Philip Dunbavin Acoustics Ltd
3 Bridgewater Court
Barsbank Lane
Lymm
WA13 0ER

ACOUSTIC CONSULTANTS

NOISE ASSESSMENT FOR ENVIRONMENT AGENCY PERMIT EPR/QP3327MG/A001

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BAKKAVOR MEALS (GREENCORE)

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Tel: 01925 759380 Email: enquiries@pdaltd.com

Registered Number 2302847 England
Registered Office: 3 Bridgewater Court, Barsbank Lane, Lymm WA13 0ER

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Client Address and Contact:	Company Address:
Dan Evans Landmark House 20 Broomgrove Road Sheffield South Yorkshire S10 2LR UK	Philip Dunbavin Acoustics Ltd 3 Bridgewater Court Barsbank Lane Lymm WA13 0ER

Issue	Date	Author	Remark	Status
01	23/10/2026	Joe Meadows BEng (Hons) AMIOA Jamie Wilson BA(Hons) MIOA	Consultant Consultant	Initial Issue
02	28/10/2026	Max de Salis PhD BEng (Hons), CEng, FIOA	Director	Second Issue

	Name	Position
Prepared By	Max de Salis PhD BEng (Hons), CEng, FIOA	Director
Checked By	Jamie Wilson BA(Hons) MIOA	Consultant

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This report has been prepared based upon a scope of works and associated resources agreed between the client and Philip Dunbavin Acoustics Ltd (PDA). This report has been prepared with all reasonable skill, care and diligence and has been based upon the interpretation of data collected. This has been accepted in good faith as being accurate and valid at the time of the collection. This report has been based solely on the specific design assumptions and criteria stated herein.

CONTENTS

1.0 SUMMARY 5
1.1 Report Overview 6
2.0 INTRODUCTION 7
3.0 SITE LAYOUT AND OPERATION 7
4.0 CRITERIA 8
4.1 Introduction 8
4.2 BS 4142:2014 + A1:2019 Methods for rating and assessing industrial and commercial sound' 8
4.2.1 Where Background Sound Levels Contain Existing Industrial Noise 10
4.2.2 Where Background Sound Levels are Low 10
4.3 BS 8233:2014 Guidance on Sound Insulation and Noise reduction for Buildings 10
4.4 WHO Guidelines for Community Noise 11
4.5 Project Specific Criteria 11
4.5.1 BS4142:2019 + A1+2019 11
4.5.2 Establishing a Representative Background Sound Level 12
4.5.3 Establishing a Representative Background Sound Level - Proxy Location 12
4.5.4 Establishing a Representative Background Sound Level – Where Background Sound Levels are "Low" 12
4.5.5 Proposed Sound Rating Level Criteria 13
5.0 PROXY SITE AMBIENT AND BACKGROUND SOUND LEVEL MEASUREMENTS 14
5.1 Fellands Gate 14
5.1.1 Site Description 14
5.1.2 Survey Times and Dates (2025) 15
5.1.3 Equipment 15
5.1.4 Measured Background and Ambient Sound Data 16
6.0 SITE SOUND LEVEL MEASUREMENTS 18
6.1 Site Operational Overview 18
6.1.1 Main Site 18
6.2 Site Visit and Sound Survey Details 19
6.3 Fixed Measurement Location 20
6.4 Sound Sources and Spot Measurement Positions 22
7.0 SOUND EMISSION MODELLING 23
7.1 Fixed Plant Items – Sound Emission Modelling 23
7.2 Vehicular Sound Sources 23
7.2.1 Main Vehicle Route 24
7.2.2 Truck Mounted Refrigeration Units 24
7.3 SoundPLAN Model 25
7.4 SoundPLAN Model Results 26
7.5 BS4142 Results 26
8.0 MITIGATION REQCOMMENDATIONS 27
8.1 Recommendations 27
8.2 Best Available Techniques 28
9.0 UNCERTAINTY 29
9.1 Uncertainty in Measurements 29
9.2 Uncertainty in Sound Power Levels 29
9.3 Uncertainty in Calculation Method 29

APPENDICES

APPENDIX A – DEFINITION OF ACOUSTIC TERMS

APPENDIX B – TABLE OF SPOT MEASUREMENTS

APPENDIX C – LOCATIONS OF SPOT MEASUREMENTS

APPENDIX D – SPOT MEASUREMENT ONE THIRD OCTAVE DATA

1.0 SUMMARY

At the request of EHS Projects a noise impact assessment has been undertaken with respect to closest receivers to the 24 hour operating facility at Bakkavor Meals (Greencore). The assessment has been commissioned to give an understanding of the current noise emissions from the site compared to typical target noise emission levels.

Our assessment has determined that, based on the company applying all practical mitigation treatments to achieve Best Practical Means / Best Available Techniques approach, and taking account of the context of the site and its standing and acoustic perception (or lack of) within the surrounding community, then the following target criteria would appear to be the most reasonable and practical target criterion for controlling noise emissions from the site:

- A noise rating level less than 10dB above representative background noise levels during the day-time, thus equating to a limit of 43 dB(A) $L_{Ar,T,r.}$
- The World Health Organisation recommendation of 45 dBA $L_{eq,T}$ outside local residential windows at night.

By achieving the above, it would achieve objectively acceptable noise emission levels whilst reflecting the fact that the site is, by necessity, a 24 hour operation

To achieve noise emission levels in the region of the above the following noise control treatments have been targeted by utilising the detailed outputs from a noise mapping model of the noise sources at site.

1. Truck Mounted Refrigerated Units – hooked up on to electric power when waiting on site will give circa 10 dBA reduction.

After application of the above mitigation schedule then the following might be considered as being true:

- all *practical* mitigation options had been exhausted,
- subsequent to the said mitigation there was unlikely to be a tangible character to the sound emission or intermittency
- there will be a significant reduction in noise levels compared to the existing scenario amounting to in the region of a minimum of 5dB at the least in all cases, therefore achieving in the region of a halving of loudness of more.

All residential receivers would be predicted to achieve the 45 dBA L_{eq} WHO recommended level at night

All receivers would be predicted to achieve the lower limit for daytime external noise set out in WHO Guidelines for Community Noise External Noise Criteria of 50 dB.

In addition the site will make a commitment to continue to strive to reduce noise emissions by adhering to a detailed noise management plan which will be updated in light of the findings of this current assessment.

1.1 Report Overview

Section 3 details the site location and the nearest noise sensitive receivers (NNSRs).

Section 4 outlines the assessment criteria and methodology from BS4142:2014+A1:2019 “Methods for rating and assessing industrial and commercial sound” and other standards as typically required by the Environmental Agency for use in the noise impact assessment.

Section 5 gives details of the Background and Ambient Sound Level Survey undertaken at 1no. proxy location away from the site.

Section 6 gives details of the site noise survey including long term measurements at locations close to the site perimeter and short term measurements to characterise noise emissions from individual plant items in more detail.

Section 7 gives details of the SoundPLAN 9.1 noise mapping model of the existing and proposed operations at site calibrated to measured sound level data and gives a noise impact assessment BS4142:2014+A1:2019 guidelines.

Section 8 gives details of potential mitigation options that could be described as being within Best Practical Means / Best Available Techniques. The section still indicates adverse impacts based on BS4142 assessment methodology, but goes on to discuss contextual mitigating circumstances and indicates that absolute sound levels at closest sensitive receivers with mitigation in place can be argued as being within acceptable threshold limits based on other guidance. Section 9 also includes an assessment of low frequency noise impacts based on NANR45 *“Procedure for the assessment of low frequency noise complaints”* and indicates that the modification proposals will have a low impact in this context.

Section 9 details uncertainties associated with the assessment process and how they have been overcome or minimised.

2.0 INTRODUCTION

Bakkavor Meals (Greencore), Old Leake, have requested a noise assessment to be undertaken to give an understanding of the current noise emissions at the site. The assessment has been undertaken to the requirements of BS4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'. The investigation also includes for measurement of background sound at 1no. proxy location away from the site to allow for comparison of site noise with background sound at a location unfettered by noise from the facility.

The noise impact assessment and reporting is in accordance with Environmental Agency (EA) online guidance as follows:

- Noise and vibration management: environmental permits - GOV.UK
- Method implementation document (MID) for BS 4142 - GOV.UK
- Noise impact assessments involving calculations or modelling - GOV.UK
- Pre application advice for Noise Impact Assessments.

The following sections set out the investigation and detail recommendations for mitigation where required.

3.0 SITE LAYOUT AND OPERATION

The location of the facility is shown in Figure 1 below, along with the nearest noise sensitive receivers (NNSRs) in Figure 1 and Table 1.

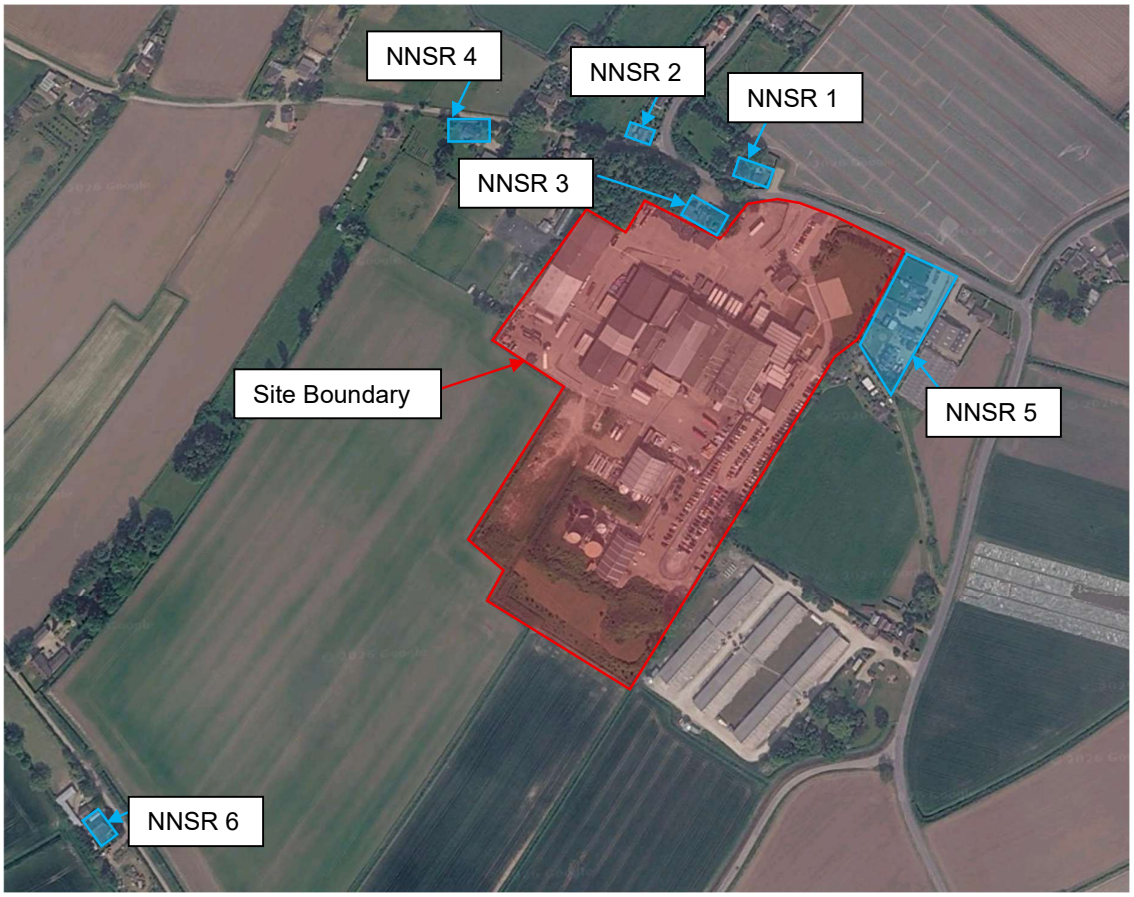


Figure 1: Site Layout showing site layout and Nearest Noise Sensitive Receiver (NNSR) Locations (Google Earth)

Table 1: NNSR Descriptions

NNSR	Description
1	Residential Dwellings off Chapel Road
2	Residential Dwelling off Fellands Gate
3	Residential Dwelling off Chapel Road (presumed unoccupied/derelict)
4	Residential Dwelling off Fellands Gate
5	Residential Dwellings off Chapel Road
6	Residential Dwellings off Cowbroads Lane

4.0 CRITERIA

4.1 Introduction

Assessment is to be undertaken to BS4142:2014+A1:2019 (see below) as per industry standard and Environment Agency requirements.

4.2 BS 4142:2014 + A1:2019 Methods for rating and assessing industrial and commercial sound'

The standard describes a method of determining the level of sound of a commercial nature, together with procedures for assessing the impact of such a sound outside nearby noise sensitive areas.

The standard may be thought of as a procedure for comparing the sound from commercial sources with background sound levels in the absence of the comercial sound and determining the likely impact of the sound on noise sensitive residences.

In accordance with BS 4142 the background sound level is the typical A-weighted sound pressure level at the assessment position that is exceeded for 90% of a given time interval (L_{A90}). The specific sound level is the equivalent continuous (L_{Aeq}) sound pressure level at the assessment position produced by the commercial source over a given time interval.

Certain acoustic features can increase the impact over that expected from a simple comparison between the specific sound level and the background level. Where such features are present, these are taken into account by adding corrections to the specific sound level.

This correction is applied based on whether the following features occur, or are expected to be present. The correction values can either be determined subjectively, or by various objective measurement procedures.

- The sound contains a distinguishable, discrete, continuous tone (whine, hiss, screech, hum, etc.). 0 – 6 dB penalty
- The sound contains distinct impulses (bangs, clicks, clatters, or thumps). 0 – 9 dB penalty.
- The sound is irregular enough to attract attention. 0 – 3 dB penalty.
- Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

From the addition of the above penalties where appropriate the rating level is established, this being the value that is compared with the background sound. Note that corrections for impulsivity and tonality may be added arithmetically where both are present and likely to affect perception within the same reference period. However, if any single feature is dominant to the exclusion of the others then it might be appropriate to apply a reduced or even zero correction for the minor charcteristics.

According to BS 4142 an initial estimate of the impact is given based on the rating level value as follows:

- a rating level 10 dB(A) or more above the background is an indication of significant adverse impact, depending on the context.
- a rating level 5 dB(A) above the background is an indication of an adverse impact, depending on the context.
- where the rating level does not exceed the background level, this is an indication of the specific sound source having a low impact, depending on the context.

BS4142 indicates that the noise source should be evaluated over the appropriate time interval which is as follows:

- 1h during the day (07:00 – 23:00 hours)
- 15 min during the night (23:00 – 07:00 hours)

The above initial assessment may then be modified depending on the context, to take into account;

- The absolute level of the sound.
- The character and level of the residual sound compared to the character and level of the specific sound.

- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:
    1. Façade insulation treatment
    2. Ventilation and / or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and
    3. Acoustic screening

4.2.1 Where Background Sound Levels Contain Existing Industrial Noise

Section 8.1 of BS4142:2014 states that

> *"….it is necessary to understand that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds…."*

4.2.2 Where Background Sound Levels are Low

It is additionally noted that BS4142 Section 11 states that:

> *"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night".*

It is noted that the previous incarnation of BS4142, i.e. BS4142:1997 – 'Method for rating industrial noise affecting mixed residential and industrial areas' also noted limitations where background noise levels are low and stated that

> *"The method is not suitable for assessing the noise measured inside buildings or when background and rating noise levels are both very low.*
>
> *NOTE. For the purposes of this standard, background noise levels below 30dB and rating levels below about 35dB are considered low."*

4.3 BS 8233:2014 Guidance on Sound Insulation and Noise reduction for Buildings

Dwelling houses, flats and rooms in residential use

British Standard 8233:2014, Guidance on Sound Insulation and noise reduction for buildings, gives guidance on internal noise levels within dwellings, flats and rooms in residential use when unoccupied. The following criteria are for Living and Dining Rooms for daytime use and Bedrooms for night time.

Table 2: BS 8233 Recommended Indoor Ambient Noise Levels

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 $L_{Aeq,16hour}$	–
Dining	Dining room/area	40 $L_{Aeq,16hour}$	–
Sleeping (daytime resting)	Bedrooms	35 $L_{Aeq,16hour}$	30 $L_{Aeq,8hour}$

It should however be stressed that the above criterion relates to steady noise excluding unusual noise events departing from the typical noise character of the area.

With regard to gardens and external areas, BS 8233:2014 (Section 7.7.3.2) gives the following advice:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50dB $L_{Aeq,T,}$ with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

4.4 WHO Guidelines for Community Noise

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following noise levels are applicable to dwellings.

Internal Spaces Noise Criteria

Table 3: WHO Guidelines for Community Noise Internal Noise Criteria

Specific Environment	Critical Health Effect(s)	L_{Aeq} dB	Time Base (hours) *
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16
Inside bedrooms	Sleep disturbance, night-time	30	8

* Typically taken to be daytime/evening - 07:00 – 23:00 hours and night time 23:00 – 07:00 hours.

In addition to the above continuous equivalent noise levels, WHO guidelines indicates that exceedances of 45 dB L_{Amax} for single sound events should be limited to no more than 10 – 15 times per night, when measured with a 'fast' time weighting.

External Spaces Noise Criteria

Table 4: WHO Guidelines for Community Noise External Noise Criteria

Specific Environment	Critical Health Effect(s)	L_{Aeq} dB	Time Base (hours)*
Outdoor living area	Serious annoyance, daytime and evening	55	16
	Moderate annoyance, daytime and evening	50	16
Outside Bedrooms	Sleep disturbance, window open (outdoor values) night time	45	8

* Typically taken to be daytime/evening - 07:00 – 23:00 hours, and night time 23:00 – 07:00 hours.

WHO guidelines state, 'To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}.'

4.5 Project Specific Criteria

4.5.1 BS4142:2019 + A1+2019

Project specific noise criteria for a site can be complex to decide upon and will often depend on contextual factors.

The most common document used by UK Regulators for determining baseline noise criteria for industrial emissions is BS4142:2014 + A1:2019 as referenced in Section 4.2 .

With regard to BS4142, then in the event that a long standing facility such as Greencore is working to Best Available Techniques in terms of noise control, then based on our previous experience regulators tend to allow for noise emission limits such that the rating noise level from the facility $L_{A,r}$ does not exceed the existing background noise level L_{A90} by more than 10dB. This satisfies the clause in BS4142 regarding a rating sound level being below a level where a significant adverse impact would be expected, depending on the context, but also recognises that Best Available Techniques are being used to mitigate noise as much as is practicable and that the proposed modifications to the plant reflect this approach.

4.5.2 Establishing a Representative Background Sound Level

To establish the said criterion from BS4142 in the previous section then a representative background sound level (the residual sound level being the sound level exceeded 90% of the time) needs to be established for the noise exposed receivers around the site.

With regard to the background sound measured at receivers close to the site, site observation indicates that this is entirely composed of sound contributions by from the site itself. However, BS4142 (see Section 4.2.1 above) indicates that *"….it is necessary to understand that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds….".*

4.5.3 Establishing a Representative Background Sound Level - Proxy Location

In light of the discussion in previous section, then clearly using background sound levels at local receivers that are dominated by site noise to establish limits can cause significant creep to levels that are unacceptable in absolute terms.

Regulatory bodies therefore generally like to see a background noise survey at a similar location to plant but without the influence of noise from the plant and our survey to this end presented in section 5.1.4 indicates a background noise level of 34 dBA L_{90} at the proxy Location during both the day-time and the night-time.

4.5.4 Establishing a Representative Background Sound Level – Where Background Sound Levels are "Low"

As detailed above, the suggested noise limit from the previous section is low and would be impractical to try and achieve and the noise control required to achieve it would go beyond what can be considered as "Best Available Techniques".

The reason that the derived limit in the previous section is so low is because the rural background noise level at night is very low. BS4142 Section 11 states that:

> *"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night".*

It is noted that the previous incarnation of BS4142, i.e. BS4142:1997 – 'Method for rating industrial noise affecting mixed residential and industrial areas' raises these limitations where background noise levels are low and states that:

> *"The method is not suitable for assessing the noise measured inside buildings or when background and rating noise levels are both very low.*
>
> *NOTE. For the purposes of this standard, background noise levels below 30dB and rating levels below about 35dB are considered low."*

As such in our opinion, noting the comments in the current incarnation of the standard, and noting the context of the current site where background noise levels are currently equal to or 10dB above those at the proxy location, then it seems reasonable to retain a lower threshold of background noise level for assessment of 30 dB L_{A90} as indicated in the 1997 edition of BS4142.

4.5.5 Proposed Sound Rating Level Criteria

Night-time Limit (Residential)

The night-time limit could be derived from the existing measured proxy location background sound level of 34dB L_{A90} which would give a noise rating level limit of 43 dB $L_{A,r}$ for the proxy location to be below a level from BS4142 where complaints would be likely on an objective basis.

Proposed Noise Limit (Residential)

The daytime limit could be derived from the existing measured proxy location background sound level of 34 dB L_{A90} for the proxy location in section 5.1.4 which would also give a noise rating level limit of 43 dB $L_{A,r}$ for the proxy.

5.0 PROXY SITE AMBIENT AND BACKGROUND SOUND LEVEL MEASUREMENTS

For comparison a background sound level (L_{A90}) was determined at 1no. proxy location in the absence of noise from the facility for comparison with emitted sound levels from Greencore to facilitate an initial comparative BS4142 assessment.

5.1 Fellands Gate

5.1.1 Site Description

The site chosen was located off Fellands Gate, Old Leake. The site was deemed to be representative of the proximity of closest receivers to the Greencore site in terms of adjacency to relevant noise sources outside of the Greencore site, but a sufficient distance away from the facility to eliminate potential contribution from sound sources from the site itself, and subjectively, on site observations suggest this was the case. The site location is shown in Figure 2 below with the sound level meter being 1km from the closest boundary of the Greencore site.



Figure 2: Location of Background Sound Level Measurement Site at Fellands Gate (Google Earth)

For the current assessment, there are two measurement parameters to determine at the site under BS4142:2014 as follows:

- The background sound level $L_{A90,T}$ for comparison to the sound level due to Greencore's operation.
- The residual sound level $L_r = L_{Aeq,T}$ which is the effective equivalent energy average sound level that would occur without the Greencore site.

5.1.2 Survey Times and Dates (2025)

The background sound measurements at Fellands Gate were conducted between 18:10 hours on 14th October 2026 and 13:30 hours on 16th October 2026. The measurement period was selected to measure several daytime and night-time background sound levels to give a good representation of the acoustic climate of the area.

5.1.3 Equipment

The background survey was conducted using the following equipment.

Table 5: Equipment List for Background Sound Survey at Fellands Gate

Manufacturer	Type	Model	Serial Number	Calibration Date	Calibration Certificate Number	Calibration Lab	Date of Expiration of Calibration
NTi	Sound Level Meter	XL2	A2A-25281-E1	06/07/2026	07802/2	University of Salford	06/07/2028
NTi	Pre-amplifier	MA220	14705	06/07/2026	07802/2	University of Salford	06/07/2028
NTi	Microphone	MC230A	A14444	06/07/2026	07802/2	University of Salford	06/07/2028
RION	Calibrator	NC-75	34856998	01/07/2026	07802/1	University of Salford	01/07/2027

The sound level meters used are Class 1 as per BS EN 61672-1:2003.

The sound level meters were set up approximately 1.5m above ground level.

All measurements were undertaken in effective accordance with BS 7445 "Description and measurement of environmental sound" wherever practicable.

The sound level meters were field calibrated both before and after the survey, during which time no significant deviation from the calibrated level was observed. The sound level meter was fitted with a microphone and windshield at all times.

All measurements were undertaken with a fast time weighting. Broadband statistics were measured throughout.

Sound level measurements were taken over contiguous 15-minute periods on fast response. A range of statistical sound indicators were measured, including L_{Aeq} and L_{A90}.

5.1.4 Measured Background and Ambient Sound Data

Weather conditions varied throughout the surveying period however were generally considered conducive to undertake noise measurements.

Figure 3 below shows contiguous 15-minute period time histories of the sound data for the measurement position at Fellands Gate:

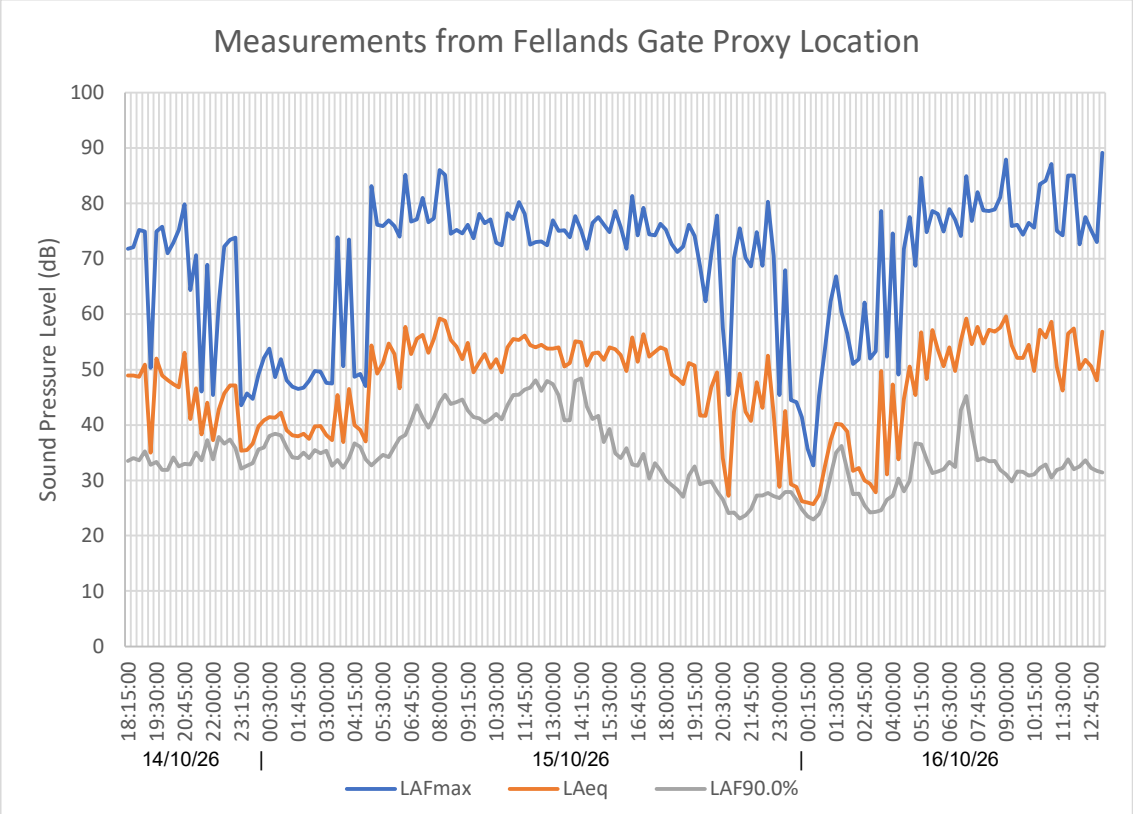


Figure 3: Contiguous 15-minute period time histories of the sound data for the measurement position at Fellands Gate

Figure 4 and Figure 5 below show a histograms of daytime and night-time L_{A90} background sound levels measured at the Fellands Gate location.

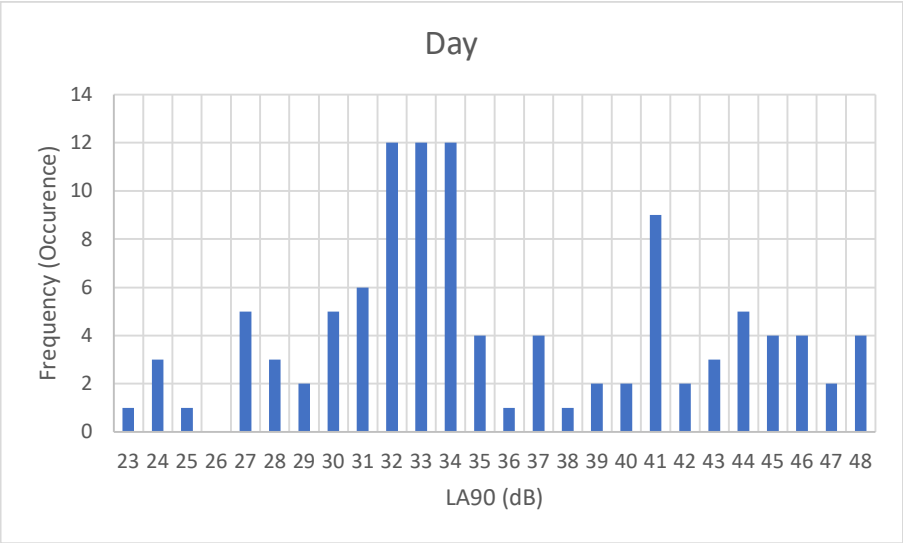


Figure 4: Histogram of daytime (0700 to 2300 hours) Background Sound Level (LA90, 15 min) [dB] at Fellands Gate

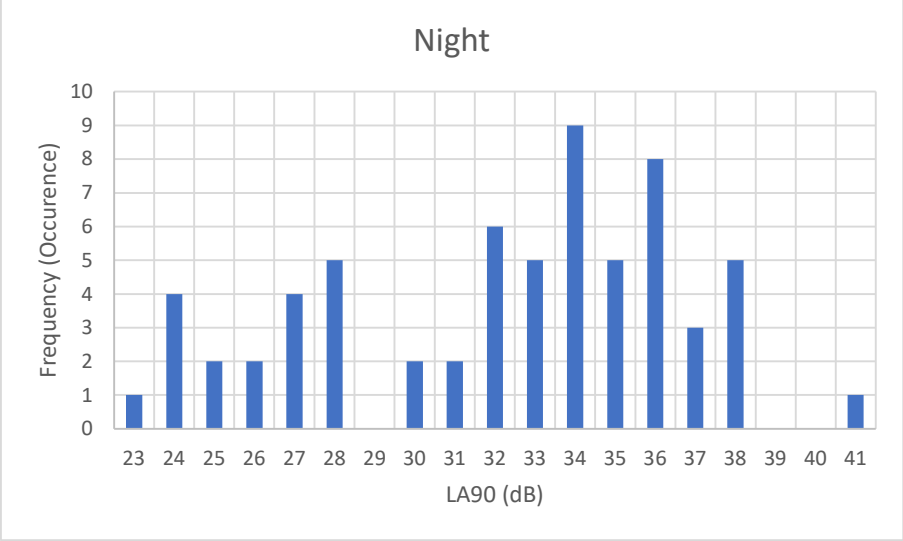


Figure 5: Histogram of night-time (0700 to 2300 hours) Background Sound Level (LA90, 15 min) [dB] at Fellands Gate

It has been determined that representative background sound levels at the measurement positions are as follows:

Table 6: Summary of Representative Background Sound Levels

Measurement Position/Location	Representative Daytime Background Sound Level L_{A90} (dB)	Representative Night-time Background Sound Level L_{A90} (dB)
Fellands Gate	34	34

6.0 SITE SOUND LEVEL MEASUREMENTS

6.1 Site Operational Overview

6.1.1 Main Site

Figure 6 below gives an outline annotated description of the main site logistics operations.

Site operation consists of HGV Wagons entering the site for deliveries to the rear of the site, these vehicles approximately follow the path of **Figure 6**. There are also various forklift activities around site with the majority located at position C.

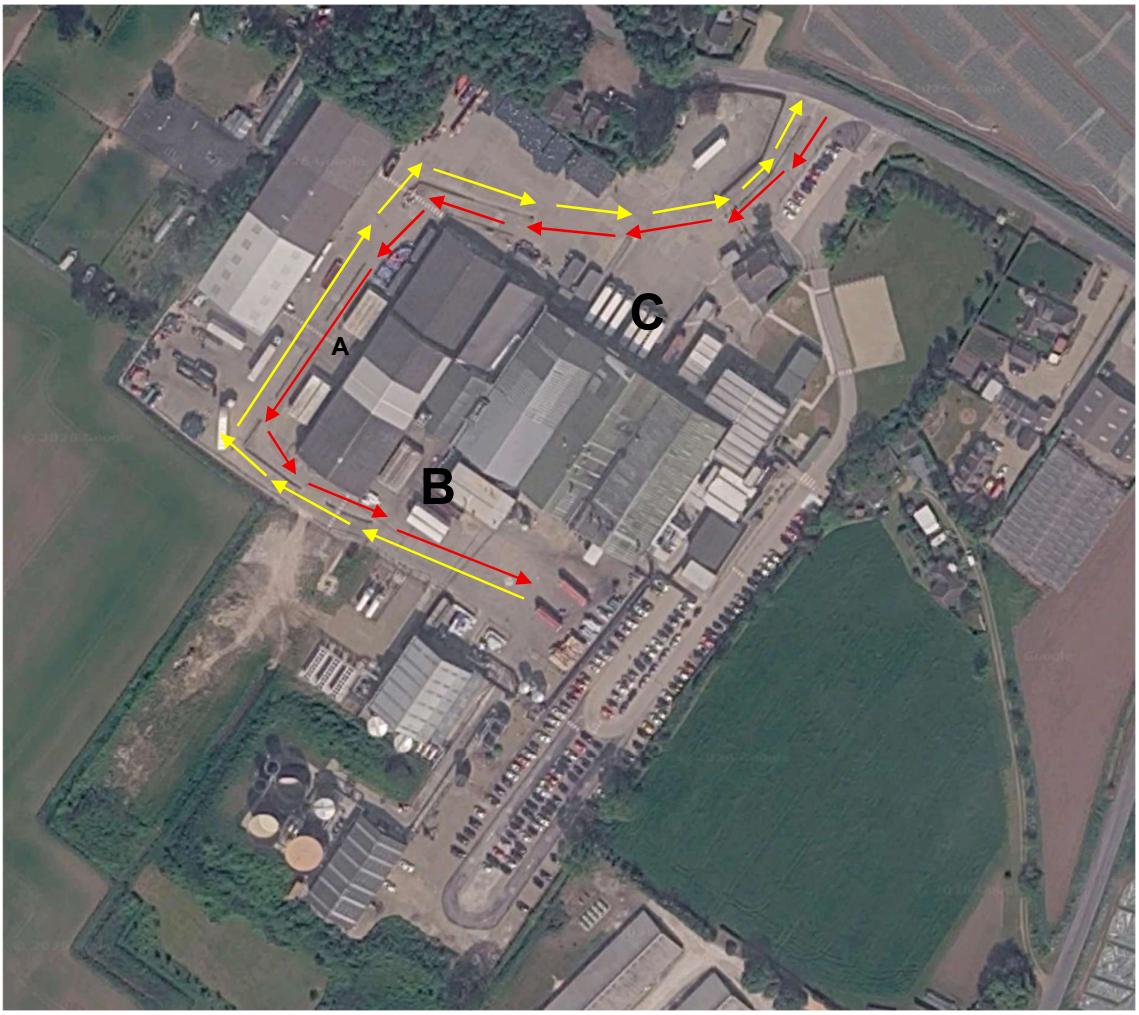


Figure 6: Main Site Layout showing site Logistic Operations

Subjectively on site, the dominating noise sources are from a combination of HGV movements and the refrigeration units in the trailer dispatch (marked C in **Figure 6**). We would note that HGV movements are largely either shielded from direct line of sight to nearby residents, or sufficiently far enough away that they are no longer a dominant source of noise. Other less significant noise sources includes contribution from various stationary plant across the development and additional contributory noise sources from forklifts movements around areas A and B in **Figure 6**.

6.2 Site Visit and Sound Survey Details

A sound survey was carried out between the hours of 16:45 on Wednesday 14th October 2026, and 13:12 on Friday 16th October 2026, to assess the external operations. All measurements were undertaken by Mr Joe Meadows and Mr Jason Craig, both of PDA Ltd.

The site sound level survey was conducted using the following sound level meters:

Table 7: Equipment List for Site Sound Survey

Manufacturer	Type	Model	Serial Number	Calibration Date	Calibration Certificate Number	Date of Expiration of Calibration	Calibration Lab
NTi	Sound Level Meter	XL2-TA	A2A-08665-E0	05/11/2025	07405/3	05/11/2027	University of Salford
NTi	Pre-amplifier	MA220	14704	05/11/2025	07405/3	05/11/2027	University of Salford
NTi	Microphone	MC230A	A28401	05/11/2025	07405/3	05/11/2027	University of Salford
RION	Calibrator	NC-75	34856999	07/09/2026	07876/1	07/09/2027	ANV
NTi	Sound Level Meter	XL2-TA	A2A-25116-E1	06/05/2026	07688/4	06/05/2028	University of Salford
NTi	Pre-amplifier	MA220	14162	06/05/2026	07688/4	06/05/2028	University of Salford
NTi	Microphone	MC230A	A26848	06/05/2026	07688/4	06/05/2028	University of Salford
Rion	Calibrator	NC75	34245621	06/05/2026	07688/3	06/05/2027	University of Salford
RION	Sound Level Meter	NL-52	810316	14/04/2026	07687/3	14/04/2028	University of Salford
RION	Pre-amplifier	NH-25	10310	14/04/2026	07687/3	14/04/2028	University of Salford
RION	Microphone	UC-59	2869	14/04/2026	07687/3	14/04/2028	University of Salford

The sound levels meters used are Class 1 as per BS EN 61672-1:2003.

6.3 Fixed Measurement Location

Fixed long term position measurements were taken at 2 locations as indicated in Figure 7 below. The fixed positions were used to give an indication of the sound climate at the nearest residential receiver and close to the boundary of the site. The measurement results were also planned to be used to help calibrate the detailed sound output model as detailed in later sections.



Figure 7: Main Site Layout showing Fixed Site Measurement Positions (Google Earth)

Overall L_{Aeq} levels day/night were 56.4/50.1 dB and 49.7/47 dB for LT1 and LT2 respectively. Contiguous 15-minute period time histories of the sound data of the fixed position sound level meters LT1 and LT2 are shown in Figures 8 and 9 below:

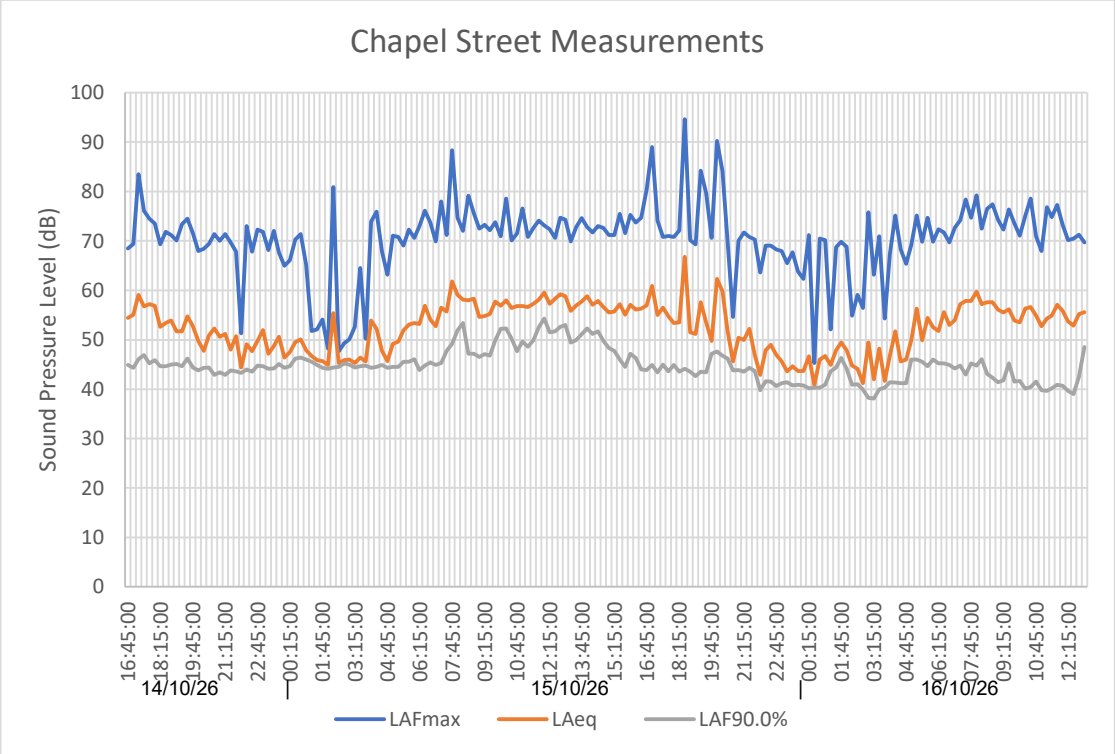


Figure 8: 15-minute sound data in fixed measurement position 1 (MP1)

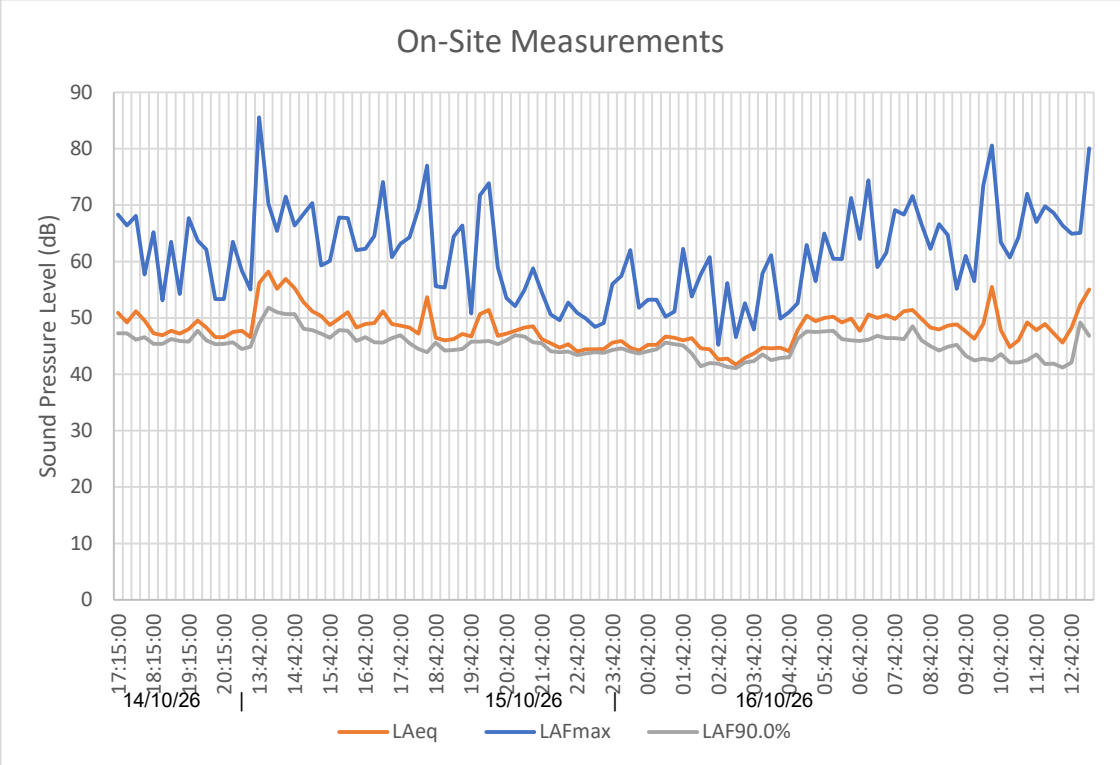


Figure 9: 15-minute sound data in fixed measurement position 2 (MP2)

6.4 Sound Sources and Spot Measurement Positions

Some of the most dominant sound sources are detailed in 6.1 above. However, a detailed survey of sound sources at site was undertaken to gauge contributions from all sources.

Appendix B gives descriptions of the sound sources being recorded at the measurement positions and the overall sound levels measured.

The location of sound measurements around the site from Appendix B is shown in Appendix C for the Main Site and the Effluent Treatment plant.

Appendix D gives the one third octave band measured sound data for the positions referenced in Appendices B and C.

7.0 SOUND EMISSION MODELLING

A 3-dimensional sound model has been created using SoundPLAN sound modelling software. The software uses the method of ISO 9613 '*Acoustics – attenuation of sound during propagation outdoors – general method of calculation'* and takes into account geometric spreading, ground effects, air attenuation, barrier attenuation and reflections.

The measured sound levels detailed in the previous sections and associated appendices were used to calibrate the model in the SoundPLAN sound mapping software. With regard to the model we note the following:

- The topographical data for the site surroundings have been sourced from DEFRA terrain height data.

- 1/1 or 1/3 octave band frequency spectra from 63 Hz to 8 kHz or 50 Hz to 10 kHz respectively were included in the model for each source based predominantly on site measurements as described elsewhere in this report.

- a ground attenuation factor of 0.1 was used for hard-standing areas, and a ground attenuation factor of 1 was used for soft ground.

7.1 Fixed Plant Items – Sound Emission Modelling

To include for sound emission from fixed plant noise sources the SoundPLAN model developed using information from measurements as detailed in section 6.4 above.

The location of sound measurements around the site is shown in Appendix C for the Main Site and the Effluent Treatment plant.

Appendix B gives descriptions of the sound sources being recorded at the measurement positions and the overall sound levels measured. Furthermore, the derived Sound Power Levels developed using the SoundPLAN model for calibration and used in the SoundPLAN model are given.

Appendix D gives the one third octave band measured sound data for the positions referenced in Appendices B and C. These one third octave band spectra were used for the sound sources in the SoundPLAN model.

7.2 Vehicular Sound Sources

For vehicular sound sources i.e. moving sound sources and vehicle mounted sound sources, PDA Ltd have a wealth of sound data from similar sites and sound sources have been modelled as below.

7.2.1 Main Vehicle Route

The main fixed plant sound sources at site are described in Sections 6.1 and 6.4 above.

In addition there are various deliveries and dispatch operations occurring at the site with the traverse routes annotated in **Figure 6** above.

Sound power calculations for truck traverses around the site calculated as follows:

$$SWL\ m^{-1} = SWL+10*\log(1/v)+10*\log(n)-10*\log(3600) \quad [1]$$

Where:

SWL is the maximum pass-by Sound Power Level for the vehicles normalized between acceleration and steady movements.

v is velocity in ms^{-1} (taken as $5ms^{-1}$ = 10mph)

(1/v) is the time taken to travel 1m, so the time associated with the single vehicle point source sound power in each meter.

n is number of vehicles per hour.

We been informed that vehicle movements vary per day, however we have been provided with an average of 13 GIST trailers which park on the front bays per day, and an addition average of 40 further HGV vehicles entering and exiting the site per day. It is understood that HGV movements to operate between the hours of 0600 and 2200, 7 days a week, with the exception of 1 HGV which is permitted to arrive outside of this timeframe.

HGV
40 no. over a 24 hour period.

For an HGV under acceleration 105.5 dB SWL has been adopted as stipulated as a maximum permitted value in EC Directive 92/97/EC. For steady HGV traffic at 10mph the maximum pass-by SWL for a number of tankers, tug units and articulated HGV units have been measured at a similar facility giving an average SWL of 101.4dBA for the Units. Based on this an average over the traverse route around site of 102.2dBA has been calculated based on 1/8 of the traverse under acceleration and 7/8 of the traverse at steady 10mph (site speed limit). Based on anecdotal evidence this is a conservative assessment as the acceleration to reach 10mph is minimal in intensity and duration.

Allowing for 3 vehicles per hour day and at 102.4 dB(A) SWL moving at circa 5 m s-1 gives an SWL m-1 of **61.6 dB(A) L_{eq}** over the traverse route shown in Figure 2.

7.2.2 Truck Mounted Refrigeration Units

With regards to trailer mounted refrigerant units, we have been informed of a daily average of 13 GIST refrigeration units, of which one was idling towards the site entrance while we were present on site. This has been modelled.

7.3 SoundPLAN Model

The SoundPLAN model is shown in Figure 10 below:

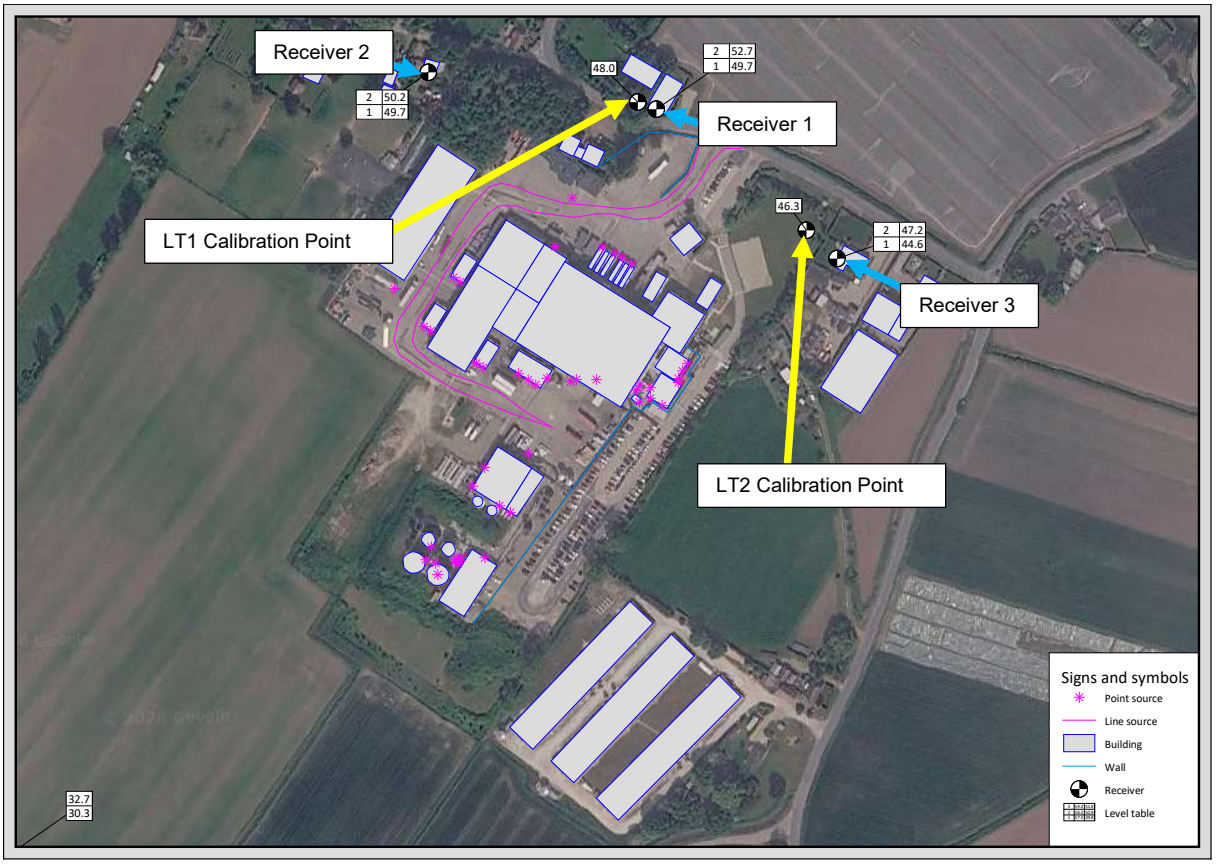


Figure 10: SoundPLAN Model of the Site

Key:
Modelled sound line source.
Modelled sound point source.
Receiver

7.4 SoundPLAN Model Results

The calculated NNSR receiver sound levels are shown in Table 4 below. Note the calibration point result for MP2 which can be compared to the sound level time history in Figure 6.

Table 6. SoundPLAN Results – Sound Pressure Levels (L_{Aeq})

NNSR Receiver	Floor level	Predicted Sound Pressure Level dB(A) L_{eq}
1 – Chapel Road (LT1)	GF	49.7
	1.FI	52.7
2 – Chapel Road	GF	49.7
	1.FI	50.2
3 – Chapel Road	GF	44.6
	1.FI	47.2
LT2	GF	30.3
	1.FI	32.7

While some level of uncertainty will be expected due to activity levels on site not remaining totally constant, it can be seen that the noise levels predicted at the calibration points of 48 dBA and 46.3 dBA for LT1 and LT2 respectively, are very close to the night-time measurements described within Section 6.3. Our model accurately calibrating to the night-time noise levels using the noise sources measured on site conservatively acts as confirmation that our measurements provide an accurate picture of the noise levels as a result of only the Greencore site, unaffected by external traffic (which will be much lower in volume and noise emission at night and will have much less effect on measured noise leels).

As such on this calibration basis the SoundPLAN model we have developed using sound power levels of plant from close proximity site measurements can be considered as producing reasonable results based on the long term site measured noise levels.

7.5 BS4142 Results

BS4142 requires character corrections to be added to the measured or predicted sound levels from industrial operations where character effects are noticeable.

Subjectively there was an intermittency to the sound at emitted from the refrigeration units. On this basis we would be of the opinion that the receivers which are dominated by refrigeration noise should have character corrections of 3dB for intermittency (as per section 9.2 of BS4142, which states: "*If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied"*) to give a sound rating level 3dB higher than the Sound Pressure Level dB L_{Aeq} value.

On the above basis the BS4142 Sound Rating Levels at the receivers are predicted as follows:

Table 7. SoundPLAN Results– Sound Rating Levels ($L_{Ar,Tr}$) dB

NNSR	Floor level	Predicted Sound Pressure Level dB(A) L_{eq}	Predicted Sound Rating Level $dBL_{Ar,Tr}$	Exceedance of $L_{Ar,Tr}$ over L_{A90} Background Sound Level (dB)	
				Daytime	Night-time
1 – Chapel Road	GF	49.7	**52.7**	**18.7**	**18.7**
	1.FI	52.7	**55.7**	**21.7**	**21.7**
2/4 – Fellands Gate	GF	49.7	**52.7**	**18.7**	**18.7**
	1.FI	50.2	**53.2**	**19.2**	**19.2**
5 – Chapel Road	GF	44.6	**47.6**	**13.6**	**13.6**
	1.FI	47.2	**50.2**	**16.2**	**16.2**
6 – Cowbroads Lane	GF	30.3	**33.3**	**-0.7**	**-0.7**
	1.FI	32.7	**35.7**	**1.7**	**1.7**

Table 7 shows indicates that for the majority of cases, the target rating levels of background sound level plus 10 are exceeded, at the worst case by up to 22 dB.

8.0 MITIGATION REQCOMMENDATIONS

8.1 Recommendations

Based on our assessment the highest noise contributors for each receiver in which the +10 dB requirement is exceeded will need to be targeted to reduce overall emissions. In terms of reductions that can be practically achieved at the dominant noise sources then the following would be recommended:

1. Truck Mounted Refrigerated Units – hooked up on to electric power when waiting on site will give circa 10 dBA reduction.

With the above reductions applied to the said dominant noise sources then, we would be of the opinion that character corrections would then not need to be applied to the site noise under the guidelines in BS4142 (both because without dominant sound noise sources being apparent then the existence of many noise sources of similar sound power tend to reduce the observable effect of sound character for individual plant items, and an electrical hook up is likely to reduce intermittency for which the penalty was applied).

As such, with the above reductions applied and the removal of character corrections as a result, the following noise rating levels are predicted using BS4142 assessment guidance:

Table 8: SoundPLAN Results– Sound Rating Levels (LAr,Tr) dB with Mitigation Applied

NNSR Receiver	Floor level	Predicted Sound Pressure Level dB(A) L_{eq}	Predicted Sound Rating Level $dBL_{Ar,Tr}$	Exceedance of $L_{Ar,Tr}$ over L_{A90} Background Sound Level (dB) at quiet proxy location	
				Daytime (34 dBL_{A90})	Night-time (34 dBL_{A90})
1 – Chapel Road	GF	41.0	41.0	**7**	**7**
	1.Fl	44.0	44.0	**10**	**10**
2/4 – Fellands Gate	GF	40.0	40.0	**6**	**6**
	1.Fl	42.9	42.9	**8.9**	**8.9**
5 – Chapel Road	GF	41.5	41.5	**7.5**	**7.5**
	1.Fl	42.3	42.3	**8.3**	**8.3**
6 – Cowbroads Lane	GF	30.0	30.0	**-4**	**-4**
	1.Fl	32.5	32.5	**-1.5**	**-1.5**

Table 8 indicates that during the derived background sound levels are exceeded by less than 10 dB during the day and night for all but one occasion when the exceedance is just equal to 10dB exceedance thus meeting or just exceeding the proposed target by the smallest incidence on one occasion.

Notwithstanding the above, external amenity areas at the residential receivers will predominantly not be used at night. As such, if it were considered that after application of mitigation the following would be true…

- all *practical* mitigation options had been exhausted,
- subsequent to the said mitigation there was unlikely to be a tangible character to the sound emission or intermittency
- there will be a significant reduction in noise levels compared to the existing scenario amounting to in the region of a minimum of 5dB at the least in all cases, therefore achieving in the region of a halving of loudness of more.

….then achieving the World Health Organisation recommendation of 45 dBA L_{eq} for "non-industrial" type noise sources at locations outside windows at night would also seem a reasonable and practical target criterion when looking at the context of the site. With regard to this criterion…

- All residential receivers would be predicted to achieve the 45 dBA L_{eq} WHO recommended level at night.

8.2 Best Available Techniques

The Environment Agency Guidance last updated 31 January 2022 regarding noise and vibration management for environmental permits indicates that operators must prevent significant pollution and also comply with the requirements to use 'appropriate measures' (Waste Framework Directive 2018/851) or 'best available techniques' (BAT) to prevent or minimise noise pollution.

The 'best available techniques' referenced above is similar to the 'Best Practicable Means' (BPM) referred to in the Environmental Protection Act 1990. In simple terms, this requires the noise-maker to operate as quietly as possible, without suffering unreasonable financial and operational restraints.

Based on the above definition the Operator could reasonably argue that operational mitigation measures such as described in section **Error! Reference source not found.** can be seen as achieving Best Practical Means / Best Available Techniques and would therefore be adequate.

9.0 UNCERTAINTY

BS4142 indicates that an assessment of noise impact should consider uncertainty within the assessment. This uncertainty can arise from: uncertainty in measurements; uncertainty in sound emission and sound power level; and uncertainty in calculation method.

9.1 Uncertainty in Measurements

It is noted that the instrumentation used for the assessment conforms to Class 1 accuracy in accordance with IEC 61672. In addition, the instrumentation has been calibrated to national standards and was field calibrated at the time of the measurements.

We would therefore consider that the effect of uncertainty on the measurement of sound would be minimal.

9.2 Uncertainty in Sound Power Levels

We would note that we have derived sound power levels of plant from on site measurements and calibration assessment for each in sound mapping software. Therefore, we would consider that the effect of uncertainty on the sound power levels will be low.

9.3 Uncertainty in Calculation Method

It should be noted that the calculation method undertaken to predict the specific sound level at the noise sensitive receivers has been undertaken in accordance with ISO 9613-2 ‘Acoustics – attenuation of sound during propagation outdoors – general method of calculation’ which is a validated method of calculation and assumes a worst-case down-wind propagation.

We would therefore consider that any uncertainty in the prediction and calculation method is unlikely to affect the outcome of the assessment.

APPENDIX A – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of sound, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB L_{Aeq}. Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous sound level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average sound level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB L_{An}. It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) L_{max}, dB L_{Amax}, etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall sound level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the sound level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.

Sound reduction index (R):

This is a measure in decibels (dB) of the sound insulation of a particular construction. It is a laboratory measured parameter independent of area, and of receiving room conditions. The sound reduction index is the value produced from laboratory tests on a construction. When tested in a laboratory, results of R are obtained over a range frequencies in 1/3rd and/or full octave bands. These may then be weighted in accordance with BS EN ISO 717: 1997: Part 1 to give the overall Weighted Sound Reduction Index R_w. Where sound reduction with respect to road traffic noise is required the frequency weighting may be adapted using the C_{tr} spectrum adaptation term. In this case the single figure value is given in terms of $R_w + C_{tr}$.

Standardised level difference (D_{nT}): this is the level difference adjusted to assume a standard reverberation time of 0.5 seconds in the receiving room so that partitions can be compared independent of the furnishing and surface finishes of the rooms. The measure is generally used in residential testing as 0.5 seconds is taken as the approximate reverberation time of a furnished living room or bedroom. The D_{nT} is usually quoted for 1/3 rd octave bands between 100 Hz and 3150 Hz.

Weighted standardised level difference ($D_{nT,w}$): the $D_{nT,w}$ is a single figure expression used to describe the sound insulation of a partition. The weighting system used to obtain the single figure $D_{nT,w}$ from the 1/3rd octave D_{nT} values is given in BS EN ISO 717: Part 1. The $D_{nT,w}$ is used for expressing sound insulation measured "in the field", and is part of the term used in Approved Document E 2003, guidance to the Building Regulations for the assessment of performance of separating elements between residences.

Spectrum adaptation terms (C, C_{tr}): These terms are single figure values which are added to a single figure R_w or D_w term to adapt the frequency weighting for different source sound spectra. Adding the C_{tr} term to a weighted parameter approximates to the human perceived sound insulation of an element when subjected to road traffic noise. The C_{tr} term may be used to determine a single figure approximation of sound insulation against road traffic noise. The C_{tr} term is part of the term used in Approved Document E: 2003 of the Building Regulations for the assessment of performance of separating elements between residences.

Flanking: Flanking is the term used to describe how sound gets from one room to another by routes other than via the wall or floor directly separating them. Such flanking paths around a party wall would be the internal leaf of the external wall or the roof void, plus any air gaps at junctions. The sound insulation of flanking paths is very important. If the insulation is poor it can result in a poor built performance in terms of sound insulation, even if the party walls or floors themselves are adequate. When a measurement of sound insulation is made in a building as opposed to an acoustic laboratory, it will include flanking sound transmission. Standards for sound insulation in residential properties now require testing of $D_{nT,w}$ + C_{tr} values which include sound transmission via flanking paths.

APPENDIX B – TABLE OF SOURCE MEASUREMENTS

Reference Number	Description	Measured SPL (L_{Aeq} dB)
1	Refrigeration Unit (Front) (Trailer dispatch) @1m	78.5
2	Refrigeration Unit (Front) (Trailer dispatch) @1m	77.8
3	Refrigeration Unit (Side) (Trailer dispatch) @0m	71.5
4	Gluten Room Unit (Collation tray store air conditioning unit) @1m	67.9
5	Refrigeration Unit (Front) (Front yard tray area) @3m	76.8
6	Refrigeration Unit (Front) (Front yard tray area) @1m	82
7	Refrigeration Unit (Side) (Front yard tray area) @0m	68
8	Lorry Movement (Old tray store external) @3m	80
9	Dawson Unit 2 (Behind goods in Dawson units) @1m	65.5
10	Dawson Unit 3 (Behind goods in Dawson units) @1m	58.9
11	Forklift + Horn (Goods in Dawson units) @1m	72.1
12	Forklift Reverse (Goods in Dawson units) @1m	77.3
13	Condenser (Behind Low Risk Dawson Units) @1m	66.4
14	Bioreactor Air Blower (Bioreactor Air Blower) @1m	84
15	Bioreactor Air Blower (Bioreactor Air Blower) @1m	86.3
16	Bioreactor Air Blower (Bioreactor Air Blower) @1m	82.6
17	Bioreactor Mixing/Aeration Pump (Bioreactor Mixing/Aeration Pump) @1m	79.3
18	Bioreactor Mixing/Aeration Pump (Bioreactor Mixing/Aeration Pump) @0.5m	77.3
19	Divert Tank Mixing/Aeration Pump (Divert Tank Mixing/Aeration Pump) @1m	72.1
20	DAF Feed Pump (DAF Feed Pump) @0.5m	68.7
21	Balance Tank Mixing/Aeration Pump (Balance Tank Mixing/Aeration Pump) @1m	76
22	Bioreactor Tank (Top) (Bioreactor Tank) @1m	77.8
23	Water Treatment Plant Building Fan (Water Treatment Plant Building Fan) @1m	74.9
24	Open Door (Energy centre back door) @1m	71.5
25	Vent (Energy centre back vent) @1m	75
26	Tanker Idling (Chemical store chemical delivery tanker) @1m	83.5
27	Tanker Idling (By Engine) (Chemical store chemical delivery tanker) @1m	82
28	Ammonia Plant Room Door (Closed) (Energy Centre access gate) @1m	78.1
29	Ammonia Plant Room Door (Closed) (Energy Centre access gate) @0m	82.5
30	Stood at End (Energy Centre access gate) @1m	69
31	End Door (Closed) (Energy Centre access gate) @0m	74.9
32	Refrigeration Unit (Front) (Pallet farm temporary trailer) @m	79.6
33	Dawson Unit 4 (Goods Inwards external corner) @0m	69.7
34	Dawson Unit 5 (Goods Inwards external corner) @0m	72.9
35	Opening (Boiler room) @0m	78.9
36	Opening (Boiler room) @2m	71.9
37	Opening (Boiler room) @0m	74.2
38	Opening (Boiler room) @1m	69.9
39	Opening (Boiler room) @0m	74.3
40	Opening (Boiler room) @0m	66
41	Vent (Gluten free LEV extraction) @1m	77.4
42	Pipes (Carbon dioxide tank pipes) @0m	64
43	Door Upstairs (Roof void external rear door) @0m	66.1
44	By Fence (Old chemical Store fence) @1m	64.7
45	Vent (Low risk kettle fire exit vent) @1m	72.2
46	TUCA AHU (TUCA AHU) @3m	80.3
47	TUCA AHU (TUCA AHU) @1m	85

Reference Number	Description	Measured SPL (L_{Aeq} dB)
48	Packing Hall AHU (High Care AHU) @1m	75.9
49	Meat Prep Tumble Chiller (High Care AHU) @0m	72.5
50	Control Panels (High Care / Capkold door control panels) @0m	76.6
51	Dawson Unit (High Care Sauce WIP Dawson units) @0m	73
52	Dawson Unit (High Care Sauce WIP Dawson units) @0m	66.6
53	Dawson Unit (High Care Sauce WIP Dawson units) @1m	74.6
54	Dawson Chiller 1 (High Care Sauce WIP Dawson units) @0m	75.9
55	Dawson Chiller 2 (High Care Sauce WIP Dawson units) @0m	63.1
56	Dawson Chiller 3 (High Care Sauce WIP Dawson units) @1m	68.7
57	Roof Unit @1m	74.2

APPENDIX C – LOCATION OF SOURCE MEASUREMENTS



APPENDIX D – SOURCE MEASUREMENT THIRD OCTAVE DATA

#	3rd Octave Frequency Band Hz (dBA)																				
	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
1	77.1	78.2	82.7	80.4	78.2	90.6	90.4	83.8	87.5	80.1	77.7	81.2	81.8	73.8	74.2	70.1	69.9	70.3	66.8	63.3	63.4
2	87.7	89.3	91.8	96.7	92	89.5	84.6	83.2	84.7	81.7	78.5	82.6	79.9	78.6	76.1	75.8	73	70.5	68.7	66.1	66.9
3	81.8	81.3	93.5	86.4	80.9	83.5	78.5	75.5	77.2	68.3	65.3	66.8	64.5	62.9	59.8	57.6	53.9	51.6	51.8	48.1	49.7
4	83.9	65.8	73.5	73.1	64.4	67.1	69.1	68	64.1	63.6	63	64.2	70.4	65.1	63.6	68.7	65.7	70.3	65.4	70	69.4
5	109.8	97.7	92.1	101.9	98.5	98.1	89.9	88.2	91.2	88.5	86.1	87.9	87.2	84.9	83.1	85.5	84.2	80.5	79.9	77.5	76.6
6	104.3	86.4	94.6	104.5	93.6	90.1	85.9	83.3	85.5	82.3	84.2	83.6	81.6	80.9	78.9	79.1	80.9	77.4	77.8	74.7	74.3
7	96.4	71.1	68.9	83.9	69.1	79.4	79.4	83.4	64.8	64	77.6	62.5	57.1	58.1	54.7	53.3	53.7	51.4	48.6	47.4	46.5
8	109.5	101.4	97.3	94.8	94.9	93.8	97	96.6	91.6	95	94.5	93.8	96.8	94.7	96.8	96.6	95.7	94.9	90.3	88.6	86.3
9	99.5	73.3	66.1	73.6	69.8	74.3	66.5	66.5	70.6	65.6	68.1	64.9	62.3	61	64.9	59.3	61.9	65	61.4	61.7	62.7
10	87.7	68.6	66.8	75.8	65.3	68.5	67.6	63.8	64.5	61.6	62.5	60.2	61	58.3	58.9	56.9	57.2	58.8	54.5	55.8	56.6
11	84.8	84.2	81.6	77.3	75.2	70.6	68.7	73.9	87.8	89.7	76.4	75.4	73.2	75.8	78.8	76.9	73.4	72.9	89.2	89.8	73.3
12	76.6	68.3	75	77.3	74.9	68.5	72	76.4	73.7	74.4	77.2	76.1	75.6	76.9	74.2	75.6	72	88.9	85.7	67.9	66.8
13	90.4	88.5	83.6	80	78.2	75.9	74	70.7	74.7	71.9	70.1	68	65.4	65.4	66.3	64.7	64.7	65.3	65.2	64.5	63.9
14	94.6	93.7	87.5	85	81.2	99.7	86.5	77.5	85.8	78.2	93.8	89.6	81.8	84.2	76	75.8	72.7	77.7	75.6	77.5	76.6
15	85.2	81.1	80.6	84	80.1	100.8	87.3	78.8	87.2	78.5	90.3	95.2	86.2	80.5	76.7	78.7	75.9	80.2	76.2	79.2	77.5
16	84.8	79.4	77.2	82.7	79.8	96.4	86.3	80	90.2	78.5	91.7	85.5	83.6	81.3	80.4	78.4	74	77.3	76	79.5	77.7
17	84.8	79.3	77.1	81.2	77.4	96.3	81.9	73.3	81.7	72.7	87.7	86	77	75.9	74.2	72	67.4	71.1	68.8	77.5	69.9
18	75.1	73.7	72	76.9	72.2	84.9	71.9	67.2	71.9	64.6	76.5	77.8	71.3	67.3	65.2	64.6	60.1	61.9	61.8	74	62.2
19	85	80.8	76.4	77.3	74.3	78.3	69.2	71.4	73.6	69.2	69.6	65.2	65.2	71.4	71.1	73.9	71.8	67.3	69.7	69.2	71.1
20	80	77.6	74.6	71.6	67.7	79.3	64.7	60.9	65.3	64.7	62.7	61.9	56.9	58.9	57.2	62.5	59.4	55.7	57.9	62.2	57
21	84.5	79.2	77.6	78.9	70.8	76.2	69.7	69.2	76.2	69.2	71	73.2	76.7	76.8	76	74.9	74.2	73.4	72.2	72.1	73.3
22	104.4	104.7	100.7	96.5	94.5	92.3	86	79.6	79.4	79.4	79.7	79.4	79.2	77.9	76.9	76.4	75.8	74.3	72.5	71.8	69.6
23	88.3	84.7	83.2	80.1	78	86.9	73.9	70.9	78.5	69.9	74	74.6	73.6	79.9	75.9	72.1	71	70.6	68	68.4	67.9
24	95.8	91.9	91.4	86.7	84.9	79.7	77	75.7	72.2	71	72.2	72.1	70.6	67.8	64.9	67.9	63.9	64.4	64	61.3	59.9
25	87.4	85.2	81.9	87.1	94.1	79.4	79.7	84.9	76.7	76.2	79.4	77.5	78.5	73.3	72	70.9	70	67.9	65.8	63.8	61
26	75.8	82.1	79.6	79.4	78.3	81.3	79	77.5	75.8	95.6	91.1	81.1	78.2	79.6	78	78.2	75.3	73.6	72.2	72.5	70.8
27	81.3	82.6	85.2	86.6	84	88.7	84.1	77.7	78.8	85.9	84.9	81.3	80.6	82.9	83.4	80.7	79.1	77.7	77.7	77.3	73.5
28	80.3	77.5	76.7	84.3	84.9	81	80.1	81.3	76.8	79.3	79.4	79.6	79.4	75	69.1	67.7	65.7	64.2	67.2	58.7	53.4
29	74.3	71.9	73.5	87.4	87.7	82.6	79.2	85.7	81.1	81.2	82.1	80.3	79.8	76.4	72.6	68.4	66.9	63.9	68.5	64.6	59.5
30	83	70.6	71.4	86.4	81.2	79.2	75	74.8	75.8	73.6	73.7	72.4	70.5	68.5	64.4	63.7	62.4	62.2	60.9	61.5	61.8
31	75.5	70.9	72.5	76.4	76.1	72.7	71.4	69	70.9	74.3	72.4	77.3	76.5	68.1	66.2	66	65.2	62.3	59.1	57.1	55.8
32	90.5	92.4	91.5	86	78.5	77.1	76	77.1	87.3	87.6	83.3	84.1	82	79	75.9	74.3	70.8	70.1	66.9	65.8	69.6
33	95.7	74.2	74.4	78.4	67	70.3	68.8	65.4	66.8	64.3	66.7	63.1	65.2	62.2	62.6	59.2	63.1	59.2	56.2	55.9	54.3
34	93.9	71.5	71	78	80.4	72.1	68.5	73.7	67.1	69.5	73.4	66.3	64.5	62.2	62.4	62.6	63	59.3	55.1	54.2	54.1
35	91	81.8	74.9	77.5	76.4	70.3	77	74	70.5	65.6	72.2	76	71.6	68.6	64.5	61.7	61.3	68	69.8	68.9	74.4
36	88.4	84	87.5	83.7	82	80.7	81.2	81	75.5	75.7	78.8	76.2	73	72.4	71.8	70.8	70.7	74.7	77.3	76.4	80.7
37	79.1	71.5	78.2	75.6	72.3	75.1	74.4	69.5	71.6	68	66	67	64.7	65.8	65.3	64.5	64.7	63.3	62.6	60.1	62.6
38	83.1	80.4	82.4	80.4	77.8	81.9	80.5	73.2	72.9	72.8	70.4	70.1	68.9	71.7	71.1	71.8	70.8	70.6	70	69.3	69.4
39	85.9	81	77.4	76.4	71.9	72.8	74.4	69.1	74.5	69.6	67.7	69	65.5	66.9	65.8	65.2	65.9	65.8	67.3	67.9	66.9
40	75.7	69	71.3	70.1	67.6	69.8	69.6	62.4	65.5	62.9	60.2	61.8	57.7	59	58	59	60.6	59.2	58.3	60.2	56.2
41	78.3	77.5	83.6	88.6	77.9	80.1	79	83.6	85.1	84.2	83.1	78.5	78.9	72.5	74.9	72.9	71.6	70.4	71.4	71.9	71.3
42	74.4	69.1	68.8	72	64.4	64.5	62.9	63.1	65.4	63.6	64.6	57.4	56.8	56.1	58.4	55	50.7	50.2	51.9	48.6	52.8
43	68	68.4	66.9	68.8	68.2	68.4	63.4	61.2	59.4	56.4	60.7	57.7	65.8	58.5	60.7	58.7	57.6	63	60.2	61.6	57.7
44	74.5	67.1	68.7	84.5	85.5	79.9	73.9	74.4	71.6	73.5	72.1	68.8	66.1	63.6	60.7	62.2	60	59.4	57.2	54.1	52.5
45	77.8	74.7	75.4	82.7	83.7	80.1	79.5	81.8	80.6	77.7	76.7	74.2	73.2	72.7	66.2	65.2	65.7	61.2	58	56.6	52.9
46	100	88.6	91.5	92.6	88	94	98.3	92.1	92.9	92.3	90.7	90.7	90.4	90.5	88.8	89.1	87.5	86.7	83.8	83.9	80
47	91.8	83.9	85	84.5	85.5	88.4	94	87.5	87	87.7	86.4	85	86	85.7	83.9	83.9	83.1	82.5	80.1	77.9	74.4
48	93.3	86.5	83.1	80.6	82.8	87.2	93	85.2	79.6	79.1	79.6	76.6	74.9	73.1	71.8	70.9	68.7	66.8	64.1	62.4	62
49	75.4	71	70.1	68.1	78.2	85.4	77.5	69.1	76.2	69	70.2	65.2	63.1	62	58.2	58.9	56.7	56.1	54.1	54.7	60.3
50	78.3	79.6	75.2	74.6	80	83.3	83.5	80.4	80.2	78.3	76.7	75.4	71.2	69.8	67.4	65.4	65.1	62	59.4	58.2	60.8
51	83.9	75.8	72	74.5	67.9	68.3	68.2	68	70	67.4	68.4	66.6	65.9	65.8	64.7	64.7	64	62.9	60.9	60	61.2
52	74.2	72.1	66.9	66.4	65.6	66.5	69.8	65.6	63.5	64	62.3	62.4	60.5	59.4	58.4	58.3	56.7	55.4	53.5	51.7	49.6
53	87	72.9	78.3	87.6	83.2	77.6	83.8	76.4	81.1	76.3	73.6	73.8	72	71.9	78.3	75.2	73.5	74.2	69.5	72.3	69.8
54	85.5	74.7	79.5	86.5	77.8	76.3	78.9	73.7	74.7	73	72.7	71.2	69.8	68.3	69.1	65.6	62.7	61.9	56.4	54.2	49.9
55	81	64.5	66.2	77.4	64.3	61.4	64.6	57.2	63	58.5	57.8	54.9	54	55.2	56.8	53	53.1	53.9	49.3	48.5	44.5
56	82.6	71.2	75.1	83.2	75.7	77.3	79.7	69.9	77.7	71.4	70.9	69.2	67.9	67.3	67.5	64.8	65.8	62.4	59.2	69.6	61.4
57	78.6	75.9	77.7	79.6	76.8	79.1	81.7	79.6	82.7	83.9	81.1	75.9	75.9	72.4	66.1	63.3	62.3	60.1	57.5	56.3	52.4