

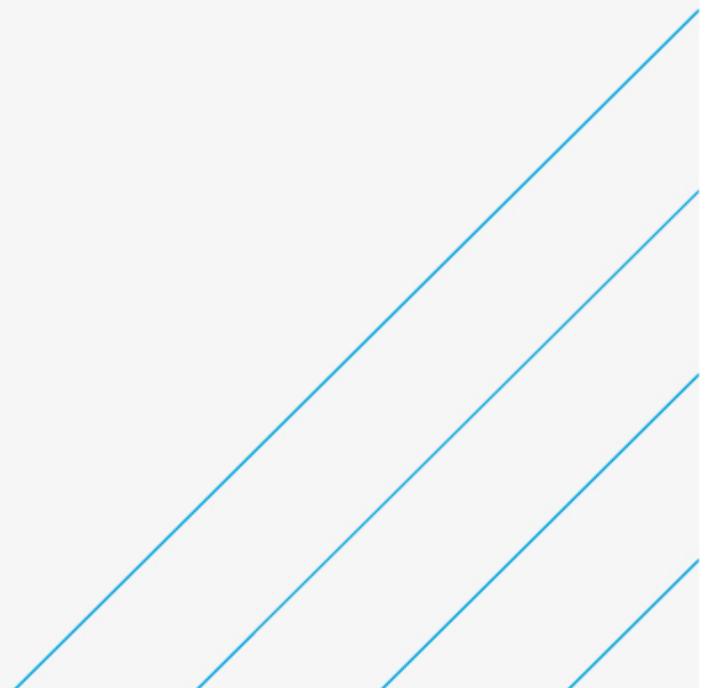
Next Generation Data - Data Centre 3

Noise Impact Assessment

Next Generation Data

29 October 2020

AC-2020/OCT/04



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1. Introduction

Next Generation Data Ltd. (hereafter NGD or ‘the operator’) provides wholesale out-of-town data centre space for some of the world’s largest companies at its facility at Imperial Park, Celtic Way, Marshfield, Newport, NP10 8BE. The facility was established in 2008/9 and holds government – some of it classified – and blue-chip company data.

Due to the sensitive and nationally significant nature of the information held at the site, a secure and reliable electricity supply is business-critical; without a continuous supply of electricity, NGD cannot guarantee their contractual customer obligations. NGD are proposing to build a new data centre that houses 10 new data halls with associated cooling plant and backup-generators. The new data centre is hereafter referred to as DC3.

At the time of assessment, selection of the generators and cooling plant for the proposed site has not been finalised, and therefore assessment of sound from specific items of plant cannot be undertaken. This assessment sets highest sound levels for each type of plant to be installed. A BS 4142 style assessment of the potential impact of sound from operation of plant is performed with these sound levels at nearby sensitive receptors.

Atkins have previously undertaken assessment of sound from existing generators on the Data Centre 1 (DC1) site and proposed generators on the Data Centre 2 (DC2) site, and knowledge gained from these has helped to inform the assessment of the new plant.

A glossary of technical terms is provided in Appendix A.

2. Regulations, Planning and Context

2.1. Newport County Council

Newport County Council (NCC) were contacted via email in September 2020 to determine the most appropriate assessment methodology for this assessment.

In this conversation it was agreed that the assessment would seek to set sound limits for plant on site that would avoid impacts above an agreed level at nearby sound sensitive receptors when assessed using BS 4142 methodology.

At the time of writing, a level of impact has not been formally agreed with NCC, and therefore, this assessment seeks to avoid significant impact during routine testing, as defined in Table 2-1 below, and Air Handling Unit (AHU) operation.. This approach is in line with the assessment of sound impacts from the adjacent Data Centre 2 application (approved on 2nd September 2020, reference number 20/0039).

2.2. Natural Resources Wales

In a previous assessment of existing generators at the site, it was agreed with Natural Resources Wales (NRW) that assessments should include 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:

- Quarterly Servicing
- Black Building test
- Emergency operation

2.3. Environmental Protection Act, 1990

Section 79 of the Environmental Protection Act 1990 places a duty on local authorities to inspect their areas periodically for statutory nuisances and to take such steps as are reasonably practicable to investigate complaints of statutory nuisance. Where a local authority is satisfied that a statutory nuisance exists, or is likely to occur or recur, the local authority is obliged to serve an abatement notice requiring the abatement of the nuisance or prohibiting or restricting its occurrence or recurrence. Section 79 (1(g)) includes “noise emitted from premises so as to be prejudicial to health or nuisance”.

Local authorities can defer serving an abatement notice under Section 80 of the Environmental Protection Act for statutory nuisance from noise for up to seven days in order to take other appropriate steps to abate the statutory nuisance.

The optional seven-day deferral was introduced by the Clean Neighbourhoods and Environment Act 2005.

2.4. 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 sources of sound 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 disturbances.

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.

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*
More than 10 dB greater than the background sound level	Major adverse	Significant*

*depending on context.

3. Site description

3.1. Sensitive receptors

The site is in a largely industrialised area in the eastern part of Imperial Park, approximately 830m from the M4. Imperial Park houses several industrial, distribution and administration facilities which are located to the north and west of the proposed development. The proposed installation is bordered by the existing NGD building to the north-west (DC1), the approved NGD Data Centre 2 (DC2) to the north, IQE's Newport Semiconductor Facility to the west, 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 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 950 to the west
2	1 Nantymor Cottages, Blacksmiths Way	Residential	Approximately 890 to the west
3	Teddies Nursery	Non-residential	Approximately 660 to the north west
4	1-4 Cardiff Road	Residential	Approximately 390 to the north west
5	19 Pencarn Avenue	Residential	Approximately 310 to the north
6	11 Pencarn Avenue	Residential	Approximately 210 to the north
7	61-65 Edmundsbury Rd	Residential	Approximately 220 to the east
8	89-95 Edmundsbury Rd	Residential	Approximately 220 to the east
9	117-119 Edmundsbury Rd	Residential	Approximately 250 to the east
10	50-62 Edmundsbury Rd	Residential	Approximately 260 to the east
11	14-16 Powis Close	Residential	Approximately 260 to the south east
12	49 Powis Close	Residential	Approximately 260 to the south east

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 on the satellite image in Figure 3-1 with DC3 shown in red.



Figure 3-1 – Nearest noise sensitive properties to the site

The ground conditions are considered to be mixed hard and soft ground between the source and the NSRs.

3.2. Proposed location and operation of plant

3.2.1. Generator Engines

The proposed diesel engines at the site are required to operate as a backup source of power generation. The engines are grouped into cells; one for each data hall. Each cell contains six engines (termed “generator sets” or “sets”).

A total of 60 diesel engines are proposed for the site and these have been arranged into cells, and have been labelled as shown on Figure 3-2 for the purpose of this assessment.

The engines will operate under emergency conditions in the event of a power failure. In this case all engines would start up at the same time.

Electricity supply failures are extremely rare – there are two separate connections to the National Grid at the existing site, and a full site electricity supply failure has not occurred since the facility commenced operation in 2009.



Figure 3-2 – DC3 Site layout

The engines will also be active during regular testing and maintenance operations that can take place on weekday daytimes between 09:00 and 17:00. There are two key modes of testing as described below:

1. **Quarterly servicing** – it is proposed that the engines will be serviced on a quarterly basis. This is in line with the NGD Maintenance Strategy (PM 18-16) for the existing site, which is in line with recommendations from the supplier of the engines, WB Power Services Ltd (WBPS). The service requires the engines to be test-run individually for up to 15 minutes after servicing.

This testing is not carried out at the same time or overlapping with any other testing mode.

The quarterly testing would last for approximately two to three days in total to allow all engines on site to be tested for the 15-minute test runs. This works out to be two to three weeks in total over the course of a year. No testing will take place at weekends.

2. **Black Building Test** – Twice per year per cell (a total of 24 times per year), a controlled mains failure is simulated to prove the system's response. In this test, a single cell is selected, power is isolated, and the system responds as it would in an emergency scenario. All engines in the cell fire up during this test. The overall test takes some 10-15 minutes to carry out for each cell.

This testing mode is not carried out at the same time or overlapping with any other testing mode.

Only one Black Building test would be carried out on any weekday. No testing will take place at weekends.

The total operational time during testing and maintenance is summarised in .

Table 3-2 - Testing Duration

Test	Duration	Frequency	Total
Quarterly testing (15 min runs)	2-3 Days	4 times a year	3 weeks per year
Black building testing	10-15 minutes each	24 times a year	2 weeks per year
Total			5 weeks per year

This shows that testing could take place for a total duration of 5 weeks per year.

In addition to the assessment of routine testing scenarios, an assessment of Emergency Operation has been undertaken to show impacts when there is a loss of power to the site in the event of a grid failure. In this scenario, all generators would operate simultaneously and could occur at any time of day or night.

3.2.2. Air Handling Units

In addition to the diesel engines, it is proposed to install rooftop Air Handling Units (AHUs) to cool internal equipment. A total of 100 AHUs are proposed for the site.

4. Acoustic survey

4.1. Locations

Acoustic surveys were carried out on Tuesday 15th May 2018 and between 27th June and 8th July 2019, to establish the existing conditions at the closest sensitive receptors to the NGD group of sites, 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.

The four locations 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 NGD 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 Nantymor 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 Nantymor 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.

4.3. 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 field-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

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 field-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

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, with the complete dataset provided in Appendix B. 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

Measurement ID	Address	Measured sound levels, dB				Main sound sources
		$L_{Aeq,T}$	L_{AF10}	L_{AF90}	L_{AFmax}	
1	11/19 Pencarn Avenue	52.0	54.7	44.7	76.4	Construction sounds from IQE, birds, local water feature
2	Powis Close	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	59.1	57.3	51.3	82.0	Distant road traffic, birds, engine/generator (possibly from NGD), possible construction
4	Buchanan Way	59.8	62.9	50.7	75.5	Local and distant road traffic, people (nursery), water, engines/ generator (possibly from NGD)

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 equipment operating at IQE, with engine sound from the existing NGD 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 in Table 4-4, Table 4-5 and Table 4-6, with the complete dataset provided in Appendix B. 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

Measurement ID	Address	Measured sound levels, dB				Main sound sources
		L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}	
1	11/19 Pencarn Avenue	47.7	43.0	39.5	73.6	Distant road traffic noise, faint hum from plant
2	Powis Close	45.2	37.7	35.6	62.7	Plant noise (500Hz hum), some local road traffic noise, local residents in gardens
3	Blacksmith Way	54.1	51.8	49.6	68.7	Road Traffic Noise from M4, some local road traffic noise, pedestrians talking
4	Buchanan Way	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

Measurement ID	Address	Measured sound levels, dB				Main sound sources
		L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}	
1	11/19 Pencarn Avenue	39.8	38.9	36.9	49.7	Distant Road Traffic Noise, faint hum from plant
2	Powis Close	40.3	38.0	36.2	58.5	Plant Noise (500Hz hum), Freight Train
3	Blacksmith Way	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}	L _{AF10}	L _{AF90}	L _{AFmax}	L _{Aeq,8h}	L _{AF10}	L _{AF90}	L _{AFmax}
1	NGD 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 Nantymor	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, as shown in Appendix B. These high noise level conditions were not observed during the attended measurements and 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.

5. Baseline Noise Levels

5.1. Summary of measured 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 equipment operating at IQE, with equipment sound from NGD 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 NGD 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 NGD site these were intermittent and are judged to have had no consequence on the measured background sound levels.

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

Table 5-1 – Background Noise Levels – Receptors with Noise Measurements

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

5.2. Estimates of sound levels at other receptors

In addition to those locations where sound measurements have been taken, there are three other noise sensitive locations which are included in the assessment. The background sound levels at these receptors have been estimated from the results in Table 5-1, taking into consideration the main baseline sound sources is road traffic noise.

Table 5-2 – Background Noise Levels – Additional Receptors

Receptor ID	Address	Background sound levels, dB		Basis
		Daytime L _{A90}	Night-time L _{AF90}	
1	Church Crescent	47	43	2dB lower than Blacksmiths Way ¹ .
4	Cardiff Road	47	43	2dB higher than Pencarn Avenue ²
7-10	Edmundsbury Road	40	38	Between Pencarn avenue and Powis Close

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

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.

6. Assessment

6.1. Methodology

A BS 4142 assessment has been undertaken, which requires the specific sound level to be predicted for a typical one hour period when the engines and AHUs are in operation during the daytime, or a 15 minute period at night-time. For the engines, based on the types testing and maintenance that are proposed to take place, the following operating scenarios have been considered:

1. Quarterly servicing, where individual engines are tested sequentially for 15 minutes. As the testing lasts for more than one hour, a single one hour period is used. The sound levels from the four engines with the highest levels are used as a worst case;
2. Black Building Test, where all engines in a cell are operating simultaneously, for 15 minutes. The test may last in total for some 10-15 minutes, and to represent a worst case the assessment assumes that the engines run for the full 15 minutes.
3. Emergency conditions, where all 60 of the DC3 engines are activated and operate simultaneously.
4. Cumulative Emergency conditions, where all engines on the DC1, DC2 and DC3 sites are activated and operate simultaneously.

A 3D noise model has been constructed using SoundPlan Version 8.2 software to predict the specific sound levels at the identified sensitive receptors for a number of 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, dimensions of nearby buildings or structures that may provide screening, and on-time of the engines and AHUs.

The specific sound levels (based on the maximum plant sound levels specified) outputted from the noise model have been used to complete a BS 4142 assessment taking into account the measured background sound levels obtained from the acoustic survey.

In line with the BS 4142 assessment methodology, acoustic penalties have been added to the predicted specific sound levels at the sensitive receptors to take into account acoustic features that may cause annoyance. The acoustic penalties were arithmetically added to the specific sound level for each corresponding source type before being logarithmically added together to give an overall rating level (e.g. acoustic penalties for AHUs were added to the AHU specific sound level only). Acoustic penalties have been applied this way as the AHUs are the dominating sound source and applying all penalties to the total specific sound level would over-estimate sound impacts from the generators. Information about the corrections applied is provided in Section 6.4.1.

It is important that the assessment that follows is read in conjunction with the context provided in section 10. This section provides additional information that should be considered when drawing conclusions from the impacts and sound levels presented.

6.2. Noise modelling assumptions and impact limits

6.2.1. Base mapping

The ground topography was modelled using open source LiDAR data accompanied with ground height information shown on scheme drawings at NGD. The ground type was modelled as mixed ground using an absorption coefficient of 0.6 throughout the study area.

The locations of buildings in proximity to NGD were modelled using OS Open Data and their heights were set to 8m above ground level. Site observations and online mapping resources such as Google Streetview were used to identify taller buildings and estimate appropriate heights.

Receivers were modelled at heights of 1.5m and 4m above ground level at sensitive receptors of interest. The worst-case predictions are reported.

6.2.2. Site features

Due to the distance between the engines and nearest sensitive receptors, the engines were modelled as point sources radiating sound omnidirectionally. The point sources were positioned at the top of the engines

(approximately 2.5m-2.8m above ground level) in order to predict the worst-case sound emissions. The positions of the engines were modelled in accordance with scheme drawings.

The DC3 building includes a 6m high acoustic louvred parapet to minimise impacts from the AHUs. For the purpose of this assessment the acoustic louvred parapet has been modelled with an acoustic performance of R_w 25dB.

6.2.3. Existing Site features

The DC1 site is already built and operational. At the time of writing, Data Centre 2 had been granted planning permission but has not been built. For the purpose of this assessment, it has been assumed the DC2 buildings will have been built before DC3 is operational. Noise contributions from DC1 and DC2 are only considered in the cumulative emergency conditions assessment.

6.2.4. Quarterly testing

During Quarterly testing, engines are run individually. The noise modelling looks at a one hour period with continuous operation of each engine, identifying those range of sound levels from all engines, with the highest sound level is used to assess the impacts to show a worst case scenario.

6.2.5. Emergency scenario

All 60 engines are assumed to run at the start of the emergency scenario.

This approach has also been used for each cell in the Black Building Test assessment where all engines in the cell start up.

6.2.6. Highest rating levels to avoid significant impacts

Based on the baseline sound levels set out in Section 5, the table below set out the highest sound rating level at each receptor to avoid significant effects as defined in BS 4142.

Table 6-1 – Maximum sound levels to avoid significant impacts

ID	Receptor	Baseline Noise Level (dB L_{AF90})		Maximum rating level ($L_{Ar,T}$ dB)	
		Daytime	Night time	Daytime	Night time
1	14 Church Crescent	47	43	51.9	47.9
2	1 Nantymor Cottages	51	45	55.9	49.9
3	Teddies Nursery	50	-	54.9	-
4	1-4 Cardiff Rd	47	43	51.9	47.9
5	19 Pencarn Avenue	45	41	49.9	45.9
6	11 Pencarn Avenue	45	41	49.9	45.9
7	61-65 Edmundsbury Rd	40	38	44.9	42.9
8	89-95 Edmundsbury Rd	40	38	44.9	42.9
9	117-119 Edmundsbury Rd	40	38	44.9	42.9
10	50-62 Edmundsbury Rd	40	38	44.9	42.9
11	14-16 Powis Close	36	36	40.9	40.9
12	49 Powis Close	36	36	40.9	40.9

6.3. Source Sound Levels

Calculations have been undertaken to determine the maximum sound power levels of the generators and AHUs at DC3 that would avoid significant impacts at nearby noise sensitive receptors during routine testing scenarios. It has been determined that, based on the proposed number of each type of plant, the following sound power levels should not be exceeded by each item of plant.

Table 6-2 – Maximum Allowable Source Noise Levels

Plant Item	Quantity on site	Sound Power Level (dB L _{WA})
Generators	60	86.0
AHUs	100	77.5

These sound levels have been used in the assessment below to demonstrate that sound impacts would not be significant.

If plant cannot be specified that meets these levels, then additional mitigation will be required.

6.4. Specific sound levels

6.4.1. AHUs

The predicted free-field specific sound levels for the AHUs are provided in Table 6-3. The sound level is given for the one hour assessment period during the daytime, and the 15 minute assessment period at night-time.

Table 6-3 – Predicted specific sound levels - AHUs

ID	Address	Floor	Specific Sound Level (L _{Aeq,T} dB)
1	14 Church Crescent	Ground	21.8
		First	22.6
2	1 Nantymor Cottages, Blacksmiths Way	Ground	23.1
		First	23.8
3	Teddies Nursery	Ground	25.5
		First	26.1
4	1-4 Cardiff Road	Ground	31.2
		First	31.5
5	19 Pencarn Avenue	Ground	20.2
		First	20.8
6	11 Pencarn Avenue	Ground	34.4
		First	35.3
7	61-65 Edmundsbury Rd	Ground	27.2
		First	28.7
8	89-95 Edmundsbury Rd	Ground	33.0
		First	34.0
9	117-119 Edmundsbury Rd	Ground	31.4
		First	32.8
10	50-62 Edmundsbury Rd	Ground	26.6
		First	32.0

ID	Address	Floor	Specific Sound Level (L _{Aeq,T} dB)
11	14-16 Powis Close	Ground	34.0
		First	35.2
12	49 Powis Close	Ground	34.7
		First	35.5

6.4.2. Quarterly testing

The predicted free-field specific sound levels for the quarterly testing scenario described above are provided in Table 6-4. A range of sound levels is given which identifies the highest and lowest sound levels of each type of testing. The specific sound level is for the full one hour daytime assessment period. The generator cells with the single highest engine sound level is indicated.

Table 6-4 – Predicted specific sound levels during routine testing

ID	Address	Floor	Cell with highest engine sound level	Specific Sound Level (L _{Aeq,1hr} dB)		
				Range of sound levels	Worst case 1 hour	Worst case 1 hour + AHUs
1	14 Church Crescent	Ground	G.01	0.0 to 13.6	13.6	22.4
		First	G.01	0.0 to 14.1	14.1	23.2
2	1 Nantymor Cottages, Blacksmiths Way	Ground	G.01	0.0 to 14.9	14.9	23.7
		First	G.01	0.0 to 15.5	15.5	24.4
3	Teddies Nursery	Ground	G.01	0.0 to 16.7	16.7	26.0
		First	G.01	0.0 to 17.4	17.4	26.6
4	1-4 Cardiff Road	Ground	G.01	0.0 to 25.4	25.4	32.2
		First	G.01	0.0 to 28.7	28.7	33.3
5	19 Pencarn Avenue	Ground	G.05	0.0 to 15.4	15.4	21.4
		First	G.05	0.2 to 16.0	16.0	22.0
6	11 Pencarn Avenue	Ground	G.04	1.8 to 31.5	31.5	36.2
		First	G.05	2.0 to 32.1	32.1	37.0
7	61-65 Edmundsbury Rd	Ground	G.05	2.8 to 15.5	15.5	27.5
		First	G.05	3.1 to 16.1	16.1	28.9
8	89-95 Edmundsbury Rd	Ground	G.10	2.1 to 28.7	28.7	34.4
		First	G.10	2.2 to 28.8	28.8	35.1
9	117-119 Edmundsbury Rd	Ground	G.10	0.3 to 25.7	25.7	32.4
		First	G.10	0.6 to 26.8	26.8	33.8
10	50-62 Edmundsbury Rd	Ground	G.10	0.0 to 23.2	23.2	28.2
		First	G.10	0.4 to 26.6	26.6	33.1
11	14-16 Powis Close	Ground	G.07	1.7 to 28.6	28.6	35.1
		First	G.07	1.9 to 31.6	31.6	36.8
12	49 Powis Close	Ground	G.09	1.4 to 31.1	31.1	36.3

ID	Address	Floor	Cell with highest engine sound level	Specific Sound Level (L _{Aeq,1hr} dB)		
				Range of sound levels	Worst case 1 hour	Worst case 1 hour + AHUs
		First	G.09	1.6 to 32.6	32.6	37.3

6.4.3. Black Building Test

The predicted free-field specific sound levels for the Black Building Test scenario described above are provided in Table 6-5. A range of sound levels is given which identifies the highest and lowest sound levels of the cells.

In each case, the sound level given is for the full one hour daytime assessment period. The assessment assumes that the engines run for 15 minutes. The total time is 25% of the one hour assessment period and the specific level is 6dB lower than the output from the sound model to take the 25% on-time into account.

Only one Black Building test would take place per day, during daytime hours. No testing would take place at weekends.

Table 6-5 – Predicted specific sound levels during Black Building Tests

ID	Address	Floor	Cell with highest engine sound level	Specific Sound Level (L _{Aeq,1hr} dB)		
				Range of sound levels	Worst case 1 hour	Worst case 1 hour + AHUs
1	14 Church Crescent	Ground	G.01	1.8 to 15.3	15.3	22.7
		First	G.01	1.8 to 15.9	15.9	23.4
2	1 Nantymor Cottages, Blacksmiths Way	Ground	G.01	1.8 to 16.7	16.7	24
		First	G.01	1.8 to 17.2	17.2	24.7
3	Teddies Nursery	Ground	G.04	1.8 to 18.5	18.5	26.3
		First	G.01	1.8 to 19.1	19.1	26.9
4	1-4 Cardiff Road	Ground	G.01	1.8 to 27.0	27.0	32.6
		First	G.01	1.8 to 30.3	30.3	33.9
5	19 Pencarn Avenue	Ground	G.05	1.8 to 15.8	15.8	21.6
		First	G.05	2.0 to 16.3	16.3	22.1
6	11 Pencarn Avenue	Ground	G.04	3.7 to 33.1	33.1	36.8
		First	G.05	3.9 to 33.8	33.8	37.6
7	61-65 Edmundsbury Rd	Ground	G.10	4.8 to 14.0	14.0	27.4
		First	G.10	5.1 to 15.0	15.0	28.9
8	89-95 Edmundsbury Rd	Ground	G.10	4.6 to 29.7	29.7	34.7
		First	G.10	4.7 to 29.8	29.8	35.4
9	117-119 Edmundsbury Rd	Ground	G.10	2.3 to 27.1	27.1	32.8
		First	G.10	2.6 to 28.3	28.3	34.1
10	50-62 Edmundsbury Rd	Ground	G.10	2.0 to 24.7	24.7	28.8
		First	G.10	2.4 to 28.2	28.2	33.5
11	14-16 Powis Close	Ground	G.07	3.6 to 30.2	30.2	35.5
		First	G.07	3.8 to 33.2	33.2	37.3

ID	Address	Floor	Cell with highest engine sound level	Specific Sound Level ($L_{Aeq,1hr}$ dB)		
				Range of sound levels	Worst case 1 hour	Worst case 1 hour + AHUs
12	49 Powis Close	Ground	G.10	3.2 to 32.6	32.6	36.8
		First	G.10	3.5 to 34.1	34.1	37.9

6.4.4. Emergency conditions

The predicted free-field specific sound levels for the emergency operational scenarios described above are provided in Table 6-6. The sound level is given for the one hour assessment period during the daytime, and the 15 minute assessment period at night-time.

Table 6-6 – Predicted specific sound levels during emergency conditions

ID	Address	Floor	Specific sound Level ($L_{Aeq,T}$ dB)	Specific Sound Level including AHUs ($L_{Aeq,T}$ dB)
1	14 Church Crescent	Ground	28.0	28.9
		First	28.5	29.5
2	1 Nantymor Cottages, Blacksmiths Way	Ground	29.3	30.2
		First	29.8	30.8
3	Teddies Nursery	Ground	31.5	32.5
		First	32.1	33.1
4	1-4 Cardiff Road	Ground	38.7	39.4
		First	41.6	42.0
5	19 Pencarn Avenue	Ground	26.4	27.3
		First	26.9	27.9
6	11 Pencarn Avenue	Ground	45.3	45.6
		First	46.1	46.4
7	61-65 Edmundsbury Rd	Ground	25.2	29.3
		First	25.8	30.5
8	89-95 Edmundsbury Rd	Ground	40.4	41.1
		First	40.6	41.5
9	117-119 Edmundsbury Rd	Ground	38.8	39.5
		First	39.9	40.7
10	50-62 Edmundsbury Rd	Ground	35.5	36.0
		First	39.3	40.0
11	14-16 Powis Close	Ground	42.8	43.3
		First	45.5	45.9
12	49 Powis Close	Ground	44.3	44.8
		First	45.8	46.2

6.5. BS 4142 assessment

It is important that this assessment is read in conjunction with the context provided in section 10. This section provides additional information that should be considered when drawing conclusions from the impacts and sound levels presented.

Results tables are presented in Appendix D.

6.5.1. Rating level corrections

A BS 4142:2014 + A1:2019 assessment has been undertaken based on the specific sound levels calculated above. Corrections have been applied to account for the low frequency tonal notes of the engines for all assessment scenarios. An intermittency correction has been included for the quarterly servicing scenario to allow for small time gaps between the testing of individual engines. As the final plant has not yet been selected, rating level corrections have been applied that are consistent with assessments and applications for other NGD sites.

The ratings levels include the following acoustic penalties:

- Quarterly servicing:
 - + 2 dB for tonality at all sensitive receptors, as engines and engine sounds were “just” perceptible during the acoustic survey
 - + 3 dB for intermittency as individual engines would be switched on and off
- Black Building Test and emergency conditions:
 - + 2 dB for tonality at all sensitive receptors, as engines and engine sounds were “just” perceptible during the acoustic survey
 - No further penalties have been applied as the sound source would be steady without any intermittent or impulsive features/
- AHUs:
 - + 3 dB as the sound would be neither tonal, impulsive or intermittent, though these have the potential to be readily distinctive against the residual acoustic environment.

The acoustic penalties were arithmetically added to the specific sound levels as set out in Section 6.1 for each to give an overall rating level. A worked example of these calculations is shown in Appendix C. The rating levels and the level of impact according to BS 4142 for each operational scenario are presented in the following subsections.

It should be noted that there have been some engines on the existing DC1 site that have been routinely tested since 2009. These testing periods are not included in the background sound level measurements, and the impact of the 60 proposed engines for DC3 is assessed in isolation.

6.5.2. AHUs

The rating levels and resultant impacts from the AHUs are provided in Table D-1 and Table D-2 in Appendix D. This assessment shows the impacts predicted at receptors under normal operation of the site, with no testing taking place.

Most impacts are predicted to be negligible during the day and at night. There are minor adverse impacts on Powis Close. These impacts are all considered to be not significant.

6.5.3. Quarterly Testing

The rating levels and resultant impacts from the quarterly testing are provided in Table D-3 in Appendix D.

The majority of impacts when considering the quarterly testing and AHUs are negligible, with minor adverse impacts at some locations on Powis Close. Although first floor impact levels at 49 Powis Close are predicted to be +5.1dB, this impact would only be during testing of the cell with highest sound levels at the receptor (G.09), and this would only be for a short duration. During the testing of all other cells, impacts would not exceed 5.0dB. Therefore, this impact, and all other impacts from quarterly testing, are not considered to be significant.

6.5.4. Black Building Testing

The rating levels and resultant impacts from the Black Building testing are provided in Table D-4 in Appendix D. Only one Black Building test would take place per day, during daytime hours. No testing would take place at weekends.

The assessment shown is worst case as it assumes that the test lasts for 15 minutes.

During the black building testing, negligible or minor adverse impacts would occur at all noise sensitive receptors. These impacts are not considered to be significant.

6.5.5. Emergency conditions

The impacts arising during emergency conditions, where all DC3 generators are operational, are provided in Table D-5 and Table D-6 in Appendix D.

Impacts at most receptors would be negligible or minor adverse during the emergency scenario for both daytime and night-time, and these impacts are not considered to be significant.

Should an emergency occur there would be a moderate or major adverse impact at some locations on Powis Close and Edmundsbury Road.

These moderate and major impacts are potentially significant; however, the likelihood of a power failure is very low, due to NGD's dual linkage direct to the National Grid and the reliability of the grid. During the operation of the existing site since 2009 there has not been a total power failure on site that would have caused the emergency scenario to occur. Therefore, it is considered that the moderate adverse impacts are not significant in this context.

7. Mitigation

Provided that the selected plant for the proposed development does not exceed the sound levels specified in Table 6-2, no further mitigation measures would be required.

8. Cumulative Assessment

The section looks at the cumulative impact of sound from the existing DC1 site, the permitted DC2 site and proposed DC3 site at receptors during an emergency scenario – i.e. where power is lost to all sites at the same time, although it is noted that a simultaneous loss of power to all 3 sites would be very unlikely. These calculations include contributions from all generators and AHUs.

Table 8-1 – Cumulative Assessment - Specific Sound Levels

ID	Address	Floor	Specific Sound Level from DC1 and DC2 (L _{Aeq,T} dB)	Specific Sound Level from DC3 (L _{Aeq,T} dB)	Total Specific Sound Level from all NGD sites (L _{Aeq,T} dB)
1	14 Church Crescent	Ground	52.1	28.8	52.2
		First	52.7	29.4	52.7
2	1 Nantymor Cottages, Blacksmiths Way	Ground	54.3	30.1	54.3
		First	55.2	30.7	55.2
3	Teddies Nursery	Ground	60.0	32.4	60.0
		First	60.7	33.0	60.7
4	1-4 Cardiff Road	Ground	66.2	39.4	66.2
		First	67.2	42.0	67.2
5	19 Pencarn Avenue	Ground	62.2	27.0	62.2
		First	63.0	27.7	63.0
6	11 Pencarn	Ground	53.1	45.6	53.8
		First	53.8	46.4	54.6
7	61-65 Edmundsbury Rd	Ground	47.6	29.3	47.6
		First	49.3	30.5	49.4
8	89-95 Edmundsbury Rd	Ground	46.2	41.1	47.4
		First	47.3	41.5	48.3
9	117-119 Edmundsbury Rd	Ground	47.7	39.5	48.3
		First	49.6	40.7	50.1
10	50-62 Edmundsbury Rd	Ground	44.0	36.0	44.6
		First	46.0	40.1	47.0
11	14-16 Powis Close	Ground	46.4	43.4	48.2
		First	47.5	45.9	49.8
12	49 Powis Close	Ground	46.4	44.8	48.7
		First	47.4	46.2	49.9

As can be seen from the table above, the total specific sound level is dominated by the generators and AHUs on the existing and permitted sites. The proposed site would generate sound levels up to 35dB lower than the existing and permitted sites.

Table D-7 and Table D-8 show the impact assessment for the cumulative emergency scenario for day and night time Table D-7 and Table D-8 show that in an emergency scenario, the cumulative effect of all sites results in

major adverse impacts at most receptors. The largest contribution to the impacts is from the generators and AHUs on the existing and permitted site.

All impacts in this cumulative scenario are potentially significant, however, the likelihood of a power failure is very low, due to NGD’s dual linkage direct to the National Grid and the reliability of the grid. During the operation of the existing site since 2009 there has not been a total power failure on site that would have caused the emergency scenario to occur. Therefore, it is considered that the moderate adverse impacts are not significant in this context.

The Table 8-2 below shows comparison of the emergency scenario from the proposed site and cumulative assessment.

Table 8-2 – Comparison of Emergency Scenario Impacts

ID	Address	Floor	Daytime Impact of Emergency Scenario		Night time Impact of Emergency Scenario	
			DC3	All NGD sites	DC3	All NGD sites
1	14 Church Crescent	Ground	-18.2	5.2	-12.2	11.2
		First	-17.6	5.7	-11.6	11.7
2	1 Nantymor Cottages, Blacksmiths Way	Ground	-18.9	5.3	-12.9	11.3
		First	-18.3	6.2	-12.3	12.2
3	Teddies Nursery	Ground	-15.6	12.0	N/A	N/A
		First	-15.0	12.7	N/A	N/A
4	1-4 Cardiff Road	Ground	-5.6	21.3	-1.6	25.3
		First	-3.0	22.2	1.0	26.2
5	19 Pencarn Avenue	Ground	-7.0	28.2	-7.0	28.2
		First	-10.3	25.0	-8.3	27.0
6	11 Pencarn Avenue	Ground	2.6	11.1	6.6	15.1
		First	3.4	11.8	7.4	15.8
7	61-65 Edmundsbury Rd	Ground	-8.7	9.8	-6.7	11.8
		First	-7.5	11.6	-5.5	13.6
8	89-95 Edmundsbury Rd	Ground	3.1	9.6	5.1	11.6
		First	3.5	10.6	5.5	12.6
9	117-119 Edmundsbury Rd	Ground	1.5	10.5	3.5	12.5
		First	2.7	12.3	4.7	14.3
10	50-62 Edmundsbury Rd	Ground	-2.0	6.8	0.0	8.8
		First	2.1	9.1	4.1	11.1
11	14-16 Powis Close	Ground	9.4	14.4	9.4	14.4
		First	11.9	16.0	11.9	16.0
12	49 Powis Close	Ground	6.8	10.8	8.8	12.8
		First	8.2	12.0	10.2	14.0

The table above shows that the impacts from the emergency scenario are up to 35dB higher in the cumulative assessment compared to the proposed site in isolation. It can therefore be concluded that the sound from the existing and permitted sites would be dominant in an emergency scenario.

9. 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:

- 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.
- The frequency data from the acoustic survey has been used to estimate the spectrum of the generator engines with an acoustic enclosure.
- 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 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.
- Additional receptors have been added on Edmundsbury Road as the proposed site is closer to these receptors than previous data centres. This has resulted in greater accuracy in the reported receptor names, and additional screening from buildings has been put into the model for previously reported receptors.
- Rating corrections have been applied to the specific sound level for each type of source rather than the total specific sound level for all sound sources combined. These corrected levels were then logarithmically summed to give an overall rating level. As shown in Appendix C, the AHU sound is dominant over the generators and therefore, taking this approach avoids overestimation of impacts from generators or AHUs.
- The effect of load shedding has not been included in this assessment.

10. Context

To fully assess impacts, BS 4142 requires context to be considered.

Site and Locality

The DC3 site is located in an already industrialised area, including an existing data centre. The background noise levels at nearby receptors already contains some noise from the existing industrial and commercial units adjacent to the DC3 site. There is an approved data centre adjacent to the DC3 site that has not yet been built. Therefore, the proposed DC3 is in character with the existing and planned noise sources in the area.

Existing Facility

There are generator engines on the existing site that have been operational since 2009 and have been subject to a similar routine testing regime as set out for DC3.

Noise levels from the testing of generators on the existing Data Centre 1 site have previously been assessed to be up to +13.4dB above background levels at receptors during Quarterly testing and +10.4dB during Black Building testing. To date, no complaints have been received from local residents in relation to the sound from these tests. For comparison, the proposed site has been assessed as having up to +5.1dB above background during Quarterly testing and up to +4.5dB above background during Black Building testing.

Assessment of the emergency scenario for existing Data Centre 1 site has previously showed potential impact from generators of +17.9dB above background at receptors on Powis Close. For comparison, the DC3 site has been assessed as having up to +12.3dB above background during daytime and up to +12.3dB above background at night.

The total testing period for the proposed site would cover approximately five weeks out of the year. No testing would take place during night-time hours or at weekends, which are particularly sensitive time periods in terms of sleep and rest.

Interpretation of BS 4142

BS 4142 notes that an increase of 5dB above background noise 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 noise as potentially being significant.

Internal Noise Levels

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 50dB $L_{Ar,1h}$ during routine testing or the emergency scenario for DC3. Therefore, it can be demonstrated that noise levels from the site will not exceed the recommended internal noise levels during the day to achieve suitable resting conditions, and the resulting impacts are not significant.

Temporary Impacts

The cumulative emergency scenario (all engines and AHUs from DC1, DC2 and DC3 operating simultaneously) is an extremely unlikely scenario. Under this scenario, the assessment showed that there is potential for significant impacts and sound levels could exceed 50dB at receptor facades. However, the potential impacts and sound levels would be temporary whilst the operator works to resolve the power outage. Temporary elevated levels would not affect health and well-being of people and are not considered to be significant. The cumulative emergency scenario shows that the largest contribution to impacts comes from the existing site. In the 11 years the existing site had been operating, the emergency scenario has never occurred.

11. Conclusion

Next Generation Data Ltd provides wholesale out-of-town data centre space for some of the world's largest companies at its existing facility at Imperial Park in Newport. NGD are looking to build four new data halls with associated backup generator engines and rooftop air handling units.

A BS 4142 worst case assessment of the impact of sound from engine testing and AHU operation at the nearest sensitive receptors has been undertaken, with reference to the baseline conditions at the sensitive receptors and manufacturer sound data where available. To fully assess impacts, BS 4142 requires context to be considered. This is discussed in Chapter 10 of the report.

11.1. DC3 site

The total engine testing time over the course of a year would be approximately five weeks.

It should be noted that there have been engines on the existing Data Centre 1 site since 2009 that already undergo routine testing without complaints, and these existing engines have previously been assessed to have a higher sound level above background at the nearest receptors than the proposed generators. These existing testing periods are not included in the background sound level measurements, demonstrating that this assessment is a worst-case assessment.

11.1.1. Plant sound levels

Maximum plant sound levels have been set to avoid significant impacts at receptors during routine testing. These levels were 86dBA L_w for generators and 77.5dBA L_w for AHUs. If plant cannot be specified that meets these levels, then additional mitigation will be required.

11.1.2. AHUs

Impacts from AHU sound during the daytime and at night are generally negligible. Receptors on Powis Close are predicted a minor adverse impact from AHU sound, however, these impacts are not considered to be significant.

11.1.3. Quarterly testing

Predicted impacts from quarterly testing are generally negligible. Receptors on Powis Close are predicted a minor or moderate adverse impact during the quarterly testing. These impacts would only occur during the testing of engines closest to the receptors and would therefore be lower during the testing of other engines on the site. In all cases, façade sound levels would not exceed 50dB and therefore internal sound levels would not exceed 35dB as recommended in BS8233.

No Quarterly testing would take place at night or on weekends.

11.1.4. Black Building testing

Impacts at all receptors are predicted to be negligible or minor adverse during Black Building testing. These impacts are not considered to be significant.

No Black Building testing would take place at night or at weekends.

11.1.5. Emergency Scenario

The emergency scenario for DC3 in isolation shows that most impacts would be negligible or minor adverse and these impacts are not considered to be significant.

There are some moderate and major adverse impacts at Powis Close during the daytime and night time, and moderate adverse impacts at Edmundsbury Road and the southern end of Pencarn Avenue at night.

The likelihood of this impact being realised is very low as the site will have dual national grid linkage. In addition to this, at the existing DC1 site (which has a similar dual national grid linkage), an emergency scenario has not occurred since that site commenced operations in 2009. Therefore, it is considered that impacts from the emergency scenario are not significant.

11.2. Cumulative Emergency Scenario

The cumulative emergency scenario, where all engines on DC1, DC2 and DC3 would be active simultaneously, shows that all impacts would be moderate or major adverse. Given that this scenario is very unlikely to occur, these impacts are not considered to be significant.

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. L_{A10} , 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 exceeded 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. Acoustic survey data

B.1. Attended Measurements

Table B-1 – Measured sound levels at 11 Pencarn Avenue

Date	Time	Duration (minutes)	Measured sound levels, dB				Main sound sources
			L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}	
15/05/2018	07:35	15	51.2	52.8	45.2	70.0	Water from water feature, aircraft, construction works at IQE, birds
15/05/2018	09:39	15	53.3	56.7	43.5	76.4	As above, repositioned to top of bund
15/05/2018	12:52	15	51.3	54.5	45.5	71.2	Same position as previous measurement. Birds, train horn? NDG generators just audible
04/07/2019	23:21	15	40.7	39.4	37.4	49.7	Distant traffic, hum from plant
05/07/2019	00:32	15	38.5	38.3	36.3	43.7	Distant traffic, hum from plant
08/07/2019	14:01	15	49.4	42.7	39.1	73.6	Faint hum from plant, aircraft, birds
08/07/2019	15:39	15	44.9	43.3	39.9	58.4	Faint hum from plant, birds, some construction noise

Table B-2 – Measured sound levels at Powis Close

Date	Time	Duration (minutes)	Measured sound levels, dB				Main sound sources
			L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}	
15/05/2018	08:03	15	46.6	50.2	37.6	62.1	Birds, hum, road traffic
15/05/2018	13:15	15	42.2	43.0	35.2	67.7	Birds, distant roads, distant construction
05/07/2019	00:09	15	40.2	38.6	36.4	46.5	500Hz tone from plant
05/07/2019	01:21	15	40.5	37.4	36.0	58.5	500Hz tone from plant, freight train at 01:30
08/07/2019	13:10	14*	47.4	38.5	36.2	62.7	500Hz tone from plant, traffic (local), birds
08/07/2019	14:50	15	40.8	36.8	35.0	60.1	500Hz tone from plant, birds, local residents talking

*measurement cut short due to local workers revving their lorry's engine

Table B-3 – Measured sound levels at Blacksmith Way

Date	Time	Duration (minutes)	Measured sound levels, dB				Main sound sources
			L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}	
15/05/2018	08:37	15	59.2	57.8	51.7	78.7	Traffic, dog, birds, possible lawn mower
15/05/2018	13:44	15	59.0	56.8	50.8	82.0	Distant roads, DIY, birds, possible generator
04/07/2019	23:45	15	49.0	48.2	45.4	62.7	Traffic (M4), traffic (local), intermittent clicks from animal deterrent
05/07/2019	00:58	15	50.9	50.0	46.2	57.7	Traffic (M4), intermittent clicks from animal deterrent
08/07/2019	13:34	15	54.8	52.4	49.7	68.3	M4 Traffic is dominant, some local traffic, distant construction noise, birds, trees
08/07/2019	15:13	15	53.4	51.2	49.5	68.7	M4 Traffic is dominant, some local traffic, birds, trees

Table B-4 – Measured sound levels at Buchanan Way

Date	Time	Duration (minutes)	Measured sound levels, dB				Main sound sources
			L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}	
15/05/2018	09:05	15	60.6	64.9	50.3	75.5	Traffic, engines, water, nursery
15/05/2018	14:05	15	58.7	60.8	51.0	74.6	Local roads, distant roads, people, water
08/07/2019	14:27	15	57.1	54.7	48.6	84.4	Traffic, vehicles in nursery carpark, people, water

B.2. Unattended measurements:

Table B-5 – Unattended Measurements at NGD site boundary, near Pencarn Avenue

Date	Time	Measured sound levels, dB			
		L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}
27/06/2019	12:00:00	50.1	51.4	44.2	71.1
27/06/2019	13:00:00	51.9	54.2	45.0	72.0
27/06/2019	14:00:00	49.6	51.9	43.9	71.1
27/06/2019	15:00:00	50.4	53.0	44.3	77.1
27/06/2019	16:00:00	48.7	51.2	45.1	66.3
27/06/2019	17:00:00	50.8	53.3	45.1	68.9
27/06/2019	18:00:00	49.3	51.7	44.9	67.7
27/06/2019	19:00:00	50.3	53.1	44.1	71.5
27/06/2019	20:00:00	46.0	45.9	41.9	69.1
27/06/2019	21:00:00	43.4	44.7	41.3	58.9
27/06/2019	22:00:00	43.3	44.5	40.7	59.7
27/06/2019	23:00:00	40.9	41.9	39.4	51.7
27/06/2019	00:00:00	39.8	40.8	38.3	50.9
27/06/2019	01:00:00	40.1	41.2	38.6	51.3
27/06/2019	02:00:00	40.3	41.6	38.7	52.9
27/06/2019	03:00:00	40.7	41.8	39.3	48.9
27/06/2019	04:00:00	52.6	48.5	41.1	73.1
27/06/2019	05:00:00	53.8	57.4	45.6	71.1
27/06/2019	06:00:00	50.6	52.7	45.3	75.8
01/07/2019	07:00:00	59.2	54.9	48.8	96.9
01/07/2019	08:00:00	52.3	54.1	49.7	70.0
01/07/2019	09:00:00	53.0	54.3	50.6	78.2
01/07/2019	10:00:00	51.8	53.3	49.4	72.0
01/07/2019	11:00:00	59.0	53.5	43.8	96.9

Table B-6 – Unattended Measurements at Powis Close

Date	Time	Measured sound levels, dB			
		L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}
05/07/2019	16:00	62.7	66.3	47.6	82.7
05/07/2019	17:00	59.2	56.1	43.0	84.3
05/07/2019	18:00	48.4	49.9	44.5	74.3
05/07/2019	19:00	52.5	53.6	46.6	78.4
05/07/2019	20:00	62.5	64.3	53.0	85.6
05/07/2019	21:00	65.3	67.8	57.2	89.5
05/07/2019	22:00	65.8	68.2	57.0	89.6
05/07/2019	23:00	63.7	66.3	53.2	87.1
06/07/2019	00:00	64.3	65.0	50.9	96.4
06/07/2019	01:00	49.6	52.0	42.2	75.5
06/07/2019	02:00	48.1	50.2	42.0	74.9
06/07/2019	03:00	44.2	46.3	40.4	64.9
06/07/2019	04:00	43.7	46.0	39.1	63.3
06/07/2019	05:00	45.5	47.2	42.5	64.7
06/07/2019	06:00	47.0	47.6	42.1	78.2

Due to equipment failure, only 10 hours of data has been measured. From evening to early morning noise levels are high. These conditions were not noted during attended measurements.

Table B-7 – Unattended Measurements at Blacksmiths Way

Date	Time	Measured sound levels, dB			
		L _{Aeq,T}	L _{AF10}	L _{AF90}	L _{AFmax}
05/07/2019	17:00	54.1	55.1	52.6	65.6
05/07/2019	18:00	55.2	56.2	53.7	62.4
05/07/2019	19:00	55.8	56.7	54.2	69.8
05/07/2019	20:00	53.7	54.8	51.3	65.6
05/07/2019	21:00	52.5	53.8	50.4	62.6
05/07/2019	22:00	51.7	52.9	49.4	69.0
05/07/2019	23:00	49.9	51.4	47.5	62.6
06/07/2019	00:00	49.9	51.4	47.0	60.7
06/07/2019	01:00	48.4	50.3	44.6	56.1
06/07/2019	02:00	47.0	49.0	43.8	53.6
06/07/2019	03:00	47.6	49.5	44.0	61.0
06/07/2019	04:00	47.3	48.9	44.4	58.9
06/07/2019	05:00	52.7	54.3	49.2	69.0
06/07/2019	06:00	50.0	51.5	47.2	70.8
08/07/2019	07:00	54.6	55.6	52.7	70.0
08/07/2019	08:00	63.5	64.0	54.6	85.3
08/07/2019	09:00	61.5	58.1	50.2	84.2
08/07/2019	10:00	51.5	52.7	49.2	66.9
08/07/2019	11:00	52.5	52.8	49.0	75.1
08/07/2019	12:00	51.1	52.1	49.1	66.6
08/07/2019	13:00	51.5	52.6	49.6	63.7
08/07/2019	14:00	51.5	52.9	49.5	62.0
08/07/2019	15:00	51.6	52.3	49.1	68.7



Figure B-1 – Measurement Locations

Appendix C. Worked example

The rating levels shown in Table C-1 include the following acoustic penalties to the specific sound levels for each source type as described in Section 6.5.1.

- +5dB for generator sound
- +3dB for AHU sound

Table C-1 - Worked Example

Address	Floor	Daytime Background sound level (L _{A90} dB)	AHU		Generators			Total		Impact (Total L _{Ar,1h} -L _{A90} dB)
			Specific Sound Level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Generator Cell	Specific Sound Level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Specific Sound Level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	
49 Powis Close	First	36.0	35.5	38.5	G.01	1.9	6.9	35.5	38.5	2.5
			35.5	38.5	G.02	2.9	7.9	35.5	38.5	2.5
			35.5	38.5	G.03	3	8.0	35.5	38.5	2.5
			35.5	38.5	G.04	2.6	7.6	35.5	38.5	2.5
			35.5	38.5	G.05	3.3	8.3	35.5	38.5	2.5
			35.5	38.5	G.06	28.8	33.8	36.3	39.8	3.8
			35.5	38.5	G.07	30.9	35.9	36.8	40.4	4.4
			35.5	38.5	G.08	30.9	35.9	36.8	40.4	4.4
			35.5	38.5	G.09	32.6	37.6	37.3	41.1	5.1
			35.5	38.5	G.10	32.6	37.6	37.3	41.1	5.1

Appendix D. BS 4142 Assessment Tables

D.1. AHUs

The rating levels shown in the Table D-1 and Table D-2 includes a 3dB acoustic penalty applied to the specific sound level as described in Section 6.5.1.

Table D-1 - BS 4142 Assessment – AHUs daytime

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} -L _{A90} dB)	Level of impact
1	14 Church Crescent	Ground	21.8	24.8	49.0	-24.2	Negligible
		First	22.6	25.6	49.0	-23.4	Negligible
2	1 Nantymor Cottages, Blacksmiths Way	Ground	23.1	26.1	51.0	-24.9	Negligible
		First	23.8	26.8	51.0	-24.2	Negligible
3	Teddies Nursery	Ground	25.5	28.5	50.0	-21.5	Negligible
		First	26.1	29.1	50.0	-20.9	Negligible
4	1-4 Cardiff Road	Ground	31.2	34.2	47.0	-12.8	Negligible
		First	31.5	34.5	47.0	-12.5	Negligible
5	19 Pencarn Avenue	Ground	20.2	23.2	45.0	-21.8	Negligible
		First	20.8	23.8	45.0	-21.2	Negligible
6	11 Pencarn Avenue	Ground	34.4	37.4	45.0	-7.6	Negligible
		First	35.3	38.3	45.0	-6.7	Negligible
7	61-65 Edmundsbury Rd	Ground	27.2	30.2	40.0	-9.8	Negligible
		First	28.7	31.7	40.0	-8.3	Negligible
8	89-95 Edmundsbury Rd	Ground	33	36.0	40.0	-4.0	Negligible
		First	34	37.0	40.0	-3.0	Negligible

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} -L _{A90} dB)	Level of impact
9	117-119 Edmundsbury Rd	Ground	31.4	34.4	40.0	-5.6	Negligible
		First	32.8	35.8	40.0	-4.2	Negligible
10	50-62 Edmundsbury Rd	Ground	26.6	29.6	40.0	-10.4	Negligible
		First	32	35.0	40.0	-5.0	Negligible
11	14-16 Powis Close	Ground	34	37.0	36.0	1.0	Negligible
		First	35.2	38.2	36.0	2.2	Minor Adverse
12	49 Powis Close	Ground	34.7	37.7	36.0	1.7	Minor Adverse
		First	35.5	38.5	36.0	2.5	Minor Adverse

Table D-2 - BS 4142 Assessment – AHUs night-time

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Night time Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} -L _{A90} dB)	Level of impact
1	14 Church Crescent	Ground	21.8	24.8	43.0	-18.2	Negligible
		First	22.6	25.6	43.0	-17.4	Negligible
2	1 Nantymor Cottages, Blacksmiths Way	Ground	23.1	26.1	45.0	-18.9	Negligible
		First	23.8	26.8	45.0	-18.2	Negligible
3	Teddies Nursery	Ground	25.5	28.5	N/A-	N/A-	N/A-
		First	26.1	29.1	N/A-	N/A-	N/A-
4	1-4 Cardiff Road	Ground	31.2	34.2	43.0	-8.8	Negligible
		First	31.5	34.5	43.0	-8.5	Negligible
5	19 Pencarn Avenue	Ground	20.2	23.2	41.0	-17.8	Negligible
		First	20.8	23.8	41.0	-17.2	Negligible
6	11 Pencarn	Ground	34.4	37.4	41.0	-3.6	Negligible
		First	35.3	38.3	41.0	-2.7	Negligible
7	61-65 Edmundsbury Rd	Ground	27.2	30.2	38.0	-7.8	Negligible
		First	28.7	31.7	38.0	-6.3	Negligible
8	89-95 Edmundsbury Rd	Ground	33	36.0	38.0	-2.0	Negligible
		First	34	37.0	38.0	-1.0	Negligible
9	117-119 Edmundsbury Rd	Ground	31.4	34.4	38.0	-3.6	Negligible
		First	32.8	35.8	38.0	-2.2	Negligible
10	50-62 Edmundsbury Rd	Ground	26.6	29.6	38.0	-8.4	Negligible
		First	32	35.0	38.0	-3.0	Negligible

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Night time Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h} - L_{A90}$ dB)	Level of impact
11	14-16 Powis Close	Ground	34	37.0	36.0	1.0	Negligible
		First	35.2	38.2	36.0	2.2	Minor Adverse
12	49 Powis Close	Ground	34.7	37.7	36.0	1.7	Minor Adverse
		First	35.5	38.5	36.0	2.5	Minor Adverse

D.2. Quarterly Testing

The rating levels shown in Table D-3 include the following acoustic penalties to the specific sound levels for each source type as described in Section 6.5.1.

- +5dB for generator sound
- +3dB for AHU sound

Table D-3 - BS 4142 Assessment - Quarterly Testing

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h} - L_{A90}$ dB)	Level of impact
1	14 Church Crescent	Ground	22.4	25.7	49	-23.3	Negligible
		First	23.2	26.5	49	-22.5	Negligible
2	1 Nantymor Cottages, Blacksmiths Way	Ground	23.7	27.0	51	-24.0	Negligible
		First	24.4	27.7	51	-23.3	Negligible
3	Teddiess Nursery	Ground	26	29.3	50	-20.7	Negligible
		First	26.6	29.9	50	-20.1	Negligible
4	1-4 Cardiff Road	Ground	32.2	35.7	47	-11.3	Negligible
		First	33.3	37.1	47	-9.9	Negligible
5	19 Pencarn Avenue	Ground	21.4	25.0	45	-20.0	Negligible
		First	22	25.6	45	-19.4	Negligible
6	11 Pencarn Avenue	Ground	36.2	40.0	45	-5.0	Negligible
		First	37	40.8	45	-4.2	Negligible
7	61-65 Edmundsbury Rd	Ground	27.5	30.6	40	-9.4	Negligible
		First	28.9	32.1	40	-7.9	Negligible
8	89-95 Edmundsbury Rd	Ground	34.4	38.0	40	-2.0	Negligible
		First	35.1	38.7	40	-1.3	Negligible

ID	Address	Floor	Worst case Specific sound level ($L_{Aeq,1h}$ dB)	Rating level ($L_{Ar,1h}$ dB)	Daytime Background sound level (L_{A90} dB)	Difference ($L_{Ar,1h} - L_{A90}$ dB)	Level of impact
9	117-119 Edmundsbury Rd	Ground	32.4	35.9	40	-4.1	Negligible
		First	33.8	37.3	40	-2.7	Negligible
10	50-62 Edmundsbury Rd	Ground	28.2	32.0	40	-8.0	Negligible
		First	33.1	36.6	40	-3.4	Negligible
11	14-16 Powis Close	Ground	35.1	38.6	36	2.6	Minor Adverse
		First	36.8	40.5	36	4.5	Minor Adverse
12	49 Powis Close	Ground	36.3	40.0	36	4.0	Minor Adverse
		First	37.3	41.1	36	5.1	Moderate Adverse

D.3. Black Building Testing

The rating levels shown in Table D-4 include the following acoustic penalties to the specific sound levels for each source type as described in Section 6.5.1.

- +2dB for Generator sound
- +3dB for AHU sound

It should be noted that a -6dB correction for the test lasting 15 minutes out of the one hour assessment period has also been applied to the generators.

Table D-4 - BS 4142 Assessment – Black Building Test

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} -L _{A90} dB)	Level of impact
1	14 Church Crescent	Ground	22.7	25.5	49	-23.5	Negligible
		First	23.4	26.3	49	-22.7	Negligible
2	1 Nantymor Cottages, Blacksmiths Way	Ground	24.0	26.8	51	-24.2	Negligible
		First	24.7	27.5	51	-23.5	Negligible
3	Teddiess Nursery	Ground	26.3	29.1	50	-20.9	Negligible
		First	26.9	29.7	50	-20.3	Negligible
4	1-4 Cardiff Road	Ground	32.6	35.4	47	-11.6	Negligible
		First	33.9	36.5	47	-10.5	Negligible
5	19 Pencarn Avenue	Ground	21.6	24.3	45	-20.7	Negligible
		First	22.1	24.9	45	-20.1	Negligible
6	11 Pencarn Avenue	Ground	36.8	39.4	45	-5.6	Negligible
		First	37.6	40.2	45	-4.8	Negligible
7	61-65 Edmundsbury Rd	Ground	27.4	30.4	40	-9.6	Negligible
		First	28.9	31.8	40	-8.2	Negligible
8	89-95 Edmundsbury Rd	Ground	34.7	37.4	40	-2.6	Negligible
		First	35.4	38.2	40	-1.8	Negligible

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} -L _{A90} dB)	Level of impact
9	117-119 Edmundsbury Rd	Ground	32.8	35.5	40	-4.5	Negligible
		First	34.1	36.9	40	-3.1	Negligible
10	50-62 Edmundsbury Rd	Ground	28.8	31.4	40	-8.6	Negligible
		First	33.5	36.2	40	-3.8	Negligible
11	14-16 Powis Close	Ground	35.5	38.2	36	2.2	Minor Adverse
		First	37.3	39.9	36	3.9	Minor Adverse
12	49 Powis Close	Ground	36.8	39.4	36	3.4	Minor Adverse
		First	37.9	40.5	36	4.5	Minor Adverse

D.4. Emergency Scenario

The rating levels shown in Table D-5 and Table D-6 include the following acoustic penalties to the specific sound levels for each source type as described in Section 6.5.1.

- +2dB to generator sound
- +3dB to AHU sound

Table D-5 - BS 4142 Assessment – Emergency scenario (daytime)

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} -L _{A90} dB)	Level of impact
1	14 Church Crescent	Ground	28.9	31.1	49	-17.9	Negligible
		First	29.5	31.7	49	-17.3	Negligible
2	1 Nantymor Cottages, Blacksmiths Way	Ground	30.2	32.4	51	-18.6	Negligible
		First	30.8	33	51	-18	Negligible
3	Teddiess Nursery	Ground	32.5	34.7	50	-15.3	Negligible
		First	33.1	35.3	50	-14.7	Negligible
4	1-4 Cardiff Road	Ground	39.4	41.6	47	-5.4	Negligible
		First	42.0	44.1	47	-2.9	Negligible
5	19 Pencarn Avenue	Ground	27.3	29.5	45	-15.5	Negligible
		First	27.9	30.1	45	-14.9	Negligible
6	11 Pencarn Avenue	Ground	45.6	47.7	45	2.7	Minor Adverse
		First	46.4	48.5	45	3.5	Minor Adverse
7	61-65 Edmundsbury Rd	Ground	29.3	32	40	-8.0	Negligible
		First	30.5	33.2	40	-6.8	Negligible
8	89-95 Edmundsbury Rd	Ground	41.1	43.3	40	3.3	Minor Adverse
		First	41.5	43.7	40	3.7	Minor Adverse

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} - L _{A90} dB)	Level of impact
9	117-119 Edmundsbury Rd	Ground	39.5	41.7	40	1.7	Minor Adverse
		First	40.7	42.9	40	2.9	Minor Adverse
10	50-62 Edmundsbury Rd	Ground	36.0	38.2	40	-1.8	Negligible
		First	40.0	42.2	40	2.2	Minor Adverse
11	14-16 Powis Close	Ground	43.3	45.5	36	9.5	Moderate Adverse
		First	45.9	48	36	12.0	Major Adverse
12	49 Powis Close	Ground	44.8	46.9	36	10.9	Major Adverse
		First	46.2	48.3	36	12.3	Major Adverse

Table D-6 - BS 4142 Assessment – Emergency scenario (night-time)

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,15min} dB)	Rating level (L _{Ar,15min} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,15min} -L _{A90} dB)	Level of impact
1	14 Church Crescent	Ground	28.9	31.1	43	-11.9	Negligible
		First	29.5	31.7	43	-11.3	Negligible
2	1 Nantymor Cottages, Blacksmiths Way	Ground	30.2	32.4	45	-12.6	Negligible
		First	30.8	33	45	-12	Negligible
3	Teddies Nursery	Ground	32.5	34.7	N/A	N/A	N/A
		First	33.1	35.3	N/A	N/A	N/A
4	1-4 Cardiff Road	Ground	39.4	41.6	43	-1.4	Negligible
		First	42.0	44.1	43	1.1	Minor Adverse
5	19 Pencarn Avenue	Ground	27.3	29.5	41	-11.5	Negligible
		First	27.9	30.1	41	-10.9	Negligible
6	11 Pencarn Avenue	Ground	45.6	47.7	41	6.7	Moderate Adverse
		First	46.4	48.5	41	7.5	Moderate Adverse
7	61-65 Edmundsbury Rd	Ground	29.3	32	38	-6.0	Negligible
		First	30.5	33.2	38	-4.8	Negligible
8	89-95 Edmundsbury Rd	Ground	41.1	43.3	38	5.3	Moderate Adverse
		First	41.5	43.7	38	5.7	Moderate Adverse
9	117-119 Edmundsbury Rd	Ground	39.5	41.7	38	3.7	Minor Adverse
		First	40.7	42.9	38	4.9	Minor Adverse
10	50-62 Edmundsbury Rd	Ground	36.0	38.2	38	0.2	Negligible
		First	40.0	42.2	38	4.2	Minor Adverse

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,15min} dB)	Rating level (L _{Ar,15min} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,15min} -L _{A90} dB)	Level of impact
11	14-16 Powis Close	Ground	43.3	45.5	36	9.5	Moderate Adverse
		First	45.9	48	36	12.0	Major Adverse
12	49 Powis Close	Ground	44.8	46.9	36	10.9	Major Adverse
		First	46.2	48.3	36	12.3	Major Adverse

D.5. Cumulative Emergency Scenario

The acoustic penalties applied to the specific sound levels for the cumulative emergency scenario are:

- +2dB for generator sound
- +3dB for AHU sound

Table D-7 - BS 4142 Cumulative Assessment – Emergency scenario (daytime)

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} - L _{A90} dB)	Level of impact
1	14 Church Crescent	Ground	52.2	54.2	49	5.2	Moderate Adverse
		First	52.7	54.7	49	5.7	Moderate Adverse
2	1 Nantymor Cottages, Blacksmiths Way	Ground	54.3	56.3	51	5.3	Moderate Adverse
		First	55.2	57.2	51	6.2	Moderate Adverse
3	Teddies Nursery	Ground	60.0	62.0	50	12.0	Major Adverse
		First	60.7	62.7	50	12.7	Major Adverse
4	1-4 Cardiff Road	Ground	66.2	68.3	47	21.3	Major Adverse
		First	67.2	69.2	47	22.2	Major Adverse
5	19 Pencarn Avenue	Ground	62.2	64.2	36	28.2	Major Adverse
		First	63.0	65.0	40	25.0	Major Adverse
6	11 Pencarn	Ground	53.8	56.1	45	11.1	Major Adverse
		First	54.6	56.8	45	11.8	Major Adverse
7	61-65 Edmundsbury Rd	Ground	47.6	49.8	40	9.8	Moderate Adverse
		First	49.4	51.6	40	11.6	Major Adverse
8	89-95 Edmundsbury Rd	Ground	47.4	49.6	40	9.6	Moderate Adverse
		First	48.3	50.6	40	10.6	Major Adverse
9	117-119 Edmundsbury Rd	Ground	48.3	50.5	40	10.5	Major Adverse

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,1h} dB)	Rating level (L _{Ar,1h} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,1h} -L _{A90} dB)	Level of impact
		First	50.1	52.3	40	12.3	Major Adverse
10	50-62 Edmundsbury Rd	Ground	44.6	46.8	40	6.8	Moderate Adverse
		First	47.0	49.1	40	9.1	Moderate Adverse
11	14-16 Powis Close	Ground	48.2	50.4	36	14.4	Major Adverse
		First	49.8	52.0	36	16.0	Major Adverse
12	49 Powis Close	Ground	48.7	50.8	40	10.8	Major Adverse
		First	49.9	52.0	40	12.0	Major Adverse

Table D-8 - BS 4142 Cumulative Assessment – Emergency scenario (night-time)

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,15min} dB)	Rating level (L _{Ar,15min} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,15min} -L _{A90} dB)	Level of impact
1	14 Church Crescent	Ground	52.2	54.2	43	11.2	Major Adverse
		First	52.7	54.7	43	11.7	Major Adverse
2	1 Nantymor Cottages, Blacksmiths Way	Ground	54.3	56.3	45	11.3	Major Adverse
		First	55.2	57.2	45	12.2	Major Adverse
3	Teddies Nursery	Ground	60.0	62.0	N/A	N/A	N/A
		First	60.7	62.7	N/A	N/A	N/A
4	1-4 Cardiff Road	Ground	66.2	68.3	43	25.3	Major Adverse
		First	67.2	69.2	43	26.2	Major Adverse
5	19 Pencarn Avenue	Ground	62.2	64.2	36	28.2	Major Adverse
		First	63.0	65.0	38	27.0	Major Adverse

ID	Address	Floor	Worst case Specific sound level (L _{Aeq,15min} dB)	Rating level (L _{Ar,15min} dB)	Daytime Background sound level (L _{A90} dB)	Difference (L _{Ar,15min} -L _{A90} dB)	Level of impact
6	11 Pencarn Avenue	Ground	53.8	56.1	41	15.1	Major Adverse
		First	54.6	56.8	41	15.8	Major Adverse
7	61-65 Edmundsbury Rd	Ground	47.6	49.8	38	11.8	Major Adverse
		First	49.4	51.6	38	13.6	Major Adverse
8	89-95 Edmundsbury Rd	Ground	47.4	49.6	38	11.6	Major Adverse
		First	48.3	50.6	38	12.6	Major Adverse
9	117-119 Edmundsbury Rd	Ground	48.3	50.5	38	12.5	Major Adverse
		First	50.1	52.3	38	14.3	Major Adverse
10	50-62 Edmundsbury Rd	Ground	44.6	46.8	38	8.8	Moderate Adverse
		First	47.0	49.1	38	11.1	Major Adverse
11	14-16 Powis Close	Ground	48.2	50.4	36	14.4	Major Adverse
		First	49.8	52.0	36	16.0	Major Adverse
12	49 Powis Close	Ground	48.7	50.8	38	12.8	Major Adverse
		First	49.9	52.0	38	14.0	Major Adverse

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