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H171P-G9-00-0710-01

Bridgwater WTE Plant, Showground Road, Bridgwater

Noise Impact Assessment

24th January 2020

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1. INTRODUCTION

1.1. Overview

inacoustic has been commissioned to prepare a Noise Assessment for the Bridgwater WTE Plant on Land at Showground Road, Bridgwater, for submission to the Environment Agency as part of a Permit Application. The Site benefits from planning permission, as granted by Somerset County Council (reference 1/37/17/00101). Condition 5 of the planning permission is relevant to noise.

The Operator is submitting a new Environmental Impact Assessment Planning Application, which will seek to update Condition 5 in accordance with the most up-to-date site baseline noise levels and the latest requirements of the National Planning Policy Framework. As such, this Noise Assessment is undertaken in accordance with the guiding aims of the Noise Policy Statement for England and BS4142:2014+A1:2019.

In addition, the following drawings showing the site layout, elevations and details of the locations of the relevant noise-generating items associated with the site have been submitted alongside this noise assessment report:

Document Number	Drawing Title
H171P-PD-00-0007 Rev 02	General Plan Layout
H171P-PD-00-0008 Rev 02	General Plan Elevations Views
N171P-PD-00-0009	Boiler and Power House Building Area – Plan View
H171P-PD-00-0011	Fuel Reception Hall – Plan View

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.2. Scope and Objectives

The scope of the noise assessment can be summarised as follows:

- Detailed sound modelling using the iNoise 2019.1 modelling suite and ISO9613[1] prediction methodology to predict sound levels at the closest noise-sensitive receptors to the Site;
- A detailed assessment of the suitability of the Site, in accordance with the relevant policy; and
- Recommendation of mitigation measures, where necessary, to comply with the requirements of the Noise Policy Statement for England[2], Horizontal Guidance for Noise Part 2 – Noise Assessment and Control[3], BS4142:2014+A1:2019[4], BS8233:2014[5], and the World Health Organisation's *Guidelines for Community Noise*[6].

[1] International Standards Organisation, 1996. ISO 9613-2:1996: Acoustics - Attenuation of Sound During Propagation Outdoors.
[2] Department for Environment Food and Rural Affairs (DEFRA), 2010. Noise Policy Statement for England.
[3] Environment Agency, 2002. IPPC Horizontal Guidance for Noise Part 2 – Noise Assessment and Control.
[4] British Standards Institution, 2019. BS4142:2014+A1:2019: Method for Rating and Assessing Industrial and Commercial Sound.
[5] British Standard Institution, 2014. BS8233:2014: Guidance on Sound Insulation and Noise Reduction for Buildings.
[6] World Health Organisation, 1999. Guidelines for Community Noise.

2. ASSESSMENT FRAMEWORK

2.1. National Policy

2.1.1. IPPC Technical Guidance Note IPPC H3 Part 2

Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single permitting process. To gain a Permit, Operators have to show that they have systematically developed proposals to apply the 'Best Available Techniques' (BAT) and meet certain other requirements, taking account of relevant local factors.

In terms of noise specifically, the use of BAT has to be considered and balanced within the wider context of other releases to different media (air, land and water) and taking issues such as usage of energy and raw materials into account. Noise cannot therefore be considered in isolation from other impacts on the environment.

The definition of pollution includes *"emissions which may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment"*. BAT is therefore likely to be similar, in practice, to the requirements of the Statutory Nuisance legislation which requires the use of *"best practicable means"* to prevent or minimise noise nuisance. In the case of noise, *"offence to human senses"* may be judged by the likelihood of complaints. However, the lack of complaint should not necessarily imply the absence of a noise problem. In some cases it may be possible, and desirable, to reduce noise emissions still further at reasonable costs and this may therefore be BAT for noise emissions.

Consequently, the aim of BAT should be to ensure that there is no reasonable cause for annoyance to persons beyond the installation boundary.

In summary, the aim of BAT should be to achieve the following:

- Underpinning of good practice, a basic level of which the operator should employ for the control of noise including adequate maintenance of any parts of plant or equipment whose deterioration may give rise to increases in noise. For example, this would include bearings, air handling plant, the building fabric as well as specific noise attenuation measures associated with plant, equipment or machinery;
- Noise levels should not be loud enough to give reasonable cause for annoyance for persons in the vicinity, which is a more appropriate environmental standard than that of Statutory Nuisance and is normally the aim of most planning or other conditions applied by Local Authorities; and
- Prevention of 'creeping background' (creeping ambient), which is the gradual increase in sound levels as industry expands and areas develop.

The indicative requirements apply to both new and existing activities but it is more difficult to justify departures from them in the case of new activities.

Indeed, because the requirements for noise are likely to be strongly influenced by the local environmental conditions, new installations are expected to meet BAT from the outset and to demonstrate that noise reduction or prevention has been built in to the process design. For most existing plant, especially where there are no existing noise limits, the focus is on good practice (BAT) and the need to ensure that there is no reasonable cause for annoyance. In assessing any noise

impact it is more normal to monitor existing levels and apply corrections and calculations, rather than rely on predictions.

The guidance makes reference to BS4142:1997, BS8233:1999 and WHO guidance for absolute levels for protection of community annoyance. The two British Standards have been updated since the guidance was published and the latest versions have been considered in this assessment.

2.1.2. Noise Policy Statement for England, 2010

The underlying principles and aims of existing noise policy documents, legislation and guidance are clarified in *DEFRA: 2010: Noise Policy Statement for England* (NPSE)[7]. The NPSE sets out the *"Long Term Vision"* of Government noise policy as follows:

"Promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development".

The NPSE outlines three aims for the effective management and control of environmental, neighbour and neighbourhood noise:

- *"Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life".*

The guidance states that it is not possible to have a single objective noise-based measure that defines *"Significant Observed Adverse Effect Level (SOAEL)"* that is applicable to all sources of noise in all situations and that not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

Paragraph 2.15 states, with regard to the third aim of the NPSE, that *"this statement expresses the long-term desired policy outcome, but in the use of "promote" and "good" recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations."*

2.1.3. National Planning Practice Guidance in England: Noise, 2014

Further guidance in relation to the NPPF and the NPSE has been published in the *National Planning Practice Guidance in England: Noise* (NPPG Noise)[8], which summarises the noise exposure hierarchy, based on the likely average response. The following three observed effect levels are identified below:

- **Significant Observed Adverse Effect Level**: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
- **Lowest Observed Adverse Effect Level**: This is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
- **No Observed Adverse Effect Level**: This is the level of noise exposure below which no effect at all on health or quality of life can be detected.

[7] Department for Environment, Food and Rural Affairs (DEFRA), 2010. Noise Policy Statement for England. DEFRA.
[8] Department for Communities and Local Government (DCLG), 2014. National Planning Practice Guidance for England: Noise. DCLG.

Criteria related to each of these levels are reproduced in Table 1.

TABLE 1: SIGNIFICANCE CRITERIA FROM NPPG IN ENGLAND: NOISE

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and Not Intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and Disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and Very Disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.2. Assessment Criteria

2.2.1. BS4142:2014:+A1:2019

BS4142:2014+A1:2019 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142:2014+A1:2019 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ 'specific sound level', immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ 'rating sound level'. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

BS4142:2014+A1:2019 states: *"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs".* An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

- *"Typically, the greater this difference, the greater the magnitude of the impact."*
- *"A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context."*
- *"A difference of around +5dB 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."*

Interpreting the guidance given in BS4142:2014+A1:2019, with consideration of the guidance given in the NPSE and NPPG Noise, an estimation of the impact of the rating sound is summarised in the following text:

- A rating sound level that is +10 dB above the background sound level is likely to be an indication of a **Significant Observed Adverse Effect Level**;
- A rating sound level that is +5 dB above the background sound level is likely to be an indication of a **Lowest Observed Adverse Effect Level**;
- The lower the rating sound 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 sound level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, and would therefore classified as a **No Observed Adverse Effect Level**.

During the daytime, the assessment is carried out over a reference time period of 1-hour, with the night-time assessment being carried out over a reference period of 15 minutes. The periods associated with day or night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

2.2.2. BS8233:2014

BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* draws on the results of research and experience to provide information on achieving internal acoustic environments appropriate to their functions. The guideline values provided are in terms of an average (L_{Aeq}) level.

The standard advises that, for steady external noise sources, it is desirable for internal ambient noise levels to not exceed the guidance values, as detailed below in Table 2.

TABLE 2: BS8233:2014 AMBIENT NOISE LEVELS

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room	40 dB $L_{Aeq,16hour}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

BS8233:2014 goes on to suggest that where development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions will still be achieved.

With regard to maximum noise levels, the standard identifies that regular individual noise events (such as passing trains or scheduled aircraft etc) can cause sleep disturbance. The standard does not provide a guideline design target, but simply goes on to suggest that a guideline value may be set in terms of SEL or $L_{Amax,F}$, depending upon the character and number of events per night. It goes on to suggest that more sporadic noise events could require separate values.

In respect of external noise levels, the guidance in BS8233:2014 suggests that "*it is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments*".

BS8233:2014 provides a much more detailed narrative on noise levels in external amenity areas and acknowledges that it may not always be necessary or feasible to ensure that noise levels remain within these guideline values.

2.2.3. World Health Organisation - Guidelines for Community Noise

The WHO document Guidelines for Community Noise sets out guidance on external noise levels at which there will be an unacceptable impact on communities. This guidance considers many different types of noise sources. In paragraph 4.1.7 the impact of noise on dwellings is considered. The document states:

"During the daytime, few people are seriously annoyed by activities with (steady) L_{Aeq} levels below 55 dB; or moderately annoyed with L_{Aeq} levels below 50 dB. Sound pressure levels during the evening and night should be 5 to 10 dB lower than during the day (i.e. 45 to 50 dB serious annoyance; 40 to 45 dB moderate annoyance). It is emphasised that for intermittent noise (such as the skateboarding activities) it is necessary to take into account the maximum (i.e. the L_{Amax}) sound pressure level as well as the number of events."

2.3. Waste Planning Authority Planning Condition

Planning Condition 5 associated with 1/37/17/00101, as permitted by Somerset County Council on the 27th February 2018, relates to noise, and states the following:

*"5 **Noise Mitigation***

(i) Prior to the commencement of the development hereby permitted an Acoustic Design Report shall be submitted to and approved in writing by the Waste Planning Authority. The report shall:

(a) detail the noise mitigation measures proposed to limit operational noise from building enclosures and external processes;
(b) detail the overall predicted noise emission contributions resulting from the MRF and ERF components of the development; and
(c) detail a noise monitoring process to confirm post development compliance with the noise control design objectives as set out above;

(ii) Operational noise emissions from fixed plant at any residential boundary shall not exceed LAeq(5-minute) 42dB between 07:00 to 23:00 hrs, and 36dB between 23:00 to 07:00 hrs.

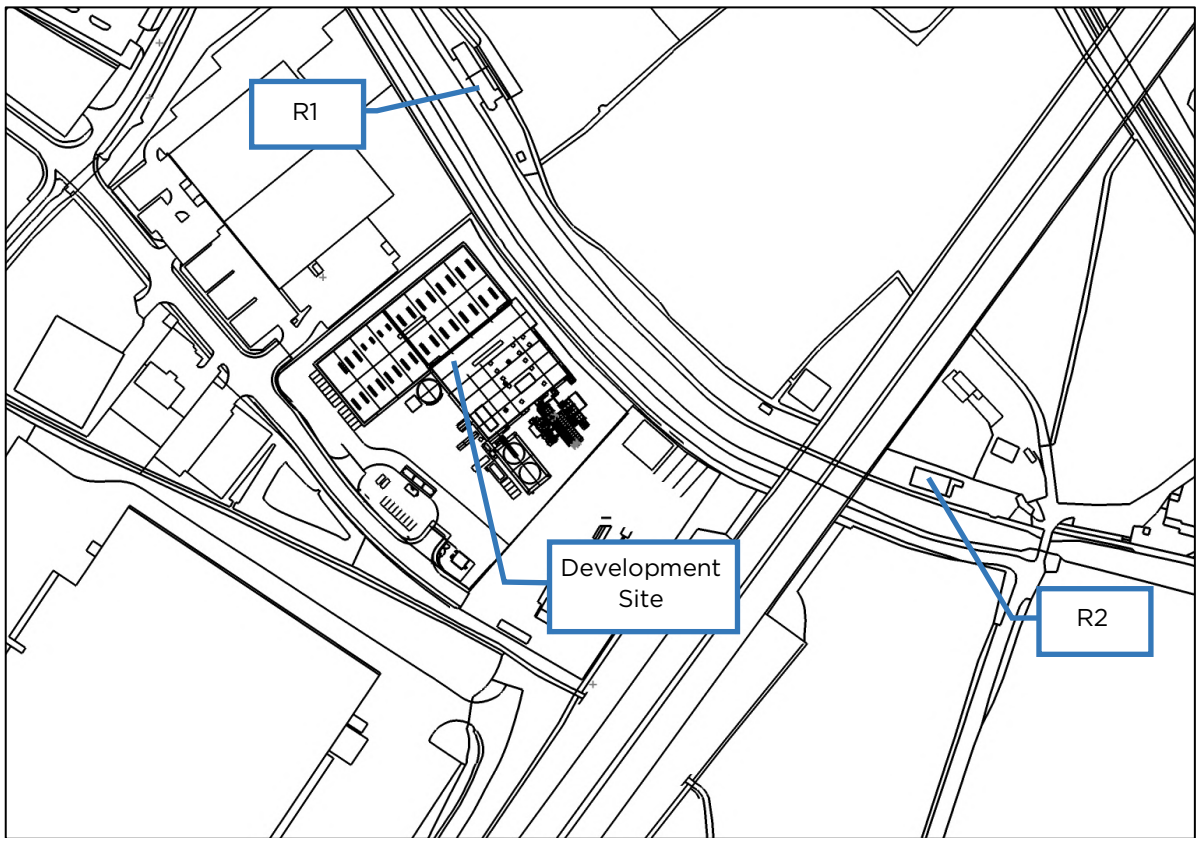
(iii) Within 6 months of the development hereby permitted first being brought into use, the operator shall undertake noise conformance measurements and submit a report based on the specification as detailed in the agreed 'Acoustic Design Report'.

3. Site Description

3.1. Site and Surrounding Area

The Site is on Land at Showground Road, Bridgwater. The location of the Site and the nearest residential receptors can be seen below in Figure 1. The Site is on land characterised by extant industrial operations and significant levels of road traffic sound associated with the nearby M5 motorway.

Figure 1: Plan of Site and Surrounding Area



The development site is located on a parcel of land off Showground Road, Bridgwater, and the extent of the site is defined by the following grid references:

- North: E:331000 N:135143
- East: E:331075 N:135050
- South: E:330996 N:134960
- West: E:330905 N:135062

There are two residential receptors located in relative proximity to the site, that are considered sensitive, as defined by the following grid references:

- R1 – 1-2 Canal Cottages: E:331001 N:135204
- R2 – 3 Canal Cottages: E:331215 N:135012

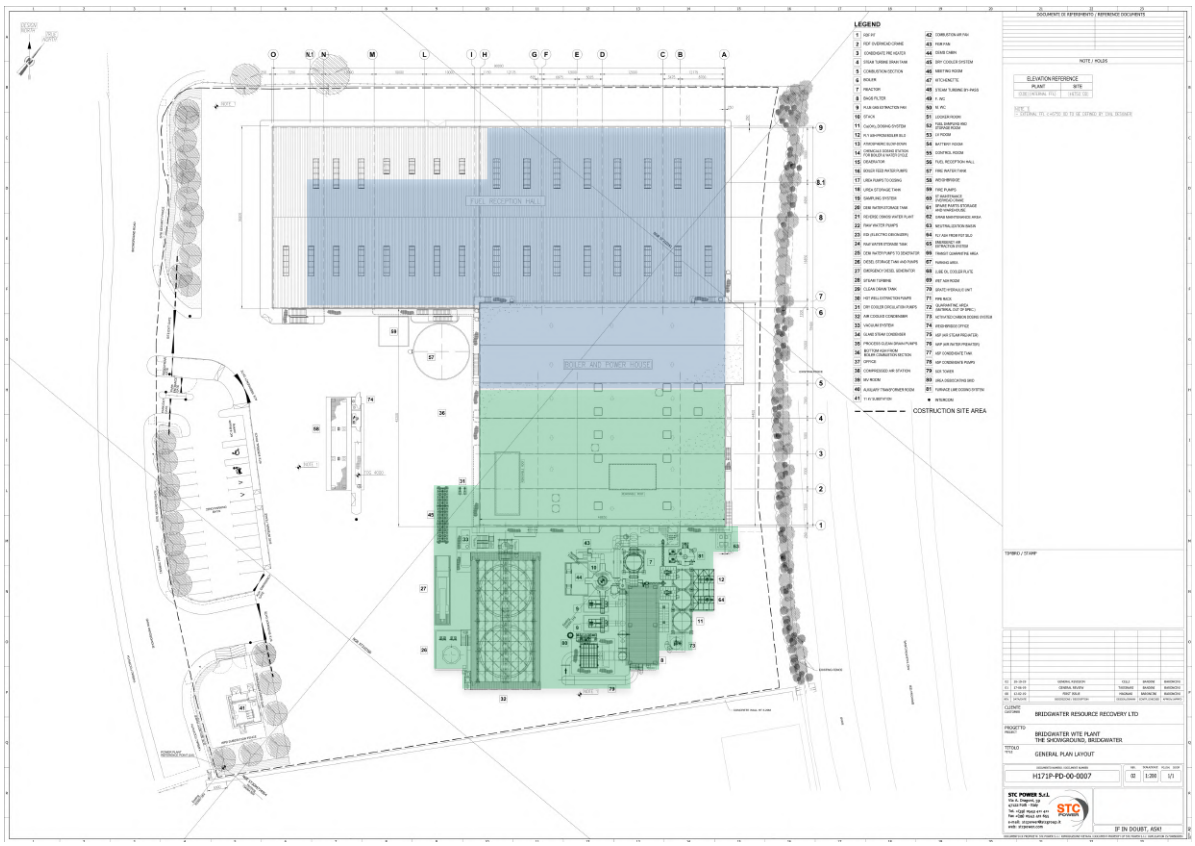
R1 is located approximately 53 m to the north of the site boundary. R2 is located approximately 138 m to the east of the site boundary. Both residential receptor locations are 2-storey buildings.

The receptors are the closest noise-sensitive receptors to the site, in terms of distance. There are other, more distant receptors, however, there is either significant distance and/or screening in the intervening land, thus reducing the specific noise level associated with the site to a level where it is insignificant.

3.2. Operations Overview

The site layout for the WTE Plant can be seen below in Figure 2.

FIGURE 2: SITE LAYOUT



The blue area indicates that Fuel Reception area of the WTE Plant, whereby waste is received and sorted by a front-end loader. Of this waste, 90% is throughput into the Boiler and Power House indicated in green, with 10% exported from the site.

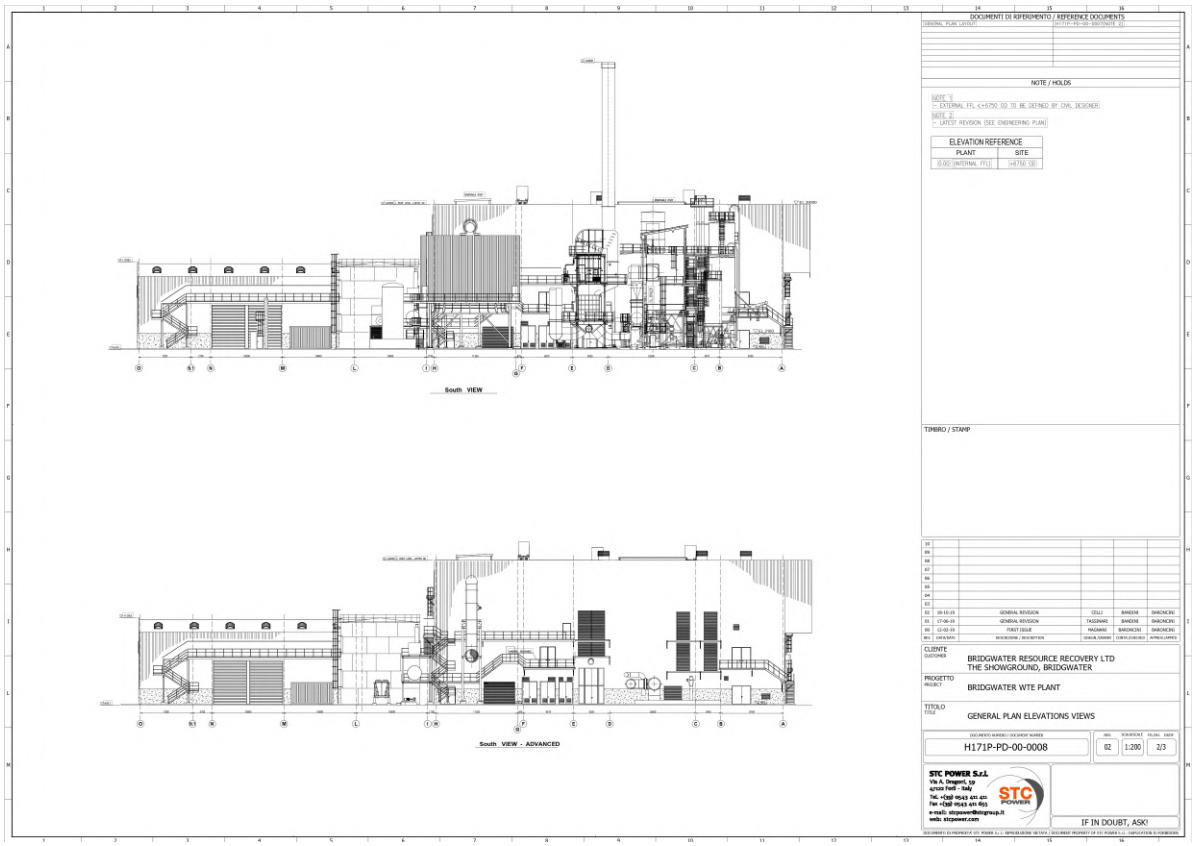
The Fuel Reception Area is an internal process, whereas the Boiler and Power House has internal and external plant areas. The internal areas of the Boiler and Power House are predominantly dedicated to the incineration of waste, with external areas of the Boiler and Power House predominantly dedicated to the discharge of emissions and cooling of the internal plant.

The Transport Statement prepared by Hydrock and submitted as part of the amended planning application, indicates that the MRF can expect approximately 30 HGV movements between the hours of 07:00 and 17:00, with 3 HGV movements occurring in a typical 1-hour period. It has been assumed that, for the purposes of this noise assessment, that 5 HGV movements will occur in any given 1-hour period, representing a robust and reasonable worst-case.

There are numerous items of plant that are dedicated to emergency situations, which have not been considered in this assessment, as they are not part of the typical operational profile of the site.

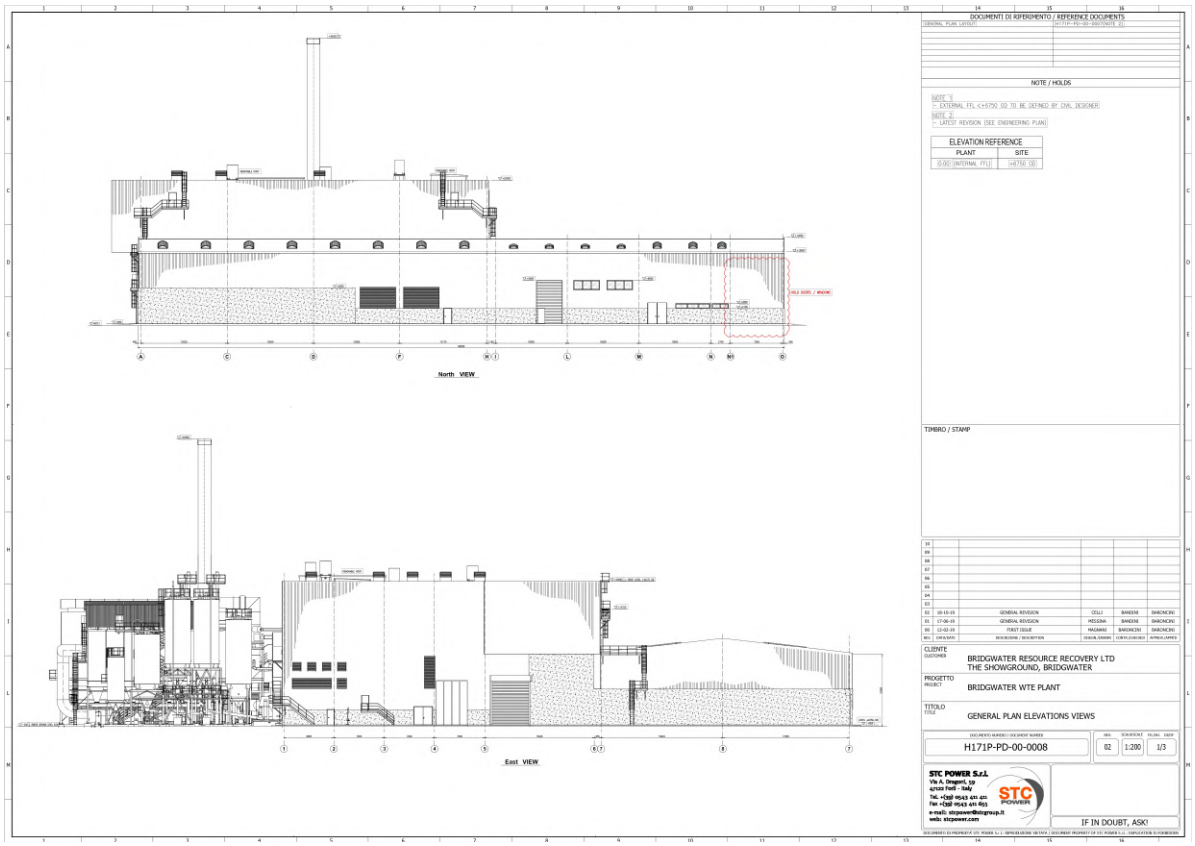
The southern elevations associated with the Site can be seen below in Figure 3.

FIGURE 3: SOUTHERN ELEVATIONS



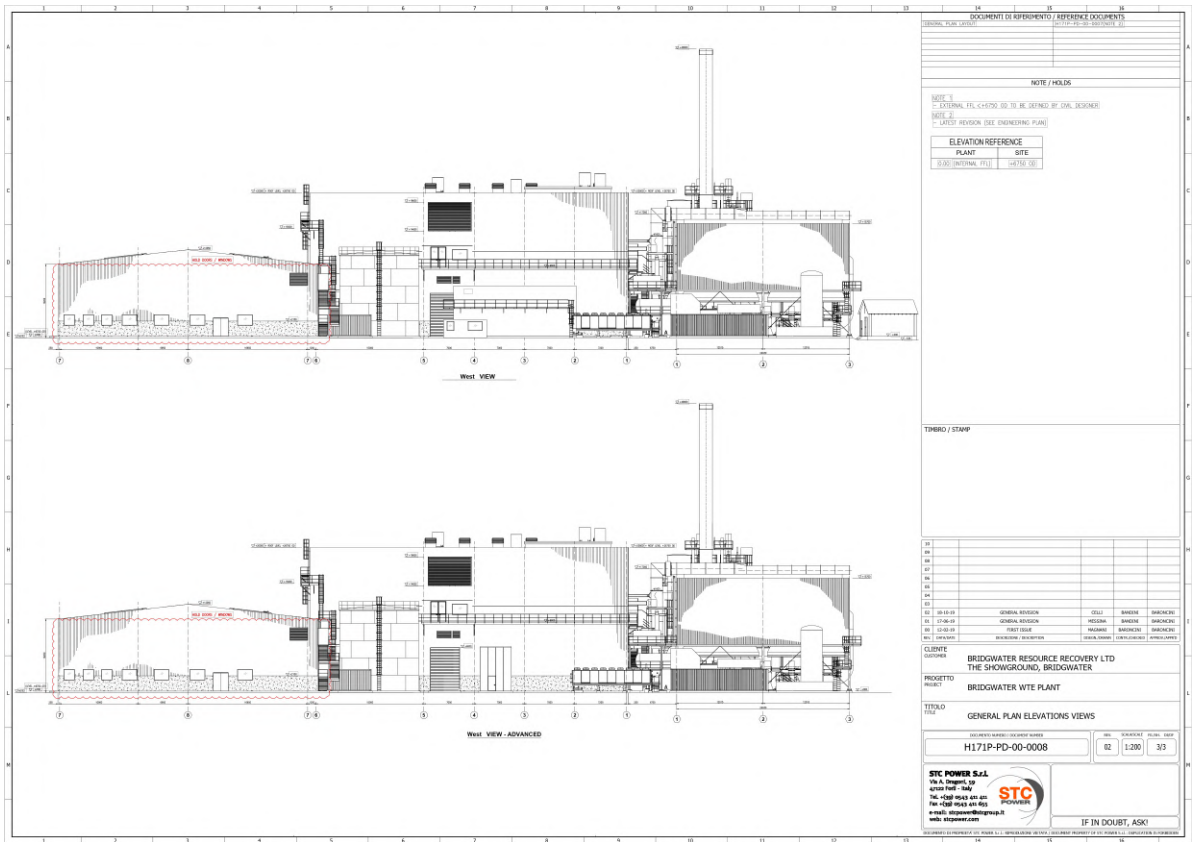
The northern and eastern elevations associated with the Site can be seen below in Figure 4.

FIGURE 4: NORTHERN AND EASTERN ELEVATIONS



The western elevations associated with the Site can be seen below in Figure 5.

FIGURE 5: WESTERN ELEVATIONS



3.3. Noise Generating Elements

The extent of the noise emitting buildings, principally the Fuel Reception Hall and Boiler and Power House, can be seen below in Table 3.

TABLE 3: LOCATION OF NOISE EMITTING BUILDINGS

Building	Grid Coordinates							
	Northern Extent		Eastern Extent		Southern Extent		Western Extent	
	Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing
Fuel Reception Hall	330994	135127	330992	135069	330946	135039	331017	135099
Boiler and Power House	331017	135099	351044	135064	351006	135033	330978	135067

The height of the Fuel Reception Hall is 10 m to eave level and 12.5 m to ridge height, and the Boiler and Power House is 20 m to eave level.

The WTE Plant has a mixture of internal and external noise-generating elements, all of which are summarised below in Table 4.

TABLE 4: SUMMARY OF NOISE-GENERATING ELEMENTS

Reference	Description	Location	Operational Profile	Grid Coordinates	
				Easting	Northing
26	Diesel Storage Tanks and Pumps	External	Emergency	331010	135018
27	Emergency Diesel Generator	External	Emergency	331002	135022
33	ACC Vacuum System	External	Continuous	331005	135030
31	Dry Cooler Pumps	External	Continuous	331002	135034
30	Condensate Extraction Pumps	External	Continuous	330998	135038
45	Dry Cooler	External	Continuous	330996	135033
32	Air Cooling Condenser	External	Continuous	331021	135023
8	Bag Filter	External	Continuous	331043	135040
9	Flue Gas Extraction System	External	Continuous	331034	135035
43	Flue Gas Recirculation Fan	External	Continuous	331026	135043
73	Carbon Silo and Dosing System	External	Continuous	331051	135041
11	Lime Silo and Dosing System	External	Continuous	331046	135048
10	Exhaust Stack	External	Continuous	331031	135041
12	Steam Dry Fly Ash Collector	External	Continuous	331047	135054
64	Boiler Dry Fly Ash Collector	External	Continuous	331049	135051
36	Dry Ash Removal	External	4hrs/day	330984	135047
59	Fire System Pump	External	Emergency	330970	135050
41	11 kV Substation	External	Continuous	330993	134976
42	Combustion Air Fans	Steam Generator Room	Continuous	331012	135067
5	Combustion Chamber	Steam Generator Room	Continuous	331012	135067
6	Steam Drum	Steam Generator Room	Continuous	331012	135067
36	Bottom Ash Conveyor	Steam Generator Room	Continuous	331012	135067
13	Atmospheric Blowdown	Steam Generator Room	Continuous	331012	135067
70	Grate Hydraulic Unit	Steam Generator Room	Continuous	331012	135067
22	Water Pumps	Steam Generator Room	Continuous	331012	135067
25	Water Pumps	Steam Generator Room	Continuous	331012	135067
28	Steam Turbine Genset	Steam Turbine Room	Continuous	331012	135067
34	Steam Condenser	Steam Turbine Room	Continuous	331012	135067
4	Steam Turbine Drain Tank	Steam Turbine Room	Continuous	331012	135067
35	Drain Tank Cleaner	Steam Turbine Room	Continuous	331012	135067
16	Boiler Feedwater	Steam Turbine Room	Continuous	331012	135067
15	Deaerator	Steam Turbine Room	Continuous	331012	135067
13	Chemical Dosing Station	Steam Turbine Room	Continuous	331012	135067
-	Lorry Movements	External	5 per hour	330963	135043
80	Urea Dissociating Skid	External	Continuous	331034	135034
81	Furnace Lime Dosing System	External	Continuous	331046	135056

4. Baseline Measurements

4.1. General

The prevailing noise conditions in the area have been determined by an environmental noise survey conducted during a weeklong survey, inclusive of a weekend period, between Tuesday 25th June 2019 and Tuesday 2nd July 2019.

4.2. Measurement Details

All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and, in accordance with the principles of BS 7445[9].

All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of British Standard 61672[10]. A full inventory of this equipment is shown in Table 5 below.

Table 5: Inventory of Sound Measurement Equipment

Position, Make, Model & Description	Serial Number	Calibration Certificate Number	Calibration Due Date
MP1 - Rion NL-52 Sound Level Meter	00965159	186134	27/02/2021
MP1 - Rion NH-25 Preamplifier	65386	186134	27/02/2021
MP1 - Rion UC-59 Microphone	10288	186134	27/02/2021
MP2 - Rion NL-31 Sound Level Meter	00531144	186135	27/02/2021
MP2 - Rion NH-21 Preamplifier	11344	186135	27/02/2021
MP2 - Rion UC-53A Microphone	308056	186135	27/02/2021
All - Cirrus CR:515 Acoustic Calibrator	72886	182959	22/11/2019

The sound measurement equipment used during the survey was field calibrated at the start and end of the measurement period. A calibration laboratory has calibrated the field calibrator used within the twelve months preceding the measurements. A drift of less than 0.2 dB in the field calibration was found to have occurred on the sound level meters.

The weather conditions during the survey were conducive to noise measurement; it being predominantly dry, with low wind speeds, as measured on-site using a rain-tipping gauge and anemometer, respectively.

When periods of inclement weather occurred, they have been removed from the dataset used to derive the typical background sound level.

[9] British Standard 7445: 2003: *Description and measurement of environmental noise*. BSI.
[10] British Standard 61672: 2013: *Electroacoustics. Sound level meters*. Part 1 *Specifications*. BSI.

The microphones were fitted with protective windshields for the measurements, which are described in Table 6, with an aerial photograph indicating their locations shown in Figure 6.

TABLE 6: MEASUREMENT POSITION DESCRIPTIONS

Measurement Position	Description	Grid Coordinates	
		Easting	Northing
MP1	An unattended weeklong measurement of sound under free-field conditions, at a height of 1.5 metres above local ground level, on land associated with CHT Silicones Ltd, immediately to the south of 1-2 Canal Cottages, taken to be representative of R1 to the immediate north. The sound environment at this location was dominated by road traffic noise from the M5.	330966	135186
MP2	An unattended weeklong measurement of sound under free-field conditions, at a height of 1.5 metres above local ground level, within the curtilage of 3 Canal Cottages. The sound environment at this location was dominated by road traffic noise from the M5.	331231	135004

FIGURE 6: MEASUREMENT POSITIONS

4.3. Summary Results

The summarised results of the environmental noise measurements are presented in Table 7, with full time histories and statistical analyses presented under Appendix B.

TABLE 7: SUMMARY OF NOISE MEASUREMENT RESULTS

Measurement Position	Period	Noise Level, dB			
		L_{AFmax}	$L_{Aeq,T}$	L_{A10}	L_{A90}
MP1	Daytime	70	60	61	49
	Night-Time	68	54	57	46
MP2	Daytime	77	65	67	58
	Night-Time	68	60	63	48

5. CALCULATIONS

5.1. Methodology

5.1.1. Source Data

The sound power levels associated with the Site, based on data supplied by the Technology Provider in Document H171P-PL-00-0029, can be seen below in Table 8. This table also contains details of any specific mitigation measures that have been considered as part of the design process.

TABLE 8: SOUND POWER LEVEL SOURCE DATA AND MITIGATION MEASURES

Source	Sound Power Level, L_{WA} (dB)	Reverberant Sound Pressure Level, L_{Aeq} (dB)	Assumed % Operating Time	Periods of Operation	Applicable Best Available Techniques (BAT)[11]
Air Cooling Condenser (Day)	95	-	100	Day	Low Noise Plant Selected, normally operate at L_{WA} 105 dB, by operating FVD Motor at 60 Hz.
Air Cooling Condenser (Night)	95	-	100	Night	Low Noise Plant Selected, normally operate at L_{WA} 105 dB, with derated FVD Motor at 50 Hz.
Lorry Movements	111	-	5 per hour	Day	-
Carbon Silo and Dosing System	88	-	100	Day/Night	-
Bag Filters	93	-	100	Day/Night	-
Steam Generator Room	-	90	100	Day/Night	Increased Façade and Roof Sound Insulation Specification
Dry Cooler Pumps	92	-	100	Day/Night	-
Dry Cooler	96	-	100	Day/Night	-
Lime Silo and Dosing System	88	-	100	Day/Night	-
Exhaust Stack	89	-	100	Day/Night	-
Steam Dry Fly Ash Collector	88	-	100	Day/Night	-
Boiler Dry Fly Ash Collector	88	-	100	Day/Night	-
Dry Ash Removal	111	-	4hrs/day	Day	-
Condensate Extraction Pumps	96	-	100	Day/Night	-
Emergency Diesel Generator	98	-	Emergency Only	Day/Night	-
Diesel Storage Tanks and Pumps	75	-	Emergency Only	Day/Night	-

[11] BAT37 (Section 5.1.8) of Best Available Techniques (BAT) Reference Document for Waste Incineration. Industrial Emissions Directive 2010/75/EU. Final Draft, December 2018.

Source	Sound Power Level, L_{WA} (dB)	Reverberant Sound Pressure Level, L_{Aeq} (dB)	Assumed % Operating Time	Periods of Operation	Applicable Best Available Techniques (BAT)[11]
Flue Gas Extraction System	83	-	100	Day/Night	-
Flue Gas Recirculation Fan	93	-	100	Day/Night	-
ACC Vacuum System	88	-	100	Day/Night	-
Steam Turbine Room	-	81	100	Day/Night	-
RDF General Arrival Area	-	73	100	Day/Night	-
RDF Arrival Area	-	73	100	Day	-
11 kV Substation	78	-	100	Day/Night	-
Fire System Pumps	107	-	Emergency Only	Day/Night	-
Urea Dissociating Skid	88	-	100	Day/Night	-
Furnace Lime Dosing System	88	-	100	Day/Night	-

The reverberant sound pressure level for the RDF Arrival Area, Steam Generator Room and Steam Turbine Room have been calculated using the sound power levels of the various items of plant; the Excel Spreadsheet calculations for these elements are submitted alongside this report.

The details of the modelled height and directivity of the external noise sources can be seen in Table 9, below.

TABLE 9: NOISE SOURCE HEIGHT AND DIRECTIVITY

Source	Height Above Ground Level (m)	Directivity
Air Cooling Condenser	10.0	Omnidirectional
Carbon Silo and Dosing System	6.0	Omnidirectional
Bag Filters	5.0	Omnidirectional
Dry Cooler Pumps	1.5	Omnidirectional
Dry Cooler	2.0	Omnidirectional
Lime Silo and Dosing System	10.0	Omnidirectional
Exhaust Stack	40.0	±90° Vertically
Steam Dry Fly Ash Collector	4.0	Omnidirectional
Boiler Dry Fly Ash Collector	4.0	Omnidirectional
Condensate Extraction Pumps	2.0	Omnidirectional
Emergency Diesel Generator	3.0	Omnidirectional
Diesel Storage Tanks and Pumps	1.5	Omnidirectional
Flue Gas Extraction System	5.0	Omnidirectional
Flue Gas Recirculation Fan	5.0	Omnidirectional
ACC Vacuum System	2.0	Omnidirectional

Source	Height Above Ground Level (m)	Directivity
11 kV Substation	2.0	Omnidirectional
Fire System Pumps	2.0	Omnidirectional
Urea Dissociating Skid	5.0	Omnidirectional
Furnace Lime Dosing System	5.0	Omnidirectional

Furthermore, in order to calculate the sound reduction through the various façades and roof of the building, the following sound reduction indices, as detailed in Table 10, have been used in the assessment.

TABLE 10: SOUND REDUCTION INDICES

Element	Sound Reduction Index, R, in Octave Bands, Hz (dB)							
	63	125	250	500	1k	2k	4k	8k
Standard Wall/Roof Panel	15	18	18	17	23	30	40	40
Enhanced Wall/Roof Panel	21	25	29	34	32	30	57	57
Acoustic Louvres	6	8	11	20	29	31	28	28
Acoustic Doors	10	15	20	25	30	35	35	40
Roller Shutter Door	2	3	5	8	10	11	13	12

The Standard Wall/Roof Panel is the Kingspan KS1000 product, which is a standard wall/roof insulated core panel used throughout industrial buildings in the UK. Where an Enhanced Wall/Roof Panel is required, the Europanel F5 product will be used, which has an increased density. Sound insulation datasheets for both products can be seen in Appendix B. It should be noted that the Sound Reduction Index for the Standard Wall/Roof Panel used in the noise model is less than that associated with the Kingspan KS1000 product, to ensure the predictions are worst case.

The Acoustic Louvres, Acoustics Doors and Roller Shutter Doors are bespoke items, as such, the Sound Reduction Indices outlined above for these items are a minimum specification for the supplier of these products, that must be achieved.

Finally, the composite sound insulation of the various apertures in the building façade have been calculated and inputted into the noise model; the Excel Spreadsheet calculations for these elements are submitted alongside this report.

5.1.2. Calculation Process

Calculations were carried out using iNoise 2019.1, which undertakes its calculations in accordance with guidance given in ISO9613-1:1993 and ISO9613-2:1996.

5.1.3. Assumptions

Given that the land between the development and the nearest receptors is mixed, the ground factor has been set according to ground type. The ground area associated with the conurbation and area surrounding the site has been set with a ground factor of 0.2. Where there is significant open countryside, the ground factor has been set to 1.0.

The ambient temperature has been assumed to be 10°C, with a relative humidity of 70% and an Air Pressure of 101.33 kPa.

It has been assumed that all processes will occur simultaneously, representing a worst-case scenario. In order to accurately model the land surrounding the development, an AutoCAD DXF drawing was produced, which was based on data provided by the Ordnance Survey. The land contours throughout the area were modelled using Environment Agency LiDAR data with a resolution of 1 m, as measured in November 2014.
Building surfaces have been modelled using emitting façades/roofs, HGVs have been modelled using moving point sources with a velocity of 20 kph, and the external plant has been modelled using point sources.

5.1.4. Screening

There is one modelled off-site building which affects the predicted specific sound levels, and is associated with the adjacent Hopkins Concrete Ltd site. The corner grid references for this building are as follows:

- North: E:331080 N:135042
- East: E:331094 N:135030
- South: E:331084 N:135018
- West: E:331070 N:135030

The building has been modelled to 6.5 m to the eaves.

In addition to this, the bridge deck associated with the M5 has been modelled as a floating building. The top of the deck is modelled at 12 m above local ground level, as per the Ordnance Survey height data for the embankment to the east of the site. The bridge deck is modelled with a thickness of 2.5 m. The length of the bridge deck is 810 m. The start of the bridge deck is E:331130 N:134967 and ends at E:331607 N:135623.

5.1.5. Emitting Façades and Roofs

The noise emissions associated with façades and roofs noise emitting buildings has been calculated and presented below in Table 11.

TABLE 11: EMITTING FAÇADES AND ROOFS

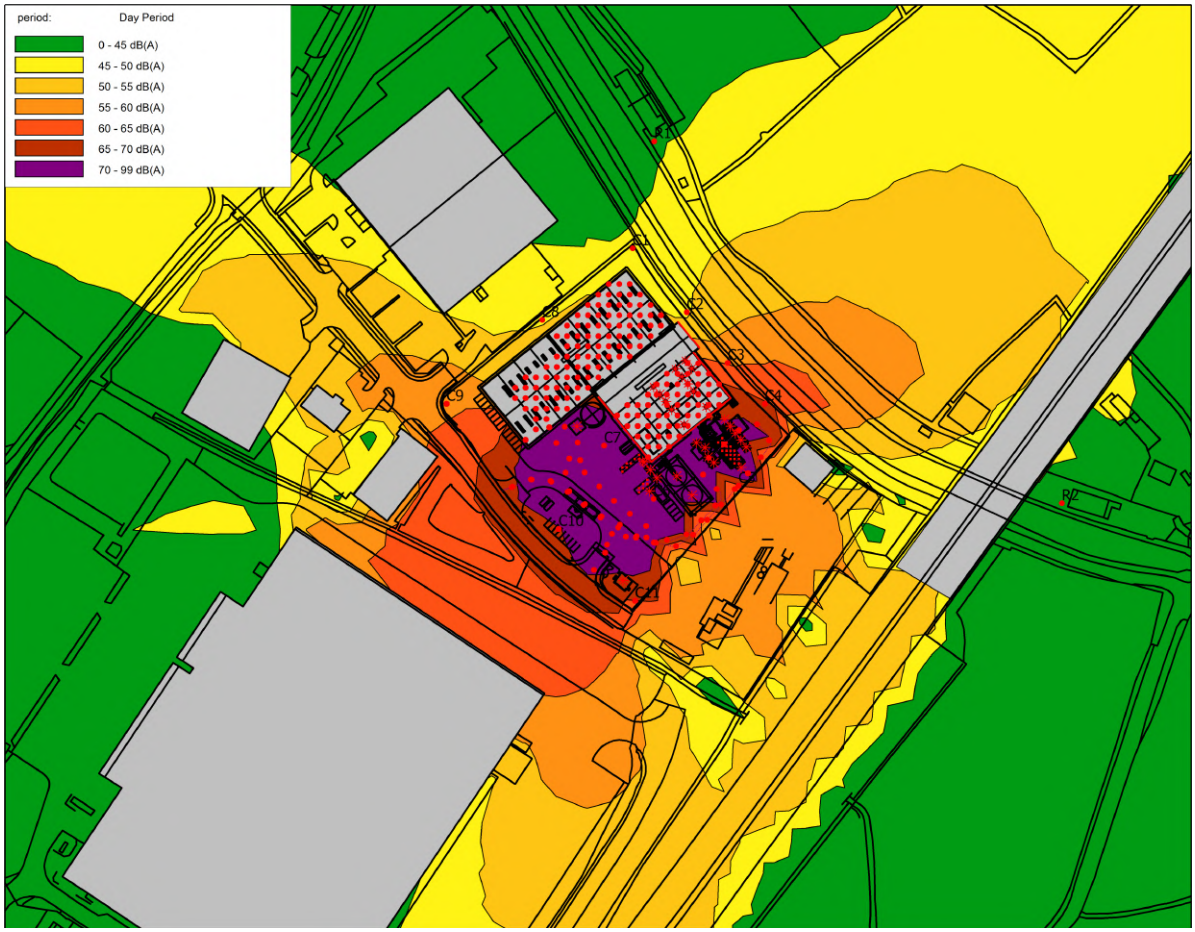
Element	Sound Power Level, L_{WA}, in Octave Bands, Hz, at per m^2 (dB)							
	63	125	250	500	1k	2k	4k	8k
RDF Arrival Area - North Façade	25	31	37	37	36	36	28	16
RDF Arrival Area – South East Façade	31	37	43	44	43	42	36	24
RDF Arrival Area – North East Façade	19	23	27	26	29	31	-	-
RDF Arrival Area – Roof	19	23	27	26	29	31	-	-
Steam Generator Room – North East Façade	49	55	55	56	56	56	51	45
Steam Generator Room – South East Façade	49	55	55	56	56	56	51	45
Steam Generator Room – Roof	41	44	43	42	46	49	19	13
Steam Turbine Room – South East Façade	19	33	34	35	42	35	19	7
Steam Turbine Room – South West Façade	19	33	34	35	42	35	19	7
Steam Turbine Room – Roof	15	28	28	32	42	35	3	-

5.2. Specific Sound Level Calculations

5.2.1. Daytime Specific Sound Level Map

The sound map showing the specific sound level emissions from the Site, during the daytime period, can be seen below in Figure 7.

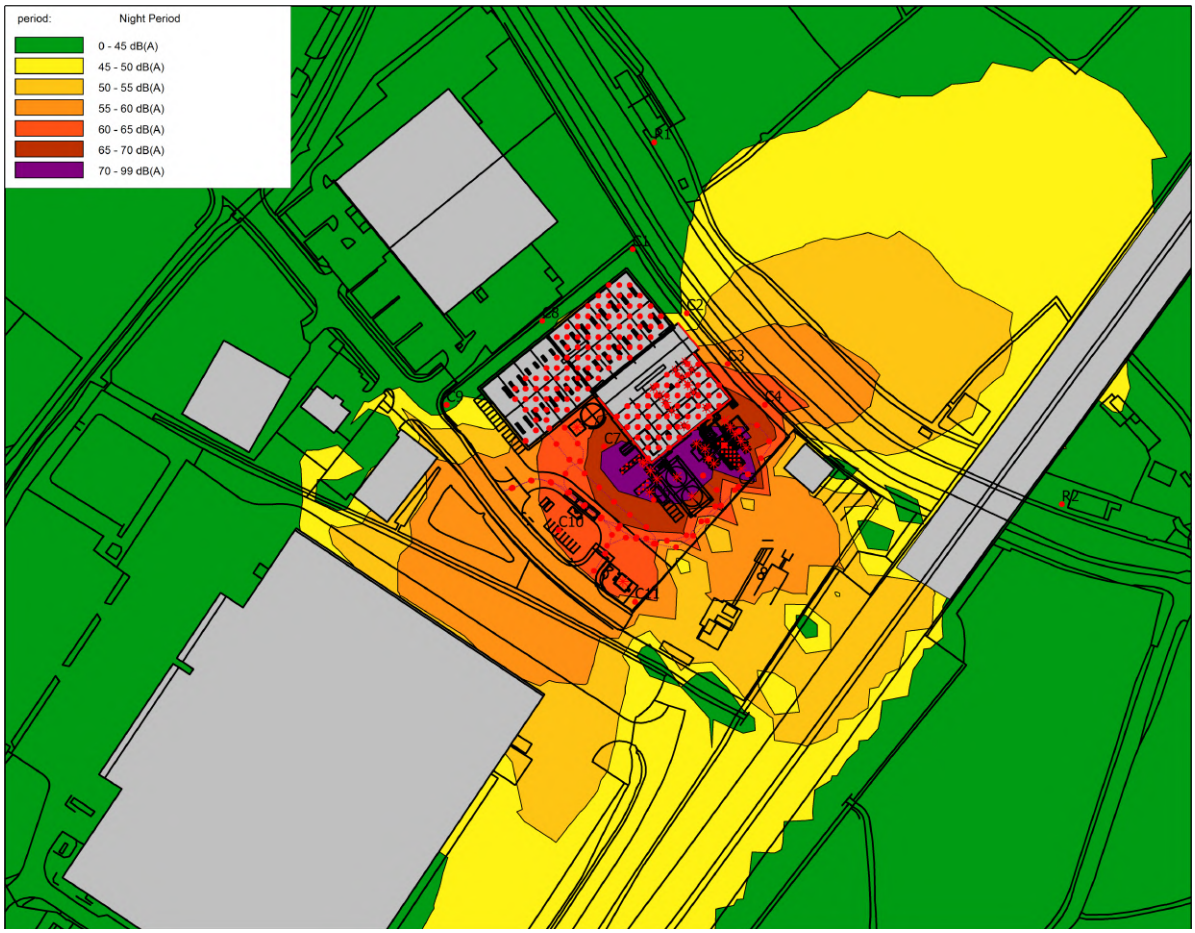
FIGURE 7: DAYTIME SPECIFIC SOUND LEVEL MAP



5.2.2. Night Time Specific Sound Level Map

The sound map showing the specific sound level emissions from the Site, during the night time period, can be seen below in Figure 8.

FIGURE 8: NIGHT TIME SPECIFIC SOUND LEVEL MAP



5.2.3. Specific Sound Level Summary

A summary of the predicted specific sound levels at the NSRs, based on the sound maps shown in Figure 7 and Figure 8, can be seen below in Table 12.

TABLE 12: PREDICTED SPECIFIC SOUND LEVEL SUMMARY

Receptors	Period	Specific Sound Level (dB)
R1	Day	45
	Night	42
R2	Day	43
	Night	42

6. ASSESSMENT

6.1. Rating Penalty Principle

Section 9 of BS4142:2014+A1:2019 describes how the rating sound level should be derived from the specific sound level, by determining a rating penalty.

BS4142:2014+A1:2019 states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:

a) subjective method;
b) objective method for tonality;
c) reference method."

Given that the Site is not operational, the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014+A1:2019, which states:

"Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.

Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources."

BS4142:2014+A1:2019 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

Tonality

A rating penalty of +2 dB is applicable for a tone which is *"just perceptible"*, +4 dB where a tone is *"clearly perceptible"*, and +6 dB where a tone is *"highly perceptible"*.

Impulsivity

A rating penalty of +3 dB is applicable for impulsivity which is *"just perceptible"*, +6 dB where it is *"clearly perceptible"*, and +9 dB where it is *"highly perceptible"*.

Other Sound Characteristics

BS4142:2014+A1:2019 states that where *"the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distance against the residual acoustic environment, a penalty of +3 dB can be applied."*

Intermittency

BS4142:2014+A1:2019 states that when the *"specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time … if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied."*

6.2. Rating Penalty Assessment

Considering the content of Section 6.1, an assessment of the various sound sources associated with the Proposed Development, in terms of whether any rating penalties are applicable, and has been detailed in Table 13 below.

TABLE 13: RATING PENALTY ASSESSMENT

Source	Tonality	Impulsivity	Intermittency	Other Sound Characteristics	Discussion
WTE	+2 dB	0 dB	0 dB	0 dB	The WTE will operate continuously, hence no correction for intermittency. Tonality may be *"just perceptible"* if the specific sound level is high enough, but the residual acoustic environment is likely to mask any significant tones. The Site will not have any regular activities likely to give rise to impulsive sources associated with it.
Lorry Movements	0dB	0 dB	0 dB	0 dB	Lorry movements are not outwith the character of the area, given the relative proximity of the M5.

In light of the above, an overall rating penalty correction of +2 dB has been applied to the combined specific sound level of the Site, to derive the rating level.

6.3. Uncertainty in Assessment

BS4142:2014+A1:2019 requires that the level of uncertainty in the measured data and associated calculations is considered in the assessment. The Standard recommends that steps should be taken to reduce the level of uncertainty.

Measurement Uncertainty

BS4142:2014+A1:2019 states that measurement uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

"
...
b) the complexity and level of variability of the residual acoustic environment;
...
d) the location(s) selected for taking the measurements;
...
g) the measurement time intervals;
h) the range of times when the measurements have been taken;
i) the range of suitable weather conditions during which measurements have been taken;
...
k) the level of rounding of each measurement recorded; and
l) the instrumentation used."

Each of the measurement uncertainty factors outlined above have been considered and discussed in Table 14 below.

TABLE 14: MEASUREMENT UNCERTAINTY FACTORS

Measurement Uncertainty Factor Reference	Level of Uncertainty	Discussion
b)	0 dB	Residual acoustic environment is relatively constant, hence no correction for a complex residual acoustic environment.
d)	0 dB	Measurements were undertaken on, or near to, land associated with the nearest noise-sensitive receptors, hence no further correction needs to be made.
g)	0 dB	Measurement time intervals were set in accordance with BS4142:2014+A1:2019, hence no further correction needs to be made.
h)	0 dB	Measurements were undertaken over a continuous, weeklong period, inclusive of a weekend.
i)	0 dB	An anemometer and rain gauge were deployed for the duration of the background sound survey. The periods of data used to derive the typical background sound levels had relatively neutral weather conditions; therefore the impact on the measured values would have been minimal.
k)	0 dB	Measured values were rounded to 0.1 dB, therefore rounding would not have had a significant impact on the overall typical background sound levels.
l)	0 dB	The acoustic measurement equipment accorded with Type 1 specification of British Standard 61672, and were deployed with appropriate wind shields.

In summary, a correction of 0 dB has been included in the assessment, to account for measurement uncertainty.

Calculation Uncertainty

BS4142:2014+A1:2019 states that calculation uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

"
...
b) uncertainty in the operation or sound emission characteristics of the specific sound source and any assumed sound power levels;
c) uncertainty in the calculation method;
d) simplifying the real situation to "fit" the model (user influence on modelling); and
e) error in the calculation process."

Each of the calculation uncertainty factors outlined above have been considered and discussed in Table 15 below.

TABLE 15: CALCULATION UNCERTAINTY FACTORS

Calculation Uncertainty Factor Reference	Level of Uncertainty	Discussion
b)	+1 dB	Sound power levels for all plant are based on manufacturer data, as supplied by the Technology Provider, but are typically in the range, or greater, than the levels given in Section 3.18 of the Best Available Techniques (BAT) Reference Document for Waste Incineration (Draft, December 2018), however, to ensure robustness, we have made an inclusion for the uncertainty budget.
c)	0 dB	Calculations were undertaken in accordance with ISO 9613-2, which is considered a *"validated method"* by BS4142:2014+A1:2019.
d)	0 dB	The real situation has not been simplified for the purposes of this assessment.
e)	+1 dB	ISO 9613-2 indicates that there is a ±3 dB accuracy to the prediction method, therefore, an uncertainty factor of +1 dB is considered appropriate and proportional, given the separation distances involved.

In summary, a correction of +2 dB has been included in the assessment, to account for calculation uncertainty.

6.4. Rating Sound Level Summary

A summary of the predicted rating sound levels at the NSRs, based on the sound map shown in Figure 7 and Figure 8, and incorporating the rating penalties discussed in Table 13, and the measurement and calculation uncertainty discussed in Table 14 and Table 15, can be seen in Table 16 below.

TABLE 16: PREDICTED RATING SOUND LEVEL SUMMARY

Receptors	Period	Rating Sound Level (dB)
R1	Day	49
	Night	46
R2	Day	47
	Night	46

6.5. BS4142:2014+A1:2019 Assessment

The rating sound level, as calculated from the predicted specific sound level, has been assessed in accordance with BS4142:2014+A1:2019, at all NSRs.

The BS4142:2014+A1:2019 assessment at all NSRs, during the daytime period, can be seen in Table 17.

TABLE 17: DAYTIME BS4142:2014+A1:2019 ASSESSMENT

Receptor	Rating Sound Level (dB)	Daytime Background Sound Level (dB)	Excess of Rating over Daytime Background Sound Level (dB)
1	49	49	0
2	46	58	-12

The assessment in accordance with BS4142:2014+A1:2019 indicates that the proposed development will have a *"Low Impact"* at the nearest noise-sensitive receptors during the daytime period, indicating that proposed development falls within the NOAEL range.

The BS4142:2014+A1:2019 assessment at all NSRs, during the night time period, can be seen in Table 18.

TABLE 18: NIGHT TIME BS4142:2014+A1:2019 ASSESSMENT

Receptor	Rating Sound Level (dB)	Night Time Background Sound Level (dB)	Excess of Rating over Night Time Background Sound Level (dB)
1	47	46	+1
2	46	48	-2

The assessment in accordance with BS4142:2014+A1:2019 indicates that the proposed development will have a *"Low Impact"* at the nearest noise-sensitive receptors during the night time period, indicating that proposed development falls within the NOAEL range.

6.6. BS8233:2014 and WHO Guidelines

The predicted specific sound levels have been compared against the recommended noise levels in BS8233:2014, and can be seen in Table 19 and Table 20, below.

TABLE 19: DAYTIME BS8233:2014 ASSESSMENT

Receptor	Specific Sound Level (dB)	Daytime Recommended Noise Levels (dB)	Excess of Specific over Daytime Recommended Noise Levels (dB)
1	45	50/55	-5/-10
2	43	50/55	-7/-12

TABLE 20: NIGHT TIME BS8233:2014 ASSESSMENT

Receptor	Specific Sound Level (dB)	Night Time Recommended Noise Levels (dB)	Excess of Specific over Night Time Recommended Noise Levels (dB)
1	42	45	-3
2	42	45	-3

The predicted specific sound levels have been compared against the recommended noise levels in the WHO Guidelines, and can be seen in Table 21 and Table 22, below.

TABLE 21: DAYTIME WHO ASSESSMENT

Receptor	Specific Sound Level (dB)	Daytime Recommended Noise Levels (dB)	Excess of Specific over Daytime Recommended Noise Levels (dB)
1	45	50/55	-5/-10
2	43	50/55	-7/-12

TABLE 22: NIGHT TIME WHO ASSESSMENT

Receptor	Specific Sound Level (dB)	Night Time Recommended Noise Levels (dB)	Excess of Specific over Night Time Recommended Noise Levels (dB)
1	42	40/45	+2/-3
2	42	40/45	+2/-3

In all instances during the daytime periods, the predicted specific sound levels from the Site are below the criterion outlined in BS8233:2014 and the WHO Guidelines. There is predicted to be an exceedance of the lower night time recommend noise levels in the WHO Guidelines of 2 dB, however, in the context of all of the other assessment protocols, which indicate compliance, this is insignificant.

6.7. Discussion and Context

The assessment indicates that, in the context of BS4142:2014+A1:2019, BS8233:2014 and the WHO Guidelines, that the Site will have a *No Observed Adverse Effect Level* (NOAEL) on the nearest residential receptors.

The Noise Planning Policy Statement for England outlines three aims for the effective management and control of environmental, neighbour and neighbourhood noise:

- *"Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life".*

The Site clearly demonstrates compliance with the first two aims of the NPSE, given the impact is predicted to be in the NOAEL range. Indeed, the Site has adopted Best Available Techniques (BAT) with regard to some of the noise sources that were predicted to have a more significant impact than others, as detailed in Table 8.

Paragraph 2.15 of the NPSE states, with regard to the third aim, that *"this statement expresses the long-term desired policy outcome, but in the use of "promote" and "good" recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations."*

The NPSE recognises that, in some instances, some sources of noise are not able to objectively demonstrate compliance with this aim; this being the case in this instance. However, by using BAT in the design, the Site is responding to the constraints of the locality by selecting technology solutions that will have, in the long-term, a low impact and should promote a congruous relationship between the Site and the surrounding residential receptors.

7. CONCLUSION

inacoustic has been commissioned to prepare a Noise Assessment for the Bridgwater WTE Plant on Land at Showground Road, Bridgwater, for submission to the Environment Agency as part of a Permit Application.

When dealt with in the manner described in this report, the Site can be brought forward in compliance with guidelines given in BS4142:2014+A1:2019, and the requirements of the IPPC Technical Guidance Note IPPC H3 Part 2, demonstrating BAT where possible, as outlined in Table 8.

In light of the above, it is considered that this report provides sufficient information to the grant the Application for a Permit for the Site.

8. APPENDICES

8.1. Appendix A – Definition of Terms

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa ($20x10^{-6}$ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

TABLE A1: TYPICAL SOUND LEVELS FOUND IN THE ENVIRONMENT

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source.

A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}.

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,15mins}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

8.2. Appendix B – Sound Insulation Datasheets

Sound Insulation Prediction (v8.0.12)

Program copyright Marshall Day Acoustics 2015

Inacoustic - Key No. 2591

Margin of error is generally within Rw +/- 3 dB

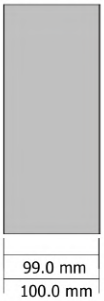
Job Name:

Notes:

Job No.: Page No.:

Date: 12 Apr 19 Initials:Antony Best

File Name: KS 1000.ixl

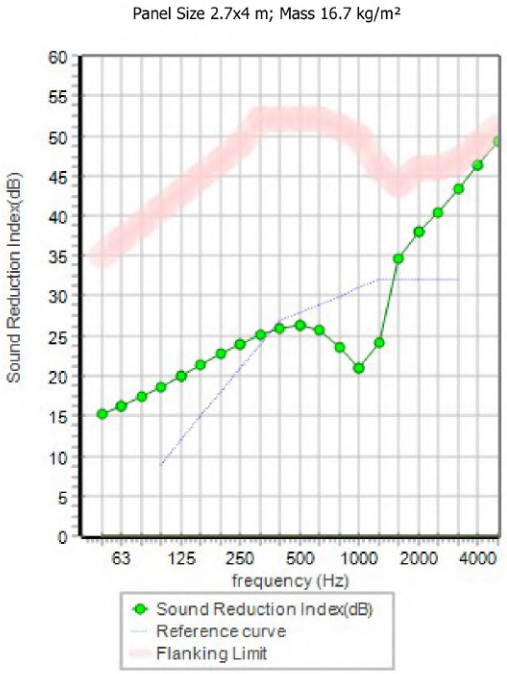


Rw	28 dB
C	-2 dB
C_{tr}	-3 dB
D_{nTw}	30 dB [V:50m3] [A:11m2]

System description

Panel 1 : 1 x 100.0 mm Kingspan KS1000 RW 80/100/120mm (ρ:7800 kg/m3,E:2.1E02GPa,η:0.15, ρs:3.9 kg/m², fc:2.5E4 Hz)

frequency (Hz)	R(dB)	R(dB)
50	15	
63	16	16
80	17	
100	19	
125	20	20
160	21	
200	23	
250	24	24
315	25	
400	26	
500	26	26
630	26	
800	24	
1000	21	23
1250	24	
1600	35	
2000	38	37
2500	40	
3150	43	
4000	46	46
5000	49	



Sound Insulation Prediction (v8.0.12)

Inacoustic - Key No. 2591

Margin of error is generally within Rw +/- 3 dB

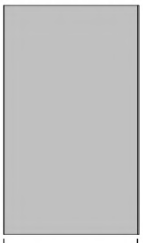
Job Name:

Notes:

Job No.: Page No.:

Date: 12 Apr 19 Initials:Antony Best

File Name: Europanel.ixl



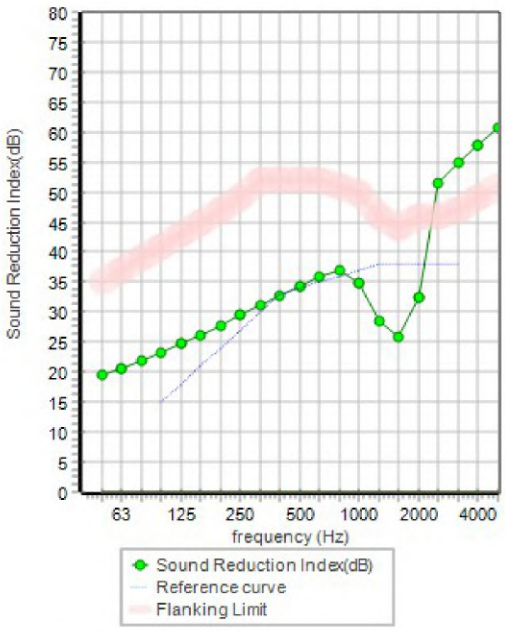
Rw	34 dB
C	-3 dB
C_{tr}	-3 dB
D_{nTw}	36 dB [V:50m3] [A:11m2]

System description

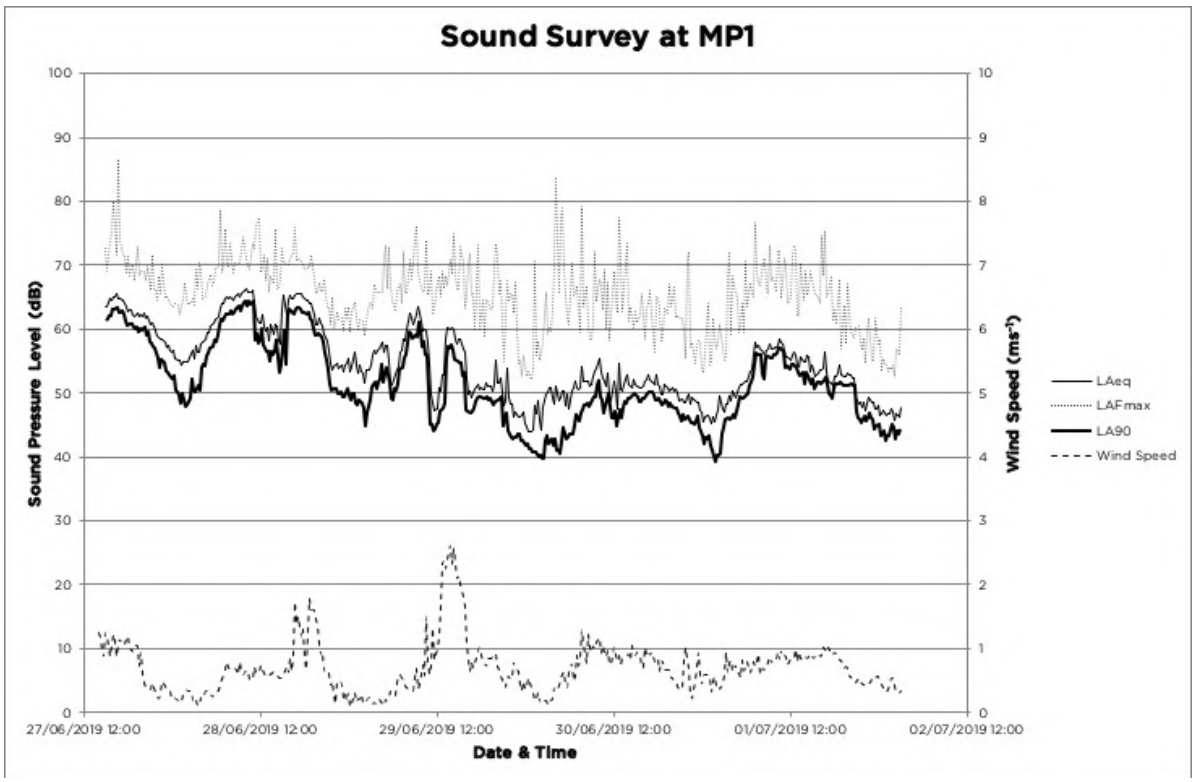
Panel 1 : 1 x 140.0 mm Europanel F5/G Series/Rainspan/Rockspan Extra (ρ:7800 kg/m3,E:2.1E02GPa,η:0.38, ρs:5.46 kg/m², fc:1.786E4 Hz)

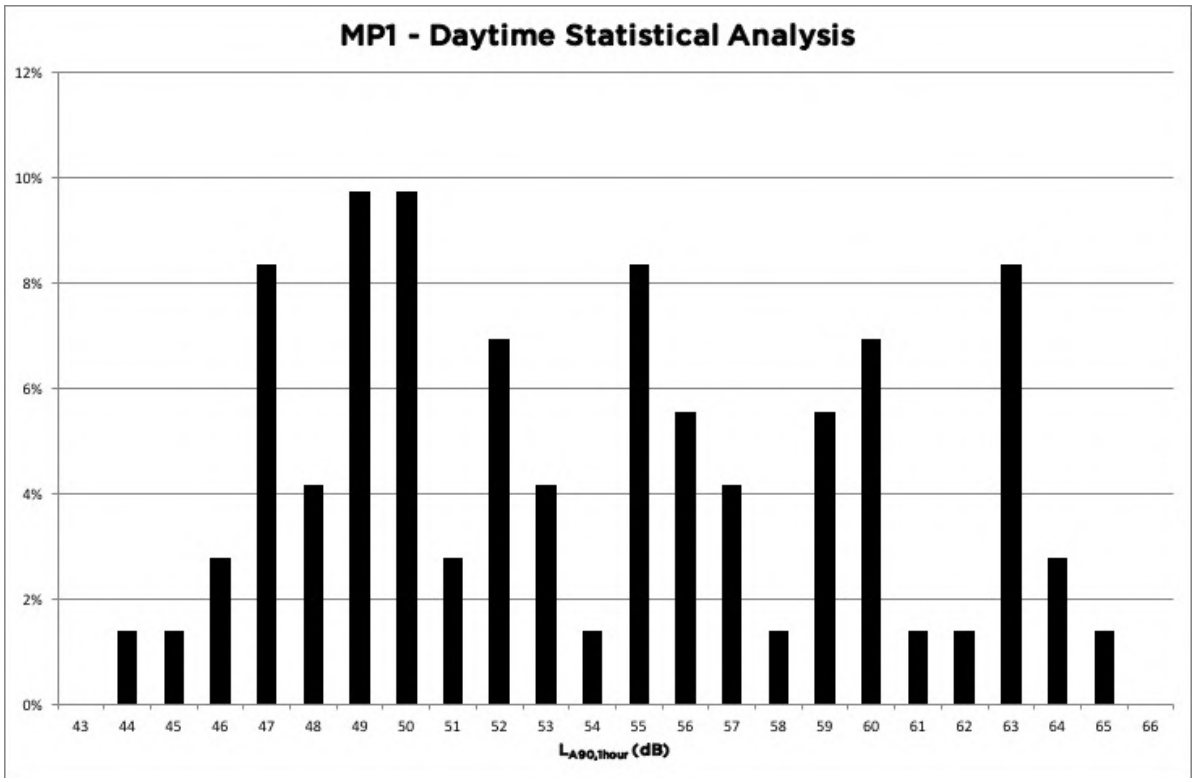
frequency (Hz)	R(dB)	R(dB)
50	20	
63	21	21
80	22	
100	23	
125	25	25
160	26	
200	28	
250	29	29
315	31	
400	33	
500	34	34
630	36	
800	37	
1000	35	32
1250	28	
1600	26	
2000	33	30
2500	51	
3150	55	
4000	58	57
5000	61	

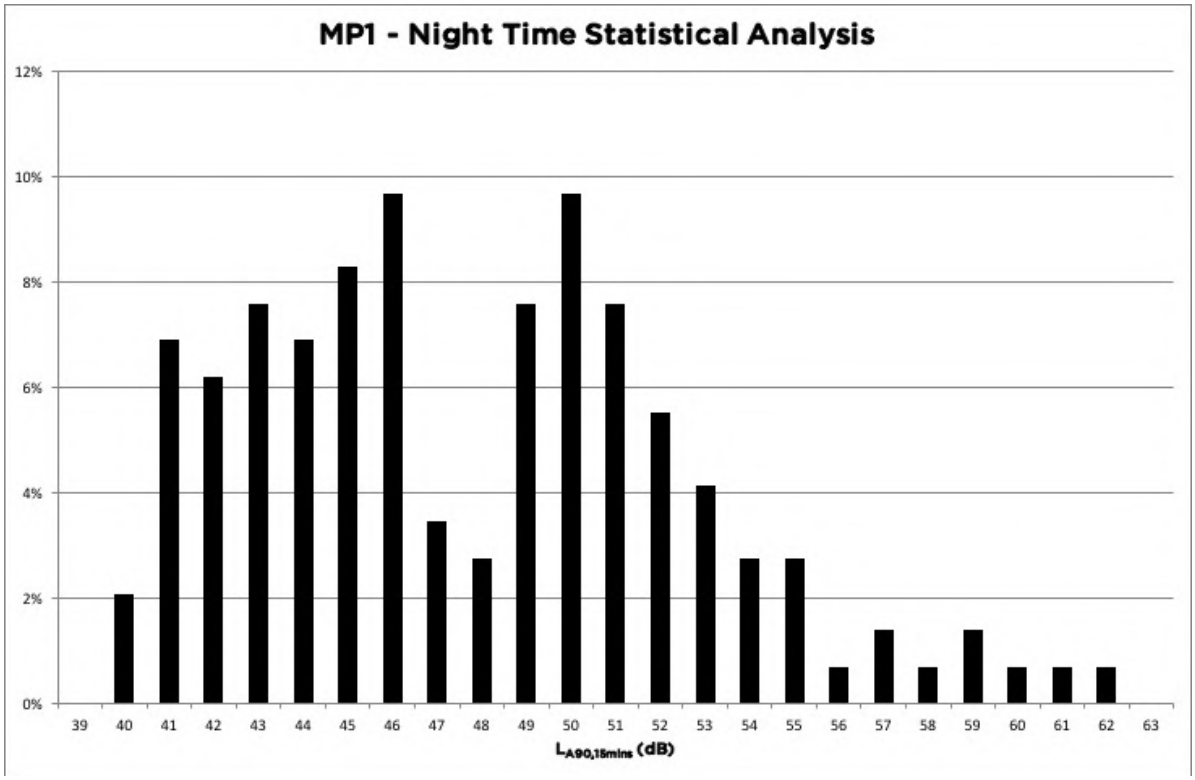
Panel Size 2.7x4 m; Mass 28.1 kg/m²

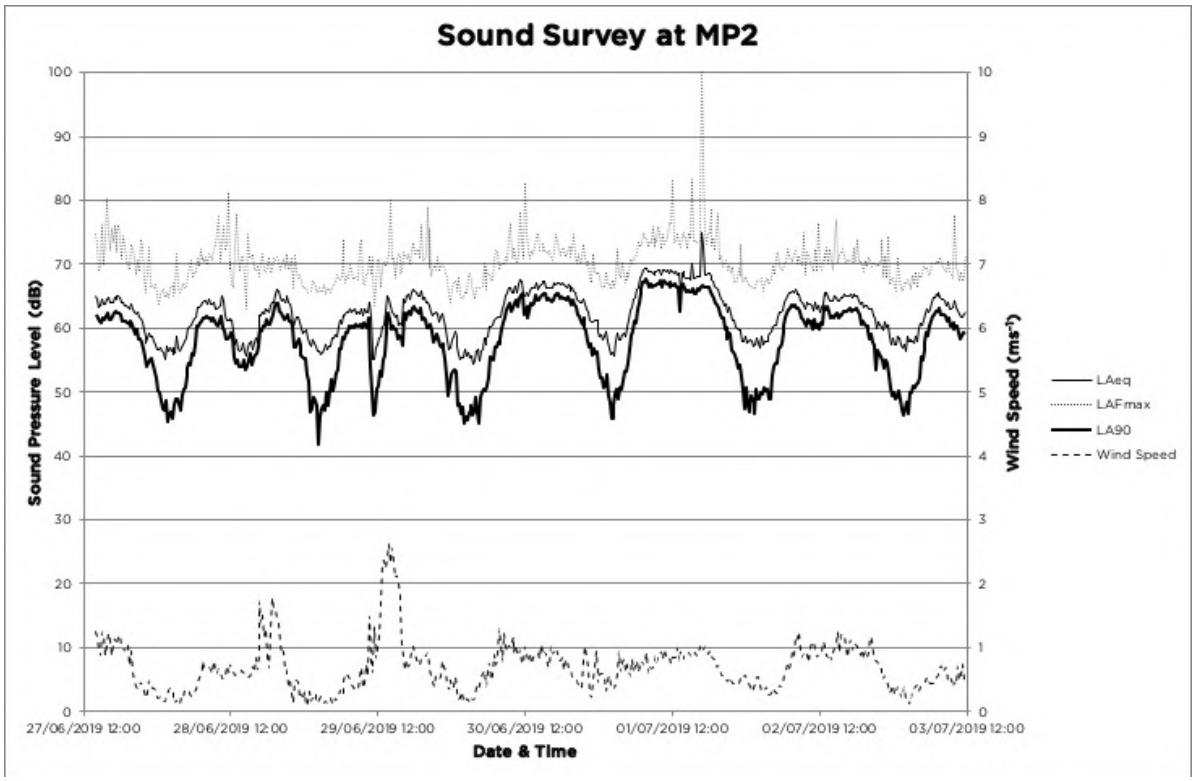


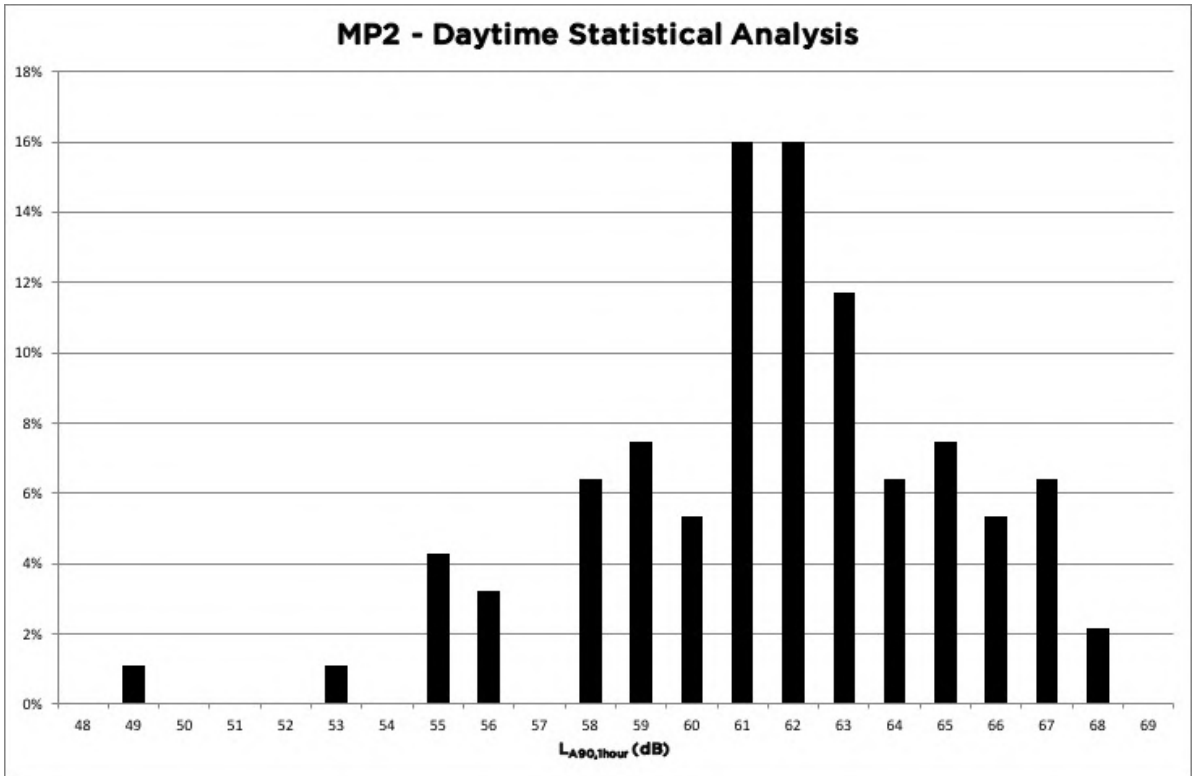
8.3. Appendix C – Measurement Results

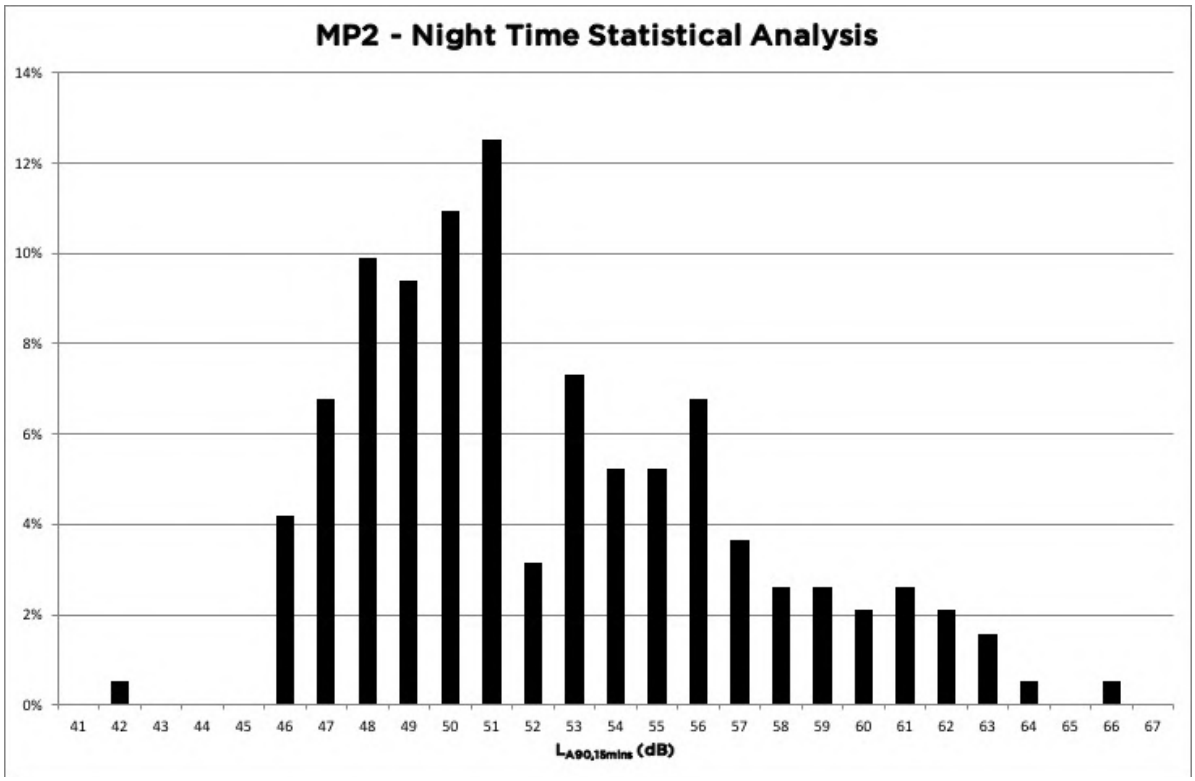





MP1 - Night Time Statistical Analysis
12%
10%
8%
6%
4%
2%
0%
39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63
$L_{A90,15mins}$ (dB)


Sound Survey at MP2
Sound Pressure Level (dB)
Wind Speed (ms⁻¹)
100
90
80
70
60
50
40
30
20
10
0
10
9
8
7
6
5
4
3
2
1
0
27/06/2019 12:00
28/06/2019 12:00
29/06/2019 12:00
30/06/2019 12:00
01/07/2019 12:00
02/07/2019 12:00
03/07/2019 12:00
Date & Time
LAeq
LAFmax
LA90
Wind Speed


MP2 - Daytime Statistical Analysis
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
$L_{A90,1hour}$ (dB)


MP2 - Night Time Statistical Analysis
14%
12%
10%
8%
6%
4%
2%
0%
41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67
$L_{A90,15mins}$ (dB)

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