AtkinsRéalis

Noise Impact Assessment

IQE plc

02 October 2024

2023/NOV/15

IQE PERMIT APPLICATION

AtkinsRéalis - Baseline / Référence

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This document has 39 pages including the cover.

Document history

Document title: Noise Impact Assessment

Document reference: 2023/NOV/15

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Issue	WW	LM	AL	AL	8/12/2023
2.0	Issue	WW	LM	AL	AL	19/12/2023
3.0	Revision to include additional information as requested	WW	LM	AL	AL	19/07/2024
4.0	Revision to include additional information as requested	WW	GX	AL	AL	02/10/2024

Client signoff

Client	IQE plc
Project	IQE PERMIT APPLICATION
Job number	5223588
Client signature/date	

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1. Introduction

New plant has been proposed for the IQE site at Imperial Park, Celtic Way, Marshfield, Newport, NP10 8BE. The plant is for the design and manufacture of semiconductors. The project, as part of support for the South Wales cluster of compound semiconductor companies, is one of the largest investments in this field in Europe to pursuing high-volume silicon technology in the UK.

The new proposed plant includes cooling units, extract fans and transformers, which are expected to operate 24 hours a day and 7 days a week. Two emergency generators are also proposed which would only operate in case of an emergency.

The proposed plant have the potential to cause noise impact on the nearby noise sensitive receptors. This report is prepared to assess the noise impact at noise sensitive receptors in support of a permit application.

The assessment includes:

- Review of relevant technical guidance, and establishment of noise assessment criteria,
- Identification of the noise sensitive receptors,
- Determination of the baseline noise conditions,
- Sound propagation modelling, and
- BS4142 noise impact assessment.

A glossary of technical terms is provided in Appendix A.

2. Regulations, Planning and Context

2.1 Natural Resources Wales

Based on consultation with Natural Resources Wales for similar projects at this area, it is understood that that assessments should principally focus on engine testing scenarios (i.e. not all engines operating at the same time as they may in an emergency scenario). Following this, assessments of the following scenarios have been undertaken:

- Normal operation
- Emergency operation

2.2 BS 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound (BS 4142) describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in the standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The standard is used to determine the rating levels for sound sources of an industrial and/or commercial nature and the ambient, background and residual sound levels at outdoor locations. These levels could be used for the purposes of investigating complaints; assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and assessing sound at proposed new dwellings or premises used for residential purposes. However, the determination of sound amounting to a nuisance is beyond the scope of the standard.

The procedure contained in BS 4142 assesses the significance of sound which depends upon the margin by which the rating level of the specific sound sources exceeds the background sound level ($L_{A90,T}$) and the context in which the sound occurs.

The reference time interval for the specific sound source ‘Tr’ is 60 minutes during the daytime and 15 minutes during the night. The reduced reference time at night reflects the increased sensitivity to sound during this period. The relevant time periods for daytime and night-time are as follows:

- Daytime – 07:00 to 23:00 hours; and
- Night-time – 23:00 to 07:00 hours.

The assessment method considers the characteristics of the sound, such as tonality, impulsivity and intermittency. Corrections are applied to the specific sound source to account for these characteristics in order to obtain the rating level; the corrections account for acoustic features which have the potential to increase disturbance.

An initial estimate of the impact of the sound source is obtained by subtracting the measured background sound level from the rating level and considering 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.

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, the standard adds a character correction to the specific sound level to obtain the rating level. Character corrections can be included for tonality, impulsivity, other sound characteristics that make it “readily distinctive”, and intermittency.

During the night time, the background sound level may be low. Absolute levels can therefore be more relevant than the margin by which the rating level exceeds the background. It is considered that if the noise from the proposed plant does not cause sleep disturbance, adverse impact is avoided. To achieve this, the noise from the external units should not exceed 45 dB L_{Aeq} at the façade of the bedroom window. In this case, the indoor noise level from the plant would be 30 dB L_{Aeq} by assuming the noise reduction with partially open windows is 15 dBA. According to BS 8233, when the indoor noise level is below 30 dB L_{Aeq}, it is unlikely to cause sleep disturbance and adverse impacts are avoided.

For this assessment the following impact scale has been adopted:

Table 2-1 – Impact assessment scale

Rating level of industrial/commercial sound	Impact	Significance
Up to 1dB above the background sound level	Negligible	Not significant
1 to 5 dB greater than the background sound level	Minor adverse	Not significant
More than 5 dB greater than the background sound level	Moderate adverse	Significant depending on context
More than 10 dB greater than the background sound level	Major adverse	Significant depending on context

3. Noise Sensitive Receptors

The site is in a largely industrialised area in the western part of Imperial Park, approximately 750 m from the M4. Imperial Park houses several industrial, distribution and administration facilities which are located around the proposed development. The proposed installation is bordered by the existing Vantage Data Centres CWL11 and CWL12 to the north and CWL13 to the east, Imperial Way to the north-east and G24 Power to the south-east. The business units in proximity to the site are industrial or commercial in nature and therefore not considered to be sensitive to sound.

There is some residential land-use near to the site, and the closest noise sensitive receptors (NSRs) are as follows:

Table 3-1 – Residential Noise Sensitive Receptors

ID	Address	Receptor Type	Location (relative to the site)
1	14 Church Crescent	Residential	Approximately 850m to the west
2	1 Nant-Y-Moor Cottages, Blacksmiths Way	Residential	Approximately 750m to the west
3	Teddies Nursery	Non-residential	Approximately 550m to the northwest
4	1-4 Cardiff Road	Residential	Approximately 340m to the north
5	19 Pencarn Avenue	Residential	Approximately 400m to the northeast
6	11 Pencarn Avenue	Residential	Approximately 410m to the northeast
7	61-65 Edmundsbury Rd	Residential	Approximately 540m to the east
8	89-95 Edmundsbury Rd	Residential	Approximately 570m to the east
9	117-119 Edmundsbury Rd	Residential	Approximately 620m to the east
10	50-62 Rd	Residential	Approximately 620m to the east
11	14-16 Powis Close	Residential	Approximately 540m to the southeast
12	49 Powis Close	Residential	Approximately 530m to the southeast

Residential dwellings are considered to be noise sensitive at all times of day and night. Non-residential receptors are considered to be noise sensitive in daytime hours only as they would not be occupied at night. The nearest NSR locations are shown in Figure 3-1 with IQE shown in red.

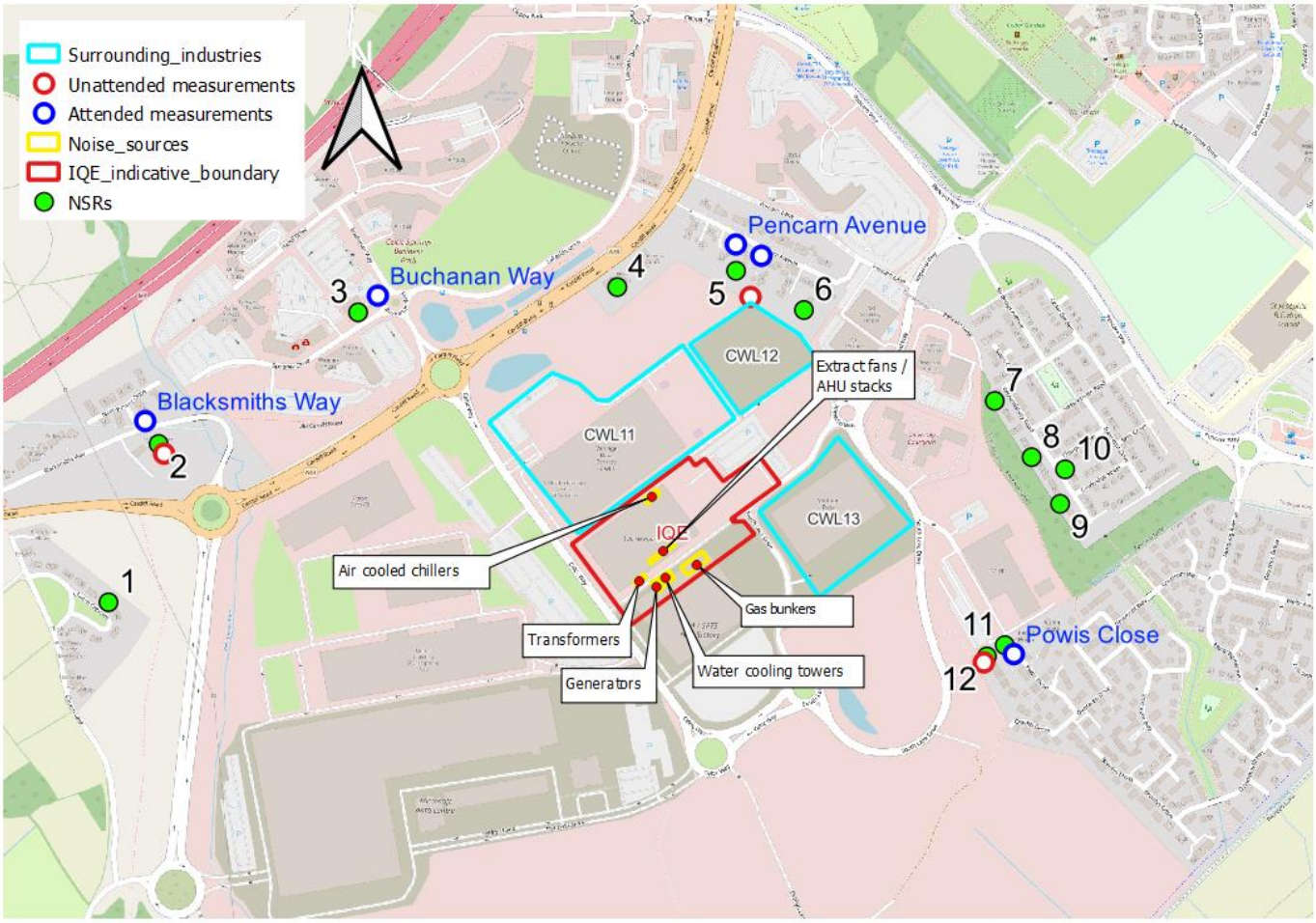

Figure 3-1 – Nearest noise sensitive properties (NSRs) to the site and measurement positions

4. Baseline Noise Survey

4.1 Locations

Acoustic surveys were carried out on Tuesday 15th May 2018 and between 27th June and 8th July 2019, and on 7th December 2020, to establish the existing conditions at the closest sensitive receptors to the adjacent data centre site, as identified in Figure 3-1. Measurements were taken under free-field conditions, unless otherwise stated, during the daytime and night-time periods and additional soundscape observations were made. Given the proximity of IQE to the data centre, these measurements are considered a valid baseline when assessing sound from IQE.

The four locations (as shown in Figure 3-1) visited were:

- Position 1 – 11 Pencarn Avenue (co-ordinates: 328421, 184808) in 2018. This location was moved to 19 Pencarn Avenue in 2019 due to the sound of a garden water feature close to number 11. Logging data was recorded on the boundary fence with Vantage at the rear of the properties, sample measurements were taken in front of the properties.
- Position 2 – 43 Powis Close (co-ordinates: 328726, 184268). Logging data was recorded in the rear garden of this property with façade reflections from the garden fence. Sample measurements were taken in front of the property in free-field conditions.
- Position 3 – 1 Nant-Y-Moor Cottages, Blacksmith Way near (co-ordinates: 327544, 184602). 2019 logging data was recorded in the rear garden of this property. Additional sample measurements were made in the layby on Blacksmith Way. The 2018 sample measurements were taken on the opposite side of the road at the junction of Blacksmith Way and Nant-Y-Moor Close.
- Position 4 – Buchanan Way (co-ordinates: 327847, 184808). Sample measurements taken on the pavement outside of Teddies Nursery.

4.2 Methodology

4.2.1 Noise Survey During 2018

The acoustic survey consisted of attended short-term measurements at each of the four survey positions. At least two measurements of 15-minute duration were recorded at each receptor position using an integrating sound level meter, that was tripod-mounted with a microphone height of approximately 1.4m above ground level.

A full range of acoustical parameters were recorded, including the ambient sound level ($L_{Aeq,T}$), background sound level ($L_{A90,T}$) and maximum sound level (L_{AFmax}). Details of the main sound sources affecting the measured sound levels and the weather conditions were recorded in site notes.

4.2.2 Noise Survey During 2019

A further acoustic survey was conducted in 2019. This survey consisted of unattended long-term logging over a period of several days at the three residential locations which are considered to be noise sensitive at night. Measurements were made using integrating sound level meters, that were tripod-mounted with a microphone height of approximately 1.3 to 1.4m above ground level. Additional attended night-time sample measurements were also made close to each logger location.

A full range of acoustical parameters were recorded, including the ambient sound level ($L_{Aeq,T}$), background sound level ($L_{A90,T}$) and maximum sound level (L_{AFmax}). Details of the main sound sources affecting the measured sound levels and the weather conditions were recorded in site notes.

4.2.3 Noise Survey During 2021

A noise survey was carried out by third party in 2021 for a planning application for a nearby site. The data are publicly accessible[1]. The measurement positions were close to NSR ID 6 (Pencarn Avenue) and NSR ID 12 (Powis Close) as shown in Figure 3-1. As the full measurement details (such as instrument, duration, weather conditions etc) are not available, this measurement is used to compare to Atkinsréalis' measurements and consider if the baseline sound environment has changed significantly since 2018/2019.

4.3 Instrumentation

4.3.1 Noise Survey During 2018

The acoustic monitoring equipment that was used for both surveys is compliant with precision class 1 or type 1 as defined in IEC 61672-1:2013 or BS EN IEC 60651/804. All equipment was calibrated on site before and after each measurement period with no noticeable drift in calibration. All equipment has been laboratory calibrated within the required period and calibration certificates are available upon request. A summary of the equipment details can be found below.

Table 4-1 - Instrumentation details – 2018 survey

Item	Model	Serial number	Date of most recent laboratory calibration before survey
Sound level meter	Norsonic 140	1403242	26/05/2017
Preamplifier	Norsonic 1209	12198	26/05/2017
Microphone	Norsonic 1225	79574	26/05/2017
Calibrator	Norsonic 1251	1859044	26/05/2017

4.3.2 Noise Survey During 2019

The acoustic monitoring equipment that was used for both surveys is compliant with precision class 1 or type 1 as defined in IEC 61672-1:2013 or BS EN IEC 60651/804. All equipment was calibrated on site before and after each measurement period with no noticeable drift in calibration. All equipment has been laboratory calibrated within the required period and calibration certificates are available upon request. A summary of the equipment details can be found below.

Initially all three logger locations were monitored simultaneously but two of the loggers suffered from power supply failures and lost the bulk of their data. Logging at these locations was therefore repeated later using different equipment.

Table 4-2 - Instrumentation details – 2019 survey

[1] Newport City Council, Planning Application File Link

Location	Item	Model	Serial number	Date of most recent laboratory calibration before survey
L1	Sound level meter	01dB Fusion	11200	31/10/2018
	Preamplifier	01dB Pre No22	1605098	31/10/2018
	Microphone	GRAS 40CE	226400	31/10/2018
	Calibrator	Brüel & Kjær 4231	2385276	30/10/2018
L2	Sound level meter	01dB Fusion	12076	13/05/2019
	Preamplifier	01dB Pre No22	1805399	13/05/2019
	Microphone	GRAS 40CD	331856	13/05/2019
	Calibrator	01dB Cal 21	35183004	16/04/2019
L3	Sound level meter	01dB Fusion	12078	13/05/2019
	Preamplifier	01dB Pre No22	1805324	13/05/2019
	Microphone	GRAS 40CD	331906	13/05/2019
	Calibrator	Rion NC-74	35125802	08/04/2019
Sample measurements	Sound level meter	Rion NL-52	00620854	13/09/2018
	Preamplifier	Rion NH-25	20914	13/09/2018
	Microphone	Rion UC-59	03690	13/09/2018
	Calibrator	Rion NC-74	35125802	08/04/2019

4.4 Measured Sound Levels

4.4.1 Noise Survey During 2018

The measured sound levels at each of the monitoring locations are summarised in Table 4-3. The $L_{Aeq,T}$ shown is the logarithmic average of the individual 15-minute readings. The L_{AFmax} is the maximum sound pressure level that was recorded during any of the measurement periods. The L_{A90} and L_{A10} levels shown in Table 4-3 have been approximated by the arithmetic means of the individual L_{A10} and L_{A90} during each sample measurement.

Table 4-3 - Summary of measured sound levels

ID	Address	Date	Start time	Measured sound levels, dB				Main sound sources
				$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$	$L_{AFmax,T}$	
1	11/19 Pencarn Avenue	15/05/2018	07:35, 09:39, 12:52	52.0	54.7	44.7	76.4	Construction sounds from IQE, birds, local water feature

ID	Address	Date	Start time	Measured sound levels, dB				Main sound sources
				$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$	$L_{AFmax,T}$	
2	Powis Close	15/05/2018	08:03, 13:15	44.9	46.6	36.4	67.7	Birds, distant road traffic, distant construction works at IQE, plant operating at the adjacent IQE site
3	Blacksmith Way	15/05/2018	08:37, 13:44	59.1	57.3	51.3	82.0	Distant road traffic, birds, engine/generator (possibly from Vantage), possible construction
4	Buchanan Way	15/05/2018	09:05, 14:05	59.8	62.9	50.7	75.5	Local and distant road traffic, people (nursery), water, engines/ generator (possibly from Vantage)

Throughout the attended measurements, observations were made on the existing acoustic environment at each location. The main sound sources were identified as local and distant roads, including the A48 and M4, birdsong, water, construction works at IQE, and plant operating at IQE, with engine sound from the existing Vantage site only occasionally being audible.

The weather conditions during the acoustic survey were dry with an air temperature of approximately 20°C. The wind conditions were still. The weather conditions are considered appropriate for acoustic surveys.

4.4.2 Noise Survey During 2019

The measured sound levels at each of the monitoring locations are summarised Table 4-4, Table 4-5 and

Table 4-6. The $L_{Aeq,T}$ shown is the logarithmic average of the individual 15-minute readings. The L_{AFmax} is the maximum sound pressure level that was recorded during any of the measurement periods. The L_{A90} and L_{A10} levels shown in Table 4-4, Table 4-5 and Table 4-6 have been approximated by the arithmetic means of the individual L_{A90} and L_{A10} during each sample measurement.

Table 4-4 - Summary of attended measured daytime sound levels

ID	Address	Date	Start time	Measured sound levels, dB				Main sound sources
				$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$	$L_{AFmax,T}$	
1	11/19 Pencarn Avenue	08/07/2019	14:01, 15:39	47.7	43.0	39.5	73.6	Distant road traffic noise, faint hum from plant

ID	Address	Date	Start time	Measured sound levels, dB				Main sound sources
				$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$	$L_{AFmax,T}$	
2	Powis Close	08/07/2019	13:10 14:50	45.2	37.7	35.6	62.7	Plant noise (500Hz hum), some local road traffic noise, local residents in gardens
3	Blacksmith Way	08/07/2019	13:54 15:13	54.1	51.8	49.6	68.7	Road Traffic Noise from M4, some local road traffic noise, pedestrians talking
4	Buchanan Way	08/07/2019	14:27	57.1	54.7	48.6	84.4	Road Traffic Noise, some movement of cars in nursery car park

Table 4-5 - Summary of attended measured night-time sound levels

ID	Address	Date	Start time	Measured sound levels, dB				Main sound sources
				$L_{Aeq,T}$	$L_{A10,T}$	$L_{A90,T}$	$L_{AFmax,T}$	
1	11/19 Pencarn Avenue	04/07/2019 05/07/2019	23:21 00:32	39.8	38.9	36.9	49.7	Distant Road Traffic Noise, faint hum from plant
2	Powis Close	05/07/2019	00:09 01:21	40.3	38.0	36.2	58.5	Plant Noise (500Hz hum), Freight Train
3	Blacksmith Way	04/07/2019 05/07/2019	23:45 00:58	50.1	49.1	45.8	62.7	Road Traffic Noise from M4. Intermittent clicking from nearby animal deterrent, some local road traffic noise

Table 4-6 - Summary of unattended measured sound levels

Measurement ID	Address	Measured sound levels, dB							
		Daytime				Night-time			
		$L_{Aeq,16h,16h}$	$L_{AF10,16h}$	$L_{AF90,16h}$	L_{AFmax}	$L_{Aeq,8h}$	$L_{AF10,8h}$	$L_{AF90,8h}$	L_{AFmax}
1	Vantage site, near Pencarn Avenue	52.8	51.6	45.2	96.9	48.7	45.7	40.8	75.8
2	Powis Close*	62.3	60.9	49.8	89.6	58.2	52.6	44.0	96.4
3	1 Nant-Y-Moor	56.3	54.8	51.0	85.3	49.2	49.7	45.4	74.6

*It is noted that there were high noise levels in the evening and early morning at this location. These high noise level conditions were not observed during the attended measurements. It is therefore considered that the unattended measurements are not representative of typical conditions and the attended measurements have been used to define the background noise climate.

Throughout the attended measurements, observations were made on the existing acoustic environment at each location.

The weather conditions during the 2019 acoustic surveys were dry with an air temperature of between 18 and 27 °C. The wind conditions were still. The weather conditions are considered appropriate for acoustic surveys.

4.4.3 Noise Survey During 2021 by the Third Party

The measure sound levels at Percarn Avenue and Powis Close are shown in Table 4-7

Table 4-7 - Summary of measured sound levels by others

Address	Measured sound levels, dB							
	Daytime				Night-time			
	$L_{Aeq,T}$	$L_{AF10,T}$	$L_{AF90,T}$	L_{AFmax}	$L_{Aeq,T}$	$L_{AF10,T}$	$L_{AF90,T}$	L_{AFmax}
Pencarn Avenue	61-70	63-67	47-50	80-99	41	42	39	53
Powis Close	52-57	47-50	35-37	77-80	43	45	36	68

4.5 Representative Background Sound Levels

In 2018, the main sound sources were identified as local and distant roads, including the A48 and M4, birdsong, water, construction works at IQE, and plant operating at IQE, with plant sound from Vantage only occasionally being audible.

In 2019, the main sound sources were identified as local and distant roads, including the A48 and M4, birdsong, plant sound from various sites including Vantage and G24 Power (especially at Powis Close), occasional aircraft, and one night-time occurrence of a freight train approximately 800m to the south-east. Construction sound from IQE was no longer present in 2019 although some light construction works were present on the Vantage site. These were intermittent and are judged to have had no consequence on the measured background sound levels.

Detailed sound environment and sources were noted during the survey in 2018 and 2019. The survey notes indicated that the measurement period captured the major noise source affecting the background sound environment. These major noise sources have not changed since the measurement period.

The measured background sound levels measured in 2021 are similar to that measured in 2018 and 2019. Daytime levels measured at Pencarn Avenue in 2021 are higher than the levels measured in 2018 and 2019, whilst night time levels are similar or slightly lower. The measurements at Powis Close are also similar to that measured in 2018 and 2019. Based on those measurements in different years, it is considered that the baseline sound conditions have not significantly changed.

The background sound levels used in the BS 4142 assessment are:

Table 4-8 - Background noise levels – Receptors with Noise Measurements

Receptor ID	Address	Background sound levels, dB		Basis
		Daytime L_{A90}	Night-time L_{A90}	
2	Blacksmith Way	51	45	Unattended measurements, 2019
3	Buchanan Way	50	-	Attended measurements, 2019
5 & 6	Pencarn Avenue	45	41	Unattended measurements, 2019
11 & 12	Powis Close	36	36	Attended measurements, 2019(note1)

Note 1: It is understood from the site visit note that the background sound environment at Powis Close is affected by both the distant road traffic and the plant noise from the existing industrial site. The noise levels at Powis Close were measured in 2018, 2019 and 2021. All the measurements indicated that the daytime background sound levels are similar to the night time.

In addition to those locations where sound measurements have been taken, there are three additional noise sensitive locations which are included in the assessment. The background sound levels at these receptors have been estimated from the results in

Table 4-8, taking into consideration the main baseline sound sources is road traffic noise.

Table 4-9 - Background noise levels – Additional Receptors

Receptor ID	Address	Background sound levels, dB		Basis
		Daytime L_{A90}	Night-time L_{A90}	
1	Church Crescent	49	43	2dB lower than Blacksmiths Way(note1).
4	Cardiff Road	47	43	2dB higher than Pencarn Avenue(note2)
7-10	Edmundsbury Road	40	38	Between Pencarn avenue and Powis Close(note3)

Note (1): 2dB lower than measurements on Blacksmiths Way to account for being further from main road sources.

Note (2): Measurements at Pencarn Avenue and Buchanan Way are both approximately 150m from A48, which will be the main noise source for the receptor at Cardiff Road. Therefore, a case could be made to use the average of the measurements on Pencarn Avenue and Buchanan Way. However, the noise levels at Buchanan Way are influenced to a greater level by traffic on M4. Therefore, it is our professional judgement that a baseline noise level 2dB greater than Pencarn Avenue is suitable as it accounts for greater contributions from A48 whilst also noting levels would be lower than Buchanan Way due to being further from M4.

Note (3): Edmundsbury Road is geographically located between Pencarn Avenue and Powis Close. The major sources affecting Pencarn Avenue, Edmundsbury Road and Powis Close are road traffic (A48, and M4 are the closest roads) and plant noise from the existing industrial site. Pencarn Avenue was considered as the most affected noise sensitive receptors as it is closest to the proposed scheme. Powis Close is likely to be the most exposed receptor to the proposed noise sources. Road traffic noise from major roads decreases with increased distance. Noise from the industrial estate is similar at these receptor locations. Therefore Pencarn Avenue and Powis Close are likely to be the most affected noise receptor. The noise surveys were carried out at these two receptors accordingly. The noise level at Edmundsbury Road has been interpolated by the noise levels measured at Pencarn Avenue and Powis Close considering its geographical location to the major sources and to Percarn Avenue and Powis Close. The assessment in the later sections demonstrates that the impact on Edmundsbury Road is negligible.

5. Existing Conditions

The existing noise sources associated with IQE include three air cooled chillers on top of the northern part of the roof (similar locations to the proposed air cooled chillers as shown in Figure 6-1). One of the existing air cooled chillers is on standby mode and the other two chillers are in operation.

The noise level of the existing air cooled chillers are assumed to be the same as the new proposed ones with the sound power level of 86 dB L_{wA}.

No noise data regarding the plant within the IQE building is available. It is understood that normal conversations could be held within the IQE building under current noise conditions. It implies that the noise levels within the IQE building is likely to be lower than 70 dB L_{Aeq}.

The external wall of the IQE buiding is a light-weight construction with 80 mm cladding panels. The roof of the IQE building is also light-weight construction with a lining sheet and 100 mm thick insulation. The sound reduction index of this type of roof could typically be higher than 25 dB R_w. It is not possible to quantify the breakout noise accurately due to the uncertainties such as internal room conditions, and internal space arrangements. It is likely that the breakout noise is negligible compared to the outdoor air cooled chillers.

The noise levels at the noise sensitive receptors are predicted with SoundPlan following the calculaiton method in ISO 9613-2 as shown in Table 5-1.

Table 5-1 – Predicted noise levels at NSRs – existing conditions

Receiver	Predicted noise levels, dB $L_{Aeq,T}$
14 Church Crescent	17
1 Nantymor Cottages, Blacksmiths Way	18
Teddies Nursery	22
1-4 Cardiff Road	22
19 Pencarn Avenue	23
11 Pencarn	25
61-65 Edmundsbury Rd	20
89-95 Edmundsbury Rd	21
117-119 Edmundsbury Rd	18
50-62 Edmundsbury Rd	19
14-16 Powis Close	22
49 Powis Close	23

The noise levels at the NSRs from the existing noise sources from IQE is much lower (more than 10 dB) than the measured noise levels at the NSRs. The noise from the existing noise sources from IQE is negligible compared to other sources affecting the NSRs. Therefore it is considered that the measured noise levels as shown in Section 4 are the residual sound levels.

6. Proposed Development

6.1 Noise Sources

The proposed plant includes cooling units, extract fans, transformers and emergency generators. These units are either at the ground level or roof level. The quantity, operating pattern, dimension, and noise data are provided by the process engineer taken from the technical specifications and are shown in Table 6-1 and Table 6-2. The noise source locations of the plant are shown in Figure 6-1. The existing noise source from IQE and other nearby industrial sites are considered as residual sound sources and part of the existing sound environment. Therefore they are not included in the noise modelling.

Table 6-1 - Noise sources associated with the development

Plant	Quantity	Operating routine	Dimension LxWxH mm	Comment
Water cooling towers	9	8 in operation and 1 standby	7250x2360x3930	Located externally at ground floor level
Existing air cooled chillers	3	2 in operation and 1 standby		It is assumed that the exiting chillers have the same sound power levels as the proposed ones
Air cooled chillers	2	All in operation	10000x2860x3150	Discharge via stack to atmosphere
Exhaust fans	8 no. Ammonia fans and 8 no. Chlorine fans	8 in operation and 8 standby	1200x1200x1200	
Transformers	6	All in operation	2000x1500x2500	Located externally at ground floor level
Generators	2	All in operation in case of an emergency	15000x2800x3000	
Gas bunker exhaust fans	8	4 in operation and 4 standby	1200x1200x1200	Located externally at ground floor level
GaN reactor bay AHU[2]	8	All in operation		Discharge via stack to atmosphere
Abatement supply AHU	2	All in operation (supply only)		Discharge via façade louvre to atmosphere
Clean corridor AHU	2	All in operation (supply only)		Discharge via façade louvre to atmosphere
Dirt corridor AHU	2	All in operation		Discharge via façade louvre to atmosphere
Water cooled chillers	4	3 in operation and 1 standby		Located internally at ground level

[2] AHU: air handling unit

Plant	Quantity	Operating routine	Dimension LxWxH mm	Comment
Boilers	4			Located internally at ground level

Table 6-2 - Noise levels of the proposed plant

Plant	Sound power level, dB L_{WA}	Sound power level, dB						
		125	250	500	1k	2k	4k	8k
Water cooling towers	98	90	94	95	93	91	89	84
Existing air cooled chillers	86	Spectrum data is not available						
Air cooled chillers	86	Spectrum data is not available						
Exhaust fans - Chlorine fans	95	76	81	88	89	88	88	80
Exhaust fans – Ammonia fans	78	65	71	67	71	72	71	67
Transformers	90	Spectrum data is not available						
Generators	99	Spectrum data is not available						
Water cooled chillers	102	Since these sources are located internally, noise breakout has been modelled by reasonable assumptions of sound insulation for the façade and roof. The existing façade is a light-weight construction with 80 mm cladding panels. The sound reduction index of this type of façade could typically be higher than 25 dB Rw. The roof above where the plant is located is 200 mm concrete slab, which can typically achieve more than 60 dB Rw.						
Boilers	78	Since these sources are located internally, the building façade is likely to provide at least 25 dB noise reduction therefore the contribution of these units are negligible compared to other external sources.						
Gas bunker exhaust fan	Not available at the moment. Assumed sound power level are specified in Section 7.5. A point source has been used in the model to represent these sources for the purpose of setting up the sound power level limit.							
AHU	Not available at the moment. Assumed sound power level are specified in Section 7.5. Point sources have been used in the model to represent the AHUs for the purpose of setting up the sound power level limits.							

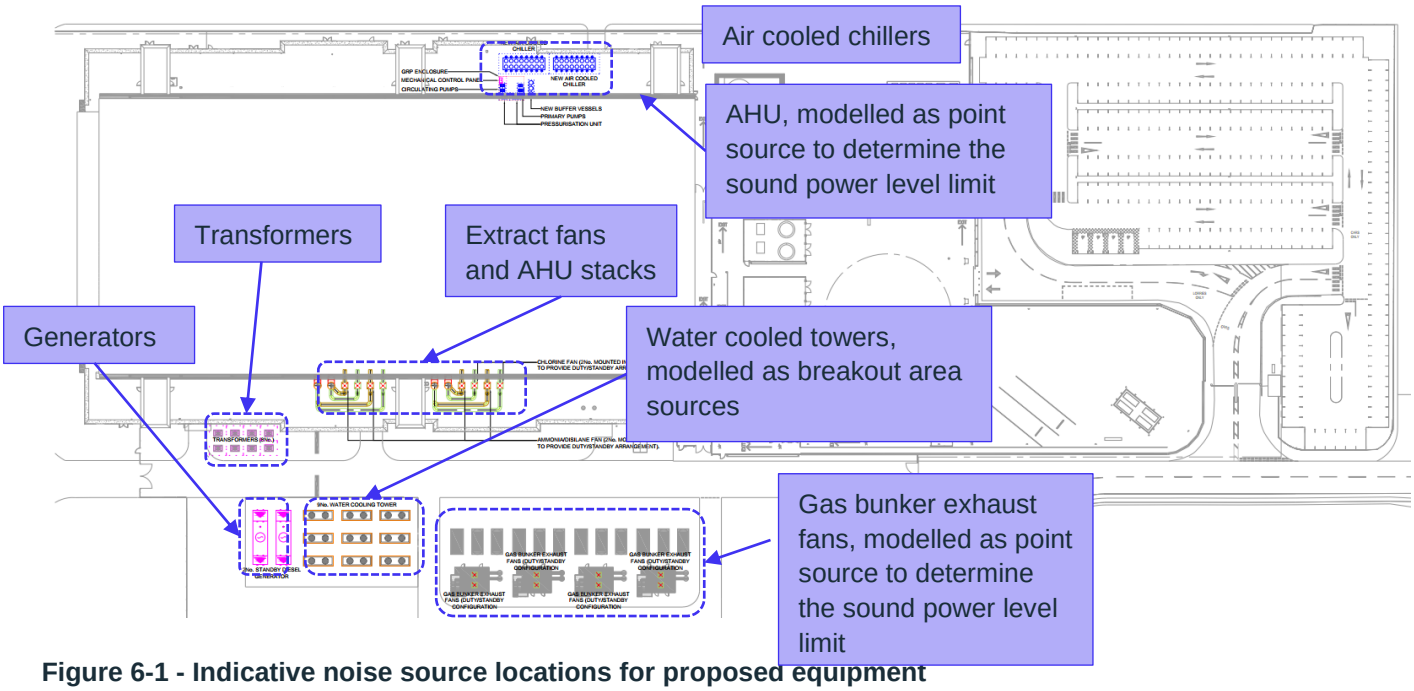

Figure 6-1 - Indicative noise source locations for proposed equipment

6.2 Operation Pattern

All plant except the emergency generators operate 24 hours a day and 7 days a week. The generators will be used only for emergency situations and tested regularly as described below:

- one test per month;
- the two generators will be tested together with both generators active simultaneously, and the test will last around 1 hour in total; and
- the tests will be carried out during normal weekday working hours between 9:00 am and 5:00 pm.

During normal operation, the plant listed in Table 6-1 will operate simultaneously and continuously. The generators will not operate during normal operation.

In case of emergency, all the plant which are in normal operation mode and the generators will operate simultaneously. The worst-case non-emergency scenario is considered to be that the overall duration for testing is less than 50 hours per year.

7. Assessment

7.1 Methodology and Assessment Scenarios

A BS 4142 assessment has been undertaken for the operation of the IQE site. This requires the specific sound level to be predicted for a typical one-hour period when the plant is in operation during the daytime, or a 15-minute period at night-time.

The following operating scenarios have been considered:

1. Normal operation scenario.

   During normal operation, the plant listed in Table 6-1, i.e. 8 no. water cooling towers, 2 no. existing air cooled chillers, 2 no. proposed air cooled chillers, 8 no. exhaust fans, 6 no. transformers, 4 gas bunker exhaust fans, and 16 AHUs will operate simultaneously. For the gas bunker exhaust fans, and AHUs, total sound power level limits are assumed as the specific products have not yet been determined. The generators will not operate during normal operation.
2. Emergency scenario.

   In case of emergency, all the plant which are in normal operation mode and the generators will operate simultaneously.
3. Generator testing scenario

   The plant operating pattern of generator testing is the same as the emergency scenario. The generators will be tested once a month. Each test will last around 1 hour. The testing will be undertaken during normal weekday working hours between 9:00 am and 5:00 pm.

A 3D noise model has been constructed using SoundPlan Version 9.0 software to predict the specific sound levels at the identified sensitive receptors for the normal and emergency operational scenarios. The noise model calculates sound propagation in accordance with ISO 9613-2 and considers ground topography, the absorption of the intervening ground type, and dimensions of nearby buildings or structures that may provide screening. It is assumed that during the reference time period the plant will operate continuously as a worst case.

The specific sound levels outputted from the noise model have been used to undertake a BS 4142 assessment taking into account the measured background sound levels obtained from the acoustic survey. Acoustic penalties have been applied to calculate the rating level for the daytime and the night-time assessment periods in line with the BS 4142 methodology. These are required to consider acoustic features that may cause annoyance to sensitive receptors.

7.2 Noise Modelling Assumptions

7.2.1 Base Mapping

The ground topography was modelled using open-source LiDAR data accompanied with ground height information shown on relevant drawings. The ground type was modelled as mixed ground using an absorption coefficient ranging from 0 to 0.8 throughout the study area, with large areas of soft ground (e.g. fields) having an absorption coefficient of 1.

The locations of buildings in proximity to Vantage were modelled using OS Open Data and their heights were set to 6m above ground level. Site observations and online mapping resources such as Google Streetview were used to identify taller buildings and estimate appropriate heights, which included industrial buildings at Imperial Park. The CWL11 and CWL13 sites are already built and operational. At the time of writing, CWL12 has been granted

planning permission but has not been built. The buildings of CWL11 and CWL13 were included in the acoustic model, but CWL12 was not included and that land was considered as open field in the model. Once CWL12 is built, the building itself will be like a noise barrier and it will further reduce the noise impact from IQE for the NSRs at Pencarn Avenue.

Receivers were modelled at heights of 1.5m and 4m above ground level at sensitive receptors of interest, with additional receivers added for taller buildings as required. The worst-case predictions are reported.

7.2.2 Site Features

Due to the distance between the plant and nearest sensitive receptors, the plant units were modelled as point sources radiating sound omnidirectionally. The point sources were positioned at the top of the plant (approximately 2.5m-4m above ground level or roof level) in order to predict the worst-case sound emissions. The plan positions of the plant were modelled in accordance with scheme drawings.

7.2.3 Sound Feature Corrections

A BS 4142:2014 + A1:2019 assessment has been undertaken based on the specific sound levels and the sound feature corrections. The plant is likely to generate broad band industrial noise and unlikely to have tonal components, and unlikely to have impulsive components. It is assumed that the plant will operate continuously during the reference 1 hour (daytime) and 15 minutes (night time) periods. Therefore, no intermittency correction is considered applicable. Considering the noise at the receptors from the proposed plant may be discernible, a +3 dB other feature correction is applied to the specific sound levels to calculate the rating levels.

7.3 Assessment of Different Scenarios

7.3.1 Normal Operation Scenario

The highest calculated rating levels (at ground and first floor levels) are shown in Table B-1 and Table B-2 for daytime and night time respectively. The calculated specific sound level contours are shown in Appendix C.

When the site in normal operation, the calculated rating levels are below the background sound levels at most of the noise sensitive receptors. The rating levels at Pencarn Avenue and Powis Close exceed the background sound levels by 3 dB and 5 dB respectively.

At Powis Close, the highest specific sound level is 38 dB $L_{Aeq,T}$. The guidance in BS 8233 describes desirable noise levels in outdoor amenity areas to be no higher than 50 dB $L_{Aeq,T}$. In this context the impact is minor. The potential variation of background sound levels during weekdays and weekends is unlikely to affect the noise impact since the specific sound levels are much lower than normal guidelines within outdoor areas.

The BS 4142 assessment indicates that the noise impact from the proposed plant is likely to have negligible to minor adverse impact on the noise sensitive receptors during normal operation. The effect is not considered significant. No further mitigation measures are considered necessary.

7.3.2 Emergency Scenario

The highest calculated rating levels (at ground and first floor levels) are shown in Table B-3 and Table B-4 for daytime and night time respectively.

In case of emergency, the rating levels are still below the background sound levels at most of the noise sensitive receptors. At the most affected noise sensitive receptor (Powis Close) the rating level is 6 dB above the background sound level. This is considered as an indication of a moderate adverse impact. The BS 4142 assessment indicate that the noise impact from the proposed plant is likely to have negligible to moderate adverse impact on the noise sensitive receptors during emergency operation. Considering that emergency situation is expected to be very rare, the effect is not considered to be significant.

7.3.3 Generator Testing Scenario

The noise sources and operating pattern in this scenario are the same as the emergency scenario (during daytime). The highest calculated rating levels are shown in Table B-3. The noise impact is the same as the emergency scenario. The noise during the testing is likely to have negligible to moderate adverse impact on the noise sensitive receptors. Considering that testing comprises one test a month for 1 hour during weekday daytime, the effect is not considered to be significant.

7.4 Context

To fully assess impacts, BS 4142 requires context to be considered. Contextual factors affecting the impact significance are discussed in the subsections below.

The IQE site is located in an already industrialised area, including a few existing data centres. The background sound levels at nearby receptors already contains some sound from the existing industrial and commercial units adjacent to the IQE site. Therefore, the proposed IQE is in character with the existing and planned noise sources in the area.

The total testing period for the IQE site would occur approximately 12 times per year, with each test lasting around one hour. No testing would take place during night-time hours or at weekends, which are more sensitive time in terms of sleep and rest.

BS 4142 notes that an increase of 5dB above background sound levels is an indication of an ‘adverse’ impact and an increase of 10dB is an indication of a ‘significant adverse’ impact. This assessment has taken the conservative approach of assessing a 5dB increase over background sound as potentially being significant.

BS 8233 ‘*Guidance on sound insulation and noise reduction for buildings*’ provides recommendations for overall noise levels inside of buildings. For daytime, the recommended level for suitable resting inside living rooms and bedrooms is 35dB $L_{Aeq,16h}$. The standard also explains that sound insulations from a partially open window can be assumed to be 15dB. This would mean that noise levels at the façade of a building would need to be 50dB $L_{Aeq,16h}$ for internal levels to exceed the recommended 35dB $L_{Aeq,16h}$ limit. Rating sound levels at receptor facades do not exceed 45dB $L_{Ar,1h}$ during normal operation or the emergency scenario for IQE. Therefore, the specific sound levels from the site will not exceed the recommended internal noise levels during the day or night to achieve suitable resting conditions, and the resulting impacts are not significant.

7.5 Suggestion for Mitigation

The assessments assume that the sound power level limits shown in Table 7-1 below for the gas bunker exhaust fans and AHUs are met. The noise from these units should not exceed the overall sound power level limits stated. The sound power level limit for each unit is calculated based on the overall sound power level and the quantity in operation.

Table 7-1 - Sound power level limits for gas bunker exhaust fans and AHUs

Plant	Quantity in operation	Sound power level limit, all plant, dB L_{Aw}	Sound power level limit for each plant unit, dB L_{Aw}
Gas bunker exhaust fan	4	97	91
GaN reactor bay AHU	8	90	81
AHUs at south façade	3	90	85
AHUs at north façade	3	90	85

Provided that there are no changes to the selected plant for the development, the development is unlikely to cause significant effect, and no further mitigation measures would be required.

8. Uncertainty

In accordance with BS 4142, this section summarises sources of uncertainty that can influence the assessment. Uncertainty can arise from the use of measured sound levels in calculations, assumptions about the sound sources, the calculation method, and simplification of data or site conditions.

Sources of uncertainty have been minimised as far as possible by undertaking the baseline acoustic survey and predicting the specific sound levels from the site using validated calculation methods. Nevertheless, the following aspects for the assessment have introduced uncertainty:

- Baseline surveys from different years were compared and no significant changes have been identified. The baseline acoustic survey was relatively short term, based on measurements over a few days. Longer measurements would give a more reliable assessment of baseline conditions.
- Detailed LiDAR has been used to provide a more accurate ground model, and therefore better reflects the real-world situation and sound propagation between the proposed development and the nearest sensitive receptors assessed in this study.
- The specific sound levels were calculated based on the manufacturer source noise data. The predictions rely on the actual plant and equipment generating no more sound than shown by the manufacturer.
- The specific sound levels were calculated assuming that sound is propagating over mixed hard and soft ground to the receptors and that there is no other localised screening which may reduce sound levels at receptors.
- Rating corrections have been applied to the specific sound level for the total specific sound levels as a prudent approach.

9. Conclusion

New plant has been proposed to the IQE site at Imperial Park in Newport to expand the current operation. The baseline sound environment has been measured and the assessment methodology has been established. An acoustic model was built to predict the specific sound levels at the surrounding noise sensitive receptors.

A BS 4142 worst case assessment of the impact of sound from the proposed plant at the nearest noise sensitive receptors has been undertaken, with reference to the baseline conditions at the sensitive receptors and manufacturer sound data where available. Three scenarios, including normal operation, emergency, and generator testing, were assessed.

The assessment indicates that the proposed plant would have negligible to minor adverse impact at all noise sensitive receptors during normal operation. Considering the exceedance of the rating level over the background sound level is low and the proposal does not introduce new type of noise sources to the area, the plant would not cause significant effect at the noise sensitive receptors.

In case of an emergency, the noise may have up to moderate adverse impact on the closest noise sensitive receptors. Considering the emergency situations are rare, the plant is unlikely cause significant effect at the noise sensitive receptors.

The rating level during generator testing may also cause moderate adverse impact. However, the testing is only scheduled once a month for less than one hour. The impact is not considered significant during generator testing.

As the impacts are not significant, no further mitigation would be required.

APPENDICES

Appendix A. Glossary

Decibel (dB)

The unit of measurement used for sound pressure levels. The scale is logarithmic rather than linear. The threshold of hearing is 0 dB and the threshold of pain is 120 dB. In practical terms these limits are seldom experienced and typical levels lie within the range 30 dB (a quiet night-time level in a bedroom) to 90 dB (at the kerbside of a busy city street).

A-weighting

An electrical frequency weighting used to represent the response of the human hearing mechanism to sound. A-weighted sound level is indicated either by placing the capital letter A after the letters dB to get dB(A) or it may be added as a subscript to the sound level parameter as in $L_{Aeq,T}$.

Percentile Level (Statistical Sound Level Indices, L_{AN}, L_{A10}, L_{A90})

L_{AN} is the dB(A) level exceeded N% of the time measured on a sound level meter with Fast(F) time weighting, e.g. L_{A90} the dB(A) level exceeded for 90% of the time, is commonly used to estimate background sound level. LA10, the level exceeded for 10% of the time, is commonly used in the assessment of road traffic noise. Research has shown that the arithmetic average of the 18, 1-hour L_{A10} levels (depicted as $L_{A10,18h}$) between 0600 and 2400 hours shows a reasonably good correlation with community responses to traffic noise. This unit is used in the UK for the assessment of road traffic noise.

Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$)

Equivalent continuous A-weighted sound pressure level is the steady sound level that has the same sound energy as the fluctuating A-weighted sound pressure level occurring over the same time period and at the same location.

Ambient Sound Level ($L_{Aeq,T}$):

Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

Background Sound level ($L_{AF90,T}$)

The A-weighted sound pressure level of the existing ambient sound level that is exceed for 90% of a given time period, T, measured using time weighting ‘Fast’.

Free-Field (acoustical)

Free-field means a position far away from any reflecting surfaces other than the ground. Several standards and guidelines recommend that to achieve free-field conditions the microphone should be positioned at least 3.5 metres from any reflecting surfaces.

Facade position

A façade position is located one metre from a building façade or large vertical structure.

Appendix B. BS 4142 Assessment Tables

B.1 Normal Operation Scenario

When the rating levels indicate a moderate adverse impact or higher, it is coloured to red otherwise, it is coloured in green.

Table B-1 - BS 4142 assessment - daytime, normal operation

Receiver	Rating level $L_{Ar,1hr}$, dB	Day background, $L_{A90,T}$, dB	$L_{Ar,1hr}$-$L_{A90,T}$ exceedance, dB	BS 4242 level of impact
14 Church Crescent	33	49	-16	Negligible
1 Nantymor Cottages, Blacksmiths Way	35	51	-16	Negligible
Teddies Nursery	36	50	-14	Negligible
1-4 Cardiff Road	35	47	-12	Negligible
19 Pencarn Avenue	37	45	-8	Negligible
11 Pencarn	41	45	-4	Negligible
61-65 Edmundsbury Rd	35	40	-5	Negligible
89-95 Edmundsbury Rd	36	40	-4	Negligible
117-119 Edmundsbury Rd	36	40	-4	Negligible
50-62 Edmundsbury Rd	36	40	-4	Negligible
14-16 Powis Close	41	36	5	Minor adverse
49 Powis Close	41	36	5	Minor adverse

Table B-2 - BS 4142 assessment – night time, normal operation

Receiver	Rating level $L_{Ar,15min}$, dB	Night time background, $L_{A90,T}$	$L_{Ar,15min}$-$L_{A90,T}$ exceedance, dB	BS 4242 level of impact
14 Church Crescent	33	43	-10	Negligible
1 Nantymor Cottages, Blacksmiths Way	35	45	-10	Negligible
Teddies Nursery	36		N/A	Negligible
1-4 Cardiff Road	35	43	-8	Negligible
19 Pencarn Avenue	37	41	-4	Negligible
11 Pencarn	41	41	0	Minor adverse
61-65 Edmundsbury Rd	35	38	-3	Negligible
89-95 Edmundsbury Rd	36	38	-2	Negligible
117-119 Edmundsbury Rd	36	38	-2	Negligible
50-62 Edmundsbury Rd	36	38	-2	Negligible
14-16 Powis Close	41	36	5	Minor adverse
49 Powis Close	41	36	5	Minor adverse

B.2 Emergency Scenario

When the rating levels indicate a moderate adverse impact or higher, it is coloured to red otherwise, it is coloured in green.

Table B-3 - BS 4142 assessment - daytime, emergency and generator testing

Receiver	Rating level $L_{Ar,1hr}$, dB	Day background, $L_{A90,T}$, dB	$L_{Ar,1hr}$-$L_{A90,T}$ exceedance, dB	BS 4242 level of impact
14 Church Crescent	38	49	-11	Negligible
1 Nantymor Cottages, Blacksmiths Way	37	51	-14	Negligible
Teddies Nursery	38	50	-12	Negligible
1-4 Cardiff Road	38	47	-9	Negligible
19 Pencarn Avenue	41	45	-5	Negligible
11 Pencarn	45	45	0	Negligible
61-65 Edmundsbury Rd	38	40	-2	Negligible
117-119 Edmundsbury Rd	40	40	0	Negligible
89-95 Edmundsbury Rd	39	40	-1	Negligible
50-62 Edmundsbury Rd	40	40	-0	Negligible
14-16 Powis Close	42	36	6	Moderate adverse
49 Powis Close	41	36	5	Minor adverse

Table B-4 - BS 4142 assessment – night time, emergency

Receiver	Rating level $L_{Ar,15min}$, dB	Night time background, $L_{A90,T}$	$L_{Ar,15min}$-$L_{A90,T}$ exceedance, dB	BS 4242 level of impact
14 Church Crescent	40	43	-5	Negligible
1 Nantymor Cottages, Blacksmiths Way	40	45	-8	Negligible
Teddies Nursery	40		N/A	N/A
1-4 Cardiff Road	41	43	-5	Negligible
19 Pencarn Avenue	41	41	0	Negligible
11 Pencarn	45	41	4	Minor adverse
61-65 Edmundsbury Rd	38	38	0	Negligible
117-119 Edmundsbury Rd	40	38	2	Minor adverse
89-95 Edmundsbury Rd	39	38	1	Minor adverse
61-65 Edmundsbury Rd	40	38	0	Negligible
50-62 Edmundsbury Rd	40	38	2	Minor adverse
14-16 Powis Close	42	36	6	Moderate adverse
49 Powis Close	41	36	5	Minor adverse

Appendix C. Specific Sound Level Contour

The calculated specific level contour map at 1.5 m above the ground level is shown in Figure C-1 and Figure C-2 for normal operation scenario and emergency scenario respectively.

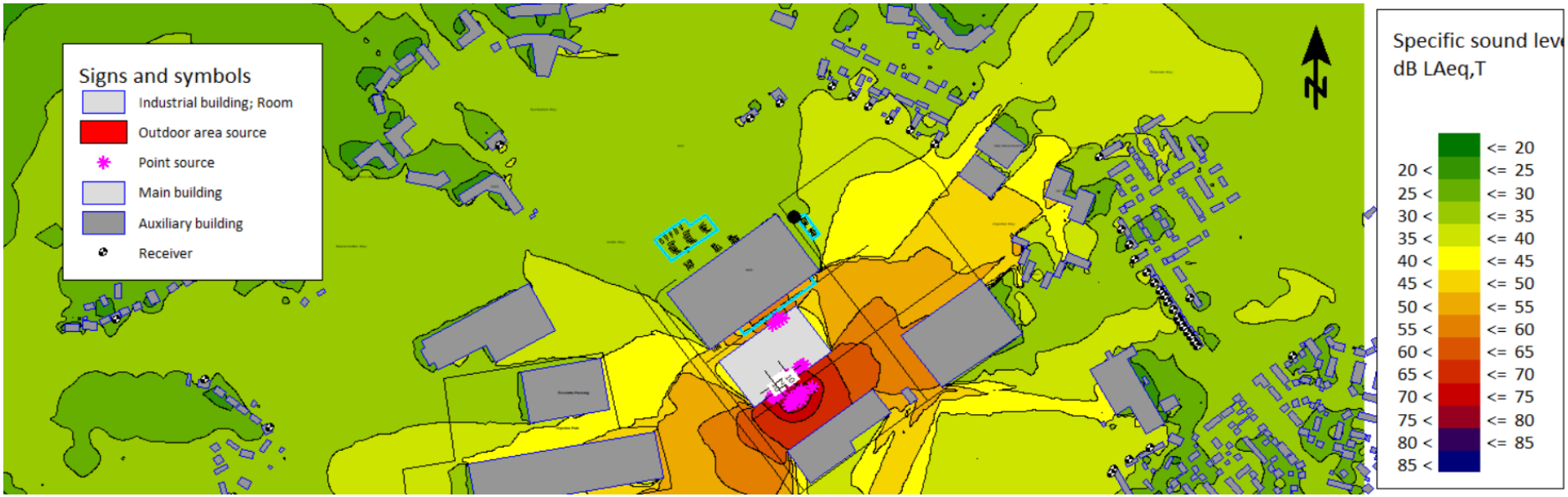

Figure C-1 - Specific sound level contour at 1.5m above the ground – normal operation

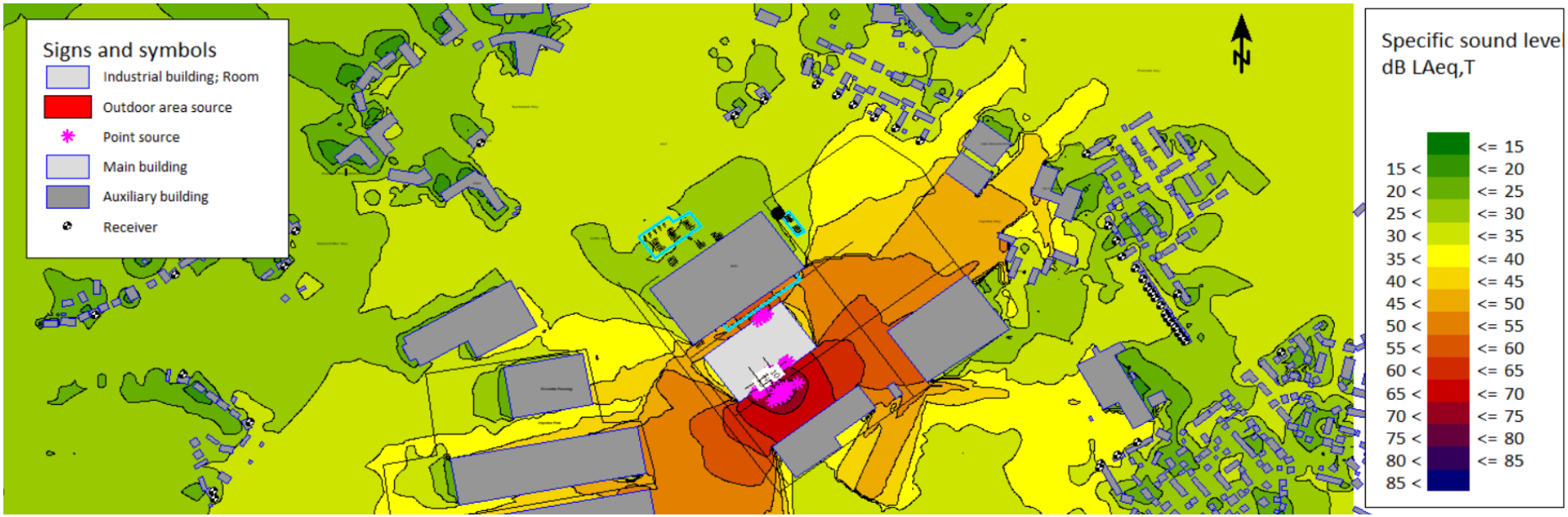

Figure C-2 - Specific sound level contour at 1.5m above the ground – emergency

Appendix D. Qualification

The report has been completed by Weigang Wei, who has 9-year experience of noise impact assessment and is a full member of the IOA. The report has been reviewed by an Associate Consultant of AtkinsRéalis Acoustics, Noise and Vibration team who has 30-year experience of noise impact assessment.

Both of the author and reviewer are full member of the IOA.

- Report author: Weigang Wei:
- Member of IOA
- PhD, Environmental noise
- Link for important publications https://biblio.ugent.be/weigang.wei

Reviewer and authoriser Adam Lawrence:

- Fellow of IOA
- BEng Electroacoustics
- Chartered Engineer

Weigang Wei
AtkinsRéalis UK Limited
Chadwick House
Birchwood Park
Warrington
WA3 6AE

Tel: +44 (0)1925 238000
Fax: +44 (0)1925 238500