



**Armstrong House  
3 Bassett Avenue  
Southampton  
SO16 7DP**

**T: 02381 555 000**

**PROPOSED WOOLFOX GARDEN VILLAGE  
RUTLAND**

**SUSTAINABILITY ASSESSMENT  
PRELIMINARY ACOUSTIC REVIEW**

Technical Report: R7813-1 Rev 3

Date: 28th March 2019

For: Pikerace Ltd  
c/o Andrew Granger & Co Ltd  
Phoenix House  
52 High Street  
Market Harborough  
Leicestershire  
LE16 7AF

## 24 Acoustics Document Control Sheet

**Project Title:** Proposed Woolfox Garden Village, Rutland – Sustainability Assessment - Preliminary Acoustic Review

**Report Ref:** R7813-1 Rev 3  
**Date:** 28th March 2019

	<b>Name</b>	<b>Position</b>	<b>Signature</b>	<b>Date</b>
<b>Prepared by</b>	Aileen Reed BEng MIOA	Principal Consultant		28/03/2019
<b>Approved by</b>	Reuben Peckham BEng MPhil CEng MIOA	Principal Consultant		28/03/2019
For and on behalf of 24 Acoustics Ltd				

### Document Status and Approval Schedule

<b>Revision</b>	<b>Description</b>	<b>Prepared By</b>	<b>Approved By</b>
0	Approved for issue	Aileen Reed	Reuben Peckham
1	Client comments	Aileen Reed	Reuben Peckham
2	Revised figure	Aileen Reed	Reuben Peckham
3	Revised figure	Aileen Reed	Reuben Peckham

### DISCLAIMER

This report was completed by 24 Acoustics Ltd on the basis of a defined programme of work and terms and conditions agreed with the Client. The report has been prepared with all reasonable skill, care and diligence within the terms of the Contract with the Client and taking into account the project objectives, the agreed scope of works, prevailing site conditions and the degree of manpower and resources allocated to the project.

24 Acoustics Ltd accepts no responsibility whatsoever, following the issue of the report, for any matters arising outside the agreed scope of the works.

This report is issued in confidence to the Client and 24 Acoustics Ltd has no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

Unless specifically assigned or transferred within the terms of the agreement, 24 Acoustics Ltd retains all copyright and other intellectual property rights, on and over the report and its contents.

© 24 Acoustics Ltd 2019

## CONTENTS

1.0	INTRODUCTION	4
2.0	SITE DESCRIPTION & PROPOSED DEVELOPMENT	4
3.0	CRITERIA	5
4.0	ACOUSTIC DESIGN REVIEW	11
6.0	CONCLUSIONS	16
	REFERENCES	17
	FIGURES	18
	APPENDIX A: NOISE UNITS	23

## **1.0 INTRODUCTION**

- 1.1 24 Acoustics Ltd has been appointed by Pikerace Limited to carry out a review of the proposed Woolfox Garden Village development on land to the east of the A1 road in Rutland in relation to noise and vibration.
- 1.2 A desk-based study has been undertaken to identify potentially significant existing sources of noise and consider these in light of the proposed development. The potential for sources of vibration has also been considered. A summary of relevant standards and guidance is provided along with design recommendations and outline recommendations for noise mitigation measures.
- 1.3 An explanation of acoustical terms used in this report is provided in Appendix A. All sound pressure levels in this report are given in dB re: 20  $\mu$ Pa.

## **2.0 SITE DESCRIPTION & PROPOSED DEVELOPMENT**

- 2.1 The site is located to the east of the A1 dual carriageway south of Stretton, Rutland. The site is bounded by Stretton Road and Clipsham Road to the north and the A1 dual carriageway to the west. Rutland county golf club lies to the south. The existing site comprises a disused air field and agricultural land.
- 2.2 Phase 1 of the proposed scheme provides the opportunity for development within the timescale of the Local Plan. The remainder of the development provides scope for further future development after 2036.
- 2.3 Phase 1 includes the following:
- 2500 residential units (around 200 units per year until 2036);
  - Secondary and primary school;
  - Mixed use local centre;
  - Employment including B1, B2 and B8 uses.
- 2.4 The remainder of the site will be brought forward in later stages and will be considered post Local Plan. This is likely to include further scope for residential development and a mixed use local centre.

2.5 The site location shown in Figure 1. The concept masterplan and phasing plan are shown in Figures 2 and 3.

### 3.0 CRITERIA

#### National Planning Policy Framework and Noise Policy Statement for England

3.1 The National Planning Policy Framework (NPPF) [Reference 1] states that planning policies and decisions should ensure that new development is appropriate for its location taking into account the likely effects of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development- and avoid noise giving rise to significant adverse impacts on health and 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.

3.2 The NPPF refers to the Noise Policy Statement for England (NPSE) [Reference 2] which is intended to apply to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise. The NPSE sets out the Government's long-term vision 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' which is supported by the following aims.

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life.

3.3 The NPSE defines the concept of a 'significant observed adverse effect level' (SOAEL) as 'the level above which significant adverse effects on health and quality of life occur'. The following guidance is provided within the NPSE:

*"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our*

*understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.”*

- 3.4 In 2014 the Planning Practice Guidance (PPG) was finalised [Reference 3]. This is written to support the NPPF with more specific planning guidance. The PPG reflects the NPSE and states that noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. It also states that opportunities should be taken, where practicable, to achieve improvements to the acoustic environment. The PPG states that noise can over-ride other planning concerns but should not be considered in isolation from the other economic, social and environmental dimensions of the proposed development.
- 3.5 The PPG expands upon the concept of SOAEL (together with Lowest Observable Adverse Effect Level, LOAEL and No Observed Effect Level, NOEL) as introduced in the NPSE and provides a table of noise exposure hierarchy for use in noise impact assessments in the planning system.
- 3.6 In general terms it is considered that a noise impact with an effects level which is lower than SOAEL is acceptable (providing the effect is mitigated to a minimum). There is currently, however, a discontinuity between the above guidance and objective technical criteria for use in planning noise impact assessments. For this site it is considered that the appropriate (technical and objective) standards for use in assessing the noise impact are British Standard 8233: 2014 and guidance from the World Health Organisation for habitable rooms in the proposed hotel and those of British Standard 4142 [Reference 4] for proposed plant items associated with the development.

#### Professional Practice Guidance on Planning & Noise (ProPG)

- 3.7 The Professional Practice Guidance on Planning and Noise (ProPG) [Reference 5] was published jointly by the Association of Noise Consultants, Institute of Acoustics and Chartered Institute of Environmental Health in May 2017. The guidance relates to the consideration of existing sources of transportation noise upon proposed new residential development and strives to:

- Advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
- Encourage the process of good acoustic design in and around new residential developments;
- Outline what should be taken into account in deciding planning applications for new noise-sensitive developments;
- Improve understanding of how to determine the extent of potential noise impact and effect; and
- Assist the delivery of sustainable development.

3.8 The guidance describes a recommended approach for new residential development, which includes four key elements of the assessment process, identified below:

- (i) Good acoustic design process;
- (ii) Internal noise level guidelines;
- (iii) External amenity area noise assessment;
- (iv) Assessment of other relevant issues.

3.9 It is important to note that the guidance in ProPG does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy. It is provided for guidance only and has no formal place within planning legislation.

#### BS 8233: 2014 and World Health Organisation Criteria

3.10 BS 8233:2014 [Reference 6] provides design guidance for dwelling houses, flats and rooms in residential use and recommends that internal noise levels in dwellings do not exceed 35 dB  $L_{Aeq,16\text{ hour}}$  in living rooms and bedrooms during the day, 40 dB  $L_{Aeq,16\text{ hour}}$  in dining rooms during the day and 30 dB  $L_{Aeq,8\text{ hour}}$  in bedrooms at night.

3.11 BS 8233 also notes that "*Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or  $L_{Amax,f}$  depending on the character and number of events per night.*"

3.12 The World Health Organisation (WHO) [Reference 7] provides guidance on desirable internal noise levels to minimise the risk of sleep disturbance. The WHO 2000 guidelines suggest internal noise levels not exceeding 30 dB  $L_{Aeq,8hr}$  or regularly exceeding 45 dB  $L_{Amax,f}$  for 'a good night's sleep'.

#### BS 4142:2014

3.13 BS 4142:2014 [Reference 4] provides a method for rating the effects of industrial and commercial sound on residential areas.

3.14 The standard advocates a comparison between the representative measured  $L_{A90}$  background noise level and  $L_{Aeq}$  noise level from the source being considered. For rating purposes if the noise source is tonal, intermittent or otherwise distinctive in character, a rating correction should be applied.

3.15 The standard states that a difference between the rating level and the background level of around +10 dBA is an indication of a significant adverse impact, depending on the context and a difference of around +5 dBA is likely to be an indication of an adverse impact, also depending on the context. Where the rating level does not exceed the background noise level, this is an indication of the specific sound source having a low impact (depending upon the context).

3.16 BS 4142 requires the noise impact to be assessed depending on the context. In relation to situations where background noise levels are low, the standard states "*Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.*"

#### BB 93

3.17 The document 'Acoustic design of schools: performance standards, Building Bulletin 93' [Reference 8] was published in December 2014 and supersedes section one of Building Bulletin 93 (BB 93, 2003). The guidance in Section 1.1.3 of the updated BB 93 also supersedes the guidance in Building Bulletin 101 (BB 101) with respect to acoustics and ventilation.

3.18 For clarity, all further references to BB 93 in this report refer to the 2014 document.

- 3.19 In order to maintain a satisfactory internal teaching environment, Building Bulletin 93 requires that an ambient noise survey be conducted. The aim is to limit external noise break-in so that it does not interfere with teaching activities once the school is operational. The limits apply to existing or known sources of noise for which the internal levels can be accurately predicted. The limits do not apply to the noise sources from within the school.
- 3.20 Ambient noise is defined as the total noise from all external sources intruding into the school together with noise from the schools own ventilation or other plant. This includes noise from road, rail and air traffic and industrial/commercial premises. It does not include noise from school activities such as teaching or sports, nor teaching equipment.
- 3.21 Internal ambient noise levels for primary school teaching spaces should not exceed the BB93 upper limit of 35 dB  $L_{Aeq, 30mins}$ .
- 3.22 The indoor ambient noise levels must be achieved with adequate ventilation, which may be provided by natural ventilation, mechanical ventilation or a hybrid system.
- 3.23 For rooms that are naturally ventilated, 'normal operation' is defined in BB 93 as providing a minimum ventilation rate of approximately 5 l/s per person. Under this 'normal operation' condition, BB 93 permits internal noise levels that are up to 5 dB above the performance standards for internal noise levels in Table 1 of BB 93 (ie, 40 dB  $L_{Aeq, 30 min}$ ).
- 3.24 For 'summertime ventilation' (i.e. to prevent overheating) and 'intermittent boost' (ie, for dilution of fumes), when provided by natural ventilation under local control of the teacher, BB 93 requires that internal noise levels (regardless of room use) are no greater than 55 dB  $L_{Aeq, 30min}$ . For mechanical systems during these periods, BB 93 permits internal noise levels that are up to 5 dB above the performance standards for internal noise levels (ie, 40 dB  $L_{Aeq, 30 min}$ ).
- 3.25 In relation to summer overheating, BB 93 notes that *'the peak summertime condition is defined as the 200 hottest hours that occur using the design summer year (DSY) weather file during normal daily school operating hours including the summer holiday period.'*

### Traffic noise

- 3.26 The assessment of noise from vehicles on the highway is usually best assessed (ie, achieve a better correlation with subjective response) by a comparison with prevailing ambient ( $L_{Aeq}$ ) noise levels. This approach has been used and accepted at several Planning Inquiries (further details are available).

### Summary of Noise Criteria

- 3.27 The impact of noise upon the site will be assessed using the following methodology:
- For internal noise levels inside proposed residential dwellings, criteria from BS 8233: 2014 and the WHO Guidelines has been adopted. An upper internal daytime level of 35 dB  $L_{Aeq, 16 \text{ hour}}$  and a night-time level of 30 dB  $L_{Aeq, 8 \text{ hour}}$  should apply to habitable rooms. A maximum night-time level of 45 dB  $L_{Amax, \text{ fast}}$  should also apply in bedrooms for regular events.
  - Noise limits for industrial / commercial development will be proposed at the nearest existing and proposed residential receptors based on BS 4142:2014.
  - Acoustic design of schools will be carried out in accordance with BB 93.
  - Comparison of traffic noise levels with prevailing ambient noise levels.

## 4.0 ACOUSTIC DESIGN REVIEW

### Phase 1 Potential Sources of Noise

4.1 The following have been identified as existing potential sources of noise in relation to proposed residential receptors in Phase 1 the development.

- A1 dual carriageway to the west of the site;
- Quarries to the east of the site (Clipsham) and to the west of the A1 (Woolfox Quarry);
- Woolfox Depot to the south-west of the site.

4.2 The following have been identified as proposed potential sources of noise in relation to proposed residential receptors in Phase 1 of the development.

- B2 and B8 employment uses proposed adjacent to the south-western site boundary.
- Plant / entertainment noise sources associated with the mixed use local centre.

### Phase 1 Potential Sources of Vibration

4.3 No sources of vibration have been identified within Phase 1 of the Woolfox development which would be considered likely to results in significant levels of vibration in relation to the proposed development.

### Phase 1 Proposed Acoustic Design

4.4 In developing the site layout, the distance between the A1 dual carriageway and proposed residential receptors will be maximised.

4.5 Commercial / industrial B2 and B8 employment uses will be located to the west of the area allocated for employment. Where possible intervening buildings (B1 uses) will be utilised to provide screening between potentially noisy commercial / industrial activities and residential receptors.

4.6 Buildings forming the allocated employment area will provide screening to proposed residential properties from road traffic noise associated with the A1 dual carriageway.

- 4.7 The proposed schools have been located to the east of the Phase 1 ensuring that the distance between the A1 dual carriageway and schools is maximised.
- 4.8 Noise will be taken into account when planning the layout of the mixed use local centre to ensure no significant noise impact on residential receptors.
- 4.9 It is considered that distances are sufficiently great between Clipsham Quarry and noise sensitive receptors on Phase 1 of the proposed development site, that this is unlikely to result in a significant noise impact on proposed receptors. It is considered likely that noise from the A1 dual carriageway will be more significant than that from Woolfox Quarry so the quarry is considered unlikely to be a significant source of noise in relation to the proposed development.
- 4.10 Where significant noise sources are identified, consideration will be given to use of acoustic barriers as / where appropriate. As necessary, mitigation measures to receptors can be specified in terms of glazing and ventilation systems to ensure that appropriate noise criteria are achieved at the detailed design stage.
- 4.11 It is considered that with appropriate consideration during the detailed design of the development it could be ensured that any noise impact in the vicinity of Phase 1 of the development could be mitigated and minimised to ensure no significant noise impact.

#### Whole Site Potential Sources of Noise

- 4.12 The following have been identified as existing potential sources of noise in relation to proposed residential receptors in the Woolfox development.
- A1 dual carriageway to the west of the site;
  - Quarries to the east of the site (Clipsham) and to the west of the A1 (Woolfox Quarry);
  - Woolfox Depot to the south-west of the site;
  - Clipsham / Stretton Roads to the north of the site;
  - Industrial / commercial units to the north-east of the site on Bidwell Lane.

- 4.13 The following have been identified as proposed potential sources of noise in relation to proposed residential receptors in the whole development.
- B2 and B8 employment uses proposed adjacent to the south-western site boundary.
  - Plant / entertainment noise sources associated with the mixed use local centres.

#### Whole Site Potential Sources of Vibration

- 4.14 No sources of vibration have been identified within the Woolfox development which would be considered likely to result in significant levels of vibration in relation to the proposed development.

#### Whole Site Proposed Acoustic Design

- 4.15 Considerable buffer zones have been included between noise sensitive receptors in the northern half of the site and the A1 dual carriageway and Clipsham / Stretton Roads. This will assist in minimising traffic noise levels at receptors.
- 4.16 During detailed design, careful consideration will need to be given to the potential for noise from Clipsham quarry if it is still operational at the time of development. Detailed consideration of the potential for noise from commercial / industrial units to the east of the development on Bidwell Lane will also be undertaken.
- 4.17 Where significant noise sources are identified, consideration will be given to use of acoustic barriers as / where appropriate. As necessary, mitigation measures to receptors can be specified in terms of glazing and ventilation systems to ensure that appropriate noise criteria are achieved.
- 4.18 It is considered that with appropriate consideration during the detailed design of the development it could be ensured that any noise impact associated with the whole development could be mitigated and minimised to ensure no significant noise impact.

### Future Noise Impact Assessment

- 4.19 Later in the process, a noise impact assessment will be undertaken to identify and quantify significant noise sources in relation to the development. Noise surveys will be undertaken to quantify significant noise sources and to allow background noise levels representative of proposed dwellings to be established. Where appropriate acoustic barriers will be specified.
- 4.20 At the detailed design stage, break-in calculations will be undertaken in accordance with BS 8233 to allow mitigation measures to dwellings in the form of specialist glazing and ventilation to be specified as required.

## **5.0 ST GEORGES BARRACKS SITE COMPARISON**

### St Georges Barracks Acoustic Review

- 5.1 The St Georges Barracks site (SGB site) is located in Rutland southeast of Rutland Water. The SGB site is currently MoD land, formerly an air base, and more recently serving as army barracks. The barracks is due to close in 2020/21 and there is a Memorandum of Understanding (MoU) between the MoD and Rutland County Council that the SGB site will be vacated and will be available for redevelopment from 2021.
- 5.2 An Evolving Masterplan for the SGB site has been developed and can be seen at Figure 4. The current masterplan has provision for 2215 homes, a business zone and B1 employment uses along with a mixed use local centre, a health centre and a primary school.
- 5.3 It is understood that housing requirements are such that either the Woolfox site or the St Georges Barracks site would proceed but not both. On that basis an acoustic design review of the SGB site has been undertaken to allow comparison of the sites.
- 5.4 The SGB site is currently bounded predominantly by land in agricultural use with the villages of Edith Weston and North Luffenham nearby. The following have been identified as existing potential sources of noise in relation to proposed residential receptors in the St Georges Barracks development.
- Road traffic on the local road network;
  - Hanson cement works.

- 5.5 The following have been identified as proposed potential sources of noise in relation to proposed residential receptors in the St Georges Barracks development.
- Proposed employment uses;
  - Plant / entertainment noise sources associated with the mixed use local centre;
  - Future mineral extraction.
- 5.6 It is considered that with appropriate consideration during the design of the development it could be ensured that any noise impact associated with the local road network and the mixed use local centre is minimised with no significant noise impact anticipated. It is considered that a large number of existing residential properties lie closer to the Hanson cement works than the proposed residential development and given the distance (> 2km), this is unlikely to result in a significant noise impact for the proposed SGB development.
- 5.7 Mineral extraction of limestone underlying the eastern area of the SGB site is required to take place and this takes priority over any other development opportunities. The extent of minerals is shown in Figure 5. In the Evolving Masterplan this area is shown predominantly as a country park.
- 5.8 It is understood that mineral extraction would commence in around 10 years time and would last for around 10 years. Assuming that the western part of the SGB site was developed in the intervening 10 years, it is considered there is potential for a significant noise impact.
- 5.9 Noise sources associated with mineral extraction are likely to include the following:
- Excavators;
  - Loading shovels;
  - Dumper trucks;
  - Crushing / screening plant;
  - HGV movements on the site;
  - Additional HGV movements on the local road network.
- 5.10 Given the proximity of the area for mineral extraction to proposed noise sensitive receptors, this will require careful consideration and will require noise mitigation measures to be specified to ensure acceptable noise levels are achieved. Appropriate noise limits will need to be set during the planning process for the mineral extraction operations in line with national guidance given in the NPPF.

### Comparison of Sites

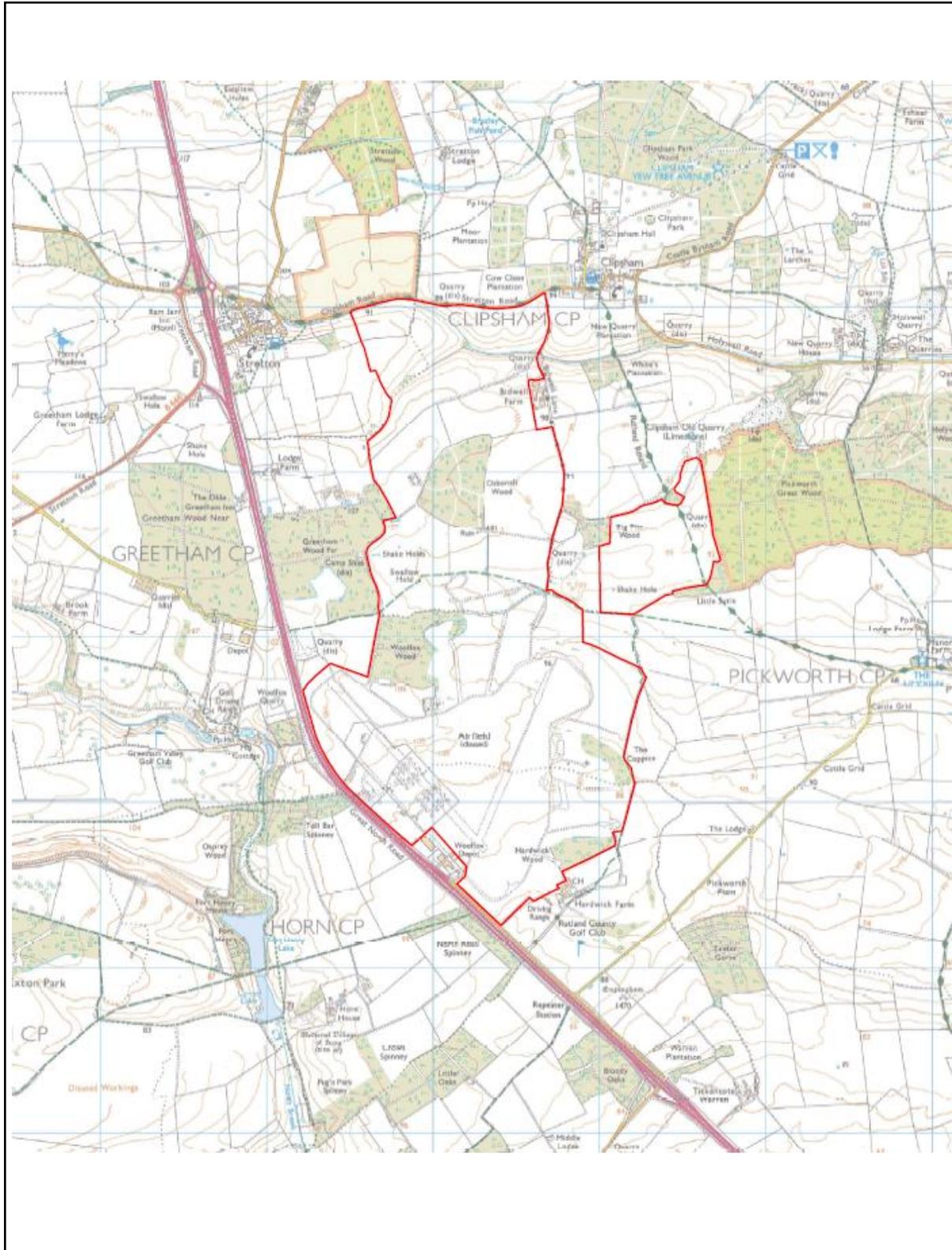
- 5.11 Both the Woolfox and the St Georges Barracks sites have existing / future significant sources of noise within the vicinity with the potential to result in a noise impact on the proposed developments.
- 5.12 It is considered, however, that for both sites, careful consideration of noise issues during development of the site layout and with appropriate noise mitigation measures specified, an acceptable noise environment could be achieved at noise sensitive receptors.

## **6.0 CONCLUSIONS**

- 6.1 Pikerace Ltd has instructed 24 Acoustics Ltd to carry out a review of the proposed Woolfox Garden Village development on land to the east of the A1 road in Rutland in relation to noise and vibration.
- 6.2 A desk-based study has been undertaken to identify potentially significant existing sources of noise and consider these in light of the proposed development. The potential for sources of vibration has also been considered. A summary of relevant standards and guidance is provided along with design recommendations and outline recommendations for noise mitigation measures.
- 6.3 Future work will include a full noise impact assessment for different phases of the development to ensure that there is no significant noise impact at noise sensitive receptors.
- 6.4 It is considered that with appropriate consideration during the detailed design of the development it could be ensured that any noise impact associated with the whole development could be mitigated and minimised to ensure no significant noise impact.

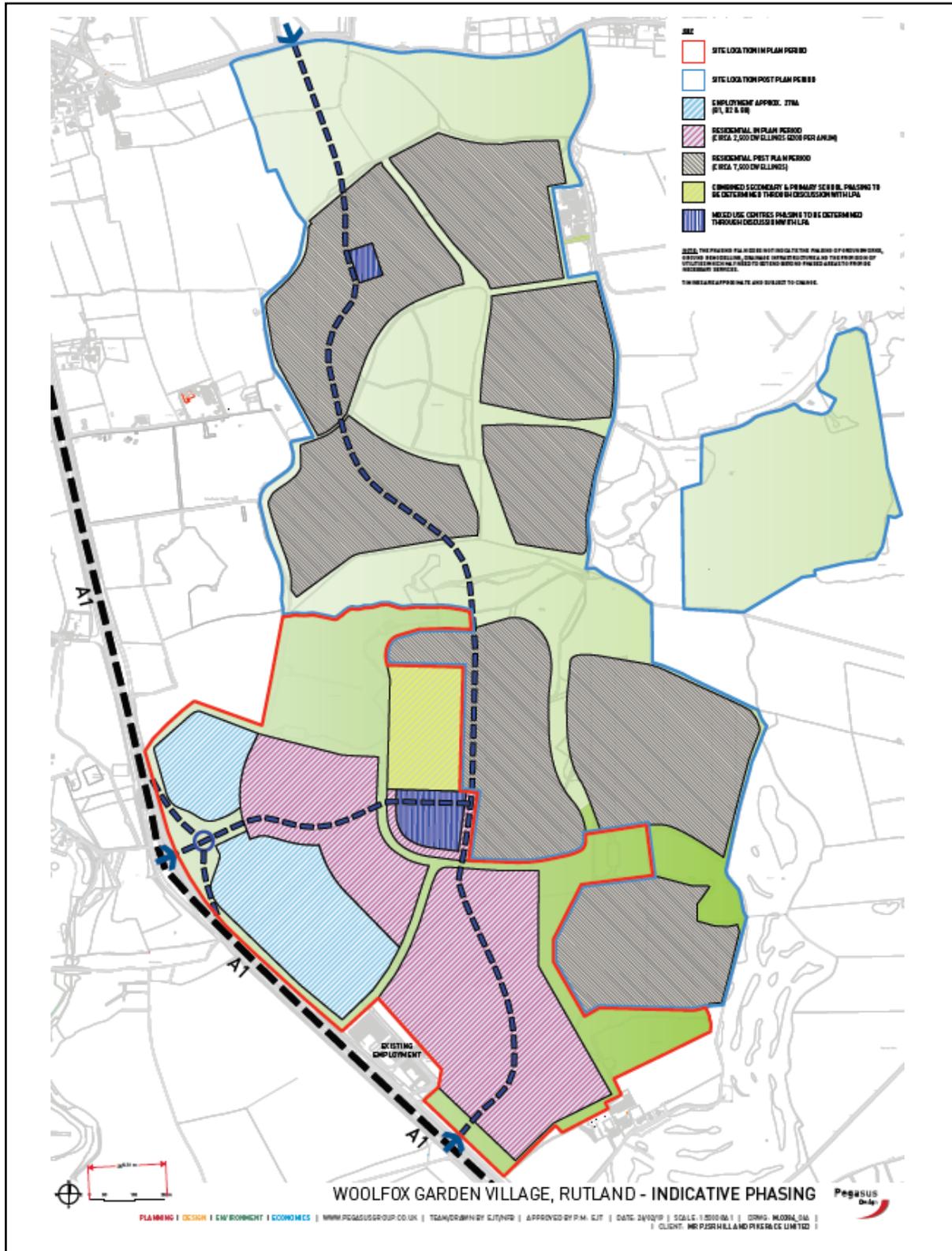
## REFERENCES

1. Department for Communities and Local Government. The National Planning Policy Framework (NPPF), February 2019.
2. DEFRA. Noise Policy Statement for England, 2010.
3. Department of Communities and Local Government. Planning Practice Guidance, March 2014.
4. British Standards Institution. British Standard 4142. Methods for Rating Industrial and Commercial Sound, 2014.
5. ProPG Professional Practice Guidance on Planning and Noise (ProPG), ANC, IOA, CIEH, May 2017.
6. British Standards Institution. British Standard 8233: Guidance on sound insulation and noise reduction for buildings, 2014.
7. World Health Organisation. Guidelines for Community Noise, 2000.
8. Department for Education, Building Bulletin 93, 'Acoustic design of schools: performance standards', December 2014



<p><b>Project:</b> Woolfox Garden Village, Rutland</p>	<p><b>Title:</b> Site Location</p>		
<p><b>DWG No:</b> Figure 1</p>	<p><b>Scale:</b> N.T.S.</p>	<p><b>Rev:</b> B</p>	
<p><b>Date:</b> March 2019</p>	<p><b>Drawn By:</b> AR</p>	<p><b>Job No:</b> 7813-1</p>	

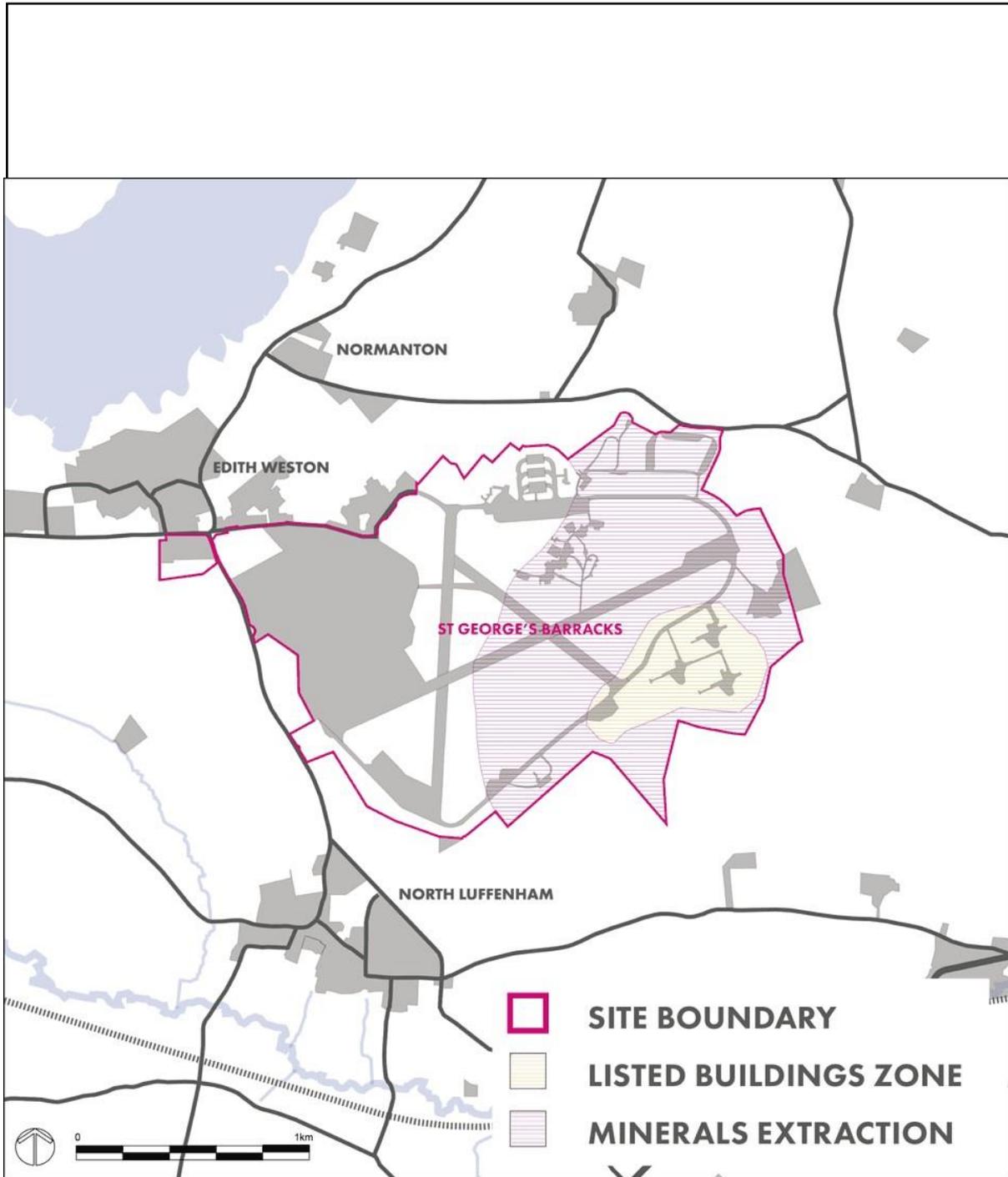




<b>Project:</b> Woolfox Garden Village		<b>Title:</b> Phasing Plan		
<b>DWG No:</b> Figure 3	<b>Scale:</b> N.T.S.	<b>Rev:</b> A		
<b>Date:</b> March 2019	<b>Drawn By:</b> AR	<b>Job No:</b> 7813-1		



<b>Project:</b> Woolfox Garden Village		<b>Title:</b> St Georges Barracks Evolving Masterplan		
<b>DWG No:</b> Figure 4	<b>Scale:</b> N.T.S.	<b>Rev:</b> A		
<b>Date:</b> March 2019	<b>Drawn By:</b> AR	<b>Job No:</b> 7813-1		



<b>Project:</b> Woolfox Garden Village		<b>Title:</b> St Georges Barracks Extent of Minerals		
<b>DWG No:</b> Figure 5	<b>Scale:</b> N.T.S.	<b>Rev:</b> A		
<b>Date:</b> March 2019	<b>Drawn By:</b> AR	<b>Job No:</b> 7813-1		

## APPENDIX A: NOISE UNITS

Noise is defined as unwanted sound. The range of audible sound is from 0 to 140 dB. The frequency response of the ear is usually taken to be around 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dB(A) weighting. This is an internationally accepted standard for noise measurements.

For variable sources, such as traffic, a difference of 3 dB(A) is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dB(A). The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/ decrease of 10 dB(A) corresponds to a doubling/ halving in perceived loudness.

External noise levels are rarely steady, but rise and fall according to activities within an area. In an attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

- i) The  $L_{Amax}$  noise level

This is the maximum noise level recorded over the measurement period.

- ii) The  $L_{Aeq}$  noise level

This is "equivalent continuous A-weighted sound pressure level, in decibels" and is defined in British Standard BS 7445 as the "value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval,  $T$ , has the same mean square sound pressure as a sound under consideration whose level varies with time".

It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.