Acoustic Planning Report

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PROJECT:

EXETER AIRPORT COMMERCIAL SITE
WESTCOTT LANE
DEVON
EX5 2UL

CLIENT:

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Contents

Executive Summary

Planning permission is being sought for the redevelopment of land near Exeter Airport, Devon. The development plans remain flexible to some degree, but it is expected to comprise of several B2 class industrial units and also a few larger B8 units, all with associated car parking and hard standing. There is also potential for relatively small ancillary offices to be included within the development.

A noise assessment has been undertaken to establish maximum operational noise limits applicable to building services systems introduced as part of the proposed development, and to assess the levels of environmental noise ingress in the potential offices to enable indicative façade sound reduction specifications to be developed to demonstrate that appropriate internal noise levels can be achieved that are conducive to office working conditions.

To facilitate these assessments, baseline noise surveys have been undertaken at the site to establish and quantify the prevailing noise climate at, and around the site. Noise monitoring results confirm the dominant noise sources of the area to be road traffic movements along major local roads (e.g. A30) and noise from regular scheduled aircraft movements to, from and within Exeter Airport.

With regards to building services plant, and in lieu of specific applicable noise standards required by East Devon Council, suitable plant noise emission limits have been specified in accordance with standard industry guidance documents. These are the noise limits that must be achieved by the fixed building services systems, cumulatively, 1 m external to the identified key noise sensitive receptors. The noise criteria are expected to be achievable through the careful selection of plant items and appropriate noise control measures.

At the request of a representative of Exeter Airport, preliminary façade sound insulation calculations have been conducted for the potential ancillary offices. Calculations indicate that on the most exposed office façade (overlooking the Exeter Airport runway) would require a glazing package achieving 49 R_w (Ctr: -4, C: 1), assuming offices are small and cellular with typical room finishes – this is considered to represent a worst-case. As the development remains flexible, calculations of noise ingress have also been conducted for other, more shielded facades, which calculations indicate would require a lower-performing glazing package achieving 31 R_w (Ctr: -4, C: -1), as a minimum. Ventilation and temperature control is expected to be provided by mechanical means and therefore no façade openings have been included for in these assessments.

1. Introduction

This noise assessment has been prepared by Hilson Moran on behalf of Paragon in support of an application to obtain planning permission to redevelop land near Exeter Airport, Devon. The proposed development will comprise of several B2 class industrial units and also a few larger B8 units, all with associated car parking and hard standing. There is also potential for relatively small ancillary offices to be included within the development.

This assessment considers the proposed development within the context of existing properties in the area and considers the potential impacts of the development on nearby noise sensitive receptors (NSRs). The suitability of the site for potential ancillary offices is also considered in outline with respect to noise ingress.

As part of the assessment the following works have been carried out:

- Correspondence with East Devon Council (EDC) over the preparation of this study to confirm the local authority's noise assessment requirements.
- Undertaking of baseline environmental noise surveys to quantify the existing climate affecting the site and at nearby sensitive receptors.
- Specification of appropriate noise emission limits for new fixed building services plant to adhere.
- Provision of outline recommendations for the control of noise emissions from building services to be considered and developed upon during the design stages, where appropriate.
- A preliminary façade sound insulation assessment to provide early indication of the façade performance required to control noise ingress to suitable levels in office working areas.

A glossary of the acoustic terminology used in this report is presented in Appendix A.

2. The Site, Site Setting and Proposed Development

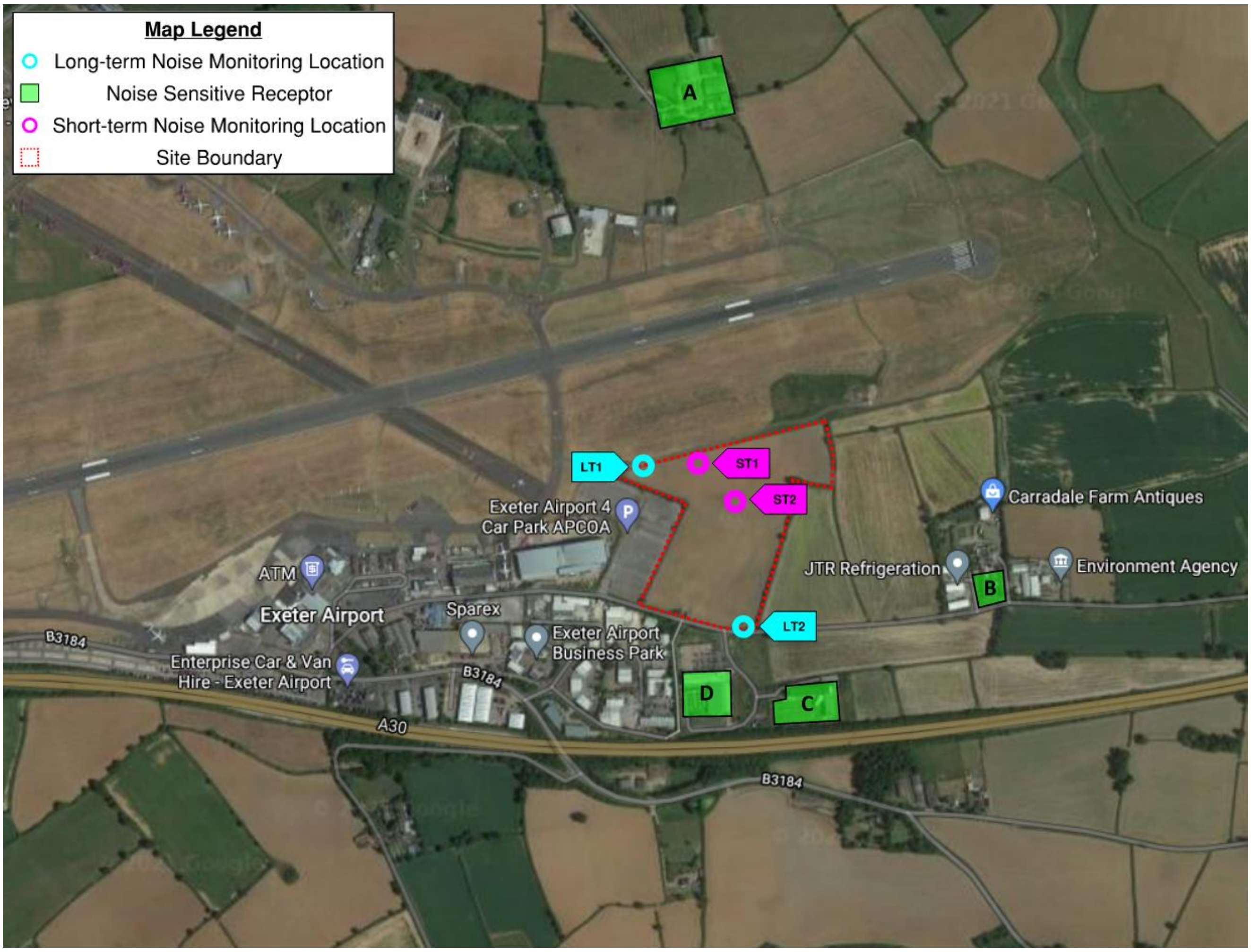
2.1. Site Description

The application site (National Grid Reference SY 00859 93382) is approximately 7.5 hectares in area and is currently green field land situated near Westcott Road, Cyst Honiton, Cranbrook, East Devon EX5 (hereby the 'Proposed Development').

The site is bound to the north and west by Exeter Airport and associated facilities. Existing commercial units are located immediately to the south of the site. Further afield, the site is surrounded by a large portion of agricultural land to the north and east. The A30 is located approximately 0.2km south of the development site.

The site location map is illustrated in Figure 2.1, showing the location of the site and orientation with respect to other existing developments and road network for the area.

Figure 2.1: Site and Noise Sensitive Receptor Locations



2.2. The Noise Climate

Road traffic movements along the A30 and local road networks contribute to the ambient noise levels on site. Aircraft movements associated with Exeter Airport dominate the maximum noise levels measured, but these should be considered individual, but regular noise events. Background noise levels at NSRs B, C and D are dominated by road traffic movements to the south of the Site. The noise climate at NSR A, although not directly observed, is expected to mainly comprise of local road traffic movements, with maximum levels dominated by the activities associated with Exeter Airport.

2.3. Noise Sensitive Receptors

For planning purposes, the impact of the noise emission from the Proposed Development on existing sensitive receptors in the vicinity of the site needs to be assessed. Noise Sensitive Receptors (NSRs) are defined as properties that are most at risk of potential noise impact, such as residential dwellings, hotels, healthcare facilities, schools, etc. Where many NSRs are present in one area, it is appropriate to assume the noise levels at the nearest NSRs to the Proposed Development represent the level at NSRs further away. The nearest NSRs identified to the Proposed Development are described in Table 2.1.

Table 2.1: Noise Sensitive Receptors

Receptor Location (Figure 2.1)	Description	Approximate Distance from Site Boundary
A	Treasbeare Farm (Diary farm)	556 m to the north
B	Residential Dwellings	354 m to the east
C	Hampton By Hilton Airport (Hotel)	128 m to the south-east
D	Virtual Job Centre (Flight school)	100 m to the south

2.4. Proposed Development

Development layout plans are not yet fixed however reference should be made to the illustrative masterplans in Figure 2.2 below. In principle, the development will comprise several B2 class industrial units and also a few larger B8 units, all with associated car parking and hard standing. There is also potential for relatively small ancillary offices to be included within the development. New items of fixed external building services plant will also be introduced as part of the development.

Figure 2.2: Illustrative Masterplan (subject to change)

3. Planning Policy and Guidance

When selecting appropriate criteria for assessment, reference has been made to relevant planning policy, regulation and guidance concerning the Proposed Development. Due consideration of advice contained within the National Planning Policy Framework (NPPF), the Noise Statement for England (NPSE) and Noise Planning Practice Guidance, although no specific numerical criteria are detailed in these documents.

With regard to acoustic design and noise control, the NPPF provides a set of overarching aims, broadly reflecting already contained in the NPSE. They are directed towards the avoidance of significant adverse impacts and reduction of other adverse impacts on health and quality of life; set within the context of the government's policy on sustainable development.

Relevant legislation, policy and guidance documents are described in further detail in Appendix B of this report.

3.1. Building Services Noise Emission Criteria

We corresponded with Robert Parkinson of the environmental health team at EDC on the 6th April 2021 in order to agree the assessment approach and establish the council's requirements regarding noise from the Proposed Development. The Council requested that noise limits be set, and the impact of noise from the development be assessed according to BS 4142:2014. There is no numerical criteria or standard plant policy adopted by the Council, and therefore Hilson Moran has developed the criteria based on relevant industry standards.

In absence of standard plant noise policy, HM has set appropriate noise level limits which the cumulative level of noise from external building services must be controlled to meet at nearby sensitive properties.

3.2. Noise Ingress Assessment Criteria

We are not aware of any planning requirements EDC have with regards to noise ingress into commercial development. However, it has been requested by a representative of Exeter Airport that an assessment of noise ingress be conducted to establish if the Site is suitable for the potential ancillary office development, given its proximity to the main airport runway (~200 m).

In selecting suitable noise ingress criteria for the offices, consideration has been given to the guidance from British Council for Offices (BCO) *Guide to Specification*. Based on the current (2019) and previous (2011) versions of this document, we recommend noise ingress is controlled so as not to exceed NR L_{eq} 35 dB, assuming a cellular office as a worst-case, when finished, unfurnished and unoccupied. In addition, BCO recommends that consideration should also be given to regular individual noise events – e.g. scheduled aircraft. The current version of BCO *Guide to Specification* recommends noise from such events should be controlled so as not to exceed 50 dB $L_{A01,1hr}$ in cellular offices. However, due to the proximity of the development to the airfield, compliance with the criterion is likely to result in L_{AFmax} events (typically higher than the $L_{A01,1hr}$ metric) that could be disruptive to working activities. We would therefore recommend that a more onerous noise ingress standard is achieved. Taking influence from the previous version of BCO *Guide to Specification* (2011 version), we recommend noise ingress levels from the airport are controlled so as not to exceed 50 dB L_{AFmax}, assuming a small cellular office, as a worst-case.

From a review of our various datasets obtained during the baseline surveys described herein, and the proposed noise ingress criteria above, it is clear that the sound reduction required to comply with the L_{AFmax} noise criterion will be significantly higher than that required to achieve the internal NR L_{eq} criterion. The latter will therefore be expected to be achieved by default through compliance with the former. Consequently, to keep the assessment herein succinct, only noise ingress of L_{AFmax} noise levels are considered further as these are likely to dictate the performance of the façade system. As the purpose of this assessment is to establish the façade acoustic requirements with respect to controlling noise ingress from the airport operation, other environmental sources have been excluded from the assessment.

4. Baseline Noise Conditions

Environmental noise surveys have been undertaken at the proposed development site to determine prevailing noise levels affecting the site and its surroundings.

4.1. Survey Strategy

Long-term unattended noise monitoring was carried out at the Site between Thursday 8th April and Friday 9th April 2021 over a 72-hour period. The purposes of these measurements was to establish and quantify the existing noise climate in and around the Site, including locations representative of the identified NSRs.

Additional short-term attended noise monitoring was carried out at the Site on Wednesday 20th July 2022. These measurements were focused on capturing noise levels associated with aircraft movements to, from and within Exeter Airport and to verify the previous measurements, which were unavoidably conducted during a time when national COVID restrictions were in place, which may have affected the regularity and type of aircraft leaving from and arriving to the airport. All monitoring positions are described in Table 4.1 and illustrated in Figure 2.1.

Table 4.1: Description of Noise Monitoring Locations

Monitoring Location (Figure 2.1)	Period	Description	Observations and Predominant Noise Sources
LT1	72 hours	Free-field measurement at the north west site boundary. Microphone affixed to a perimeter fence post at a height of 2.5m above ground level (AGL).	Road traffic noise from A30 and local roads contributes to the ambient noise climate at the measurement location. Maximum noise events are typically from ground and airborne activities associated with Exeter Airport. Nature sounds contribute to the noise climate in quieter periods.
LT2	72 hours	Free-field measurement at the south east site boundary. Microphone fixed in a position 1.0m from the roadside and 2.0m AGL.	Road traffic noise from A30 is audible at this position in the measurement location, as are traffic movements from the local road network. Maximum noise events are typically from vehicle noise along the unnamed road to the south of the site.
ST1	2 hours	Free-field measurement at the north of the site. Microphone fixed to a tripod 5.0m from the perimeter fence and 1.5m AGL.	Road traffic noise from A30 dominates in the measurement location. Maximum noise events are typically from ground and airborne activities associated with Exeter Airport. Nature sounds contribute to the noise climate in quieter periods.
ST2	2 hours	Free-field measurement at the north of the site. Microphone fixed to a	Road traffic noise from A30 dominates in the measurement location.

		tripod 30.0m from the perimeter fence and 1.5m AGL.	Maximum noise events are typically from ground and airborne activities associated with Exeter Airport. Nature sounds contribute to the noise climate in quieter periods.

All measurements of noise were undertaken in accordance with BS 7445-1:2003 which defines parameters, procedures and instrumentation required for noise measurement and analysis. Each Class 1 sound level meter was set-up to continuously record, integrating over 125 ms fast response time constant intervals the L_{eq}, L_{90}, L_{10}, L_{Fmax} and L_1 noise indices in the A-weighting network for the duration of the survey. These indices describe in turn the average, background, road traffic, maximum and maximum noise level that discounts one-off events. Full details of the instrumentation used for the noise measurements, including equipment calibration certificates are available on request.

Meteorological conditions were noted to be appropriate for the measurement of environmental noise, being clear and dry with only light prevailing winds ($<5^{-2}$ m/s).

4.1.1. Long-term Noise Survey Results

The full results of the long-term noise measurements are displayed graphically in time-history format in

Figure 4.1 and Figure 4.2, whilst a summary of the measured daytime (07:00 to 23:00 hours) and night- time (23:00 to 07:00 hours) noise levels for the survey period are provided in Table 4.2.

Table 4.2: Summary of Measured Noise Levels

Position	Duration	dB $L_{Aeq,5mins}$	dB $L_{A10,5mins}$	dB $L_{A90,15mins}$	dB $L_{AFmax,5mins}$
		Ave[1]	Ave[2]	Range (Ave[2])	Range (15th Highest[3])
LT1	Daytime, 16 hours	63	57	42 – 72 (49)	47 – 97 (80)
	Night-time, 8 hours	56	52	39 – 55 (44)	49 – 88 (62)
LT2	Daytime, 16 hours	62	62	47 – 62 (54)	61 – 89 (81)
	Night-time, 8 hours	57	58	42 – 57 (46)	58 – 82 (70)

Notes: [1] Logarithmic average over the survey period; [2] Arithmetic average over the survey period; [3] 15th Highest value taken over the survey period, considered representative of the highest noise level experienced excluding anomalies

Figure 4.1: Noise Level Time History at Position LT1

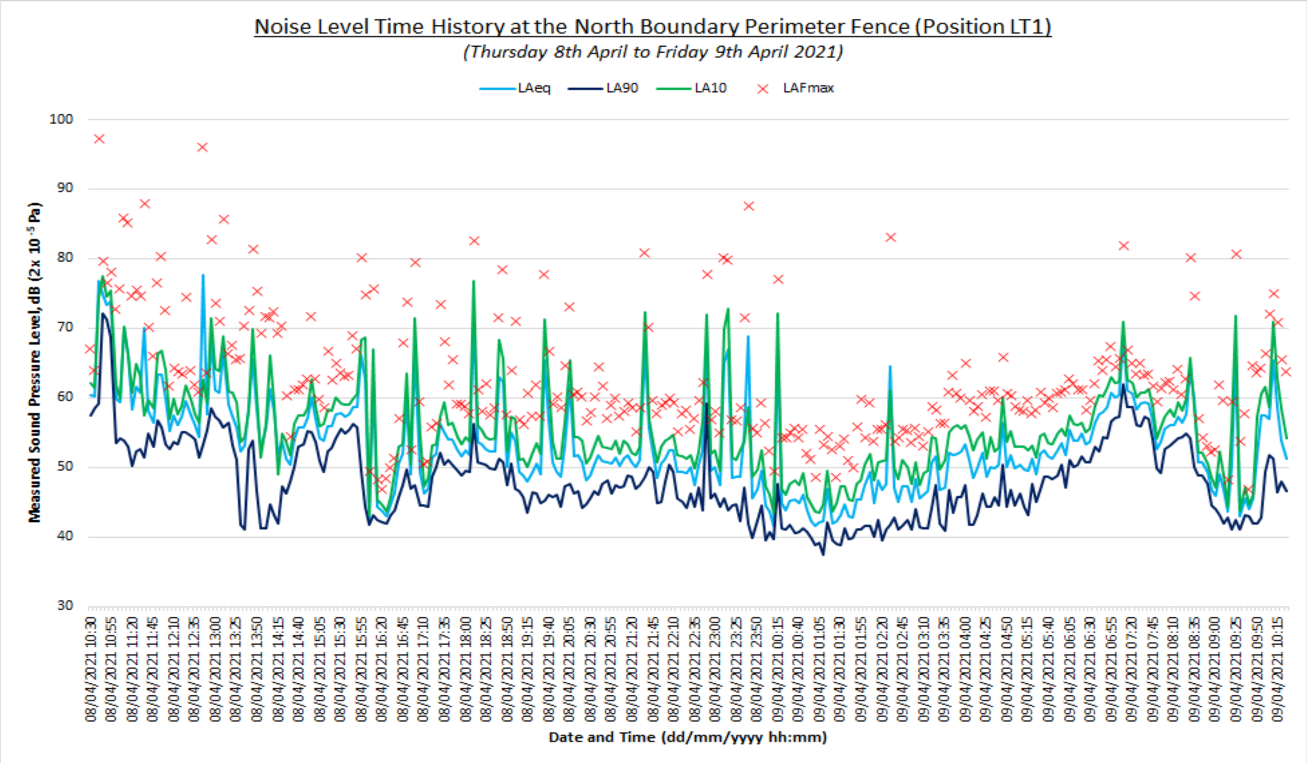
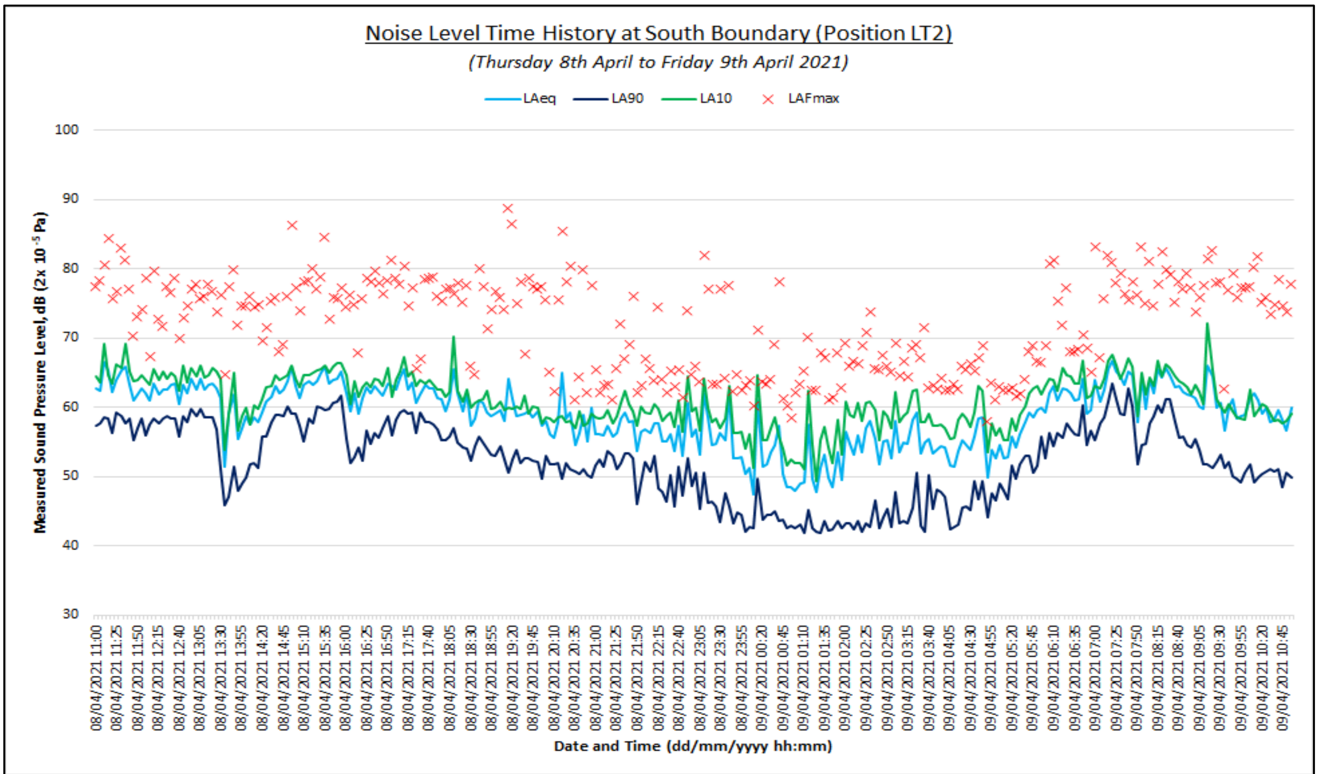


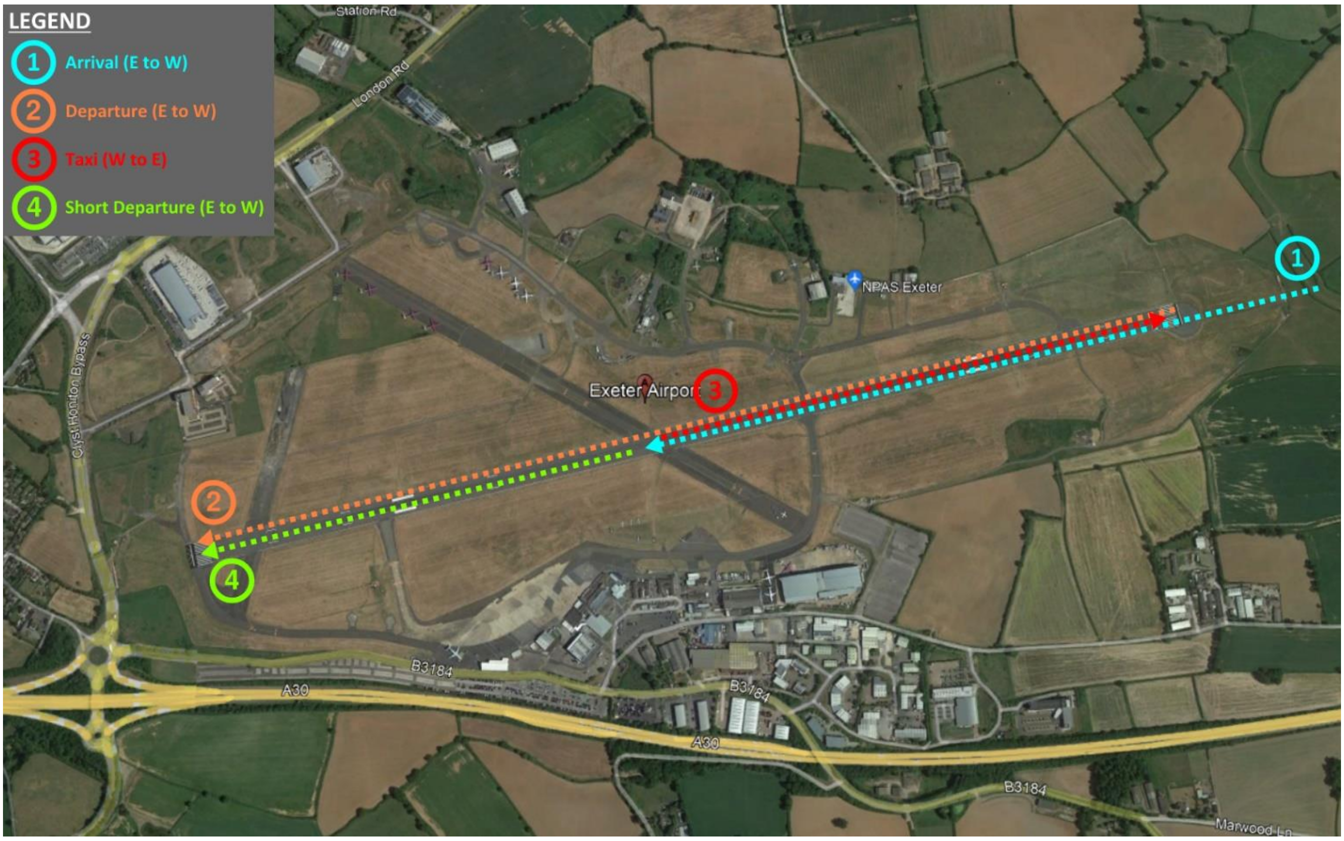
Figure 4.2: Noise Level Time History at Position LT2



4.1.2. Short-term Noise Survey Results

The highest measured L_{AFmax} noise levels for the short-term survey period are tabulated in Appendix C. Figure 3.3 shows the various aircraft movements observed during the short-term noise survey. These are considered to capture all typical movements performed within the airport.

Figure 4.3: Location Plan Indicating Measured Aircraft Movements



5. Building Services External Noise Emissions

At this stage in the design of the development, specific details of the type, number and configuration of new building services plant are not available. Therefore, it is not currently possible to undertake predictions to determine whether the noise standards might be met by the proposed building services installations. Therefore, noise emission limits to which plant should adhere have been set, based on the results of the baseline noise survey (see Section 4) and the external noise emission requirements (see Section 3).

In absence of standard plant noise criteria from the local authority (East Devon Council), Hilson Moran have proposed noise limiting criteria based on the most relevant industry standard guidance available.

BS4142:2014+A1:2019 provides a methodology for the rating and assessing industrial and commercial noise. In brief, a noise rating level is established based on characteristics of the specific noise from new sources introduced as part of the proposed development. This rating level is then compared to the existing background noise level at surrounding sensitive property to assess the impact of noise from the proposed development. In alignment with BS 4142, an appropriate plant noise rating level limit is established in this section.

BREEAM New Construction 2018 Pol 05 'Reduction of Noise Pollution' seeks to minimise nuisance noise to neighbours and local wildlife from new development. The assessment criteria for Pol 05 states that:

'the noise level from the assessed building, as measured in the locality of the nearest or most exposed noise-sensitive development, must be at least 5 dB lower than the background noise throughout the day and night.'

Therefore, we propose that the cumulative contribution of noise from all fixed items of building services plant associated with the Proposed Development is controlled so as not to exceed the limits presented in Table 5.1 at a position 1.0m from the windows of the identified NSRs.

Table 5.1: External Cumulative Plant Noise Level Limits

Location	Period[1]	Measured Background Noise Level, L_{A90}	Plant Noise Rating Level, $L_{Ar,Tr}$ dB
NSR A	Daytime (07:00–23:00)	49	44
	Night-time (23:00-07:00)	44	39
NSR B, C and D	Daytime (07:00–23:00)	54	49
	Night-time (23:00-07:00)	46	41

Notes: [1] Building services plant is anticipated to normally operate during the daytime period due to the nature of the proposed businesses, however night-time noise limits are provided for completeness.

The emissions from plant introduced as part of the proposed development should be rated in accordance the methodology in BS 4142:2014+A1:2019, including corrections applied to account for acoustic characteristics that are discernible at the receptor locations. Note these limits are subject to agreement by EDC.

5.1. Indicative Mitigation Guidance

At this stage, it is expected that the building services design is sufficiently flexible so that it can incorporate the necessary noise control measures needed to meet the limits above. The following measures are typically provided as standard, where appropriate, and should therefore be considered at this early stage:

* Selection and procurement of modern, high-quality low noise equipment.
* Housing of equipment that generates significant noise emissions internally within a plant room or plant area to help reduce their noise levels at identified sensitive receptors.

* Strategic zoning of plant, with consideration of the most favourable orientation, natural screening, distance, etc.
* Provision of proprietary acoustic screening.
* Use of plant enclosures where necessary.
* Installation of appropriately sized ductwork silencers.
* Application of acoustic lagging on exposed ductwork where if significant noise breakout is likely.

6. Indicative Assessment of Noise Ingress into Potential Offices

6.1. Establishment of External Design Values

In establishing appropriate maximum (L_{Fmax}) external noise levels upon which to base the noise ingress calculations, the five highest measured noise events during the short-term attended surveys conducted on Wednesday 20th July 2022 have been logarithmically averaged. A logarithmic average was used as a worst case as it provides an average in each octave band which is influenced most strongly by the highest value of the averaged dataset. Consequently, the levels used in the noise ingress calculations are considered to represent the typical highest L_{Fmax} noise levels measured in each octave band. Table 6.1 below presents the five highest measured noise levels at ST1 and ST2 used in the assessment.

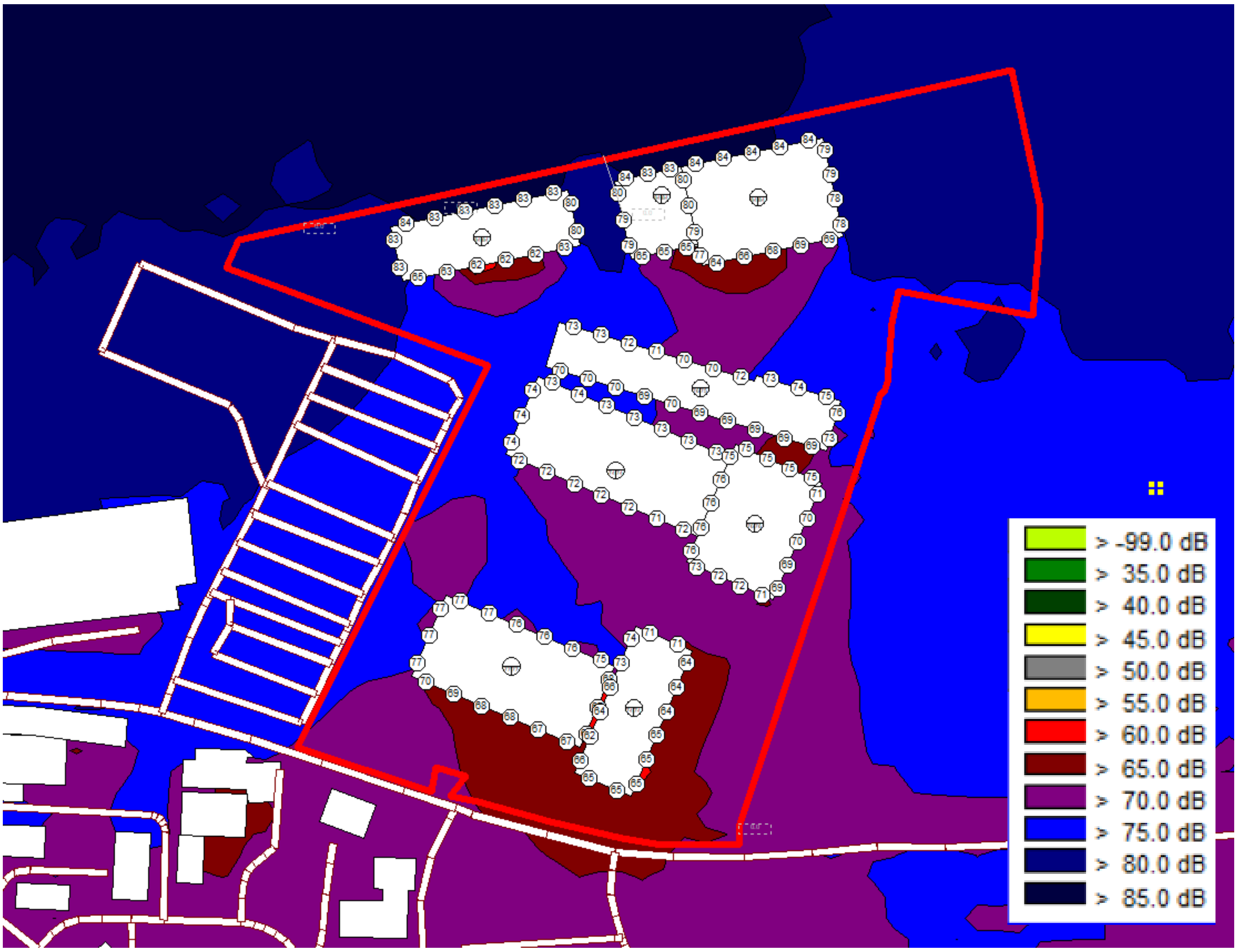
Table 6.1: Five Highest L_{Fmax} Noise Levels Measured

#	Movement Type	Aircraft Type	Monitoring Location	Maximum Measured L_{AFmax} Noise Level (dB)								
				63	125	250	500	1k	2k	4k	8k	dBA
1	2	Commercial Jet	ST1	85	78	71	80	83	80	76	69	86
			ST2	82	75	69	78	83	77	71	61	85
2	N/A	Helicopter Flyover	ST1	82	78	73	81	81	74	66	46	83
			ST2	76	81	74	70	76	72	70	56	81
3	2	Small Jet	ST1	75	67	65	74	79	76	70	61	82
			ST2	71	63	58	67	73	70	75	52	79
4	2	Small Jet	ST1	64	57	54	62	71	76	77	74	82
			ST2	68	60	62	76	78	72	69	59	80
5	N/A	Helicopter Flyover	ST1	75	85	77	82	78	70	65	53	82
			ST2	73	78	76	79	75	67	61	49	79
-	**LOG AVERAGE**		**ST1**	**80**	**77**	**72**	**79**	**80**	**76**	**73**	**68**	**84**
			ST2	**77**	**77**	**72**	**77**	**79**	**73**	**71**	**57**	**82**

6.2. Noise Modelling Results

A three-dimensional computer model of the Proposed Development has been developed using acoustic software package CadnaA to predict and illustrate the levels of noise associated with aircraft movements that are likely to be experienced at the different office facades. The model was constructed using the architectural development layout plans, allowing for indicative building heights. The output of the model has been calibrated with the highest measured L_{AFmax} noise results presented in Table 6.1 to provide reliable predictions. The modelled noise contour plot is shown below showing the highest predicted L_{AFmax} values emitted from the airport at each building façade and across the Site.

Figure 5.1: Noise Contour Plot showing Predicated L_{AFmax} Noise Levels from Exeter Airport on Development



The different coloured noise bands correspond to different levels of noise exposure, with the highest exposures broadly relating to where the Site extends closest to and has the clearest line of sight to the airport and A30. Modelled noise levels indicates the worst-affected façades to be those facing to the north where highest daytime noise levels of 62 dB $L_{Aeq,8hr}$ and 84 dB L_{max} are experienced.

The degree of external environmental noise intrusion into internal areas depends on the acoustic performance of all elements of the façade, but it is generally determined by the components providing the least airborne sound insulation, in this case the glazing.

Preliminary calculations have been conducted to determine the likely sound reduction requirements of the external building fabric of the potential office areas, with a view of achieving the noise ingress targets specified in Section 3.2. Calculations have been undertaken for a worst-case (noisiest) and best-case (quietest) façade to demonstrate the variation of noise ingress across the Proposed Development and to enable flexibility in the positioning of office spaces in this final development layout.

As the scheme layout and design is currently in its early stages, the noise ingress calculations have been based on a number of reasonable assumptions, which can be summarised as follows:

* To provide favourable working conditions are provided, assessment has been based on measured daytime L_{max} noise levels during typical working hours (9AM – 5PM), considering the highest maximum noise levels expected to be caused by aircraft movements to and from Exeter Airport.

* The external non-glazed façade elements to the office spaces are assumed to achieve an acoustic performance of at least $R_w + C_{tr}$ 50 dB, typical of a masonry construction or suitably treated lightweight cladding finish.
* The internal layouts and elevations for the scheme are not yet fixed. We have therefore based calculated noise ingress levels on an 80% glazed area. If the glazed areas were to change by +/- 10% of the façade area, then the performance of the glazing units would need to change accordingly.
* Mechanical ventilation and temperature will be provided to the offices, removing the need for passive façade openings.
* The internal finishes of the room will affect the reverberant component of the overall noise levels. A conservative assumption has been made in that surface finishes will reflect those expected in a typical modern office space, including a carpeted floor, plasterboard walls, glazing and exposed services and structural soffit.
* The location of the offices are not yet fixed, although they have been shown, indicatively in Figure 2.2. To enable flexibility in the final development layout, it has been assumed that offices could be located along any building façade and could have access to up to two facades.

Based on the assumptions above, Table 6.2 below presents the indicative minimum sound reduction performances required by the different office façades in terms of a Weight Sound Reduction Index (R_w) – a single number quantity used to characterise the airborne sound insulation performance of a system or material over the frequency range 100 to 3150 Hz, with a C_{tr} and C adjustment factors (negative numbers) used to take account of the low and high frequency noise reduction characteristics of the chosen glazing system, respectively.

Table 6.2: Indicative Sound Reduction Specifications for Offices

Elevation	Parameter (airport noise)	Predicted Highest Façade Noise Level (dB)	Target Internal Noise Criteria (dB)	Minimum Sound Insulation of Glazing, dB R_w (Ctr; C)	Example Glazing Configuration
North (Exeter Airport)	Highest Daytime L_{max}	84	$\leq L_{AFmax}$ 50	49 (-4; -1)	10/200/6
South (A30)	Highest Daytime L_{max}	65	$\leq L_{AFmax}$ 50	31 (-4; -1)	4/12/4

Please note that the glazing specifications and zoning provided in this report are purely indicative to show that the require internal noise levels can be met from airport sources, in principle, for planning purposes. During the details design phase of the project, a more detailed noise ingress assessment must be undertaken and used to identify the detailed zoning and specification of external façade build-ups and window types. This assessment should identify the minimum octave band sound insulation performance for all external façade elements where noise ingress into the building is a concern.

7. Conclusions

A noise impact assessment has been conducted by Hilson Moran for the redevelopment of land near Exeter Airport, Devon.

As part of the assessment, noise measurements were undertaken in and around the site to establish and quantify the prevailing noise levels in the area to enable the calculation of limiting building services at key noise sensitive receptors, to which the development should adhere, and to provide outline indication of the building fabric sound insulation requirements likely to be necessary to reduce noise from Exeter airport into potential future ancillary offices.

Daytime noise levels incident on areas of the development overlooking the airport are exposed to typical daytime noise levels of 84 dB L_{AFmax} and 63 dB $L_{Aeq,16hr}$. Areas of the development shielded from the airport or overlooking Long Lane are expected to be exposed to daytime noise levels of 81 dB L_{AFmax} and 62 dB $L_{Aeq,16hr}$, dominated by noise from Long Lane, with noise associated with the airport at these development areas being significantly lower.

Taking influence from BCO *Guide to Specification,* noise ingress levels into the offices should be controlled so as not to exceed 50 dB L_{AFmax} and L_{eq} NR 35 dB.

Calculations indicate that the façades most exposed to (overlooking the Exeter Airport runway) would require a glazing package achieving 49 R_w (Ctr: -4, C: 1). Calculations of noise ingress for facades more shielded from the airport indicate these would require a lower-performing glazing package achieving at least 31 R_w (Ctr: -4, C: -1).

The non-glazed areas of the building fabric into the offices is expected to require a sound reduction specification of at least $R_w + C_{tr}$ 50 dB, typical of a construction containing masonry or high mass elements.

Detailed calculations will need to be conducted during design development based on the frozen proposed development layout.

Building services noise limits have been set for daytime and night-time operation, to be achieved at the identified noise sensitive receptors.

Appendix A – Acoustic Terminology

The table below provides a layperson's explanation of the acoustics terms that commonly appear in reports. It is not intended to give full scientific definitions and explanations or go into detail on how and why things are as they are. Some obsolete terms and abbreviations have been included as they still appear in documents from time to time.

Term	Description
Decibel, dB	The decibel is a logarithmic unit of measurement used for quantifying sound. It is derived from the logarithm to base 10 of the ratio of two quantities. Use of a logarithmic scale has the advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers.
Frequency, Hz	In sound, the number of cycles per second of a pressure fluctuation and frequency in sound is proportional to its pitch. Different frequencies are divided into octave and one third octave bands.
Sound Pressure Level, L_p	This is the unweighted or linear level which is measured prior to any weightings being applied. The sound pressure level is 20 times the logarithm to base 10 of the ratio of the reference sound pressure ($2x10^{-5}$) and the measured sound pressure.
Sound Power Level, L_W	This is the total sound energy radiated from a given source. The sound power Level is 10 times the logarithm to base 10 of the ratio of the reference sound power level ($1x10^{-12}$) and the measured power.
Frequency Weightings	Weightings can be applied to a spectrum of sound and act as a filter to account for different sensitivities and conditions.
Time Weightings	A time weighting to denote the response of the sound level meter. For most measurements the Fast time weighting is selected (F) however, a slow time weighting (S) is often used to for the measurement train noise and vibration.
A-weighted sound pressure level, L_{pA}	The sound pressure level with the A-weighting applied. The A-weighting is used for most environmental noise measurements and is used to weight a spectrum of sound to match the sensitivity of the human ear.
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	The L_{Aeq} is an energy average and defined as the level of sound which, over a given period of time, would equate to the same A-weighted sound energy as the actual fluctuating sound.
Octave Bands	A band of frequencies in which the upper limit of the band is twice the frequency of the lower limit.
Maximum noise Level, L_{AFmax}	The maximum instantaneous noise level measured during a given period of time. The time weighting to which the meter is set for this measurement parameter is always indicated by either an F or S.
Minimum Noise level, L_{AFmin}	The minimum instantaneous noise level measured during a given period of time. The time weighting to which the meter is set for this measurement parameter is always indicated by either an F or S.
Percentile level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting F, which is exceeded for N% of a specified time interval. An example of this is background noise which is quantified with the L_{A90} descriptor, which is the A-weighted level which is exceeded for 90% of the measurement period.
Sound exposure level L_{AE}	A level of a sound, of 1 s duration, that has the same sound energy as the actual noise event considered.
Rating Level, $L_{Ar,Tr}$	The equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise.

Ambient Noise Level	The noise level in a given environment whilst it is subject to all of its normal sources of noise.
Background Sound / Noise Level, L_{A90}	These are amongst the lowest noise levels measured over a given period of time and exclude short term, intermittent noise sources. The background noise level is quantified by the L_{A90} descriptor and is therefore the level which is exceeded for 90% of a given period of time.
Reverberation Time, T	The time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped. The descriptor T, often includes other nomenclature to describe the type of reverberation time measurement or if the reverberation time is an average taken for specific frequencies. For example a T_{mf} is the mid-frequency reverberation time.
Absorption Coefficient, α	The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.
Absorption, A	The acoustic absorption derived from the multiplication of the absorption coefficient by the surface area of a given material.
Acoustic Class, A - E	Classification of sound absorbers into Sound Absorption Classes A-E, according to BS EN ISO 11654, including frequencies 200-5000 Hz
NRC	A single-number rating system used to compare the sound-absorbing characteristics of building materials. A measurement of the acoustical absorption performance of a material, calculated by averaging its Sound Absorption Coefficients at 250, 500, 1000 and 2000 Hz
Sound Reduction Index, R	The laboratory measured sound insulation properties of a material or building element in octave or third octave bands.
Weighted Sound Reduction Index, R_w	A single number which represents the sound reduction of a material. It is derived by plotting the sound reduction index against a set of reference curves. The curves are shifted until a best-fit is established and the curve which best fits the sound reduction spectrum is used to represent the single figure value.
Weighted Level Difference, D_w	The weighted level difference between a pair of rooms, stated as a single figure.
Standardized Weighted Level Difference, $D_{nT,w}$	The standardized, weighted difference in sound level between a pair of rooms, stated as a single figure. The level difference in octave bands is first normalized to a reference reverberation time and then plotted against a set of reference curves to establish a single figure value.
Weighted, Normalised Flanking Level Difference, D_{nFw}	The normalised, weighted difference in sound level between a pair of rooms via a flanking element, such as mullion or ceiling detail. The level difference in octave bands is first normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.
Normalised Element Level Difference D_{ne}	The normalised difference in sound level between a pair of rooms via a small element such as a trickle ventilator. The level difference in octave bands is normalized to a reference amount of absorption.
Weighted, Normalised Element Level Difference, D_{new}	The normalised, weighted difference in sound level between a pair of rooms via a small element such as a trickle ventilator, stated as a single figure. The level difference in octave bands is normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.
C_{tr}	A correction term applied to the sound insulation single-number values (R_w, D_w, and $D_{nT,w}$). Applying the C_{tr} penalises a construction's performance if its low frequency performance is poor in relation its performance at higher frequencies.
Impact Sound	The noise generated by an impact on a structure. This is normally used to describe the noise created by people walking on a floor structure.
Weighted standardized impact sound pressure level, $L_{nT,w}$	A single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies.

Cross-talk	Noise transmission between one room and another room or space via a duct or other path.
Insertion Loss, IL	The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence.
Dynamic Insertion Loss, DIL	The reduction of noise level due to the presence of a noise control device such as an attenuator, including any regeneration noise created by its presence.
NR	The Noise Rating level. This is a single figure value derived by plotting a noise spectrum against a set of curves. The curve under which the spectrum fits is the resulting NR level.
Vibration	The vibratory motion of a surface can be characterised by: (a) displacement (m), (b) velocity (m/s), or (c) acceleration (m/s^2). The magnitude of the vibration can be quantified in several ways: **Peak to Peak** - The total excursion of the oscillation about the zero datum. **Peak** - This value gives the maximum excursion of the oscillation above or below the zero datum. **r.m.s.** - This value gives the root mean square of the time history over a specific time interval (time constant). **dB** - Vibration levels can be expressed in dB. A reference level of 10-6 m/s^2 r.m.s. is usually used for acceleration.
Ground borne noise	Audible noise caused by the vibration of elements of a structure, for which the vibration propagation path from the source is partially or wholly through the ground
Structure borne noise	Audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements.
V.D.V,	The VDV is the Vibration Dose a person is expected to be exposed to over the course of the day or night. The VDV is given by the fourth root of the time integral of the fourth power of the acceleration after it has been frequency-weighted.
eVDV	The estimated vibration dose value based on short duration measurements of transients with known durations and occurrences

Appendix B – Legislation, Planning Policy and Noise Guidelines

Control of Pollution Act (1974)

The Control of Pollution Act 1974 gives local authorities special powers for controlling noise and vibration arising from construction and demolition works. These powers may be exercised either before or after works have been started.

Section 60 enables the local authority of an area in which works are scheduled or currently underway, to serve a notice of its requirements for the control of construction site noise/vibration on the person who appears to the local authority to be undertaking the works.

Section 61 provides a mechanism for the contractor or developer to take the initiative in approaching the local authority to ascertain its noise/vibration requirements before construction work starts.

The Act also covers Noise Abatement Zones, Codes of Practice and Best Practicable Means (BPM) regarding noise pollution.

Environmental Protection Act (1990)

Section 79 of the Environmental Protection Act 1990 defines statutory nuisances and the requirement for local authorities to inspect their area for statutory nuisances, taking such steps as are reasonably practicable to investigate any complaint of a statutory nuisance.

Section 80 of the act gives local authorities the right, where a statutory nuisance exists or is likely to be caused, to serve an abatement notice requiring the abatement, prohibition or restriction of the nuisance.

Section 82 of the act allows a person aggrieved by a statutory nuisance to make a complaint to a Magistrates Court in an attempt to seek an abatement notice served on the person responsible for the nuisance.

National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) seeks to contribute to and enhance the natural and local environment, including preventing new and existing developments from contributing to, and/or, being put at an unacceptable risk from noise pollution. In support of this, paragraph 180 of the NPPF states that:

> *'Planning policies and decisions should 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 impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and 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.'*

Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) was published in March 2010 by the Department for Environment, Food and Rural Affairs (DEFRA) and forms the overarching statement of noise policy for England. It sets out the long-term vision of Government noise policy, which is to:

> *'Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.'*

The policy aims, through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development, to:

- Avoid significant adverse effects on health and quality of life.
- Mitigate and minimise adverse effects on health and quality of life.
- Where possible, contribute to the improvement of health and quality of life.

The NPSE sets out three terms with regard to noise effects:

- No Observed Effect Level (NOEL) – the level below which no effect can be detected and below which no detectable effect on health and quality of life due to noise can be established.
- Lowest Observed Adverse Effect Level (LOAEL) – the level above which adverse effects on health and quality of life can be detected.
- Significant Observed Adverse Effect Level (SOAEL) – the level above which significant adverse effects on health and quality of life occur.

The above terms are not defined numerically in terms of absolute levels within the NPSE which acknowledges that these will change depending on, but not limited to, the noise source, the receiver type and the time of day/day of week.

British Standard BS 4142:2014+A1:2019 '*Acoustics – Methods for rating and assessing industrial and commercial sound*'

It is common industry practice for plant noise levels to be determined in accordance with BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound' .

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature for the purposes of: (a) investigating complaints, (b) assessing sound from proposed, new, modified or additional sources of sound of an industrial/commercial nature, and, (c) assessing sound at proposed new residential premises.

In summary, the procedure compares the measured (or predicted) sound level from the source known as the Specific sound level (notated $L_{Aeq,T}$) 1 metre outside of the habitable windows of the dwellings, with the background sound level (notated $L_{A90,T}$) that exists in the absence of the source in question. If the sound is tonal, impulsive, intermittent or otherwise distinctive in character at the assessment location, a character correction of between 0 dB and +9 dB is added to the Specific sound level (correcting for the influence from any residual sound) to obtain the Rating level (notated $L_{Ar,Tr}$).

After making any relevant corrections, the background sound level is compared to the Rating level and an initial estimate of the potential impact of the sound source in question is made with consideration to the following:

- typically, the greater this difference, the greater the magnitude of the impact.
- a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- a difference of around +5 dB or more is likely to be an indication of an adverse impact, depending on the context.
- 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 sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Appendix C – Highest Measured Noise Levels

Movement & Aircraft Type	Monitoring Location	Highest Measured Lmax								
		63	125	250	500	1k	2k	4k	8k	Over all
1, IFA6140, Small Twin Jet	ST1	68.1	57.6	48.4	55.2	61.3	64.5	59.0	41.5	67.7
	ST2	63.2	49.8	47.2	57.7	60.8	54.1	49.9	37.8	62.5
1, IOS510, Small Twin Prop	ST1	56.5	67.8	62.0	63.4	63.5	62.7	57.3	47.2	68.2
	ST2	53.2	63.0	58.1	56.0	62.0	63.1	57.1	40.2	67.1
1, IOS514, Small Twin Prop	ST1	68.7	58.4	50.1	58.9	70.0	62.4	56.8	45.9	71.2
	ST2	59.2	65.1	52.9	57.3	66.9	63.7	60.9	48.1	70.0
1, LM545, Commercial Twin Jet	ST1	58.2	51.5	50.4	58.0	65.0	63.8	60.3	44.2	69.1
	ST2	66.9	57.9	56.3	63.0	66.0	60.3	55.4	42.2	68.1
1, MSPOR, Small Twin Prop	ST1	62.9	57.7	49.1	58.0	61.9	66.3	62.4	44.8	69.9
	ST2	67.6	56.7	48.6	57.1	65.3	66.9	57.9	44.4	70.3
2, BY340, Commercial Jet	ST1	85.1	77.8	71.0	80.4	82.9	80.1	75.8	68.0	86.1
	ST2	81.9	75.4	69.1	78.0	83.0	76.8	71.7	61.2	84.8
2, IFA6140, Small Jet	ST1	75.4	67.0	65.2	73.6	79.2	75.6	69.7	60.9	82.0
	ST2	70.9	63.3	58.0	67.1	73.1	69.9	75.1	52.1	78.5
2, LM546, Commercial Jet	ST1	73.7	65.5	68.4	77.5	75.2	75.3	71.8	70.3	81.2
	ST2	71.4	61.4	59.0	75.8	74.4	69.6	63.7	60.6	78.0
2, MSPOR, Small Twin Prop	ST1	67.6	73.7	62.1	75.7	66.2	61.1	57.7	46.8	73.8
	ST2	62.3	67.4	64.2	67.7	68.5	61.2	55.4	42.3	70.8
2, QAJ1, Small Jet	ST1	64.2	56.5	54.2	62.1	70.6	76.4	77.3	74.1	82.0
	ST2	67.8	59.8	62.0	75.7	78.1	71.5	68.6	58.5	80.1
3, BY340, Commercial Jet	ST1	65.0	58.6	50.8	59.0	69.5	62.8	57.0	47.0	70.9
	ST2	59.8	49.0	47.1	61.7	66.8	55.7	52.5	45.4	67.7
3, IFA6140, Small Jet	ST1	77.0	66.0	55.7	52.5	50.8	48.3	45.6	41.0	60.0
	ST2	66.6	55.2	45.8	47.8	48.9	55.6	52.5	42.2	59.0
3, LM546, Commercial Jet	ST1	68.5	52.7	52.0	62.4	58.2	59.0	66.5	56.1	69.2
	ST2	60.6	48.1	48.8	58.2	57.1	55.7	55.4	50.6	62.6
3, MSPOR, Small Twin Prop	ST1	71.3	60.5	50.9	62.2	61.4	57.7	55.5	49.4	65.3
	ST2	54.5	43.8	40.9	61.0	56.4	49.7	38.7	30.0	61.0
3, QAJ1, Small Jet	ST1	65.3	51.1	42.4	53.8	57.7	62.7	64.4	48.4	68.2
	ST2	45.9	38.0	34.9	43.1	49.6	49.2	51.0	35.2	55.4
4 Small Prop (Private)	ST1	78.7	68.7	54.6	58.9	66.7	62.1	55.0	41.4	68.9
	ST2	63.3	50.6	42.9	46.4	59.0	50.6	42.5	30.4	59.8

4, IOS11M, Small Twin Prop	ST1	84.3	72.4	62.0	47.4	43.8	40.4	40.6	37.4	61.3
	ST2	67.4	57.3	45.6	59.7	56.7	44.8	37.1	31.4	59.3
Grounded helicopter start up and run opposite side of runway	ST1	70.4	70.1	79.8	75.7	67.1	58.8	54.9	41.8	75.7
	ST2	74.0	71.5	79.0	72.2	64.2	56.0	51.2	39.2	73.5
Military Helicopter Flyover (East to West)	ST1	81.8	77.5	73.4	80.5	80.6	74.1	65.5	46.4	82.8
	ST2	76.2	80.7	74.1	79.5	76.3	72.1	70.4	55.8	80.8
Military Helicopter Flyover (East to West)	ST1	74.7	81.8	76.8	81.8	78.3	70.3	64.6	52.5	81.7
	ST2	72.7	78.3	75.8	78.6	74.7	66.5	61.3	49.2	78.5
Military Helicopter Flyover (East to West)	ST1	71.7	79.1	78.6	81.6	75.9	70.3	66.2	55.3	80.8
	ST2	81.1	80.6	77.0	79.7	73.2	67.7	59.8	44.7	78.8