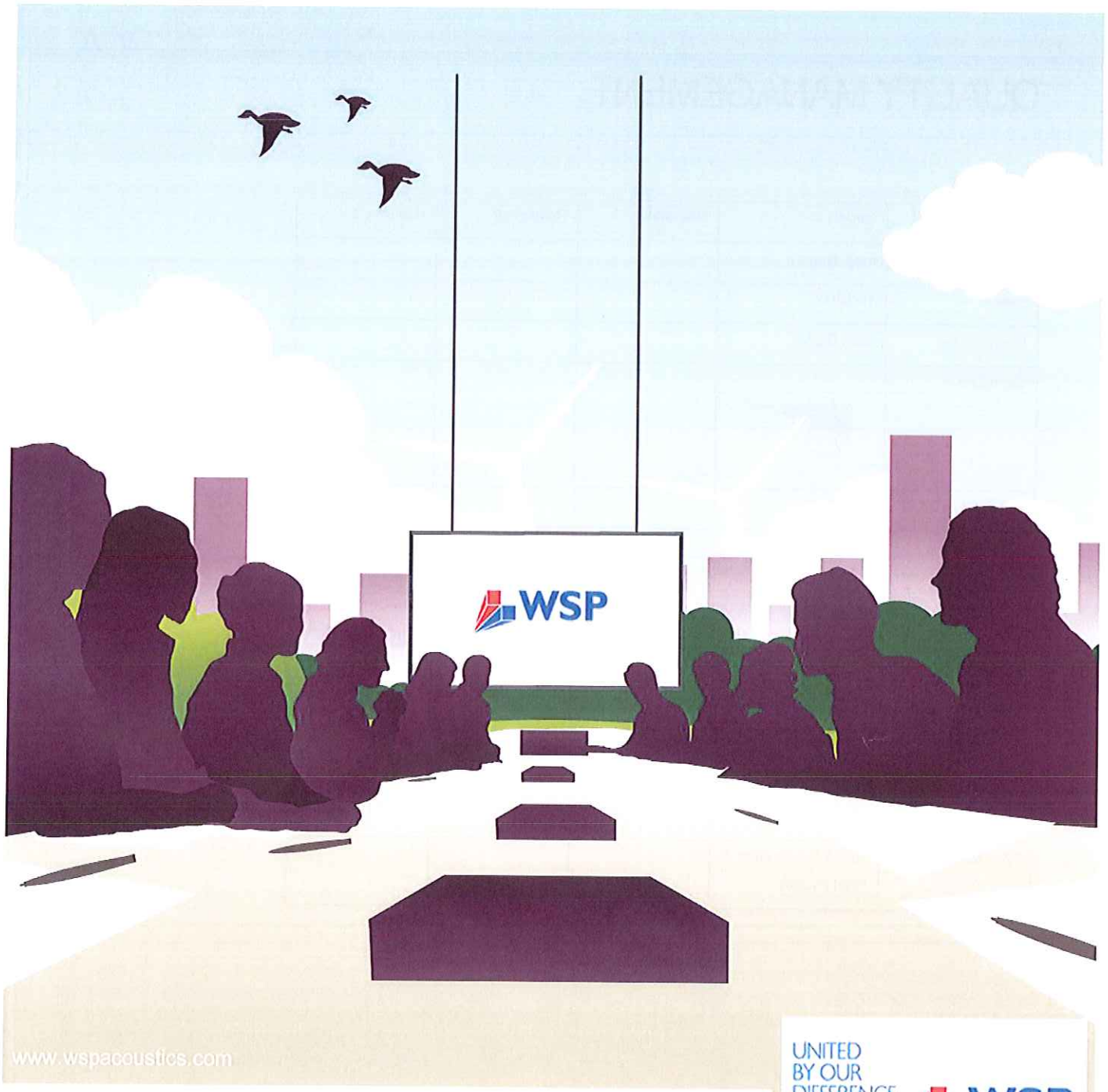

Title: Doves Nest Farm (North) Potash / Polyhalite Drilling Noise Assessment

Client: York Potash Limited

17 December 2012

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QUALITY MANAGEMENT

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
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1 Introduction

1.1 SUMMARY

1.1.1 WSP Acoustics has been appointed to undertake an environmental noise assessment of proposed temporary drilling work at a site known as Doves Nest Farm (North). The site is located immediately adjacent to the B1416 to the west of the site and Whinny Wood to the south east. The site lies approximately 1.5 km to the south-west of the village of Sneatonthorpe in North Yorkshire.

1.1.2 The drilling work is proposed to determine the presence of underground Potash and Polyhalite. Whilst the proposed drilling site is in a fairly remote location and drilling works would be temporary in nature (an approximate 6 months drilling period is anticipated), it is proposed that the works would be undertaken 24 hours a day 7 days a week. The purpose of this assessment is therefore to determine the noise levels that are likely to be generated by such works at the closest local noise sensitive receptors (e.g. dwellings) and whether the resulting levels would be acceptable.

1.1.3 During consultation with the Environmental Health Department of Scarborough Borough Council (SBC), it was agreed that this assessment should be undertaken to determine likely compliance with appropriate $L_{Aeq,T}$ (see Appendix A) noise level limits adopted from Minerals Policy Statement 2: *Controlling and Mitigating the Environmental Effects of Mineral Extraction in England - Annex 2: Noise*. Subsequent to the completion of this consultation, the *National Planning Policy Framework* (NPPF) dated March 2012 has been adopted, which replaces MPS 2 (along with a number of other previous Planning Policy Guidance Notes, Planning Policy Statements, Mineral Policy Statements and Mineral Planning Guidance documents). However, the *Technical Guidance* document which accompanies the NPPF (also dated March 2012) duplicates the key noise level limits detailed within the earlier MPS 2. The criteria agreed for adoption with SBC therefore remain valid and concordant with both the MPS2 and the new NPPF.

1.1.4 The adopted noise level limits are also concordant with a stringent interpretation of the guidance contained with British Standard 5228: 2009: *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*. The guidance contained within the 1999 World Health Organisation publication: *Guidelines for community noise* and British Standard 8233: *Sound insulation and noise reduction for buildings - Code of practice* has also been referenced with respect to the L_{Amax} noise index (See appendix A).

1.1.5 Drawing upon the results of source noise emission data for two of the drilling rigs which are options for use at this site, a series of noise level predictions have been undertaken. These predictions have been undertaken in accordance with the methodology prescribed in International Standard Organisation (ISO) 9613*: Attenuation of sound during propagation outdoors - Part 2: General method of calculation*. It should be noted that this assessment method assumes downwind propagation and can therefore be considered to be worst case in this regard.

1.1.6 Where any exceedances of the applicable assessment criteria are identified, consideration has been given to appropriate noise mitigation measures.

1.1.7 This report is necessarily technical in nature, so to assist the reader, a glossary of acoustic terminology is presented in Appendix A.

2 Site Description

2.1 LOCATION

2.1.1 The site is located in a rural area south-west of Sneatonthorpe in North Yorkshire. The area being proposed for drilling is approximately 350m to the north west of the Doves Nest Farm buildings and approximately 1.3 km east of the village of Littlebeck. The site is adjacent to the southbound carriageway of the B1416 and is shown in Figure B1 of Appendix B.

2.2 LOCAL NOISE-SENSITIVE RECEPTORS

2.2.1 The closest noise sensitive receptors to the site have been identified by means of a desk review and a site walkover. The desk review included an appraisal of Ordnance Survey mapping for the site and surrounding area, and a review of available on-line aerial photography.

2.2.2 It is understood that the proprietors of Doves Nest Farm are financially involved with the development and have indicated an acceptance of any potential noise impact associated with the proposed drilling activities. Given this acceptance and involvement, the next closest receptors to the site are considered the most sensitive houses and have been considered in this assessment. The following have been identified as a representative sample of the closest receptors to the proposed drilling site:

- Receptor 1: Moor House Farm, approximately 580m west / south-west of the site;
- Receptor 2: Park Down, approximately 610m north-east of the site;
- Receptor 3: Moorside Farm, approximately 640m south-west of the site;
- Receptor 4: Knaggy House Farm, approximately 780m north-east of the site;
- Receptor 5: Thorn Hill, approximately 980m south-west of the site;
- Receptor 6: Red Barn Farm, approximately 1000m west / north-west of the site.

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2.2.3 The above receptors are also identified in Figure B1 of Appendix B.

2.3 LOCAL NOISE ENVIRONMENT

2.3.1 During the site visit, the local noise environment was observed to consist of local road traffic movements on B1416 and distant road traffic noise.

2.3.2 Other noise sources included natural sources such as rustling / movement of vegetation and bird song etc.

3 Legislation, Guidance and Consultation

3.1 NATIONAL PLANNING POLICY FRAMEWORK AND SUPPORTING TECHNICAL GUIDANCE NOTE

3.1.1 Published in March 2012, the *National Planning Policy Framework* (NPPF) sets out the Government's planning policies for England and how these policies are expected to be applied. The NPPF replaces a number of previous Planning Policy Guidance Notes (PPG's), Planning Policy Statements (PPS's), Mineral Policy Statements (MPS's) and Mineral Planning Guidance (MPG's), including *Mineral Policy Statement 2: Controlling and Mitigating the Environmental Effects of Mineral Extraction in England - Annex 2: Noise*. However the *Technical Guidance to the National Planning Policy Framework* (which accompanies the NPPF and is also dated March 2012) duplicates the key noise levels limits detailed within the former MPS 2

3.1.2 As the proposed drilling works are associated with potential mineral extraction, this document constitutes the key guidance for this assessment.

3.1.3 In the section entitled Facilitating the sustainable use of minerals, the NPPF states that in preparing Local Plans, local planning authorities should following a number of points, including:

- *"set out environmental criteria, in line with the policies in this Framework, against which planning applications will be assessed so as to ensure that permitted operations do not have unacceptable adverse impacts on the natural and historic environment or human health, including from noise, dust, visual intrusion, traffic, tip- and quarry-slope stability, differential settlement of quarry backfill, mining subsidence, increased flood risk, impacts on the flow and quantity of surface and groundwater and migration of contamination from the site; and take into account the cumulative effects of multiple impacts from individual sites and/or a number of sites in a locality;*
- *when developing noise limits, recognise that some noisy short-term activities, which may otherwise be regarded as unacceptable, are unavoidable to facilitate minerals extraction;"*

3.1.4 It also presents a number of points for local authorities to follow when determining planning applications concerned with facilitating the sustainable use of minerals. These include:

- *"ensure that any unavoidable noise, dust and particle emissions and any blasting vibrations are controlled, mitigated or removed at source, and establish appropriate noise limits for extraction in proximity to noise sensitive properties"*

3.1.5 In the section entitled Mineral Policy, the following text is provided covering noise standards.

"Subject to a maximum of 55dB(A)LAeq, 1h (free field), mineral planning authorities should aim to establish a noise limit at the noise-sensitive property that does not exceed the background level by more than 10dB(A). It is recognised, however, that in many circumstances it will be difficult to not exceed the background level by more than 10dB(A) without imposing unreasonable burdens on the mineral operator. In such cases, the limit set should be as near that level as practicable during normal working hours (0700-1900) and should not exceed 55dB(A) LAeq, 1h (free field). Evening (1900-2200) limits should not exceed background level by more than 10dB(A) and night-time limits should not exceed 42dB(A) LAeq,1h (free field) at noise-sensitive dwellings. Where tonal noise contributes significantly to the total site noise, it may be appropriate to set specific limits for this element. Peak or impulsive noise, which may include some reversing bleepers, may also require separate limits that are independent of background noise - e.g. Lmax in specific octave or third-octave bands - and should not be allowed to occur regularly at night.

All mineral operations will have some particularly noisy short-term activities that cannot meet the limits set for normal operations. Examples include soil-stripping, the construction and removal of baffle mounds, soil storage mounds and spoil heaps, construction of new permanent landforms and aspects of site road construction and maintenance. However, these activities can bring longer-term environmental benefits. Increased temporary daytime noise limits of up to 70dB(A) LAeq 1h (free field) for periods of up to 8 weeks in a year at specified noise-sensitive properties should be considered to facilitate essential site preparation and restoration work and construction of baffle mounds where it is clear that this will bring longer-term environmental benefits to the site or its environs. Where work is likely to take longer than 8

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weeks, a lower limit over a longer period should be considered. In some wholly exceptional cases, where there is no viable alternative, a higher limit for a very limited period may be appropriate in order to attain the environmental benefits. Within this framework, the 70 dB(A) LAeq 1h (free field) limit referred to above should be regarded as the normal maximum."

3.1.6 Given that night-time workings are proposed, this assessment has adopted the night-time noise level limit of 42dB(A) $L_{Aeq,T}$ as this is considered to be the limiting scenario. This noise level limit is also concordant with sample assessment criteria contained within BS5228, as summarised below

3.1.7 Whilst the supporting technical guidance to the NPPF makes reference to the need to consider 'peak' or 'impulsive' noise, no specific guidance criteria are presented. Accordingly, consideration has been given to the guidance presented in BS8233, and that provided by the World Health Organisation, as summarised below

3.1.8 The noise standards detailed in the paragraphs above are concordant with the content of the former MPS2. For general information, a summary of MPS 2 is presented below.

3.2 MINERALS POLICY STATEMENT 2: CONTROLLING AND MITIGATING THE ENVIRONMENTAL EFFECTS OF MINERAL EXTRACTION IN ENGLAND - ANNEX 2: NOISE

3.2.1 This document states that it is "*a statement of the policy considerations in relation to mineral workings and associated operations, and how they should be dealt with in local development frameworks and in consideration to individual applications.*"

3.2.2 Paragraph 2.19 of this document describes a series of noise level limits applicable to mineral sites during different times of the day, evening and night-time. It is stated that the specified noise level limits will normally be set at the noise-sensitive properties, as this enables the effect of noise to be related most directly to its impact on local people, but that in some instances it may be more appropriate to set the limits at the site boundary or other point. For the purpose of this assessment, the noise level limits used relate to the closest noise-sensitive receptors.

3.2.3 It is stated that the noise level limit should not exceed a maximum of 55dB(A) $L_{Aeq,1hour}$ (free-field) and that the Mineral Planning Authority (MPA) should aim to establish a noise level limit that does not exceed the background noise level by more than 10dB(A), but the point is made that in many circumstances, this will be difficult to achieve without placing unreasonable burden's on the mineral operator. Accordingly, the following free-field limits are also specified:

- During normal working hours (07:00 to 19:00): Emission levels should be as near as possible to 10dB(A) above the background level, but not exceeding 55dB $L_{Aeq,1hour}$;
- Evening (19:00 to 22:00): Emission levels should not exceed the background noise level by more than 10dB(A); and
- Night-time (time period not stated but assumed to be the remaining hours of 22:00 to 07:00): Emission levels should not exceed 42dB(A) $L_{Aeq,1hour}$.

3.2.4 These noise limits apply to a free-field condition external to the property/receptor.

3.2.5 In addition to the limits specified above, which are for '*normal*' operations, this document also identifies that some short-term activities may generate higher noise levels, but which also have longer term environmental benefits. Stated examples include soil stripping, the construction and removal of baffle mounds, soil storage mounds and spoil heaps. For such activities, higher noise levels limits, of up to 70dB(A) $L_{Aeq,1hour}$ (free-field) are proposed for periods of up to 8 weeks a year.

3.2.6 With regards to 'peak' or 'impulsive' noise, MPS 2, as with the technical guidance to the NPPF, MPS 2 states that such noises may require separate noise level limits, but no specific guidance criteria is provided.

3.3 BS5228: 2009: CODE OF PRACTICE FOR NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES – PART 1: NOISE

3.3.1 This Standard sets out techniques to predict and assess the likely noise effects from construction works, based on detailed information on the type and number of plant being used, their location, and the length of time they are in operation. This Standard includes example criteria for the assessment of the significance of noise effects. Such criteria are concerned with fixed noise limits and ambient noise level changes.

3.3.2 With respect to fixed noise limits, BS5228 discusses those included within Advisory Leaflet 72: 1976: *Noise Control on Building Sites*. These limits are presented according to the nature of the surrounding environment. For a 12-hour working day, the following noise levels limits are presented:

- 70.0 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise; and
- 75.0 dB(A) in urban areas near main roads and heavy industrial areas.

3.3.3 When working outside normal working hours (e.g. 19:00 to 22:00), it is suggested that the above limits could be reduced by 10dB (i.e. to 60 and 65 dB(A) respectively). No specific limit is suggested for the night-time (22:00 to 07:00), but it is stated that work likely to cause annoyance locally should not be permitted. It can therefore be seen that higher limits apply during the daytime and evening compared to the night-time.

3.3.4 The standard goes on to provide methods for determining the significance of construction noise levels considering the change in the ambient noise level as a result of the construction operations. Two example assessment methods are presented, these are the ABC method and the 5 dB(A) change method. Both of these methods are subject to an absolute lower level criteria during the night-time period, regardless of the prevailing background noise levels.

3.3.5 The ABC method compares the total noise level (including construction noise) against a series of criteria for daytime, evening and night periods. Three categories of criteria are provided (A, B and C), each with separate limits for the daytime, evening and night-time. For each category, the daytime limit is 10dB higher than the evening limit which is in turn 10dB higher than the night-time limit. The category which is to be adopted (A, B or C) depends on the prevailing level without construction. However, assuming that the night-time level without construction is less than 42 dB $L_{Aeq,T}$, then the most stringent of the Categories (A) will always apply, and the allowable construction noise level (alone) will also always be at least 42 dB $L_{Aeq,T}$.

3.3.6 For the 5dB change method, construction noise levels are deemed to be significant if the total noise level (with construction) exceeds the level without construction by 5dB or more, subject to a lower cut-off values of 65, 55, and 45 dB $L_{Aeq,T}$ (construction only) for the daytime, evening and night-time periods. It can therefore be seen that again, the most stringent criteria applies during the night-time and that in this case, the allowable construction noise level during the night-time period will always be at least 45 dB $L_{Aeq,T}$.

3.3.7 Accordingly, adoption of a 42 dB $L_{Aeq,T}$ criterion for the night-time period can be seen to be in accordance with the NPPF, the former MPS2, whilst also being concordant with a worst case interpretation of BS5228. It can also be concluded that higher noise level limits should apply during both the daytime and evening periods compared to the night-time, and therefore that the night-time period is that which poses the greatest constraint.

3.4 BS 8233: 1999: SOUND INSULATION AND NOISE REDUCTION FOR BUILDINGS - CODE OF PRACTICE

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

3.4.2 The standard suggests suitable internal noise levels within different types of buildings, including residential dwellings. This document includes guidance on the acceptability of noise levels generated by individual events during the night-time, in terms of the L_{Amax} noise index, stating that "*individual noise events should not normally exceed 45 dB L_{AFmax} in bedrooms at night*".

3.4.3 This criteria applies internally. Assuming a 12dB loss through an open window[1], the equivalent external criterion is 57 dB L_{AFmax}, free-field.

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[1] BS8233 states that with windows open to provide rapid ventilation and summer cooling, the noise reduction through a window opening will reduce to about 10 or 15dB. The same range is also stated within Planning Policy Guidance Note 24: *Planning and noise*.

3.5 WORLD HEALTH ORGANISATION (WHO): 1999: GUIDELINES FOR COMMUNITY NOISE

3.5.1 This is a wide ranging document describing the effects of community noise. It provides information about the effects of noise that may occur at certain levels of exposure. For dwellings, the critical effects of noise are taken to be sleep disturbance, annoyance and speech interference.

3.5.2 This document also includes guidance on the acceptability of maximum noise levels within dwellings and makes reference to the findings from research conducted by Vallet & Vernet, 1991. This research states:

> *"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than 10-15 times per night"*

3.5.3 Again, this criterion applies internally. Assuming a 12dB loss through an open window[1], the equivalent external criterion is 57 dB L_{AFmax} not more than 10 to 15 times per night.

3.6 ASSESSMENT CRITERIA

3.6.1 Drawing upon the above guidance documents, the following assessment criteria have been adopted for the night-time period:

- An external noise emission level of 42dB $L_{Aeq,T}$ free-field; and
- An external noise emission level of 57dB L_{Amax}, free-field.

3.7 ISO 9613: ACOUSTICS - ATTENUATION OF SOUND DURING PROPAGATION OUTDOORS, PART 2: GENERAL METHOD OF CALCULATION

3.7.1 This document presents a standardised method for the determination of environmental noise levels at distance from sources with known emission levels. The standard is stated to be applicable to a variety of different sources under favourable meteorological conditions for propagation (i.e. downwind). The prescribed method consists specifically of octave band algorithms (for the octaves centred on 63Hz to 8kHz), for calculating the attenuation of sound from a point source. The algorithms are used to determine the attenuation from a number of effects including:

- geometrical divergence (i.e. distance);
- atmospheric absorption;
- ground effect;
- reflection(s) from surfaces; and
- screening by obstacles.

3.8 CONSULTATION

3.8.1 At the outset of the project, consultation was undertaken with the Environmental Health Department of Scarborough Borough Council (SBC), and the above assessment criteria (which were based on MPS2) were agreed in principle. It should be noted that at the time of consultation, the NPPF had not been published and the guidance and noise level criteria contained within MPS2 were the latest at that point. Subsequent to the completion of consultation, the NPPF has superseded MPS 2. However, the guidance on appropriate noise level limits for mineral sites remains the same. Accordingly, the previously agreed noise assessment criteria remain valid, appropriate and up to date.

3.8.2 The approach to the prediction of drilling noise levels was also agreed, including use of the ISO 9613 prediction methodology, with source data adopted from the results of environmental noise measurements previously undertaken for the proposed drilling rig option for use at the site.

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4 Source Data

4.1 SUMMARY

4.1.1 Environmental noise measurement reports have been provided for two of the proposed drilling rigs which are options for use at this site. The pertinent data from these reports are presented below.

4.2 BRITISH DRILLING AND FREEZING (BDF) RIG 28

4.2.1 The environmental noise levels generated by BDF Rig 28 were determined in 2005 by Acoustic and Engineering Consultants (AEC) Ltd. The pertinent technical report presents the results of environmental noise measurements during drilling works at a depth of approximately 3500ft.

4.2.2 Noise measurements were undertaken under free-field conditions at eight different locations around the perimeter of the drilling site. Measurements were undertaken using Type 1 specification noise measurement equipment which was calibrated at the beginning and end of measurements. It is understood that no significant drifts in calibration were noted.

4.2.3 Measurements were undertaken during the operation of all rig equipment, including an auxiliary generator and centrifuge. These two items are not standard equipment items for this rig, i.e. they are not permanently associated with Rig 28 and may not be present in all deployments. It is stated within the report that levels between 2 and 3dB lower than those measured are anticipated without the operation of these two plant items.

4.2.4 The completed noise measurements included octave band spectra. A summary of the measurement results are presented in Table 1 below.

TABLE 1 MEASURED SOUND PRESSURE LEVEL SPECTRA FOR BDF RIG 28, AND RESULTING SOUND POWER LEVELS, dB, LINEAR UNLESS STATED

Location Reference	Distance	Direction	Octave band Centre Frequency (Hz)								A-weighted Noise Level, dB(A)	Level Normalised to 1m, dB(A)	A-weighted Sound Power Level (L_{WA})
			63	125	250	500	1k	2k	4k	8k			
1	25	N	79	74	70	68	63	61	57	49	69.8	97.8	105.8
2	35	NW	81	79	76	71	67	63	57	47	73.4	104.3	112.3
3	35	NE	72	72	68	65	61	55	49	40	66.6	97.5	105.5
4	32	SE	70	69	68	68	63	54	45	36	68.1	98.2	106.2
5	20	S	75	72	78	72	68	61	54	46	74.0	100.0	108.0
6	32	SW	74	71	72	68	63	58	51	41	69.3	99.4	107.4
7	25	E	70	67	69	63	56	51	44	37	64.5	92.5	100.5
8	25	W	85	81	81	76	74	70	62	53	79.1	107.1	115.1
Energy Averaged Sound Power Level, dB(A)													**109.6**

4.2.5 It can be seen from Table 1 above that the measured noise emission level depends upon the measurement location (and therefore the orientation of the equipment) as well as the measurement distance. At this stage, the orientation of the equipment within the drilling site is flexible, therefore, it is appropriate to adopt the energy averaged level which tends towards the higher measured noise levels.

4.2.6 Drawing upon the table above, an energy averaged octave band spectra has been calculated and is presented in Table 2 below. The spectrum presented in Table 2 is in terms of Sound Power Level, and should therefore not be compared directly with the sound pressure level spectra presented in Table 1 above.

TABLE 2 ENERGY AVERAGED OCTAVE BAND SOUND POWER LEVEL SPECTRA FOR BDF RIG 28, L_{WA}, dB, LINEAR UNLESS STATED

Octave band Centre Frequency (Hz)								A-weighted Sound power Level (L_{WA})
63	125	250	500	1k	2k	4k	8k	
115.7	112.8	111.9	107.3	104.0	99.5	92.6	83.5	109.6

4.2.7 The results of short term attended measurements are also presented within the report at distance from the drilling site but during typical operations. The highest measured L_{Amax} noise level was identified to be 55dB(A) at 390m. This maximum noise level was measured during 'tripping out' operations. Lower maximum noise levels were measured during drilling operations.

4.3 FORACO BF831 POLYVALENT TRUCK-POWERED TOP DRIVE RIG

4.3.1 The environmental noise levels generated by the Foraco BS831 rig were determined in 2003 by Spectrum Acoustic Consultants. The pertinent technical report presents the results of environmental noise measurements during drilling works at Boreholes 1G and 2G at the Hole House Gas Storage Facility west of Warmington in Cheshire.

4.3.2 Noise measurements were undertaken in four different directions around the perimeter of the drilling site. Measurements were undertaken at both 50 and 100m in each direction selected and a total of eight measurement locations were therefore adopted. Measurements were undertaken using Type 1 specification noise measurement equipment and a portable acoustic calibrator. It is understood that the equipment had been calibrated to traceable standards.

4.3.3 Measurement data were reported in terms of broad-band A-weighted values (i.e. not spectral data), and a summary of the results can be seen in Table 3 below.

TABLE 3 NOISE MEASUREMENTS AROUND FORACO BF831 RIG, WITH CALCULATED SOUND POWER LEVEL (L_W)

Measurement Direction	$L_{Aeq,1minute}$ dB(A)	
	50m	100m
A	69	64
B	70	-
C	69	62
D	67	62
Energy Average	69	63
Sound power Level	**110**	**111**

4.3.4 It is considered that the most accurate sound power level determination would be calculated based on the measurement data at 50m, as at this distance there is less potential for errors associated with factors such as ground absorption, air absorption and meteorological conditions etc.

4.3.5 Maximum noise levels were also measured at distances of 600m and 1100m from the drilling site, but it is evident form the report text that the measured levels at 1100m were primarily dominated by local sources, not the drilling operation, and it is anticipated that the measured maximum noise levels at 600m may also have been contaminated by sources other than the drilling operation.

4.3.6 Comparing Tables 2 and 3, it can be seen that very similar sound power levels are determined for the two sample rigs. Therefore, given that the BDF Rig includes spectral data, the noise emission data presented in Table 2 have been used in the determination of the noise levels that may be generated at receptors local to this site. To determine the resulting maximum noise levels the BDF measurement data of 55dB(A) L_{Amax} at 390m has been adopted.

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5 Assessment

5.1 DETAILED NOISE MODEL

5.1.1 To facilitate the ISO9613 noise level predictions, a detailed noise model of the site and surrounding area has been prepared within the CadnaA® PC based noise modelling suite. The approach to the preparation of the detailed noise model is presented below.

- The noise model was set to apply the ISO 9613 *Acoustics – Attenuation of sound during propagation outdoors* noise prediction methodology. By default, this methodology predicts the noise level that would be generated downwind from the source in question (wind direction within an angle of +/- 45 degrees of the direction connecting the source and receiver, with wind blowing from the source).
- Ordnance Survey mapping of the site and surrounding area was calibrated into the noise model based on known Ordnance Survey grid reference points.
- Ordnance Survey 10m ground contour detail for the site and surrounding area was incorporated into the model to account for any topographic effects such as screening.
- To reflect the local ground cover, ground absorption was set to 1 (soft ground) as appropriate for a rural area.
- A point noise source representing the proposed drilling works was located at the centre of the proposed drilling site. A nominal source height of 1.5m was selected.
- The octave band sound noise data presented in Table 2 was applied to the point noise source.
- No perimeter noise bunding was incorporated around the drilling site boundary, although in practice such bunding will be created when stripped top soil is stored on site.

5.1.2 The closest existing noise sensitive receptors to the drill site were incorporated as receivers with a height of 1.5m above ground.

5.1.3 The noise model was run twice, firstly to determine the resulting $L_{Aeq,T}$ noise level at each individual receptor point, and secondly to generate a noise map of the local area at a height of 1.5m above ground. The resulting noise map can be seen in Figure C1 of Appendix C, with the individual receptor noise levels presented in Table 4 below.

5.1.4 Also presented in Table 4 are the calculated L_{Amax} noise levels at each receptor. The L_{Amax} noise levels have been calculated by applying a standard acoustic distance correction for a point source (a 6dB loss per doubling of distance) to the source data detailed in paragraph 4.3.6.

5.1.5 Table 4 also presents the adopted assessment criteria, and the amounts by which each of the criteria are predicted to be achieved or exceeded at each receptor location.

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TABLE 4 ASSESSMENT OF PREDICTED DRILLING NOISE LEVELS FOR THE NIGHT-TIME PERIOD, FREE-FIELD, dB(A)

Receptor Reference	Receptor Description	Noise Index	Predicted Emission Noise Level [A]	Night-time Assessment Criterion [B]	[A] – [B]
1	Moor House Farm	$L_{Aeq,T}$	33	42	Met by 9 dB
		L_{Amax}	52	57	Met by 5 dB
2	Park Down	$L_{Aeq,T}$	33	42	Met by 9 dB
		L_{Amax}	51	57	Met by 6 dB
3	Moorside Farm	$L_{Aeq,T}$	30	42	Met by 12 dB
		L_{Amax}	51	57	Met by 6 dB
4	Knaggy House Farm	$L_{Aeq,T}$	30	42	Met by 12 dB
		L_{Amax}	49	57	Met by 8 dB
5	Thorn Hill	$L_{Aeq,T}$	27	42	Met by 15 dB
		L_{Amax}	47	57	Met by 10 dB
6	Red Barn Farm	$L_{Aeq,T}$	11	42	Met by 31 dB
		L_{Amax}	47	57	Met by 10 dB

5.1.6 It can be seen from Table 4 above that the adopted night-time assessment criteria are predicted to be achieved at both of the closest receptors to the proposed drilling site. As discussed in Paragraph 3.3.7, the night-time assessment criteria are the most stringent. Therefore, applicable daytime and evening criteria are also expected to be achieved.

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6 Mitigation

6.1.1 As the adopted night-time assessment criteria are predicted to be achieved at each of the most sensitive local receptors to the proposed drilling site, specific consideration to noise mitigation measures is not warranted.

6.1.2 However, given that the adopted source data identified varying noise levels depending on the measurement location and equipment layout, it should be noted that the final noise levels will depend upon the site equipment orientation. Therefore, in order to minimise generated noise levels, care should be taken with the proposed plant layout. For example, noisy plant items should be screened where possible by the careful location of solid structures such as the site workshop, office, sleeper units, lockers, tanks etc.

6.1.3 Furthermore, additional noise attenuation can be afforded by the formation of earth bunds around the perimeter of the drilling site, for example where stripped soil has to be stored. To ensure the acoustic integrity of such bunds, they should be continuous and fully screen the line of sight between the receptors and the noise sources within the drilling site. MPS 2 states that reductions of between 5 and 10dB can be achieved by bunds close to the source, depending on whether the noise is partially or completely screened from the measurement point (e.g. the receptor). The NPPF (which has superseded MPS 2) does not provide any guidance on how to determine the noise attenuation that can be afforded by noise barriers. However, the performance values presented within MPS 2 are also supported by the noise barrier attenuation calculation methodology detailed within BS5228-1. Accordingly the barrier performance values detailed within MPS2 remain valid and appropriate for use.

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7 Conclusion

7.1.1 WSP Acoustics has been appointed to undertake an environmental noise assessment of proposed temporary drilling work at a site known as Doves Nest Farm (North). The site is located in a rural area south-west of Sneatonthorpe in North Yorkshire, approximately 1.3 km east of the village of Littlebeck.

7.1.2 The drilling work is proposed to determine the presence of underground Potash and Polyhalite. Whilst the proposed drilling site is in a fairly remote location, and drilling works would be temporary in nature (an approximate 6 month drilling period is anticipated), it is proposed that the works would be undertaken 24 hours a day 7 days a week. Accordingly, this assessment has been undertaken to determine the noise levels that are likely to be generated by such works at the closest local noise sensitive receptors (e.g. dwellings), and whether the resulting levels would be acceptable during the daytime, evening and night-time.

7.1.3 The nearest dwelling to the site is Doves Nest Farm. However, the owners of this property have a financial involvement in the development, accordingly, the assessment has identified the next closest receptors to the drilling site to be the most noise-sensitive. These are Thorn Hill, Moorside Farm, Moor House Farm, Park Down, Knaggy House Farm and Red Barn Farm.

7.1.4 In accordance with the result of consultation with the Environmental Health Department of Scarborough Borough Council (SBC), a series of noise level predictions have been undertaken in accordance with the methodology prescribed in International Standard Organisation (ISO) 9613*: Attenuation of sound during propagation outdoors -- Part 2: General method of calculation*, to determine the noise levels that are likely to be generated at the closest identified receptors to the drilling site. The noise level predictions have been based on the results of noise emission data which have previously been determined for the drilling rig proposed for use at this site.

7.1.5 The results of the noise level predictions have been assessed based on noise level criteria applicable to the night-time period (a worst case, with less stringent criteria being applicable to evening and daytime periods).

7.1.6 The noise level criteria adopted within the completed assessment are in full accordance with the guidance contained within the *National Planning Policy Framework* (NPPF) and supporting technical guidance, as well as the former Minerals Policy Statement 2: *Controlling and Mitigating the Environmental Effects of Mineral Extraction in England - Annex 2: Noise* which the NPPF has superseded. The adopted noise level limits are also concordant with a worst case interpretation of the guidance contained with British Standard 5228: 2009: *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*. The guidance contained within the 1999 World Health Organisation publication: *Guidelines for community noise* and British Standard 8233: *Sound insulation and noise reduction for buildings - Code of practice* has also been referenced with respect to the L_{Amax} noise index.

7.1.7 In accordance with these documents, the night-time assessment criteria which have been adopted are emission levels of 42dB $L_{Aeq,T}$ and 57dB L_{Amax}, external, free-field (equivalent to 30dB $L_{Aeq,T}$ and 45dB L_{Amax} internal assuming partially open windows).

7.1.8 The results of the completed noise level predictions have identified that the adopted criteria will be met at the most sensitive local receptors, and by margins of between 5 and 31dB. Accordingly, it can be concluded that the resulting noise levels will be acceptable during the night-time period, and also during the daytime and evening periods for which applicable criteria would be achieved by even greater margins.

7.1.9 As the applicable criteria are expected to be achieved, no further consideration to noise mitigation measures is considered warranted. Nonetheless, advice has been provided regarding good practice in the design and setup of the drilling rig, and also with regards to additional attenuation that could be afforded by the formation of earth bunds for soil storage around the drilling site.

7.1.10 In summary, the completed assessment has identified that the noise levels predicted to be generated by the proposed drilling works will be acceptable and will meet appropriate daytime, evening and night-time assessment criteria determined in accordance with a stringent interpretation of applicable national guidance, including the *National Planning Policy Framework* (NPPF) and Minerals Policy Statement 2: *Controlling and Mitigating the Environmental Effects of Mineral Extraction in England - Annex 2* (which the NPPF has superseded). It is therefore concluded that noise need not be considered a determining factor in granting planning approval for 24 hour drilling works at this site.

Appendix A 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.

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 4 0dB(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

ACOUSTIC TERMINOLOGY

dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2x10^{-5}$ Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq\,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall 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_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Façade Level	A sound field determined at a distance of 1m in front of a large sound reflecting object such as a building façade.
Sound Pressure Level	The sound pressure level at a point is measured in decibels (dB) and is equal to 20 times the logarithm to the base 10 of the ratio of R.M.S. sound pressure to the reference sound pressure. The reference sound pressure in air is taken to be $2x10^{-5}$ Pa.
Sound Power Level	Sound power is neither room dependent nor distance dependent. Sound power belongs strictly to the sound source. The sound power level SWL, L_W, or L_{Pac} of a source is expressed in decibels (dB) and is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to a reference sound power. It is thus a logarithmic measure. The reference sound power in air is normally taken to be 10^{-12} watt.
Background Noise Level	The noise level in the absence of the industrial source noise under consideration, measured in L_{A90}.

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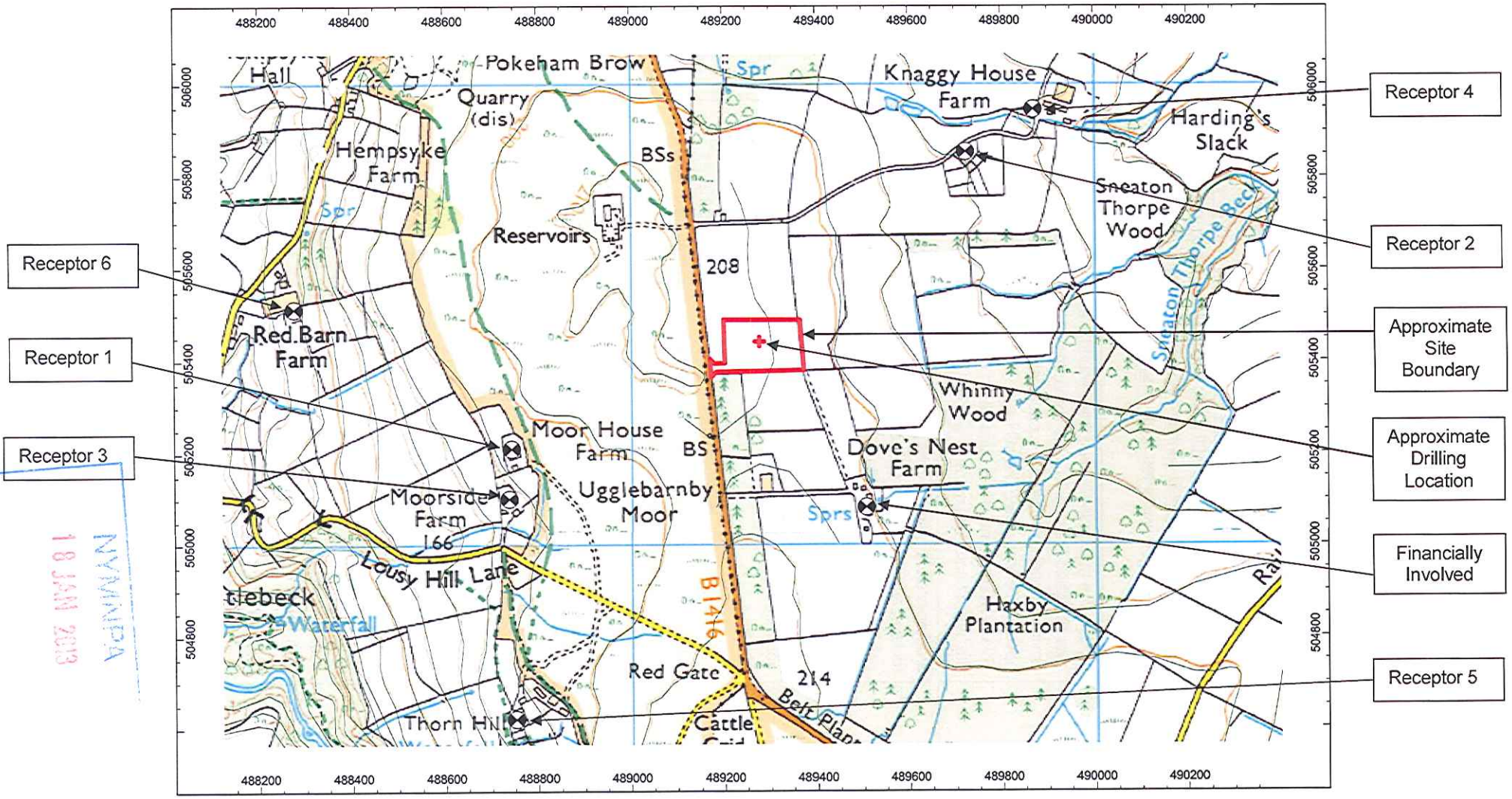
Appendix B Site Receptor Locations

FIGURE B1 SITE LOCATION AND LOCAL NOISE-SENSITVE RECEPTORS



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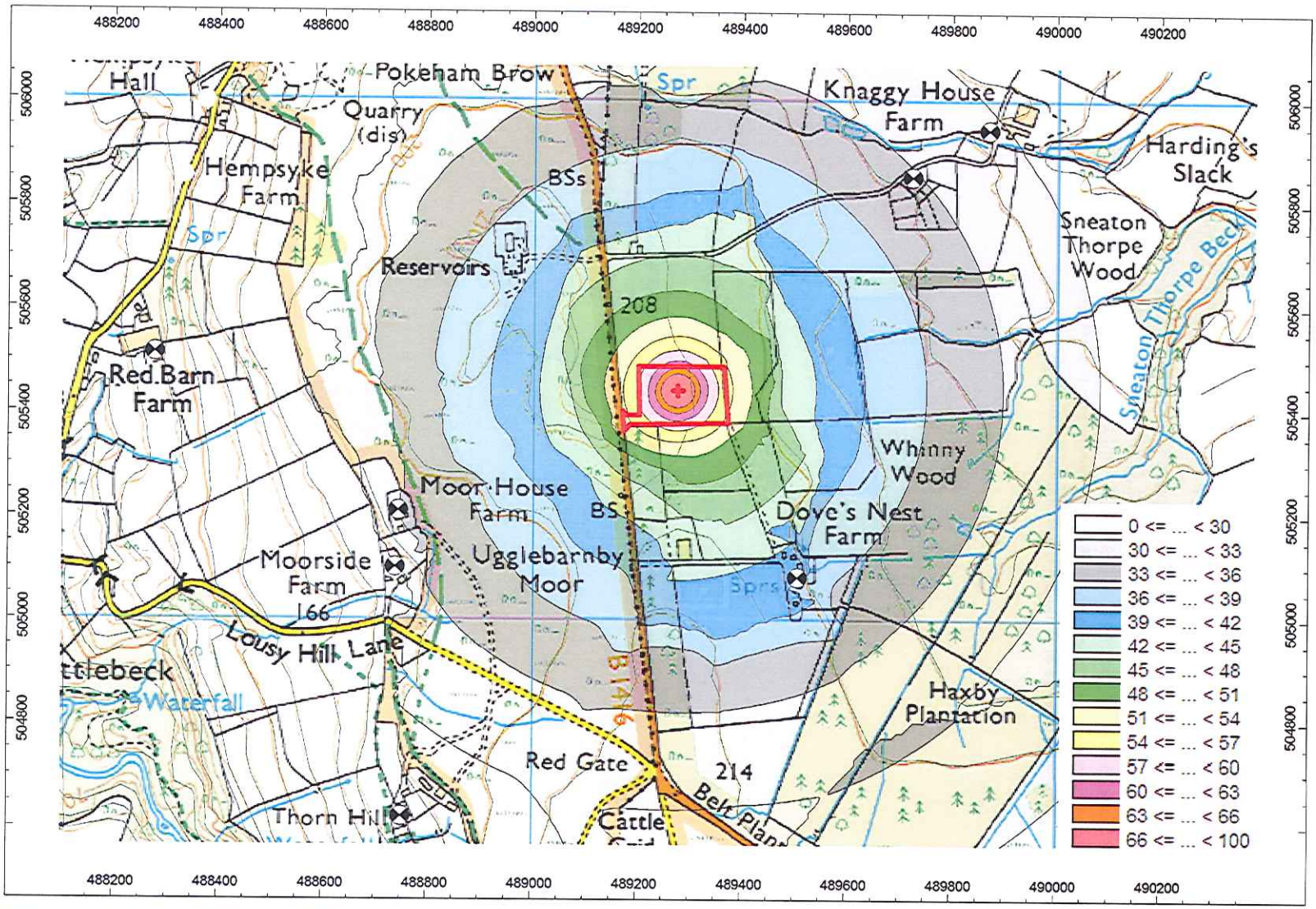
Appendix C Noise Plot

FIGURE C1 DRILLING OPERATION NOISE PLOT, $L_{AEQ,T}$, dB(A) FREE-FIELD AT 1.5M ABOVE LOCAL GROUND



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Appendix D Limitations

NOTES ON LIMITATIONS

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