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Officers' Meadow, Shenfield

Assessment of noise and vibration effects on proposed residential use

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1.0 Introduction

1.1 Sharps Acoustics LLP (SAL) has been commissioned by Croudace Homes Ltd to carry out an assessment of the impact of noise and vibration on proposed residential development at land at Officers' Meadow, Shenfield, Part of allocated Site R03: Land North of Shenfield.

1.2 This report considers the likely noise and vibration effects of existing noise source on future occupiers of the following proposed development:

> *Full planning application for 344 units including 35% affordable housing, safeguarded land for a 2FE primary school and early years facility, public open space and associated landscaping, drainage and highways infrastructure.*

1.3 The Site forms part of the Strategic Site R03 allocated in the Brentwood Local Plan (BLP) (March 2022). The Site is the largest parcel of land, at 21.32 hectares (ha), which is being independently brought forward by Croudace Homes Ltd as part of the Development Framework for Site R03 alongside a consortium of developers including Redrow Homes, Countryside Properties and Stonebond Properties.

1.4 The Site is located to the north of Shenfield, a 20 minute walk and a 10 minute cycle to the Shenfield Town Centre. The Site is bound to the north west by Chelmsford Road, its associated dwellings and their rear residential curtilages. Beyond Chelmsford Road lies the A12 (dual carriageway) and open farmland. The eastern boundary of the site is delineated by Ancient Woodland, an area of undesignated woodland and a railway line, beyond which lies additional areas of woodland, residential development, and further farmland.

2.0 Assessment Criteria

NPPF

2.1 The Government's overarching policy in relation to planned development is contained in the National Planning Policy Framework (NPPF).

2.2 Paragraph 174 of the NPPF advises that planning polices and decisions should:

> *"… contribute to and enhance the natural and local environment by … preventing new and existing development from contributing to, being put at unacceptable risk from … noise pollution."*

2.3 Paragraph 185 of the NPPF states that Planning policies and decisions should ensure that any:

> *"… 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:*

a) 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 …"

2.4 The NPPF does not provide prescriptive advice on how to avoid noise from giving rise to significant adverse impacts on health and quality of life. Therefore, it is necessary to consider advice in other guidance documents. This advice is discussed below.

2.5 In relation to the statement in paragraph 185 of the NPPF about significance, there is a footnote stating:

"See Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food &Rural Affairs, 2010)". This is the NPSE – discussed below.

NPSE

2.6 The Noise Policy Statement for England was prepared by DEFRA and is dated March 2010.

2.7 Paragraph 1.5 of the NPSE states that the advice within the document applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise.

2.8 The NPSE, paragraph 2.12, explains that the WHO defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

2.9 The Noise Policy Aims of the NPSE (NPSE paragraphs 2.22 to 2.24) can be summarised as follows:

- avoid significant adverse impacts on health and quality of life…;
- mitigate and minimise adverse impacts on health and quality of life…; and
- where possible, contribute to the improvement of health and quality of life.

2.10 The NPSE makes a distinction between "quality of life", which is a subjective measure, and "health", which refers to physical and mental well-being.

2.11 The latest WHO Guidelines (Environmental Noise Guidelines for the European Region, 2018) explain that impacts that may result from noise such as annoyance and sleep disturbance are considered to be "critical health outcomes" and that quality of life, well-being and mental health are "important health outcomes". Sleep disturbance is also referred to as having an effect on quality of life.

2.12 The NPSE introduces the concepts of the "no observed effect level" (NOEL); the "lowest observed adverse effect level" (LOAEL); and a "significant observed adverse effect level" (SOAEL).

2.13 It is the last of these criteria – the SOAEL – that is the level above which significant adverse effects on health and quality of life occur. As can be seen from paragraphs 2.3 and 2.9 above, this criterion equates to the first aim of the NPSE and the policy requirement in the NPPF.

2.14 The second aim of the NPSE is to mitigate and minimise adverse impacts between LOAEL and SOAEL.

2.15 The NPSE does not provide noise guideline values or limits above which SOAEL occurs. Indeed, the document advises that it is not possible to have a single objective noise-based measure that defines SOAEL (NPSE paragraph 2.22). Therefore, it is necessary to refer to other advisory documents in order to seek to define such levels.

PPG - Noise

2.16 This "Planning Practice Guidance note – Noise" was released on 6th March 2014 and has been updated since, most recently in July 2019.

2.17 The PPG reinforces the concept of LOAEL and SOAELs discussed above and seeks to define a person's perception at these different effect levels. It describes what is meant by levels below the LOAEL (at the NOEL and NOAEL) under the heading, "How can it be established whether noise is likely to be a concern?", as follows:

> *"At the lowest extreme, when noise is not perceived to be present, there is by definition no effect. As the noise exposure increases, it will cross the 'no observed effect' level. However, the noise has no adverse effect so long as the exposure does not cause any change in behaviour, attitude or other physiological responses of those affected by it. The noise may slightly affect the acoustic character of an area but not to the extent there is a change in quality of life. If the noise exposure is at this level no specific measures are required to manage the acoustic environment."* Paragraph: 005 Reference ID: 30-005-20190722. Revision date: 22 07 2019

2.18 NPPG describes the NOAEL as, "noise can be heard, but does not cause any change in behaviour, attitude or other physiological response …", whereas at a LOAEL, "noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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." Noise levels below the LOAEL are described as "present and not intrusive" whereas levels above the LOAEL but below the SOEAL are described as "present and intrusive".

2.19 A "significant" effect is described as "present and disruptive" resulting in "a material change in behaviour, attitude or other physiological response …".

2.20 The PPG provides a hierarchy of planning actions required for different perceptions and effects of noise. Between LOAEL and SOAEL the recommended action is to mitigate noise and reduce to a minimum. At SOAEL the action recommended is to avoid. These are the same terms used in the NPPF and NPSE. The NPPF, NPSE and NPPG do not ascribe noise levels to any of the effects discussed within the three documents. Therefore, it is necessary to consider other guidance which attributes noise levels to health effects such as annoyance during the day or sleep disturbance at night.

Local Policy

2.21 Relevant local policy is set out in the Brentwood Local Plan 2016-2033. Strategic Policy BE14: "Creating successful places" requires that:

"Proposals will be required to meet high design standards and deliver safe, inclusive, attractive and accessible places. Proposals should:

…

mitigate the impact of air, noise, vibration and light pollution from internal and external sources, especially in intrinsically dark landscapes and residential areas."

Relevant Guidance and Standards

2.22 It is possible to apply objective standards to the assessment of noise and the design of new dwellings should seek to achieve these objective standards. Such guideline values are given in the World Health Organisation (WHO) document "Guidelines for Community Noise" (partially superseded, but still valid in relation to night time maximum levels which could lead to sleep disturbance from certain noise sources) and within British Standard, BS 8233:2014 which is principally intended to assist in the design of new dwellings.

2.23 Guideline values in BS8233 are described as "desirable" and, as such can be considered to represent a robust level below which there would be no adverse effect (so below the LOAEL). Likewise, the maximum level recommended by the WHO guidance is an internal level required to avoid critical health effects and thus would result in levels below the LOAEL.

2.24 Table 2.1 below contains a summary of the recommended internal noise guideline levels to achieve levels below LOAEL.

Table 2.1: Internal design guideline for noise from WHO / BS8233: 2014

Activity	Location	Period		
		Day (0700 to 2300 hours)	Night (2300 to 0700 hours)	
Resting	Living Room	35dB $L_{Aeq,\ 16hr}$	-	-
Dining	Dining Room	40dB $L_{Aeq,\ 16hr}$		
Sleeping	Bedroom	35dB $L_{Aeq,\ 16hr}$	30dB $L_{Aeq,\ 8hr}$	45dB L_{Amax}

2.25 This is considered a robust but balanced view in the context of current policy towards supporting residential development. Where a development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal targets may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

2.26 BS 8223:2014 considers outdoor areas and external amenity areas (gardens and patios), suggesting that, "a level of 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, the standard recognises that where design standards cannot be achieved for these traditional amenity spaces then the 'lowest practical levels' should be achieved. A robust aim would be to achieve the WHO guidelines for daytime, outdoor living areas, although in some developments these absolute limits may not be achievable.

2.27 The Planning Practice Guidance on Noise, (PPG referred to above), gives further consideration relating to mitigating the impact of noise on residential developments and considers that noise may be partially off-set if residents of the dwellings have access to:

- A relatively quiet façade (containing windows to habitable rooms as part of their dwelling
- A relatively quiet external amenity space for their sole use such as a balcony which is generally considered as desirable
- A relatively quiet nearby external space for use by a number of residents as part of the amenity of their dwellings and / or
- A relatively quiet external, publicly accessible amenity space that is nearby (e.g. within a 5 minute walk).

Impact of noise on proposed school

2.28 Schools are subject to a number of mandatory requirements for internal sound levels under the School Premises Regulations 2012, which are normally met through the design of the buildings, glazing and ventilation. For the purposes of site selection and design of the Development at outline planning stage (as with the Development in this case), external sound levels (i.e. for playgrounds and playing fields) are of more importance.

2.29 The Institute of Acoustics "Acoustics of Schools" (2015), contains design guidance as follows:

> *"For new schools, 60 dB LAeq,30min should be regarded as an upper limit for external noise at the boundary of external areas used for formal and informal outdoor teaching and recreation."*

and:

> *"Noise levels in unoccupied playgrounds, playing fields and other outdoor areas should not exceed 55 dB LAeq,30min and there should be at least one area suitable for outdoor teaching activities where noise levels are below 50 dB LAeq,30min. If this is not possible, due to a lack of suitably quiet sites, acoustic screening should be used to reduce noise levels in these areas as much as practicable, and an assessment of noise levels and options for reducing these should be carried out."*

Vibration

2.30 British Standard 6472: 2008 *'Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting'*, contains a method for assessing the human response to vibration in terms of the vibration dose value. The advice contained in Section 3.5 of BS 6472 states:

> *"The effect of building vibration on the people within is assessed by finding the appropriate vibration dose. Present knowledge shows that this type of vibration is best evaluated with the vibration dose value (VDV).*

The VDV defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response".

2.31 The vibration dose value is a single figure descriptor that represents the cumulative dose of transient vibrations, taking into account the frequency spectrum and duration of each event. The measured values are weighted to account for the way in which people perceive building vibration, which is dependent on various factors, including the vibration frequency and direction.

2.32 For occupants within buildings, the frequency-weighting curve is defined in British Standard 6841: 1987 Measurement and Evaluation of Human Exposure to Whole-Body Mechanical Vibration and Repeated Shock. The vibration dose value is determined over a 16 hour daytime period or 8 hour night-time period, and the guidance in BS 6472 is as shown in Table 2.2.

Table 2.2: Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings, $ms^{1.75}$

Period	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Day (16 hours)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Night (8 hours)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

3.0 Noise Survey

3.1 An environmental noise and vibration survey was carried out between Wednesday 22nd and Thursday 23rd January 2023 to assess the existing ambient noise environment where road traffic noise was at its highest level, at the northern boundary in free field conditions to the rear of 167 Chelmsford Road.

3.2 During the same period, measurements were made to the south of the site, 5 meters from the boundary fence (and 25 metres from the local line and 45 meters from the main line railways). Measurements were taken continuously over this period. Co-located with the sound level metre was a vibration monitor. Measurements at this location were to determine the single event level and vibration levels of passing trains.

3.3 At the time of the survey, the site comprised several distinct fields southeast of Chelmsford Road (A1023) and accessed from the road via a farm gate. Chelmsford Road has two lanes and is a main road leading in and out of Shenfield with a 40-mph speed limit. North of the road is the A12 dual lane carriageway.

3.4 Along the northern boundary of the site are existing residential properties fronting onto the main road. To the southeast are wooded areas and fields through which the main line railway (Norwich to London, Liverpool Street) and local railway line (Greater Anglia) traverse. The railways carry both passenger and freight traffic.

3.5 The ambient noise on site during the attended surveys was dominated by road traffic from the A12 and A1023. On the southernmost boundary, the road traffic noise is lessened and interspersed by noise from passing trains on local and main line railways.

3.6 The sound level measurement locations are shown as locations 1 and 2 in Figure A1 in Appendix A and the vibration level meter was installed in close contact with the ground at location 3 shown in Figure A3 in Appendix A. Microphones were at a height of approximately 1.5 metres above ground level in free field locations.

3.7 The dominant noise source at the time of the survey was road traffic passing along the A12. Other noises were apparent such as bird song and high-level commercial jet air traffic (bound for London Airports).

3.8 All sound level measurements were made using an 01dB Fusion and Norsonic 140 sound level meters and vibration measurements were made using a Rion VM-56 triaxial ground borne vibration level meter vibration monitor. The SLMs used were Class 1 sound level meters and they were field checked for calibration before and after the measurements. No significant drift was noted. The vibration level meter was set up so that the X axis was aligned parallel to the trainline; the Y axis was aligned perpendicular to the trainline and the Z axis is aligned vertically.

3.9 In addition to the survey work described above, on Thursday 23 February 2023, road noise was measured at two locations (locations 4 and 5 shown in Figure A1 in Appendix A) with an 01dB Fusion fully integrating sound level meter. The microphone was set at a height of 1.5 metres to passing traffic.

3.10 Location 4, on the A12, was in a layby approximately 8 metres from the kerb line. Location 5, on Chelmsford Road was from the verge approximately 4 metres from the kerb line. Measurements at locations 4 and 5 were over a 15-minute period for three consecutive hours.

3.11 On Friday 25 February 2023, sample measurements over 15-minute periods were taken across the site in eight locations (shown as locations 6 to 13 on Figure A1 in Appendix A) with an 01dB Fusion fully integrating sound level meter. The microphone was set at a height of 1.5 metres in free field conditions at each location.

3.12 For each survey, the sound level meters were calibrated before and after use with no noticeable drift observed.

3.13 Meteorological conditions were generally suitable for the measurement of environmental noise during the surveys with weather records (from timeanddate.com Southend on Sea Airport weather station) data as shown in Table 3.1 below:

Table 3.1: Weather data for survey period

Date	Temp (Celsius)	Windspeed (mph)	Direction	Precipitation
22/02/2023	4 to 9	2 to 6	Westerly	None
23/02/2023	6 to 8	5 to 10	Northerly	None
24/02/2023	1 to 10	0 to 12	North westerly	None

3.14 Since the wind was from the direction of the principle noise source, road traffic, (from the north, northwest and west) during the survey, measured levels are representative of worst case levels around the site. When the wind is from other directions, measured levels would be lower.

3.15 For information purposes it can be noted:

- Measurements of sound level were all made with the A-weighting, which is a filter applied to the sound level meter to simulate the frequency response of the human ear, which is more sensitive to high frequency sound than low.
- L_{Aeq} is the equivalent continuous noise level which is a method of averaging the varying noise level over the time period into a single figure value. The L_{Aeq} has the same sound energy as the fluctuating level over that period.
- L_{Amax} is the highest level within the measurement period.
- L_{A90} is the noise level exceeded for 90% of the time and is referred to as the background noise level.
- The vibration level meter measured and calculated a range of vibration parameters including Root Mean Squared Acceleration (A_{rms}). Acceleration values in each axis are weighted according to the guidance given in BS 6472-1:2008. The X and Y axes are weighted using a W_d weighting curve and the Z axis is weighted using a W_b weighting curve.
- Parameters derived from weighted acceleration values are indicated by a subscript 'W', 'b' or 'd' following them. Vibration does value (VDV), which combined the magnitude of $A_{w,rms}$ as well as its duration to give an indication of the likely human response due to vibration, were also calculated by the meter.

3.16 Survey results are shown in Appendix B. A summary of key values is at the long term continuous monitoring locations is presented in Table 3.2 below.

Table 3.2: Measured levels at locations 1 and 2

Date	Day			Night		
	L_{Aeq}, dB	**L_{A90}, dB**	**L_{Amax}, dB**	**L_{Aeq}, dB**	**L_{A90}, dB**	**L_{Amax}, dB**
Location 1	57	56	74	53	46	61
Location 2	57	53	79	52	47	77

3.17 Vibration Dose Value (VDV) was derived and calculated by the vibration meter from its measured weighted acceleration values in all 3 axes. These measurements have been resampled into 16 and 8-hour day and night time VDV values, respectively. Table 3.2 below shows the measured VDV values as 16 hour and 8 hour values.

Table 3.2: VDV values at location 3

Period	VDV ($ms^{-1.75}$)		
	X axis	Y axis	Z axis
VDV,day	0.004	0.004	0.020
VDV,night	0.003	0.003	0.013

4.0 Assessment

Noise Environment around the proposed development

4.1 Noise levels from trains as described in Section 3 above has been combined with road traffic noise which has been predicted using the prediction method in Calculation of Road Traffic Noise (CRTN), Department of Transport, Welsh Office (1988) (CRTN). Road traffic noise levels which with the development complete have been predicted by modelling, based on flow data, speed, road surface and percentage of vehicles over 3.5 tonnes, using the calculation method set out in CRTN and using the traffic flows from published Department of Transport figures.

4.2 Rail noise has been modelled using CRN, using flows shown in Table 4.1 below for each line which was obtained from railway timetable data.

Table 4.1: Rail line traffic on each line

Train type	Main line		Branch line	
	Day	Night	Day	Night
Passenger	210	31	102	16
Freight	21	8	0	0

4.3 A 3D noise model has been created using proprietary software, SoundPLAN, correcting output to ensure that predicted noise levels match those found on the site. The approach described in CRTN is good for predicting noise levels close to busy roads, but becomes less reliable over longer distances, particularly where ground is uneven and covered in vegetation. SAL have found that it overpredicts by around 4-5dB (under downwind conditions) in this type of environment, at the distances of the closest proposed dwellings in the northwest part of the site and 3-4dB more than this in the southeastern part of the site. The CRTN predicted levels have therefore been reduced by 4.4dB over the whole site to match those measured, so far as possible. The daytime predicted noise levels over the open site are shown in Figure C1.

4.4 These noise contours have been combined with rail noise contours and are shown for day time in Figures C2 and C3, respectively in Appendix C, with the proposed layout in place. Additionally, the night time maximum level contours (described using the L_{Amax} parameter) are shown in Figure C4 in Appendix C.

4.5 In these locations, windows could be openable to allow for purge ventilation but would need to be closed to achieve the required acoustic performance of the structure. Alternative means of background ventilation would therefore be necessary to satisfy the requirements of Building Regulations Approved Document F.

Noise mitigation – external areas

4.6 Throughout the development, 1.8m high timber fences have been assumed to be provided to all private gardens; these provide some sound reduction due to screening. External noise levels would be below 55dB in the vast majority of external amenity areas, with parts of a very small number of some gardens in the north west corner experiencing noise levels a little above this. No further noise mitigation is therefore required for private external areas.

4.7 Approximately 80% of the land safeguarded for the school provision would experience noise levels below 55dB, $L_{Aeq,16hr}$ and the screening provided by the proposed school building would provide at least one outdoor area suitable for outdoor teaching activities where noise levels are below 50 dB $L_{Aeq,16hr}$. The illustrative proposed location of the school building shows that it would be possible to meet the required design standards described in Section 2.0 above.

Noise mitigation required - internal

4.8 Figures C5 and C6 show the category of noise mitigation which would be required for windows and ventilation systems (which we have defined as "low", "medium", "high" and "very high") to meet the daytime and night time values in Table 2.1 above, respectively.

4.9 Acoustic specifications for these categories would be as shown in Table 4.2 below. "Very high" and "High" specifications are not included, as none of the facades would require acoustic performance above "Medium" in this instance.

Table 4.2: Acoustic specifications for windows and ventilation systems in each category

Category	Window performance required, dB, R_w+C_{tr}	Ventilation performance, dB, $D_{n,ew}$	Examples of systems which would meet the spec
Low	28	35	SG Solaglas - 4-6-4mm + Acoustic trickle vent (eg. Trimvent Select S16, open)
Medium	32	39	Pilkington Insulight™ Phon incorporating Pilkington K Glass™ 6/16/6.8* + High specification acoustic trickle vent or wall vent (eg. Greenwood: AWV39)

4.10 As can be seen from Figure A5, there are many facades which will not require any noise mitigation during the day (shown as light blue dots), meaning that windows to living rooms at these locations could remain open and a desirable internal noise level would still be achieved. Noise mitigation required for the remainder of the site would be no higher than a "medium" rating, with the majority requiring just "low" acoustic specification. Such noise mitigation is readily available and in common use throughout the UK in urban areas or where dwellings are placed near to road, rail or aircraft noise sources.

4.11 Internal noise levels can therefore be adequately controlled, even at the worst affected dwellings, using closed windows and passive means of ventilation. However, if overheating (due to the need to keep windows closed) is predicted to be a problem and the overall balance of having a MVHR system is beneficial (when all factors, including sustainability are considered) then such a system could be included in the scheme design. If this were to be the case, acoustic specification for the system would need to be drawn up once further details were known, including room volumes, glazed areas and location and type of MVHR inlets and outlets are fixed. This should be done after planning permission has been granted once these details are known.

4.12 It is normal practice in this situation for a local authority to impose a condition in the planning permission requiring a more detailed submission showing glazing, ventilation and screening required for the finalised scheme design, based on finalised layout, room sizes and window areas once these are known.

Vibration levels

4.13 The levels at the closest proposed dwelling to the railway line are below the level at which there would be a low probability of an adverse comment during both day and night (as shown in Table 2.2 above). There would therefore be no adverse vibration effects affecting the proposed development.

5.0 Conclusions

5.1 An assessment was carried out of the potential adverse effects which might arise from noise and vibration from the road traffic and rail use in the vicinity of the proposed development.

5.2 A review has been carried out of relevant policy, standards and guidance to determine appropriate noise and vibration assessment criteria.

5.3 A survey of noise and vibration levels was carried out and it was found that:

- No noise mitigation would be required for the majority of the site during the day.
- Where noise mitigation is required, this could be readily achieved, even in the areas with the highest noise levels using "off the shelf" windows and ventilation systems with a "low" or, for a handful of receptors in the northwest corner, "medium" level of acoustic performance.
- Vibration levels would result in no adverse effects.

5.4 Noise levels around the site for all residential plots and for the land safeguarded for the provision of a school would meet national policy requirements. No further noise mitigation would be required.

Appendix A: Plans

Figure A1: Site location plan

Figure A2: Proposed site layout

Figure A3: Aerial view showing noise and vibration monitoring locations

Appendix B: Survey results

Figure B1: Noise survey results at location 1

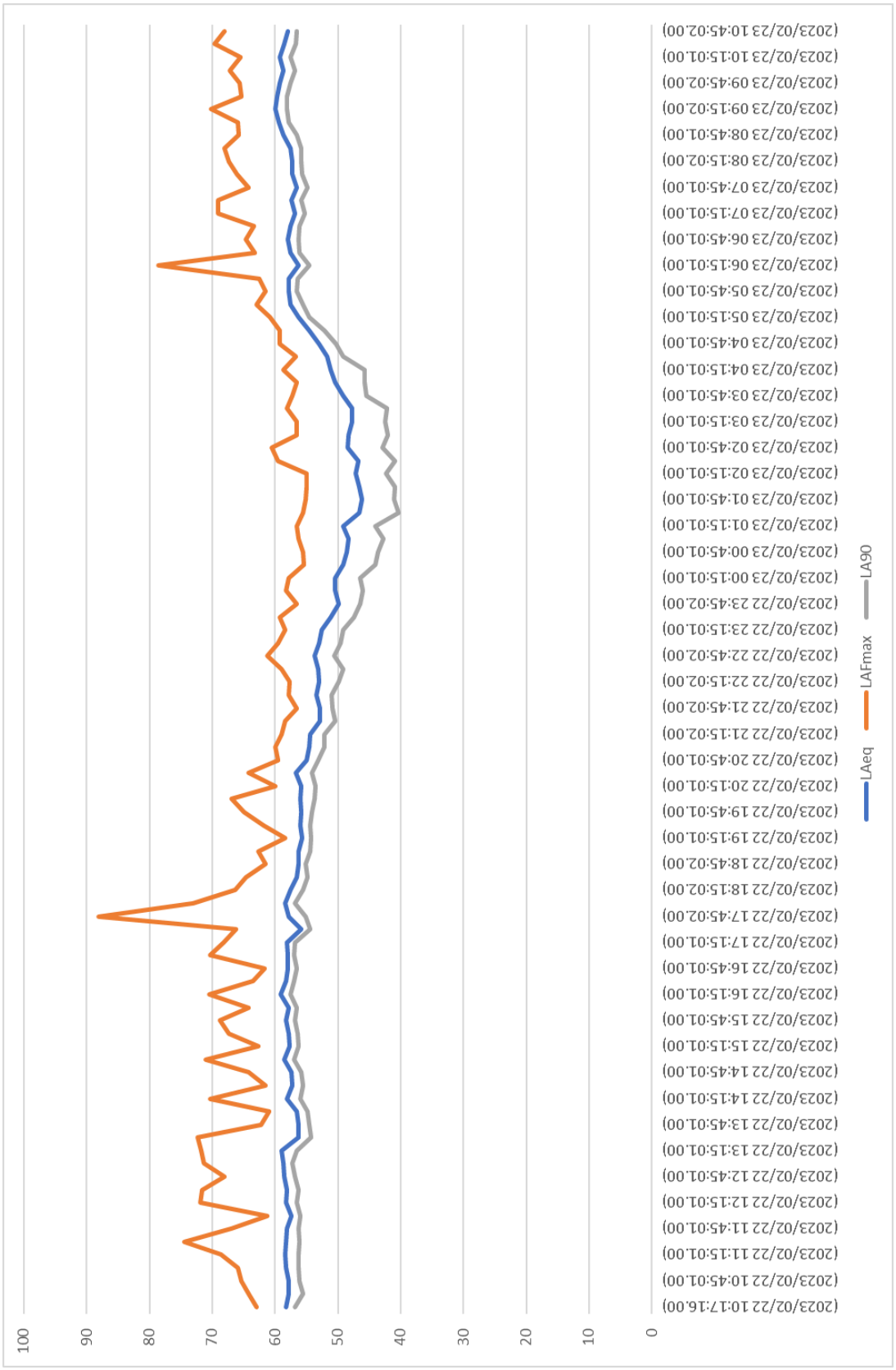

Figure B2: Noise survey results at location 2

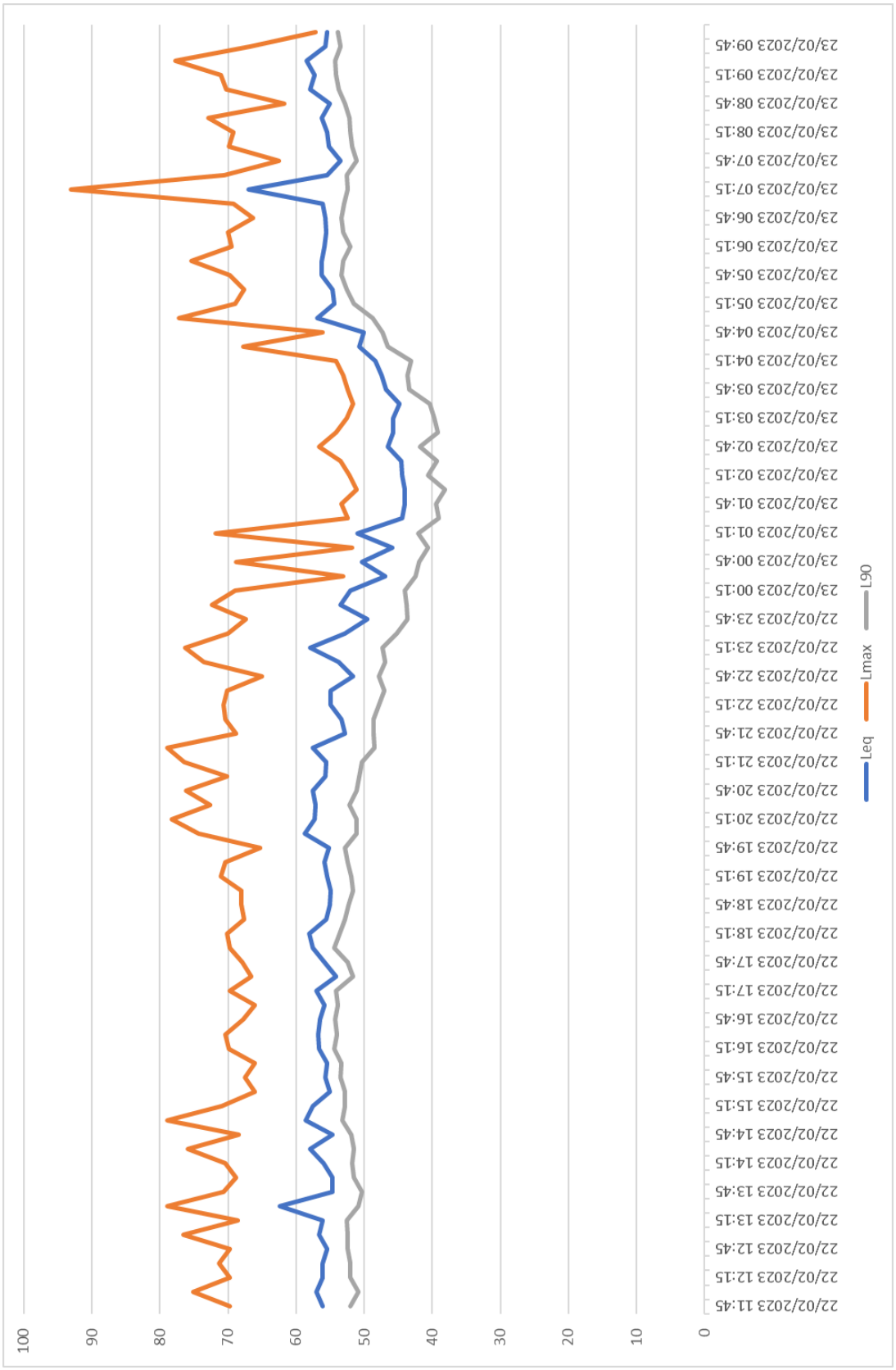

Table B1: Survey results at Location 4: 15 minute samples

Time	L_{Aeq}, dB	L_{Amax}, dB	L_{A10}, dB	*Cars/Vans	*HGVs
12:00	82	89	84	136	19
13:07	81	88	84	134	20
14:00	82	89	84	142	15

* Two lanes (dual carriageway) southbound only; timed over 5 minutes; 70mph speed limit and black tarmac in good condition.

Table B2: Survey results at Location 5: 15 minute samples

Time	L_{Aeq}, dB	L_{Amax}, dB	L_{A10}, dB	**Cars/Vans	**HGVs
12:33	75	86	79	88	4
13:38	75	82	78	83	2
14:30	75	85	78	95	1

** Both lanes (single) north and south bound; timed over 5 minutes; 40 mph speed limit and black tarmac in reasonable condition.

Table B3: Spot check levels on Friday 25 February 2023, 15-minute periods

Start Time	L_{AeqT}, dB
6	60
7	56
8	57
9	58
10	56
11	55
12	58
13	56

Appendix C: Noise contour plots

Figure C1: Daytime noise contours, $L_{Aeq,16h}$: open site

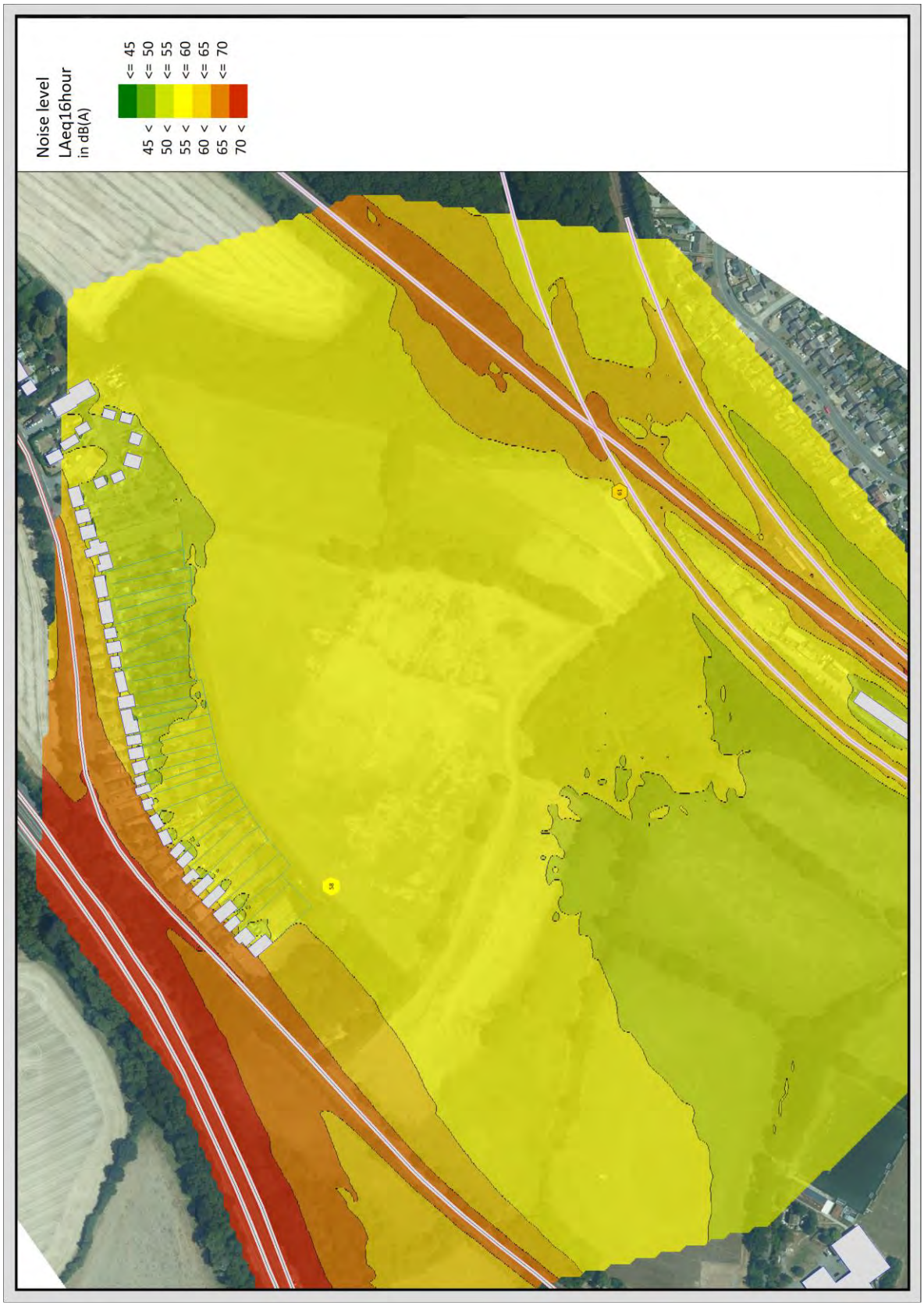

Figure C2: Daytime noise contours, $L_{Aeq,16h}$: with development

Figure C3: Night time noise contours, $L_{Aeq,8h}$

Figure C4: Night time noise contours, L_{Amax}

Figure C5: Day time noise mitigation requirements

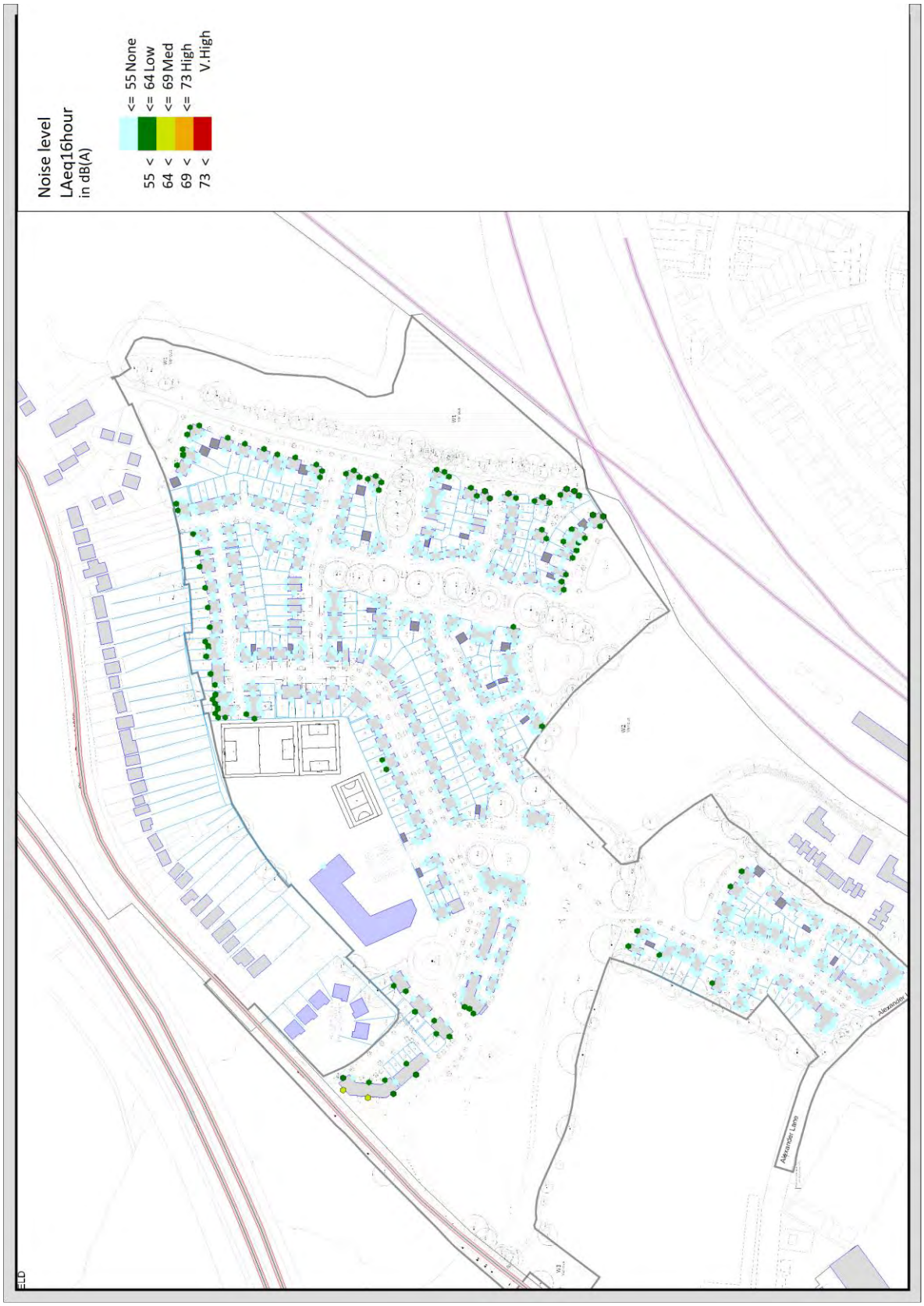

Figure C6: Night time noise mitigation requirements