parkerjones acoustics

Land at Severn Road

Hallen, Bristol, South Gloucestershire

Noise Impact Assessment

17th March 2023

First Issue

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Revision History

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Executive Summary and Conclusions

This document, a Noise Impact Assessment (NIA) has been written to assess the risk of adverse impact from noise 'pollution' generated by the proposed plans for the erection of a *"gas powered peaking plant with associated infrastructure and landscaping works"*, on land to the north of Severn Road, Avonmouth, Bristol.

The objective is to ensure that the risk of noise impact will be controlled sufficiently. This is based upon ensuring that the noise emissions from the plant at the proposed development will not cause a significant increase in external ambient noise levels at neighbouring residential properties once operational.

The assessment has been conducted in accordance with BS 4142:2014+A1:2019 by assessing plant noise emissions (predicted through noise modelling) against existing background noise levels (determined by a baseline noise survey) in neighbouring residential gardens and outside of neighbouring windows.

In summary, the noise emissions at peak operation are considered unlikely to result in an adverse impact on the nearest residential receptors (which are over 650m away), or the neighbouring industrial estate.

For further context, the predicted noise levels are almost identical to those predicted with the *Wood* noise assessment issued with the most recently approved planning application at the site, for the same usage but with a different quantity of engines/generators. Hence the alteration to the site is not expected to cause a change in impact from that already approved.

Therefore, noise should not pose a constraint to achieving planning permission for the proposed development.

Contents

1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Impact Assessment to accompany a planning application for the erection of a *"gas powered peaking plant with associated infrastructure and landscaping works"*, on land to the north of Severn Road, Avonmouth, Bristol.

1.1 Scope of Report

This document has been written to assess the risk of adverse impact on local noise-sensitive receptors from noise generated by the proposed plant. The objective is to ensure that the risk of noise impact will be controlled sufficiently. This is based upon ensuring that the noise emissions from the proposed plant will not cause a significant increase in external ambient noise levels outside of neighbouring noise-sensitive buildings once operational.

Therefore, the purpose of this report is to determine a representative background sound level outside of neighbouring residential properties; set appropriate noise level criteria based upon this pre-existing noise level; and finally, demonstrate whether the plant has been designed and located to sufficiently mitigate noise levels to meet these noise level limits successfully – and if not, provide recommendations on how to mitigate the impact to an acceptable level.

It should be noted that the development is similar in nature to an already approved application at the site which included 25 no. 2MW generators (ref: 19/17024/F) – with the latest plans instead including 11 no. 4.5MW generators. This report cites information regarding the baseline noise conditions from the report produced by *Wood Environment & Infrastructure Solutions UK Limited* as part of that application.

Whilst every attempt has been made to ensure that this report communicates effectively to a reader who might not have much knowledge of acoustics, some parts are necessarily technical. A glossary of acoustic terminology and concepts is provided in Appendix A.

1.2 Regulations and Guidelines

This report takes into consideration national planning policies including the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the Planning Practice Guidance on Noise (PPG-N) (summarised in Appendix B), which outline the purpose and long-term vision of planning policy with respect to noise. The assessment is aimed at limiting the impacts to no greater than the Lowest Observed Adverse Effect Level (the level above which adverse effects on health and quality of life can be detected).

More specifically, the assessment has been undertaken with reference to:

- BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound', which assesses the risk of an adverse impact of noise pollution from a sound source (or sources) of a commercial or industrial nature (i.e., mechanical/electrical plant);
- BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings'; and
- the WHO Environmental Noise Guidelines for the European Region.

2.0 Site and Development Description

The application site is on land to the north of Severn Road, Avonmouth, Bristol (northing: 354355, easting: 181240).

As shown in Figure 2.1, the site is in an industrial area, with much of the surrounding area characterised by industrial use, including a recently constructed BESS facility on the south boundary (with a further site planned west of that), a distribution centre to the north/west, and Hallen Industrial Estate to the east.

The nearest residential properties to the proposed development are approximately 650m to the south-east of the site, beyond the M49, at the junction of Severn Road and Minor's Lane.

The site in question already has planning permission (ref: 19/17024/F and PT17/4276/F) for a gas fuelled capacity mechanism generation plant / gas powered peaking plant – the latest consisting of 25 no. 2MW gas fired engines generating electrical power.

The latest proposals are similar in nature, with a small number but higher power generating engines – 11 no. 4.5MW, each housed in a container with air intakes and outlets. Each container has a 12m high exhaust gas flue fitted with a silencer, and each container includes 2 roof mounted radiators (5.9m high). Other noise generating plant includes a single gas skid and a single large transformer. Plans and elevations of the proposals are shown in Figure 2.2 and Figure 2.3 respectively.

The primary function of the development is to provide a backup electricity supply for the local network within times of peak demand or lack of supply – as such, they have a short-term operational nature. The site is likely to operate between 06:00 and 23:00 hrs, with an approximately a 1% chance of night-time operation.

Figure 2.1 – Aerial view of the site and surrounding area

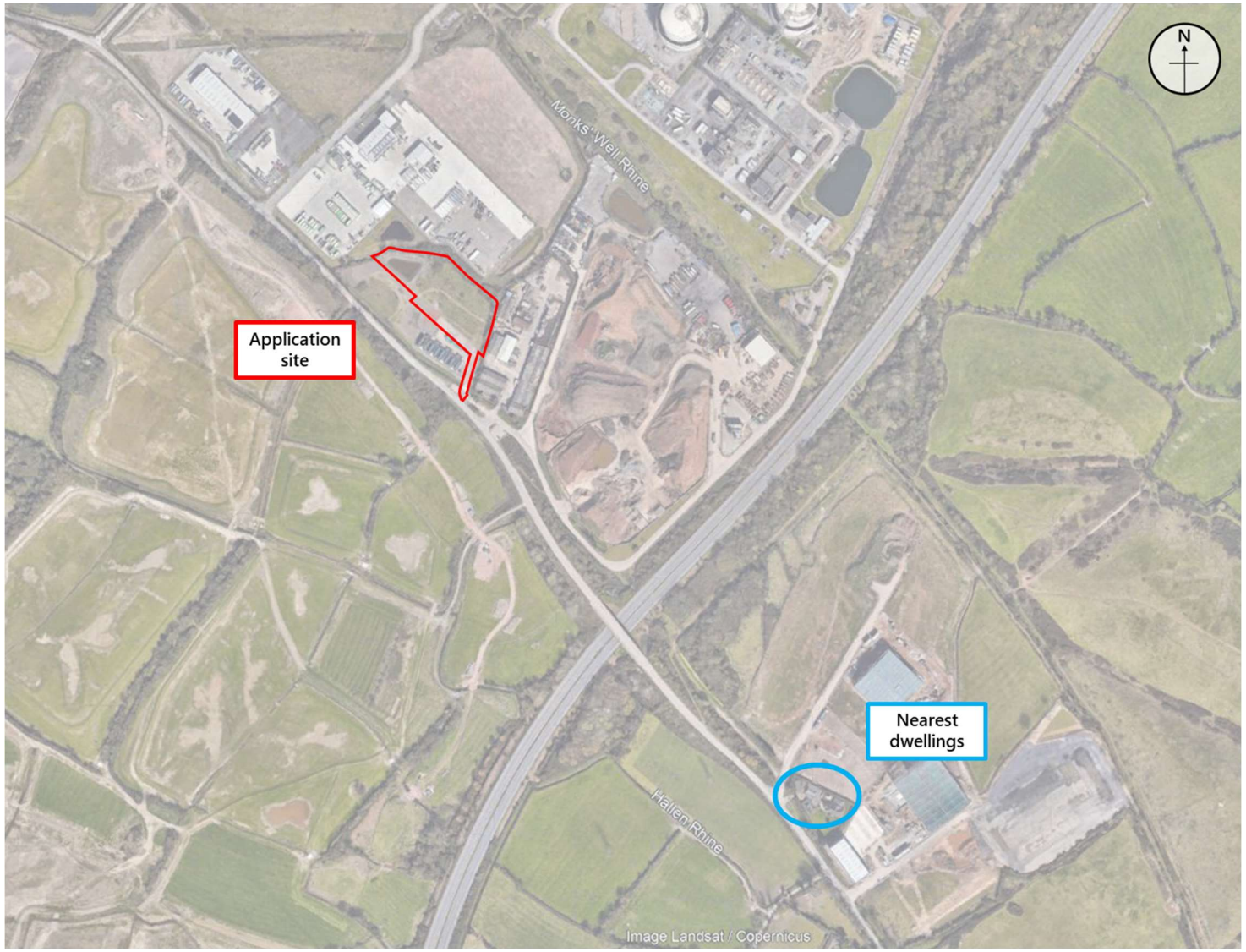


Figure 2.2 – Proposed site plan

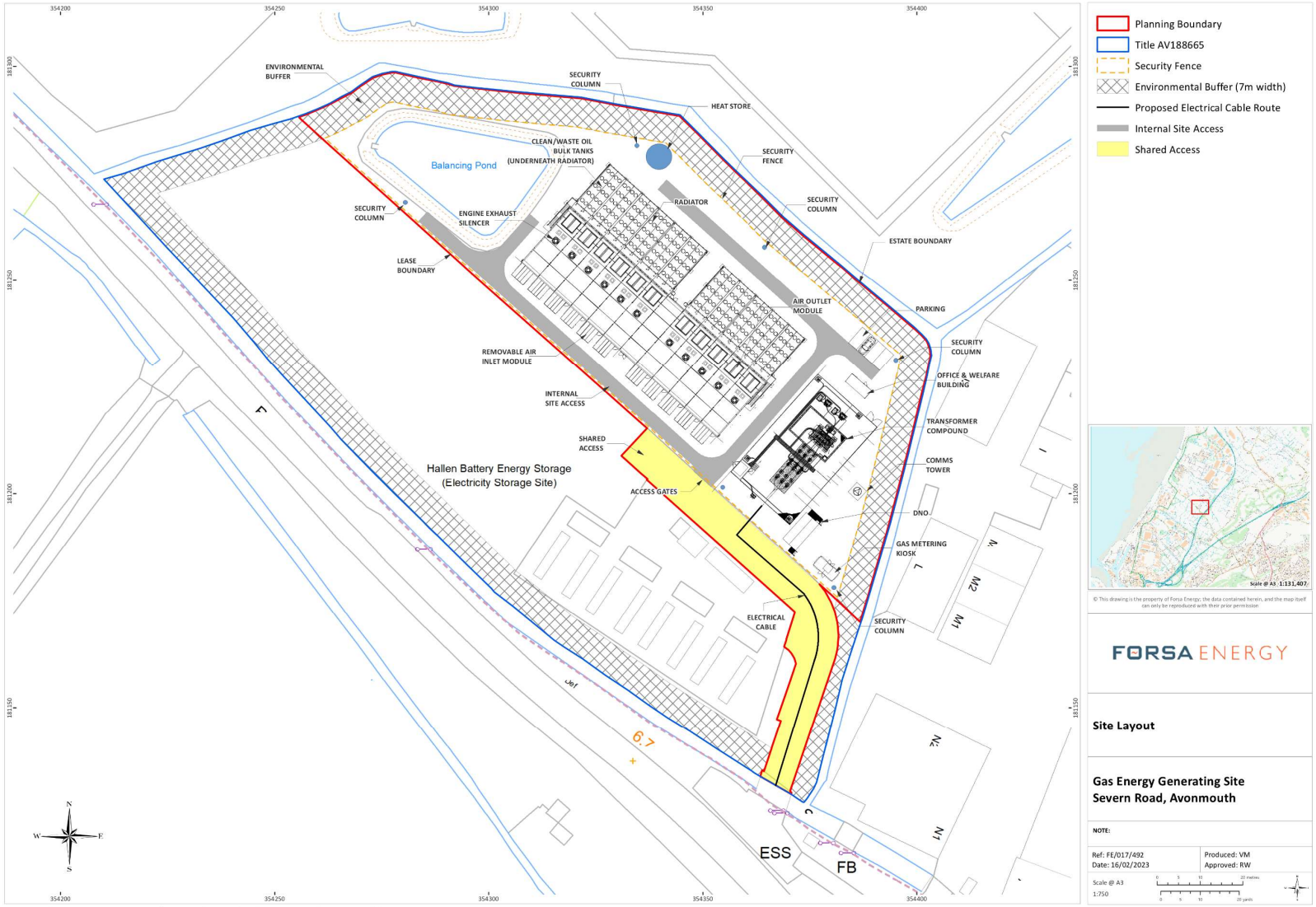
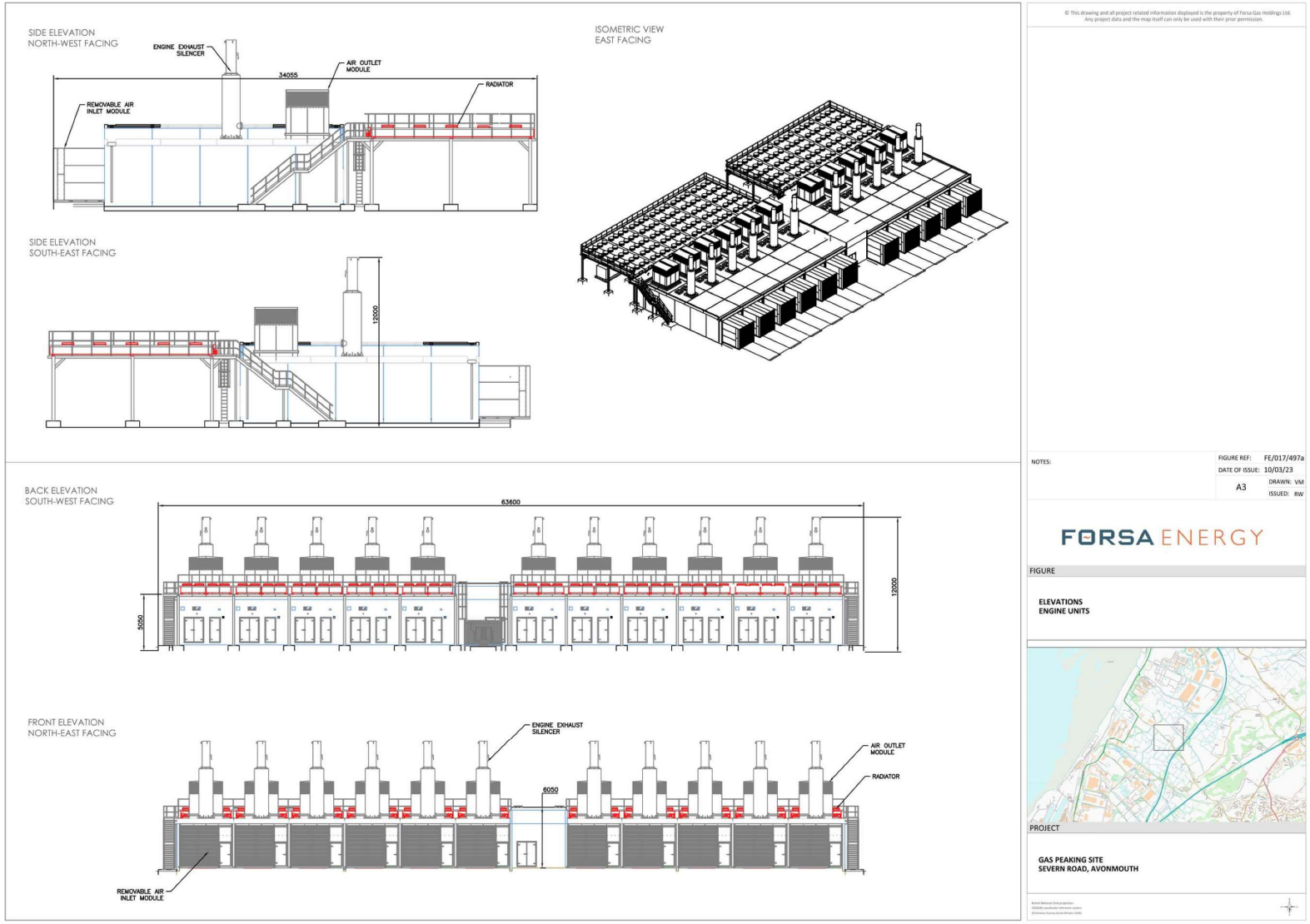


Figure 2.3 – Proposed elevations



3.0 Relevant Guidelines

3.1 BS 4142:2014

BS 4142:2014 *'Methods for rating and assessing industrial and commercial sound'* is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations (i.e., residential windows) within the context of the existing sound environment.

The method is based upon assessing the predicted noise emissions from plant/equipment against the existing background sound levels at NSRs, the latter of which is determined by a noise survey conducted at the site.

The predicted noise emissions are termed as a 'rating level', which is the 'specific sound level' from plant (the actual measurable noise level), plus 'penalties' which account for whether the noise has distinguishing characteristics such as tonality, intermittency, impulsivity, or is generally distinguishable from the ambient noise environment. Such features may attract attention and be considered annoying, hence sounds with these qualities should be penalised over sounds at the same specific noise level which is less intrusive.

The general aim is for the 'rating level' (plant noise emissions) to not exceed the existing background sound levels outside of residential windows. BS 4142:2014 states that *"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."*

Appendix B.4 explains the methodology in further detail.

3.2 BS 8233:2014

BS 8233:2014 '*Guidance on Sound Insulation and Noise Reduction for Buildings*' suggests appropriate criteria and limits for different situations.

3.2.1 Residential Dwellings

Table 4 of BS 8233:2014 provides internal ambient noise level (IANL) limits for dwellings from *"steady external noise sources"*. These are summarised in Table 3.1 below.

Table 3.1 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

Annex G.1 of BS 8233:2014 suggests that "*if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB*". Therefore, a noise limit directly outside of the nearest residential windows could be set based on the values above plus 15 dB.

Therefore, to meet internal noise targets in nearby residential dwellings, noise from the proposed plant should not exceed 50 dB L_{Aeq} during the daytime and 45 dB L_{Aeq} during the night-time when measured/calculated directly outside of a residential bedroom or living room window.

3.2.2 Industrial Buildings

Guidance is provided on noise inside workshops for maximum steady noise levels which should not be exceeded in order to achieve reliable speech communication, as presented in Table 3.2. Whilst speech communication is not always important, BS 8233:2014 states that "it is important that audible warnings and information announcements can be heard clearly".

Table 3.2 – Maximum steady noise levels for reliable speech communication

Distance between talker and listener (m)	Noise level dB(A)	
	Normal voice	Raised voice
1	57	62
2	51	56
4	45	50
8	39	44

3.3 World Health Organisation (WHO) Environmental Noise Guidelines

The WHO document *Guidelines for Community Noise 1999* has recently been superseded by the *Environmental Noise Guidelines for the European Region*. However, the updated guidance states that *'all WHO guidelines for community noise (CNG) indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid'*.

The document sets out guidance as to noise levels at which there will be an unacceptable impact on the local community. WHO guidelines state:

- To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise.
- To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB $L_{Aeq.}$

4.0 Baseline Noise Levels

4.1 Nearest Residential Property

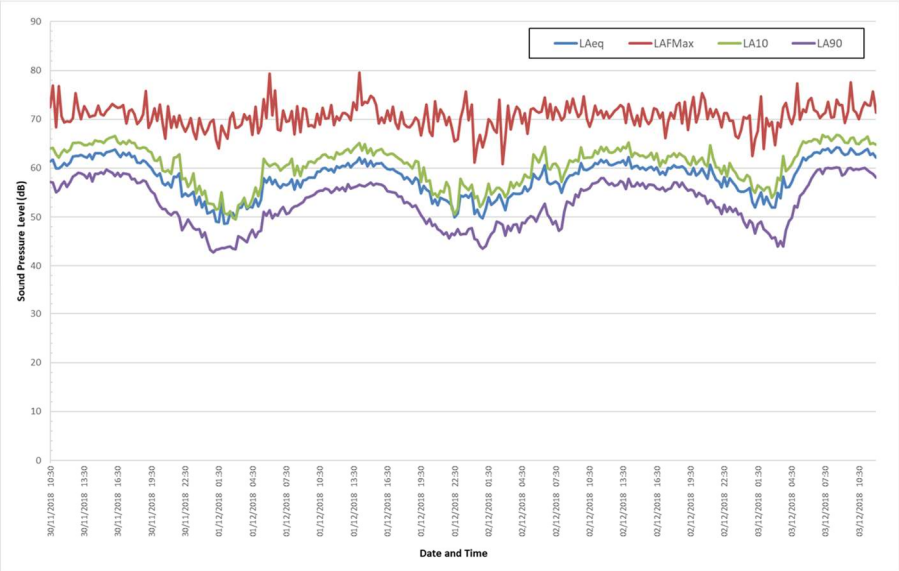
A baseline noise survey at the nearest residential receptor (those highlighted in Figure 2.1) has previously been conducted by the author of this report when under the employment of *SLR Consulting Limited* as part of a planning application at Avonmouth HWRC (application ref: 19/01223/F with Bristol City Council) – report reference 402.08721.00002 dated February 2019 [1].

The survey was conducted between the 30th of November – 3rd of December 2018. The survey results should still be valid/worst-case, given the amount of development in the area, it is highly unlikely that baseline levels would have decreased since these surveys were carried out. Given that the survey was conducted at the nearest residents assessed herein, using the same methodology that PJA would have used (particularly the SLR report, in which the author conducted the survey and wrote the report), the results are appropriate to use here. The survey:

- used Class 1 sound measuring equipment which was within calibration;
- was conducted by a consultant sufficiently qualified and competent in environmental noise monitoring;
- was conducted in appropriate weather conditions (dry with low wind speeds);
- was conducted at representative measurement positions;
- generally followed the guidelines of British Standard 7445: 2003: Description and measurement of environmental noise;

The results from the survey are shown in Figure 4.1, showing a time history of the monitored noise levels. The survey determined minimum values of 46 dB and 43 dB $L_{A90,15mins}$ during the daytime (07:00 – 23:00) and night-time (23:00 – 07:00) periods respectively.

Figure 4.1 – Time history of measured noise levels at the nearest NSR (Figure 03-4 in the *SLR Consulting Limited* report)



1 - https://pa.bristol.gov.uk/online-applications/files/E940541CAE3B1F2383EF656375AF1F96/pdf/19_01223_F-NOISE_IMPACT_ASSESSMENT-2053166.pdf

4.2 Neighbouring Industrial Estate

As detailed in the *Wood* noise impact assessment for the previous successful application, a noise survey was carried out by *TA Enviro Ltd* as part of a similar development at the same site. Monitoring was undertaken to the west of the DJL Fabrication Unit (on the edge of Hallen Industrial Estate) from 15:00 on the 13th of July 2016 for a duration of approximately 21 hours.

The survey results should still be valid/worst-case, given the amount of development in the area, it is highly unlikely that baseline levels would have decreased since these surveys were carried out – only increased, particularly with the neighbouring battery storage facility.

Table 4.1 – Summary of measured sound levels on the west side of Hallen Industrial Estate

Period	dB $L_{Aeq,1hr}$	dB $L_{A90,1hr}$ Mean	dB $L_{A90,1hr}$ Mode
Daytime (07:00 to 23:00)	55	44	45
Night-time (23:00 – 07:00)	52	41	40

5.0 Assessment

5.1 Impact on Residential Properties

5.1.1 Methodology

The assessment has been undertaken in accordance with BS 4142:2014+A1:2019. The following summarises the main steps of action in the assessment method:

- a representative background sound level $L_{A90,Tr}$ is determined based upon the results of the environmental noise surveys conducted by *SLR Consulting Limited* in November/December 2018;
- the specific sound level L_s generated by the proposed plant is predicted outside of the windows of neighbouring noise-sensitive windows in the area and residential gardens;
- the rating level $L_{Ar,Tr}$ is determined by the application of any 'penalties' which adjust for characteristic features of the sound which may be perceptible and potentially cause annoyance at each NSR;
- the predicted rating level $L_{Ar,Tr}$ is compared to the $L_{A90,Tr}$ and the recommendations of BS 4142:2014+A1:2019;
- the predicted specific noise levels are also compared against the guidelines of the WHO and BS 8233:2014, to provide further 'context' to the results (as referenced by BS 4142:2014+A1:2019);
- if necessary, mitigation measures are recommended to reduce the predicted rating level.

5.1.2 Representative Background Sound Levels

In accordance with BS 4142:2014, the predicted rating level should be assessed against a 'representative' background sound level. This is commonly determined through the results of a baseline sound survey, as has been done here.

BS 4142:2014 states that *"in using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."* BS 4142:2014 further states that *"a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either minimum or modal value"*.

As a worst-case assessment, it is appropriate to take the minimum values of $L_{A90,15min}$ measured during the survey to be the representative background sound level – as listed in Table 5.1.

Table 5.1 – Derived representative background sound level $L_{A90,T}$ at nearby NSRs

Noise-Sensitive Receptor (NSR)	Period	Representative Background Sound Level L_{A90} (dB)
1m outside of the windows of neighbouring noise-sensitive buildings	Daytime (07:00 to 23:00)	46
	Night-time (23:00 – 07:00)	43

5.1.3 Proposed Plant

Table 5.2 below presents the input data used in the noise modelling, based on the description of noise sources outlined in Section 2.0. The noise data has been supplied to PJA by the applicant and is based on manufacturer data or measurements at operational sites where available.

Data for the engine accounts for the sound reduction provided by the surrounding container. Similarly, the gas exhaust data accounts for the reduction from the in-duct silencer.

Table 5.2 – Sound power data for the proposed noise generating plant

Equipment	Quantity	Modelled Height	Sound Power Levels (SWL), dB									
			Octave Band Centre Frequencies, Hz									dB(A)
			31.5	63	125	250	500	1 k	2 k	4 k	8 k	
Engine enclosures	11	5m	100	95	90	81	74	65	57	51	51	78
Air intakes	11	3m	-	101	99	90	87	84	80	80	85	91
Air outlets	11	8.1m	-	102	102	93	84	81	78	79	85	91
Exhaust outlets	11	12m	119	108	96	86	84	81	77	80	-	89
Radiators	22	5.9m	-	-	86	87	86	88	86	82	73	92
Gas skid	1	2m	89	81	76	70	77	69	66	74	80	82
Transformer	1	2m	73	82	87	86	86	80	75	70	63	86

5.1.4 Predicted Noise Emissions

The noise predictions in this report have been made using a noise model which has been constructed using the CadnaA® software package, a commonly used 3-D noise mapping software that implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996. A full explanation of the noise modelling is provided in Appendix C, along with images and noise maps/results from the model.

The model has been set up to reflect the site plan and elevations in Figure 2.2/Figure 2.3.

Figure C.2 in Appendix C shows the predicted specific noise levels from all of the plant operating simultaneously, at a height of 1.5m at residential receptors (the results are the same at the 1st floor).

As per Appendix B.4, a rating level penalty should be applied when assessing in accordance with BS 4142:2014+A1:2019

- Tonality – a 2 dB penalty for 'just perceptible' tonality, ventilation fans have the potential to produce a tonal quality, which may be just perceptible despite the high background noise levels;

- Impulsivity – no penalty as fans (the noise generating component) do not generally generate impulsive noises.
- Intermittency – a 3 dB penalty, on the basis that the site will only reach full capacity for a short period during peak demand / times of low energy supply.

Table 5.3 shows the rating level 1m outside the worst affected residential windows in comparison to the background sound level.

Table 5.3 – Predicted noise levels and comparison with the representative background sound level

Location	Period	Specific Noise Level $L_{Aeq,Tr}$ (dB)	Rating Level Penalties (dB)	Rating Level $L_{Ar,Tr}$ (dB)	Background Sound Level $L_{A90,T}$ (dB)	Difference (dB)
1m from the worst affected residential window	Daytime (07:00 – 23:00) Tr = 1 hour	35	+5	40	46	**-6**
	Night-time (23:00 – 07:00) Tr = 15-minutes				43	**-3**

BS 4142:2014+A1:2019 states 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.

For further context, Annex G.1 of BS 8233:2014 suggests that "if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB".

Studies by Napier University [2] show that the sound insulation for partially open windows can be higher when open far enough to provide normal levels of background ventilation. The research shows that the typical attenuation of side hung, top hung, and bottom hung windows that are open with a free area of 0.2 m2 is 18 – 19 dB $D_{n,e,w}$, with a relatively high performance at low frequencies (31.5, 63, and 125 Hz).

However, assuming as a worst-case that the performance is 15 dB, an external specific noise level of 35 dB would equate to an internal level of 20 dB. This would comfortably meet night-time internal noise level targets (of 30 dB $L_{Aeq,8hrs}$) from BS 8233:2014 and WHO guidelines.

Therefore, the level of impact from noise on local residents is expected to be negligible.

2 - Napier University. NANR116: 'Open/Closed Window Research' Sound Insulation through Ventilated Domestic Windows. (2007)

5.2 Impact on the Neighbouring Industrial Estate

Figure C.3 in Appendix C shows the predicted specific noise levels from all of the plant operating simultaneously, at a height of 1.5m. Levels are plotted on facades which appear to contain doors or windows.

It is seen that the highest specific noise level incident on the closest building is 58 dB(A).

Assuming again that an open window (or open door) provides a 15 dB reduction from outside to inside, an external level of 58 dB(A) would result in an internal level of 43 dB(A). This is within the internal noise level criteria for reliable speech communication at 4m (see Section 3.2.2).

The predicted external levels are 3 dB above the existing ambient daytime sound level of 55 dB(A). This excess is not considered to be significant, particularly in the context of operation with the site only reaching full capacity for a short period at a time, and likely reaching this at peak energy usage times which are typically before and/or after the working day.

In summary, the resultant noise levels are considered unlikely to result in an adverse impact on the adjacent industrial estate.

5.3 Conclusions

In summary, the noise emissions at peak operation are considered unlikely to result in an adverse impact on the nearest residential receptors (which are over 650m away), or the neighbouring industrial estate.

For further context, the predicted noise levels are almost identical to those predicted with the *Wood* noise assessment issued with the most recently approved planning application at the site, for the same usage but with a different quantity of engines/generators. Hence the alteration to the site is not expected to cause a change in impact from that already approved.

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio of the root-mean-square pressure of the sound and a reference pressure (2x10-5 Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e., 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period. This parameter is typically considered as a good representation of the 'average' overall noise level. It is referred to technically as the A-weighted equivalent continuous sound level and is a dB(A) as defined above.
$L_{A90,T}$	The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level'.
$L_{A10,T}$	The A-weighted noise level that is exceeded for 10% of the measurement period T. This parameter is often considered as the 'average maximum level';
$L_{AFmax,T}$	The maximum A-weighted noise level during the measurement period T.

A.2 – Subjective Changes in Noise Level

Table A.2 – Subjective loudness from an increase or decrease in sound pressure level

Change in sound pressure level	Relative change in sound power energy (multiplier)		Change in apparent subjective loudness (for mid-frequency range)
	Decrease	Increase	
3 dB	1/2	2	'Just perceptible'
5 dB	1/3	3	'Clearly noticeable'
10 dB	1/10	10	'Half or twice as loud'
20 dB	1/100	100	'Much quieter, or louder'

Appendix B – Relevant Planning Policies and Guidelines

B.1 – National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The NPPF provides a framework within which local people and their council can produce their own distinctive local and neighbourhood plans. With explicit reference to noise, the NPPF states that *"Planning policies and decisions should contribute to and enhance the natural and local environment by … preventing new and existing development from contributing to, being put at unacceptable risk from … noise pollution"*.

B.2 - Noise Policy Statement for England (NPSE)

The NPPF refers to the Noise Policy Statement for England (NPSE), which applies to most forms of noise including environmental noise. The NPSE sets out the long-term vision of Government policy which is to *"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."*. It aims that *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The use of the terms *"significant adverse"* and *"adverse"* are key phrases within the NPSE. The guidance establishes the concept of how the level of adverse effect on health and quality of life can be referenced including:

- NOEL – No Observed Effect Level - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level - This is the level above which *adverse* effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level - This is the level above which *significant adverse* effects on health and quality of life occur.

Under the first aim of the NPSE ("avoid significant adverse impacts on health and quality of life"), an impact in line with SOAEL should be avoided. Under the second aim ("mitigate and minimise adverse impacts on health and quality of life"), where the impact lies somewhere between LOAEL and SOAEL, requiring that all reasonable steps are taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, but does not mean that such adverse effects cannot occur.

B.3 - Planning Practice Guidance on Noise (PPG-N)

The Planning Practice Guidance on Noise (PPG-N) is part of a suite of web-based guidance which is intended to support the implementation of the policies in the NPPF and the NPSE.

It aids in expanding on the definitions form the NPSE of NOEL, LOAEL and SOAEL, by linking these terms to 'examples of outcomes', i.e., changes in behaviour and/or attitude to noise. The table below summarises the guidance from PPG-N in this regard.

Table B.1 – Noise exposure hierarchy based on the likely average response – adapted from PPG-N

Perception	Examples of outcomes	Increasing effect level	Action
NOEL - No Observed Effect Level [1]			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
LOAEL - Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g., turning up the volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
SOAEL - Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to a change in the acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise leading to psychological stress or physiological effects, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory	Unacceptable Adverse Effect	Prevent

[1] This line is an assumption of the adverse effect level and is not explicitly referenced by PPG-N, though this appears to be a safe assumption.

B.4 - BS 4142:2014

BS 4142:2014 *'Methods for rating and assessing industrial and commercial sound'* is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations within the context of the existing sound environment.

B.4.1 - Definitions

BS 4142:2014 provides the following definitions which are relevant at this pre-construction stage of assessment:

- **Background Sound Level, $L_{A90,T}$:** A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
- **Rating Level, $L_{Ar,Tr}$:** Specific sound level plus any adjustment for the characteristic features of the sound.
- **Reference Time Interval, T_r:** Specified interval over which the specific sound level is determined. This is 60-minutes during the day (07:00 – 23:00) and 15-minutes at night (23:00 – 07:00).
- **Specific Sound Level, $L_s = L_{Aeq,Tr}$:** Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.
- **Specific Sound Source:** Sound source being assessed.

The BS 4142:2014 definition of sound of an industrial and/or commercial nature includes "*sound from fixed installations which comprise mechanical and electrical plant and equipment*". The scope of BS 4142:2014 is not intended for sound from the passage of vehicles on public roads; people; and 'other sources falling within the scopes of other standards or guidance'.

B.4.2 - Specific Sound Level

The specific sound level L_s is the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r, of 60-minutes during the day (07:00 – 23:00) and 15-minutes at night (23:00 – 07:00).

B.4.3 - Rating Level

The rating level $L_{Ar,Tr}$ is the specific sound level L_s plus any 'penalties' which account for the characteristic features of the sound.

BS 4142:2014 provides the following with respect to the application of penalties to account for *"the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention"*.

- ***Tonality*** *– For sound ranging from not tonal to predominantly tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible;*

- *Impulsivity – A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible;*
- *Intermittency – When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied; and*
- *Other Sound Characteristics – Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."*

PJA consider the word 'perceptible' to be important, and variable depending on the context of a site. For example at a site with a relatively high background sound level of 50 dB(A), an 'impulsive' sound source with a specific sound level of 30 dB(A) at an NSR is unlikely to be perceptible and should probably not be penalised.

However, the same source at a site with a lower background level of 30 dB(A) would be perceptible, and therefore a penalty of 3 or 6 dB could be applied to the rating level, with possibly a 9 dB penalty being applied if the specific sound level were to rise from 30 to 40 dB(A). Therefore the context is important in applying rating level penalties.

B.4.4 - Background Sound Level

BS 4142:2014 states that *"in using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."*

BS 4142:2014 further states that *"a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either minimum or modal value"*. Hence BS 4142:2014 does not provide a 'black and white' method of obtaining the assessment level for background sound $L_{A90,T}$. Note that it is standard practice that the $L_{A90,T}$ is determinable from the results of a baseline sound survey conducted at positions representative of sound levels at the nearest or worst affected NSRs.

B.4.5 - Assessment of Adverse Impact

The assessment of adverse impact contained in BS 4142:2014 is undertaken by comparing the rating level $L_{Ar,Tr}$, to the measured representative background sound level $L_{A90,T}$ outside the sensitive receptor location.

The significance of the impact of an industrial or commercial sound source depends on both the margin by which the rating level $L_{Ar,Tr}$ exceeds the background sound level $L_{A90,T}$ and the context in which the sound occurs. It is therefore essential to place the sound in context. But in general, *"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."*

Appendix C – Predicted Noise Emissions

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package which implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

All of the objects within the model (buildings, roads, barriers, foliage, etc) have been imported from OpenStreetMap. The heights of the buildings and roads have been based upon Google Earth Pro, using the 3D view to be able to measure the elevation heights at the tops of objects, and then inserting this manually into the model. Lastly, the scaled site plan, floor plan, and elevation for the proposed development have been accounted for in the model.

The noise model has been used to predict the resulting L_{Aeq} *specific* noise emissions from the proposed plant.

The noise model has assumed:

- a maximum reflection factor of two where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;
- a ground absorption factor of 0 on the site and any roads/tarmacked areas, and 1 in greenfield land.
- receptor heights on the façade at ground floor (1.5m) and top floor (5.5m) levels;
- atmospheric sound absorption based upon a temperate of 10°C and a humidity level of 70%, as per Table 2 of ISO 9613-2:1996;
- downwind propagation, i.e., a wind direction that assists the propagation of sound from source to receptor, as a worst-case.

The images on the following pages contain the results of the mapping, showing the predicted specific noise levels (rating level penalties are not included).

Figure C.1 – 3D view of the model setup

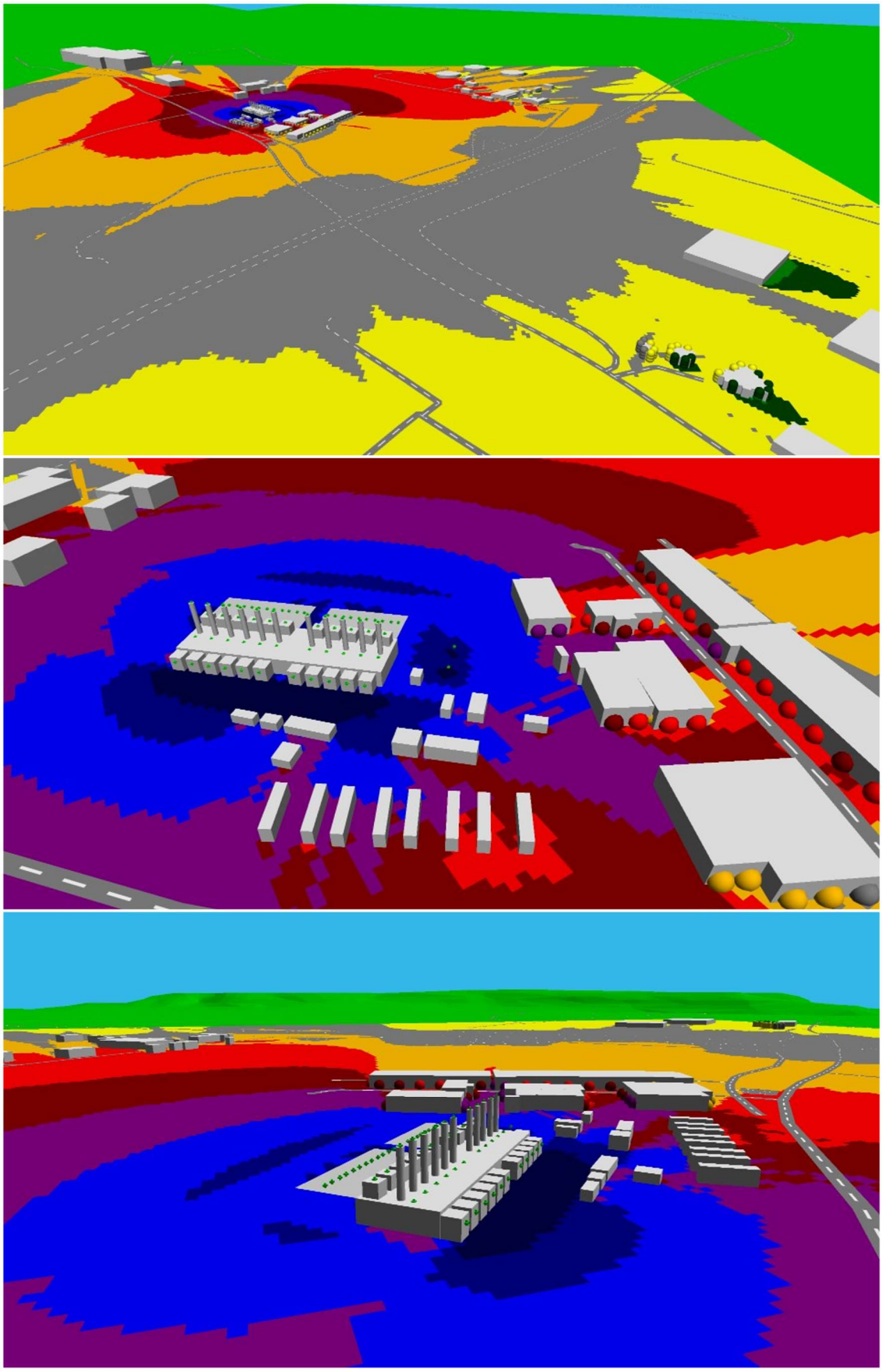


Figure C.2 – Predicted specific noise levels (dB L_{Aeq}) – all plant operating simultaneously/full capacity – residential receptors

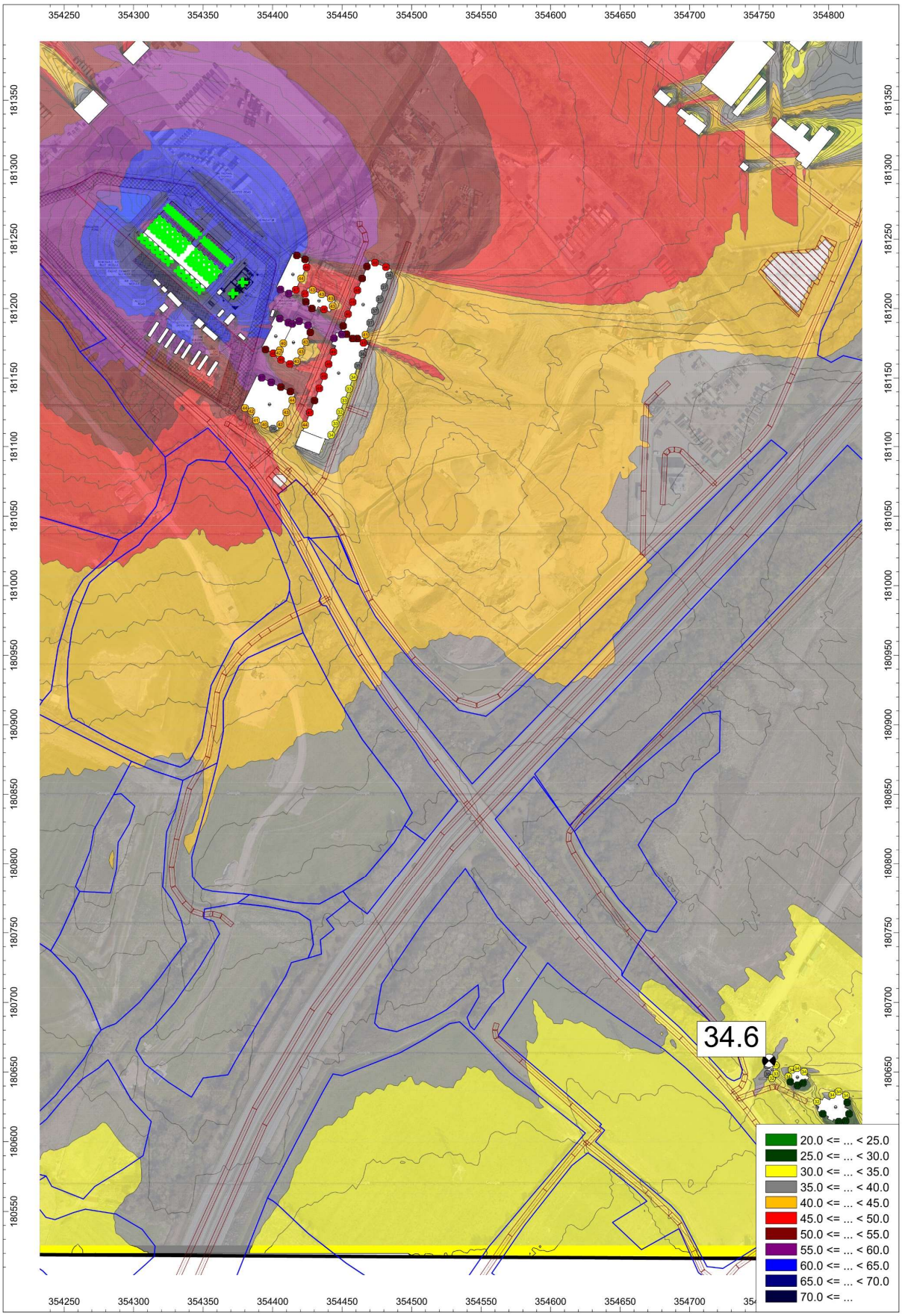
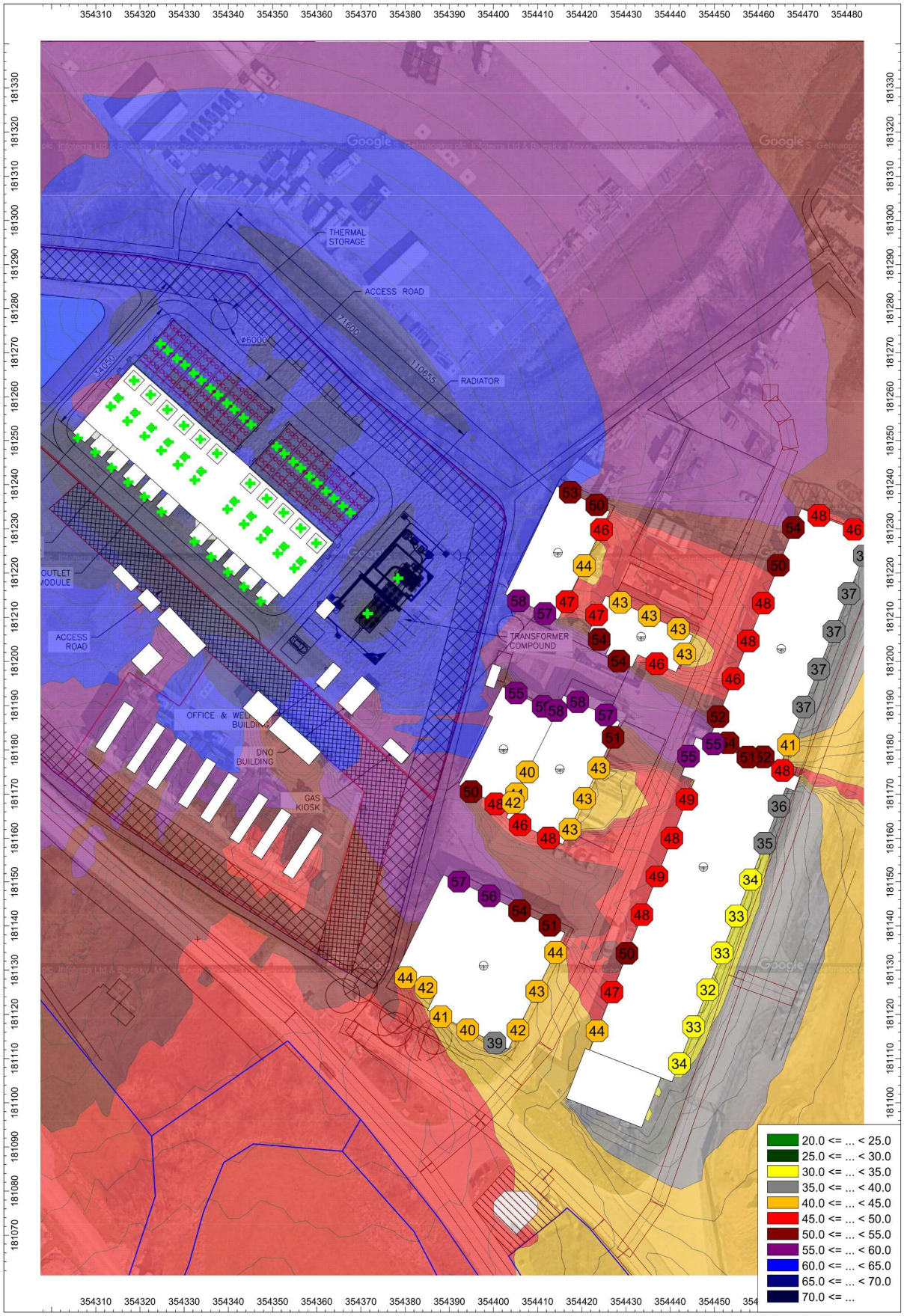


Figure C.3 – Predicted specific noise levels (dB L_{Aeq}) – all plant operating simultaneously/full capacity – industrial receptors



Appendix D - Author Qualifications

This report has been produced by Chris Parker-Jones, the director and primary acoustic consultant at ParkerJones Acoustics. Chris holds the following qualifications:

- MIOA (Member of the Institute of Acoustics)
- BSc in Music Systems Engineering from the University of the West of England – 1st Class
- MSc in Sound and Vibration Studies from the University of Southampton - Distinction

Chris has worked as an acoustic consultant for various companies since July 2011.

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