac 6/14/4

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$

Figure 14: Enhanced Lounge SRI 27dB Calculation

Acoustic Associates

Non Frequency Dependent Variables		
Term	Derivation	Value
Ao	Given in BS EN 20140-10 = 10 (m^2)	10
Sf	Total Facade Area (m^2)	8.5
Swi	Window Area (m^2)	2
Sew	External Wall Area (m^2)	6.5
Srr	Ceiling Area (m^2)	0.00001
S	Total Area sound enters the room (m^2)	8.5

Key for Table Below	
Rwi	Sound Reduction of Window (Octave)
Rew	Sound Reduction Index of External Wall (Octave)
Rrr	Sound Reduction Index of Roof/Ceiling (Octave)
A	Equivalent Absorbtion Area of Rx Room
Dn,e	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	59	62	62	57	54	49
Dn,e	29 dB Vent	34	32	26	31	31	37
Rwi	Velfac 4/16/4	20	18.9	28.5	37.5	38.7	34.9
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	No Roof	100	100	100	100	100	100
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	10.00	13.00	15.00	15.00	14.00	14.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
Leq,ff	59	62	62	57	54	49
Ao/S . 10^(-Dn,e/10)	0.0004684	0.000742	0.002955	0.000934504	0.000934504	0.000234737
Swi/S . 10^(-Rwi/10)	0.0023529	0.003031	0.000332	4.18419E-05	3.17403E-05	7.61397E-05
Sew/S . 10^(-Rew/10)	6.074E-05	9.63E-05	3.04E-05	4.82497E-06	7.64706E-07	2.41821E-07
Srr/S . 10^(-Rrr/10)	1.176E-16	1.18E-16	1.18E-16	1.17647E-16	1.17647E-16	1.17647E-16
10log10(S/A)+3	2.2941893	1.154756	0.533277	0.533276667	0.8329089	0.8329089
Leq,2	35.891197	39.03158	37.742	27.45072212	24.68721323	14.76216375
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**19.791197**	**30.43158**	**34.542**	**27.45072212**	**25.88721323**	**15.76216375**

Prediced Building Envelope SRI	26

Velfac 4/16/4

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$

Figure 15: Bedroom SRI 26dB Calculation

Acoustic Associates

Non Frequency Dependent Variables		
Term	Derivation	Value
Ao	Given in BS EN 20140-10 = 10 (m^2)	10
Sf	Total Facade Area (m^2)	8.5
Swi	Window Area (m^2)	2
Sew	External Wall Area (m^2)	6.5
Srr	Ceiling Area (m^2)	0.00001
S	Total Area sound enters the room (m^2)	8.5

Key for Table Below	
Rwi	Sound Reduction of Window (Octave)
Rew	Sound Reduction Index of External Wall (Octave)
Rrr	Sound Reduction Index of Roof/Ceiling (Octave)
A	Equivalent Absorbtion Area of Rx Room
Dn,e	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	59	62	62	57	54	49
Dn,e	Simon EHA 36dB	40	36	35	33	37	37
Rwi	Velfac 4/14/6.4	24	25	36	40	42	47
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	No Roof	100	100	100	100	100	100
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	10.00	13.00	15.00	15.00	14.00	14.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
Leq,ff	59	62	62	57	54	49
Ao/S . 10^(-Dn,e/10)	0.0001176	0.000296	0.000372	0.000589632	0.000234737	0.000234737
Swi/S . 10^(-Rwi/10)	0.0009367	0.000744	5.91E-05	2.35294E-05	1.48461E-05	4.69473E-06
Sew/S . 10^(-Rew/10)	6.074E-05	9.63E-05	3.04E-05	4.82497E-06	7.64706E-07	2.41821E-07
Srr/S . 10^(-Rrr/10)	1.176E-16	1.18E-16	1.18E-16	1.17647E-16	1.17647E-16	1.17647E-16
10log10(S/A)+3	2.2941893	1.154756	0.533277	0.533276667	0.8329089	0.8329089
Leq,2	31.767376	33.70797	29.17574	25.44306598	18.81834156	13.62910544
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**15.667376**	**25.10797**	**25.97574**	**25.44306598**	**20.01834156**	**14.62910544**

Prediced Building Envelope SRI	**32**

Velfac 4/14/6.4

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$

Figure 16: Enhanced Lounge SRI 32dB Calculation

Acoustic Associates

8.6 Plant Datasheet

MODEL		CAHV-P500YA-HPB
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	125%
	SCOP	3.19
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+
	η_s	139%
	SCOP	3.54
HEATING*1 (A-3/W35)	Capacity (kW)	42.6
	Power Input (kW)	15.2
	COP	2.80
OPERATING AMBIENT TEMPERATURE (°C DB)		-20~+40°C
SOUND PRESSURE LEVEL AT 1M (dBA)*2*3		59
LOW NOISE MODE (dBA)*2		Variable
FLOW RATE(l/min)		126
WATER PRESSURE DROP (kPa)		18
DIMENSIONS (mm)	Width	1978
	Depth	759
	Height	1710 (1650 without legs)
WEIGHT (kg)		526
ELECTRICAL SUPPLY		380-415v, 50Hz
PHASE		3
NOMINAL RUNNING CURRENT [MAX] (A)		17.6 [52.9]
FUSE RATING - MCB SIZES (A)*4		63

*1 Under normal heating conditions at outdoor temp: -3°CDB / -4°CWB, outlet water temp 35°C, inlet water temp 30°C
*2 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 35°C, inlet water temp 30°C as tested to BS EN14511
*3 Sound power level of the CAHV-P500YA-HPB is 70.7dBA. Tested to BS EN12102
*4 MCB Sizes BS EN60898-2 & BS EN60947-2

η_s is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

Acoustic Associates