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Project No: 313223.001

Noise Impact Assessment

Prepared for:

2ZLF Ltd

West Meadows Industrial Estate
Derby
DE21 6HA

Contents Amendment Record

This report has been issued and amended as follows:

Revision	Description	Date	Signed
2.0	FINAL	May 2023	R. Sargent

Acknowledgement

This report has been prepared for the sole and exclusive use of 2ZLF Ltd in accordance with the scope of work presented in Mabbett & Associates Ltd (Mabbett) Additional Services Letter Agreement (311233/LA/RS), dated 25 April 2023. This report is based on information and data collected by Mabbett. Should any of the information be incorrect, incomplete or subject to change, Mabbett may wish to revise the report accordingly.

This report has been prepared by the following Mabbett personnel:

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Section 1.0: Introduction

1.1 Background

2ZFL Ltd submitted a permit variation application to the Environment Agency (EA) in February 2022 to increase the waste processing capability at their West Meadow site from 10t per day to 100t per day of hazardous waste, along with an increase in hazardous waste storage capacity from 10t to 150t at any one time.

In addition to the change in hazardous waste volumes sought under this Permit variation, a new wet waste dewatering plant was installed three years ago in readiness to treat the increased volume of hazardous waste. This Noise Impact Assessment includes the improvement of this item of processing plant.

To 'duly make' the application, the EA have now given 2ZLF until 2 June 2023 to provide supplementary information and to respond to various requests for clarification.

2ZLF have commissioned Mabbett & Associates Ltd (Mabbett) to provide an assessment of potential noise impacts as a result of the operation of the new waste processing plant.

A summary of sound terminology is given in Appendix A.

1.2 Site Description

The 2ZLF site is located off Downing Road, West Meadows Industrial Estate, Derby. The site consists of a large yard area for the storage of waste, a building containing various items of waste processing plant, additional external processing plant and a couple of buildings/office.

To the immediate south of the site is a spur from the Midlands Mainline railway to some Network Rail sidings. Beyond the sidings is a large area of waste land. Beyond the wasteland is Pride Park, which consists of a number of commercial premises, car showrooms, Pride Park Football Stadium and Derby Railway Station.

To the north of the site are a couple of other industrial units on the West Meadows Industrial Park, beyond which is the busy A52. Beyond the A52, to the north-east, is an established residential area, and to the north-west is the Sawley Business Park with residential properties past.

To the east and west of the site are numerous industrial and commercial premises on the West Meadows Industrial Estate.

Observations when on site identified that the traffic on the A52 was the dominant noise source in the area.

The location of the noise sensitive receptors relative to the application site are given below and are illustrated in Appendix B.

Table 1.1: Selected Noise Sensitive Receptors

Receptor	Address	Distance from Site Boundary	Direction from Site Boundary
R1	134 Nottingham Road, Chaddesden	410m	NW
R2	1 Highfield Cottages, off Highfield Lane, Chaddesden	490m	NE

1.3 Operating Hours

The standard Operating Hours for the facility, in accordance with the Planning Permission are as follows:

- Monday to Sunday: 00:00 – 23:59

The site will not undertake operations on Public Holidays.

However, the site is open for deliveries as follows;

- Monday to Sunday: 07:00 – 17:00
- Saturday: By appointment only

Whilst the Planning Permission from the site allows 24/7 operation, it is understood that the processing of waste is only undertaken during the hours of 06:30 and 17:30, Monday to Saturday.

1.4 Existing Site Operations

The site consists of designated waste reception and storage areas for the hazardous and non-hazardous waste activities. Amenities for the entire site include a weighbridge for incoming wastes and a quarantine area for non-conforming incoming wastes (which will ensure that quarantined wastes do not contaminate those which have been deemed suitable for treatment) as well as two soil washing plants – one for hazardous wastes and one for non-hazardous wastes.

Wastes contaminated with heavy metals and/or hydrocarbons/oils are brought onto site in enclosed/sheeted vehicles. After initial inspection at the weighbridge, vehicles are directed to the reception area and physically inspected. Once accepted, the loads are loaded into specially provided bays and covered prior to treatment.

Treatment activities consist of the washing of hydrocarbon and heavy metal contaminated wastes.

The material is loaded into a hopper which can process 10 tonnes per hour. From here the waste passes through a screener to remove all oversized components down to 5mm – all oversize which exceeds 25mm is sent off site for disposal. All components between 5 – 25mm are non-hazardous and are either treated in the system or removed from site.

Once the material has been screened it is then ‘scrubbed’ with water to remove the contaminants from the soil/sands. The soils/sands are then subjected to a density separator which separates fine and coarse sands by weight. Course clean sand is separated out and removed from the system.

The finer sand is then treated by a hydro-cyclone which separates out particles by applying a centripetal force – i.e., the material is suspended via a liquid suspension and the hydro-cyclone spins the waste, separating it from the rest of the medium based on the density of the sand. The sand is then passed through a dewatering screen and removed from the system.

The next step of treatment is to then remove any oil from the system. Once the fines have been removed from the system, an anti-foam polymer is added to suppress the production of foam from the hydro-cyclone. The material is then passed through to the Lamella. The Lamella is a series of plates which are set on an angle and are designed to remove oil from suspension (the oil adheres to the plates). The oil is then recovered and removed off site.

The fines are then dropped out of the system to a sludge tank and are then subject to a centrifuge, which separates out the water from the material – forming a filter cake. The filter cake is then removed from the site as waste material.

The resulting water is recycled back to the water tank where it is either reused in the treatment process, or it is treated before being reintroduced back into the treatment process or is used for washdown water. This ensures that all water which is used in the system is ultimately recycled through the system.

1.5 West Waste Dewatering Plant Details

The new wet waste dewatering plant is located central to the site, to the west of the existing processing building, and approximately 10 m north of existing external processing equipment. The new processing plant consists of:

- Screw hopper
- Vibrating screen with sump and submersible pump
- Scrubber skid consisting of:
  - Mixing tank
  - Transfer pump
  - Scrubber
  - Upflow classifier
  - Exit screw
- Lamella
- Flocculator
- Storage tank

Section 2.0: Guidance

2.1.1 British Standard 7445-1:2003 and 7445-2:1991

BS 7445 'Description and measurement of environmental noise'[1] defines parameters, procedures and instrumentation required for noise measurement and analysis.

2.1.2 British Standard 4142:2014

BS 4142 'Methods for rating and assessing industrial and commercial sound'[2] can be used for assessing the effect of noise of an industrial nature, including mechanical services plant noise, upon residential receptors. The method is based on a comparison between the 'rating level' of the industrial noise and the 'background level' at the receptor position.

2.1.3 British Standard 8233:2014

BS 8233 'Guidance on sound insulation and noise reduction for buildings'[3] provides acceptable internal noise levels for various spaces during daytime and night-time periods, including residential, offices, places of worship, hospitals and educational establishments.

2.1.4 World Health Organisation

The World Health Organisation's (WHO) 'Guidelines for Community Noise'[4] recommends external daytime and evening environmental noise limits, and internal night-time limits to avoid sleep disturbance.

The WHO 'Night Noise Guidelines for Europe'[5] recommend updated guidelines on night-time noise limits to avoid sleep disturbance.

[1] BS 7445: 2003 'Description and Measurement of Environmental Noise'. British Standards Institution.
[2] BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound'. British Standards Institution.
[3] BS 8233:2014. Guidance on sound insulation and noise reduction for buildings. British Standards Institution.
[4] Guidelines for Community Noise', World Health Organisation, 1999.
[5] World Health Organisation (WHO) (2009) Night Noise Guidelines for Europe.

Section 3.0: Methodology

3.1 Sound Measurements

Sound monitoring was carried out in accordance with the guidance in British Standard BS 7445: 2003 'Description and Measurement of Environmental Noise'[6].

At the receptor locations the sound level meter was set to measure the L_{Aeq}, L_{A90} and L_{AFmax} values, logging in contiguous periods of 15 minutes. All noise measurements were taken at between 1.2 and 1.5 metres above ground level and located in free-field conditions (at least 3.5 metres from any vertical reflecting surfaces).

All equipment was checked with a field calibrator before and after each measurement. No significant drift in the calibration was noted. Calibration certificates are available on request.

Sound measurements were undertaken for a period of thirty minutes at each receptor when the new processing plant was not operating, and for a further thirty minutes at each receptor when the plant was operating.

In addition to the measurements at the receptors, measurements were undertaken of the various items of plant and activities at the 2ZLF site.

Further information on the sound monitoring is provided in Section 4 and Appendix C.

3.2 Operational Noise

3.2.1 BS 4142 Assessment

Response to sound is subjective and affected by many factors, both acoustic and non-acoustic. In general, the likelihood of complaints in response to sound depends on factors, including:

- the margin by which it exceeds the background sound level;
- the absolute sound level;
- the character of the sound;
- the time of day;
- the change in the sound environment; and
- the nature of the local area.

The standard used for assessing industrial sound and determining community reaction is British Standard BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound'[7]. According to the standard, it can be used for:

- "investigating complaints;
- assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and
- assessing sound at proposed new dwellings or premises used for residential purposes."

The basis of BS 4142 is a comparison between the rating level of the noise source under consideration and the background sound level in the vicinity of residential locations. The relevant parameters in this instance are as follows:

- Background Sound Level – $L_{A90,T}$ – defined as the 'A' weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T. This is measured using time weighting F and quoted to the nearest whole number of decibels;
- Specific Sound Level – $L_{Aeq,Tr}$ – the equivalent continuous 'A' weighted sound pressure level produced by the specific sound source at the assessment location over a given time interval, T;

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[6] BS 7445: 2003 'Description and Measurement of Environmental Noise'. British Standards Institution.

[7] BS 4142: 2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'. British Standards Institution.

- Residual Sound Level - $L_{Aeq,T}$ - the equivalent continuous ‘A’ weighted sound pressure level at the assessment location in the absence of the specific sound source under consideration, over a given time interval, T; and
- Rating Level – $L_{Ar,Tr}$ – the specific sound level plus any penalties applied for the characteristic features of the specific sound source such as tonality, impulsivity and intermittency.

To determine the overall Rating Level, characteristics of the specific sound need to be considered and corrections applied (if deemed appropriate). These corrections can include the following:

Subjective Assessment of Tonality:

- +2 dB if tonal noise was slightly perceptible;
- +4 dB if tonal noise was clearly perceptible; and
- +6 dB if tonal noise was highly perceptible.

Impulsivity:

- +3 dB if impulsive noise was slightly perceptible;
- +6 dB if impulsive noise was clearly perceptible; and
- +9 dB if impulsive noise was highly perceptible.

Intermittency:

When the specific sound is identified as being of an inherently intermittent in nature, and the intermittency is perceived to be distinctive against the residual acoustic environment, a correction of +3 dB can be applied to the specific noise level.

Other Sound Characteristics:

Where the specific sound features characteristics that are neither tonal nor impulsive but is perceived to be distinctive against the residual acoustic environment, a correction of +3 dB can be applied to the specific noise level.

Following the calculation of the rating level, this is then compared to the background noise level in order to estimate the potential impact of the noise on the receptor. Generally, as the margin by which the rating level exceeds the background level increases, the magnitude of impact also increases.

Section 11 of BS 4142 provides the following guidance:

Table 3.1: BS 4142 Magnitude of Impact from Industrial Noise

Excess of Rating Level over Background Level	Indicative Outcome	Mabbett Assessment
≥ 10 dB	Likely to be an indication of a significant adverse impact, depending upon the context.	Significant Adverse Impact
≥ 5 dB	Likely to be an indication of an adverse impact, depending upon the context.	Adverse Impact
≥ 0 ≤ 5 dB	Some impact, but less likely to be an adverse impact, depending upon the context.	Low Impact
≤ 0 dB	Indication of no/low impact, depending on the context.	Negligible/No Impact

Importantly, BS 4142:2014+A1:2019 also requires that the rating level of the sound source under assessment is considered in the context of the environment when defining the overall significance of the impact. The standard suggests that in assessing the context, all relevant factors should be taken into consideration, including the following:

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

- 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."

Section 4.0: Baseline Conditions

4.1 Sound Monitoring Details

A survey of the background and operating sound levels at representative off-site receptors was carried out on Wednesday 03 May 2023.

Sound monitoring was carried out for representative periods during the day at two locations, representative of the closest residential receptors to the 2ZLF site.

These locations were:

Table 4.1: Noise Monitoring Locations

Receptor	Details
M1	On the pavement to the west of 134 Nottingham Road, representative of receptor R1.
M2	At the end of Highfield Cottages, representative of Receptor R2.

Measurements were undertaken at the receptor locations both with the new wet waste dewatering plant operating and without it operating. Measurements were also undertaken at the receptors at night when the 2ZLF site was not operating.

Additional measurements were undertaken at locations around the 2ZLF site to determine the specific sound levels of activities on the site.

The sound monitoring locations are illustrated in Appendix B.

Details of the instrumentation used are presented in Appendix C.

Weather conditions during the surveys fell within the requirements of BS 7445. Full weather details are given in Appendix C.

4.2 Survey Results

The measured data were processed to define the L_{Aeq}, L_{A90} and L_{AFmax} sound levels during the daytime and night-time periods, and the results are presented below.

Table 4.2: Sound Monitoring Results

Receptor	Date	Start-time	Duration Hr:min	Sound Levels		
				$L_{Aeq,T}$ dB	Typical $L_{A90,T}$ dB	L_{AFmax} dB
New Processing Plant Not Operational						
M1	03/05/2023	14:45	00:30	63	56	80-84
M2	03/05/2023	14:00	00:30	57	54	66
New Processing Plant Operational						
M1	03/05/2023	12:30	00:30	63	55	77-81
M2	03/05/2023	13:30	00:30	57	54	67-72
Night (2ZLF Site Not Operational)						
M1	03/05/2023	23:30	00:30	57	41	72-88
M2	04/05/2023	00:15	00:30	46	39	55-65

At monitoring location M1, during the day the dominant noise source was noted to be road traffic on Nottingham Road. During lulls in traffic, activities at the Sawley Business Park were audible, in particular manufacturing noise from the Derby Kitchen Manufacturers premises. The operations at 2ZLF site were not audible at this location. At night, the dominant noise was from traffic on Nottingham Road. In lulls in the traffic, distant road traffic on the A52 was audible.

At monitoring location M2, during the day the dominant noise source was constant road traffic on the A52. The operations at 2ZLF site were not audible at this location. At night, road traffic on the A52 remained the dominant noise source.

4.3 Spectral Data

A comparison of the spectral data with and without the new processing plant operational, are given in Figures 4.1 and 4.2 below.

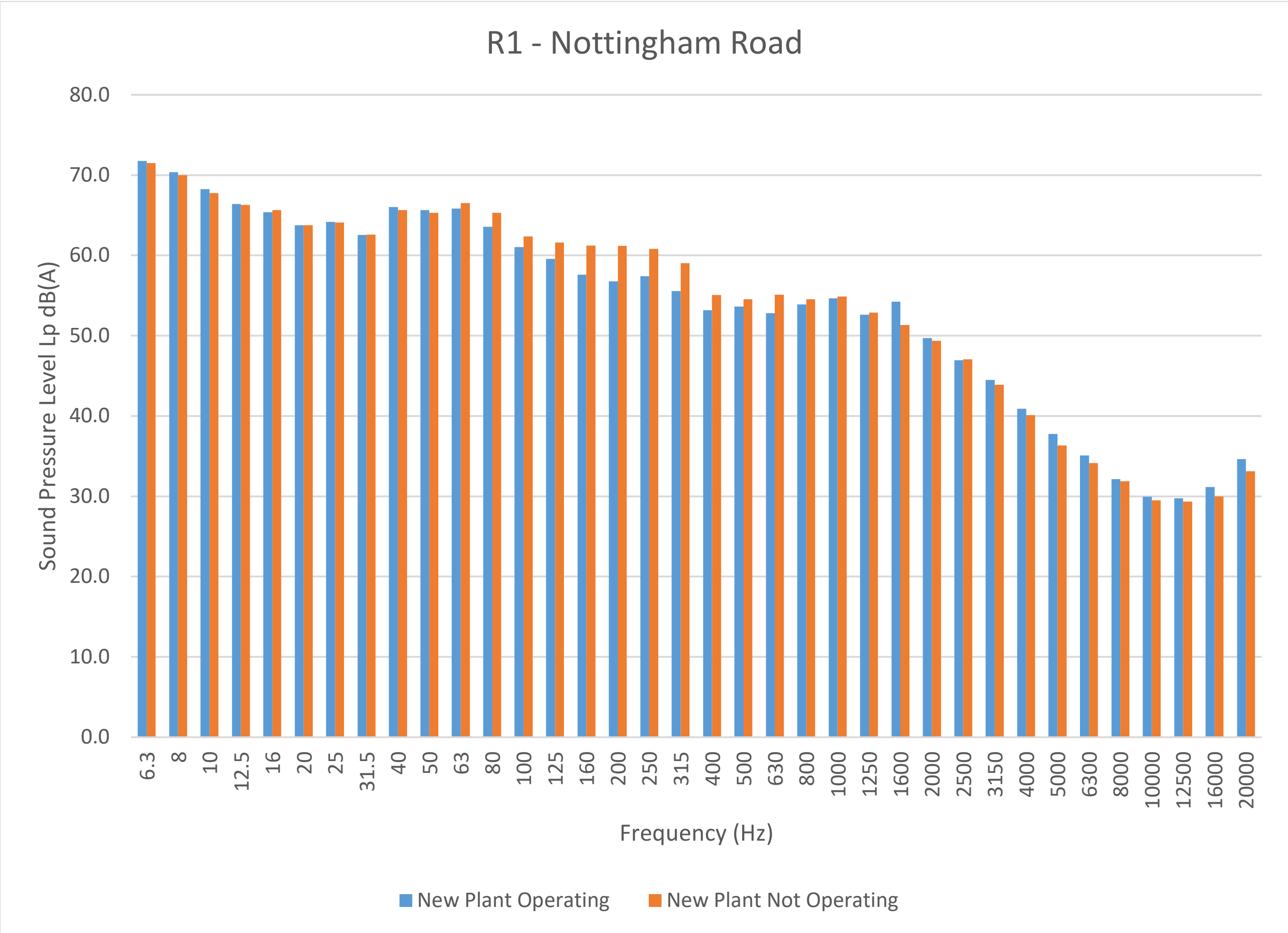


Figure 4.1: Comparison of Operational and Not-Operational Spectral Data – Receptor R1

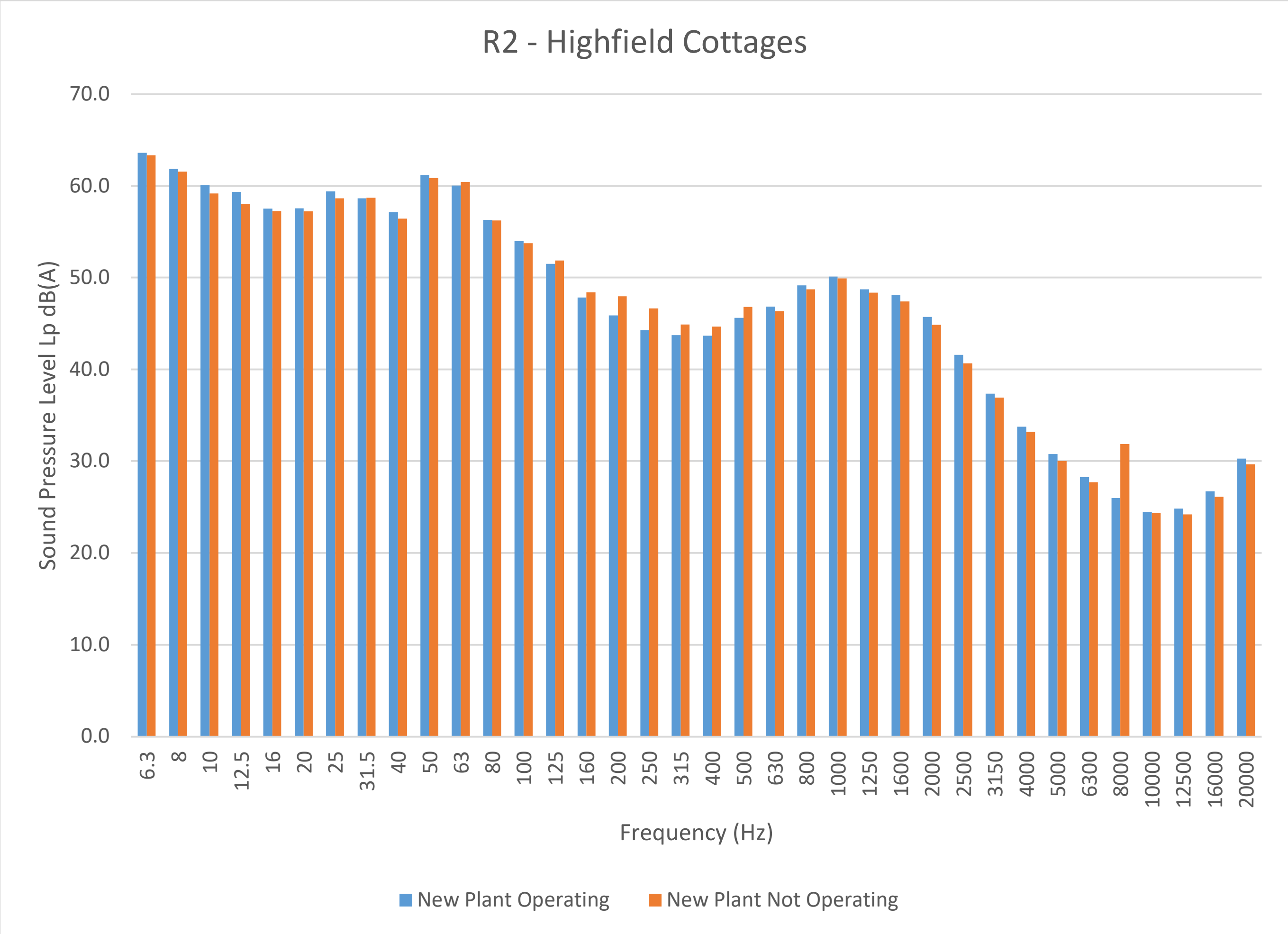


Figure 4.1: Comparison of Operational and Not-Operational Spectral Data – Receptor R2

As illustrated, when the new processing plant is operational there is no change in the spectral data experienced at the receptor locations.

Section 5.0: Sound Assessment

5.1 Operational Noise Assessment

5.1.1 Comparison of Measured Noise Levels at Receptors

As illustrated in Table 4.2 in Section 4, the measured L_{Aeq} and L_{A90} levels, both with the new wet waste dewatering plant not operational and with it operational, are the same, therefore indicating that the new dewatering plant does not increase the noise impact upon the closest receptors.

Whilst the site starts operating at 06.30am, noise levels in the area and at the closest receptors are likely to be similar to those during the rest of the daytime period due to road traffic on the busy A52 trunk road into the city of Derby. The assessment is therefore deemed representative for the full operating hours of the site.

However, to fully demonstrate the 2ZLF site does not result in a noise impact on the closest receptors, a basic sound propagation calculation has been undertaken utilising the measured noise levels of activities at the 2ZLF site. For a worst-case assessment, a prediction of noise incident on the closest receptors from all activities at the 2ZLF site has been undertaken, not just the new wet waste dewatering plant.

5.1.2 Operational Sound Calculations

Basic sound propagation calculations have been undertaken in SoundPLAN 8.2, based on the measured levels taken around the 2ZLF site of operational plant and activities at close proximity. The predicted levels do not account for topographical features between the 2ZLF site and the receptors. Measured sound data are provided in Appendix D.

The predicted levels are given in Table 5.1.

Table 5.1: Predicted Sound Level at Receptors – All 2ZLF Operations/Activities

Receptor	Predicted Sound Level at Receptor from the 2ZLF site L_{Aeq}, dB	Minimum attenuation provided by shielding i.e. buildings between the 2ZLF site and receptors dB	Calculated Sound Level at Receptor from 2ZLF site L_{Aeq}, dB
R1	40	-10	**30**
R2	37	-10	**27**

As illustrated in Table 5.1, the measured and predicted levels at the receptors are significantly lower than the measured residual levels at the receptors, with the predicted level being 33 dB below the ambient level at R1 (63 dB L_{Aeq}) and 30 dB below the ambient level at R2 (57 dB L_{Aeq}). As the predicted levels are greater than 10 dB below the measured levels at the receptors, this indicates that the operations at the 2ZLF site do not contribute to the ambient levels experienced at the receptors.

The calculated specific sound level has been used in the BS 4142 assessment to determine the magnitude of impact from the operation of the 2ZLF site.

5.2 BS 4142 Operational Noise Assessment

Observations when undertaking the measurements at the closest receptors determine that there was no high frequency tonal noise emitted by operations at the site, although there was a low frequency rumble type sound. There were no intermittent or impulsive activities or noise sources, other than a loader revving and the bucket of the loader being dragged across the concrete slab. Therefore, for a worst-case assessment, a penalty of 3 dB for 'other characteristics' has also been applied.

The nature of the proposed operational sound sources is also not dissimilar to the existing environment given that the application site is located in close proximity to a busy road and a mainline railway.

Following the procedures outlined in BS 4142:2014, the rating level of the specific sound has been compared to the background sound level, as shown in Table 5.2.

Table 5.2: BS 4142 Assessment

Receptor	Specific Sound Level $L_{Aeq,Tr}$ dB	Acoustic Feature Correction dB	Rating Level $L_{Ar,Tr}$ dB	Typical Background Level $L_{A90,T}$ dB	Excess of Rating Level over Background dB	BS 4142 Assessment Outcome
Daytime						
R1	30	+3	33	56	-23	No impact
R2	27	+3	30	54	-24	No impact
Night-time						
R1	30	+3	33	41	-8	No impact
R2	27	+3	30	39	-9	No impact

The BS 4142 assessment indicates that operations at the 2ZLF site does not give rise to noise impacts upon the closest receptors, both during daytime and night-time periods.

5.2.1 Context and Uncertainty

The context is that the operation of the 2ZLF site is located within an existing industrial area where there are vehicles such as HGVs manoeuvring and idling and other industrial activities. The closest receptors are also in close proximity to busy roads, which provides masking of noise from the operation of the 2ZLF site.

Some uncertainty in the measured data and calculations is unavoidable. Mabbett have undertaken the following reasonable steps with a view to minimising the level of uncertainty in the results.

With regards to the measured data, this has been minimised as follows:

- Undertaking attended baseline sound monitoring at locations considered representative of the closest receptors to the site. Measurements were undertaken during the daytime period when the 2ZLF site was operational for representative periods of time, both with and without the new processing plant operating.
- Consideration of weather conditions based on observations while onsite. Uncertainties due to weather conditions are considered to be low, as during the monitoring conditions remained dry and windspeeds were below 5 m/s. Please refer to Appendix C for details of the prevailing weather data recorded.
- Use of suitable Class 1 sound level meters which comply with the relevant standards and have been calibrated at a UKAS accredited laboratory within the previous year.
- Field calibration of the measurement system on site at the start and end of each monitoring period.
- Local sound generating facilities (i.e. road traffic noise, industrial activities) were noted during the survey.

With regards to the calculations, uncertainties have been minimised as follows:

- The calculations have been undertaken using in-situ sound measurements both with and without the new processing plant operating. This gives a realistic assessment of the potential noise impacts from its operation.
- Measurements were also undertaken at various locations around the 2ZLF site, and the subsequent data used to calculate a likely noise level at receptors using a basic sound propagation model in SoundPLAN 8.2.

The author and reviewer's qualifications and experience are provided in Appendix E.

Section 6.0: Conclusions and Recommendations

Sound from the operation of the 2ZLF site located on Downing Road, West Meadows Industrial Estate, Derby, has been assessed. The site currently operates between the hours of 06:30 and 17:30, Monday to Saturday.

Baseline sound measurements without the wet waste dewatering plant operating were carried out during daytime and night-time periods at the two locations representative of the closest off-site sensitive receptors to quantify the prevailing sound climate.

Further sound measurements were undertaken at the receptors when the new wet waste dewatering plant was operational. A comparison of the measured noise levels at the receptor locations both with and without the processing plant operating clearly indicates that there is no change in the noise levels experienced.

Sound measurements of activities at the 2ZLF site and the new wet waste dewatering plant when operating were also undertaken to determine the noise emitted by the site. These measured levels were used to predict the noise level incident on each receptor.

The predicted noise level at each receptor are significantly below the measured L_{Aeq} and L_{A90} levels during both daytime and night-time periods. Therefore, this is a good indication that the operation of the 2ZLF site does not cause a noise impact upon the closest receptors.

An assessment of the noise impact from all operations at the 2ZLF site was undertaken using the method given in BS 4142. The rating level above the background level at the receptors, both during daytime and night-time periods result in no noise impact.

As it has been demonstrated that the operation of the 2ZLF site does not result in a noise impact upon the closest noise sensitive receptors, no specific noise mitigation measures are required. However, it is recommended that a Noise Management Plan is followed for the site to reduce any potential noise impacts.

Appendix A: Acoustic Terminology

Decibel dB
From the lowest audible sound to the loudest tolerable sound there is a million to one ratio in sound pressure (measured in pascals, Pa). Because of this wide range a sound level scale based on logarithms is used in sound measurement called the decibel (dB) scale. Audibility of sound covers a range of approximately 0 to 140 dB. Humans generally can only notice changes in sound levels of no less than 3 dB(A). It is generally accepted that a change of 10 dB(A) in an overall, steady sound level is perceived to the human ear as a doubling (or halving) of the sound level.

A-Weighting
The human ear system does not respond uniformly to sound across the detectable frequency range and consequently instrumentation used to measure sound is weighted to represent the performance of the ear. This is known as the 'A weighting' and annotated as dB(A) or L_{pA} dB.

Ambient or Activity Sound Levels
The equivalent continuous A-weighted sound pressure level, L_{Aeq} (or L_{eq} dB(A)) is the single number that represents the total sound energy measured over that period. L_{Aeq} is the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period. It is commonly used to express the energy level from individual sources that vary in level over their operational cycle.

Background Sound Levels
The parameter that reflects the human perception of the ambient sound is the background sound level, L_{90}, this is usually A weighted and can be displayed as L_{90} dB(A) or L_{A90} (dB). This is the sound level exceeded for 90% of the measurement period and generally reflects the sound level in the lulls between individual sound events. Over a one hour period, the L_{A90} will be the sound level exceeded for 54 minutes.

Sound Power
Sound power is the rate per unit time at which airborne sound energy is radiated by a source. It is expressed it watts (W). Sound power level or acoustic power level is a logarithmic measure of the sound power in comparison to the reference level of 1 pW (picowatt). The sound power level is given the letter "L_w" or SWL. It is not the same thing as sound pressure (Lp). Any L_p value is dependent of the distance from the sound source and the environment in which it was measured. L_w values are preferred for noise prediction purposed as their value is independent of distance or environment. There are recognised formulas for converting L_w to L_p. A-weighted sound power levels are usually denoted L_{wA} (dB) or sometimes L_w (dBA) or SWL (dBA).

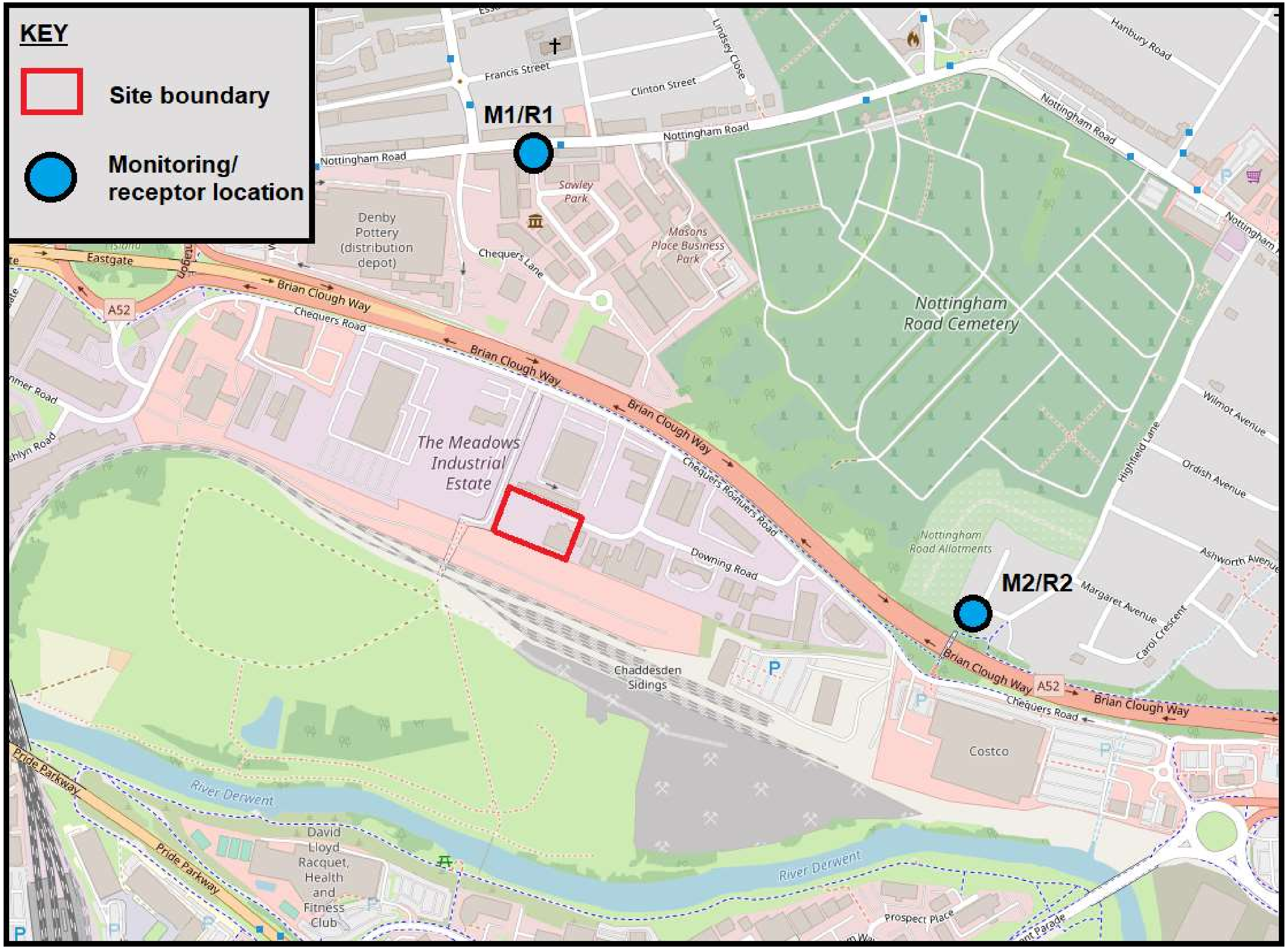
Lmax
The $L_{Amax,slow}$ and $L_{Amax,fast}$ measurement parameters are the maximum instantaneous sound pressure level attained during the measurement period (30 seconds, 5 minutes etc.), measured on the 'slow' or 'fast' response setting of the sound level meter. This is sometimes expressed as L_{Amax} dB or L_{max} dB(A). Even though sounds appear fairly steady to the human ear they are seldom if ever steady in level. To accommodate this factor, sound level meters (SLMs) are generally provided with at least two meter responses or exponential averaging circuits. Fast meter response has a time constant of 1/8th of a second (125ms) and approximates the integration time of human hearing. The slow time response (time constant = 1 second) is intended to obtain an approximate average value of rapidly fluctuating levels from simple meter readings.

Internal Sound Levels
In an enclosed space such as an individual room, or a building, the sound from a source cannot propagate in the same way as outdoors because the propagation of the sound is obstructed by the boundaries (walls, ceiling and floor) of the building. These surfaces together with the contents of the building reflect a proportion of the sound back inside the building or room, the amount depending on the absorption coefficient of the various surfaces. Therefore the overall sound level at a position within the building is a combination of the sound received directly from the source (the direct sound field) and the sound received from reflections from the internal surfaces (the reverberant sound field). The more absorptive the surfaces in a building the less sound is reflected and the lower the contribution of the reverberant sound field to the overall noise level.

Sound Reduction Index
The sound insulation properties of a material are described by the term 'sound reduction index' (R) i.e. it is a measure of the reduction in the amount of sound transmitted through a material. The higher the sound reduction index the greater the attenuation provided by the material. The value of R depends on a range of factors, in particular the mass of the material, the nature of the material, and the frequency of the sound. The R values for individual octave bands can be combined into an overall single figure, the weighted sound reduction index R_w.

Frequency Spectrum
Frequency is the rate at which the air particles vibrate. The more rapid the vibrations, the higher the frequency and perceived pitch. Frequency is measured in Hertz (Hz). A young person with average hearing can generally detect sounds in the range 20 Hz to 20,000 Hz (20 kHz). Human speech is predominantly in the range 250 Hz - 3000 Hz.
The musical term 'octave' is the interval between the first and eighth note in a scale and represents a doubling of frequency. A series of octave and one-third octave bands have been derived, and these are commonly used in sound measurements where it is necessary to describe not only the level of the sound source but also the frequency content. The frequency content of a sound source can be useful for identifying acoustic features such as a whine, hiss or screech.

Appendix B: Monitoring and Receptor Locations



Source: OpenStreetMap

Figure B.1: Sound Monitoring Locations and Selected Receptors

Appendix C Sound Monitoring

Instrumentation

All measurements were taken at approximately 1.2-1.5 m above ground level, and in accordance with the requirements of British Standard BS 7445. All monitoring locations were positioned at least 3.5 m from any reflecting surface, other than the ground (i.e. free-field). Details of ongoing activities and typical noise sources in the area were recorded during the surveys.

The SLM used was a Class 1 precision instrument, programmed to log a number of parameters including L_{Aeq}, L_{A90}, L_{A10} and L_{Amax} values, in 15-minute contiguous intervals.

The following equipment was used for the noise monitoring exercise:

Table C.1: Sound Monitoring Equipment Information

Monitoring Location	Equipment Item	Model & Type	Meter Serial Number	Calibration Date
M1	Sound Level Meter	CR:171B	G303957	13 June 2022
	Microphone	MK:224	215828D	21 June 2022
	Acoustic Calibrator	CR:515	99089	21 June 2022

On-site Calibration Details

The calibration of the sound level meter was checked throughout the measurements and are detailed below.

Table C.2: Calibration Details

Measurement	Start Calibration level dB	End Calibration level dB	Drift
Site measurements	93.7	93.5	-0.2
Receptor locations - day	93.7	93.4	-0.3
Receptor locations - night	93.7	93.2	-0.5

As illustrated in Table C.3, the drift of the calibration level of the sound level meter was less than ±0.5 dB.

Weather Conditions

Weather conditions observed during monitoring are detailed in Table C.3.

Table C.3: Weather Conditions during Sound Monitoring

Date	Period	Typical Temperature	Typical Wind speed	Typical Wind Direction	Conditions
03/05/2023	Daytime	11-14°C	2.1 ms^{-1}	E	Dry
	Night	6°C	<1 ms^{-1}	E	Dry

Photos

Figure C.1: Monitoring Location M1

Figure C.2: Monitoring Location M2

Figure C.3: New Wet Waste Dewatering Plant

Figure C.4: New Wet Waste Dewatering Plant

Appendix D 2ZLF Site Sound Levels

Noise Source Data

Table D.1: Operational Noise Source Data

Plant	Sound Power Level (Lw) dB(A)	Octave Band Centre Frequency (Hz)									
		31.5	63	125	250	500	1,000	2,000	4,000	8,000	16,000
Loader	99	-	113	107	97	75	72	90	84	75	-
Existing screen unit	92	99	94	87	83	80	79	87	86	85	75
Existing conveyor motor	83	98	93	84	81	79	77	76	71	71	61
Existing vibrating screen	83	110	94	86	82	78	77	74	72	68	59
New vibrating screen	95	102	95	89	97	94	91	81	76	70	64
New settlement tank pump	99	107	103	94	93	95	93	93	88	80	69
New Siltbuster pump	93	110	96	91	93	92	87	84	81	79	77
New silo pump	95	113	109	94	92	92	89	86	87	80	72

* due to all items of plant operating during the measurements, measured noise levels for each item of plant may be higher due to influence of other plant.

Appendix E BS 4142 Supporting Information

Qualifications and Experience

Ruth Sargent MSc BSc(Hons) MIOA – Monitoring and Assessment
Ruth has worked on sound and vibration related projects for over 17 years. Since completing a Bachelors Degree in Environmental Science, a Masters in Environmental Management, and a Diploma in Acoustics and Noise Control, she has gained a wide range of practical experience in Environmental acoustics and vibration in a consultancy role. Ruth is a Member of the Institute of Acoustics.
The majority of Ruth's experience relates to the provision of sound and vibration impact assessments to support planning applications and full Environmental Impact Assessments. These include large residential and mixed use schemes, waste management facilities, power generation schemes and mineral/quarry facilities.
She is experienced in the use of environmental sound modelling software SoundPLAN, which implements a range of methodologies including Calculation of Road Traffic Sound (CRTN), Calculation of Railway Sound (CRN), BS 5228 and ISO 9613-2.

Stuart Hill, BEng, MSc, AMIOA, MInstPhys – Monitoring and Assessment
Stuart has over eight years' experience in environmental consultancy working on, and project managing a range of projects to include residential, transportation, mining, industrial and energy developments, undertaking noise and vibration assessments across the UK and Europe. Stuart has an Honours Degree in Electronics Engineering, a Masters in Radiation Physics, and a Certificate of Competence in Environmental Noise Measurement. He is an Associate Member of the Institute of Acoustics.
Stuart also has experience working in the renewables sector providing technical support for noise propagation and predictions for proposed energy storage, solar PV and wind farm sites, implementing ETSU-R-97 & BS4142 methodology.
He is experienced in the use of environmental sound modelling software, which implements a range of methodologies including Calculation of Road Traffic Sound (CRTN), Calculation of Railway Sound (CRN), BS 5228 and ISO 9613-2.

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