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LAND AT WOODHEAD ROAD, BROCKHOLES

NOISE ASSESSMENT

MAY 2016

WSP | PARSONS BRINCKERHOFF

LAND AT WOODHEAD ROAD, BROCKHOLES

NOISE ASSESSMENT

Miller Homes Ltd

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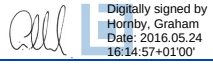
Signature	 Digitally signed by Hornby, Graham Date: 2016.05.24 16:14:57+01'00'			
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APPENDICES

1 INTRODUCTION

1.1 OVERVIEW

1.1.1 WSP | Parsons Brinckerhoff have been appointed by Miller Homes to undertake a noise assessment to support the outline planning application for a proposed residential development at a site known as Land at Woodhead Road, Brockholes, West Yorkshire.

1.1.2 This report describes the noise monitoring, assessment and appropriate mitigation measures required in order achieve applicable internal and external noise level criteria in order to provide an appropriate level of protection to noise sensitive properties within the proposed development, as agreed with the local authority.

1.1.3 The report is necessarily technical in nature and so, to assist the reader, a glossary of terms is included in **Appendix A**.

2 SITE DESCRIPTION

2.1 EXISTING SITE

2.1.1 The site is currently open greenfield, within Brockholes, near Honley in West Yorkshire. To the north of the site is Hope Bank Works, a sheet metal manufacturing facility. The east of the site is bounded by existing residential properties on New Mill road and Burdwell Works. The west of the site is bounded by Woodhead Road with few existing residential properties. Directly to the south of the site are residential properties on Haggroyd Lane, beyond which is a wooded area.

3 CRITERIA

3.1 BRITISH STANDARD 4142: 2014 METHODS FOR RATING AND ASSESSING INDUSTRIAL AND COMMERCIAL SOUND (BS 4142)

3.1.1 The BS 4142 Standard describes methods for rating and assessing the following:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train movements on or around an industrial and/or commercial site.

3.1.2 The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident. The Standard advises the purpose of the methodology includes the assessment of sound from any plant and activities associated with existing industrial and/or commercial uses at proposed residential dwellings.

3.1.3 If appropriate, the specific sound level of the source ($L_{Aeq,T}$) is corrected, by the application of one or more corrections for acoustic features such as tonal qualities and/or distinct impulses, to give a 'rating' level ($L_{Ar,Tr}$).The Standard effectively compares and rates the difference between the rating level of the specific sound and the typical background sound level ($L_{A90,T}$) in the absence of the specific sound.

3.1.4 The Standard advises that the time interval ('T') of the background sound measurement should be sufficient to obtain a representative or typical value of the background sound level at the time(s) the source in question operates or is proposed to operate in the future.

3.1.5 The Standard states that the assessment methodology is applicable for the assessment of industrial and/or commercial sound at proposed new dwellings. However the guidance also states:

"NOTE Where a new noise-sensitive receptor is introduced and there is extant industrial and/or commercial sound, it ought to be recognized that the industrial and/or commercial sound forms a component of the acoustic environment. In such circumstances other guidance and criteria in addition to or alternative to this standard can also inform the appropriateness of both introducing a new noise-sensitive receptor and the extent of required noise mitigation."[1]

3.2 BRITISH STANDARD 8233:2014: GUIDANCE ON SOUND INSULATION AND NOISE REDUCTION FOR BUILDINGS

3.2.1 This standard provides guidance for the control of noise in and around buildings. The guidance provided within the document is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

3.2.2 The guidance provided includes appropriate internal and external noise level criteria which are applicable to dwellings for steady external noise sources. It is stated that it is desirable that the internal ambient noise level does not exceed the following criteria set out in **Table 1** below:

Table 1: Summary of internal ambient noise levels to be achieved in habitable rooms when assessed in accordance with BS 8233

Activity	Location	Period	
		07:00 to 23:00 Hours, i.e. Daytime	23:00 to 07:00 Hours, i.e. Night-time
Resting	Living Room	35 dB $L_{Aeq,\ 16\ Hour}$	-
Dining	Dining Room/area	40 dB $L_{Aeq,\ 16\ Hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,\ 16\ Hour}$	30 dB $L_{Aeq,\ 8\ Hour}$

[1] Section 8.5 of BS4142:2014

3.3 CONSULTATION WITH KIRKLEES COUNCIL

3.3.1 Prior to carrying out the assessment, the potential noise impacts on the proposed development and general principles of the assessment methodology were discussed and agreed with Mr Kevin Moore of Kirklees Council (KC).

3.3.2 It was the view of KC that the key noise source requiring assessment would be the potential impact of the existing Hope Bank Works to the north of the site which was agreed to be assessed in line with BS 4142:2014. The potential impact of Woodhead Road to the western boundary of the site was also discussed and is to be considered as part of this assessment.

3.3.3 It was also pointed out by KC that there is no history of noise complaints in the local area as a result of noise emissions from Hope Bank Works.

4 NOISE MONITORING

4.1 OVERVIEW

4.1.1 To inform the assessment and determine the current prevailing noise climate at the site a detailed baseline noise survey has been undertaken. WSP | Parsons Brinckerhoff's acoustics team visited the site and found the noise environment to the north-eastern part of the to be dominated by noise from the Hope Bank Works during the daytime, though the noise climate across the site in general was dominated by road traffic noise from the surrounding road network. To the eastern site boundary is a stream and beyond that existing residential properties on New Mill Road and Burdwell Works, from which no audible noise was apparent during attendance on site.

4.1.2 The local topography is such that the north end of the site (adjacent to Hope Bank Works) is elevated by approximately 2m above ground level at Hope Bank Works. Additionally there is a steep slope to the western boundary, such that the ground level where properties are proposed to be located is approximately 3m lower than ground level at Woodhead Road. The effects of local topography have been accounted for in calculations carried out for the assessment. The constraints plan showing the topography of the site as prepared by ARP Associates is shown in Appendix D.

4.1.3 The baseline noise survey included a combination of continuous 24 hour noise measurements and short-term fully attended measurements at locations representative of the proposed residential area of the development site. The baseline noise survey measurements were undertaken between approximately 11:30 hours on the 04th May 2016 and concluding at approximately 13:40 hours on the 05th May 2016.

4.2 MEASUREMENT LOCATIONS

4.2.1 The measurement locations adopted throughout the survey are shown in **Appendix B**, and can be described as follows:

- **Measurement Location 1 (ML1)**: This measurement location was located at the western site boundary, approximately 3 metres from the edge of Woodhead Road. This measurement location was positioned at a height of 1.5m above the local ground level and in free-field conditions with clear line of sight to the road.
- **Measurement Location 2 (ML2)**: This measurement location was located at the approximate centre of the site, such that it was well removed from the Hope Bank Works and Woodhead

Road. This measurement location was positioned at a height of 1.5m above the local ground level and in free-field conditions.

→ **Measurement Location 3 (ML3)**: This measurement location was located to the northern boundary of the site, adjacent to Hope Bank Works. This measurement location was positioned at a height of 1.5m above the local ground level and in free-field conditions.

4.2.2 A measurement position to the eastern boundary of the site was not deemed suitable following the site walkover due to the fast flowing river along the eastern boundary of the site above which no significant noise from Burdwell Works or any other source was audible.

4.3 METEOROLOGICAL CONDITIONS

4.3.1 Over the course of the baseline noise survey, meteorological conditions remained ideal for environmental noise measurements remaining dry throughout and sunny with winds typically below 5 m/s.

4.4 MEASUREMENT EQUIPMENT

4.4.1 The baseline noise survey measurements were undertaken using the following Type 1 specification noise measuring equipment:

Table 2: Noise measurement equipment

Equipment	Make and Model	Serial Number	Calibration Due Date
Sound Level Meter	01dB-Stell Solo Master	11810	06 July 2016
Pre-amplifier	01dB-Stell PRE 21 S	12495	
Microphone	Microtech Gefell GmbH MCE212	67311	
Calibrator	01dB-Stell Cal 21	34323996	14 July 2016
Sound Level Meter	01dB-METRAVIB Solo Master	60845	22 March 2017
Pre-amplifier	01dB-Stell PRE 21 S	13164	
Microphone	Microtech Gefell GmbH MCE212	67302	
Calibrator	01dB-Stell Cal 21	51031216	29 June 2016

4.4.2 The sound level meters and associated measurement chains had been calibrated to traceable standards within the preceding two years and the corresponding portable calibrators within the preceding 12 months. The sound level meters were calibrated both prior to and upon completion of the surveys for which they were used. No significant drift was noted.

4.5 MEASUREMENT RESULTS

4.5.1 A summary of the noise levels measured at ML2 and ML3 is presented within **Table 3**.

Table 3: Summary of continuous noise measurement results at Measurement Locations 2 and 3, Free-field (dB(A))

Measurement Location	Period	Measurement Period	$L_{Aeq,T}$	$L_{A90,T}$
2	Daytime (07:00 – 23:00)	1 hour	49.0	44.6
3	Daytime (07:00 – 23:00)	1 hour	62.8[1]	-
	Night time (23:00 – 07:00)	15 min	47.3	40.0

[1]*Measurement taken as worst case period as a result of all noise sources from Hope Bank Works within that period.*

4.5.2 The main sources of noise at the Hope Bank Works were observed to be music being played within the site building and works within the main building of the site including welding and power sawing / cutting. Additionally, the use of forklifts and HGV / wagon delivery movements and associated loading noise were observed.

4.5.3 During the survey it was confirmed that through the night-time, there are no deliveries to the works or ongoing operations such as those listed above, though there is low level noise from plant running within the factory.

Table 4: Summary of the measurement of road traffic noise at 3m from the carriageway of Woodhead Road at measurement location, Free-field (dB(A))

Measurement Location	Period	$L_{Aeq,T}$	$L_{A10,T}$
1	12:00 – 13:00	65.5	70.3
	13:00 – 14:00	66.1	70.4
	14:00 – 15:00	65.6	70.2

4.5.4 The attended daytime measurements of road traffic noise at Measurement Location 1 were carried out in accordance with the Shortened Measurement Procedure set out in the Department of Transports technical memorandum "*Calculation of Road Traffic Noise*" 1988 (CRTN). This requires that traffic noise is measured over 3 consecutive hours between 10:00 and 17:00 hours. The $L_{A10\ 18\ hour}$ is then calculated from the arithmetic average of the three consecutive $L_{A10\ 1\ hour}$ noise levels by subtracting 1dB. The results of the CRTN measurements can be compared to the assessment criteria by making a small adjustment to the noise levels in accordance with a method set out in BS 8233 (which suggests that the $L_{A10\ 18\text{-}hour}$ value can be converted to $L_{Aeq\ 16\text{-}hour}$ value by subtracting 2dB).

4.5.5 Road traffic noise levels over an 8-hour night-time period can be derived using calculated $L_{A10,18\ Hour}$ based on the TRL *Method for Converting the UK Road Traffic Noise Index* $L_{A10,\ 18h}$ *to the EU Noise Indices for Road Noise Mapping*. These conversions take into account the lower traffic flows during the night-time period. In accordance with the TRL Ltd method the L_{night} value for non-motorway roads as follows:

$$L_{night}\ dB = (0.90 \times L_{A10,18\ Hour} - 3.77)$$

Table 5: Calculated levels of road traffic noise at 3m from Woodhead Road, Free-field dB(A)

Measurement Location	Period	$L_{A10,T}$	$L_{Aeq,T}$
1	06:00 – 00:00 – 18 Hour	69.3	-
	07:00 – 23:00 – 16 Hour	-	67.3
	23:00 – 07:00 – 8 Hour	-	58.6

5 NOISE ASSESSMENT

5.1 DETERMINING THE EXTERNAL NOISE LEVEL

5.1.1 In order to determine the suitability of the site for residential development it is necessary to determine the existing sources of noise which have the potential to affect the future residents of the proposed development. The dominant noise sources across the site are noise emissions as a result of operations at Hope Bank Works and road traffic noise from Woodhead Road. As a worst case, the nearest affected proposed properties to each noise source have been used as a basis for this assessment. The nearest proposed properties to Hope Bank Works and Woodhead Road are 48m (NR1) and 16m (NR2), respectively. The nearest proposed properties and therefore those used for the purposes of this assessment are shown in Appendix B.

5.2 ASSESSMENT OF NOISE FROM HOPE BANK WORKS

5.2.1 Based on the results of noise measurements undertaken at MP2 and MP3 and the application of standard acoustic distance corrections external (free-field) noise levels have been predicted at NR1. The predicted noise levels have been assessed in accordance with BS 4142: 2014; the results of this assessment are presented in Table 6.

5.2.2 For the purposes of this assessment, the worst case 1 hour period has been used to determine the specific sound level from the works during the day. Hope Bank Works does not typically operate during the night time, though low level plant has been identified to operate within the factory throughout the day and night, as such the average $L_{Aeq,15min}$ has been used for the purposes of the night-time assessment.

5.2.3 An applicable acoustic a penalty of 3 dB has been applied to the specific sound level during the day in accordance with BS 4142:2014 due to the intermittent nature of the noise sources.

Table 6: BS 4142 assessment of noise emissions from Hope Bank Works on nearest proposed properties

Assessment Location	Period	Specific Sound Level ($L_{Aeq,1hr}$)	Acoustic Penalty Corrections	Rating Level ($L_{Ar,Tr}$)	Background Sound Level ($L_{A90,T}$)	Excess of Rating Level over Background Sound Level
NR1	Daytime (0700 – 2300)[1]	48[2]	3	51	45	6
	Night-time (2300 – 0700)[1]	29[3]	0	29	40	-11

[1]Applicable time periods during daytime hours is 1 hour and 15 min during the night
[2] Specific Sound Level (daytime) was 63dB $L_{Aeq,1hr}$ measured at 6.5m from source. Level reported here is calculated level at NR1 (38m distance from source).
[3] Specific Sound Level (night-time) was 44dB $L_{Aeq,15min}$ measured at 6.5m from source. Level reported here is calculated level at NR1 (38m distance from source).

5.2.4 Based on the results of the above assessment, it can be seen that predicted noise levels will exceed background noise levels by 6 dB at the proposed properties during the daytime, though is 11 dB below background during the night.

5.2.5 BS 4142 states the following with regard to assessment of impacts:

- 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 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.

5.2.6 During the night-time, the rating level has been calculated to be 11 dB below the background sound level, therefore is not likely to cause adverse impact. Therefore at this stage, the consideration of mitigation measures is not considered necessary for the night-time period.

5.2.7 Given the context of the site, in that operations at Hope Bank Works are existing and occupants would be moving into the site in the knowledge there are commercial units in the vicinity, there are existing residential receptors closer to the works than those proposed as part this application and that no complaints have been raised against the works regarding noise, it is considered appropriate to assess the potential impact on the proposed receptors in line with external and internal noise level criteria within BS 8233.

5.2.8 For proposed external areas, when looking at noise level criteria set out in BS 8233: 2014, a noise level of below 50 to 55 dB is suggested in gardens without the requirement for any mitigation. It can be seen from Table 7 that the predicted noise levels in the proposed gardens are below this range and as such consideration of mitigation to protect gardens is considered unwarranted.

5.2.9 Consideration should also be given to achieving internal noise criteria specified in BS8233. Table 7 below presents the predicted noise level at the façade and sound insulation performance required to achieve internal noise levels for habitable rooms during the daytime.

Table 7: Required sound insulation / attenuation performance for dwellings closest to Hope Bank Works, dB

Assessment location	Period	Exterior Noise level	Target noise level criteria L_{Aeq}	Required sound insulation / attenuation
Residential Garden (NR1)	Daytime ($L_{Aeq,16hr}$)	48	55	N/A
Residential Property (NR1)	Daytime ($L_{Aeq,16hr}$)	48	35	13

5.2.10 As seen in Table 7 above, the sound reduction required from the façade is 13 dB, which should be achieved by a partially open window. Therefore an acoustic glazing and ventilation scheme is not required for the property.

5.2.11 It should be noted that this assessment has been carried out for the nearest property (NR1) as shown in Appendix C, Other proposed properties further into the site will be subject to lower noise levels due to increased distance from the source and screening afforded by other proposed properties within the development.

5.3 ASSESSMENT OF ROAD TRAFFIC NOISE

5.3.1 Noise levels at the location of the nearest receptor to Woodhead Road (NR2) have been determined drawing upon the noise level data detailed within Table 5, and the application of standard acoustic distance corrections (a 3 dB gain per halving of distance for a line source ($L_{Aeq,T}$ noise levels)).

5.3.2 The resulting noise levels at NR2 are presented in Table 8 below, along with the sound insulation / attenuation performances that would be required to achieve appropriate internal and external noise level criteria adopted from BS 8233: 2014.

Table 8: Required sound insulation performance / attenuation for dwellings closest to Woodhead Road, dB

Assessment location	Period	Exterior Noise level	Target noise level criteria L_{Aeq}	Required sound insulation / attenuation
Residential Garden (NR2)	Daytime ($L_{Aeq,16hr}$)	63	55	8
Residential Property (NR2)	Daytime ($L_{Aeq,16hr}$)	51	35	16
	Night-time ($L_{Aeq,8hr}$)	44	30	14

5.3.3 As the noise levels detailed in Table 8 indicate that the external noise level criteria from BS 8233:2014 have the potential to be exceeded at the properties closest to Woodhead Road. Accordingly, consideration has been given to appropriate noise mitigation measures within the following section.

6 NOISE MITIGATION

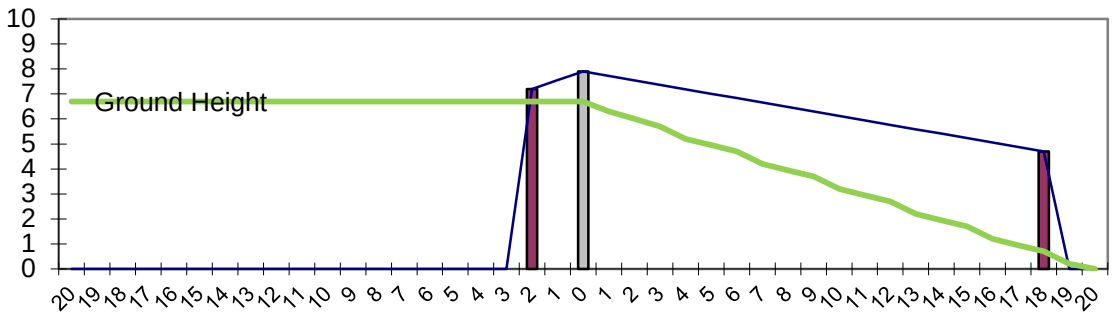
6.1 WOODHEAD ROAD

6.1.1 The properties adjacent to Woodhead have been identified to exceed external noise level criteria set out in BS 8233, therefore it is necessary to give consideration to generic mitigation measures. It is noted that it is the rear gardens of dwellings that back onto Woodhead road which is taken to be the primary external amenity space for these dwellings.

6.1.2 External noise levels are predicted to be 63 dB in residential gardens (as shown in Table 8); therefore it is necessary for noise mitigation to reduce noise levels in the main garden areas to at least 55 dB. As such consideration has been given to a noise barrier. Calculations have been undertaken to in order to determine the required barrier height in order to achieve acceptable noise levels in gardens, based on these calculations, it is proposed that a continuous barrier at 1.2m in height would provide sufficient reduction to achieve external noise levels in gardens.

6.1.3 To inform the barrier loss calculations a source height of 0.5m was assumed for cars on the nearside carriageway of Woodhead Road (as per CRTN) and local topography (as provided in the form of a topographic survey by the client) was taken into account. Specifically the road height is 6m above that at where the property at NR2 is proposed. Receiver heights were set to be 1.5m and 4m in height at the property for calculation of the day and night time attenuation, respectively. To calculate noise levels in the garden, the approximate centre of the proposed garden was used at a distance of 9m from the road and a receiver height of 1.5m above local ground level. Figure 6-1, below shows the heights used for calculation undertaken for the night-time.

Figure 6-1: Geometry used to inform barrier calculations at property (NR2) during night-time as per results of topographical survey (see constraints plan, Appendix D)



6.1.4 The barrier would be best installed at road level to the rear of the gardens, in order to take full advantage of the benefit afforded by the local topography. Calculations have been carried out assuming that installation would be such that the foot of the barrier would be located at road height.

6.1.5 The proposed location of the recommended noise barrier is shown in Appendix C. To ensure the acoustic integrity of any acoustic barrier, they should be continuous, imperforate (i.e. no holes/perforations), sealed at the base and have a mass per unit area of 10-15 kg/m^2. Such a construction would typically be achievable with the use of a close boarded timber fence of appropriate thickness (thickness based on the selected timber mass, according to the stated mass per unit area). For example, a close boarded timber fence with a mass per unit area of 12.5kg/m^2 can be achieved with 22mm thick marine grade plywood.

6.1.6 Assuming this specification of barrier the calculated attenuation for the barrier is shown in table 9 below.

Table 9: Calculated barrier attenuation

Assessment location	Period	Exterior Noise level (dB $L_{Aeq,T}$) [A]	Calculated Barrier Attenuation, dB [B]	Exterior Noise Level (dB $L_{Aeq,T}$) [A]-[B]
Residential Garden (NR2)	Daytime ($L_{Aeq,16hr}$)	63	12	51
Residential Property (NR2)	Daytime ($L_{Aeq,16hr}$)	60	12	48
	Night-time ($L_{Aeq,8hr}$)	51	11	40

Table 10: Required sound insulation / attenuation performance for dwellings closest to Woodhead Road, following implementation of noise barrier

Assessment location	Period	Predicted Exterior Noise level Following barrier Installation	Target noise level criteria L_{Aeq}	Required sound insulation / attenuation
Residential Garden (NR2)	Daytime ($L_{Aeq,16hr}$)	51	55	N/A
Residential Property (NR2)	Daytime ($L_{Aeq,16hr}$)	48	35	13
	Night-time ($L_{Aeq,8hr}$)	40	30	10

6.1.7 Assuming installation of the barrier is carried out as detailed in this report and based on the resulting predicted noise levels shown in Table 10 above, the required sound insulation of the façade required to achieve internal noise levels during both the day and night could be easily achieved by means of openable windows (assuming a reduction of 13 dB from a partially open window).

7 CONCLUSIONS

7.1.1 WSP | Parsons Brinckerhoff have been appointed by Miller Homes to provide a noise assessment to support the planning application for a proposed residential development at a site off Woodhead Road in Brockholes.

7.1.2 This report has described the noise monitoring, assessment and appropriate mitigation measurements in order to achieve applicable internal and external noise level criteria for proposed noise sensitive receptors.

7.1.3 It has been recommended that a barrier at a height of 1.7m be installed at road level along the edge of the gardens to properties adjacent to Woodhead Road. This is in order to ensure that both external and internal noise levels at these properties can be achieved.

7.1.4 Additionally it considered that noise from the existing Hope Bank Works can be controlled by means of an appropriate glazing and ventilation specification.

Appendix A

GLOSSARY OF TERMS

GLOSSARY OF ACOUSTIC TERMINOLOGY

Noise

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

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

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc., according to the parameter being measured.

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

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

Table A1 - Typical sound levels found in the environment

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

Table A2 – Terminology relating to noise

Terminology	Description
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa ($20x10^{-6}$ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1 / s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m.
Façade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Octave Band	A range of frequencies whose upper limit is twice the frequency of the lower limit.

Appendix B

NOISE MONITORING LOCATION PLAN AND ASSESSMENT LOCATIONS

File: Created using iGIS, WSP's Online Mapping System Drawn By: UKBXR001 Date Modified: 20/05/2016 15:46

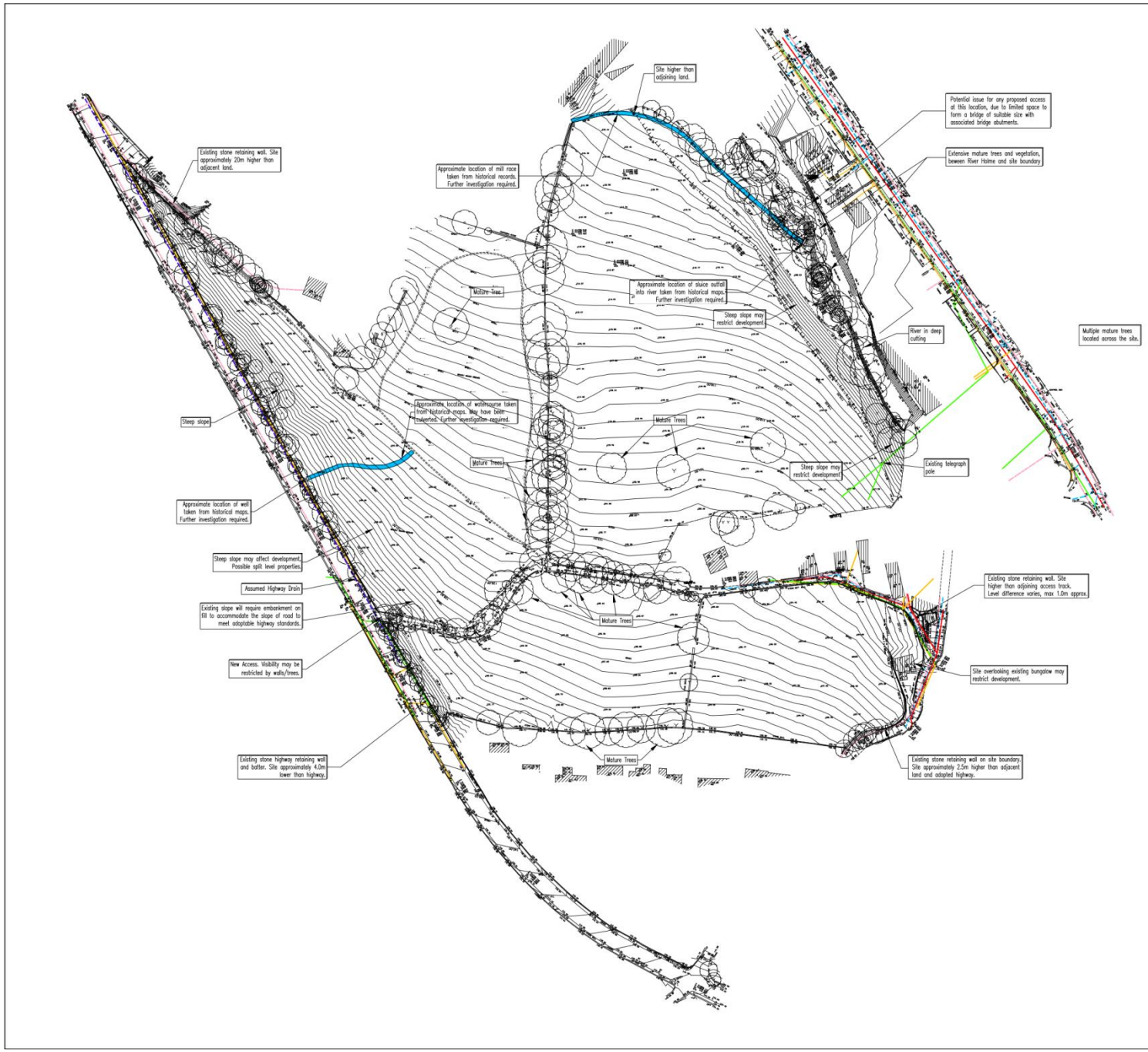
Appendix C

PROPOSED SITE LAYOUT AND PROPOSED BARRIER LOCATION


miller homes
NR1
NR2
Proposed Barrier Location (indicative)
Phoenix Works
BANKS ROAD
Hope Bank
Kennels
Holly Edge
Larkfield
ROBINSON LANE
DESIGNATED LANDSCAPING AREA
Longmead
The Haggroya
The Spinney
The Smithy House
SALES AREA
STEN ARCHITECTURE
SK02 | DECEMBER 2015 | 1:500@A0
WOODHEAD ROAD, BROCKHOLES

Appendix D

CONSTRAINTS PLAN



N O T E S

1. This drawing should be read in colour.
2. The location of all existing sewers, rising mains & utilities are shown approximate based on the services plans received.

- Potential Culverted Watercourse
- Public Combined Sewer
- Yorkshire Water Rising Main
- Assumed Highway Drain
- BT Openreach
- Northern Powergrid
- Northern Gas Network

Rev	By	Date	Revision	Chk
A	WMW	26.09.13	Combined sewer location corrected. Minor alterations.	
/	WW	16.09.13	Issued for approval	ARP

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TITLE
CONSTRAINTS PLAN

PROJECT
WOODHEAD ROAD,
BROCKHOLES

CLIENT
MILLER HOMES
(YORKSHIRE)

Scale	Date	Drawn	Chk.
1:1000 @ A1	AUG'13	WMW	ARP

Org. No.	Rev
425/58/01	A

Appendix E

BARRIER CALCULATIONS

Table E-1: Barrier Calculation (NR1 - Garden)

Project	**Woodhead Road, Brockholes**		**E1**	**Source Elevation (above datum)**			**7.2**	**m**
Job No	**70021709**		E2	Receiver Elevation (above datum)			5.2	m
Date	**24/05/2016**		E3	Barrier Height (above datum)			7.9	m
By	**BR**		D1	Distance - Source to Barrier			2	m
Sheet	**1**		D2	Distance - Barrier to Receiver			9	m
	a	+	b	-	c	=	d	
	2.12	+	9.40	-	11.18	=	0.33	
			Barrier Loss =	-12.03				

Table E-2: Barrier Calculation (NR2 - Property, Day)

Project	**Woodhead Road, Brockholes**		**E1**	**Source Elevation (above datum)**			**7.2**	**m**
Job No	**70021709**		E2	Receiver Elevation (above datum)			2.2	m
Date	**24/05/2016**		E3	Barrier Height (above datum)			7.9	m
By	**BR**		D1	Distance - Source to Barrier			2	m
Sheet	**2**		D2	Distance - Barrier to Receiver			18	m
	a	+	b	-	c	=	d	
	2.12	+	18.88	-	20.62	=	0.38	
			Barrier Loss =	-12.40				

Table E-3 - Barrier Calculation (NR2 - Property, Night)

Project	**Woodhead Road, Brockholes**		**E1**	**Source Elevation (above datum)**			**7.2**	**m**
Job No	**70021709**		E2	Receiver Elevation (above datum)			4.7	m
Date	**24/05/2016**		E3	Barrier Height (above datum)			7.9	m
By	**BR**		D1	Distance - Source to Barrier			2	m
Sheet	**3**		D2	Distance - Barrier to Receiver			18	m
	a	+	b	-	c	=	d	
	2.12	+	18.88	-	20.62	=	0.25	
			Barrier Loss =	-11.25