Miller Goodall
Environmental Services

NOISE ASSESSMENT

on behalf of

GRAYS BIOGAS LIMITED

for the site at

MONA INDUSTRIAL ESTATE, MONA, ANGLESEY

REPORT DATE: 15TH MARCH 2016

REPORT NUMBER: 101217

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Summary

A noise assessment was undertaken to predict the potential impact of noise from a development consisting of an Anaerobic Digestion (AD) Plant and associated Combined Heat and Power (CHP) plant at Mona Industrial Estate, Mona, Anglesey. The impact assessment was requested by Natural Resources Wales (NRW) to support the application for an Environmental Permit for an A1 Installation.

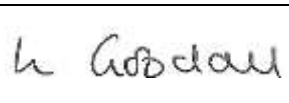
Measurements were made at the location of the nearest residential dwellings to the proposed site to identify the pre-development Background Sound levels. This data was subsequently used to predict the potential impact of noise from likely activities associated with the proposed development when in use.

A noise model has been assembled for the proposed development site, the results from which are provided within this report.

Assessment using the BS 4142:2014 methodology indicates a likelihood of adverse impact at night time, at the nearest receptor or group of receptors to the proposed Installation when all Phase 1 and Phase 2 plant is operating together, namely the CHP.

Mitigation is recommended in the form of enhancements to the acoustic sound insulation of the CHP container.

This report concludes that with the implementation of these recommendations, it is considered that a suitable and commensurate level of protection against noise will be provided to the occupants of the nearest noise sensitive dwellings.

Prepared By	Iain Kelly AMIOA	Reviewed By	Lesley Goodall MIOA
Signed		Signed	
Date	15th March 2016	Date	15th March 2016

Record of changes

Version	Date	Change	Initials
1	11/03/16	Draft issue	IK
2	15/03/16	Final Issue	IK

Contents

1 Introduction

1.1 Miller Goodall Environmental Services Ltd (MGES) has, on behalf of Grays Biogas Limited, undertaken a noise assessment in relation to a proposed Anaerobic Digestion (AD) Plant and associated Combined Heat and Power (CHP) plant, for the generation, storage and utilisation of biogas, otherwise referred to in the report as the Installation. The site lies within the administrative boundary of Isle of Anglesey County Council (IoACC).

1.2 The noise impact assessment report has been produced to support the application for an Environmental Permit for operation of a facility which is classed as an A1 Installation.

2 Site Description

2.1 The site is located approximately 4 km west of the town of Llangefni. The site is currently undeveloped and lies to the east of an existing commercial and industrial park. The site location is shown outlined in red in Appendix 1.

2.2 Directly north of the site is a chicken farm, beyond which is a residential property which lies approximately 170 m from the red line boundary of the development site. The road of Llangefni runs along the eastern boundary of the site, with open fields beyond.

2.3 There are a small number of residential properties to the east of the site, the closest residence to the site being 100 m from the boundary. To the south and west of the site are fields and business units associated with Mona Industrial Estate. A waste recycling business and a highways depot occupy land to the west and north-west of the development site respectively and a relief airfield belonging to RAF Valley on Anglesey which is used for flight training is located approximately 500m to the north-west.

3 Proposed Development

3.1 The proposed development consists of an Anaerobic Digestion (AD) Plant and associated Combined Heat and Power (CHP) plant to be located at Mona Industrial Estate, Mona, Anglesey.

3.2 The Installation is designed for the digestion of liquid and solid feedstock with an anticipated gas production flow of 810 Nm^3 / hour. The feedstock will be buffered and then fed into a digester.

3.3 The liquid feedstocks (or pumpable feedstocks) will be buffered in the buffer tanks and then fed automatically into a digester.

3.4 The solid feedstock will comprise chicken dung and silage. The chicken dung will be stored in a building and its doors will only be opened when a delivery of material is received at the Installation and when the material is taken out to the feeding system. This material will be handled using a wheeled loader.

3.5 Silage will be stored in the silage clamps which will be open at the northern end. Material from these will be transported to the feeding system using a wheeled loader. The mixed solid feedstocks are then fed automatically into the digesters.

3.6 The anaerobic process takes place in the digesters and the biogas produced flows from here into the gas storage dome on the post digester. Material from the post digester is then fed into a solid and liquid separation process.

3.7 The plant comprising the separation, drying and evaporation processes along with the composting process form Phase 2 of the Installation.

3.8 The biogas stored in the post digester is conditioned before being utilised in the CHP plant. The thermal heat required for the digestion process is produced by the hot water cooling system of the CHP. The electricity produced is fed into the grid network.

3.9 At this stage it is proposed that the development will progress in two distinct phases, as follows;

- Phase 1 – All processes except the drying and composting operations;
- Phase 2 – Digestate treatment, including evaporators, drier, composting system, separator and pasteurisation systems.

3.10 There will be two permit applications that will cover the respective Phases described above. The report assesses the noise impact from Phase 1 plant and activities and includes all Phase 2 activities in a cumulative impact assessment.

3.11 A general layout and elevation drawings for the site is shown in Appendix 2a and 2b (plan reference A2529UK_MONA-00-01-layout and A2529UK_MONA-00-00.

4 Policy Context

4.1 Environmental Permitting (England and Wales) Regulations 2010[1]

4.1.1 The Environmental Permitting (England and Wales) Regulation 2010 were introduced on April 2010 and replaced the 2007 Regulations, combining the Pollution Prevention Control (PPC) and Waste Management Licensing (WML) Regulations.

4.1.2 Part 2 of Schedule 1 to the Regulations defines an Installation and lists the activities of the Installation that fall within a Part A(1) activity or a Part A(2) activity. Part A(1) activities are regulated by the Environment Agency in England and by Natural Resources Wales (NRW) in Wales, through an Environmental Permit.

4.1.3 The regulation of Part A(1) permitted activities seek to regulate emissions to air land and water as well as considering issues such as noise, waste and energy efficiency. Applications for permits should include information on how these emissions will be minimized.

[1] Environmental Permitting (England and Wales) Regulations 2010.

4.1.4 For noise and vibration the operator must;

"prevent or minimize noise and vibration if you have an installation permit…To do this you must;

- *factor noise levels in to your plant design, and your plans for maintaining and operating your plant;*
- *position noisy operations (that increase the noise in any area above background noise) away from delivery or vehicle routes;*
- *use noise reduction equipment like balancing fans and fixing loose covers on noisy operations;*
- *isolate noisy operations through measures like acoustic enclosures, silencers, closed doors and walls;*
- *avoid noisy work during evenings and weekends;*
- *switch off your entire plant, or specific vehicles, ventilation units and equipment, when they're not in use."*

4.1.5 Environmental management guidance states site noise levels *"must not be significantly above background noise levels (the noise level in the area surrounding your site). If possible, your site noise level should be well below the background level."*

4.1.6 If the operation is identified as potentially causing noise beyond the site boundary then there may be a requirement to produce a written noise management plan. The Horizontal Guidance Note document H3, Part 2 *Noise Assessment and Control*[2] provides supplementary information relevant to all sectors to assist in preventing and minimizing emissions of noise and vibration.

5 Consultation

5.1 Huw Thomas at IoACC[3] and Stuart Ross of NRW[4] were consulted in respect of the survey scope and assessment methodology used. The consultation document forwarded to the relevant Officers is not included in the report but is available on request.

5.2 The main points that were raised and agreed with IoACC are summarised below;

- Unattended monitoring of background and ambient noise levels would be undertaken at a location representative of the nearest noise sensitive receptor and would be undertaken over a weekend period during suitable weather conditions;
- Following successful completion of the noise survey external noise levels from the operation of the waste plant would be predicted at the nearest noise sensitive receptors using the

[2] Horizontal Guidance Note IPPC H3 Horizontal Guidance for Noise, Part 2 – Noise Assessment and Control. 2004
[3] Email sent to Huw Thomas, Environmental Protection, IoACC 08/01/2016. Reply received 13/01/2016 accepting proposals.
[4] Email sent to Stuart Ross, Regulatory Officer, NRW 11/02/2016. Reply received 18/02/2016.

prediction software CadnaA, and the manufacturers' plant data and source directivity where available. Where this data was not available we would use our experience of assessing similar sites and research to present appropriate representative data in prediction of typical noise levels; and

- The predictions would focus on the receptors closest to the proposed development i.e. the residential receptors to the north at Swn-y-Gwynt and residential receptors to the east.

5.3 The following external noise levels would be derived in octave bands at the assessment location(s):

- Daytime 16 hour ($L_{Aeq,16hr}$); and
- Night time 8 hour ($L_{Aeq,8hr}$)
- Typical night time maximum, based on the 95th percentile of $L_{AFmax,15min}$ measurements made between 23:00 and 07:00 hrs.

5.4 Predicted external noise levels would be rated and assessed using BS 4142:2014 – Methods for Rating and Assessing Industrial and Commercial Sound using the lowest repeatable background (L_{A90}) sound levels measured during the baseline noise survey.

5.5 Where both Residual and Background Sound levels are low then care would be taken to ensure that these levels are not influenced by self-generated noise within the monitoring system. Where this is suspected to have occurred then this data would not be included in the assessment process.

5.6 Internal noise levels would be predicted in octave bands by following the methodologies set down in BS 8233:2014. This, in turn, references the detailed calculation procedure set down in BS EN ISO 12354-3. The calculations would take into account typical external wall, window and sliding door constructions.

5.7 The predicted internal noise levels would be compared to recognised criteria provided in BS 8233:2014 and WHO Guidelines for Community Noise.

5.8 BS 8233:2014 adopts guideline external noise values provided in WHO for external amenity areas such as gardens and patios. The standard states that it is "desirable" that the external noise in such areas does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$.

5.9 The main points that were raised with NRW are included and quoted from their response email of the 18th February 2016;

"We have considered the points raised in your e-mail and the monitoring consultation document as provided- we have the following comments;

- *For a site that is operational 24/7/365 there may be seasonal variation in the sound level not only from the operation but also due to meteorological factors. The meteorological effect may not be significant in the short distance to the receptor but variations in plant operations / vehicle movements (e.g. import of fuel crops late summer / export of digestate Spring / Autumn) may need to be considered in the modelling;*

- *The report proposes the use of a noise logger over a weekend period. As the plant will be operational 24/7 it would be beneficial to collect background data during a weekday period.*

- *Weather conditions should be presented at the measurement location. Unattended long term measurements will require a meteorological station at the monitoring location.*

- *Attended Measurement – consideration must be given as to how many 1 hour (day) and 15 minute (night) periods will be collected to ensure that the values are reliable.*

- *The report states that 'residual & background measurements will be made during the quietest periods of the night i.e. after midnight and before 03:00 hrs'. BS4142 clause 8.1 states:*

"The background sound level is an underlying level...the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods". It is therefore important to consider the times when people are most likely to be disturbed rather than the quietest period. The unattended measurement period would pick this up but not necessarily the attended."

5.10 NRW also requested that the information requirements for the noise impact assessment include the points detailed in the guidance note, *Noise impact assessment – information requirements (for applications which include computer modelling or spreadsheet calculations)*[5].

6 Acoustic Standards and Guidance

6.1 BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

6.1.1 This standard provides recommended guideline values for internal noise levels within dwellings which are similar in scope to guideline values contained within the World Health Organisation (WHO) document, Guidelines for Community Noise (1999)[6]. These guideline noise levels are shown in Table 1, below and are those agreed with the Local Authority.

[5] Document accessed 18/02/2016, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/432592/LIT_10022.pdf
[6] World Health Organisation Guidelines for Community Noise, 1999

Table 1: BS 8233: 2014 guideline indoor ambient noise levels for dwellings

Location	Activity	07:00 to 23:00	23:00 to 07:00
Living Room	Resting	35 dB $L_{Aeq,16hr}$	-
Dining room/area	Dining	40 dB $L_{Aeq,16hr}$	-
Bedroom	Sleeping (daytime resting)	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

6.1.2 BS 8233:2014 advises that:

> *"regular individual noise events…can cause sleep disturbance. A guideline value may be set in terms of SEL[7] or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values".*

6.1.3 The previous edition of BS 8233:1999 suggested a guideline threshold value of 45 dB L_{AFmax} over 8 hours at night in bedrooms.

6.1.4 BS 8233:2014 adopts guideline external noise values provided in WHO for external amenity areas such as gardens and patios. The standard states that it is "desirable" that the external noise does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ whilst recognising that development in higher noise areas such as urban areas or those close to the transport network may require a compromise between elevated noise levels and other factors that determine if development in such areas is warranted. In such circumstances, the development should be designed to achieve the lowest practicable noise levels in external amenity areas.

6.2 World Health Organisation (WHO) Guidelines for Community Noise 1999

6.2.1 The WHO Guidelines 1999 recommends that to avoid sleep disturbance, indoor night-time guideline noise values of 30 dB L_{Aeq} for continuous noise and 45 dB L_{AFmax} for individual noise events should be applicable. It is to be noted that the WHO Night Noise Guidelines for Europe 2009[8] makes reference to research that indicates sleep disturbance from noise events at indoor levels as low as 42 dB L_{AFmax}. The number of individual noise events should also be taken into account and the WHO guidelines suggest that indoor noise levels from such events should not exceed approximately 45 dB L_{AFmax} more than 10 – 15 times per night.

6.2.2 The WHO document recommends that steady, continuous noise levels should not exceed 55 dB L_{Aeq} on balconies, terraces and outdoor living areas. It goes on to state that to protect the majority of individuals from moderate annoyance, external noise levels should not exceed 50 dB L_{Aeq}.

[7] Sound exposure level or L_{AE}
[8] WHO Night Noise Guidelines for Europe 2009

6.3 BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound'

6.3.1 BS 4142: 2014[9] provides guidance on the assessment of the likelihood of complaints relating to noise from industrial sources. It replaced the 1997 edition of the Standard in October 2014. The key aspects of the Standard are summarised below.

6.3.2 The standard presents a method of assessing potential noise impact by comparing the noise level due to industrial sources (the Rating Level) with that of the existing background noise level at the nearest noise sensitive receiver in the absence of the source (the Background Sound Level).

6.3.3 The Specific Noise Level - the noise level produced by the source in question at the assessment location - is determined and a correction applied for certain undesirable acoustic features such as tonality, impulsivity or intermittency. The corrected Specific Noise Level is referred to as the Rating Level.

6.3.4 In order to assess the noise impact, the Background Sound Level is arithmetically subtracted from the Rating Level. The standard states the following:

- *Typically, the greater this difference, the greater the magnitude of the impact,*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context,*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context,*
- *The lower the Rating Level is relative to the measured Background Sound Level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the Rating Level does not exceed the Background Sound Level, this is an indication of the specific sound source having a low impact, depending on the context.*

6.3.5 In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014 edition places emphasis upon an appreciation of the context, as follows:

> *An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.*

6.3.6 The 2014 edition of BS 4142 also introduces a requirement to consider and report the uncertainty in the data and associated calculations and to take reasonably practicable steps to reduce the level of uncertainty.

[9] BS 4142:2014 Methods for rating and assessing industrial and commercial sound

7 Noise Survey

7.1 Measurements of Existing Noise Sources

7.1.1 Noise measurements were undertaken at a location consistent with the nearest noise sensitive receptor in accordance with BS 7445-1: 2003[10] by Iain Kelly and Lesley Goodall of Miller Goodall Environmental Services Ltd.

7.1.2 The measurement location was within the rear garden of residential property at grid reference; SH 42219 75548 as shown in Appendix 1. Huw Thomas of IoACC was in attendance when the survey equipment was being deployed and assisted in agreeing a location for the monitoring equipment. Measurements were made under free-field conditions at a height of 1.4 m above the ground. Figure 1 illustrates the equipment at the measurement location.

Figure 1: Installation of the sound level meter and weather station

7.1.3 All instrumentation used during the surveys were fully calibrated and traceable to UKAS standards and satisfy the requirements for Class 1 instruments described in BS EN 61672-1:2013[11].

7.1.4 The conformity of the sound level meter (SLM) was checked before and after measurements with negligible deviation (<0.1 dB). Details of the equipment used are shown in Table 2, below.

[10] BS 7445-1: 2003 Description and measurement of environmental noise - Part 1: Guide to quantities and procedures
[11] British Standards Institution (2013) 61672-1 Electroacoustics – Sound level meters – Part 1: Specifications, BSI. London

Table 2: Noise monitoring equipment

Equipment Description	Type Number	Manufacturer	Serial No.	Date Calibrated	Calibration Certification Number
Class 1 Sound Analyser	Type NOR 140	Norsonic	1406017	22/05/15	U18820
Microphone	Type NOR 1225	Norsonic	151206	22/05/15	18658
Calibrator	Type NOR 1251	Norsonic	34123	03/07/15	02352/1
Outdoor microphone housing	Type NOR 1217	Norsonic	12175146	N/a	N/a
Weather Station	Vantage Vue	Davis	MJ150128029	N/a	N/a

7.1.5 The noise levels measured during the surveys included the following noise indices;

- L_{Aeq} – the equivalent continuous sound pressure level over the measurement period;
- L_{Amax} – the maximum sound pressure level occurring within the defined measurement period;
- L_{A90} – the sound pressure level exceeded for 90% of the measurement period and is used within BS 4142 as a descriptor of background noise level; and
- L_{A10} – the sound pressure level exceeded for 10% of the measurement period.

7.1.6 The time constant of the SLM was set to 'Fast' during all measurements. This corresponds to an integration time of 125 ms and is commonly used to approximate the temporal response of the human ear, or the human ear's integration time for a fluctuating noise level.

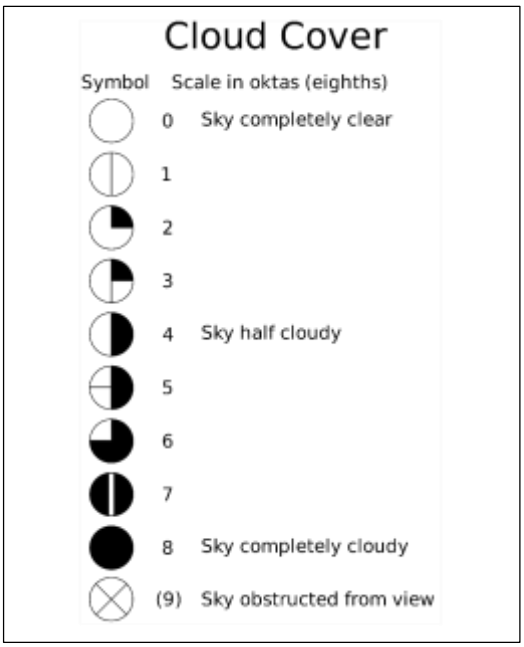
7.1.7 Weather conditions were determined both at the start and on completion of the survey specified in Table 3 below.

7.1.8 A fully integrated wireless weather station was used to provide information on meteorological conditions during the unattended survey. The weather station was tripod mounted at a height of 1.8 m above ground level and this was positioned approximately 2.0 m from the SLM at the off-site monitoring location.

7.1.9 Periods of the measurement data where wind speeds exceeded 5.0 m/s and where precipitation was noted were removed from the data set before calculations were made. A period of intermittent rain was noted between 13:00 hrs on the 11/02/2016 and 01:30 hrs on the 12/02/2016. Wind speeds were noted to be less than 1.0 m/s throughout the monitoring period.

7.1.10 The meteorological data in relation to wind speeds and hourly precipitation is presented graphically in Appendix 3.

Table 3: Dates, times and weather conditions during attended noise measurements

Measurement Locations	Date/Time	Weather conditions		
		Description	At Start of Survey	On Completion
MP1	10/02/16, 14:45 to 15/02/16, 13:00	Temperature:	7.0 ºC	6.0 ºC
		Precipitation:	Dry	Dry
		Cloud cover (oktas – see opposite):	2/3	0
		Any fog/snow/ice?	No	No
		Any damp roads/wet ground?	No	No
		Wind speed:	1 - 2 m/s	None
		Wind direction:	Variable, generally westerly	N/A
		Any conditions that may cause temp. inversion (e.g. calm nights with no cloud):	No	No

7.1.11 Measurements were taken at times considered to be representative of the periods during which the nearest noise sensitive receptors would be subject to the highest levels of noise from the proposed plant.

7.1.12 A subjective assessment of the existing noise sources observed during the deployment and collection of the SLM and from the recorded audio gathered during the monitoring survey, and within the vicinity of the measurement location MP1 are summarised in Table 4 , below:

Table 4: Description of noise sources at the measurement location

Locations	Date	Time Period	Noise Sources
MP1	10-11/02/2016	23:00hrs – 07:00hrs	Very distant road noise, agricultural sounds, birdsong and occasional dog barking (paused from measurements).
MP1	11/02/2016	07:00hrs – 23:00hrs	Occasional vehicles passing on local road. Jet aircraft overhead from 08:34hrs to 09:36hrs. Distant road noise, occasional light aircraft, agricultural sounds, birdsong and occasional dog barking (paused from measurements). Intermittent periods of data when rainfall occurred (15:00hrs to 23:00hrs) removed from data.
MP1	11-12/02/2016	23:00hrs – 07:00hrs	Very distant road noise, agricultural sounds, birdsong and occasional dog barking (paused from measurements). Period of rainfall from 00:30hrs to 01:30hrs paused from measurement.
MP1	12/02/2016	07:00hrs – 23:00hrs	Jet aircraft throughout the daytime period. Occasional domestic sounds, distant road noise, agricultural sounds, birdsong and occasional dog barking (paused from measurements).
MP1	12-13/02/2016	23:00hrs – 07:00hrs	Occasional domestic sounds, very distant road noise, agricultural sounds, and birdsong
MP1	13/02/2016	07:00hrs – 23:00hrs	Occasional vehicles passing on local road. Distant road noise, domestic sounds, agricultural sounds, birdsong.
MP1	13-14/02/2016	23:00hrs – 07:00hrs	Occasional domestic sounds, very distant road noise, and birdsong.
MP1	14/02/2016	07:00hrs – 23:00hrs	Occasional vehicles passing on local road. Distant road noise, domestic sounds, agricultural sounds, birdsong. Occasional dog barking (paused from measurements).
MP1	14-15/02/2016	23:00hrs – 07:00hrs	Very distant road noise, occasional domestic sounds, and birdsong.
MP1	15/02/2016	07:00hrs – 13:00hrs	Distant road noise, agricultural sounds, occasional jet aircraft, birdsong and occasional dog barking.

7.2 Monitoring Results

7.2.1 A summary of the broadband measurement data is provided for MP1 in Table 5. Whilst all the individual noise measurement data are not presented in this report, they are kept on file for future reference. All data are sound pressure levels in dB re 20 μPa.

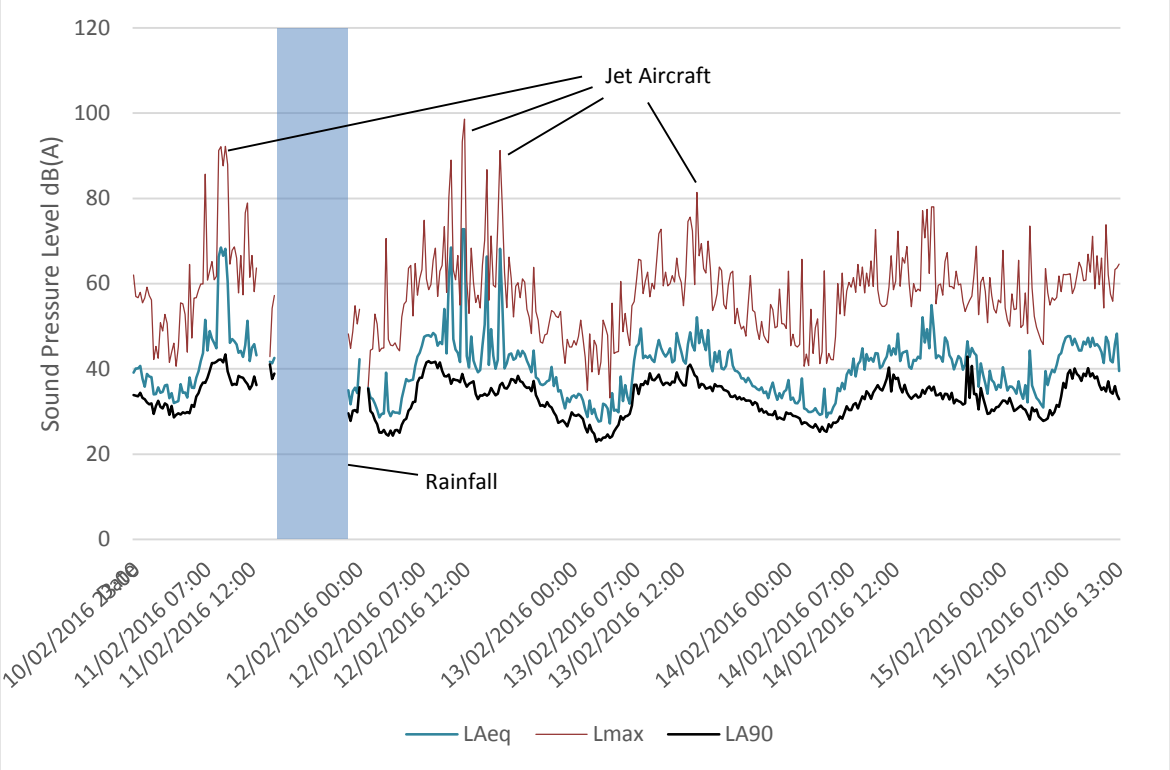
Table 5: Summary of noise measurements at MP1

Period	Sound Pressure Level, dB	
	$L_{Aeq,T}$	L_{Amax}
Night time Wed 10/02/16 23:00 to Thurs 11/02/16 06:59	37.6	64.5
Day-time Thurs 11/02/16, 07:00 – 22:59*	59.6	92.2**
Night time Thurs 11/02/16 23:00 to Fri 12/02/16 06:59*	35.6	70.6
Day-time Fri 12/02/16, 07:00 – 22:59	59.7	98.6**
Night time Fri 12/02/16 23:00 to Sat 13/02/16 06:59	32.7	60.5
Day-time Sat 13/02/16, 07:00 – 22:59	43.9	81.4
Night-time Sat 13/02/16 23:00 to Sun 14/02/16 06:59	33.6	65.7
Day-time Sun 14/02/16, 07:00 – 22:59	44.6	78.0
Night-time Sun 14/02/16 23:00 to Mon 15/02/16 06:59	37.2	65.5
Day-time Mon 15/02/16, 07:00 – 13:00	45.8	73.8

*Periods of data removed due to precipitation (rainfall) from 1245 hrs to 2300 hrs on 11/02/16 and from 0030 hrs to 0130 hrs on 12/02/16.
** L_{Amax} due to jet aircraft.

7.2.2 The level versus time history plots for MP1 are presented for the full duration of the monitoring survey in Figure 2.

Figure 2: Time history of measurements at MP1, 10/02/16 – 15/02/16



7.2.3 It can be seen from Figure 2 that a number of distinct noise events occurred during the weekday daytime periods. An audio recording function on the sound level meter allowed these events to be investigated and were found to be jet aircraft passing overhead. Other noise events throughout the measurement period were noted to be from a barking dog and occasional light aircraft using the airfield. The periods of the data where dogs barking in the vicinity of the measurement location were removed from the data. Periods where precipitation occurred were also removed from any further analysis and is indicated on the level time plot in Figure 2.

7.3 Determination of the Background Sound Levels

7.3.1 When assessing the impact of the proposed development at the nearest noise sensitive receptors it was deemed appropriate to assess weekday periods separately from weekend periods due to the contributions to the ambient sound levels from activity associated with the airfield.

7.3.2 Care was taken to ensure that any measured low Background Sound levels were not less than 10 dB above the noise floor of the SLM. The Norsonic Nor140 instrument in the configuration of a 1209 pre-amplifier and 1225 free field microphone has a self-generated noise level of 18 dB in the A-weighted spectral weighting function.

7.3.3 The background sound levels for the day and night time assessment periods were derived by looking at distinct periods of the day time (07:00hrs to 23:00hrs) and night time (23:00hrs to 07:00hrs), corresponding to the likely operation of fixed plant and machinery.

7.3.4 The background sound levels for the day and night time assessment periods for weekday and weekend periods were derived using statistical analysis of the measured $L_{A90,15min}$ levels. The results of the analysis are presented in Figure 3 to Figure 6 below.

Figure 3: Weekday Day-time Background Noise Level Histogram

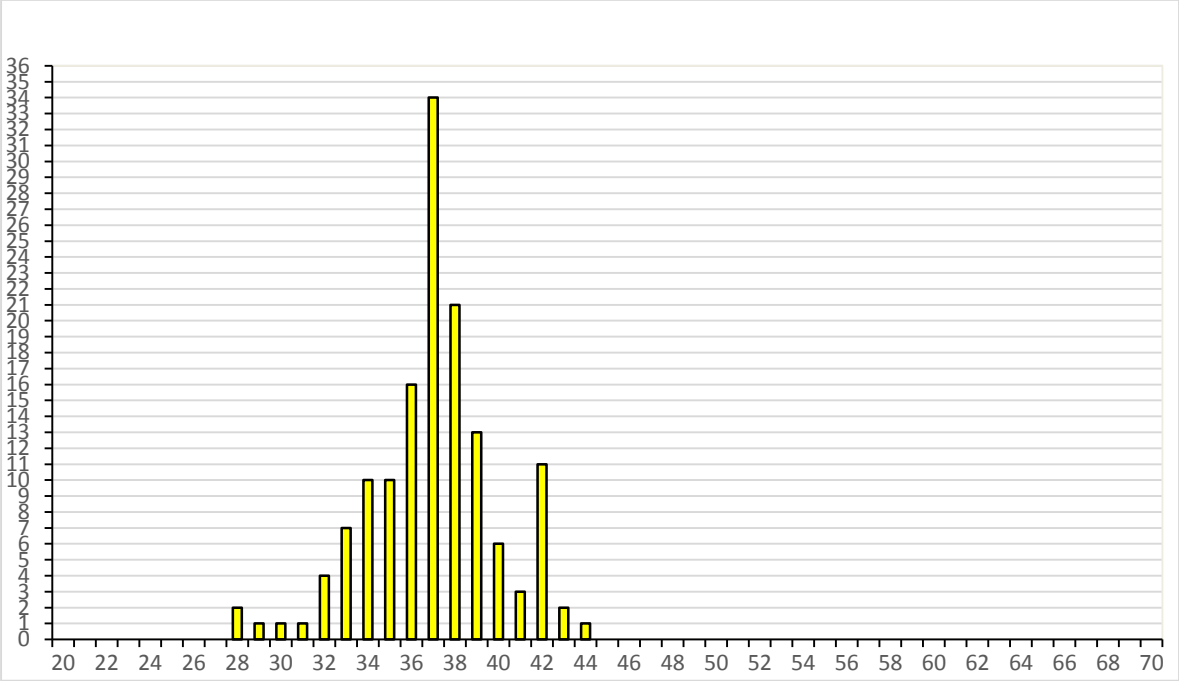


Figure 4: Weekday Night-time Background Noise Level Histogram

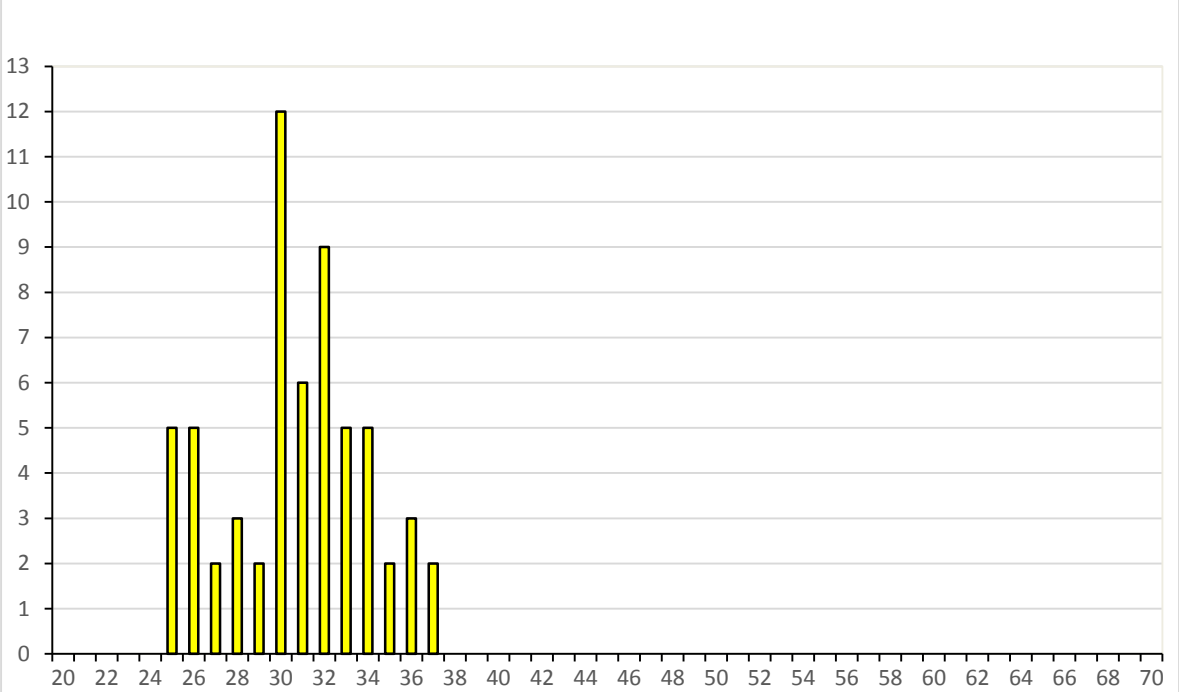


Figure 5: Weekend Day-time Background Noise Level Histogram

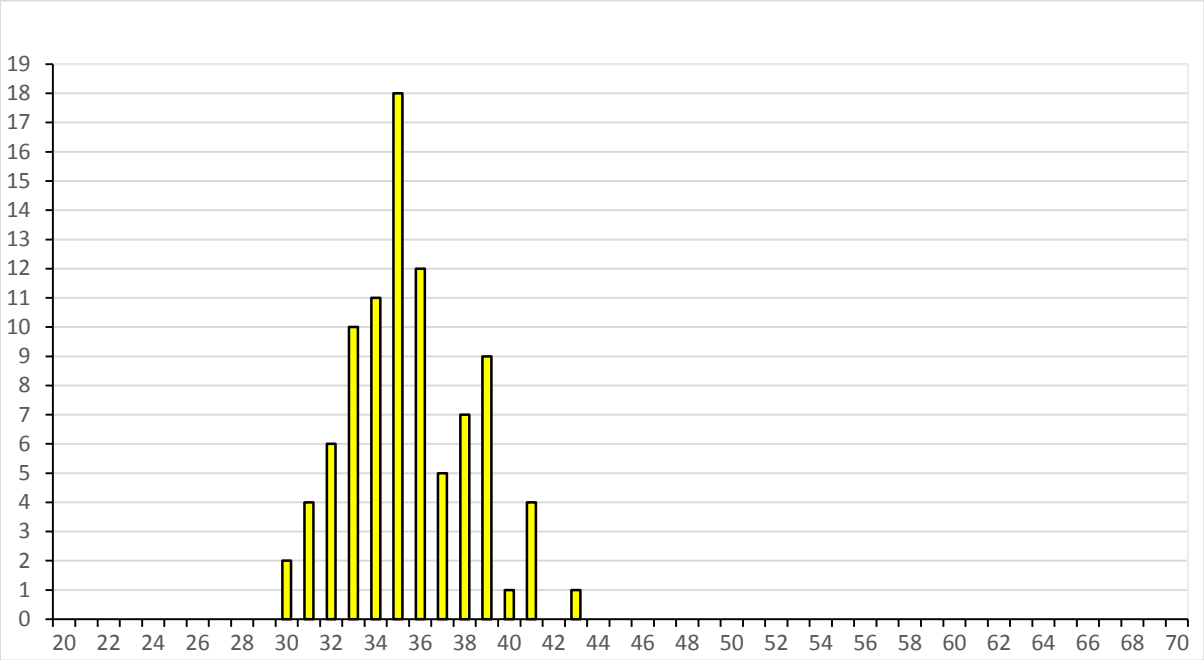
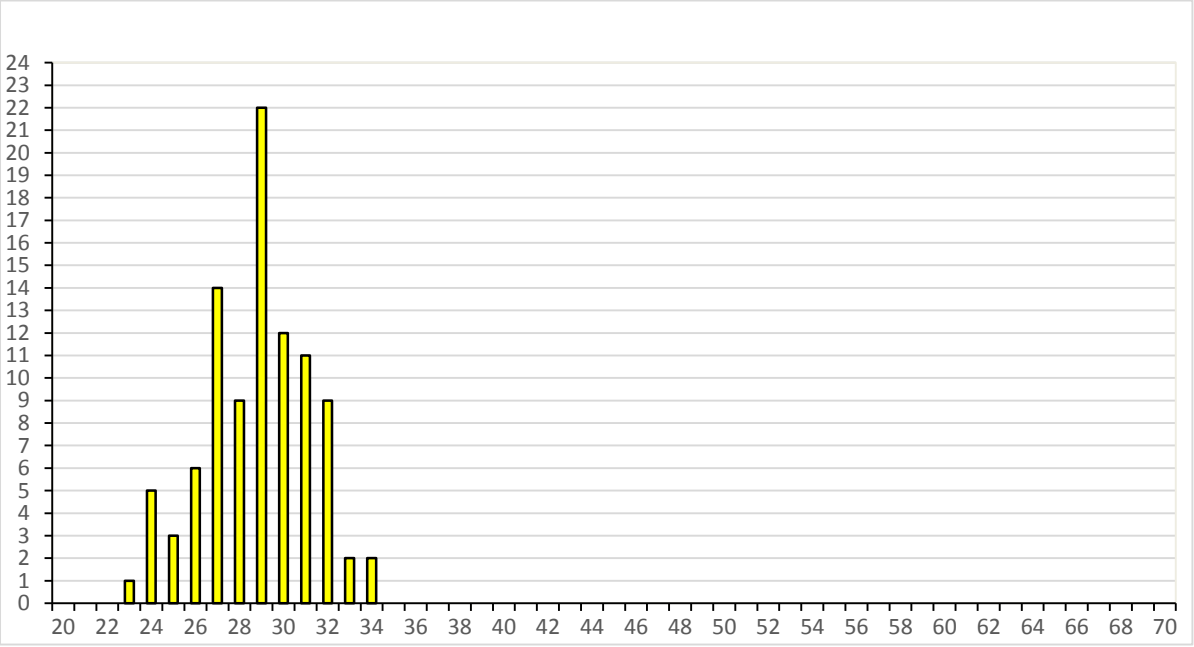


Figure 6: Weekend Night-time Background Noise Level Histogram



7.3.5 Using statistical analysis the most frequently occurring value of the measured $L_{A90,15min}$ levels was obtained for the time periods presented in Table 5. Table 6 presents the derived L_{A90} values for the day and night time assessment periods corresponding to the periods used to assess the various operational states of the Installation.

Table 6: Summary of Derived LA90 Values for the Day and Night time Periods at MP1

Period	Sound Pressure Level, dB $L_{A90, 15min}$
Weekday daytime (07:00 to 23:00hrs)	37
Weekday night-time (23:00hrs to 07:00hrs)	30
Weekend daytime (07:00 to 23:00hrs)	35
Weekend night-time (23:00hrs to 07:00hrs)	29

7.3.6 In this instance the most frequently occurring background sound level over the measurement period is chosen to be representative of the typical background sound level for the time periods of interest at the nearest noise sensitive receptor or group of receptors. In this case, the values of 37 dB L_{A90} during the week day and 30 dB L_{A90} during the weekday night are considered to be typical. At weekends a value of 35 dB L_{A90} during the day and 29 dB L_{A90} during the night are considered to be typical.

8 Modelling of Noise From the Development

8.1 Computer Modelling

8.1.1 Predictions of noise levels at the nearest noise sensitive receptors to the proposed development were undertaken using the CadnaA noise modelling package.

8.1.2 The general horizontal plan information of the area surrounding and including the proposed development site was imported from Google Earth. This was used to determine road positions, existing building footprint areas and relative locations, and is considered accurate to within 5%. Building height information was based on site observations. The size of the study area warranted the inclusion of topography in the design of the model, although it was noted that the proposed site is flat with little variation in terrain height.

8.1.3 Additional development drawings and base maps were provided by Agraferm Technologies, as follows;

- Drawing number A2529UK_MONA-00-01-layout (Appendix 2a);
- Drawing number A2529UK_MONA-00-00-elevation plan (Appendix 2b).

8.1.4 Specific model parameters were applied as follows:

- Propagation of noise using algorithms within ISO 9613: 1993 *Acoustics - Attenuation of sound during propagation outdoors*;

- Ground absorption G = 0.6 (equivalent to grassed areas and consistent with the dominant ground cover at the site);
- Ground attenuation: spectral all sources;
- No adverse meteorological effects; and
- Two orders of reflection.

8.1.5 The study area for the noise assessment comprised the area immediately adjacent to the proposed Installation and the receptors in proximity to the site likely to be affected by the scheme.

8.1.6 The noise model was used to predict the impact of noise from the following sources:

1) HGV and vehicle deliveries and on site movements, including Phase 1 plant - Daytime;
2) Loading and operation of the Havelberger hopper, including all Phase 1 plant - Daytime;
3) Phase 1 plant only - Daytime;
4) Phase 1 plant only – Night time;
5) Standby situation (all plant, emergency genset and flare) Daytime and Night time; and
6) Cumulative situation (all Phase 1 and Phase 2 plant including vehicle movements) Daytime and Night time.

8.1.7 To complete the noise assessment the following data sources were used:

- HGV traffic flow data used in the prediction of noise impacts from deliveries to the Installation were provided by Oaktree Environmental Limited;
- Noise levels for the HGV's were obtained from previous surveys undertaken by MGES Limited and the noise source data library contained within the CadnaA noise modelling package; and
- The source noise levels of plant and equipment were obtained from data supplied by Agraferm Technologies. These are presented in Section 8.

8.2 Noise from HGV and Vehicle Movements

8.2.1 Noise from HGV and vehicle movements on a site form an intrinsic part of the total sound emanating from Industrial and Commercial premises. The scope of BS 4142:2014 includes for the rating and assessment of sound of this nature.

8.2.2 The Installation is expected to receive several deliveries per week and several outbound vehicle movements transporting material off site. CadnaA noise modelling software was utilised to predict the noise effects from delivery noise associated with the development. Operational vehicle activity was based on information provided by Oaktree Environmental Ltd. and presented in Table 7.

Table 7: Summary of Vehicle Movements to and from the Installation

Activity	Vehicle Type	Trips per week	Trips per day
Chicken Litter	Tractor and Trailer	23	3
DAF Effluent Tankers	44 Tonne Bulk Tanker Rig	12	2
Effluent Tankers	Tractor and Trailer Effluent Tank	12	2
Glycerol	44 Tonne Bulk Tanker Rig	2	1
Silage Trailers	Tractor and Silage Trailer	53*	8*
Whole Crop Rye	Tractor and Silage Trailer	21**	3**

* During maize silage in the months of October and November

** During whole crop rye harvest months of June and July

8.2.3 As the daytime assessment reference period for BS 4142:2014 is up to 1 hour, it was assumed that not all of the vehicles expected in a single operating workday (07:00hrs to 19:00hrs) would arrive and depart in the 1 hour period. Therefore to present a conservative assessment, the impact of 2 tractors towing trailers and 1 vehicle of each remaining type in the 1 hour reference period was predicted at the nearest noise sensitive receptors. This situation is likely to be representative of periods during maize silage and whole crop rye harvest and represents the worst-case scenario.

8.2.4 The operating hours for deliveries to and from site are;

- Monday to Friday 07:00 hrs to 19:00 hrs
- Saturday 07:00 hrs to 16:00 hrs
- Sunday 09:00 hrs to 16:00 hrs

8.2.5 Delivery and export of feedstocks will take place only during the hours stated above and there will be no operation of mobile plant on site outside of those hours. The impact of noise from the mobile plant and HGV / Tanker deliveries were assessed for weekday and weekend daytime periods only.

8.2.6 Table 8 details the modelled inputs and assumptions for the vehicles and mobile plant likely to contribute to the operational phase activity at the Installation.

Table 8: List of Vehicles and Mobile Plant Included in the Model

Activity	Plant	Reference data	Sound Pressure level (L_p) dB(A) at 10m	Modelled Input Type
Mobile Plant	Wheeled Loader	BS 5228:2009 C.6.34	76	Line Source
	Wheeled Loader loading hopper 23 t	BS 5228:2009 C.6.32	75	Point Source
Deliveries and Collections	HGV / Effluent Tankers 44 t	BS 5228:2009 C.11.4	83	Moving line source at 20 km/h
	Tractor and Trailer	BS 5228:2009 C.4.75	79	Moving line source at 16 km/h
	Tractor and Trailer Effluent Tank	BS 5228:2009 C.6.38	83	Moving line source at 16 km/h

8.2.7 Table 9 presents the octave band noise level spectra for the HGV's and mobile plant used in the modelled predictions.

Table 9: Octave band noise level spectra of Modelled HGV's and Mobile Plant

Description	Sound Pressure Level, dB in Octave Band Centre Frequency, Hz								dB(A)
	63	125	250	500	1k	2k	4k	8k	
Wheeled Loader 23 t	82	82	71	73	69	67	66	58	76
Wheeled Loader loading hopper 23 t	83	77	70	70	70	68	64	58	75
HGV / Effluent Tankers 44 t	82	80	78	75	76	78	75	69	83
Tractor and Trailer	93	86	76	76	73	72	64	59	79
Tractor and Trailer Effluent Tank	78	86	84	78	78	77	70	69	83

8.3 Noise from Phase 1 Fixed Plant

8.3.1 Plant data and operational specification was supplied by Agraferm Technologies which included A-weighted broadband sound pressure levels. Typical plant spectral sound levels were obtained from manufacturer information where available. This was used to populate the environmental noise model at the proposed Installation.

8.3.2 The modelled inputs considered the worst-case continuous operation of most plant items and that these will operate concurrently and during the day and night time.

8.3.3 Table 10 presents the included plant information for each of the Phase 1 processes at the Installation.

Table 10: List of Plant for the Phase 1 Noise Impact Assessment

Activity	Plant	Make/Model	No.	Sound level dB L_{Aeq}	On-time %
Energy Generation	CHP	Edina / TCG 2020V20	1	65 (at 10 m)	100
	Intercooler and dump radiator	Edina	1	65	100
Flaring	Flare	Uniflare / UFO ENV-850	1	75	100*
	Gas booster	Continental – Type 020-02	1	75	100*
Gas Conditioning	Gas Compression	Meidinger AG / A-HA/125/1020/1 G	1	85 (at 1 m)	100
	Gas Cooling	FriConAir 250/850-55-36-0-0	1	44 (at 10 m)	100
	Gas Cooling	FriConAir 250/850-36-15-0-0	1	54 (at 10 m)	100
Standby Power	Emergency Genset	Pramac / GSW150V	1	68 (at 7 m)	100*
Solid Feed System	Havelberger Hopper	Havel berger Fahrzeug - H50M3	2	70	100
	Screw Conveyors	Havel berger Fahrzeug	2	Negligible	100
Digesters 1 & 2	Agitator gear vertical	Steverding Rührwerkstechnik GmbH	8	<75 (at 1 m)	15
	Agitator motor vertical	Steverding Rührwerkstechnik GmbH	8	62 (+/- 3 dB) (at 2 m)	15
Post Digester	Paddle Agitator horizontal	Steverding Rührwerkstechnik GmbH	2	72 (at 2 m)	15

	Mixer	Suma Rùhrtechnik GmbH	1	75 (1 m)	15
Storage Tank	Mixer	Suma Rùhrtechnik GmbH	2	75 (1 m)	15
Pumps	Various uses	Netzsch & Wangen	13	70 & 60	100

* Only during emergency standby situation.

8.3.4 The combined heat and power plant (CHP) will comprise an Edina TCG 2020 v20 model with 2.0 MW electrical power generation to be housed in a containerised unit. This will include an inverter driven intercooler heat dump radiator situated on the roof of the container, gas exhaust with silencer and air intake and outlets with acoustic louvres.

8.3.5 The CHP container was modelled as a building (H= 3.4 m, W= 3.0 m, L= 14.0 m) with area sources attached to the sides and roof of the building. The intercooler heat dump radiator was modelled as a point source on the roof of the container. The CHP container construction was modelled as having a Sound Reduction Index value of 45 dB R_w for a sandwich construction of steel plus damping and 100 mm glass fibre core. Table 11 provides the sound reduction index values in octave bands for the CHP container.

Table 11: Modelled Sound Reduction Index values for the Enhanced CHP Container

CHP Enclosure	Sound Reduction Index, dB R_w in Octave Band Centre Frequency, Hz								R_w
	63	125	250	500	1k	2k	4k	8k	
Enhanced CHP enclosure.	17	21	37	52	61	59	72	72	45

8.3.6 A standby gas flare and booster will be situated to the north of the storage tank and is typically expected to operate when the CHP is in shutdown for servicing or in case of emergency. Both the flare and the booster were input in to the model as point sources. To represent a worst case scenario these plant items were modelled as being operational for 100 percent of the assessed time period when the CHP plant is in shutdown and the emergency generator is in operation.

8.3.7 Gas conditioning plant, consisting of an air and water cooler and a Meidinger AG compressor, is to be situated between the Storage tank, Post Digester and Digesters 1 and 2. These were input into the model as point sources and as continuous steady state operation.

8.3.8 The loading and handling of solid feedstock will take place to the south of Digesters 1 and 2 and will comprise two Havelberger feed hopper units that will be loaded by a wheeled loader. The wheeled loader was input into the model as a point source and with an operational height of 1.5 m above ground level. It was assumed that for the assessment period of 1 hour for the daytime this plant

would not be operational for more than 25 percent of the time. It is not anticipated that this plant will be used during the night.

8.3.9 The Havelberger hoppers were input as buildings with area sources attached to each end to represent the approximate location of the milling drums. It was assumed that for the assessment period of 1 hour for the daytime, this plant would be operational continuously. The conveyors that transport the product into the digesters were not modelled as the noise produced by these will be negligible.

8.3.10 The storage, movement and handling of chicken dung will take place in the building to the northeast of the silage clamps. A roller shutter door will provide access to the building for the loading and unloading of material. This will only be opened to allow access of vehicles and will remain closed during the handling of material by a wheeled loader. This was modelled with the input of the roller shutter door as an area source with the wheeled loader operating inside the building. The transmission loss value for the roller shutter was derived from within the global library in CadnaA using a weighted sound reduction index value of 19 dB R_w.

8.3.11 The digesters will each have four vertical paddle agitators with an agitator gear and motor being the main noise producing components. These were modelled as point sources at a height equivalent to the height of the digester tanks (11.7 m above ground level).

8.3.12 A further two horizontal paddle agitators and mixers were included in the model at the Post Digester and the Storage tanks. These were modelled as points sources snapped to the façade of the tanks with an operational period of 10 percent of the assessment period.

8.3.13 A machine room will be situated between Digesters 1 and 2 and this will contain pumps, compressed air supply and the digester heating distribution system.

8.3.14 Various pumps serving the feedstock delivery, buffer tanks, collecting and mixing, and holding tank have been included in the model as point sources with a continuous steady operating time. A drawing in Appendix 2c illustrates the approximate location of the pumps for reference (circled in yellow).

8.3.15 As most of the fixed plant will operate 24 hours a day, 7 days a week on a demand basis it was deemed appropriate to assess the impact of sound from these items for both day and night time periods. It was considered that as the lowest ambient sound levels occur at weekends the assessment would only include for these periods so as to represent a worst case assessment.

8.4 Noise from Phase 2 Fixed Plant

8.4.1 In addition to the plant detail provided in Table 10, a cumulative impact assessment considered the operation of all of the Phase 1 application plant with the process plant that will form a part of the Phase 2 application. This includes all the plant that serves the drying and composting operations namely the evaporator, drier and separators and is presented in Table 12.

Table 12: List of Plant for the Phase 2 Noise Impact Assessment

Activity	Plant	Make/Model	No.	Sound level dB L_{Aeq}	On-time %
Composting	Press Screw Separation	SP800 HDS040	4	60 (at 10m)	50
Digestate Treatment	Evaporator Chillers	MKR Metzger GmbH/ RT-600	1	72 (at 10m)	100
Separators	Separator	EYS Dewatering and Composting Solutions BC-50	4	60 (at 10m)	50

9 Results – CadnaA Outputs

9.1 CadnaA Modelled Outputs

9.1.1 Screen shots from the noise model indicating the noise contours and the highest predicted broadband L_{Aeq} noise levels at the nearest noise sensitive receptors are shown in Appendices 5.1 to 5.7. Note that the model includes a 3.0 m high wall to the eastern boundary of the Installation in the vicinity of the Digesters and Storage tank and walls in the vicinity of the CHP plant. The wall to the eastern boundary was present during the visit to install the unattended SLM and is assumed will be retained as the scheme is developed. The walls in the vicinity of the CHP plant have been interpreted from the elevation drawing A2529UK_Mona-00-00 supplied by Agraferm Technologies.

9.1.2 The predicted noise levels from the model are the A-weighted sound pressure levels at the location of first floor windows unless stated otherwise. In summary, the model indicated the following:

- Highest predicted daytime noise level at the nearest noise sensitive receptors from the HGV and vehicle deliveries and on site movements, including Phase 1 plant is **30 dB L_{Aeq} at the nearest existing dwelling;**
- Highest predicted daytime noise level at the nearest noise sensitive receptors from the loading and operation of the Havelberger hopper, including all Phase 1 plant is **35 dB L_{Aeq} at the nearest existing dwelling;**
- Highest predicted daytime noise level at the nearest noise sensitive receptors from the Phase 1 plant only is **30 dB L_{Aeq} at the nearest existing dwelling;**
- Highest predicted night-time noise level from the Phase 1 plant is **30 dB L_{Aeq} at the nearest existing dwelling;**
- Highest predicted noise level from a standby situation (all plant, emergency genset and flare) is **31 dB L_{Aeq}, at the nearest existing dwelling;**
- Highest predicted daytime noise level from a cumulative situation (all Phase 1 and Phase 2 plant) is **36 dB L_{Aeq}, at the nearest existing dwelling; and**
- Highest predicted night time noise level from a cumulative situation (all Phase 1 and Phase 2 plant) is **32 dB L_{Aeq}, at the nearest existing dwelling.**

10 Assessment of Impact of Development Noise

10.1 BS 4142: 2014 Assessment

10.1.1 A BS 4142 noise impact assessment has been undertaken in order to assess the potential noise impact at the nearest noise sensitive receptor located 100 m from the east boundary of the site for both day and night time periods. A residential receptor 260m from the southern boundary of the Installation at (Grid reference X241937 Y375211) was discounted from the assessment due to the large separation distances and its close proximity to the A5 and A55 carriageway.

10.1.2 The BS 4142:2014 assessment summary of noise impact at the location of the highest predicted noise level is shown in Table 13 and Table 14 for the following operational situations;

1) HGV and vehicle deliveries and on site movements, including Phase 1 plant - Daytime;
2) Loading and operation of the Havelberger hopper, including all Phase 1 plant - Daytime;
3) Phase 1 plant only - Daytime;
4) Phase 1 plant only – Night time;
5) Standby situation (all plant, emergency genset and flare) Daytime and Night time; and
6) Cumulative situation (all Phase 1 and Phase 2 plant) Daytime and Night time.

10.2 Daytime Noise Assessment

10.2.1 Appendix 4 presents the Tables illustrating the steps in calculating the Rating levels for each operational situation.

Table 13: BS 4142:2014 Noise Impact Assessment Summary - Daytime

Situation	Description	Calculated Free Field level dB $L_{Aeq,T}$	Acoustic Feature Correction dB	Calculated Rating level dB $L_{Aeq,T}$	Assessment Level ($_{Rating}$ – $_{Background\ level}$)	BS 4142 Assessment of Impact
1	HGVs & Phase 1 plant	30	0*	30	(30-35) -5	Low Impact
2	Hopper loading and Phase 1 plant	35	3**	38	(38-35) +3	Low likelihood of Adverse Impact
3	Phase 1 Plant	30	0*	30	(30-35) -5	Low Impact
5	Standby Genset	31	0*	31	(31-35) -4	Low Impact
6	Cumulative Situation	36	3**	39	(39-35) +4	Low likelihood of Adverse Impact

* Acoustic feature correction not applicable as predicted level is significantly lower than daytime ambient sound level at assessed receptor location and assessment has considered worst-case operational scenario.

** Acoustic feature correction added for just perceptible impulsivity from loading of hoppers at receptor location, based on context of distance from source and existing daytime ambient sound level being 10 dB higher than predicted specific level.

10.2.2 It can be seen from Table 13 that the assessment indicates a low likelihood of adverse impact at the nearest receptor or group of receptors to the proposed development when hopper loading activities and all Phase 1 and Phase 2 plant are operating.

10.2.3 The initial estimate of noise impact from the Phase 1 plant, operational traffic and standby situation associated with the Installation during the daytime periods, based on the BS 4142:2014 methodology, indicates a low impact at the nearest receptor or group of receptors to the proposed development.

10.3 Night time Noise Assessment

Table 14: BS 4142:2014 Noise Impact Assessment Summary – Night time

Situation	Description	Calculated Free Field level dB $L_{Aeq,T}$	Acoustic Feature Correction dB	Calculated Rating level dB $L_{Aeq,T}$	Assessment Level ($_{Rating}$ – $_{Background\ level}$)	BS 4142 Assessment of Impact
4	Phase 1 Plant	30	2*	32	(33-29) +3	Low likelihood of Adverse Impact
5	Standby Generator	31	2*	33	(33-29) +4	Low likelihood of Adverse Impact
6	Cumulative Situation	32	2*	34	(34-29) +5	Adverse Impact

* Acoustic feature correction includes for a just perceptible tone at the assessed receptor location.

10.3.1 The assessment of noise impact from the operational activities associated with the Installation during the night time periods, based on the BS 4142:2014 methodology, indicates a low likelihood of adverse impact at the nearest receptor or group of receptors to the proposed development when all Phase 1 plant is operating.

10.3.2 When the Installation CHP plant is in shutdown and the site emergency generator is operating, the assessment indicates a low likelihood of adverse impact at the nearest receptor or group of receptors to the proposed development.

10.3.3 It is possible that at certain times, a tone may be just perceptible at the receptor location when all Phase 1 and Phase 2 plant is operating, due to the occasionally very low background sound levels. Therefore a 2 dB acoustic tonal correction was added to the derived specific sound level when the plant is operating at night.

10.3.4 When all Phase 1 and Phase 2 plant is operating concurrently the assessment of noise impact from the operational activities associated with the Installation during the night time periods, indicates a likelihood of adverse impact at the nearest receptor or group of receptors.

10.3.5 The assessment has considered the worst-case continuous operation of most plant items and that these will operate concurrently and during the day and night time.

10.3.6 In the context that the assessment relates to a new noise source in an area where the existing acoustic environment does not include noise of a commercial or industrial nature that presently operates through the night and that at times the background sound level is very low (i.e. less than 30 dB L_{A90}) mitigation is recommended to reduce the likelihood of adverse impact.

10.3.7 It should be noted that Section 11 of BS 4142 states that for situations where the background sound and rating levels are low then absolute levels may be more relevant rather than looking at the margin by which the rating level exceeds the background sound level and that this is most relevant at night time when people are sleeping indoors.

10.4 Assessment of Internal Noise to BS 8233 and WHO Guidelines

10.4.1 The assessment of impact from activities associated with the development have been assessed using the internal guideline values specified in BS 8233;2014 and presented in Table 1.

10.4.2 The assessment has identified that the highest predicted noise levels from the operation of all Phase 1 and Phase 2 plant during the night with no additional mitigation, would lead to a night time façade noise level at the bedroom window of the nearest noise sensitive receptor of 35 dB $L_{Aeq,\ 8\ hour}$.

10.4.3 To assess indoor noise levels within existing dwellings, allowance needs to be made for the attenuation via the building envelope, which is generally governed by the weakest construction elements, acoustically speaking. Invariably, these are glazing or any ventilation openings.

10.4.4 The simplest form of natural ventilation is provided by open windows and the generally accepted rule of thumb is that a window left open for ventilation provides 10 - 15 dB attenuation from external noise sources, with the WHO Guidelines for Community Noise suggesting 15 dB. The DEFRA report NANR116: Open/Closed Window Research[12] suggests the figure to be between 12 and 18 dB for road and rail traffic

10.4.5 Within bedrooms and living spaces during the night time, and assuming a typical attenuation of 15 dB across a window left open for ventilation (as referenced in the WHO guidelines), levels of around 20 dB L_{Aeq} would be expected, which is well below the WHO and BS 8233 guideline value of 30 dB L_{Aeq} for bedrooms at night.

11 Mitigation Measures

11.1.1 Predictions showed that sound from the containerised CHP plant was the main contributor to the total sound level predicted at the nearest noise sensitive receptors during the night time. With this in mind further mitigation is recommended to reduce sound emissions from this plant.

[12] NANR116: 'Open/closed window research' Sound Insulation through ventilated open windows, Defra April 2007

11.2 Combined Heat and Power Plant

11.2.1 As discussed in Section 10.0 it is recommended that enhanced sound attenuation measures for the CHP container are implemented before the commissioning and use of such plant at the Installation in its current proposed configuration.

11.2.2 Enhanced sound attenuation measures can include;

- Acoustic lining of container to achieve an overall weighted sound reduction index value of greater than 45 dB R_w;
- Attenuation of air intake and outlets; and
- Acoustic lagging and inclusion of exhaust gas silencer.

11.2.3 The mitigation should be sufficient to achieve a specific sound level reduction of 2-3 dB at the nearest noise sensitive receptor. Further reductions could be achieved with gypsum board lined containers with absorbent filled cavities, and these are recommended to ensure that the specific sound level does not exceed the background sound level at the assessed receptors.

11.2.4 The option of barriers should be regarded as a secondary measure to mitigate impacts from the operation of the CHP at night due to the large distance from the source to the receptors and it is to be expected that any reductions from such mitigation will be negligible.

12 Conclusions

12.1 Background noise measurements have been taken at the location representative of the nearest dwellings to a proposed Installation located at Mona, Anglesey.

12.2 The potential impact of the proposed development consisting of an Anaerobic Digestion (AD) Plant and associated Combined Heat and Power (CHP) plant have been predicted.

12.3 Predictions of noise from operational traffic, vehicle movements on site and Phase 1 plant were undertaken in order to assess the potential impact of noise on existing residential receptors in the vicinity of the site. Using the methodology described in BS 4142:2014 to assess the impact during day time periods it was found that there would be a low impact for all the assessed scenarios for Phase 1.

12.4 When the cumulative situation of Phase 1 and Phase 2 plant including, hopper loading, operational traffic and vehicle movements was assessed, it was found that there would be a low likelihood of an adverse impact at the nearest noise sensitive receptor during day time periods.

12.5 During the assessment of night time periods there was found to be an adverse impact at the nearest receptor or group of receptors when all Phase 1 and Phase 2 plant is operating concurrently. In particular it was found that the CHP was the main contributor to the total sound level predicted at the nearest noise sensitive receptors during the night time.

12.6 Noise modelling was used to predict the noise levels at the nearest dwellings and when assessed to BS 8233 and WHO guidelines were found to be well below the recommended guideline values for internal spaces.

12.7 Mitigation was recommended in the form of enhancements to the acoustic sound insulation of the CHP container and any weak points in the container where air intakes and outlets are positioned.

12.8 With the implementation of these recommendations, it is considered that a suitable and commensurate level of protection against noise will be provided to the occupants of the nearest noise sensitive dwellings.

Glossary of Terms

Decibel (dB) The unit used to quantify sound pressure levels; it is derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 µPa, the threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is usually only perceptible under controlled conditions.

dB L_A Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB L_A broadly agree with an individual's assessment of loudness. A change of 3 dB L_A is the minimum perceptible under normal conditions, and a change of 10 dB L_A corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB L_A; normal conversation about 60 dB L_A at 1 meter; heavy road traffic about 80 dB L_A at 10 meters; the level near a pneumatic drill about 100 dB L_A.

$L_{A90,T}$ The A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142: 1997 it is used to define background noise level.

$L_{Aeq,T}$ The equivalent continuous sound level. The sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.

L_{Amax} The highest A weighted noise level recorded during the time period. It is usually used to describe the highest noise level that occurred during the event.

NOEL No observed effect level: the level of noise exposure below which no effect at all on health or quality of life can be detected.

LOAEL Lowest observed adverse effect level: the level of noise exposure above which adverse effects on health or quality of life can be detected.

SOAEL Significant observed adverse effect level: the level of noise exposure above which significant adverse effects on health or quality of life can be detected.

R_w Single number rating used to describe the sound insulation of building elements and is defined in BS EN ISO 10140-2: 2010 (formerly BSEN ISO 140-3:1995). It is derived by measurement under laboratory conditions and does not take into account the effects of flanking transmissions.

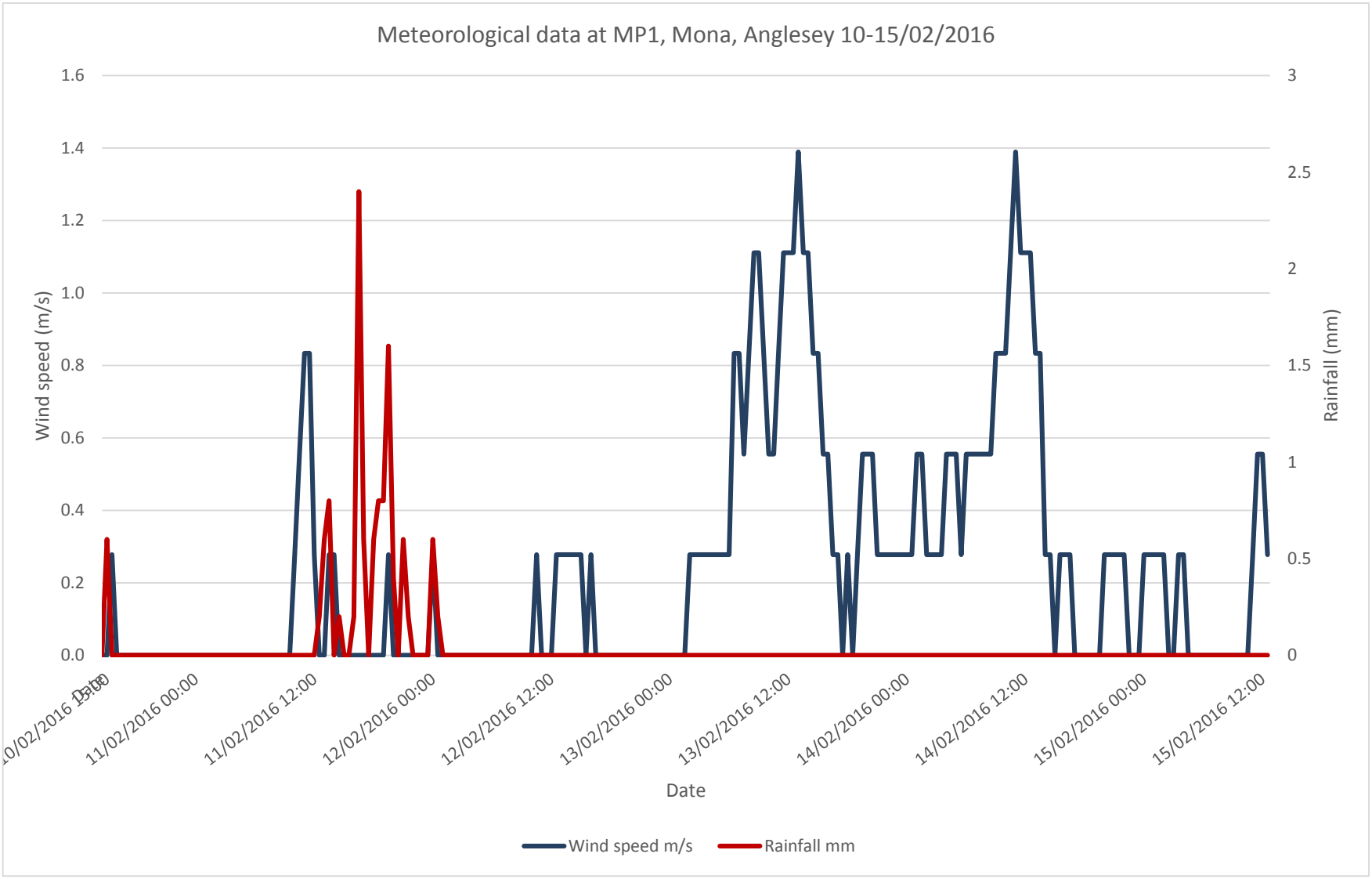
Appendix 1: Measurement Positions

Appendix 2a: Proposed Development Layout

Appendix 2b: Elevation Layout

Appendix 2c: Proposed Fixed Plant Layout (Pumps circled yellow)

Appendix 3: Meteorological Data



Appendix 4: BS 4142:2014 Noise Impact Assessment

HGVs and Phase 1 plant - Daytime

Results		Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level	$L_{AF90,15mins}$ = 35 dB	8.1.2 8.3	Representative day time background sound level determined from range of measurements
Assessment made during the night time, so the reference interval is 60 minutes		7.2	
Specific Sound Level	$L_{Aeq,1hour}$= 30 dB	7.3.6	Determined from CadnaA model
Acoustic feature correction	0 dB	9.2	At a distance of 10m from the plant there is likely to be a tonal characteristic when in operation. The predicted level is 15 dB lower than the measured day time ambient sound level in the vicinity of the assessed noise sensitive receptor, audible sound from the Installation is considered unlikely
Rating Level	(30 + 0) dB = 30 dB		
Excess of Rating Level over Background Sound Level	(30 – 35) dB = -5 dB		
Assessment of impact: low impact, depending on the context		11	
Context		11 8.5	The assessment relates to a new noise source in an area where the existing daytime acoustic environment includes noise of a commercial or industrial nature that presently operates through the day.
Uncertainty of the assessment		10	The uncertainty of the measurement is unlikely to affect the outcome of the assessment due to the difference in the rating level over the background sound level.

Hopper loading and Phase 1 plant - Daytime

Results		Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level	$L_{AF90,15mins}$ = 35 dB	8.1.2 8.3	Representative day time background sound level determined from range of measurements
Assessment made during the night time, so the reference interval is 60 minutes		7.2	
Specific Sound Level	$L_{Aeq,1hour}$= 35 dB	7.3.6	Determined from CadnaA model
Acoustic feature correction	3 dB	9.2	At a distance of 10m from the plant there is likely to be a tonal characteristic when in operation. There could at times be a just perceptible impulsive sound from the loading of the hoppers at the nearest receptor, but this is likely to be worst case based on the predicted level being 10 dB lower than the measured day time ambient sound level in the vicinity of the assessed noise sensitive receptor.
Rating Level	(35 + 3) dB = 38 dB		
Excess of Rating Level over Background Sound Level	(38 – 35) dB = +3 dB		
Assessment of impact: low likelihood of an adverse impact, depending on the context		11	
Context		11 8.5	The assessment relates to a new noise source in an area where the existing daytime acoustic environment includes noise of a commercial or industrial nature that presently operates through the day.
Uncertainty of the assessment		10	The uncertainty of the measurement is unlikely to affect the outcome of the assessment due to the difference in the rating level over the background sound level.

Phase 1 plant - Daytime

Results		Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level	$L_{AF90,15mins}$ = 35 dB	8.1.2 8.3	Representative day time background sound level determined from range of measurements
Assessment made during the night time, so the reference interval is 60 minutes		7.2	
Specific Sound Level	$L_{Aeq,1hour}$= 30 dB	7.3.6	Determined from CadnaA model
Acoustic feature correction	0 dB	9.2	At a distance of 10m from the plant there is likely to be a tonal characteristic when in operation. The predicted level is 15 dB lower than the measured day time ambient sound level in the vicinity of the assessed noise sensitive receptor, audible sound from the Installation is considered unlikely
Rating Level	(30 + 0) dB = 30 dB		
Excess of Rating Level over Background Sound Level	(30 – 35) dB = -5 dB		
Assessment of impact: low impact, depending on the context		11	
Context		11 8.5	The assessment relates to a new noise source in an area where the existing daytime acoustic environment includes noise of a commercial or industrial nature that presently operates through the day.
Uncertainty of the assessment		10	The uncertainty of the measurement is unlikely to affect the outcome of the assessment due to the difference in the rating level over the background sound level.

Standby Generator Situation - Daytime

Results		Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level	$L_{AF90,15mins}$ = 35 dB	8.1.2 8.3	Representative day time background sound level determined from range of measurements
Assessment made during the night time, so the reference interval is 60 minutes		7.2	
Specific Sound Level	$L_{Aeq,1hour}$= 31 dB	7.3.6	Determined from CadnaA model
Acoustic feature correction	0 dB	9.2	At a distance of 10m from the plant there is likely to be a tonal characteristic when in operation. The predicted level is 14 dB lower than the measured day time ambient sound level in the vicinity of the assessed noise sensitive receptor, audible sound from the Installation is considered unlikely
Rating Level	(31 + 0) dB = 31 dB		
Excess of Rating Level over Background Sound Level	(31 – 35) dB = -4 dB		
Assessment of impact: low impact, depending on the context		11	
Context		11 8.5	The assessment relates to a new noise source in an area where the existing daytime acoustic environment includes noise of a commercial or industrial nature that presently operates through the day.
Uncertainty of the assessment		10	The uncertainty of the measurement is unlikely to affect the outcome of the assessment due to the difference in the rating level over the background sound level.

Phase 1 plant – Night time

Results		Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level	$L_{AF90,15mins}$ = 29 dB	8.1.2 8.3	Representative night time background sound level determined from range of measurements
Assessment made during the night time, so the reference interval is 15 minutes		7.2	
Specific Sound Level	$L_{Aeq,15\ mins}$= 30 dB	7.3.6	Determined from CadnaA model
Acoustic feature correction	2 dB	9.2	At a distance of 10m from the plant there is likely to be a tonal characteristic when in operation. The predicted level is 3 - 7 dB lower than the measured night time ambient sound level in the vicinity of the assessed noise sensitive receptor. To present a robust assessment it is possible that at certain times, a just perceptible tone may be audible at the receptor location due to the occasionally very low ambient and background sound levels
Rating Level	(30 + 2) dB = 32 dB		
Excess of Rating Level over Background Sound Level	(32 – 29) dB = +3 dB		
Assessment of impact: likelihood of an adverse impact, depending on the context		11	
Context		11 8.5	The assessment relates to a new noise source in an area where the existing acoustic environment does not include noise of a commercial or industrial nature that presently operates through the night. The assessment has considered a conservative assumption of all phase 1 plant operating concurrently.
Uncertainty of the assessment		10	The uncertainty of the measurement is unlikely to affect the outcome of the assessment due to the difference in the rating level over the background sound level.

Standby Generator Situation – Night time

Results		Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level	$L_{AF90,15mins}$ = 29 dB	8.1.2 8.3	Representative night time background sound level determined from range of measurements
Assessment made during the night time, so the reference interval is 15 minutes		7.2	
Specific Sound Level	$L_{Aeq,15\ mins}$= 31 dB	7.3.6	Determined from CadnaA model
Acoustic feature correction	2 dB	9.2	At a distance of 10m from the plant there is likely to be a tonal characteristic when in operation. The predicted level is 2 - 6 dB lower than the measured night time ambient sound level in the vicinity of the assessed noise sensitive receptor. To present a robust assessment it is possible that at certain times, a just perceptible tone may be audible at the receptor location due to the occasionally very low background sound levels.
Rating Level	(31 + 2) dB = 33 dB		
Excess of Rating Level over Background Sound Level	(33 – 29) dB = +4 dB		
Assessment of impact: low likelihood of an adverse impact, depending on the context		11	
Context		11 8.5	The assessment relates to a new noise source in an area where the existing acoustic environment does not include noise of a commercial or industrial nature that presently operates through the night. The assessment has considered a conservative assumption of all phase 1 plant operating concurrently.
Uncertainty of the assessment		10	The uncertainty of the measurement is unlikely to affect the outcome of the assessment due to the difference in the rating level over the background sound level.

Cumulative Situation – Day time

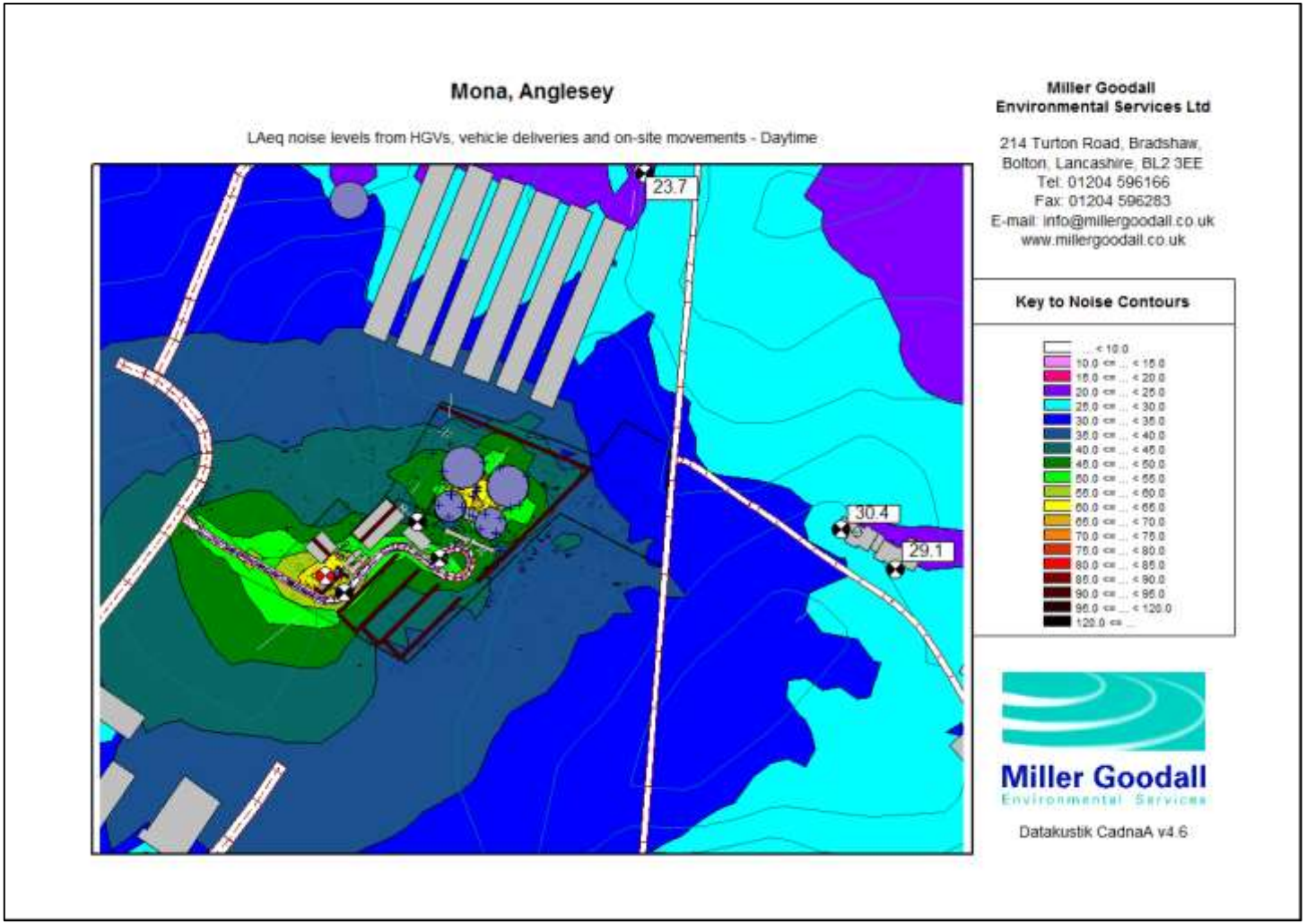
Results		Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level	$L_{AF90,15mins}$ = 35 dB	8.1.2 8.3	Representative day time background sound level determined from range of measurements
Assessment made during the night time, so the reference interval is 60 minutes		7.2	
Specific Sound Level	$L_{Aeq,1hour}$= 36 dB	7.3.6	Determined from CadnaA model
Acoustic feature correction	0 dB	9.2	At a distance of 10m from the plant there is likely to be a tonal characteristic when in operation. The predicted level is 9 dB lower than the measured day time ambient sound level in the vicinity of the assessed noise sensitive receptor, audible tones from the Installation are considered unlikely
Rating Level	(36 + 0) dB = 36 dB		
Excess of Rating Level over Background Sound Level	(36 – 35) dB = 1 dB		
Assessment of impact: low likelihood of an adverse impact, depending on the context		11	
Context		11 8.5	The assessment relates to a new noise source in an area where the existing daytime acoustic environment includes noise of a commercial or industrial nature that presently operates through the day.
Uncertainty of the assessment		10	The uncertainty of the measurement is unlikely to affect the outcome of the assessment due to the difference in the rating level over the background sound level.

Cumulative Situation – Night time

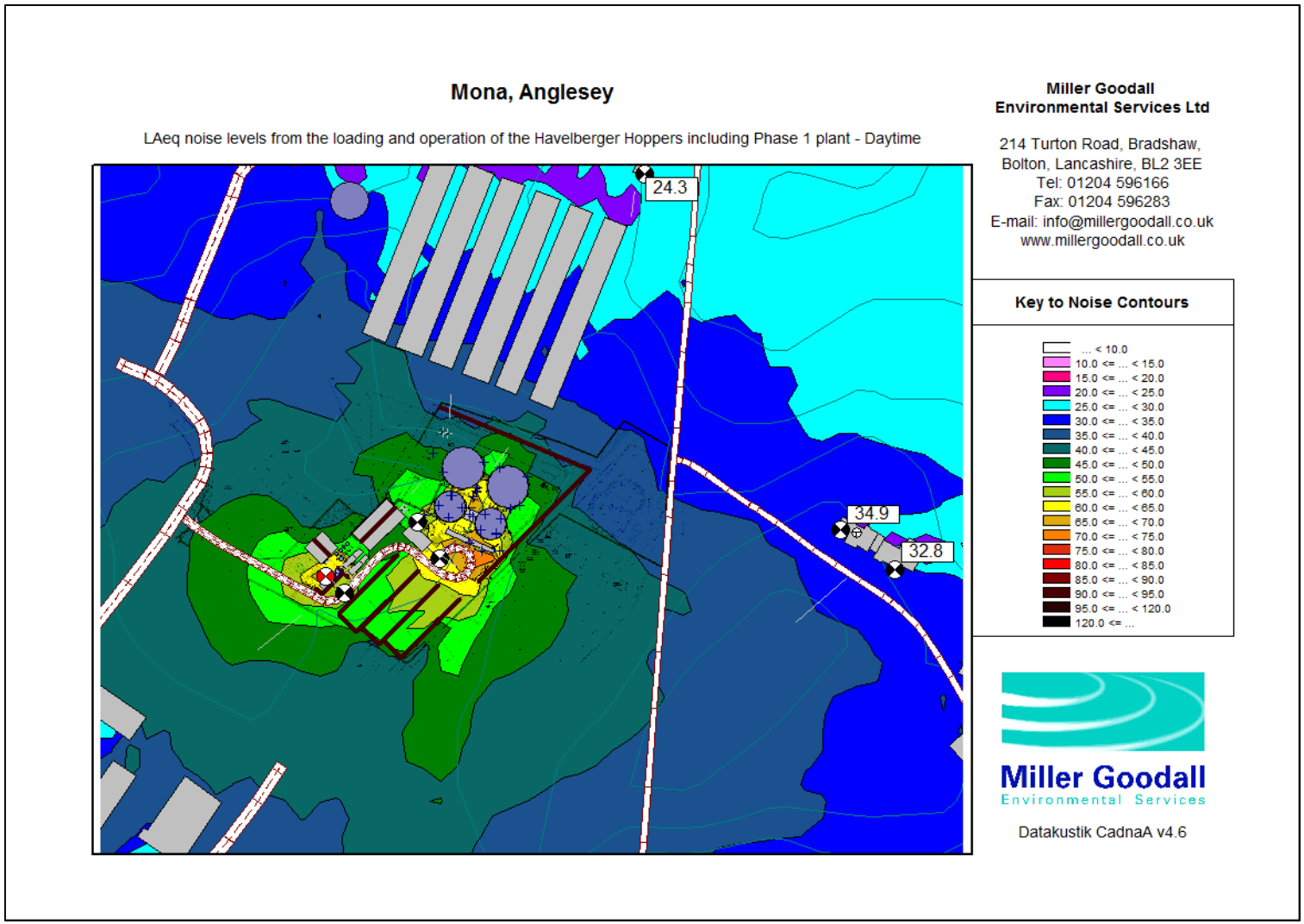
Results		Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level	$L_{AF90,15mins}$ = 29 dB	8.1.2 8.3	Representative night time background sound level determined from range of measurements
Assessment made during the night time, so the reference interval is 15 minutes		7.2	
Specific Sound Level	$L_{Aeq,15\ mins}$= 32 dB	7.3.6	Determined from CadnaA model
Acoustic feature correction	2 dB	9.2	At a distance of 10m from the plant there is likely to be a tonal characteristic when in operation. The predicted level is 1 - 5 dB lower than the measured night time ambient sound level in the vicinity of the assessed noise sensitive receptor. To present a robust assessment it is possible that at certain times, a just perceptible tone may be audible at the receptor location due to the occasionally very low ambient and background sound levels.
Rating Level	(32 + 2) dB = 34 dB		
Excess of Rating Level over Background Sound Level	(34 – 29) dB = +5 dB		
Assessment of impact: likelihood of adverse impact, depending on the context		11	
Context		11 8.5	The assessment relates to a new noise source in an area where the existing acoustic environment does not include noise of a commercial or industrial nature that presently operates through the night. The assessment has considered a conservative assumption of all phase 1 and phase 2 plant operating concurrently.
Uncertainty of the assessment		10	The uncertainty of the measurement is unlikely to affect the outcome of the assessment due to the difference in the rating level over the background sound level.

Appendix 5: CadnaA Screenshots

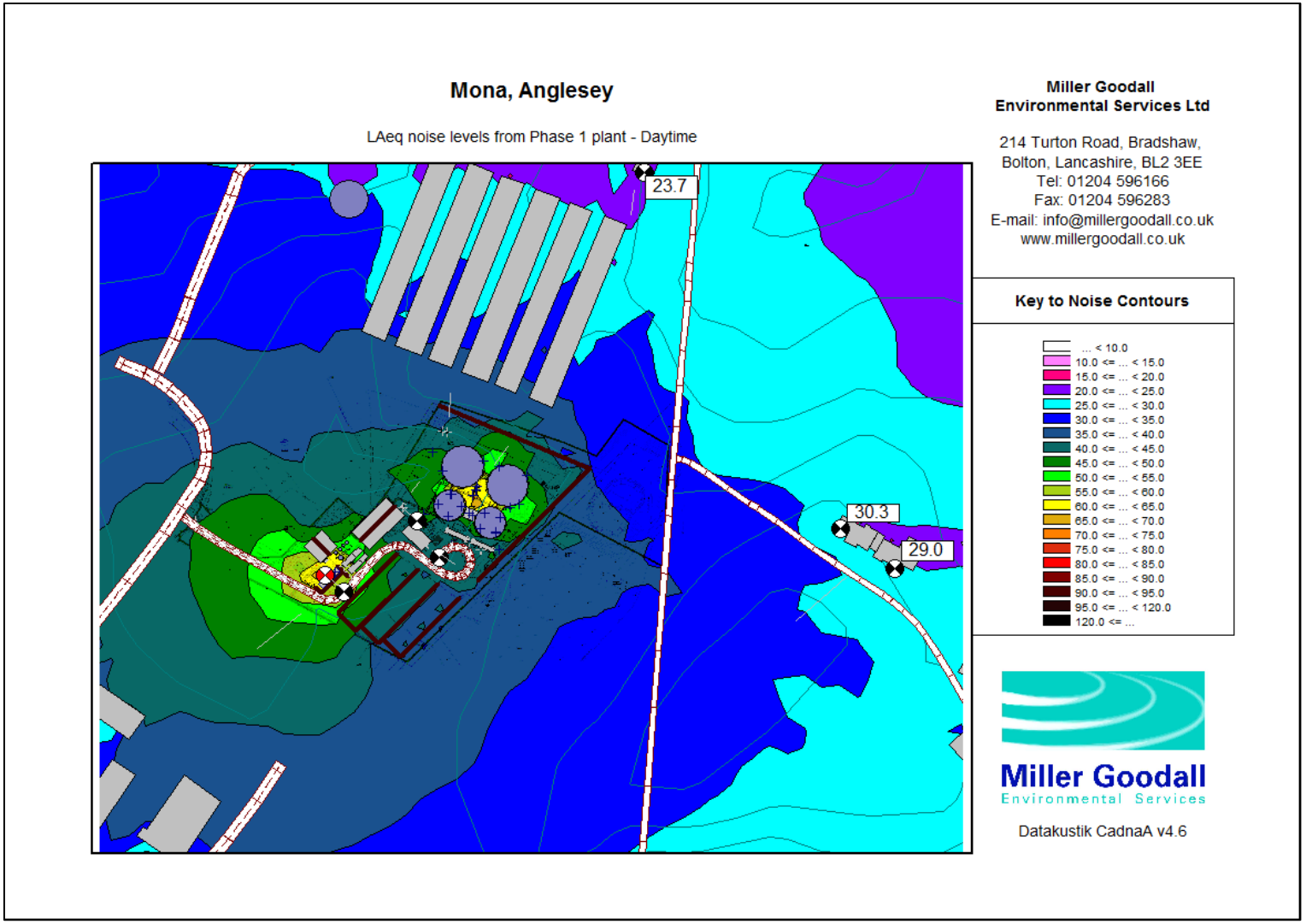
Appendix 5.1: CadnaA Screenshot of Predicted Day time LAeq Noise Levels from HGVs and vehicle deliveries



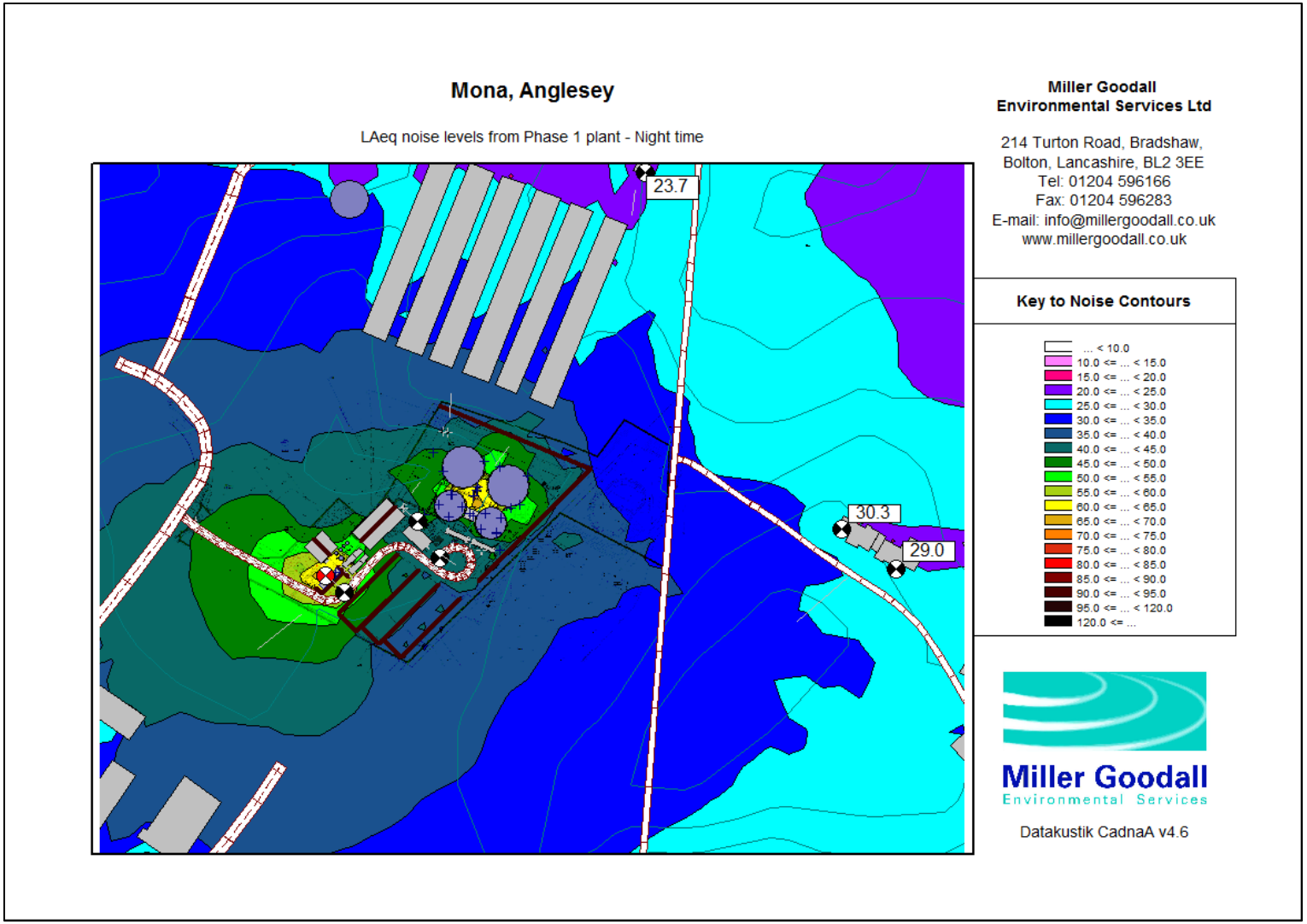
Appendix 5.2: CadnaA Screenshot of Predicted Day time LAeq Noise Levels from the Havelberger Hoppers



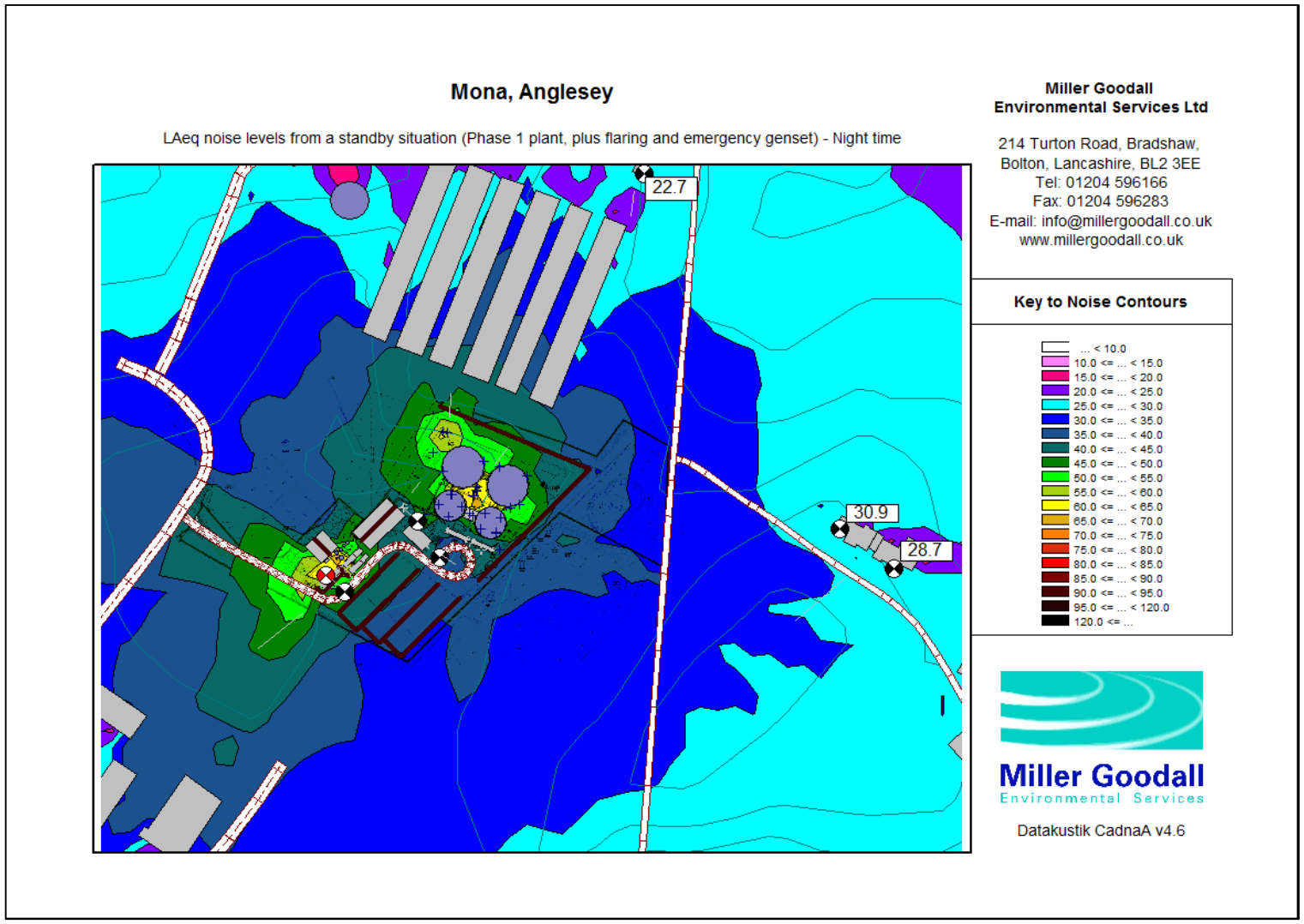
Appendix 5.3: CadnaA Screenshot of Predicted Day time LAeq Noise Levels from Phase 1 plant



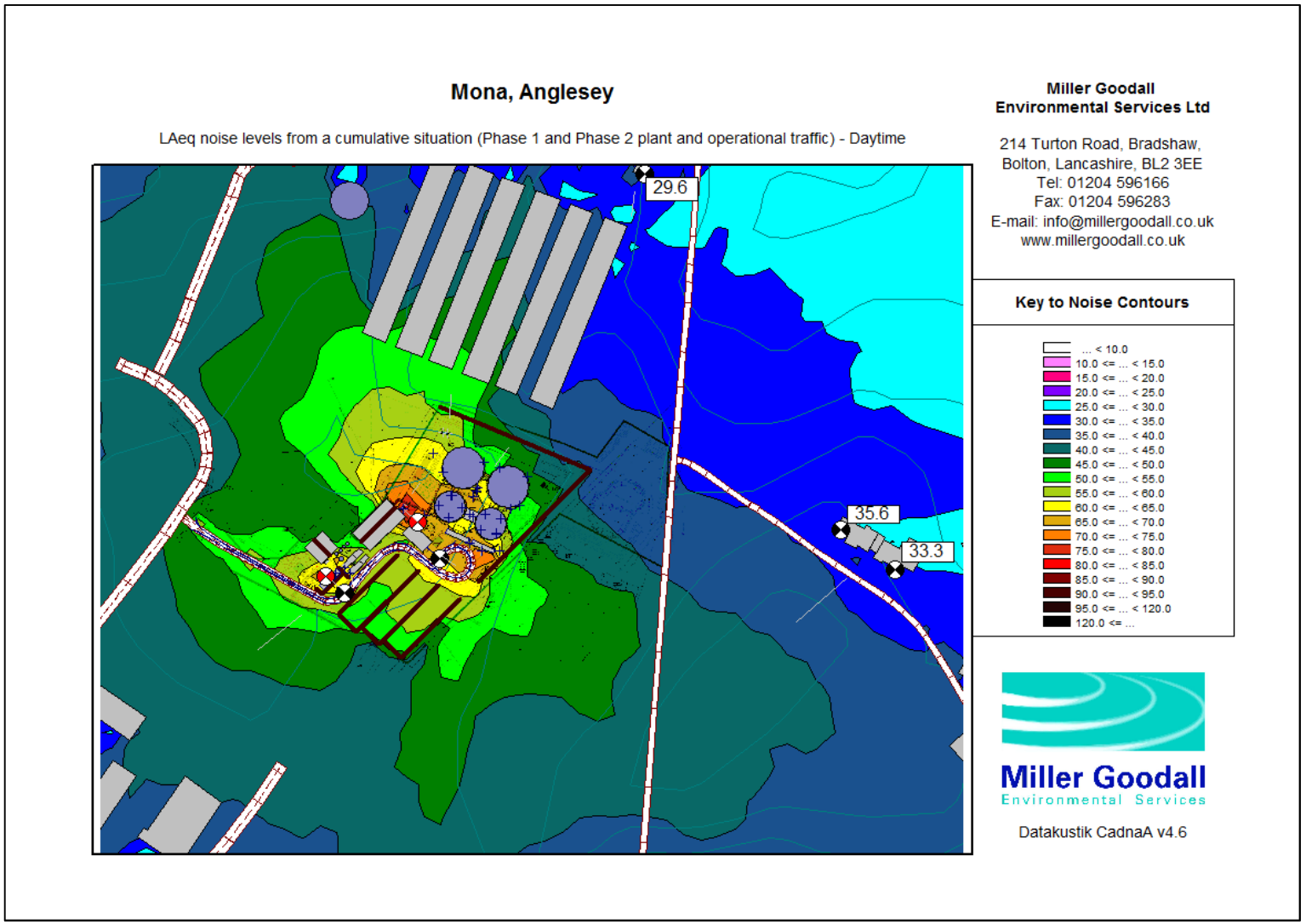
Appendix 5.4: CadnaA Screenshot of Predicted Night time LAeq Noise Levels from Phase 1 plant



Appendix 5.5: CadnaA Screenshot of Predicted Night time LAeq Noise Levels from standby generator



Appendix 5.6: CadnaA Screenshot of Predicted Daytime LAeq Noise Levels from Cumulative Situation



Appendix 5.7: CadnaA Screenshot of Predicted Night time LAeq Noise Levels from Cumulative Situation