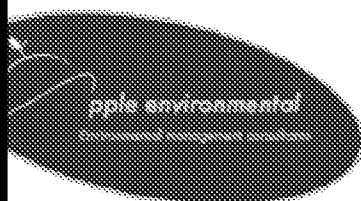


SOUND LEVEL IMPACT ASSESSMENT

Barfoots of Botley Limited
Sefter Farm
Pagham Road
Pagham
Bognor Regis
West Sussex
PO21 3PX



June 2016

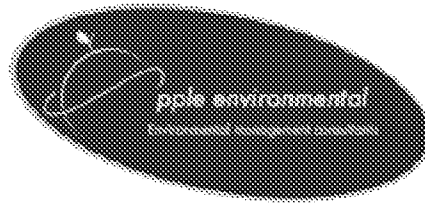
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1 Introduction

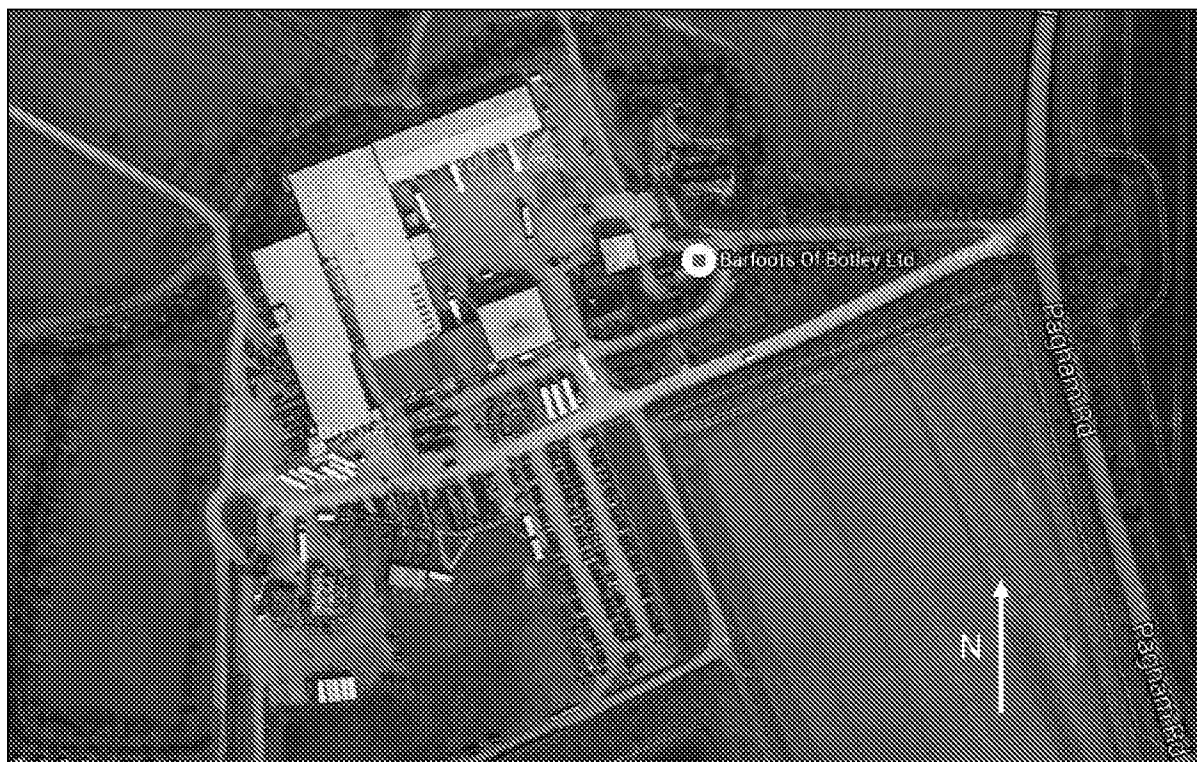
This sound level assessment has been requested by Barfoots of Botley Limited in support of a planning application to construct a new food processing facility on part of the existing site.

Prior to undertaking this work contact was made with Arun District Council to discuss the format of the assessment, from which it was felt that the British Standard for rating industrial and commercial sound, BS4142:2014, was not a relevant method of appraisal in this instance due to the generally quiet characteristics of the surrounding area.

The overall aim of this work therefore is to make an assessment of the sound pressure levels likely to propagate away from the proposed new facility and its associated activities, to determine the impact that these may be having on the nearest receptor.

The existing site layout of the site is shown below in Figure 1.

Figure 1 Existing site layout



Ref. Google Earth

2 Development proposal

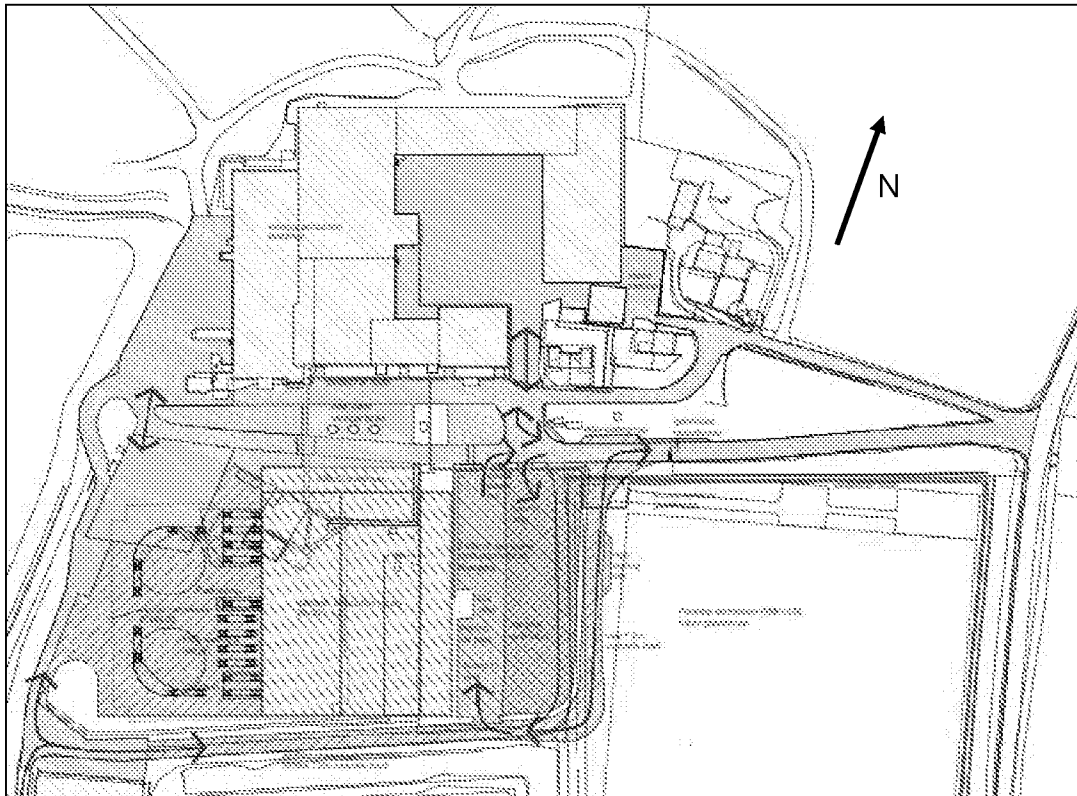
The proposed food processing facility is to be located on an area of largely redundant land to the south of the existing buildings, as shown (hatched in red) below in Figure 2.

The new building will cover a footprint area of around 7000m² which will lie around 250m from Pagham Road to the east. As seen below, the new facility exists as a single structure; the northernmost section of which will be a plant room containing an expected two refrigeration units.

Vehicles will enter the site as they currently do from Pagham Road to the east, whereupon those visiting the new processing plant will continue on towards the proposed loading and unloading area, which is to be located at the western façade of the new building. Vehicles will use the existing driveway, although the section that runs parallel to Pagham Road is expected to be moved around 10m closer to Pagham Road; albeit still around 150m from the road.

Much of this existing driveway currently has a gravel covering however as part of the development proposal this will be surfaced with concrete.

Figure 2 Proposed site layout



The proposed facility will inevitably see an increase in heavy vehicle traffic entering the site, although conversely it is expected to also see a decrease in light vehicle traffic due to a proposed new private-public transport arrangement.

Data has been obtained from the transport analysis which has also been undertaken in support of this proposal, from which it is understood that the introduction of the new facility should result in a maximum overall heavy vehicle increase of 15%, from an existing day-time peak of 137 movements and night-time peak of 6 movements, to a possible day-time peak of 158 and night-time peak of 7.

Of these, it is expected that this will result in a day-time number of 81 vehicles, and a night-time number of 4 vehicles being re-routed to the new facility in order to load or unload.

In addition to the proposed processing facility on the site, planning permission has already been granted for the construction of a new glasshouse on the eastern section of the site, for the growing of produce (Planning Ref. P/68/15/PL).

The glasshouse is expected to cover an area of some 32000m², and would effectively screen the proposed processing facility from the road (Pagham Road). This has also been shown (outlined in red) on the proposed site layout plan in Figure 2 above, to the east of the food processing facility.

Through reference to the transport assessment undertaken for this separate application, the glasshouse is expected to result in a further increase of around 4 HGV movements per day, which considering the existing and proposed numbers discussed above is deemed to be negligible.

3 Aims and objectives

The previously undertaken sound level assessment in February 2016 has concluded that ordinarily the sound coming from both the existing AD plant and lorry yard (loading and unloading) are unlikely to affect the nearest receptor, although this conclusion can not account for instances when specific sounds are present that would not normally be heard.

In view of the findings from the previous assessment, this current assessment aims to determine whether or not the expected additional activity occurring as part of the proposed siting of a new food processing unit will be such that sounds emanating from the site could now have an adverse effect on the nearest receptor.

The immediate activities of particular concern are the additional heavy vehicle movement - including associated loading and unloading, along with any new plant operating as part of the processes. Typically this could include refrigeration units, cooling fans, compressors, and air extraction units.

The objectives therefore being as follows:

- to obtain the sound pressure levels associated with the movement of a single heavy vehicle using the access driveway leading to the proposed new facility;
- to obtain the sound pressure levels typified during the loading and unloading of heavy vehicles within the existing lorry yard, such that this may be similar to that expected at the loading/unloading area of the proposed new facility;
- to obtain manufacturer sound level data for any fixed plant that may be installed;
- to use all of the above measurement data to predict associated sound levels based upon the projected activity at the proposed facility;
- to combine these predicted sound levels with existing sound levels to obtain an overall estimation of the sound level characteristics of the site in general;
- to recall typical day-time and night-time background sound pressure levels at the nearest dwelling to the east of the site at the intersection of Pagham Road and Sefter Road (1 Old Sefter School House); and
- to determine whether or not any predicted increase in operational sound levels at the at the proposed facility will have an unacceptable effect on the nearest receptor.

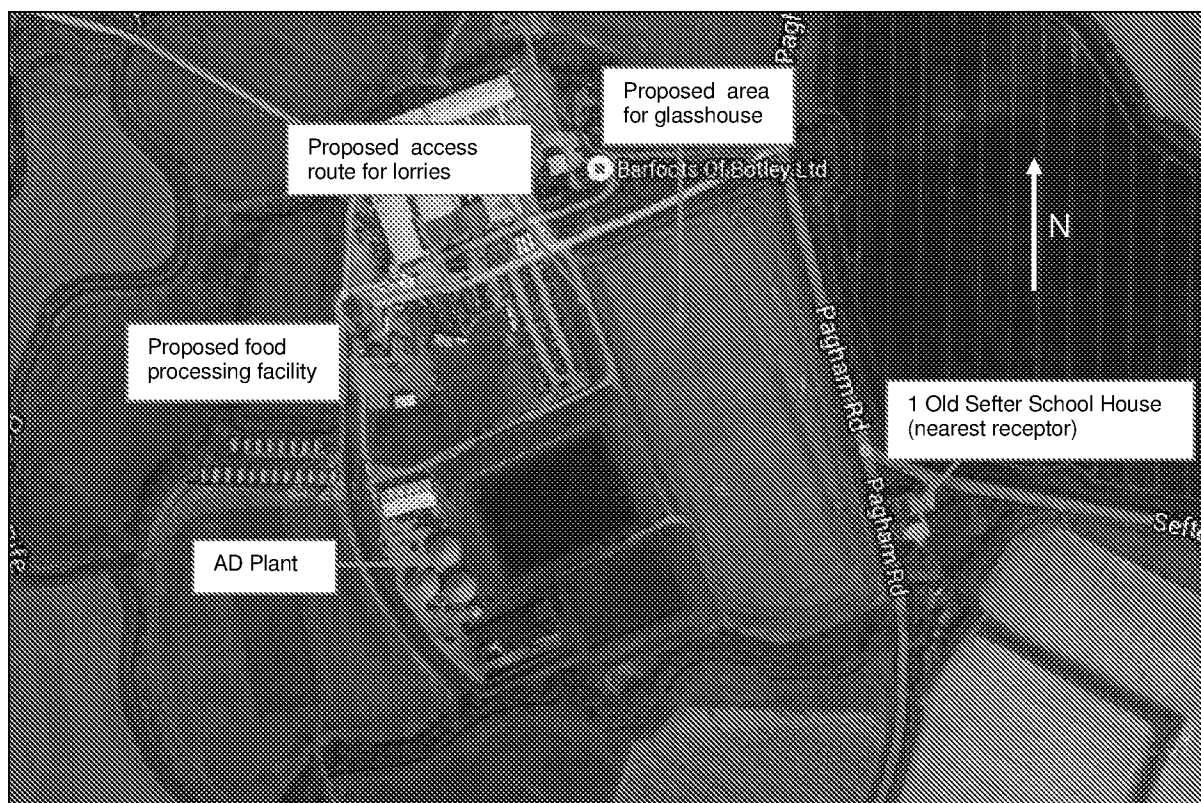
4 Background information

The Barfoots of Botley Limited site is located within Sefter Farm, which itself is situated within a predominantly rural area, some 4.5km due south of the A27 Chichester Bypass. The land that surrounds the site exists as flat farmland and open fields in all directions, although the land beyond this to the south and east is extensively developed with housing. Sefter farm is home to Barfoots food processing facility and anaerobic digestion (AD) plant.

The nearest off-site receptor to the proposed new facility would be a dwelling at 1 Old Sefter School House, located on the junction of Pagham Road with Sefter Road, approximately 320m southeast of the proposed new processing facility. This receptor is also located approximately 250m to the southeast of the proposed access road to the new facility. There would effectively be a clear line of sight from the receptor dwelling to the proposed facility, although this may not be the case once the glasshouse has been constructed.

There is no other industry located in this area within a radius of 500m from the AD plant. These discussed features have been identified in Figure 3 below.

Figure 3 Site location showing the immediate area



Ref. Google Earth

The existing facilities on site operate over a 24 hour day, and over 7 days per week. This includes both the loading and unloading of heavy vehicles and the AD plant.

Pagham Road links the A27 Chichester Bypass with Pagham and surrounding areas. Sefter Road, which runs eastwards from Pagham Road at the aforementioned Old Sefter School House junction, carries traffic eastwards to Bognor Regis and the surrounding areas.

It is understood that the heavy vehicles which enter and leave the site will normally approach the site from the north, and leave the site driving northwards, towards the A27. As a consequence, these vehicles would not normally pass the aforementioned nearest receptor. The distance from the site entrance to this receptor is approximately 275m. The closest that a vehicle is likely to get to this receptor would be part-way along the aforementioned proposed access track, when a vehicle could be approximately 220m from this dwelling at its closest. Only very occasionally will vehicles exit the site to the south.

A noise impact assessment was previously carried out for the existing site in February 2016, in order to address complaints by the occupants of this nearest dwelling. Upon visiting the receptor (Old Sefter School House), it was noted that both Pagham Road and Sefter Road appear to have a steady stream of traffic during the day-time, and to a much lesser degree during the night-time. The only sound noticeably during the day-time was the traffic using the roads. The wind at the time was 'slight', blowing from a west-northwesterly direction. The principal sound noticed during the night-time was a low frequency 'hum' emanating from the AD plant. There was no wind.

The overall findings from this assessment were that the existing activity on the site should not ordinarily give rise to any complaints. The levels obtained have been summarised below in Table 1, and have been referred to for this current assessment.

Table 1 Relevant sound levels previously obtained for the site and nearest receptor

	L_{(A)eq(t)}	L_{(A)90(t)}
Day-time at the source during general activities (t = 14-hours)	63.2	-
Night-time at the source during general activities (t = 8-hours)	62.4	-
Day-time at the nearest receptor during these activities (t = 15-minutes)	-	47.0
Night-time at the nearest receptor during these activities (t = 30-minutes)	-	35.2

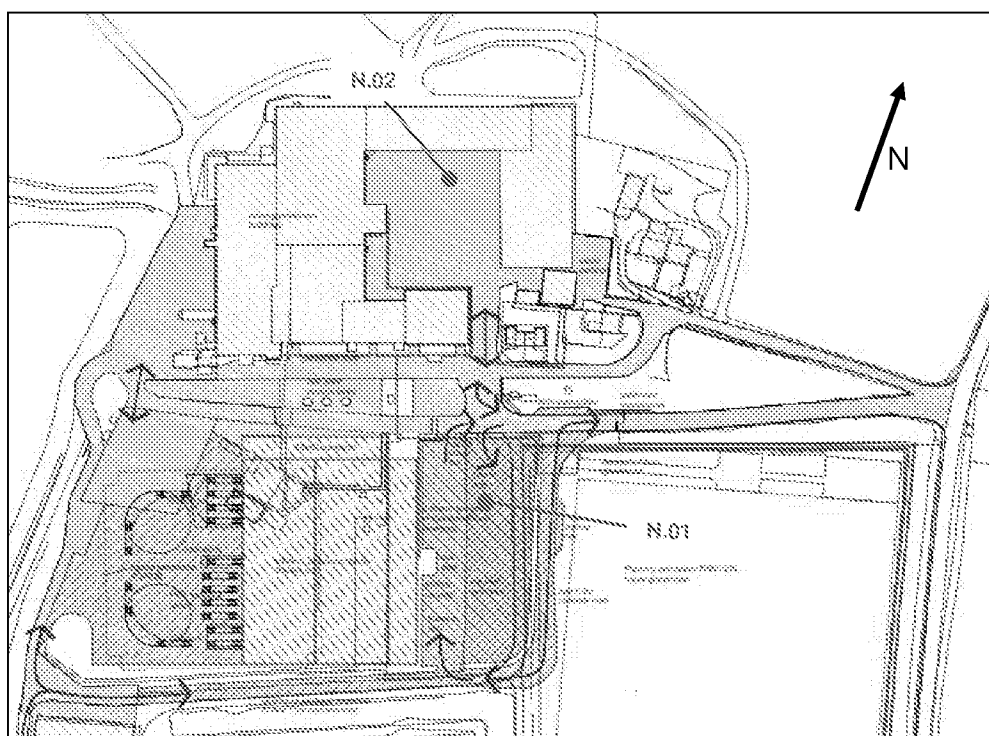
5 Methodology

The sound level monitoring for this assessment was undertaken on the evening of Tuesday 14th June 2016 between the hours of 20.00H and 22.00H. In each instance a Cirrus Optimus CR:171B Type I integrating sound level meter was used (Serial No.s G068537 and G068504). Each meter was externally calibrated both prior to, and after use at 94dB using a Cirrus CR:515 acoustic calibrator (Serial No. 70846).

For the purposes of determining the sound levels associated with new heavy vehicle movement at the site, the measurement of a single goods vehicle using the proposed access driveway was obtained. In doing so, a sound level meter was positioned at the point where the access route separates from the main entrance driveway and recorded the sound associated with the complete vehicle movement cycle. This involved driving to the proposed loading bay area, turning around, and then returning to the main driveway to exit the site. The entire cycle lasted approximately 6 minutes.

For the purposes of determining the sound levels associated with the expected loading and unloading at the new facility, the general measurement of sound levels were obtained from the existing lorry yard. In doing so, a sound level meter was positioned adjacent to the loading bays in use, and left in place for one hour. Throughout this time a total of five vehicles entered or exited the yard, and loaded or unloaded. The measurement locations are shown below in Figure 4 and in Photographs 1 and 2.

Figure 4 Showing the sound level measurement positions



Photograph 1 Showing the sound level measurement position at N.01



Photograph 2 Showing the sound level measurement position at N.02



With specific regard to each of these measurement exercises the following points should be noted.

In the first instance the measurements were made during a late evening in order to eliminate any other noises from general activities being undertaken at the site.

Secondly, the access track shown in Photograph 1 currently has a gravel covering, whereas the proposed driveway will have a concrete surface. As a consequence, the sound levels recorded for this assessment are expected to be greater than those expected when then the new facility is operational. This therefore provides for a worst-case situation.

Thirdly, the lorry yard as shown in Photograph 2 is an enclosed yard surrounded on all sides by sheet-metal sided buildings up to a height of around 8m. As such it is likely that there could be a potentially significant (and complex) sound reflection occurring here. By contrast, the loading and unloading area of the new facility will be open on three sides, facing west across open fields. This therefore again provides for a worst-case situation.

With regards to the loading and unloading of heavy vehicles at the new facility, as stated, this will be occurring at the western façade of the building. As a consequence, not only is this area facing away from the aforementioned nearest receptor, but also the actual loading and unloading sound will presumably be fully screened from the receptor by the building itself. Hence it is expected that the only sounds potentially affecting the receptor would be the vehicles using the access track and any other general plant sounds that may be present.

The weather conditions and other noise characteristics were noted at the time of the assessment, as shown in Table 2 below.

Table 2 Weather conditions and other characteristics during monitoring

	Mean temperature	Mean wind speed	Mean wind direction	Cloud cover	Rainfall	Ground conditions
Weather	16°C	0.5m/s	SW	6 Oktas	0mm	Dry
Principal sounds	Vehicle engines, hydraulic releases, reversing alarms, doors closing and on-board refrigeration units.					
Secondary sounds	Distant traffic, nearby general plant sounds and voices.					
Influential characteristics	Some building reflection within yard area.					

6 Monitoring results

For the purpose of this assessment the following source sound level measurements were obtained:

- existing lorry yard expressed as the $L_{Aeq(1-hour)}$ and one-third octave banding over the same period; and
- the proposed lorry route to the new building expressed as the $L_{Aeq(6-minutes)}$ and one-third octave banding over the same period.

In undertaking the measurement within the lorry yard, the sound level meter was positioned approximately 10m from the row of vehicles loading and unloading, although during the general movement of vehicles within the yard the distance to the dominant sound varied at different times. In some instances lorries drove to within 5m of the microphone. Despite this, in order to simplify the assessment it is suggested that the levels reported below should be considered as being obtained 10m from the source.

In undertaking the measurement for the movement of vehicles approaching the proposed new facility, the microphone was positioned at the start of the access drive; albeit some 10m from the vehicle as it entered the driveway. The vehicle proceeded to a farthest distance of approximately 150m away from the microphone before returning. For the purposes of this report, and again for simplifying the assessment, the levels reported below are considered to have been obtained at a distance of 10m from the source, at the start of the new driveway.

Note also that the measurement time stated above for the proposed lorry route to the new building reflects the actual time that a single lorry should take to approach the new building, then turn around to come back and exit the site.

The $L_{(A)eq}$, $L_{(C)Peak}$ and dominant frequency obtained during each measurement period are reproduced below in Table 3. The $L_{(A)eq}$ profiles over the complete measurement period are also reproduced below, in Figures 6 and 7.

Of these, Figure 6 shows the sound level profile for a lorry using the proposed access drive. The two peaks on the profile represent the two periods when the lorry was closest to the microphone. i.e. when the lorry entered the driveway and when the lorry left the driveway.

Figure 7 shows the profile during the general loading and unloading procedure, from which it can be seen that the sound level was fairly stable; albeit with momentary increases representing sporadic vehicle movement.

The frequency profiles are also reproduced below, in Figures 8 and 9.

Table 3 Source sound level readings obtained

	L_{eq}	L_{Peak}	Dominant frequency
	dB(A)	dB(C)	Hz
Lorry yard during loading and unloading L _{eq(A)(t)}	68.8	102.9	80
Lorry travelling along the proposed access route	59.5	96.3	63

Note: Time 't' = 1 hour for the lorry yard, and 't' = 6 minutes for a lorry using the access drive.

Figure 6 Sound level L_{eq} profile - lorry using the access drive

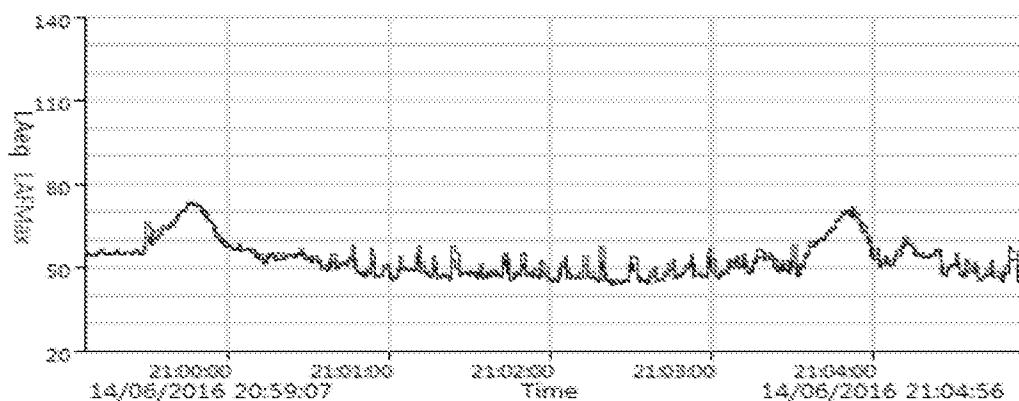


Figure 7 Sound level L_{eq} profile - existing lorry yard during loading and unloading

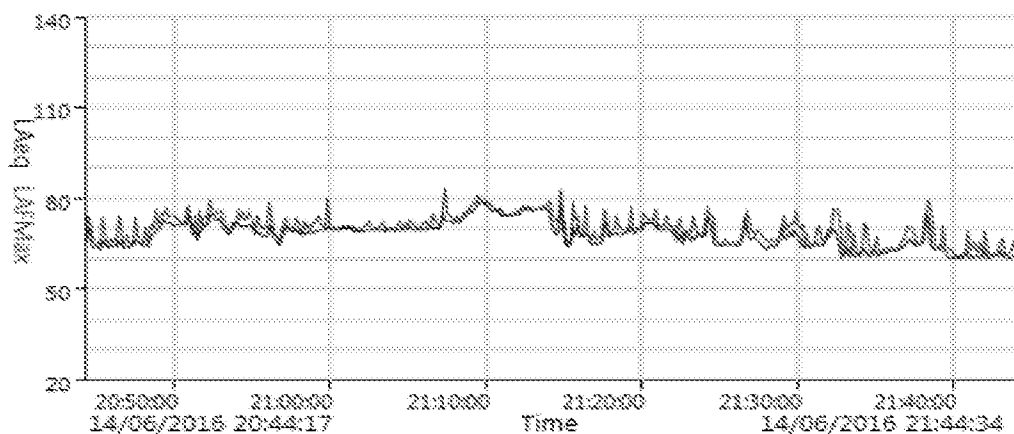


Figure 8 One-third octave banding (un-weighted) - lorry yard during loading and unloading

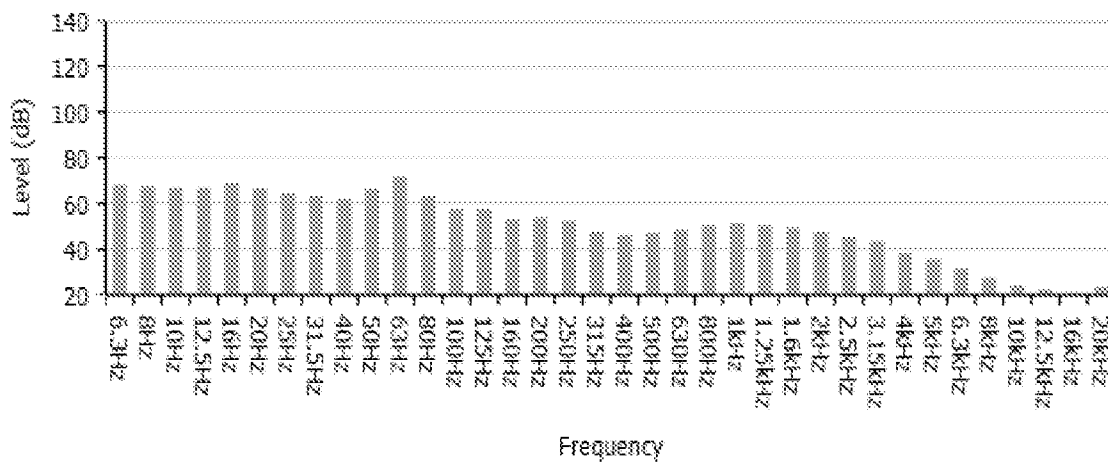
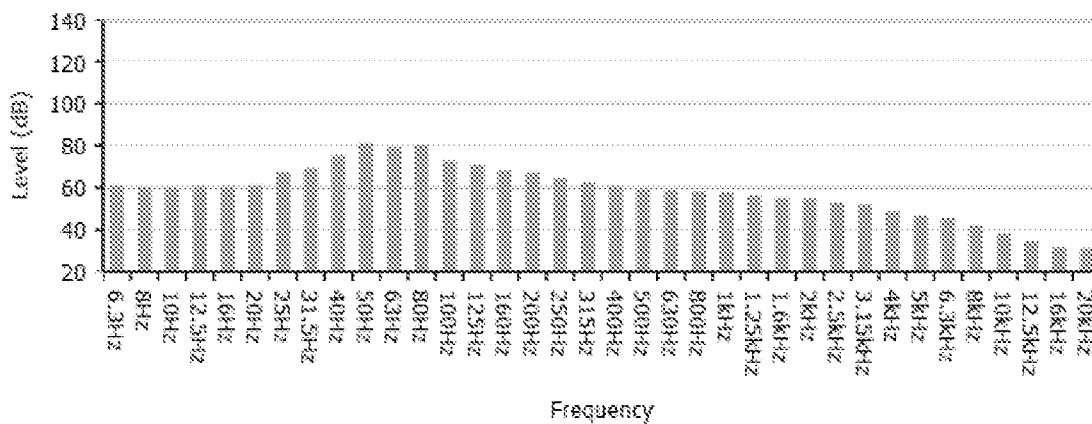


Figure 9 One-third octave banding (un-weighted) - lorry route along proposed access route



7 Justification for use of specified sound level data

7.1 Contributory sources

In undertaking this assessment there are four sources of sound to consider. These are:

- the loading and unloading of vehicles at the proposed facility;
- the associated vehicle movements visiting the proposed facility;
- the new fixed plant being introduced at the proposed facility (i.e. refrigeration); and
- the existing activity occurring at the site.

7.2 Loading and unloading vehicles

Considering firstly the loading and unloading of vehicles, the measured L_{eq} is shown as 68.8dB(A), at 10m from the 'activity'. On the presumption that this 'activity' is considered to be a 'point source' then the sound pressure level at 1m from the activity can be calculated accordingly using the following:

$$L_2 = L_1 - 20\log(r_2/r_1)$$

Where: L_1 is the sound level measurement at 10m of 68.8dB(A), r_1 is 10m and r_2 is 1m; hence:

$$L_2 = 68.8 - 20\log(0.1) = \underline{88.8\text{dB(A)}}$$

For the purpose of this assessment therefore, the mean sound level during the loading and unloading of vehicles is presumed to be 88.8dB(A).

7.3 Vehicles accessing the proposed facility

Considering secondly the driving of a vehicle along the driveway to the proposed plant, the measured L_{eq} is shown as 59.5dB(A) at 10m from the 'activity'. The characteristics of this sound are such that the sound is expected to behave more as a line source due to the vehicle moving continually along this driveway.

On this basis, the sound pressure level at 1m from the activity can be calculated accordingly using the following:

$$L_2 = L_1 - 10\log(r_2/r_1)$$

Where: L_1 is the sound level measurement at 10m of 59.5dB(A), r_1 is 10m and r_2 is 1m; hence:

$$L_2 = 59.5 - 10\log (0.00625) = \underline{81.6\text{dB(A)}}$$

For the purpose of this assessment therefore, the sound level from a single vehicle using the access driveway is presumed to be 81.6dB(A) when taken at 1m from the proposed facility.

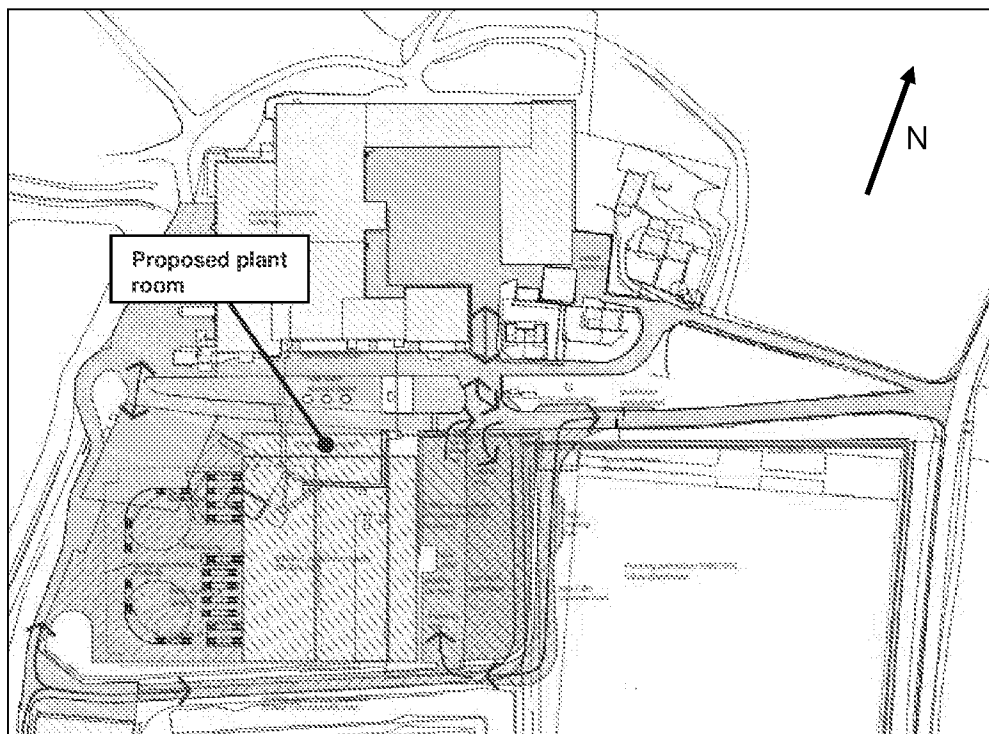
These two above calculations have been performed in order to standardise the location of the sound for the purposes of undertaking an assessment of their influence at the nearest receptor.

7.4 The use of new fixed plant

Considering thirdly the plant that is to be installed at the new facility, it is understood that a possible two refrigeration units will be located within the plant room on the northern façade of the proposed building. This area has been indicated below in Figure 10.

In addition to this, there is to be an air compressor housed within an acoustic enclosure; the location of which is not known as yet. Other plant of potential interest will be housed within the proposed building itself. It is understood that there are to be no other fans or heat exchange units located at the building façade.

Figure 10 Showing the location of the proposed plant room



The manufacturer sound level specification for the refrigeration units state that the sound pressure level of each should be around 70dB at 10m. The understanding is that the compressor enclosure has been designed to attain a sound pressure level of around 30dB at 10m.

It is not expected for any other fixed plant to have any influential sound characteristics.

7.5 Applying values for vehicles accessing the proposed facility

With regards to the expected increase in heavy vehicles using the site, this report has calculated a single 'action' of visiting the facility as having a sound level of 81.6dB lasting for approximately 5 minutes. As also stated above it is expected for there to be 81 movements each day-time, and 4 movements each night-time. The accumulative time for each therefore, being 405 minutes throughout the day-time and 20 minutes throughout the night-time.

Through reference to the aforementioned previous assessment report it has been measured that the general sound level at the AD plant - which is adjacent to the proposed new facility, and at a similar distance to the nearest receptor - was 63.2dB during the day-time and 62.4dB during the night-time.

As a consequence, it may be presumed that the sound levels at the proposed facility associated with expected vehicle movement will correspond to the following:

- Day-time: 6.75 hours @ 81.6dB and 11.25 hours @ 63.2dB
- Night-time: 0.3 hours @ 81.6dB and 7.7 hours @ 62.4dB

In order to obtain the equivalent continuous sound level for each period the following can be used:

$$L_{Aeq,T} = 10\log \left[\frac{(t_1 10^{L_1/10} + t_2 10^{L_2/10})}{T} \right]$$

Where:

For the day-time calculation - t_1 is 24300 seconds, t_2 is 40500 seconds and T = 64800 seconds. L_1 is 81.6dB and L_2 is 63.2dB.

For the night-time calculation - t_1 is 1200 seconds, t_2 is 27600 seconds and T = 28800 seconds. L_1 is 81.6dB and L_2 is 62.4dB.

The corresponding equivalent continuous sound levels are:

Day-time $L_{Aeq,T} = \underline{77.4dB}$

Night-time $L_{Aeq,T} = \underline{68.8dB}$

7.6 Applying values for the loading and unloading vehicles

With regards to the sound generated during loading and unloading of the vehicles the reported value of 88.8dB(A) can be used.

In doing so it should be noted that for the purpose of assessing any influence at the nearest receptor this will in actuality be an unrealistic value. This is because the loading and unloading of vehicles will be occurring at the rear of the building (western façade) whereupon the building itself will act as a very effective barrier in preventing this sound from reaching the nearest receptor. Despite this, the uninfluenced stated level of 88.8dB will still be used in order to demonstrate a worst-case situation.

7.7 Applying values from proposed new plant

With regards to the sound generated from new plant to be introduced at the site, in order to standardise the assessment the above sound power level of 70dB has been re-calculated to represent the sound power level corresponding to two units at a distance of 1m.

Using the following:

$$L_2 = L_1 - 20\log(r_2/r_1)$$

Where: L_1 is the sound level measurement at 10m of 70dB(A), r_1 is 10m and r_2 is 1m; hence:

$$L_2 = 70 - 20\log(0.1) = \underline{90\text{dB(A)}} \text{ per refrigeration unit}$$

Using the following:

$$L_{\text{Aeq.}} = 10\log(10^{L_1/10} + 10^{L_2/10})$$

Where: L_1 and L_2 are the sound power levels of the refrigeration plant at 1m or 90dB each, hence:

$$L_{\text{Aeq.}} = 10\log(10^{9.0} + 10^{9.0}) = \underline{93\text{dB(A)}}$$

For the purpose of this assessment therefore, the sound level emanating from the plant room in total is presumed to be 93dB(A).

7.8 Applying sound levels from the pre-existing site activity

Fourthly, the findings from the aforementioned previously undertaken assessment can be used to represent the general sound levels due to existing activity occurring at the site.

In doing so, it has been reported that the day-time sound level at the site, expressed as the $L_{(A)eq(14\text{-hours})}$ was 63.2dB, and the night-time level expressed as the $L_{(A)eq(8\text{-hours})}$ was 62.4dB.

The levels previously obtained from the lorry yard area were lower than these values, and therefore the higher values from the area of the AD plant will be used in order to present a worst-case situation.

8 Determination of sound influence at the receptor

8.1 Calculation of the overall site sound level

This report has identified four sources of sound with the potential to influence the nearest off-site receptor, as stated above, these are:

- the loading and unloading of vehicles at the proposed facility;
- the associated vehicle movements visiting the proposed facility;
- the new plant being introduced at the proposed facility (i.e. refrigeration); and
- the existing activity occurring on the site.

Section 7 above has aimed to justify the use of specified sound pressure levels relating to each of these sources for the purpose of evaluating the overall sound emanating from the site once the proposed new food production facility is in place, and in use. The values to be used have been summarised below in Table 4. In order to standardise and simplify the assessment all sound levels have been calculated back to location of the building, and quoted as sound pressure levels at 1m.

In actuality the sound sources will originate from different positions within the general location of the proposed building, however in view of the great distance to the nearest receptor it is believed that these variables are negligible for the purposes of the calculation.

Despite, in order to address this variation, the calculations below have assessed the sound influence using two source locations. The first of these is the eastern façade of the proposed building - at a distance of 320m from the nearest receptor façade, and the second is the easternmost point on the access drive leading to the building at a distance of 260m from the nearest receptor.

Table 4 Source sound level readings to be used

	$L_{(A)eq}$ (dB)	$L_{(A)eq}$ (dB)
	Day-time	Night-time
Lorries loading and unloading	88.8	88.8
Lorries using the proposed access driveway	77.4	68.8
Fixed plant in use on-site	93.0	93.0
Existing sound levels at the site	63.2	62.4

Using the above values, the overall sound level can be calculated using the following:

$$L_{Aeq.} = 10\log (10^{L_1/10} + 10^{L_2/10} + 10^{L_3/10} + 10^{L_4/10})$$

Where: L_1 is the mean sound level from the loading and unloading of lorries, L_2 is sound level from lorries using the access driveway, L_3 is the expected sound level from the use of plant, and L_4 is the existing site mean sound level.

Hence for the day-time:

$$L_{Aeq.} = 10\log (10^{8.88} + 10^{7.74} + 10^{9.3} + 10^{6.32}) = \underline{94.4dB(A)}$$

Hence for the night-time:

$$L_{Aeq.} = 10\log (10^{8.88} + 10^{6.88} + 10^{9.3} + 10^{6.24}) = \underline{94.4dB(A)}$$

As shown, due to the over-riding characteristics of the proposed plant sound - which is presumed to occur 24 hours per day - the day-time and night-time sound levels have been calculated to be identical.

The calculated value of 94.4dB has therefore effectively been considered to be the sound power level of the entire site in the vicinity of the proposed building.

8.2 Determining the influence of the overall site sound level on the nearest receptor

In order to determine the effect that this calculated level of sound may have on the receptor, two scenarios are used.

As discussed above, the first of these considers a situation where the calculated source sound emanates from a position at the façade of the proposed new building, whereas the second considers a situation where the calculated source sound emanates from a position on the access driveway at the closest point to the nearest receptor.

In considering the first of these, the source sound is positioned at a distance of 320m from the nearest receptor, and for the second scenario the sound source is positioned at a distance of 250m from the receptor.

The intervening ground surface predominantly soft landscaped. As such 'spherical' sound radiation would be expected, for which the following formula can be used to determine the extent that the sound is expected to diminish over this distance:

$$L_2 = L_1 - 20\log r - 11\text{dB}$$

Where: L_1 is the source sound level and r is the distance to the receptor; hence for the first scenario:

$$L_2 = 94.4 - 20\log(320) - 11\text{dB} = \underline{33.3\text{dB}}$$

For the second scenario:

$$L_2 = 94.4 - 20\log(250) - 11\text{dB} = \underline{35.4\text{dB}}$$

In conclusion therefore, the expected influence that the proposed site sound will have at the nearest receptor is expected to be no greater than 35.4dB.

In obtaining this value it has been considered that all the site sound will emanate from a position on the access driveway, whereas in reality the most dominant sound will be produced by the refrigeration units within the plant room, which is to be located around 370m from the nearest receptor.

As a consequence, a more representative calculation is considered to be:

$$L_2 = 94.4 - 20\log(370) - 11\text{dB} = \underline{32.0\text{dB}}$$

This assessment has therefore emerged with three sound level possibilities at the nearest receptor: 35.4dB, 33.3dB and 32.0dB. Considering however the potential inaccuracies that lie within the presumptions made, it may be prudent to work with the highest of these values for this assessment.

The background sound levels at the nearest receptor, as measured previously, (and reported above in Table 1), were as follows:

- day-time level measured as the $L_{(A)90}$ (15-minutes) = 47.0dB
- night-time level measured as the $L_{(A)90}$ (30-minutes) = 35.2dB

In considering these values, it is concluded that a sound level of 35.4dB at the receptor emanating from the proposed facility will have negligible influence on the existing background day-time sound level of 47dB or night-time background sound level of 35.2dB. This can be shown by means of adding the existing and expected two values together.

Hence:

$$\text{Day-time } L_{Aeq} = 10\log (10^{4.7} + 10^{3.54}) = \underline{47.3\text{dB}}$$

$$\text{Night-time } L_{Aeq} = 10\log (10^{3.52} + 10^{3.54}) = \underline{38.3\text{dB}}$$

In order to quantify the effect that this marginal increase in existing background levels may have at the receptor, reference can be made to BS8233:2014 (Guidance on sound insulation and noise reduction for buildings).

The standard states that for reasonable resting conditions, the sound level within a living room should not exceed 30dB (expressed as the $L_{(A)eq}$) for a 'good' standard of living, or 40dB for a 'reasonable' standard of living. Whereas for a bedroom it should not exceed 30dB (expressed as the $L_{(A)eq}$) for a 'good' standard of sleeping, or 35dB for a 'reasonable' standard of sleeping.

As shown above, this assessment has suggested that the sound level at the receptor façade during the day-time would be 47.3dB, whereas at the night-time it would be 38.3dB.

It is generally accepted that a partially open double-glazed window will reduce the external façade sound level internally by 10dB or greater; hence it is not unreasonable to suggest that an internal day-time sound level of around 37dB should be readily achievable, and a night-time sound level of around 28dB in this instance.

8.3 Uncertainties

In undertaking sound level measurements for this assessment a number of uncertainties are potentially present, although in all instances efforts are made to minimise or eliminate such.

More specifically, in the first specific instance, although efforts were made to measure in 'free space' this was not entirely possible within the lorry yard. As such there was likely to be some degree of influence from the high metal surfaces around the yard perimeter, such that the corresponding readings reproduced may well have been over-reported due to reflective effects. In view of the fact that these source sound pressure levels are being used to determine off-site levels mathematically this will presumably provide a worst-case receptor exposure outcome.

Secondly, the nature of the activities occurring at each of the source locations has some degree of variability. A presumption can be made that measurement was performed under typical working conditions; otherwise it must be considered that the findings are viewed with an appropriate degree of caution. It is however considered likely that the source sound level would have to increase greatly to affect the nearest off-site receptor due to the large distance from the identified sources.

Thirdly, again in view of the comparatively large distance between the sources and receptor, influence from the weather can often be significant. Consequently the sound exposure level at the façade of the receptor can potentially be highly variable. In this specific instance when the measurements were obtained at the receptor the wind was reported to have been blowing towards the receptor, during the day-time thereby once again presumably providing a worst-case outcome. There was no wind during the night-time measurement period.

Fourthly, with regards to the determination of the likely sound levels at the proposal site, a number of presumptions have been made. These include the following:

- the precise location of each source sound;
- the number of vehicle movements expected;
- the precise day-time and night-time contribution from each sound source;
- the sound power rating of the proposed fixed plant.

In view of these presumptions the potential exists for the sound levels quoted to have been under-estimated, however in actuality the likelihood is that they have in fact been over-estimated due to the fact that this report has not been able to quantify any influential aspects of the proposed development building infrastructure itself.

More specifically this includes the fact that the proposed facility will screen all loading and unloading noise from the nearest receptor due to this occurring at the northern façade of the building. Secondly, part of the route taken by lorries visiting the facility will be along the northern façade as they prepare to gain access for loading and unloading. Throughout this time these too will be screened from the nearest receptor. As a result, the time during which lorry noise is likely to be audible at the measurement point could be considerably shorter than that which has been used for the corresponding sound level calculations.

Thirdly, and possibly most significantly, it is proposed to construct a large glasshouse building on the area of land to the immediate east of the new vehicle access driveway. In the absence of this structure it has been concluded that the expected sound levels from the new facility should not affect the nearest receptor, however, once this glasshouse is present not only should it reduce any sound exposure even further, but it should also act as a safeguard against any random or unanticipated sounds occurring on-site.

9 Summary

This report has made a calculation of the sound levels expected at the proposed new food production facility on this site in order to determine the likely influence that these may have at the façade of the nearest receptor.

In doing so, this report has identified four main sources of sound, for which an accumulative sound level of 94.4dB has been calculated. There is expected to be no difference between the day-time accumulative level and the night-time accumulative level due to the fact that the refrigeration plant sound is expected to be dominant.

In order to calculate this sound level a number of presumptions have been made, which have been discussed within the report. These may well contain some inaccuracies, however overall it is expected that the above stated sound level may well be overestimating the situation due in part to the fact that there will eventually be a potentially significant barrier effect created by a proposed 32000m² glasshouse structure situated midway between the source sound and receptor.

The overall findings of this assessment are that a source sound level of 94.4dB should have a resultant sound level at the receptor façade of around 35dB.

As such, considering the previously measured background levels at the nearest receptor, this assessment has suggested that the resultant day-time sound levels at the façade of this dwelling would be marginally above the existing levels, at 47.3dB and 38.3dB. This corresponds to an increase of less than 1dB on the existing day-time levels and around 3dB on the existing night-time levels.

Despite this level of increase, it is still expected that a good standard of living and sleeping could still be readily achievable under normal circumstances within the dwelling, even with a partially open window.

In reaching this conclusion, it is still quite possible that activities could occur on the site in such a manner that could result in an adverse effect at each of the receptors. Typically, amongst other things these could correspond to maintenance work, accidents, or generally thoughtless 'noisy' actions. It can therefore only be recommended that procedures and measures are put in place to minimise any such unplanned 'noisy' actions occurring, and similarly to fully consider the effects of sound propagation during the undertaking of planned activities.

APPENDIX

Calibration certification

Certificate of Calibration



Equipment Details

Instrument Manufacturer Cirrus Research plc
Instrument Type CR:171B
Description Sound Level Meter
Serial Number G068537

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards (A.0.6). The standards are:

Microphone Type	B&K 4192	Serial Number	1920791	Calibration Ref.	S6450
Pistonphone Type	B&K 4220	Serial Number	613843	Calibration Ref.	S6388

Calibrated by

Calibration Date

Calibration Certificate Number

15 July 2015

230166

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH

Conditions of Tests:

Barometric Pressure 1011 mBar
Relative Humidity 33 %
Temperature 24 °C

Signature: P1.77 Date: 10/07/2015

Cirrus Research plc
Acoustic House, Hummerby YO14 0PH UK
www.cirrusresearch.co.uk

Specifications:

Outside Diameter:

13.2mm with protecting grid
12.7mm without protecting grid

Mounting Thread:

11.7mm Ø0.1UKS 2

Ambient Pressure Coefficient:

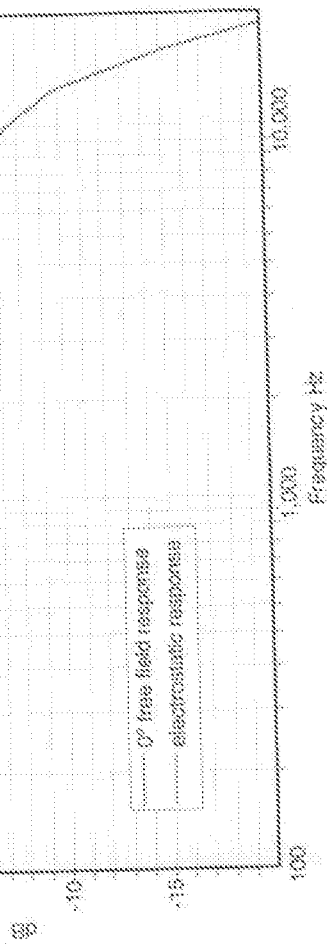
-0.02 to +0.02 dB/kPa for
±10% pressure change at 250Hz

Temperature Coefficient:

-10°C to +50°C
Approx. -0.013dB/% at 250Hz

Dynamic Range:

50% below which total harmonic
distortion is <1%: 130dB



Certificate of Calibration



Equipment Details

Instrument Manufacturer Cirrus Research plc
Instrument Type CR:171B
Description Sound Level Meter
Serial Number G068504

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards (A.0.6). The standards are:

Microphone Type	B&K 4192	Serial Number	1920791	Calibration Ref.	S6450
Pistonphone Type	B&K 4220	Serial Number	613843	Calibration Ref.	S6388

Calibrated by

M. BERRY

Calibration Date

15 July 2015

Calibration Certificate Number

230167

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH



Conditions of Tests:

Barometric Pressure 1011 mbar

Relative Humidity 33 %

Temperature 25 °C

Signature: *h. h.* Date: 10/07/2015

Cirrus Research plc

Acoustic House, Hummerby YO14 0PH UK

www.cirrusresearch.co.uk

Specifications:

Outside Diameter:

13.5mm with protecting grid

12.7mm without protecting grid

Mounting Thread:

11.7mm 60 UNF 2

Ambient Pressure Coefficient:

-0.02 to +0.02 dB/kPa for

±10% pressure change at 250Hz

Temperature Coefficient:

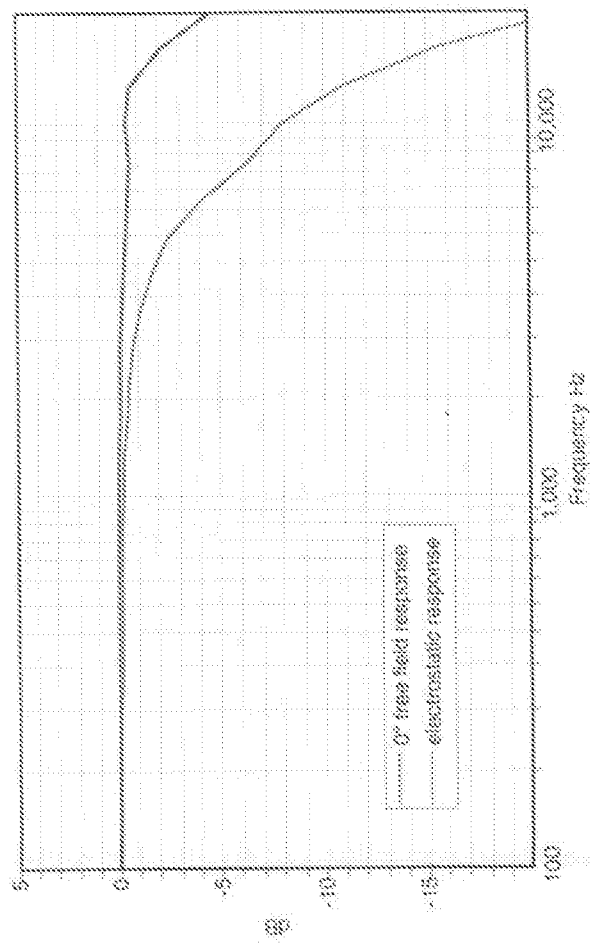
-10°C to +50°C

Approx. -0.015dB/A at 250Hz

Dynamic Range:

SPL below which total harmonic

distortion is <1%: 130dB



Certificate of Calibration



Certificate Number: 102237

Date of Issue: 15 July 2015

Instrument

Manufacturer: Cirrus Research plc

Type: Acoustic Calibrator

Model Number: CR:515

Serial Number: 70846

Calibration Procedure

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC 60942:2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

Date of Calibration: 14 July 2015

Initial Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	94.06	1000.3	0.36
2	94.07	1000.3	0.36
3	94.04	1000.3	0.36
Average	94.06	1000.3	0.36
Uncertainty	± 0.13	± 0.1	± 0.10

The reported uncertainties of measurement are expanded by a coverage factor of $k=2$, providing a 95% confidence level.

Adjusted Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	94.00	1000.3	0.36
2	94.01	1000.3	0.37
3	93.99	1000.3	0.36
Average	94.00	1000.3	0.36
Uncertainty	± 0.13	± 0.1	± 0.10

The reported uncertainties of measurement are expanded by a coverage factor of $k=2$, providing a 95% confidence level.

Cirrus Research plc, Acoustic House, Bridlington Road
Hullmanby, North Yorkshire, YO14 0PH, United Kingdom

Web: www.cirrusresearch.co.uk

UK Registration No: 987160



Environmental Conditions

Pressure: 100.96 kPa
Temperature: 23.9 °C
Humidity: 61.8 %

Evidence of Pattern Approval

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC 60942:2003 Annex A to Class 1. This has been confirmed with the Physikalisch-Technische Bundesanstalt (PTB).

Statement of Calibration

As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the Class 1 requirements of IEC 60942:2003.

Frequency (Hz)	Sound Pressure Level (dB)	Uncertainty (dB)	Reference
125	115.0	±0.5	IEC 60942:2003
250	115.0	±0.5	IEC 60942:2003
500	115.0	±0.5	IEC 60942:2003
1000	115.0	±0.5	IEC 60942:2003
2000	115.0	±0.5	IEC 60942:2003
4000	115.0	±0.5	IEC 60942:2003
8000	115.0	±0.5	IEC 60942:2003

Calibration Laboratory

Laboratory: Cirrus Research plc
Acoustic House, Bridlington Road, Hunmanby
North Yorkshire, YO14 0PH, United Kingdom

Test Engineer: Shane Doveton