Merlin Entertainments Alton Towers Resort, Spa Expansion

Noise Assessment

10 March 2014

Executive Summary

It is proposed to extend the existing Alton Towers Hotel (ATH) Spa on land to the east of the Alton Towers Hotel (ATH). The proposed Spa expansion will include a reception building and a Spa garden area where a hydro pool and a sauna will be located. Hydro pool pumps and compressors will be located in a new plant room located to the east of the existing Spa building, condensers will be located inside a service yard and reception intake/ extract fans will be located inside the new reception building.

Therefore, it is necessary to assess the noise impact of the proposed Spa expansion plant/ equipment on the existing and future on-site noise sensitive receptors (NSR) and existing off-site NSRs.

The nearest existing on-site NSR is the ATH located to the north which is about 30m from the Spa plant room and the nearest existing off-site receptors are Lower Ground Farm at about 800m and Crumpwood Farm at about 500m located to the north and south, respectively. Proposed on-site NSRs are the new accommodation units with its nearest lodge at approximately 80m from the Spa plant room, and new hotel extension located to the southwest which is approximately 35m from the Spa expansion plant room.

To assess the noise impact of the proposed Spa expansion guidance given in the National Planning Policy Framework (NPPF) have been followed.

A worst case plant operational scenario was established.

Indoor noise criteria based on guidance given in British Standard BS8233: 1999 were used to assess the likely Spa expansion plant noise impact on the nearest on-site NSRs. It was found that the adopted internal unoccupied room noise criteria would be met inside all existing and proposed on-site NSRs.

To assess the nearest off-site NSRs British Standard BS4142: 1997, which provides guidance on assessing the noise from stationary plant, was followed and for this purpose noise levels measured previously in the region were used to obtain the background noise levels at the nearest off-site NSRs.

It was found that the existing background noise levels in the region and the estimated rating noise levels at the nearest off-site NSRs were too low for carrying out BS4142 significance assessments. Therefore, the impact of the proposed Spa expansion plant on the nearest existing off-site NSRs were assessed against the adopted outdoor and indoor noise criteria based on BS8233: 1999. It was found that the adopted noise criteria would comfortably be met at the nearest off-site NSRs.

Noise control measures have been recommended and they should be implemented.

Recommended noise control measures include: introducing sound attenuators to the atmospheric sides of the Spa reception intake/ extract fan systems; using an acoustic fence around the service yard; using acoustic Spa plant room door set; introducing sound absorbent treatment into the Spa plant room; using acoustic plant room louvres; using compressors having factory fitted acoustic enclosures; using low noise hydro pool pump sets.

General good practice measures such as keeping the service yard acoustic fence door closed when it is not in use, devising and implementing a suitable plant maintenance regime and considering low noise plant/ equipment are also included.

Notice

This document and its contents have been prepared and are intended solely for Merlin Entertainments information and use in relation to Alton Towers Resort, Spa expansion on Wootton Lane in Stoke-on-Trent, Staffordshire.

Atkins Ltd. assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 54 pages including the cover.

Document history

Job number: 5106861.014			**Document ref: Noise Emission Assessment**			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	DRAFT	MP		IE	IE	10/03/14

Client signoff

Client	Merlin Entertainments
Project	Alton Towers Resort, Spa expansion
Document title	Noise Assessment
Job no.	5106861
Copy no.	
Document reference	Noise Assessment

Table of contents

Chapter Pages

LIST OF TABLES

LIST OF FIGURES

1. Introduction

Atkins has been commissioned by Merlin Entertainments to assess the noise impact of the proposed Spa expansion on the existing and proposed noise sensitive receptors (NSR).

The existing Spa is located to the south of the Alton Towers Hotel (ATH) and the proposed Spa expansion will introduce an open Spa garden, a hydro pool and a sauna to the east of the existing Spa building. Planning red line is shown in Nichols Brown Webber drawing no. 373/50.2-1.

A new Spa plant room located to the east of the existing Spa building will be used to accommodate compressors and hydro pool pumps and a new hydro pool filtration building will be introduced to the south of the existing Spa building. Existing 3No. Spa condenser units located above the existing Spa plant room will be retained.

Guidance given in the National Planning Policy Framework (NPPF) and British Standards BS8233: 1999 and BS4142: 1997 have been followed.

Results of the noise surveys carried out previously in the region were used to establish the background noise levels at the nearest on- and off-site NSRs. Noise data are provided in Appendix E.

The nearest off-site NSRs have been identified as Lower Ground Farm located to the north and Crumpwood Farm located to the south at ~800m and ~500m from the proposed Spa plant room, respectively.

The nearest existing on-site NSR is identified as the ATH. In addition to these, proposed on-site NSRs, namely new accommodation units and hotel extension, are also assessed.

A worst case scenario has been established based on the proposed Spa expansion plant locations and operating times to determine the likely impact of the plant noise emissions on the nearest on- and off-site NSRs.

The existing Spa treatment rooms, Spa lounge and hotel & Spa lounge or internal/ external building fabric are not assessed in this report except for areas where new Spa expansion plant are proposed to be housed. New Spa expansion plant has yet to be designed in detail, however, advice has been set out in this report. It is also recommended that detailed assessments are carried out during the detailed design stage to ensure compliance with the findings of the report.

This document has been produced to support the planning application for the proposed Spa expansion.

An explanation of acoustic terminology used in this report is given in Appendix A. Drawings referred to are given in Appendix C.

2. Scope of Works

Scope of this assessment includes:

- Assessing the noise impact of the Spa expansion plant and the existing ATH Spa external plant located to the east of the existing Spa building on the existing on- and off-site noise sensitive receptors;
- Using previously gathered environmental noise data to establish the background noise levels at the nearest off-site noise sensitive receptors;
- Assessing noise break in to the proposed Spa reception building;
- Assessing the noise impact of the Spa expansion plant and the existing ATH Spa external plant on the proposed new accommodation units and new hotel extension building;
- Confirming that the noise emissions from the proposed Spa expansion plant and the existing ATH Spa external plant will not have adverse effects on the above mentioned NSRs;
- If required making recommendations to control noise emission levels to ensure that the adopted outdoor and indoor noise criteria are satisfied.

3. Guidance and noise level criteria

3.1. National Planning Policy Framework 2012

The National Planning Policy Framework (NPPF) published by Department for Communities and Local Government in March 2012 provides guidance that should be taken into account during planning of new developments. It is stated in NPPF that the following are taken into consideration during planning:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established, and;*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

Therefore, to assess the likely noise impact of the proposed and existing Spa plant/ equipment on the existing on- and off-site noise sensitive receptors (NSR) and proposed on-site NSRs (new accommodation units and hotel extension building) guidance given in BS8233: 1999 and BS4142: 1997 have been followed as appropriate. The standards used during the noise assessment and the adopted noise criteria are given below.

3.2. BS 8233: 1999 "Sound insulation and noise reduction for buildings - Code of practice"

British Standard BS 8233: 1999 provides guidance on room internal noise levels that should be considered to achieve "good" or "reasonable" standards. The following unoccupied room noise levels are recommended in the standard.

Living rooms[1] :	$L_{Aeq,T}$ = 30dB (to achieve "good" resting conditions)
	$L_{Aeq,T}$ = 40dB (to achieve "reasonable" resting conditions)
Bedrooms[1]:	$L_{Aeq,T}$ = 30dB (to achieve "good" resting conditions)
	$L_{Aeq,T}$ = 35dB (to achieve "reasonable" resting conditions)
Reception[2]	$L_{Aeq,T}$ = 35 to 40dB (to achieve "reasonable" acoustic privacy)

It is also mentioned in BS 8233: 1999 that to achieve a reasonable standard inside bedrooms the Fast time weighted maximum r.m.s. (root mean square) Sound Pressure Level (SPL) of individual events should not normally exceed 45dB(A) inside bedrooms.

[1] Table 5 "Indoor ambient noise levels in spaces when they are unoccupied", BS8233: 1999.
[2] Table 6 "Indoor ambient noise levels in spaces when they are unoccupied and privacy is also important", BS8233: 1999.

Noise limits for external resting areas such as balconies and gardens are also given in subsection 7.6.1.2 “Design criteria and limits for intrusive external noise” of BS 8233: 1999.

Gardens and balconies : $L_{Aeq,T}$ = 50dB (desirable limit for day time steady noise level)

$L_{Aeq,T}$ = 55dB (upper limit for day time steady noise level)

It is mentioned in BS 8233: 1999 that the lower of the outdoor area noise limits should be used and the upper noise limit should not be exceeded.

3.3. BS 4142: 1997 “Method for rating industrial noise affecting mixed residential and industrial areas”

BS 4142 provides guidance on how to assess the impact of industrial noise on residential dwellings. Rating level ($L_{Ar,Tr}$) is compared against the background noise level ($L_{A90,T}$) measured at the assessment position using Fast time weighting and the result is compared to the assessment method given in Section 9 “Assessment method” of BS 4142.

According to the assessment method:

“complaints are likely” if $L_{Ar,Tr} – L_{A90,T} \geq +10dB$

“marginal significance” if $L_{Ar,Tr} – L_{A90,T} \approx +5dB$

“complaints are unlikely” if $L_{Ar,Tr} – L_{A90,T} < -10dB$

BS 4142 considers both rating noise levels less than about 35dB and background noise levels less than about 30dB as very low. This assessment method is referred to as ‘BS 4142 significance assessment’ in this report.

3.4. Adopted noise criteria

3.4.1. Assessment of proposed new accommodation units

To determine the impact of the existing noise sources in the region and the proposed plant on the nearest NSRs located on-site the following unoccupied room ambient noise levels given in Table 5 and Table 6 of BS 8233: 1999 are adopted.

Inside Lodges (day time): $L_{Aeq,T}$ = 40dB (to achieve “reasonable” resting conditions)

Inside Lodges (night time): $L_{Aeq,T}$ = 35dB (to achieve “reasonable” resting/sleeping conditions)

Inside reception: $L_{Aeq,T}$ = 40dB (to achieve “reasonable” acoustic privacy).

To determine the impact of the existing noise sources in the region and the proposed plant on the outdoor resting areas on-site the following noise limits recommended in BS 8233: 1999 are adopted.

Outdoor resting spaces: $L_{Aeq,T}$ = 50dB(A)
(highest level not to exceed $L_{Aeq,T}$ = 55dB(A))

3.4.2. Identification and assessment of existing on- and off-site noise sensitive receptors

Table 3-1 provides information on the existing and proposed receivers and whether or not they are considered to be noise sensitive.

Table 3-1 – Identification of on- and off-site noise sensitive receptors.

Receiver	Existing or Proposed	Location	Comment (Use)	Assessment
Lower Ground Farm	Existing	Off-site to the south of the application site	Noise sensitive (Residential)	Assessed.
Crumpwood Farm	Existing	Off-site to the north of the application site	Noise sensitive (Residential)	Assessed.
Alton Towers Hotel (ATH)	Existing	On-site to the north of the proposed Spa expansion	Noise sensitive (Accommodation)	Assessed.
Lodges	Proposed	New accommodation site located to the east	Noise sensitive (Accommodation)	Assessed.
Tree Houses	Proposed	New accommodation site located to the east	Noise sensitive (Accommodation)	Assessed.
Hotel Extension	Proposed	New hotel building located to the southwest	Noise sensitive (Accommodation)	Assessed.

Based on the information given in Table 3-1 all receivers are considered to be noise sensitive receptors (NSR). In addition to the NSRs mentioned above the proposed Spa expansion reception is also assessed.

4. Assessment Method

Indoor noise criteria based on guidance given in British Standard BS8233: 1999 will be used to assess the likely Spa expansion plant noise impact on the nearest on-site NSRs.

To assess the nearest off-site NSRs British Standard BS4142: 1997, which provides guidance on assessing the noise from stationary plant, will be followed and for this purpose noise levels measured previously in the region will be used to establish the background noise levels at the nearest off-site NSRs. Details of the noise surveys are given in Appendix E.

However, if carrying out a BS4142 'significance assessment' is found not to be suitable then the noise criteria adopted for bedrooms and given in subsection 3.4.1 will be considered here.

The adopted noise criteria and assessment methodology outlined above are thought to be suitable for assessing the noise impact of the proposed Spa expansion on the nearest on- and off-site NSRs.

4.1. Noise parameters

Definitions of the noise parameters used in this report are included in Appendix A.

4.2. Method for obtaining L_P for plant noise at assessment position 'r'

To convert the given plant octave band Sound Power Levels (SWL) to L_p Sound Pressure Levels (SPL) the following formula is used[3].

$$L_p = L_w - 10 \cdot \log(r^2) \cdot (1 - s) - (10 \cdot \log(r^{2.5}) - 7) \cdot s - 8 \quad \text{in dB}$$

Where:

L_p is the linear SPL (ref. 20μPa) in decibel at one of the 1/1 octave band centre frequencies between 63Hz and 8kHz.

L_W is the linear SWL of a specific plant at one of the 1/1 octave band centre frequencies between 63Hz and 8kHz.

r is the distance between the source and the assessment position in metres.

s is the ratio of the distance of sound propagation over soft ground to the total sound propagation distance. s = 0 if there is only hard ground. If there is only soft ground then s = 1. Soft ground correction is only applied when r ≥ 25m.

The above equation assumes that the sound source radiates hemi-spherically. The third term of the above equation accounting for the soft ground attenuation is based on BS5228-1: 2009.

If either the source height or the receiver height is greater than 2.5m but less than 15m then this should be taken into consideration and the attenuation due to soft ground should be reduced accordingly as mentioned in BS5228-1: 2009 (Subsection F.2.2.2.2).

Rating noise level (BS4142: 1997 assessment) was obtained at 1.5m above ground and outdoor noise level was obtained at 4.5m above ground (BS8233: 1999 assessment). Also some of the noise sources considered here were positioned more than 2.5m above the local ground level, therefore, only 50% of the sound propagation path was taken as soft ground. This should compensate for loss of soft ground

[3] Derived from formulae given in Chartered Institution of Building Services Engineers (CIBSE) Guide B 2005 Heating, ventilating, air conditioning and refrigeration (Eq. 5.A7.3) and BS 5228-1:2009 (Eqs F.1 and F.2).

attenuation due to sources located more than 2.5m above the ground level. Table 5.2 gives the source heights used. As can be seen from Table 5.2 no source was higher than 15m.

It is assumed that the plant can be considered to behave like a point source at the assessment distance 'r' and hemispherical sound radiation theory holds.

The octave band SPLs are then summed up by taking into account the 'A' frequency weighting (Appendix A) and a single figure A-weighted SPL is obtained for the plant considered. Then an overall single figure accounting for the contributions from all plant is obtained by summing all individual plant A-weighted SPLs using the energy method given by the following formula[4].

$$Lp = 10 \cdot \log\left(10^{\frac{Lp1}{10}} + 10^{\frac{Lp2}{10}} + \ldots + 10^{\frac{Lp_n}{10}}\right) \text{ in dB}$$

Where:

Lp_1 to Lp_n are the SPLs for plant no.1 to plant no. 'n' where 'n' represents the n^{th} plant.

Lp is the total SPL at the assessment position at distance 'r'.

4.3. Method for obtaining Lp2 (sound level in a room) from Lp1 (external sound level)

For this purpose an equation has been derived based on BS EN 12354-3: 2000 "Building acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound". It is given in Appendix B of this report.

The equation given in Appendix B has been used to estimate the likely noise break in levels inside the NSRs.

[4] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Handbook 2009: Fundamentals, Chapter 8 Sound and Vibrations Eq.11.

5. Plant Noise Emission Assessment

5.1. Sound levels of the proposed plant

It is understood that the following plant sound pressure levels (SPL) represent the proposed candidate mechanical services plant sound levels. SPL figures given are for a single unit and free-field conditions are assumed.

Plant/ equipment noise levels based on the mechanical services consultants Ce^{2}'s equipment schedule dated January 2014 (Appendix C.2) :

- 2No. Spa variable refrigerant flow (VRF) condensers located outside in service yard: SPL= 60dB(A) at 3m (each unit);
- 1No. Spa reception extract fan outlet located at high level on the ground floor: SPL= 53dB(A) at 1.5m from duct outlet;
- 1No. Spa reception intake fan inlet located at high level on the ground floor: SPL= 53dB(A) at 1.5m from duct opening;
- 2No. Spa fridge/freezer condensers located outside: SPL= 49dB(A) at 10m (each unit);
- 2No. Spa water heaters: SPL= 51dB(A) at 2m from the flue terminal (each unit).

Plant/ equipment noise levels assumed to be representative of the existing and proposed Spa plant :

- 2No. Spa 10bar 4kW compressors: SPL=68dB(A) at 1m (each unit);
- 4No. Spa 1hp circulation pumps: SPL<67dB(A) at 1m (each unit);
- 8No. Spa 5hp jet pumps: SPL<70dB(A) at 1m (each unit);
- 1No. Existing Spa plant room extract: SPL= 63dB(A) at 3m;
- 1No. Existing Spa plant room intake: SPL=59dB(A) at 3m;
- 1No. Existing Spa condenser: SPL=50dB(A) at 3m;
- 1No. Existing Spa double condenser: SPL=52dB(A) at 3m.

The above plant noise levels taken from the proposed plant schedule (Appendix C.2), unless otherwise stated, have been used to determine the likely day time and night time noise emissions from the proposed Spa expansion and existing Spa plant. All plant quantities are assumed and assumed positions of the above mentioned noise sources are given in Appendix D.

5.2. Assumptions made during noise break in calculations

The following external glazing and door sound insulation performances have been assumed for lodges, tree houses and Spa reception building.

External glazing and doors:

- Lodges and tree houses: Minimum sound reduction index of R_w=37dB.
- Spa reception, new and existing hotel rooms: Minimum sound reduction index of R_w=35dB.

It is assumed that the Spa plant room (Figure D.1- 1 in Appendix D) doors, louvres, walls and ceiling/ roof would provide high sound insulation to ensure that plant/ equipment noise break out level would be controlled. The exact acoustic performance specifications for these elements should be confirmed at the detailed design stage.

It is assumed that service yard would have a 2.5m high close boarded timber fence with matching access door.

Doors of the Spa plant room and service yard would be kept closed.

It is understood that reception building will have a mechanical ventilation system.

5.3. Assumptions on sound propagation paths

During the Spa plant/ equipment noise emission calculations no soft ground attenuation has been accounted for when noise emission levels at the nearest existing and proposed NSRs located on-site were considered.

However, when the nearest off-site NSRs were considered it was assumed that 50% of the sound propagation path would be soft ground.

This approach has been chosen so any potential reduction of the soft ground attenuation due to sources located more than 2.5m above the local ground level would not have a significant impact on the estimated noise levels at the receivers. No noise source was located about 5m above the local ground level, therefore, the 15m height limit given in BS5228-1: 2009 was not breeched.

During the latest site noise measurements it was observed that the sound propagation paths between the proposed plant and the receivers are mostly soft ground. Therefore, these assumptions are considered to be conservative.

5.4. Worst case scenario

It is understood that the candidate plant, given in Table 5-1, operating simultaneously and at normal duty would represent the worst case scenario during the proposed ATH new Spa expansion's normal operational life.

Table 5-1 – Sources used for the worst case scenario.

Source ID(1)	Description	Operating Times(2)
S1	1No. existing Spa plant room intake	24 hours a day
S2	1No. existing Spa plant room extract	24 hours a day
S3	2No. Water heaters	24 hours a day
S4	2No. VRF condensers	24 hours a day
S5	1No. existing single and 1No. double Spa condensers	24 hours a day
S6	1No. Reception intake fan	24 hours a day
S7	1No. Reception extract fan	24 hours a day
S8	2No. Fridge/freezer condensers	24 hours a day
S9	2No. Compressors	24 hours a day
S10	4No. 1hp circulation pumps and 8No. 5hp jet pumps for hydro pool	between 7am and 10pm

(1) Assumed source positions are given in Figure D.1- 1 in Appendix D.

(2) Spa expansion plant operating times are based on information from the Alton Towers Resort new accommodation units development plant operating times.

In addition to the above it is also assumed that all plant would be kept in good working condition.

Table 5-2 gives the assumed source heights for the noise sources included in the worst case scenario.

Table 5-2 - Source heights with respect to local ground level

Source	Approximate height above local ground level (m)
Existing Spa extract and intake fan atmospheric connections	4
Reception extract and intake fan atmospheric connections	4
VRF condensers	<1

Source	Approximate height above local ground level (m)
Fridge/freezer condensers	<1
Water heaters	4.5
Existing Spa condensers	<1.5

5.5. Proposed site layout plan

Figure 5-1 shows the proposed layout for the new Spa expansion. Also shown are the proposed new accommodation units and the relocated 72 space car park.

Figure 5-1 - New Spa expansion and nearest existing and proposed on-site NSRs.

5.6. Estimated proposed Spa plant/ equipment noise levels at nearest existing and proposed on-site NSRs

Proposed plant/ equipment noise break in levels have been calculated following the guidance given in BS EN 12354-3: 2000. It was found that without introducing any noise control measures noise levels at the nearest on-site noise sensitive receptors (NSR) would exceed the adopted unoccupied room internal noise criteria when the worst case scenario defined under subsection 5.4 is considered. Noise emissions from the proposed Spa reception fans as well as the plant/ equipment proposed to be located inside an external Spa plant room were found to be dominant.

Therefore, noise control measures were taken into account and the calculations were revised.

It was found that with the noise control measures in place the predicted noise break in levels inside the nearest existing and proposed NSRs and reception building would meet the adopted unoccupied room ambient noise criteria.

The results of the noise break in calculations after the noise control measures are taken into account are given in Table 5-3. The recommended noise control measures are given in section 8.

Table 5-3 - Estimated indoor noise levels due to the operations of the proposed Spa plant/ equipment at the nearest existing and proposed on-site NSRs.

Noise source: Spa plant/ equipment				
Receiver ID	**Description**	**Estimated Plant/ Equipment Noise Break-in Levels $L_{Aeq,T}$ / dB**	**Adopted Noise Criteria $L_{Aeq,T}$ / dB**	**Comment**
R1	Existing ATH west bedroom (day time)	28	40	Estimated plant/ equipment noise break in level is 12dB(A) less than the adopted indoor day time noise criterion.
R1	Existing ATH west bedroom (night time)	28	35	Estimated plant/ equipment noise break in level is 7dB(A) less than the adopted indoor night time noise criterion.
R2	Existing ATH east bedroom (day time)	31	40	Estimated plant/ equipment noise break in level is 9dB(A) less than the adopted indoor day time noise criterion.
R2	Existing ATH east bedroom (night time)	31	35	Estimated plant/ equipment noise break in level is 4dB(A) less than the adopted indoor night time noise criterion.
R3	New hotel bedroom (day time)	32	40	Estimated plant/ equipment noise break in level is 8dB(A) less than the adopted indoor day time noise criterion.
R3	New hotel bedroom (night time)	32	35	Estimated plant/ equipment noise break in level is 3dB(A) less than the adopted indoor night time noise criterion.
R4	Spa reception (day time)	40	40	Estimated plant/ equipment noise break in level is equal to the adopted indoor day time noise criterion.
R5	Inside nearest lodge (day time)	29	40	Estimated plant/ equipment noise break in level is 11dB(A) less than the adopted indoor day time noise criterion.
R5	Inside nearest lodge (night time)	29	35	Estimated plant/ equipment noise break in level is 6dB(A) less than the adopted indoor night time noise criterion.
R6	Inside nearest tree house (day time)	28	40	Estimated plant/ equipment noise break in level is 12dB(A) less than the adopted indoor day time noise criterion.
R6	Inside nearest tree house (night time)	28	35	Estimated plant/ equipment noise break in level is 7dB(A) less than the adopted indoor night time noise criterion.

It is assumed that the proposed lodges and tree houses would be fitted with acoustic entrance doors, double glazing and trickle ventilation units (free area 8000mm^2).

It is assumed that the hotel bedrooms would be fitted with double glazing and they would have mechanical ventilation.

It is also assumed that Spa reception entrance door would be acoustic rated and reception building would be fitted with double glazing and it would have a mechanical ventilation system.

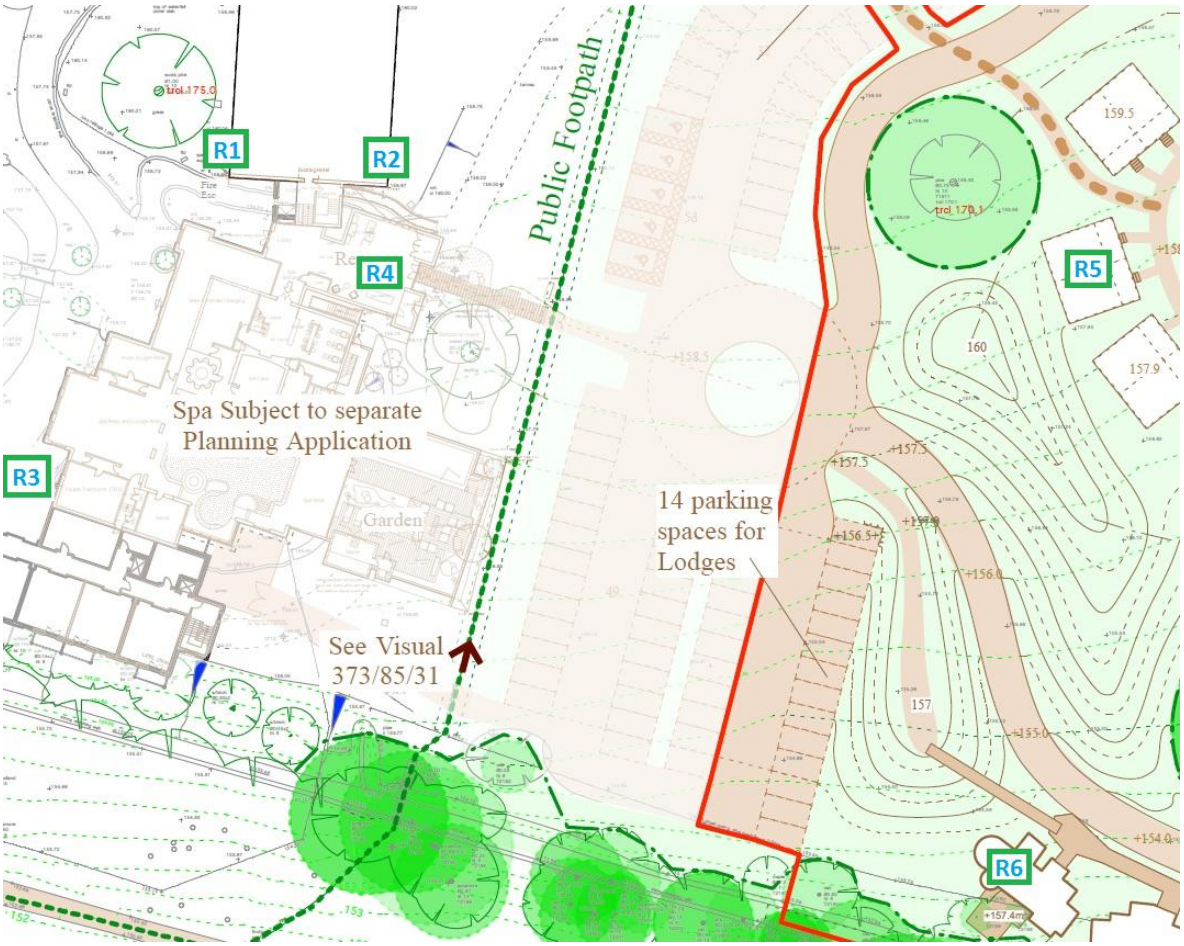

Figure 5-2 – On-site receiver positions used during assessment.

5.7. BS4142 significance assessments of the proposed plant at the existing nearest off-site NSRs

Noise emission levels estimated at the existing nearest off-site NSRs are given in **Table 5-1** for the worst case plant operational scenario defined under subsection 5.4.

It was assumed that the noise levels measured at Position 10C (Figure E.1-1 in Appendix E) would be representative of the noise climate at the nearest off-site NSRs.

The lowest background noise level was measured as 25dB(A) on Sunday, 03/02/13 at 2:20am at Position 10C. Then this level was corrected for the SLM's self noise (17dB(A)) and a background noise level of 24dB(A) was obtained. Then the estimated rating noise levels were compared against this background noise level. The estimated rating noise levels are based on the assumption that all the recommended noise control measures will fully be implemented.

Table 5-4 - Predicted Spa plant/ equipment noise emission levels (rating noise levels) at the nearest off-site NSRs.

Noise source: Spa plant/ equipment				
Receiver ID	**Receiver**	**Estimated (free-field) Rating Noise Level[(1)] $L_{Ar,Tr}$ / dB**	**Lowest Night Time Background Noise Level Measured[(2)] $L_{AF90,5min}$ / dB**	**Comment**
R7	Lower Ground Farm at about 800m	21	24[(3)] (03/02/2013 at 02:20)	The estimated rating noise levels and the corrected background noise level are lower than the minimum rating noise level of 35dB(A) and background noise level of 30dB(A) given in BS4142: 1997, respectively. According to BS4142: 1997 when this occurs carrying out a BS4142 significance assessment is not considered to be appropriate.
R8	Crumpwood Farm at about 500m	23		

(1) It is assumed that 50% of the sound propagation path would be soft ground for the off-site NSRs.
(2) It is assumed that noise levels measured at Position 10C would be representative of the noise levels at the nearest off-site NSRs.
(3) After SLM's self noise correction is applied. According to Rion NL-52 Instruction Manual this SLM's inherent noise is 17dB(A) or less. Therefore, 17dB(A) has been taken as the SLM self noise level and the measured background noise level of 25dB(A) was corrected to remove the SLM's influence.

In Table 5-4 only the night time period is considered as it is usually the most critical assessment period.

As it can be seen from Table 5-4 the highest predicted rating noise levels at the nearest existing off-site NSRs are estimated as 23dB(A) and 21dB(A) at Crumpwood Farm and Lower Ground Farm, respectively. Both of the estimated rating noise levels are less than 35dB(A).

Also the lowest background noise level at Position 10C on 03/02/2013 at 2:20am and assumed to be representative of the background noise levels at the nearest existing on- and off-site NSRs is 24dB(A) which is less than 30dB(A).

Therefore, based on these outcomes it was concluded that a BS4142 significance assessment would not be appropriate in this case as the predicted rating noise levels and measured background noise level corrected for the SLM influence are considered to be very low by BS4142:1997.

However, assessments based on the outdoor resting area and unoccupied room ambient noise level criteria adopted have been carried out to confirm that the plant noise emission levels at the nearest off- site NSRs would not exceed the adopted noise criteria. These are carried out in the following section.

5.8. Estimated proposed plant noise levels at the nearest off-site NSRs

Day time outdoor noise levels were estimated at the nearest off-site NSRs and the results are given in Table 5-5 below for the worst case scenario defined under subsection 5.4. The estimated free-field outdoor noise levels are below the adopted outdoor resting area desired noise limit of 50dB(A).

Table 5-5 – Estimated free-field outdoor noise levels at the nearest off-site NSRs.

Noise source: Spa plant/ equipment				
ID	**Receiver**	**Estimated Day Time Outdoor Free-field Noise Levels[1] $L_{Aeq,T}$ / dB**	**Adopted Day Time Outdoor Noise Criterion $L_{Aeq,T}$ / dB**	**Comment**
R7	Lower Ground Farm at about 800m	16	50 (not to exceed 55)	34dB(A) less than the adopted outdoor noise criterion
R8	Crumpwood Farm at about 500m	18		32dB(A) less than the adopted outdoor noise criterion

[1] Free-field noise levels and it is assumed that 50% of the sound propagation path would be soft ground.

Noise break in levels for the night time are also carried out and the results are given in Table 5-6 below. According to BS8233: 1999, a façade having a partially open window provides about 10 to 15dB outside to inside sound insulation. Therefore, assuming that the external windows are partially open, thus accounting for a 10dB facade reduction, $L_{Aeq,8h}$ = 11dB and $L_{Aeq,8h}$ = 9dB have been estimated as the unoccupied room noise levels at Crumpwood Farm and Lower Ground Farm, respectively, as a result of the proposed Spa plant operations. The estimated indoor noise levels are below the adopted night time room noise criterion of $L_{Aeq,8h}$ = 35dB.

Table 5-6 - Estimated room noise levels due to the proposed Spa expansion plant/ equipment at the nearest off-site NSRs.

Noise source: Spa plant/ equipment							
ID	**Receiver**	**Estimated Night Time Outdoor Free-field Noise Levels[1] $L_{Aeq,T}$ / dB**	**Estimated Façade Noise Levels[2] $L_{Aeq,T}$ / dB**	**Assumed Façade Sound Insulation When A façade Window Is Partially Opened / dB**	**Estimated Noise Break In Level $L_{Aeq,T}$ / dB**	**Adopted Night Time Indoor Noise Criterion $L_{Aeq,T}$ / dB**	**Comment**
R7	Lower Ground Farm at about 800m	16	19	10	9	35	26dB(A) less than the adopted indoor noise criterion
R8	Crumpwood Farm at about 500m	18	21	10	11	35	24dB(A) less than the adopted indoor noise criterion

[1] Free-field noise levels and it is assumed that 50% of the sound propagation path would be soft ground.
[2] +3dB façade correction has been included.

5.9. Relocated car park noise levels at the nearest existing and proposed on-site NSRs

It is understood that a 72 space car park will be relocated to the east of the proposed Spa expansion. It is also understood that guests would most likely to be using the relocated car park between 9am and 4pm and 70% occupancy is expected and the relocated car park would be used by cars only. It is expected that the quietest times will be between 5pm and 9am.

Therefore, likely noise levels due to guests using the relocated car park have been estimated. For this purpose it is assumed that day time would be the critical period due to the expected usage. Therefore, an assessment has been carried out to estimate the likely noise levels in terms of $L_{Aeq,1hour}$ at the nearest existing and proposed NSRs.

It is assumed that 70% occupancy would occur within one hour and this would reflect the worst case scenario. It is also assumed that each car would produce L_{AE}~79dB(A) at 2m. Based on these assumptions $L_{Aeq,1hour}$ noise levels have been estimated at the nearest existing and proposed on-site NSRs and the results are given in **Table 5-7**.

Table 5-7 - Estimated car park noise break in levels at the nearest existing and proposed on-site NSRs.

Noise source: relocated 72 space car park with 70% occupancy					
ID	**Receiver**	**Estimated Day Time Outdoor Free-field Noise Levels $L_{Aeq,1h}$ / dB**	**Estimated Noise Break In Level $L_{Aeq,1h}$ / dB**	**Adopted Day Time Indoor Noise Criterion $L_{Aeq,T}$ / dB**	**Comment**
R1	Existing ATH west bedroom (day time)	50	33	40	7dB(A) less than the adopted indoor noise criterion
R2	Existing ATH east bedroom (day time)	56	38	40	2dB(A) less than the adopted indoor noise criterion
R3	New hotel bedroom (day time)	47	29	40	11dB(A) less than the adopted indoor noise criterion
R4	Spa reception (day time)	57	38	40	2dB(A) less than the adopted indoor noise criterion
R5	Inside nearest lodge (day time)	56	39	40	1dB(A) less than the adopted indoor noise criterion
R6	Inside nearest tree house (day time)	53	39	40	1dB(A) less than the adopted indoor noise criterion

As it can be seen from Table 5-7 the estimated noise from the relocated 72 space car park when it is used at 70% capacity would be below the adopted internal noise criteria at the nearest on-site NSRs.

6. Discussion

The noise levels estimated at the assessment positions are based on the assumption that the noise control measures given in Section 7 'Noise Control Measures' would fully be included in the design and all assumptions made in this report would hold.

6.1. Estimated proposed Spa plant/ equipment noise levels at nearest existing and proposed on-site NSRs

Noise break-in calculations were carried out to determine the impact of the proposed Spa plant/ equipment on the nearest existing and proposed on-site NSRs. The proposed Spa reception building was also assessed.

Noise break in calculations were carried out following the guidance given in BS EN 12354-3: 2000 as appropriate.

The estimated noise break-in levels are compared against the adopted unoccupied room noise criteria in Table 5-3.

The estimated noise break in levels were found to be equal to $L_{Aeq,T}$=31dB during day and night time inside the nearest existing hotel bedroom (R2) confirming that both of the adopted day time and night time noise criteria would be satisfied inside all existing hotel bedrooms. Inside the nearest proposed hotel bedroom (R3) the estimated day and night time noise break-in levels were both found to be equal to $L_{Aeq,16h}$=32dB.

The estimated noise break in levels were found to be equal to $L_{Aeq,T}$=29dB during day and night time inside the nearest proposed lodge (R5) confirming that both of the adopted day time and night time noise criteria would be satisfied. Inside the nearest proposed tree house (R6) the estimated day and night time noise break-in levels were both found to be equal to $L_{Aeq,16h}$=28dB.

For completeness the proposed Spa reception (R4) was also assessed. It was found that noise break in level due to the proposed Spa plant/ equipment would be equal to $L_{Aeq,16h}$=40dB, therefore, confirming that the adopted internal noise criterion will be satisfied.

Assumptions made in section 5 were taken into consideration during the calculations and it was also assumed that the noise control measures recommended in section 7 will fully be implemented.

6.2. BS4142 significance assessments of the proposed plant at the existing nearest off-site NSRs

Subsection 5.7 gives the outcome of the BS4142 assessment for the worst case plant operational scenario defined in subsection 5.4.

Crumpwood Farm was found to be the most critical noise sensitive off-site receiver due to its location with respect to the proposed Spa expansion. The predicted rating noise level at Crumpwood Farm was found to be equal to 23dB(A).

A background noise level of 24dB(A) was obtained from the noise levels measured on 03/02/2013 at 2:20am at Position 10C (Figure E.1-1 in Appendix E) which was assumed to be representative of the background noise levels at the nearest off-site NSRs considered.

According to BS 4142:1997 both rating noise level less than 35dB(A) and background noise level less than 30dB(A) are considered to be very low.

Therefore, both the predicted rating noise levels and the measured lowest background noise level are considered to be very low. Consequently, a BS4142 assessment was ruled out.

Assumptions made under section 5 were taken into consideration during the calculations. No sound attenuation due to screening that might be provided by the existing topography between the proposed plant and the nearest off-site NSRs were taken into account. However, it was assumed that 50% of the sound propagation path between the nearest off-site NSRs and the Spa expansion plant would be soft ground.

6.3. Estimated proposed plant noise levels at the nearest off-site NSRs

As carrying out a BS4142 “significance assessment” was ruled out, guidance provided in BS8233: 1999 was used to determine the likely noise impact of the proposed plant on the existing off-site NSRs. This is presented in subsection 5.8.

Outdoor free-field and indoor noise levels were estimated and the results are given in Table 5-5 and Table 5-6, respectively.

As it can be seen from Table 5-5, the adopted outdoor noise criterion 50dB(A) are comfortably met at the nearest off-site NSRs when the worst case plant operational scenario defined under subsection 5.4 is considered.

Night time was considered to be the critical assessment period when indoor noise levels were estimated. First floor habitable rooms of the nearest off-site NSRs were taken as the critical receiver positions.

Noise emission levels predicted, not taking into account the acoustic character correction of +5dB, were considered to reflect free-field noise levels at the nearest existing off-site NSRs. +3dB was added to the predicted free-field noise levels as the façade correction prior to subtracting 10dB to account for the reduction provided by a room facade wall having a partially open window.

The estimated noise break in levels are 9dB(A) and 11dB(A) at Lower Ground Farm and Crumpwood Farm, respectively. Therefore, at the nearest off-site NSRs the adopted night time indoor noise criterion 35dB(A) will be met with good margins.

Assumptions made and plant/ equipment sound levels given in section 5 were used during the assessments as appropriate. No sound attenuation due to screening that might be provided by the existing topography between the proposed plant and the nearest off-site NSRs were taken into account. However, it was assumed that 50% of the sound propagation path between the nearest off-site NSRs and the Spa expansion plant would be soft ground.

6.4. Relocated car park noise levels at the nearest existing and proposed on-site NSRs

Noise impact of the relocated 72 space car park was carried out to determine its likely noise impact on the nearest on-site NSRs. For this purpose 70% car park usage was considered to be adequate as this would represent the expected occupancy.

Day time was considered to be the most critical period as quests are expected between 9am and 4pm while the quietest time is expected to occur between 5pm and 9am.

As it can be seen from subsection 5.9 the noise break-in levels due to the usage of the relocated 72 space car park would be equal to $L_{Aeq,1h}$=39dB at the nearest lodge (R5) and tree house (R6), therefore, meeting the adopted room day time noise criterion of 40dB(A).

It was also found that noise break-in levels at the existing ATH bedroom (R2) and proposed (R3) nearest hotel bedroom would be equal to $L_{Aeq,1h}$=38dB and $L_{Aeq,1h}$=29dB, respectively.

For completeness the proposed Spa reception was also assessed. It was found that noise break in level due to the relocated 72 space car park would be $L_{Aeq,1h}$=38dB, therefore, confirming that the adopted internal noise criterion will be satisfied.

7. Noise Control Measures

Recommended noise control measures are given in this section.

A boxing-in detail for treating the reception fans has been provided and it is recommended that the fans are supported resiliently and they are connected to ducts on either side using flexible duct connectors.

For the atmospheric sides of the Spa reception intake/ extract fans sound attenuators have been recommended.

Also noise limits given in subsection 5.1 should be met by the existing Spa mechanical services louvres located in the existing Spa building's east facade and the existing single and double Spa condenser units located externally below these louvres.

It is recommended that where possible low noise plant/ equipment are used.

It should be noted that in addition to the recommended intake/ extract fan atmospheric side sound attenuators there will be a need to introduce sound attenuators between the intake/ extract fans and room side ventilation diffusers to control room internal noise levels. Furthermore, other noise control measures such as boxing-in the Spa reception fans and ductwork to control casing radiated noise and duct noise break out, respectively, might be required. However, as carrying out a room side ventilation noise assessment is beyond the scope of works no further information has been provided in regards with room side noise control.

7.1. Spa reception intake and extract fans

The assumed fan octave band in duct sound power levels (SWL) between 63Hz and 8kHz centre frequencies and the recommended atmospheric side reception intake/ extract fan attenuators are given in Table 7-1.

The sound attenuators should be positioned as close as possible to the external louvres provided that the transition between them occurs smoothly. The transition slope should have an angle less than 20degrees to prevent turbulent air flow.

The Spa reception intake/ extract fans should resiliently be connected to the supporting structures and flexible duct connections should be used between the fans and the associated ductwork as indicated in Figure 7-1. The Spa reception intake/ extract fans should be boxed in to control the casing radiated noise.

The recommended boxing-in detail shown in Figure 7-1 comprises 2No. layers of 15mm thick dense plasterboard (density >830kg/m^3) with 50mm thick mineral wool insulation (density 48kg/m^3) placed between the plasterboard and the fan casing. The plasterboard joints should be staggered and taped/ caulked as appropriate and non-setting intumescent sealant should be applied at the edges to provide good perimeter seals. Alternatively, a proprietary acoustic fan jacket providing adequate sound insulation could be used.

Noise intrusion into internal building spaces are not part of the scope of works, therefore, duct break out noise is not assessed here.

It is assumed that Spa reception would require a minimum of 8 air changes per hour (ACH)[5].

[5] Table 1'General Design Criteria' in Section 3, 2007 ASHRAE Handbook, Heating, Ventilating and Air-Conditioning Applications (Si Edition), The American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Table 7-1- Recommended Spa reception intake/ extract fan sound attenuator specifications for atmospheric sides. Assumed fan in duct inlet and extract SWLs are also included.

Description	Octave Band Centre Frequency in Hz							
	63	125	250	500	1000	2000	4000	8000
Spa Reception Intake Fan Sound Attenuator (to be located between the reception intake fan and atmospheric connection) L=1200mm								
Fan in duct inlet sound power level (SWL)(1)	71	71	63	55	58	58	55	48
Sound attenuator dynamic insertion loss in dB (face area 0.28m^2) (2)	6	9	14	27	35	23	18	13
Self noise power levels in dB (face velocity -5ms^{-1}) (2)	31	32	32	31	30	30	<20	<20
Attenuator static pressure drop 27Nm^{-2}								
Spa Reception Extract Fan Sound Attenuator (to be located between the reception extract fan and atmospheric connection) L=1200mm								
Fan in duct outlet sound power level (SWL)(1)	76	76	67	67	71	71	68	60
Sound attenuator dynamic insertion loss in dB (face area 0.28m^2) (3)	5	11	18	26	36	37	24	20
Self noise power levels in dB (face velocity +5ms^{-1}) (3)	39	35	32	32	30	25	20	<20
Attenuator static pressure drop 98Nm^{-2}								

(1) Nuaire ESX6-X / 1.1kW / 1272RPM. This fan is assumed to be representative of the reception intake/ extract fans.

(2) Based on Industrial Acoustics Company sound attenuator model CL (∅600mm)

(3) Based on Industrial Acoustics Company sound attenuator model CS (∅600mm)

Notes:

A) Transitional ducts may be required at the input and output of sound attenuators. Ensure that transition occurs smoothly to prevent disturbances of the normal air flow. The transition slope should have an angle less than 20degrees.

B) Ensure that there are at least 3 duct diameters between the fan inlet/ outlet and sound attenuators, take-offs, elbows, tees and dampers.

C) Use radius elbows with turning vanes. The elbow radius 'r' should be greater than 0.5xD (D=duct diameter) provided that it is not less than 150mm. If 0.5xD is less than 150mm then use 150mm for 'r' (Figure 7-2).

D) Avoid sudden changes in duct directions/ duct cross sectional areas and keep off-set angles under 15degrees.

E) In addition to the above recommended atmospheric side sound attenuators, sound attenuators between the Spa reception intake/extract fans and the reception diffusers might also be required to ensure that noise levels inside the reception are in line with the recommendations of relevant standards and guidance. It may also be required to boxing-in the reception intake/ extract fans to control casing radiated noise. However, an internal acoustic noise assessment is beyond the scope of works of this report, therefore, a reception ventilation system noise assessment for the room side is not carried out here.

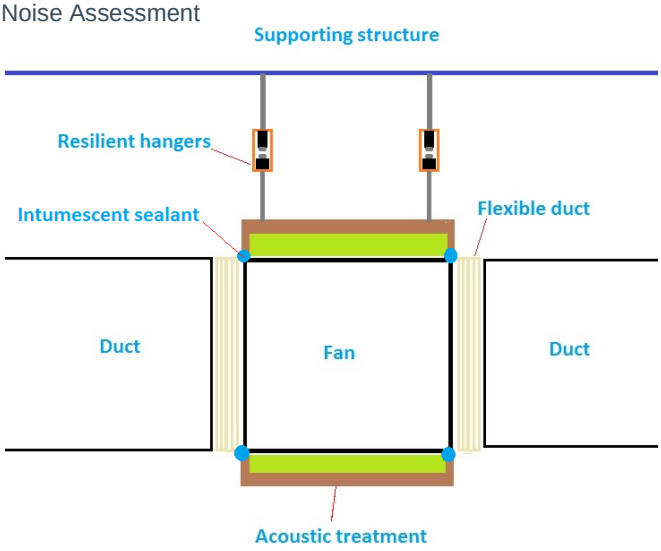

Figure 7-1- Boxing in detail for the intake/extract fans.

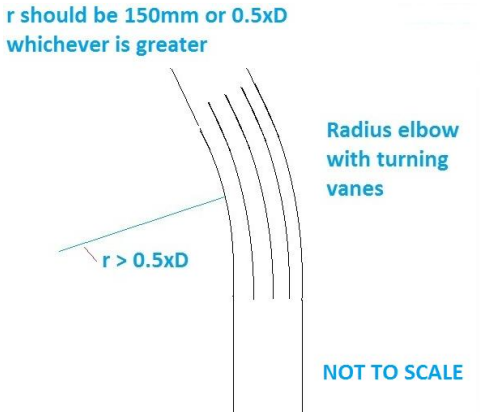

Figure 7-2 – Radius elbow with turning vanes.

7.2. Sound attenuators used in sensitive locations

If sound attenuators having film liners (e.g. Mylar) are to be used then ensure that the sound attenuators incorporate stand offs placed between the perforated liners and film liners to improve the acoustic performance of the attenuators. Also ensure that the film liners used inside the sound attenuators will meet all requirements of fire regulations that apply to this project.

7.3. Compressors

Compressors that would be located inside the Spa expansion plant room should have factory fitted noise control measures to ensure that noise level from each compressor does not exceed 68dB(A) at 1m.

7.4. Hydro pool pumps

It is assumed that the proposed hydro pool pumps would be installed inside the Spa expansion plant room. Depending on the actual pump set specifications it may be required to use additional noise control measures. Therefore, it is recommended that once the details of the pump sets are available they should be assessed to ensure that their noise will not result in any adverse impact on the on- and off- site NSRs.

7.5. Fence around external plant located at service yard

The perimeter walls of the service yard should be formed using close boarded timber fence or similar and it should have a minimum of 2.5m height. The thickness of the timber board should be minimum 22mm.

It is likely that an access door will be required in the fence. Ensure that the access door has the same surface mass as the rest of the fence and there are no perimeter gaps between the access door and the fence. The access door should be closed when it is not in use and it should close tight.

There should be no gaps or weaknesses between the ground and the bottom of the fence and also between the boards.

Ensure that the fence is not used as support for any tools, equipment, plant or anything else that may interfere with its functionality.

Lining the inner part of the timber fence with a weather resistant sound absorbent material would be beneficial as it would help to absorb the sound energy bouncing from the inner faces of the fence, thus, reducing the magnitude of the sound energy escaping outside in the direction of the NSRs.

Also ensure that no plant or associated mechanical and electrical services are rigidly connected to the fence.

The fence should stay in its places during its assumed life time.

Adequate space should be left around the plant to ensure that the fence does not have any adverse effect on the plant performance.

Alternatively, another material that has a similar surface mass to the 22mm thick solid timber boards may be used to form the 2.5m high fence and its access door.

7.6. Spa plant room external and internal building fabric

The Spa plant room that will be housing the compressors and pumps should have the following minimum performance specifications.

- Spa expansion plant room roof should be at least 150mm thick dense concrete (density > 2200kg/m^3);
- Spa expansion plant room walls should be at least 100mm thick dense brickwork/ blockwork (density > 2000kg/m^3);
- Spa expansion plant room doors should be rated at Rw=50dB;
- Spa expansion plant room louvres should be double bank acoustic type, such as Galloway L-AD-300. It is assumed that maximum total (inlet/ outlet) free open area would be less than or 0.7m^2.

Ensure that there are no weaknesses in the external building fabric of the proposed Spa expansion plant room and its acoustic integrity is not compromised.

The plant room access door should be kept closed when not in use.

It is recommended that 50% of the inner surfaces of the plant room walls and 90% of the plant room ceiling are covered with sound absorbing materials meeting the minimum octave band sound absorption figures given in Table 7-2.

Table 7-2 – Recommended minimum Spa expansion plant room sound absorber performance specification.

Description	Octave band centre frequency in Hz					
	125	250	500	1000	2000	4000
50mm thick plant room wall/ ceiling lining(1)	0.30	0.85	1.00	1.00	0.96	0.84
(1) Plant room sound absorbent panels by CMS acoustic solutions.						

7.7. Relocated car park

Inside bedrooms of all assessed nearest on-site existing and proposed NSRs it was shown that the noise from the relocated 72 space car park would be met.

7.8. General

If plant that is noisier than those assumed within this assessment is to be used then the suitability of the selected plant should be checked with the project acoustician prior to procurement.

All plant should be placed at least 600mm away from room walls/ ceiling and no rigid connections should be established between the plant, its associated elements and the room walls and ceiling to prevent transmission of plant/ equipment vibrations.

Once the exact details of the proposed plant/ equipment are finalised it is recommended that the buildings where noisy plant will be housed, such as the Spa expansion plant room, are assessed to ensure that the proposed external building fabric will provide adequate sound insulation.

It may also be necessary to consider factory fitted plant/ equipment noise control measures.

Ensure that all plant room doors close airtight and are kept closed when they are not in use.

Where a door set has a meeting stile then ensure that it does not become an acoustically weak point when the door is fully closed.

Avoid running mechanical services ductwork above noise sensitive areas.

Ventilation louvres should be fitted tightly and there should be no air gaps between the louvre frames and the supporting wall structures.

Ensure that all plant run at their manufacturers' recommended optimum operating conditions and they are kept in good working conditions. It is recommended that a suitable plant maintenance programme is devised and implemented.

Manufacturers of materials where acoustic ratings have been assigned to should provide laboratory reports to support their claims for the acoustic performances of their products. The airborne sound insulation performance should be laboratory tested. Laboratory tests should be undertaken in accredited test facilities complying with ISO10140-5[6] or its predecessor BS EN ISO140-1[7]. The laboratory airborne sound insulation

[6] ISO10140-5:2010 Acoustics, Laboratory measurement of sound insulation of building elements, Part 5: Requirements for test facilities and equipment.
[7] BS EN ISO140-1: 1998 Acoustics, Measurement of sound insulation in buildings and of building elements, Part 1: requirements for laboratory test facilities with suppressed flanking transmission.

tests should be carried out to ISO10140-2[8] or its predecessor BS EN ISO140-3[9]. The test results should be rated in accordance with ISO717-1:1997[10].

[8] ISO10140-2: 2010 Acoustics, Laboratory measurement of sound insulation of building elements, Part 2: Measurement of airborne sound insulation.
[9] BS EN ISO140-3: 1995 Acoustics, Measurement of sound insulation in buildings and of building elements, Part 3: Laboratory measurement of airborne sound insulation of building elements.
[10] BS EN ISO717-1: 2013 Acoustics, Rating of sound insulation in buildings and of building elements Part 1: Airborne sound insulation.

8. Conclusions

A new Spa expansion and relocated 72 space car park are proposed to be located to the east of the existing ATH Spa. Therefore, noise impact assessments have been carried out to determine the likely noise emissions from the proposed Spa expansion plant/ equipment and relocated 72 space car park on the on- and off-site noise sensitive receptors (NSR). For this purpose in line with the requirements of National Planning Policy Framework guidance given in relevant British Standards were followed. Where required noise control measures were recommended and importance of carrying out further assessments during the design stage has been highlighted.

8.1. Assessment of proposed Spa expansion plant noise levels at nearest existing and proposed on-site NSRs

Noise emissions from the proposed Spa expansion plant/ equipment were estimated to determine the likely indoor noise levels at the nearest existing and proposed on-site NSRs and to confirm if the adopted unoccupied room noise criteria will be met.

It was found that the adopted indoor unoccupied room noise criteria would be met inside the existing and future on-site NSRs provided that noise control measures recommended are fully implemented and the plant/ equipment noise levels mentioned are not exceeded.

8.2. BS4142 significance assessments of the proposed plant at the existing nearest off-site NSRs

BS4142:1997 have been tested to see if carrying out BS4142 significance assessments would be useful in this situation to determine the noise impact of the proposed plant/ equipment on the existing nearest off-site NSRs.

It was found that the measured lowest background noise level at Position 10C was 24dB(A) after it was corrected for the equipment self noise. And the estimated Spa expansion plant rating noise levels at the nearest off-site NSRs were below 35dB(A) when the worst case plant operational scenario defined in subsection 5.4 was considered.

According to BS4142 background and rating noise levels less than 30dB(A) and 35dB(A) are too low for carrying out a significance assessment. Therefore, it was concluded that a BS4142 significance assessment would not be appropriate to assess the noise impact of the proposed Spa expansion plant/ equipment in this case.

Therefore, further assessments have been carried out to assess the noise impact of the proposed plant on the nearest off-site NSRs.

8.3. Assessment of the proposed plant noise levels at the nearest existing off-site NSRs

As carrying out BS4142 significance assessments were found to be unsuitable the noise impact of the proposed plant on the nearest existing off-site NSRs were assessed by carrying out assessment based on guidance given in BS8233: 1999.

It was found that the adopted night time outdoor noise criterion 50dB(A) will be met at the nearest off-site NSRs, namely Lower Ground Farm and Crumpwood Farm, by 34dB(A) and 32dB(A) margins, respectively.

It was also found that the adopted night time noise criterion 35dB(A) will be met inside the bedrooms of Lower Ground Farm and Crumpwood Farm by 26dB(A) and 24dB(A) margins.

Any assumptions made during the assessments are included in the body of this report.

8.4. Assessment of relocated car park

Likely noise impact of the relocated 72 space car park was estimated based on a worst case scenario assuming that the expected quests would all arrive within the same hour and 70% car park usage would occur. Based on the information provided day time usage of the relocated 72 space park was considered to be more critical as it is understood that quietest period would be between 5pm and 9am.

It was found that provided that the recommended noise control measures are fully implemented the adopted day time room noise criteria would be met inside the nearest existing and proposed on-site NSRs.

It was, therefore, concluded that at the existing nearest off- site NSRs that are located much further away the noise break-in levels due to the use of the relocated 72 space car park would be lower therefore meeting the adopted unoccupied room noise criterion at these NSRs as well.

8.5. General

An investigation has been carried out to find out if the proposed Spa expansion site located to the east of the existing ATH Spa would result in any adverse noise impact on the existing and proposed on-site NSRs and existing off-site NSRs.

The outcome of the noise surveys carried out between January and March 2013 at Position 10C near the existing JCB test site has been considered to be representative of the prevailing noise climate in the region. Therefore, the recommendations made here are based on this assumption.

The adopted outdoor resting/ seating area noise level was also found to be satisfied at the nearest off-site NSRs.

The noise impact of the proposed Spa expansion plant/ equipment on the nearest existing and proposed on-site and existing off-site NSRs was also assessed.

It was found that without any noise control measures the Spa expansion plant noise emission levels would be high at the nearest on-site NSRs when the worst case scenario defined in subsection 5.4 is considered. Therefore, noise control measures are recommended and they should be implemented to ensure that the proposed Spa expansion plant noise emission levels meet the adopted outdoor and indoor noise criteria.

Appendices

Appendix A. Appendices Glossary of Acoustical Terms

A.1. A-weighting:

A frequency weighting used to represent the response of the human hearing mechanism to sound at approximately 40-phon. A-weighted sound level is indicated either by placing the capital letter A after the letters dB to get dB(A) or it may be added as a subscript to the noise level parameter as in $L_{Aeq,T}$. Table A.8-1 gives the A-Weighting correction figures between 63Hz and 8000Hz octave band centre frequencies.

Table A.8-1 - A-Weighting Correction

Octave Band Centre Frequency in Hz	63	125	250	500	1000	2000	4000	8000
A-Weighting Correction in dB	-26.2	-16.1	-8.6	-3.2	0.0	1.2	1.0	-1.1

A.2. Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$):

Equivalent continuous A-weighted sound pressure level is the steady sound level that has the same sound energy as the fluctuating A-weighted sound pressure level occurring over the same time period and at the same location.

A.3. Ambient Noise Level ($L_{Aeq,T}$):

Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

A.4. Specific Noise Level ($L_{Aeq,Tr}$):

The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source (the pump motors) over a given reference time period.

A.5. Rating Level ($L_{Ar,Tr}$):

The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time period after acoustic characteristic feature correction (+5dB according to BS4142:1997) is taken into account.

A.6. Residual Noise Level ($L_{Aeq,T}$):

The equivalent continuous A-weighted sound pressure level at the assessment position due to sound from many sources at the absence of the specific noise source. It is measured over a given reference time period.

A.7. Background Noise level ($L_{AF90,T}$):

The A-weighted sound pressure level of the existing ambient noise level that is exceed for 90% of a given time period, T, measured using time weighting 'Fast' and quoted to the nearest whole decibel. It refers to the residual noise. The background noise level is given as L_{AF90}.

A.8. Free-Field (acoustical):

Free-field means a position far away from any reflecting surfaces other than the ground. It is frequency dependent. Lower the frequency of concern, higher the required distance from any reflecting surfaces apart from the ground. For example, a minimum of 16m is required to measure the sound level at 16Hz octave band to establish the necessary free-field condition. BS8233: 1999 recommends that to achieve free field conditions microphone should be positioned at least 3.5 metres from any reflecting surfaces, other than the ground.

A.9. Maximum Sound Pressure Level ($L_{Amax,T}$):

The maximum root mean square value of sound pressure level measured during a given reference time period.

A.10. Sound Reduction Index (R):

R is ten times the logarithm to the base 10 of the sound power incident on the test specimen (W_1) to the sound power transmitted through it (W_2). The frequency band should be stated. $R=10\log_{10}(W_1/W_2)$.

A.11. Weighted Sound Reduction Index (R_w):

This is the single number rating for the laboratory airborne sound insulation performance of a building element. It corresponds to the decibel value at 500Hz after the reference curve is shifted. The sum of unfavourable deviations with respect to the reference curve should not exceed 32dB when one-third octave band analysis across 16 one-third octave bands (100Hz to 3150Hz) is carried out or not to exceed 10dB when octave band analysis across 5 octave bands (125Hz to 2kHz) is carried out. The measurements are carried out in accordance with ISO10140-2:2010 or its predecessor ISO140-3:1995 and the rating is carried out in accordance with ISO717-1:1996.

A.12. Apparent Weighted Sound Reduction Index (R'w.):

This is the single number rating for the field airborne sound insulation performance of a building element. The measurements are carried out in accordance with ISO140-4:1998 and the rating is carried out in accordance with ISO717-1: 1996.

A.13. Z-Weighting:

A frequency weighting used to represent linear response. Z-weighted sound level is indicated either by placing the capital letter Z after the letters dB to get dB(Z) or it may be added as a subscript to the noise level parameter as in $L_{Zeq,T}$.

A.14. Reference Sound Pressure:

Reference sound pressure for sound pressure levels given in decibel in this report is 20µPa.

A.15. Reference Sound Power:

Reference sound power for sound power levels given in decibel in this report is 1pW.

Appendix B. Noise Break In

B.1. BS EN 12354-3: 2000 "Building acoustics – Estimation of acoustic performance of buildings from the performance of elements - Part 3: Airborne sound insulation against outdoor sound"

BS EN 12354-3: 2000 provides a calculation model for determining the airborne sound insulation of a building façade or other part of the building shell. This information then can be used to estimate the noise break in level inside a room following the guidance given in Appendix E of the standard. The following equation has been derived.

$$L_{2,nT} = L_{1,2m} - 10\cdot\log\left[\sum_{i=1}^{m}\left(\frac{S_i}{S_s}\tau_{f,i}\right) + \sum_{j=1}^{n}\left(\frac{A_0}{S}\tau_{e,j}\right) + \sum_{k=1}^{o}\left(\frac{S_k}{S}\tau_{e,k}\right)\right] + 10\cdot\log\left(\frac{S}{A}\right) \quad \text{in dB}$$

$$L_{1,2m} = L_{eq,ff} + 3 \quad \text{in dB}$$

$\tau_{f,i}$ of the first summation inside the logarithm sign is for flanking building elements: $\tau_{f,i} = 10^{\frac{-R_{f,i}}{10}}$.

$\tau_{e,j}$ of the second summation inside the logarithm sign is for small building elements: $\tau_{e,j} = 10^{\frac{-D_{n,e,j}}{10}}$

$\tau_{e,k}$ of the third summation inside the logarithm sign is for other building elements: $\tau_{e,k} = 10^{\frac{-R_{e,k}}{10}}$

Where :

$\tau_{f,i}$ is the ratio of the transmitted sound power to the incident sound power and is called sound transmission factor. The subscript i indicates that it is for the i^{th} flanking element. i = 1, 2, …, m and m is the number of individual flanking elements;

$\tau_{e,j}$ is the sound transmission factor for the j^{th} small element. j = 1, 2, …, n and n is the number of individual small elements;

$\tau_{e,k}$ is the sound transmission factor for the k^{th} other building element. k= 1, 2, …, o and o is the number of other individual elements;

$R_{f,i}$ is the sound reduction index of the i^{th} flanking element in decibels;

$D_{n,e,j}$ is the normalised level difference of the j^{th} small building element in decibels;

$R_{e,k}$ is the sound reduction index of the k^{th} (other) element in decibels;

S_i is the surface area of the i^{th} flanking element;

S_s is the total surface are of the separating construction (e.g. floor slab) in m^2;

A_0 is the reference sound absorption and it is equal to $10m^2$.

S_k is the surface area of the k^{th} other building element;

S is the total surface area transmitting sound in m^2;

A is the equivalent absorption area inside the receiving room in m^2 (unit of metric sabines is also used);

$L_{1,2m}$ is the sound pressure level (SPL) 2m from the façade in dB (ref. 20μPa) and it is equal to the free field SPL ($L_{eq,ff}$) plus three decibels;

$L_{2,nT}$ is the SPL inside the receiving room in decibels (ref. 20μPa).

Where the flanking sound is negligible the above equation might yield to ‘Equation 1’ given in BS8233: 1999 provided that the building elements considered are the same.

Appendix C. Drawing References and Plant Schedule

C.1. Drawings used during Alton Towers Resort Spa expansion plant noise assessment

Table C.1. 1 - Drawings used during ATR Spa expansion plant noise impact assessment

Originator	Drawing Number	Description
Simpson Associates	12796:SK8	Drainage strategy for Spa expansion
Nichols Brown Webber	373/50.2-1	Key plan
Nichols Brown Webber	373/85/3	Site plan showing constraints
Nichols Brown Webber	373/50.2/04	Alton Towers hotel Spa extension
Melt	ATS-PL-100-B	Level 1 plan as existing showing extant
Melt	ATS-PL-101-C	Level 1 plan as proposed showing extant
Melt	ATS-PL-102-B	Level 2 plan as existing showing extant
Melt	ATS-PL-103-C	Level 2 plan as proposed showing extant
Melt	ATS-PL-200-C	Front and side (east and north) as existing showing extant
Melt	ATS-PL-201-C	Front and side (west and south) as existing showing extant
Melt	ATS-PL-202-D	Front and side (east and north) as proposed showing extant
Melt	ATS-PL-203-D	Side (east) elevation as proposed showing extant
Melt	ATS-PL-205-D	Front and side (west and south) as proposed showing extant

C.2. Plant Schedule

SCHEDULE OF EQUIPMENT AND NOISE LEVELS

The noise levels (dBA) as detailed below are taken from literature provided by the manufacturer of each item of plant and are for guidance only. Generally these levels are taken at a 3m distance from the item of plant in question and where different is detailed.

VRF CONDENSERS (EXTERNAL) – located in service yard
Max. 60dBA

Reception/Lounge EXTRACT/INTAKE (Lossnay Unit) (outlet/inlet points at high level on ground floor)
Max 53dBA (duct outlet @ 1.5m from unit)

FRIDGE/FREEZER CONDENSER (EXTERNAL)
Max. 49dba @ 10m (notional – specialist contractor to confirm)

WATER HEATERS – flue terminals located on roof of arrivals building
Max 51dBA @ 2m from flue terminal

Alton Towers Page 2 of 2 © Ce² Ltd 2012

Appendix D. Plant Locations

D.1. Assumed Plant/ Equipment Locations

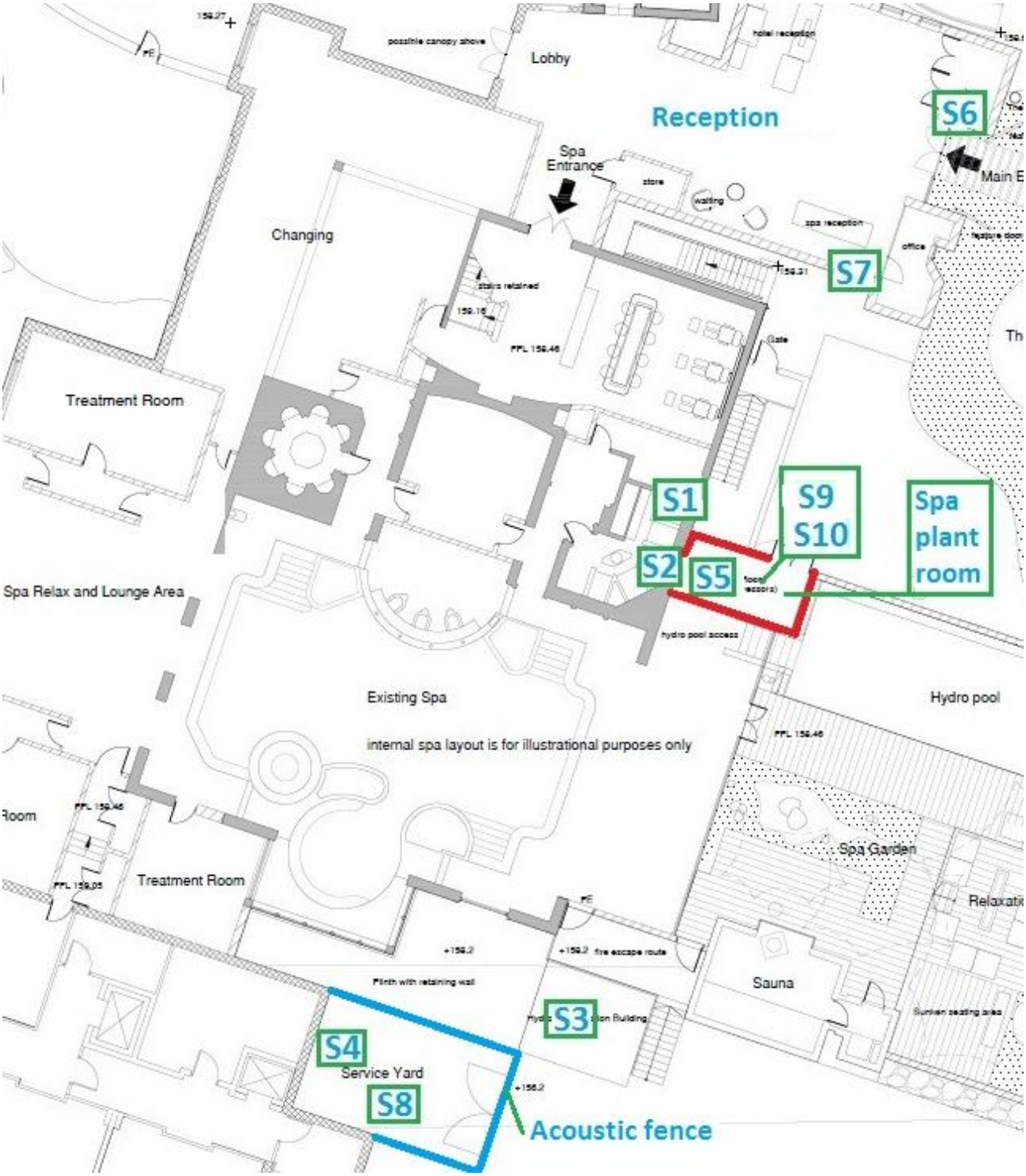

Figure D.1- 1 – Assumed locations of the Spa plant/ equipment.

Appendix E. Noise Survey

E.1. Environmental Noise Survey

A noise logger marked up as 10C in Figure E.1-1 below was set up along the eastern site boundary of the application site. Noise levels were measured from Thursday 24/01/13 to Thursday 07/02/13 and from Friday 22/02/13 to Friday 08/03/13. This has allowed gathering noise level data on week days as well as on weekends. On the days when the noise logger was attended by an acoustic consultant observations on the noise climate were made for one hour.

A-weighted broadband maximum sound pressure level (SPL), equivalent continuous SPL as well as the statistical noise parameters L_{AF10} and L_{AF90}, usually used to represent the road traffic noise and background noise, respectively, were sampled every 5 minutes.

The 5-minute sampling period was chosen to meet the requirements of BS4142: 1997 for the night time period (11pm to 7am). Usually, night time is the more critical assessment period when carrying out a BS4142: 1997 significance assessment. This is because, generally, during night time the background noise levels are lower. Also the assessment period is 5 minutes whereas it is 1 hour during day time which means that short duration noise events with high SPLs will have more influence on the measured noise level during night time because the averaging duration is considerably shorter.

A manned day time environmental noise survey was also carried out on Wednesday 5th of December 2012 and noise levels were measured at Positions 1 and 18. Positions 1 and 18 are previously used ATR baseline boundary measurement positions and represent the nearest off-site NSRs w.r.t. the application site. The sample period was chosen as 10 minutes to be consistent with the previous baseline noise measurements during these measurements.

Measurement positions including the historic baseline measurement positions Positions 1, 9 and 18 are shown in Figure E.1-1.

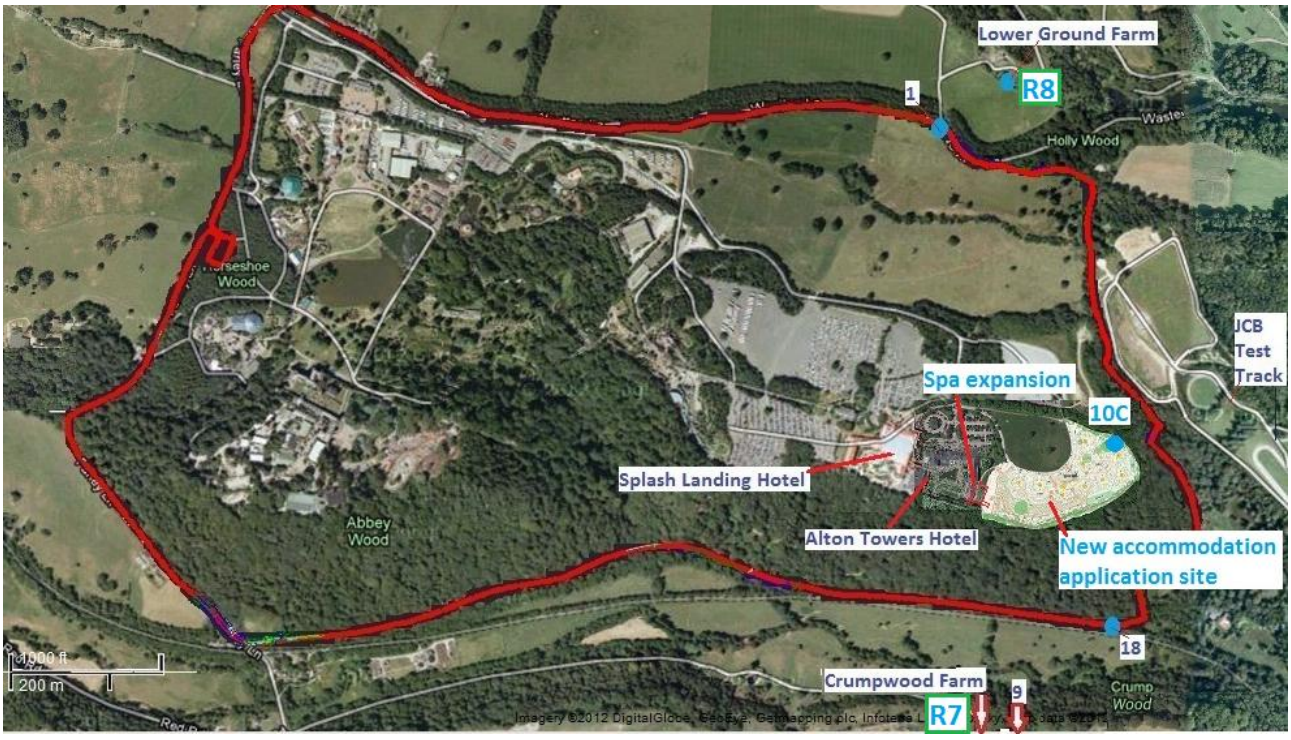

Figure E.1- 1 - An aerial view of the ATR with the proposed Spa expansion. Location of noise logger (10C) along the east site boundary is also shown.

E.2. Noise Survey Equipment

Class 1 and Type 1 Sound Level Meters (SLM) and Class 1 Acoustic SLM calibrators were used. Details of the SLMs and Acoustic SLM Calibrators used are given in Table E.2-1.

Table E.2. 1 - Equipment details.

Location	Manufacturer	Model	Module	Serial No.	Calibration Date	Calibration Certificate No.	Calibration Body
10C	Rion	UC-59	Microphone	03883	05/11/12	TCRT12/1267	ANV
		NH-25	Preamplifier	21004			
		NL-52	Sound level meter	00620963			
		NC-74	Calibrator	35125804	07/12/12	CONF111225	ANV
1 and 18 (06/12/12)	Norsonic	1225	Microphone	59992	11/04/12	00801/02	University of Salford
		1206	Preamplifier	30627			
		118	Sound level meter	31653			
		1251	Calibrator	31228	10/04/12	00801/01	

Norsonic 118 was used for the manned noise measurements while Rion NL-52 SLM was used for long-term noise monitoring.

SLMs were field calibrated using Class 1 Acoustic SLM Calibrators before and after the noise surveys. No discernible deviations were observed on December 2012 survey. The calibration of the noise logger indicated a negligible drift (0.1dB).

All SLMs and Acoustic SLM Calibrators used have been laboratory calibrated within the last two years by UKAS[11] accredited calibration facilities. Calibration details are given in Table E.2-1 and associated laboratory calibration certificates are kept on file by Atkins and can be provided upon request.

E.3. Weather

Table E.3-1 below provides information on the weather conditions observed during attendance at site.

Table E.3- 1 - Weather conditions observed during attendance at site

Date	Wind speeds	Wind Direction	Precipitation	Notes
24/01/2013	<5m/s	NE	None	Snow on the ground
30/01/2013	8-10m/s	SW	None	-
07/02/2013	<5m/s	W	None	-
22/02/2013	<5m/s	NE	None	-
01/03/2013	<=5m/s	NE	None	-
08/03/2013	<5m/s	NE	None	Fog

[11] United Kingdom Accreditation Service

On Thursday 6th of December 2012, weather was dry during the day time but became wet and windy later on.

Figure E.6-1 and Figure E.6-2 show the extracts of data obtained from weather underground web site (www.wunderground.com) for the survey periods for Birmingham area which is considered to be representative of the weather conditions around the site. Days of noise surveys are highlighted using blue rectangles.

E.4. Noise climate

Noise climate around the proposed development site comprises but not limited to distant road traffic noise (RTN), very light RTN on the ATR site access roads, some noise from the adjacent JCB test site, occasional aircraft and helicopter noise, occasional farm equipment noise and birdsong.

Whilst on site, the following noise sources were noticeable:

- Distant road traffic noise (RTN)
- Light RTN from ATR access roads
- Occasional aircraft
- Birdsong
- Noise from foliage in trees and bushes as a result of the wind
- Snow falling from branches (24th only)
- JCB site noise (more audible at north east ATR boundary)
- Livestock

During the attended periods on site, it was observed that when the JCB site was audible the dominant source of noise was from the breaking area located to the northwest of the JCB test site.

E.5. Noise Data

Table E.5-1 gives the manned noise measurement results while Figure E.5-1 and Figure E.5-2 give long term noise monitoring results obtained at Position 10c.

Table E.5- 1– Sound levels measured at Positions 1 and 18 on Thursday 06/12/12 (10min samples).

Position	File	Start Time	$L_{Aeq,10min}$	$L_{Amax,Fast}$	$L_{AMin,Fast}$	L_{AF10}	L_{A90}
1	NOR118_7089362_121206_0004.NBF	14:36:44	39.6	57.2	34.6	41.0	36.3
18	NOR118_7089362_121206_0005.NBF	15:32:46	40.6	55.8	35.0	43.1	36.2

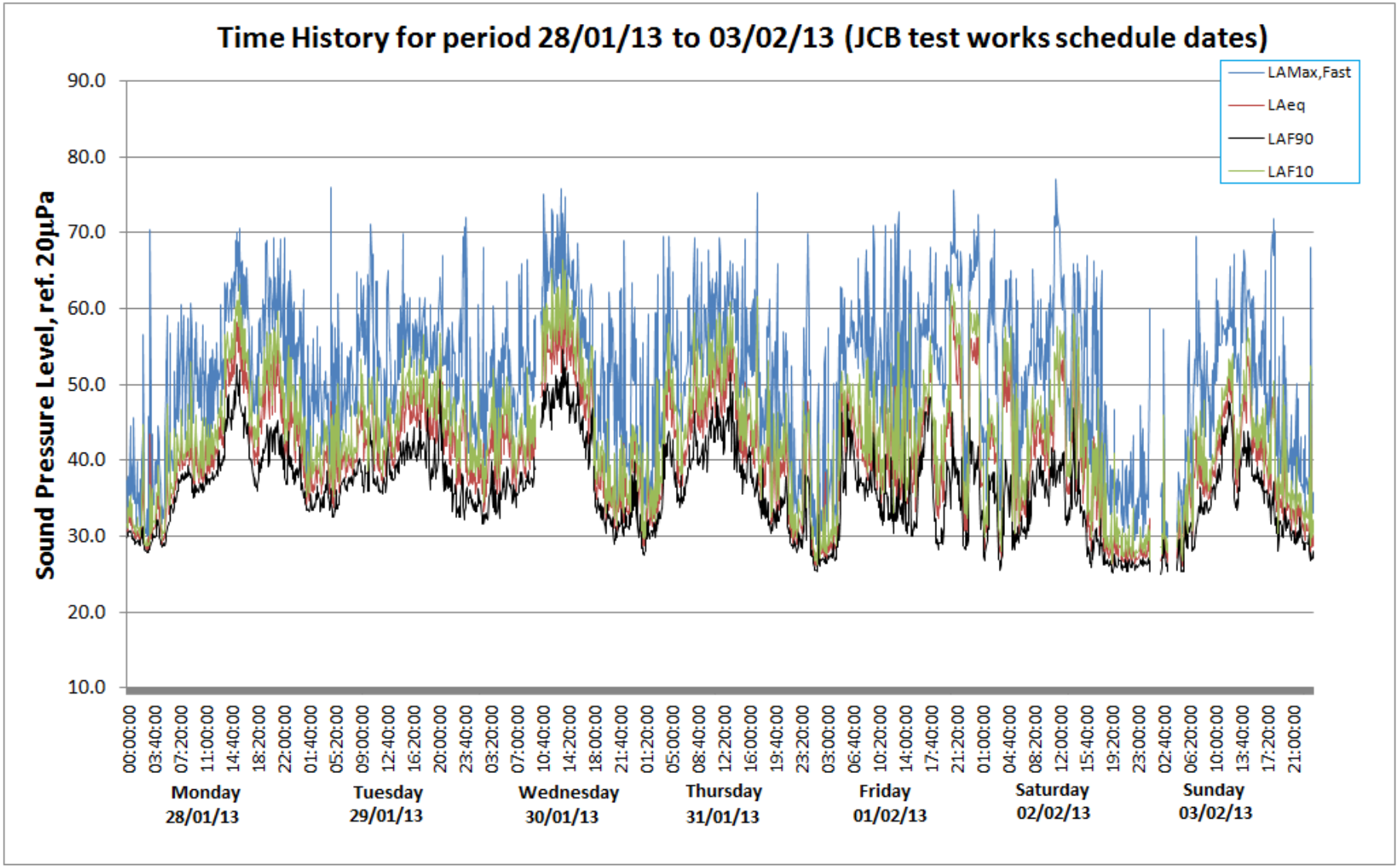

Figure E.5- 1 – Sound levels measured at Position 10C between Monday 28th January and Sunday 3rd February 2013 (5min samples). This time period is the same as the test site activity schedule provided by JCB for their Plumpton Test Site.

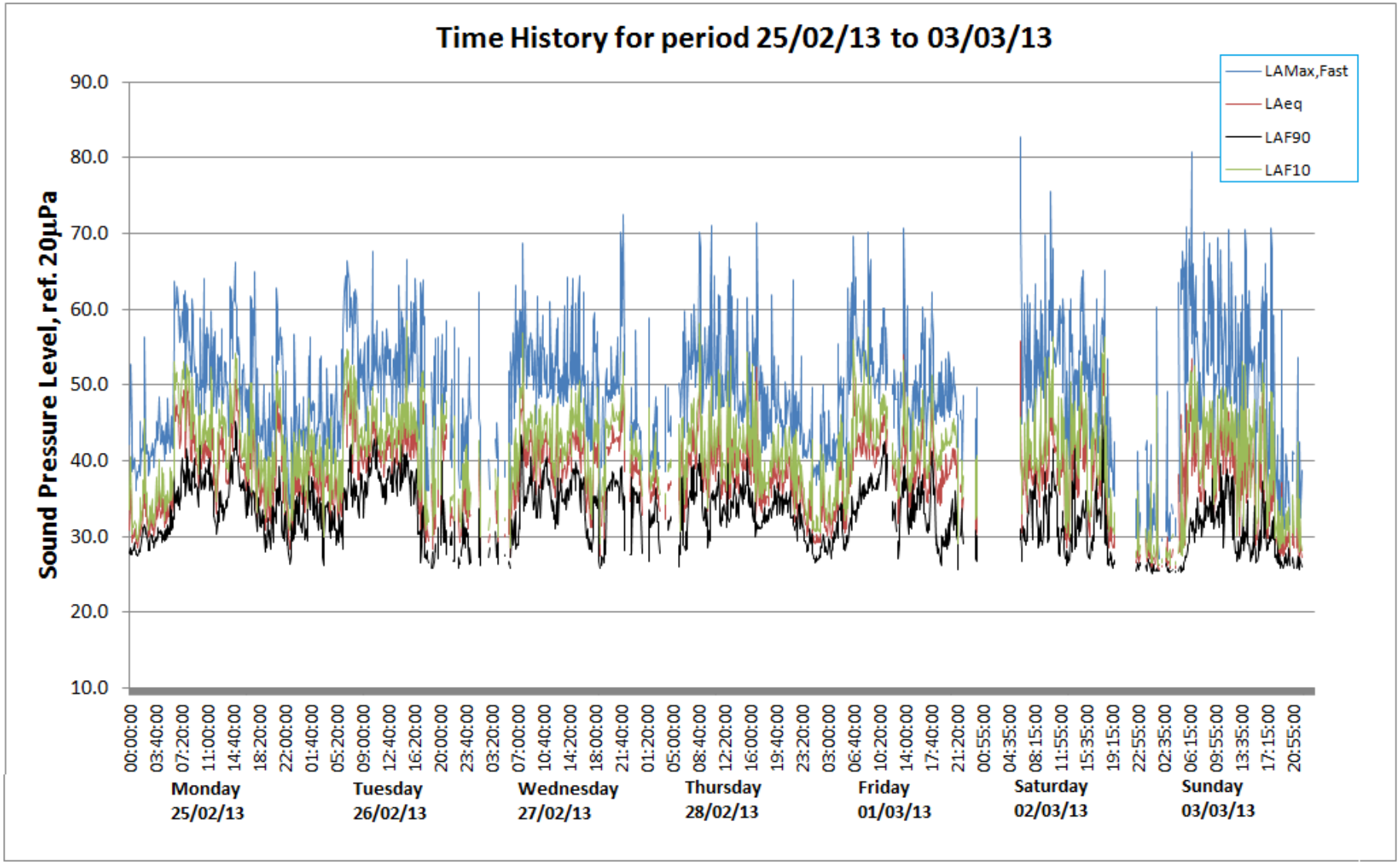

Figure E.5- 2 – Sound levels measured at Position 10C between Monday 25th February and Sunday 3rd March 2013 (5min samples).

E.6. Weather Data

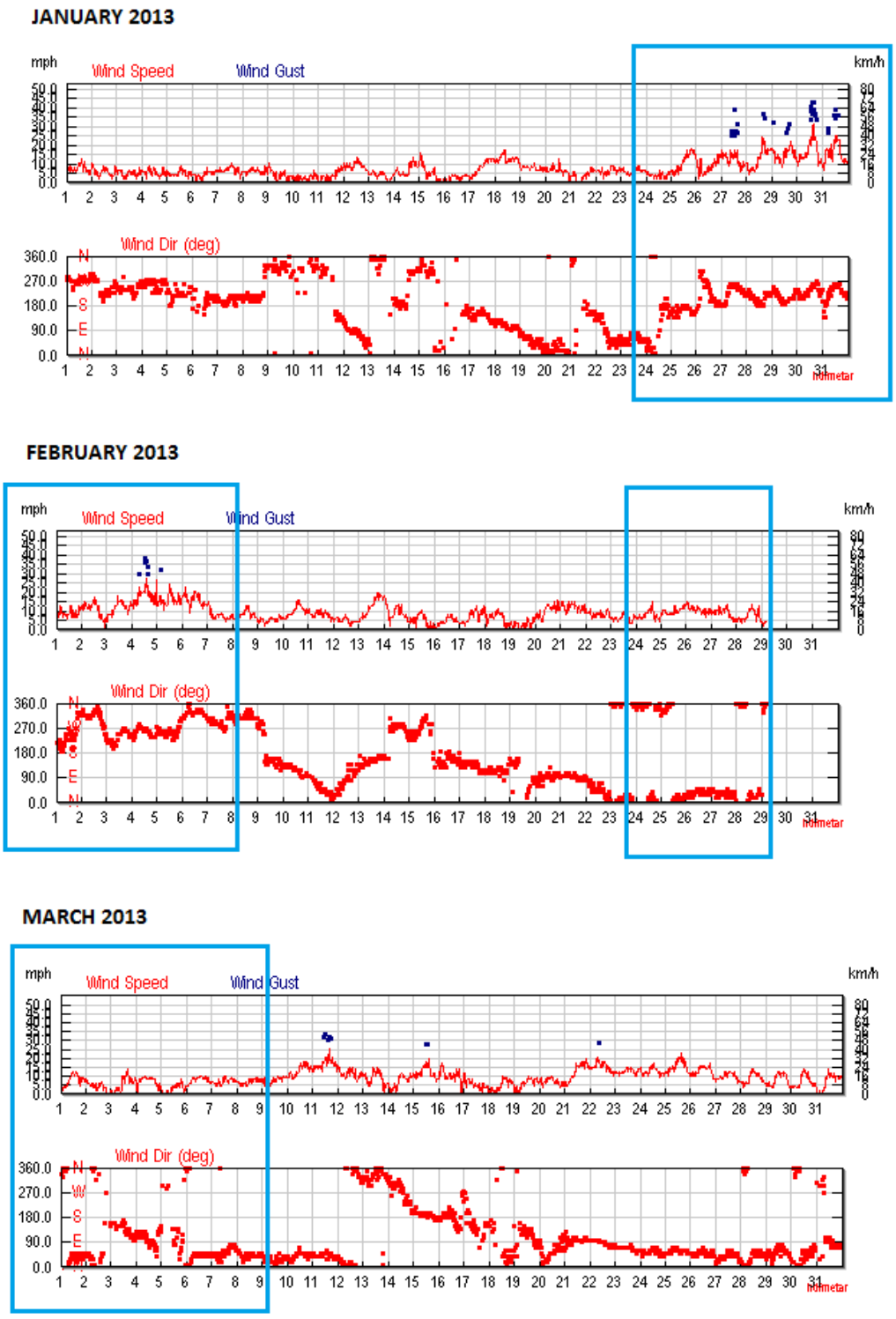

Figure E.6- 1 - Wind speeds and directions during the noise surveys carried out between 28th January and 3rd March 2013 for the Birmingham area which are considered to be representative of the site (ref. www.wunderground.com).

6 DECEMBER 2012

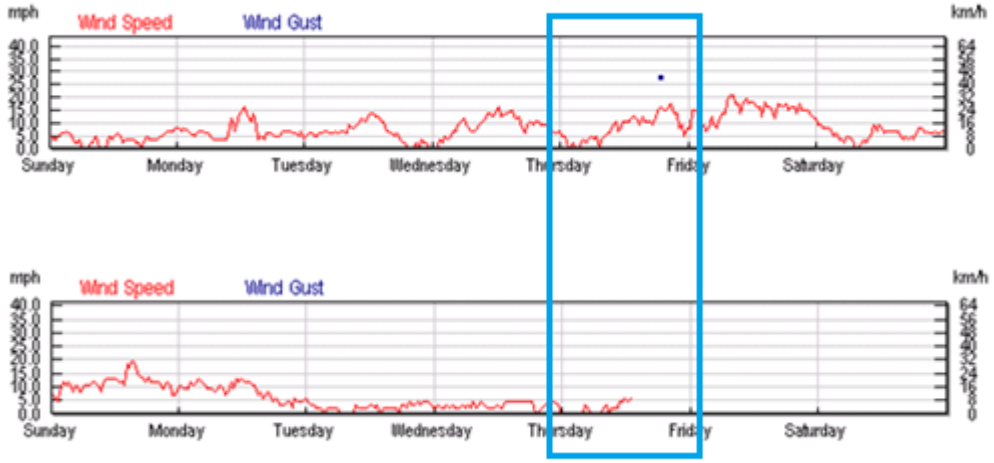

Figure E.6- 2 - Wind speeds and directions during the noise surveys carried out on 6th December 2012 for the Birmingham area which are considered to be representative of the site (ref. www.wunderground.com).

E.7. JCB Test Work Schedule

Table E.7- 1– Test site activity schedule received from JCB for their Plumpton Test Site.

Date	Machine	Test Work	Start Time	Finish Time	Location
28.01.2013	T213	Reach & Place	13:00	14:30	Top of site
		Rough Terrain Roading	15:00	16:00	Top of site
		Placing	16:00	16:30	Top of site
		Rough Terrain Roading	19:40		Top of site
		Placing	19:55		Top of site
		Placing	20:00		Top of site
		Rough Terrain Roading	21:00		Top of site
		Rough Terrain Roading	21:40		Top of site
		Rough Terrain Roading	23:10		Top of site
		Rough Terrain Roading	23:40		Top of site
		Rough Terrain Roading	00:30		Top of site
28.01.2013	BHLS98	Breaking	11:30	11:50	Top of site
		Rough Terrain Roading	13:30	13:00	Rough Terrain Track
		Breaking	13:00	14:00	Top of site
		Breaking	17:50	18:45	Concrete noise pad
		Jack Hammer	19:35		Top of site
		Quarry Roading	21:30		Rough Terrain Track
		Excavating	22:45		Hard Dig area
		Quarry Roading	23:45		Rough Terrain Track
		Excavating	01:35		Hard Dig area
		Quarry Roading	02:40		Rough Terrain Track
		Excavating	03:40		Hard Dig area
28.01.2013	VMD100	Rolling	11:30	12:30	Hard Dig area
		Rolling	15:00	16:00	Hard Dig area

Date	Machine	Test Work	Start Time	Finish Time	Location
28.01.2013	BHLS95	Rehandling	13:00	13:35	Concrete noise pad
		Rehandling	14:05	14:20	Concrete noise pad
		Rehandling	15:00	15:30	Concrete noise pad
		Excavating	15:30	16:00	Concrete noise pad
28.01.2013	JS20MH	Loading into skip	20:00		Noise pad
		Roading	22:10		Noise pad
		Skip work	00:10		Noise pad
		Roading	00:40		Noise pad
		Skip work	01:30		Noise pad
		Roading	03:45		Noise pad
29.01.2013	BHLS98	Excavating	07:30	09:15	Deep Dig
		Breaking	10:40	11:20	Deep Dig
		Breaking	12:55	13:25	Noise Pad
		Breaking	16:15	16:50	Noise Pad
		Breaking	17:45		Noise Pad
		Breaking	20:30	21:30	Top of site
		Breaking	23:55	00:45	Top of site
		Back End Work	02:30	03:20	Hard Dig area
		Back End Work	04:35	05:20	Hard Dig area
29.01.2013	T213	Placing	07:20	08:20	Top of site
		Rough Terrain Roading	08:20	08:50	Rough Terrain Track
		Lift & Place	08:50	09:15	Top of site
		Placing	10:05	10:50	Top of site
		Rough Terrain Roading	10:50	11:30	Rough Terrain & Brake Run
		Rough Terrain Roading	23:20	00:20	Rough Terrain Track
		Placing	02:25	03:25	Noise Pad

Date	Machine	Test Work	Start Time	Finish Time	Location
29.01.2013	VMD100	Rolling	13:00	14:00	Deep Dig
29.01.2013	BHLS95	Bucket bangs & reverse horn	15:08	15:21	Top of site
		Bucket bangs & reverse horn	15:45	16:48	Top of site
29.01.2013	JS20MH	Loading waste	19:30	06:00	Top of site
30.01.2013	T213	Placing	22:00	22:10	Top of site
		Placing	23:30	00:00	Top of site
30.01.2013	BHLS95	Bucket Banging	11:15	11:45	Top of site
30.01.2013	BHLS98	Hammering	10:30	12:00	Top of site
		Hammering	13:00	14:30	Top of site
		Reverse Alarm / Bucket Banging	15:50	16:05	Top of site
		Breaking	23:45	00:45	Top of site
		Breaking	01:45	02:45	Top of site
		Roading	02:45	03:15	Rough Terrain Track
		Excavating	04:15	05:15	Hard Dig
30.01.2013	JS20MH	Roading / Rehandling	07:48	09:07	Noise Pad
		Rehandling	10:15	11:41	Noise Pad
		Rehandling	13:00	14:14	Noise Pad
		Rehandling	15:25	16:30	Noise Pad
		Roading	19:30	20:10	Noise Pad
		Rehandling	20:15	22:10	Noise Pad
		Rehandling	23:20	00:15	Noise Pad
		Roading	00:15	01:00	Noise Pad
		Roading	05:50	06:40	Noise Pad
31.01.2013	T211	Pick & Place	07:30	08:30	Top of site
		Reversals	08:30	09:00	Top of site

Date	Machine	Test Work	Start Time	Finish Time	Location
		Pick & Place	10:00	11:00	Top of site
31.01.2013	JS20MH	Rehandling	07:35	09:05	Noise pad
		Rehandling	11:00	11:40	Noise pad
		Rehandling	12:50	14:05	Noise pad
		Rehandling	14:55	16:30	Noise pad
31.01.2013	T213	Placing	19:40	20:40	Top of site
		Roading	23:45	00:45	Top of site
31.01.2013	BHLS98	Hammering	20:15	21:15	Top of site
		Hammering	23:45	00:45	Top of site
01.02.2013	T213	Placing	07:52	08:16	Noise pad
		Placing	08:35	09:18	Noise Pad
		Placing	10:40	11.00	Noise Pad
		Reversals	20:00	21:00	Top of site
		Pick & Place	21:30	22:20	Top of site
		Placing	23:30	00:30	Top of site
		Reversals	00:30	00:50	Top of site
		Reversals	02:30	03:10	Top of site
		Pick & Place	06:00	06:30	Top of site
01.02.2013	T211	Reverse horn / Placing	13:50	14:15	Top of site
		Reverse horn / Placing	15:15	15:45	Top of site
		Roading	15:45	16:15	Rough Terrain Track
		Reverse horn / Placing	17:45	18:15	Top of site
		Reverse horn / Placing	19:45	21:30	Top of site
		Roading	23:15	23:45	Noise pad
		Placing	23:45	00:45	Top of site
		Placing	02:00	03:00	Top of site
		Roading	03:00	03:15	Top of site

Date	Machine	Test Work	Start Time	Finish Time	Location
		Roading	04:00	05:10	Top of site
01.02.2013	JS20MH	Skip work	07:40	09:10	Top of site
		Skip work	10:40	11:46	Top of site
		Skip work	12:55	14:15	Top of site
		Skip work	15:28	16:22	Top of site
		Skip Work	17:55	18:28	Top of site
		Roading	19:20	19:40	Top of site
		Skip work	19:40	22:15	Top of site
		Roading	22:15	23:25	Top of site
		Skip work	23:30	03:00	Top of site
		Roading	03:00	03:35	Top of site
		Roading	03:50	04:15	Top of site
		Skip work	04:15	05:15	Top of site
		Roading	05:15	06:00	Top of site
01.02.2013	BHLS100	Breaking	07:30	09:00	Top of site
		Breaking	10:30	11:45	Top of site
		Bucket banging	11:45	12:00	Top of site
		Bucket banging	12:40	13:30	Rough Terrain Track
		Excavating	13:30	14:15	Hard Dig
		Roading	15:30	17:00	Rough Terrain Track
		Roading	17:30	18:30	Brake Run
		Hammering	20:30	22:00	Noise Pad
		Bucket banging	22:00	22:15	Top of site
		Hammering	23:15	00:45	Top of site
		Hammering	04:00	05:15	Top of site
02.02.2013	BHLS100	Breaking	12:05	12:46	Top if site
		Breaking	13:47	14:58	Top of site

Date	Machine	Test Work	Start Time	Finish Time	Location
		Excavating	16:55	18:54	Top of site
02.02.2013	T213	Fork Rattles	07:35	08:25	Top of site
		Fork Rattles	08:50	09:50	Top of site
		Fork Rattles	10:50	11:15	Top of site
		Lifting / Placing	15:00	15:45	Top of site
		Lifting / Placing	17:55	18:10	Top of site
02.02.2013	T211	Pick & Place	07:30	09:00	Top of site
		Lifting / Placing	09:00	09:45	Top of site
		Lifting / Placing	10:45	11:45	Top of site
		Lifting / Placing	11:45	12:30	Top of site
02.02.2013	JS20MH	Skip work	07:30	09:30	Top of site
		Skip work	11:00	12:30	Top of site
03.02.2013	VMT260	Rolling	11:50	12:40	Rough Terrain Track
03.02.2013	T213	Fork work	13:50	14:40	Rough Terrain Track
		Fork Rattling	16:35	16:50	Top of site
		Roading	17:50	18:30	Rough Terrain Track
03.02.2013	UST8	Lifting / Placing	07:45	08:31	Top of site
		Laden weight on forks	12:07	12:45	Rough Terrain Track
03.02.2013	BHLS100	Excavating	07:20	09:20	Top of site
		Breaking	11:00	12:30	Top of site
		Roading	12:30	13:00	Rough Terrain Track
		Rehandling	13:40	14:30	Top of site
		Breaking	14:30	15:00	Top of site
		Excavating	15:00	16:30	Hard Dig
03.02.2013	T213	Reversals	07:30	09:00	Top of site
		Reversals	10:30	11:30	Top of site

Date	Machine	Test Work	Start Time	Finish Time	Location
03.02.2013	T211	Pick & Place	07:30	07:50	Top of site
		Pick & Place	10:25	11:10	Top of site
		Pick & Place	14:30	15:00	Top of site
		Pick & Place	18:10	18:30	Top of site

Figure E.7- 1 – Locations of JCB test site activities

E.8. Previous noise surveys

Previously noise surveys had been carried out at ATR to obtain boundary noise levels. Two of the previous noise measurement locations were considered to be relevant. These positions are Position 1 (Lower Ground Farm) and Position 18 (Crumpwood Farm). Therefore, results of previous noise surveys are included in Table E.8-1 in Appendix F for information.

Table E.8- 1 - Noise levels measured by the nearest off-site NSRs and at the ATR boundary between 1992 and 2004.

Date	Start Time	Duration	$L_{AMax,Fast}$	L_{Aeq}	L_{AF90}	Comments
ID No. 1: Lower Grounds Farm by cattle grid at Wootton Lane end of drive to Farm						
8.4.92	11:25	15min	-	54	36	Birds. Breeze in trees. Occasional distant aircraft. 2 local cars. Tractor at farm. Occasional screaming just audible. Wind speed 1-2m/s from northeast.
8.4.92	11:04	15min	-	43	36	Birds. Tractor in field at rear of farm. Occasional distant light aircraft. Breeze in trees. Occasional screaming just audible. Wind speed 1-2m/s from northeast.
8.4.92	19:00	10min	-	39	28	Birds. Occasional distant traffic, tractor, cattle and voices from farm. Still air.
8.4.92	20:25	10min	-	34	28	Occasional birds and distant traffic. Wind speed <1m/s from northeast.
6.7.03	10:04	10min	60	42	34	Birds. Distant traffic. Distant aircraft. Screaming and some ride noise occasionally just audible. Wind speed<2m/s from south.
6.7.03	15:30	10min	59	43	33	Birds. Distant traffic. Corkscrew lift motor, screaming and some ride noise occasionally just audible.
5.7.03	14:20	10min	57	38	37	Birds. Occasional rustling of leaves. Corkscrew lift motor occasionally just audible. Screaming and some ride noise occasionally audible.
14.08.04	12:17	10min	66	47	34	Lifts (33-40), running noise (34-42) and screams (34-46) audible at times, but generally immeasurable against L_{A90}. Birds (33-50). 2 local cars (64-66). Occasional distant sheep (44) and leaves rustling. Wind speed <1m/s from SW.
14.08.04	12:37	10min	60	44	33	Running noise (≤42) and screams (33-44) audible at times, but immeasurable against L_{A90}. Tannoy (37) occasionally just audible. Birds (43-54). 2 light aircraft (41-60). Distant sheep (46-59). Wind speed <1 m/s from SW-NE variable.
15.08.04	13:30	10min	65	46	38	Running noise (44-54) and screams (44-60) clearly audible with 1-2 m/s, gusting 3m/s wind from SW. Leaves rustling (40-43). Alton Towers noise barely audible with still air. Birds (40-50). 2 local cars (60-65). Helicopter (47-56).
23.09.09	09:59	10min	65	49	42	Track running noise (40-50) and occasional screams audible but generally not measurable against L_{A90}. Birds (35-50). 3 local cars (62-64). Leaves rustling (45-55). Wind speed 1-3m/s, gusting 4m/s at ground level from SW.
24.09.09	11:54	10min	65	43	33	Track running noise and screams occasionally audible but not measurable against L_{A90}. Birds (33-46). 1 local car (65). 3 distant aircraft (40-48). Occasional leaves rustling. Wind speed <1 m/s at ground level from SE-S-SW variable.
25.09.09	13:36	10min	69	52	35	Continuous birdsong (35-62). Track running noise and screams occasionally audible but not measurable against L_{A90}. 4 distant aircraft (36-40). 2 local cars (65-68). Wind speed <1 m/s at ground level, variable easterly direction.

As it can be seen from Table above noise from the JCB test site was not noted in the noise measurement records from the previous surveys undertaken in 2004 and 2009.

Murat Papaker
The Hub
500 Aztec West
Almondsbury
Bristol
BS32 4RZ

Email: murat.papaker@atkinsglobal.comTelephone: 01454 662 222
Direct telephone: 01454 663 333
Fax: 01454 663 333