



NOISE IMPACT ASSESSMENT

FOR

DE TRAFFORD

AT

PHOENIX WORKS, CASTLEFIELD

AC109563-1R1

25TH NOVEMBER 2020

Prepared For

Natasha Evans
DeTrafford

Prepared By

Ross Millington
Ensafe Group

EXECUTIVE SUMMARY	4
1.0 INTRODUCTION.....	5
1.1. Background.....	5
1.2. Site Location and Proposed Development	5
1.3. Limitations	5
1.4. Confidentially.....	5
2.0 ASSESSMENT METHODOLOGY	6
2.1. National Planning Practice Guidance.....	6
2.2. British Standard BS8233:2014: Guidance on Sound Insulation and Noise Reduction for Buildings.....	8
2.3. World Health Organisation's (WHO) 'Guidelines for Community Noise'	9
2.4. BS4142: 2014 'Methods for rating and assessing industrial and commercial sound'	Error! Bookmark not defined.
3.0 SURVEYS	11
3.1. Road Traffic Noise Survey – Chester Road.....	11
3.2. Road Traffic Noise Survey – Ellesmere Street.....	11
4.0 NOISE IMPACT ASSESSMENT.....	13
4.1 Road Traffic Sound.....	13
5.0 MITIGATION.....	16
5.1. Internal Habitable Rooms	16
6.0 CONCLUSION	18

Appendix I	Limitations
Appendix II	Glossary of Acoustic Terminology
Appendix III	Figures

DISTRIBUTION LIST

Issued To	Title / Company / Location	Telephone No
Natasha Evans	Assistant Project Manager - DeTrafford	01625 583 541

QUALITY ASSURANCE

Issue / Revision	Issue 1	Revision 1	Revision 2
Remarks	Initial Draft Report	Addressed Client Comments	
Date	20/11/2020	25/11/2020	
Prepared By	Ross Millington	Ross Millington	
Job Title	Acoustic Consultant	Acoustic Consultant	
Signature			
Checked By	Elizabeth Samphier	Elizabeth Samphier	
Job Title	Senior Acoustic Consultant	Senior Acoustic Consultant	
Signature			
Authorised By	Conal Kearney	Conal Kearney	
Job Title	Head of Noise and Air	Head of Noise and Air	
Signature			
Project Number	AC109563-1r0	AC109563-1r1	

EXECUTIVE SUMMARY

Ensafe has been commissioned by DeTrafford Group to provide a Noise Impact Assessment to support a planning application for a residential development at Phoenix Works in Manchester.

A series of surveys have been undertaken in order to determine the existing levels of noise across the Site due to road traffic noise associated with Ellesmere Street and Chester Road on the proposed Apartment Buildings.

The Noise Impact Assessment has determined that no mitigation measures are required on behalf of external noise levels within the proposed rooftop terraces. However, mitigation measures are required for internal habitable rooms. The required mitigation measures are listed below:

- Higher specification glazing that has a performance of at least 32dB R_w+C_{tr} is required for bedrooms on the first 4 floors of the north-western façade overlooking Ellesmere Street; and
- An alternate means of ventilating habitable rooms that does not necessitate the opening of windows is required for the majority of the site.

All facades that require alternate ventilation are displayed in figures 4 and 5 of Appendix III.

The Noise Impact Assessment has determined that with mitigation measures in place, the NOAEL with noise being noticeable and not intrusive and with the following advice:

“Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.”

The assessment has been based on robust and worst-case assumptions. This assessment has shown that, in principle, there should be no adverse impact at the closest receptors as a result of the existing noise sources.

1.0 INTRODUCTION

1.1. Background

Ensafe has been commissioned by DeTrafford, Group to provide a Noise Impact Assessment to support a planning application for a residential development at Phoenix Works in Manchester, to be referred to hereafter as “the site”.

1.2. Site Location and Proposed Development

The site is located on a plot of land off of Ellesmere Street in Castlefield, Manchester among a series of other ongoing and completed DeTrafford developments. The site currently exists as construction site, to the west is a vacant commercial unit that is to be demolished and developed with DeTraffords Gallery Gardens Scheme.

The site is bound to the north by Ellesmere Street, to the east by the Roof Gardens DeTrafford residential development and to the south by the Sky Gardens DeTrafford residential development, beyond which lies the A56 Chester Road.

The key noise sources impacting upon the Site are vehicles using Ellesmere Street and the A56 Chester Road.

The proposed development includes for the construction of a multi storey apartment building along with car park, ground floor commercial units and ancillary works.

This assessment has been undertaken with due regard to the supplied planning layout shown on the following planning drawings:

- GA 00 – 12 Floor Plans BW (Dwg No: 20098-CW-B1-A-2200 to 2212) drawn by Corstorphine - Write Architects dated 16/07/2020; and
- GA Elevations (Dwg No: 20098-CW-B1-ZZ-DR-A-2030 to 2033) created by Corstorphine - Write Architects dated 07/08/2020.

The Layout Plans are shown in Figure 1 of Appendix III depicting the Noise Measurement Position.

1.3. Limitations

Where mitigation measures are specified in our report, it should be noted that these measures are relative to a specific sound source, both in terms of the measured sound pressure level and the character of the source. Where either the sound pressure level or the character of the sound varies following completion of the sound survey, Ensafe Consultants cannot be held responsible for any subsequent variations in the proposed mitigation performance.

Further limitations of this report are presented in Appendix I.

1.4. Confidentially

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

2.0 ASSESSMENT METHODOLOGY

2.1. National Planning Practice Guidance

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

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

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

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

The Observed Effect Levels are as follows:

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

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

Table 1: Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not Intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and Disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Effect	Avoid
Noticeable and Very Disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of	Unacceptable Adverse Effect	Prevent

	appetite, significant, medically definable harm, e.g. auditory and non-auditory		
--	---	--	--

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

These factors include:

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

More specific factors to consider when relevant:

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

2.2. British Standard BS8233:2014: Guidance on Sound Insulation and Noise Reduction for Buildings

Noise Criterion Limits

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

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

Error! Reference source not found.: **BS2233 Recommended Internal Noise**

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

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

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

BS8233 goes on to say:

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

Ventilation Requirements

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

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

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

Section 7.7.2 states:

"NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

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

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

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

The guidelines go on to state:

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

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

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

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

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

3.0 SURVEYS

3.1. Road Traffic Noise Survey – Chester Road

Ensafe has conducted a Road Traffic Noise Survey in order to measure the level of noise generated by vehicles using Chester Road. The Noise Survey took place over the following period:

- 10:21 until 13:21 on Monday 19th October 2020.

The following location was chosen for the survey:

- Noise Measurement Position 1 (NMP1): Located on a patch of grass to the south-west of the Site, approximately 4.3m from the nearest kerbside of Chester Road. The microphone was located 1.5m above ground level and in free-field conditions.

A summary of the measured sound pressure levels is presented below.

Table 3: Summary of Measured Road Traffic Noise Levels; NMP1

Period Start Time	Average Measured Sound Pressure Levels, Free-Field (dB)		10 th highest L _{Amax,fast}
	L _{Aeq,T}	L _{A10,T}	
10:21	73.9	76.9	¹ 87.9
11:21	74	76.9	
12:21	74.3	77.1	
L _{Aeq,16hr} as calculated from CRTN	74.0		
L _{Aeq,8hr} as calculated from CRTN and TRL Document	64.6		
¹ 10 th highest L _{Amax,fast} measured during the entire 3-hour period			

The L_{AMax} parameter tabulated is obtained by outputting the L_{AMax,f} parameter for each 1 minute interval during the 3 hour survey. These are ordered in declining intensity and the 10th highest selected.

3.2. Road Traffic Noise Survey – Ellesmere Street

Ensafe has conducted a Road Traffic Noise Survey in order to measure the level of noise generated by vehicles using Ellesmere Street. The Noise Survey took place over the following period:

- 10:57 until 13:57 on Wednesday 14th October 2020.

The following location was chosen for the survey:

- Noise Measurement Position 2 (NMP2): Located to the east of the Site, approximately 4m from the nearest kerbside of Ellesmere Street. The microphone was located 1.5m above ground level and in free-field conditions.

A summary of the measured sound pressure levels is presented below.

Table 4: Summary of Measured Road Traffic Noise Levels; NMP2

Period Start Time	Average Measured Sound Pressure Levels, Free-Field (dB)		10 th highest L _{Amax,fast}
	L _{Aeq,T}	L _{A10,T}	
10:57	64.4	67.6	177.5
11:57	63.8	65.7	
12:57	63.4	65.3	
L _{Aeq,16hr} as calculated from CRTN	63.3		
L _{Aeq,8hr} as calculated from CRTN and TRL Document	55.0		
1 10 th highest L _{Amax,fast} measured during the entire 3-hour period			

The L_{AMax} parameter tabulated is obtained by outputting the L_{AMax,f} parameter for each 1 minute interval during the 3 hour survey. These are ordered in declining intensity and the 10th highest selected.

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

The Noise Survey was completed using the following noise measurement equipment.

Table 5: Noise Measurement Equipment

Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
Sound Level Meter	01dB-Metravib Black Solo	11536	15 October 2021
Pre-amplifier	01dB-Metravib PRE 21 S	Internal	
Microphone	01dB Metravib MCE212	291871	
Calibrator	01dB-Metravib CAL-21	34975432	16 October 2021

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

4.0 NOISE IMPACT ASSESSMENT

4.1 Road Traffic Sound

For the purposes of this assessment, Ensaf have used noise modelling software, CadnaA 2019 MR2 to determine the impact of road noise from Ellesmere Street and Chester Road upon the proposed development.

As the DeTrafford developments that surround the site are due to be completed before first residency, they have been included in the noise model to accurately include the screening that the building envelopes will provide.

The following inputs have been included in the model:

- Proposed floor plans As described in section 1.2;
- Site elevations have been taken using 1m Lidar DTM data;
- Existing buildings and proposed DeTrafford buildings that provide shielding from any of the noise sources have been included in the model, DeTrafford development heights provided by client;
- A floor height of 3m has been assumed;
- A reflection order of 2 has been used in all calculations; and
- Noise levels generated using ISO 9613-1 and ISO 9613-2 “Acoustics – Attenuation of sound during propagation outdoors” as incorporated into CadnaA software.

4.1.1. External Amenity Area Noise Level Assessment

In order to assess the noise levels present in the proposed external amenity areas, receivers were placed at 1.5m high in the centre of each of the proposed roof terraces.

According to BS8233:2014, “It is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors might be warranted”. Therefore, due to the locality of the site and its proximity to a number of strategic transport networks, the appropriate criterion to achieve is 55dB.

Figure 2 determined that noise levels in the proposed roof terrace areas all fall below 55dB during the daytime periods. Therefore, no mitigation is required for these external amenity areas.

With no mitigation in place, the No Observed Adverse Effect Level (NOAEL), perceived as ‘noticeable and not intrusive’, would be achieved for these garden areas resulting in the following:

“Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life”

4.1.2. Internal Noise Level Assessment

In order to accurately determine the noise levels within habitable rooms, it has been necessary to calculate the external noise level immediately outside the façade resulting from road noise using a noise model.

With regards to internal noise levels, BS8233:2014 suggest that a glazing unit with configuration 6mm glass/12mm air space/6mm glass affords insulation performance in the order of 33dB however this is for a pink noise spectrum. The same unit, weighted for road traffic noise using the ‘+C_{tr}’ correction, has a sound insulation performance value

of approximately 30dB and so this value has been used to calculate internal noise levels. It also goes on to recommend that a partially open window provides approximately 15dB attenuation.

It can be seen in figures 4 and 5 that the façade levels on behalf of road noise reach a maximum of 63dB during the day and 55dB during the night. With standard thermal double glazing in place, these would result in internal levels of 33dB and 25dB respectively. These fall below the day and night time criteria for habitable rooms as set out in BS8233 and therefore no higher specification glazing is required on behalf of average hourly levels.

However, with regards to alternative ventilation, it has been assumed that the opening of windows would be required for fresh air flow and background ventilation. If windows are opened, it has been shown that the internal criteria for habitable rooms would be exceeded for most facades in the proposed buildings. Therefore, a system is required that provides fresh air flow and background ventilation to the habitable rooms with windows remaining openable for purge ventilation. The facades that require alternate ventilation are highlighted in blue in figures 4 and 5 of Appendix III.

With regard to the maximum instantaneous noise levels at night due to Ellesmere Street, the 10th Highest measured level at NMP2 was 77.5dB $L_{Amax,fast}$. A noise model has been run using this maximum noise level as a road source. The following table presents the instantaneous maximum levels at each of the facades overlooking Ellesmere Street.

Table 6 Internal Instantaneous Max Levels

Façade Orientation	Floor	Predicted Instantaneous Maximum Noise Level at the Façade, $L_{Amax,fast}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Amax,fast}$ (dB)	Difference with BS8233:2014 Internal Criterion, $L_{Amax,fast}$ (dB)
North West Overlooking Ellesmere Street	Ground	77	47	+2
	1 st	77	47	+2
	2 nd	77	47	+2
	3 rd	76	46	+1
	4 th	75	45	+0
	5 th	74	44	-1
	6 th	73	43	-2
	7 th	73	43	-2
	8 th	72	42	-3

Accordingly, with an instantaneous maximum internal level of 45 to 47dB L_{Amax} up-to the 3rd floor, standard glazing is found to be insufficient for proposed bedrooms on these facades. As such higher specification glazing is required on behalf of maximum instantaneous noise levels from Ellesmere Street.

Additionally, there would be an internal level of up-to 62dB $L_{Amax,fast}$ with windows open, leading to a +17dB exceedance. Accordingly, an alternate means of ventilation would be required for all bedrooms overlooking Ellesmere Street on behalf of instantaneous maximum levels.

Without mitigation in place, LOAEL is achieved which would be noticeable and disruptive resulting in the following while windows are partially opened:

“Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance”.

Exact mitigation requirements are discussed in Section 5.0.

5.0 MITIGATION

5. Internal Habitable Rooms

It has been shown in section 4 that higher specification glazing is required on behalf of maximum instantaneous road noise during the night-time period for the north western facing façade overlooking Ellesmere Street.

The specifications for the higher performance glazing required in habitable rooms are presented below.

Table 7 Higher Specification Glazing Requirements

Façade Orientation	Floor	Predicted Instantaneous Maximum Noise Level at the Façade, $L_{Amax,fast}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Amax,fast}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 45dB $L_{Amax,fast}$ (dB)	Higher Specification Glazing Performance $R_w + C_{tr}$ (dB)
East	Ground	77	47	+2	32
	1 st	77	47	+2	32
	2 nd	77	47	+2	32
	3 rd	76	46	+1	31

Additionally, the previous section determined that daytime and night-time internal noise limits are exceeded for many facades when windows are open. These facades are marked up on Figure 4 for daytime amenity, and Figure 5 for bedrooms.

Accordingly, it is necessary to consider an alternative ventilation scheme which does not require the opening of windows to provide fresh air flow and background ventilation and matches the noise reduction provided by the windows.

The exact requirement for alternative ventilation ultimately falls to the developer and, from an acoustics perspective, needs to ensure that fresh air flow can be achieved without the need for opening windows. It is necessary to meet the requirements given in BS8233:2014, Section 8.4.5.4, which states that:

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

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

Section 7.7.2 states:

“NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.”

With mitigation in place, it is concluded that the NOAEL is achieved which would be noticeable and not intrusive resulting in the following:

“Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.”

6.0 CONCLUSION

Ensafe has been commissioned by DeTrafford Group to provide a Noise Impact Assessment to support a planning application for a residential development at Phoenix Works in Manchester.

A series of surveys have been undertaken in order to determine the existing levels of noise across the Site due to road traffic noise associated with Ellesmere Street and Chester Road on the proposed Apartment Buildings.

The Noise Impact Assessment has determined that no mitigation measures are required on behalf of external noise levels in the proposed rooftop terraces. However, mitigation measures are required for internal habitable rooms. The required mitigation measures are listed below:

- Higher specification glazing that has a performance of at least 32dB R_w+C_{tr} is required for bedrooms on the first 4 floors of the north-western façade overlooking Ellesmere Street; and
- An alternate means of ventilating habitable rooms that does not necessitate the opening of windows is required for the majority of the site.

All facades that require alternate ventilation are displayed in figures 4 and 5 of Appendix III.

The Noise Impact Assessment has determined that with mitigation measures in place, the NOAEL with noise being noticeable and not intrusive and with the following advice:

“Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.”

The assessment has been based on robust and worst-case assumptions. This assessment has shown that, in principle, there should be no adverse impact at the closest receptors as a result of the existing noise sources.

END OF REPORT

APPENDIX I - LIMITATIONS

LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between Ensaf e and the Client as indicated in Section 1.2.
2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
3. Ensaf e cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by Ensaf e is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by Ensaf e in this connection without their explicit written agreement there to by Ensaf e.
4. Where a noise survey is required to inform the assessment, Ensaf e will endeavour to ensure that all noise measurements taken are robust, representative and reliable in order to inform an accurate noise impact assessment. Where limitations or constraints exist which prevent a suitable noise survey being completed, Ensaf e will take all reasonable steps to make the client fully aware of any such limitations or constraints with a view to achieving the best possible outcome for the client. Where additional sound surveys are required, over and above those specified in our scope of works, then Ensaf e reserves the right to charge additional fees.
5. Where mitigation measures are specified in our report, it should be noted that these measures are relative to a specific sound source, both in terms of the measured sound pressure level and the character of the source. Where either the sound pressure level or the character of the sound varies following completion of the sound survey, Ensaf e cannot be held responsible for any subsequent variations in the proposed mitigation performance.

APPENDIX II – GLOSSARY OF ACOUSTIC TERMINOLOGY

NOISE

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

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

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or LAeq, LA90 etc., according to the parameter being measured.

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

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

Table A1: Typical Sound Pressure Levels

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

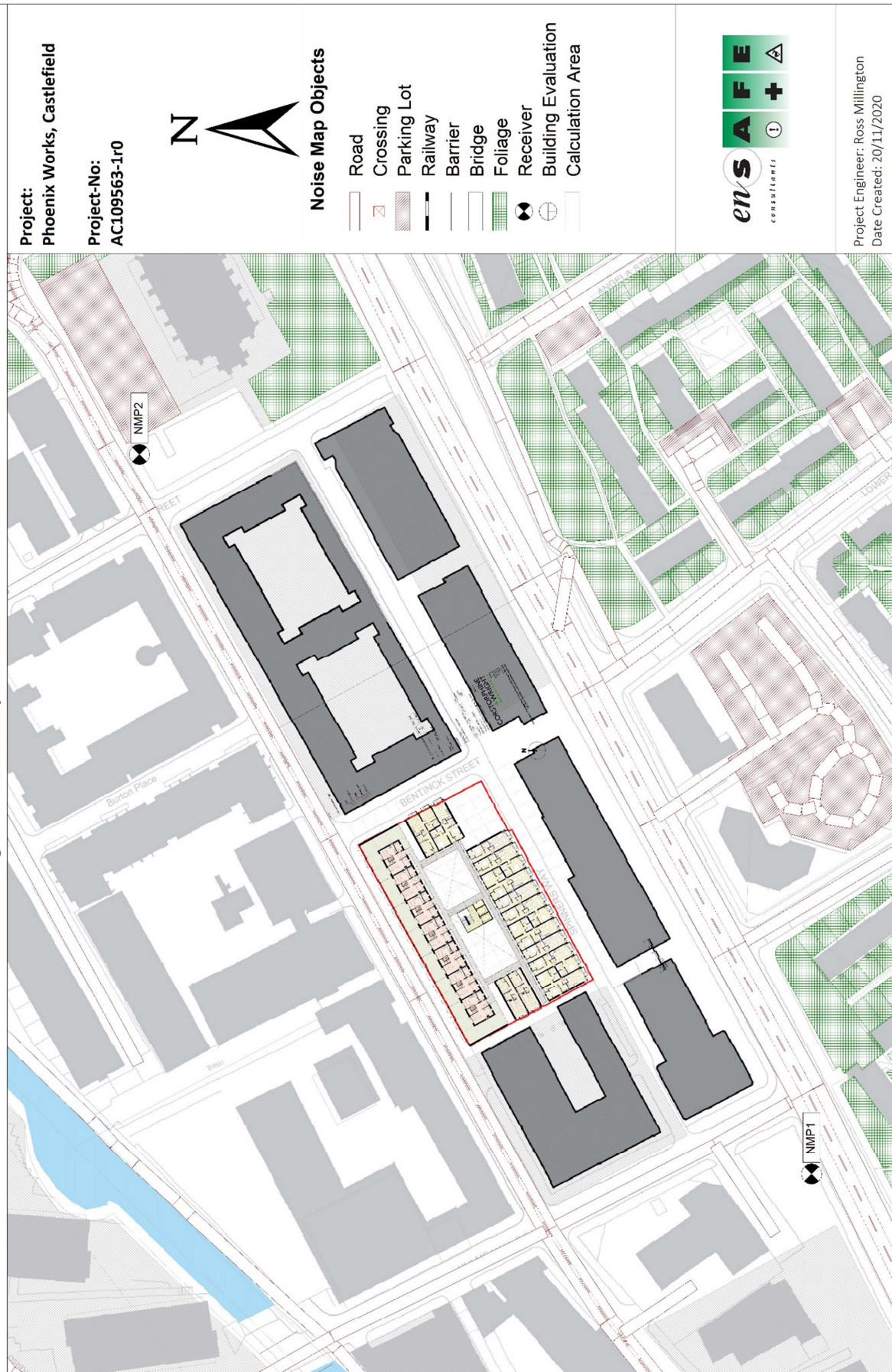
ACOUSTIC TERMINOLOGY

Table A2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10 ⁻⁵ Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
L _{Aeq, T}	L _{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L _{Amax}	L _{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L _{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L ₁₀ & L ₉₀	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L ₁₀ is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L ₉₀ is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L ₁₀ index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally, this is measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX III – FIGURES

Figure 1 - Noise Survey Measurement Positions



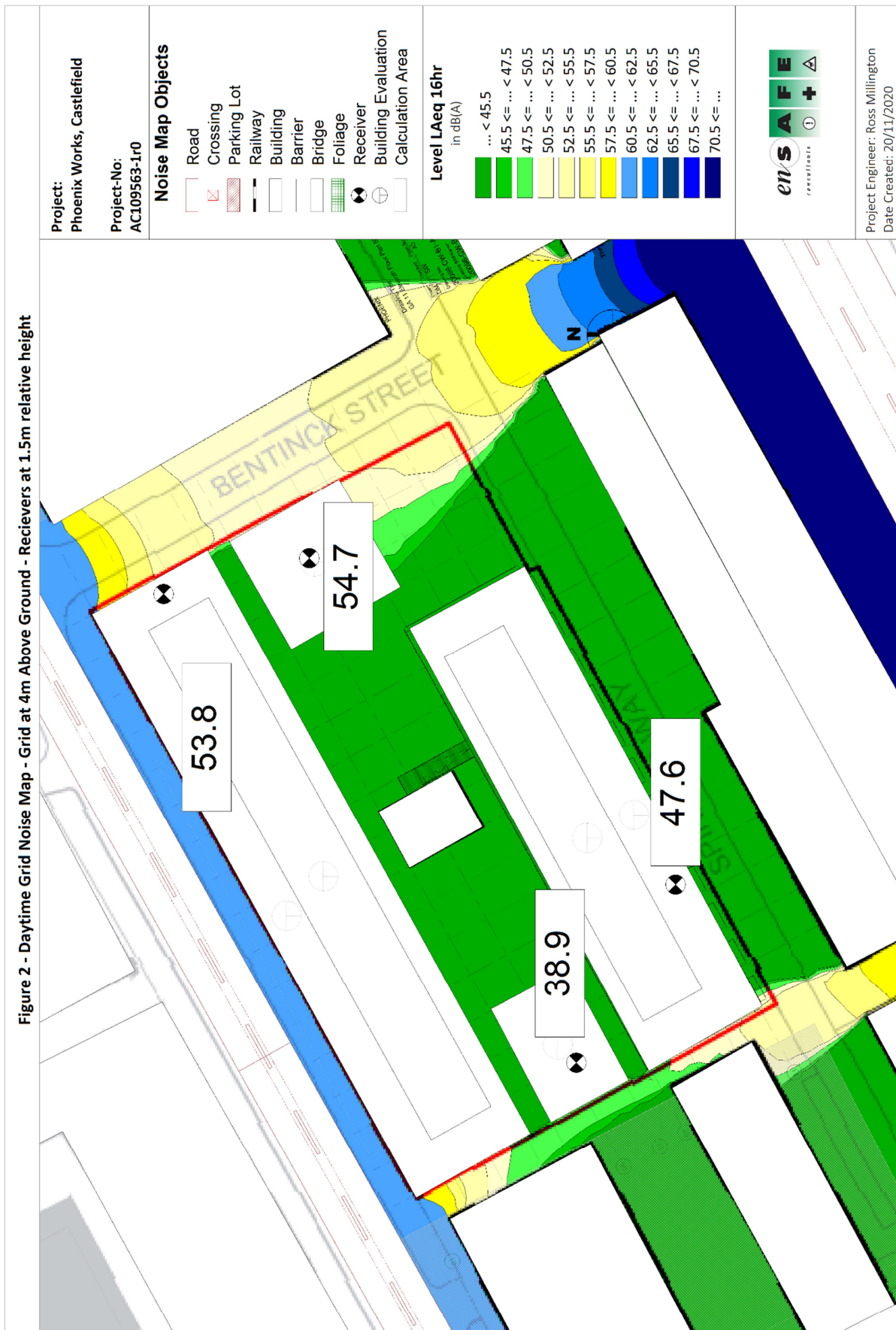


Figure 3 - Night-time Grid Noise Map - Calculation at 4m Above Ground



Figure 4 - Daytime Facade Evaluations - Blue = Alternate Ventilation, Orange = Higher Spec Glazing

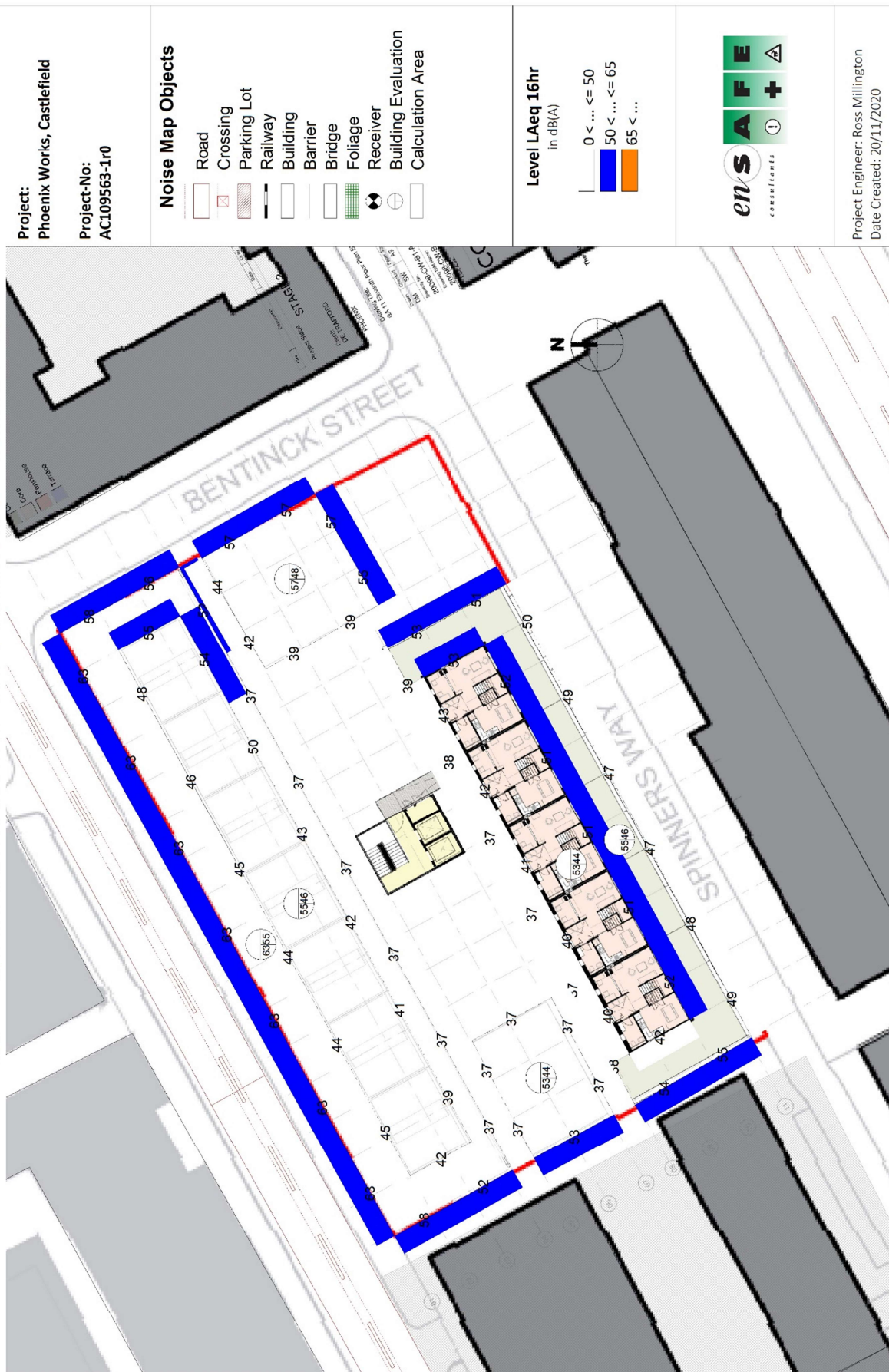


Figure 5 - Night-time Facade Evaluations - Blue = Alternate Ventilation, Orange = Higher Spec Glazing

