



Acoustic Impact Assessment of Northfleet Green Hydrogen Development

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1.0 INTRODUCTION

This report provides an acoustic impact assessment of the proposed Northfleet Green Hydrogen Development, referred to as ‘the Proposed Development’ or the ‘site’ herein. Three Members of the Institute of Acoustics have been involved in its production. Details of their experience and qualifications can be found at Appendix A.

The scope includes the prediction of the sound levels resulting from the operation of the Proposed Development and a comparison of the results with relevant noise criteria referenced within current planning policy and that suggested by the Environmental Health Officer (EHO) dealing with the site on behalf of Gravesham Borough Council (GBC).

2.0 PLANNING POLICY, GUIDANCE & STANDARDS

2.1 *National Planning Policy Framework (NPPF)*

The treatment of noise is defined in the context of planning by the National Planning Policy Framework (NPPF) [1] which details the Governments’ planning policies and how these are expected to be applied. The NPPF provides advice on the role of the planning system in helping to prevent and limit potential adverse effects of noise, stating that planning policies and decisions should aim to avoid noise giving rise to significant adverse impacts, whilst at the same time mitigating and reducing other adverse impacts on health and quality of life to a minimum. The NPPF refers to the Noise Policy Statement for England (NPSE) which provides guidance on the categorisation of impact levels.

2.2 *Noise Policy Statement for England (NPSE)*

The Noise Policy Statement for England (NPSE) [2] sets out the long-term vision of Government noise policy which is to ‘... promote good health and quality of life through effective noise management within the context of sustainable development’. In order to weigh noise impacts against the economic and social benefits of the activity under consideration, the NPSE defines three categories of effect levels:

- No Observed Effect Level (NOEL) - noise levels below this have no detectable effect on health and quality of life;
- Lowest Observed Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and,
- Significant Observed Adverse Effect Level (SOAEL) - the level above which effects on health and quality of life become significant.

2.3 *National Planning Practice Guidance (NPPG): Noise*

National Planning Practice Guidance (NPPG) [3] on noise puts the effect levels defined by the NPSE into greater context by explaining how such noise levels might be perceived, providing examples of outcomes based on likely average response, and advising on appropriate actions. These are reproduced at Table 1.

In addition to this guidance, which is applicable to all forms of environmental noise, specific guidance relating to nationally significant energy infrastructure has been published by the Department of Energy and Climate Change (DECC). Whilst the proposed development is not of a scale that would be deemed nationally significant, the relevant National Policy Statements (NPS) are informative in that they suggest an assessment methodology that would be considered appropriate for the type of development being proposed.

Table 1 - Noise Exposure Hierarchy

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

2.4 The Overarching National Policy Statement for Energy (EN-1)

The Overarching National Policy Statement for Energy (EN-1) [4] outlines the need for new electricity capacity from renewable sources as the country transitions to a low carbon electricity system. However, when referring back to the NPSE, EN-1 recognises the potential for energy infrastructure to impact on health and quality of life if it results in excessive noise and goes on to state that where noise impacts are likely to arise, they should be assessed according to the principles of the relevant British Standards. Of the examples provided, the standards BS 4142 and BS 8233 (discussed below) relate to operational sound/noise. A revised draft of EN-1 was published for consultation purposes in March 2023. There would be no substantive changes in the approach to assessing noise should the draft document, as written, be adopted.

2.5 The National Policy Statement for Electricity Networks Infrastructure (EN-5)

The National Policy Statement for Electricity Networks Infrastructure (EN-5) [5], relevant to the transmission and distribution parts of the electricity network along with any associated infrastructure, such as substations and converter stations, again points to the appropriateness of BS 4142 (discussed below) in assessing the acoustic impact of such projects. Revised drafts of EN-5 were published in September 2021 and March 2023 for consultation purposes. There would be no substantive changes in the approach to assessing noise should the draft document, as written, be adopted.

2.6 BS 4142 Methods for Rating and Assessing Industrial & Commercial Sound

BS 4142 [6] describes methods for rating and assessing sound of an industrial or commercial nature. Outdoor sound levels are used to assess the likely effects on people who might be inside or outside a residential property via the comparison of the pre-existing background noise levels with the predicted/modelled noise associated with the introduction of a particular development, known as the ‘rating’ level, which also accounts for any distinguishing characteristics of the emitted sound.

To determine a value for the background noise level at a specific assessment point, a series of measurements are made at a location at, or representative of, a dwelling or receptor of interest. The standard requires that the background noise measurements ($\text{dB } L_{A90, T}$ - the noise level exceeded for 90% of the time, or the lowest 10 % of noise, for the reference time period, T) should be measured during times when the noise source in question could or will be operating and that the individual measurement intervals should not normally be less than 15-minutes in length. The objective is then to determine a justifiable representative background noise level for time periods of interest via statistical analysis and/or observations of the data set collected. The standard states that the representative background noise level ‘... should not automatically be assumed to be either the minimum or modal value’.

The ‘rating’ level is defined as the ‘specific’ sound level ($\text{dB } L_{Aeq}$ - the average sound level) plus any corrections for the presence of tones (i.e. whines, whistles or hums) or other impulsive character (i.e. banging, crashing or tapping) in the sound generated by the source in question. In instances where the source is unlikely to have a specific character at the assessment location then the ‘rating’ level can be assumed to equal to the ‘specific’ sound level. Where tones are present a correction of 2 to 6 dB can be added to the ‘specific’ sound level to determine the ‘rating’ level and a further addition of up to 9 dB maybe added where the source is highly impulsive.

The defined representative background sound level(s) and rating level(s) are then compared to determine the possible impact but with consideration of the context in which the industrial or commercial sound source to be introduced presents itself in respect of other noise sources and the existing character of the area. Table 2 provides a summary of expected impacts when comparing background and rating levels.

Table 2 - BS 4142 Assessment Criteria

Rating Level	BS 4142 Assessment Criteria
Equal to or below background	‘...an indication of the specific sound source having a low impact, depending on the context’.
Approximately +5 dB greater than the background noise level	‘...an indication of an adverse impact, depending on the context’.
Approximately +10 dB or more greater than the background noise level	‘...an indication of a significant adverse impact, depending on the context’.

Further to the above, it may not be appropriate or proportionate to undertake a full assessment in accordance with the BS 4142 standard, particularly when the sound level associated with the new source is particularly low at neighbouring receptors and/or is expected to be much lower than the existing background sound levels. The previous version of BS 4142 [7] stated that the standard is not appropriate for use in instances where background and rating noise levels are very low and that ‘... background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low’.

2.7 BS 8233 Guidance on Sound Insulation and Noise Reduction for Buildings

BS 8233 [8] provides a range of desirable internal average noise levels for dwellings which may be achieved via appropriate design rather than providing guidance on assessing the effect of changes in external noise levels on occupants of existing buildings. These levels are provided at Table 3 for reference and include additional detail as provided within the ProPG: Professional Practice Guidance on Planning & Noise document discussed below.

2.8 ProPG: Professional Practice Guidance on Planning & Noise

The ProPG: Professional Practice Guidance on Planning & Noise document [9], similarly to BS 8233, is intended to provide guidance in terms of assessment and design of new or newly refurbished housing development in terms of pre-existing airborne noise sources impacting on them (typically from transportation noise) and the requirements to achieve a suitable internal noise environment for potential inhabitants. Table 3 shows the desirable noise levels referenced within BS 8233 for reference and with the additional detail and notes the ProPG provides.

Table 3 - Internal Noise Criteria

Activity	Location	Daytime	Night-time
		07:00 - 23:00 hrs	23:00 - 07:00 hrs
Resting	Living room	35 dB $L_{Aeq, 16 \text{ hr}}$	-
Dining	Dining room/area	40 dB $L_{Aeq, 16 \text{ hr}}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 16 \text{ hr}}$	30 dB $L_{Aeq, 8 \text{ hr}}$ 45 dB $L_{Amax,F}$ (Note 4)
NOTE 4: Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45 dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).			

The guideline internal noise values specified are based on values specified within the Guidelines for Community Noise, published by the World Health Organisation (WHO) [10].

The principals and guideline internal noise levels provided within the ProPG guidance and BS 8233 standard have been referenced and used to provide general context and criteria as a basis of assessment.

2.9 Local Council Guidance & Consultation

Gravesham Borough Council (GBC) do not have any specific or formal written guidance as to any preferred method of assessment or preferences regarding potential impacts associated with new noise generating development. As a result, the planning policy and guidance detailed above are used to form the basis of assessment provided herein.

The Environmental Protection department of the council were consulted as to the assessment required for the Proposed Development. The pre-application response to the development proposals states that the ‘...internal ambient noise levels in all habitable rooms of the nearest residential properties shall not exceed the guideline L_{Aeq} values found in Table 4 of BS 8233:2014’ and that the ‘... maximum internal noise levels in all habitable rooms of the nearest residential properties should not exceed 45dB L_{Amax} more than 10 times per night in accordance with the Professional Practice Guidance on Planning & Noise and the WHO Guidelines for Community Noise’. The internal noise levels specified as part of BS 8233, ProPG and the WHO Guidelines are shown earlier, at Table 3 of this report.

The BS 8233, ProPG and WHO guidance and standards specify that average internal noise levels for daytime and night-time periods should not exceed 35 and 30 dB L_{Aeq} respectively. This is equivalent to external daytime and night-time limits of 45 and 40 dB L_{Aeq} when assuming a minimum reduction in sound pressure level of 10 dB (normally assumed to be 10-15 dB) externally to internally. The guideline internal noise levels are typically intended to apply to the total noise level from all relevant infrastructure in a given area, notwithstanding the requirements of BS 4142 in terms of industrial noise. However, the application of these criteria on the development proposals will ensure that noise levels resulting from the operation of the site are relatively low and have been retained as a simplified basis of assessment given the large distance between the site and neighbouring residences. Furthermore, if the predicted external sound levels associated with the site do not exceed 35 dB L_{Aeq} (see Section 2.6, with reference to BS 4142) the BS 8233, ProPG and WHO criteria would also be met.

3.0 BASELINE/BACKGROUND NOISE ENVIRONMENT

3.1 Noise Sensitive Receptors

The nearest existing dwellings which could be considered sensitive to noise associated with the operation of the proposed hydrogen plant are located approximately 400 m to the southwest of the site, to the north and south of the B2175 (High St/London Rd). Some of these dwellings are located next to the cliff edge that runs parallel to the road and separates the residential areas from the commercial/industrial area at the bottom of the cliff.

3.2 Existing Noise Environment

The current noise environment is expected to be influenced by the presence of existing commercial and industrial facilities neighbouring the Proposed Development in varying degrees, marine traffic along the River Thames (passing to the north of the site), localised human activities, bird song and reasonably high volumes of traffic passing along local roads. The area has many existing noise sources which would serve to result in background noise levels that could be considered reasonably high in the context of the assessment provided herein.

A survey of the existing background noise levels has not been undertaken due to the distance of the site relative to the nearest noise sensitive dwellings and the likely low levels of noise

associated with the operation of the Proposed Development at these properties as a result. The Environmental Protection Team representing Gravesham Borough Council (GBC) did not request a noise survey to be undertaken as part of the assessment, instead referring to guidance and limiting requirements which could be used in the absence of background noise monitoring (see Section 2.9).

4.0 PREDICTIONS

4.1 Noise Model

A noise model of the proposed hydrogen facility and the surroundings has been developed using CadnaA¹ noise modelling software. The ISO 9613-2 [11] noise propagation/prediction methodology has been employed to predict the noise levels resulting from the development at nearby residential properties, incorporating various assumptions which are considered appropriate for use here:

- The various plant to be installed as part of the development has been modelled as point sources with a height of 4 m and these sources are assumed to be operating at their maximum potential output for all time periods;
- Hard reflective ground conditions have been assumed (i.e. $G=0$);
- Atmospheric attenuation corresponding to a temperature and relative humidity of 10 °C and 70 % respectively, as defined within ISO 9613-1 [12] which represents relatively low levels of sound absorption in the atmosphere;
- The topography of the site and surroundings has been included within the noise model. This incorporates the cliff edge separating residential receptors and the industrial commercial facilities below and various other topographical features;
- Large commercial/industrial premises located between the site and the nearest residential dwellings have been included within the model and assigned a nominal height of 8 m. In reality, many of these buildings are taller but the approach taken represents a conservative basis of assessment as the approach results in less potential for the path of sound to be obstructed by the modelled structures;
- The buildings included within the model are assumed to have hard reflecting surfaces and the model accounts for two potential reflections from the building façades;
- The structures to be introduced as part of the development may also result in additional shielding of noise depending on the finalised design of the site. However, this aspect has not been accounted for within the noise model and represents a conservative basis of assessment; and,
- The receptor(s) have been assigned a height of 4 m which further reduces/minimises the potential effect of shielding from the presence of the industrial/commercial premises located between the site and the residential dwellings and is also considered to represent a conservative approach.

The combination of assumptions detailed above are considered to provide a conservative prediction/modelling basis overall.

4.2 Source Noise Levels

The predominant sources of sound to be introduced as part of the Proposed Development are the hydrogen electrolyzers, compressors, substations, pressure let down system, instrumentation air unit and the water feed tank. The specific locations of these plant and

¹ <https://www.datakustik.com/>

overall design of the hydrogen facilities are shown elsewhere within the documentation supporting the planning application for the development.

The assumed sound power data for the equipment to be installed is provided at Table 4. The overall levels correspond to the maximum expected sound output for each of the respective plant, as advised by a manufacturer of the potential equipment. The propagation modelling based on this data is therefore considered to represent a conservative scenario and the sound levels would be expected to be less when the site is not operating at maximum capacity. The source noise data is further supplemented by the level of noise in octave bands, as provided at Table 5. This information is based on RES experience of similar plant and has not been independently verified but is considered to represent a reasonably realistic basis of assessment.

Table 4 - Overall Sound Power Levels

Equipment & ID	Sound Power Level, dB L _{WA}
Hydrogen Electrolyser (HEL)	93
Compressor (COM)	88
DNO Substation (DNO)	83
Hydrogen Facility Substation (HFS)	83
Pressure Let Down System (PLD)	88
Instrumentation Air Unit (IAU)	88
Water Feed Tank (WFT)	88

Table 5 - Octave Band Sound Power Levels

Equipment ID	Overall, dB L _{WA}	Centre of Octave Band (Un-weighted Levels), Hz							
		63	125	250	500	1k	2k	4k	8k
HEL	93.0	100.8	96.3	93.3	88.0	89.0	83.8	80.2	75.8
COM	88.0	97.5	97.5	87.5	82.5	79.5	80.5	77.5	69.5
DNO	83.0	75.2	84.2	81.2	84.2	76.2	66.2	57.2	49.2
HFS	83.0	75.2	84.2	81.2	84.2	76.2	66.2	57.2	49.2
PLD	88.0	97.5	97.5	87.5	82.5	79.5	80.5	77.5	69.5
IAU	88.0	97.5	97.5	87.5	82.5	79.5	80.5	77.5	69.5
WFT	88.0	95.8	91.3	88.3	83.0	84.0	78.8	75.2	70.8

The sound emitted by the plant is expected to be broadband in character, with no perceivable tonality at residential distances from the site and is not expected to generate impulsive or intermittent sound.

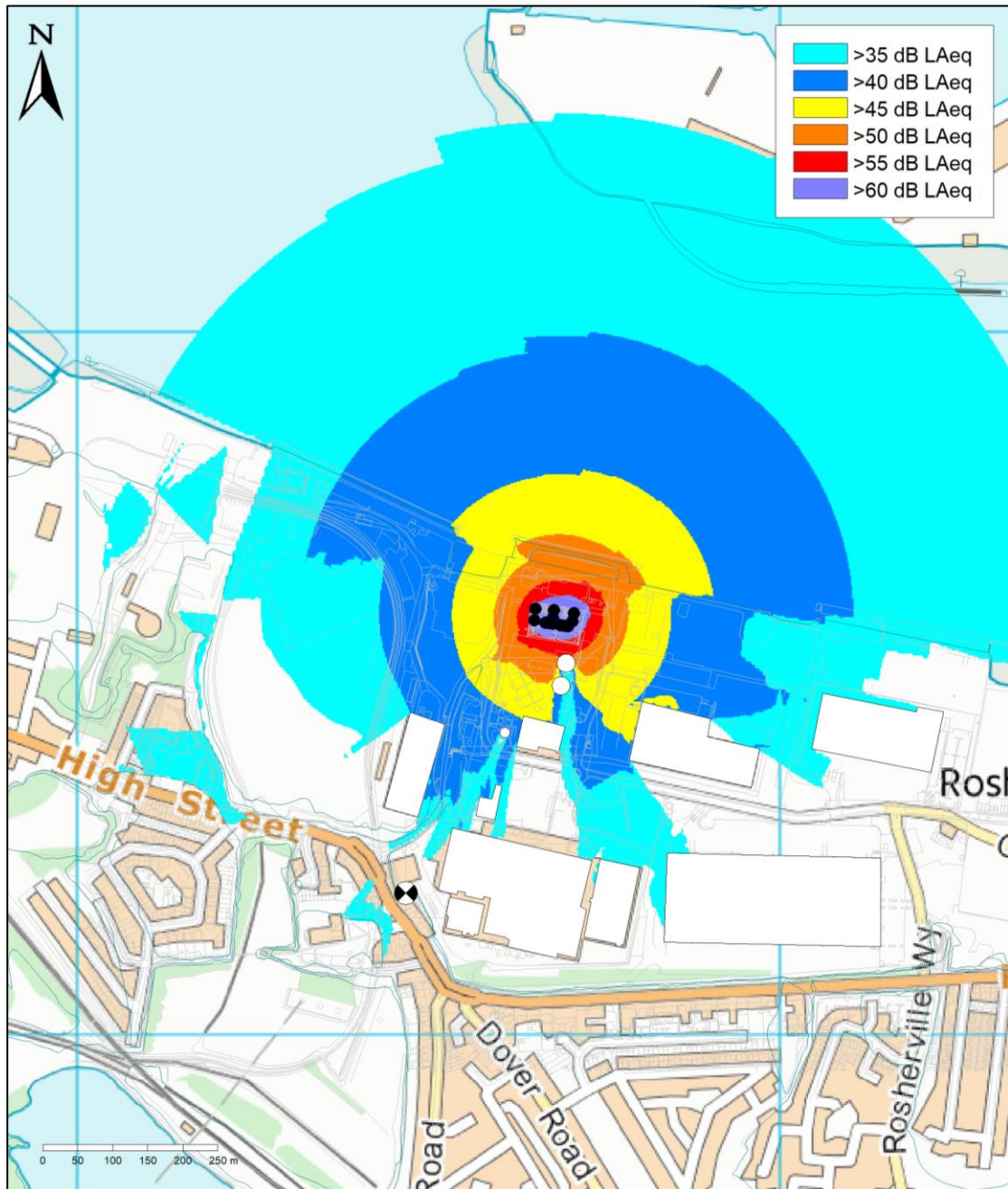
5.0 ASSESSMENT

A noise contour plot showing the predicted external sound levels resulting from the proposed hydrogen facility are shown at Figure 1. This shows that the predicted maximum levels at dwellings located closest to the site, and which have the least obstructed view of the development proposals, are just below 35 dB L_{Aeq}.

The external sound received at the properties is not expected to be readily distinctive against the existing residual acoustic environment in terms of overall level and tonal/impulsive character, particularly given the potential for existing industrial, commercial and transportation noise sources in the area to mask the low levels of noise generated by the development at the residential locations. As a result, the 'specific' predicted 35 dB L_{Aeq} noise level is considered the same as the 'rating' level defined within BS 4142 (see Section 2.6), with no character penalties being applied. This level is also very low according to the previous 1997 version of the BS 4142

standard and is not expected to be above the existing background noise levels for daytime, evening or night-time periods. According to BS 4142, this is ‘...an indication of the specific sound source having a low impact, depending on the context’. Additionally, given the industrial/commercial nature of the area in which the Proposed Development is sited (see Section 3.2) it is considered that a ‘rating’ level of up to 5 dB above the existing background noise could be justifiable in this context.

Figure 1 - Noise Contour Plot, dB LAeq



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The general requirements of BS 8233, ProPG and WHO guidelines, as referenced by Gravesham Borough Council (GBC) as appropriate for use here, are set out at Table 3 (see Sections 2.7, 2.8 & 2.9). An open window typically provides 10 - 15 dB of sound attenuation externally to internally and the resultant predicted internal noise levels due to the Proposed Development would therefore be calculated to be a maximum of 25 dB LAeq within the closest residential

locations which are most exposed to noise from the site. Therefore, predicted operational sound levels sit comfortably within these BS 8233/ProPG/WHO guideline values, as shown at Table 3 of this report, when considering the site operating in isolation and no mitigation measures to reduce sound levels have been proposed as a result.

Overall, based on the noise modelling assumptions and assessment results presented here, the sound emitted by the Proposed Development can be considered ‘present and not intrusive’ in terms of government policy and guidance provided within the NPSE & NPPG (see Sections 2.2 & 2.3 respectively). This corresponds to the ‘No Observed Effect Level’ (NOEL) and no specific action is required to mitigate operational noise associated with the introduction of the site. As a result, it is considered that the site should not be refused planning permission on the grounds of potential sound levels emitted by the development proposals.

The wording for a suggested planning condition that would restrict noise/sound associated with the introduction of the Proposed Development, should the site gain planning consent, is provided at Appendix B.

6.0 CONCLUSIONS

An acoustic impact assessment of the Northfleet Green Hydrogen Development has been undertaken in consultation with Gravesham Borough Council (GBC) and with reference to relevant planning policy and sound/noise guidance.

The assessment results demonstrate that the development would not be expected to be significant in terms of the requirements of BS 4142, BS 8233, ProPG, WHO guidelines and overarching policy in respect of sound emitted by industrial developments. Specific mitigation measures will not be required to reduce the sound levels generated by the Proposed Development for the current site design and noise modelling assumptions used in undertaking the assessment.

7.0 REFERENCES

- [1] Department for Communities and Local Government (July 2021) ‘National Planning Policy Framework’
- [2] Department for Environment, Food and Rural Affairs (March 2010) ‘Noise Policy Statement for England’
- [3] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government (July 2019) ‘National Planning Practice Guidance: Noise’
- [4] Department of Energy and Climate Change (July 2011) ‘Overarching National Policy Statement for Energy (EN-1)’
- [5] Department of Energy and Climate Change (July 2011) ‘National Policy Statement for Electricity Networks Infrastructure (EN-5)’
- [6] The British Standards Institution (2019) BS 4142:2014 + A1:2019 ‘Methods for rating and assessing industrial and commercial sound’
- [7] The British Standards Institution (1997) BS 4142:1997 ‘Rating industrial noise affecting mixed residential and industrial areas’
- [8] The British Standards Institution (2014) BS 8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’

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- [9] Association of Noise Consultants, Institute of Acoustics & Chartered Institute of Environmental Health (2017) 'ProPG: Planning & Noise: Professional Practice Guidance on Planning & Noise: New Residential Development'
 - [10] World Health Organisation (2000) 'Guidelines for Community Noise'
 - [11] International Organisation for Standardisation (December 1996) ISO 9613-2:1996 'Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation'
 - [12] International Organisation for Standardisation (June 1993) ISO 9613-1:1993 'Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere'

APPENDIX A - EXPERIENCE & QUALIFICATIONS

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APPENDIX B - SUGGESTED PLANNING CONDITION WORDING

The green hydrogen facility shall be designed and operated to ensure that the rating level, determined using the BS 4142:2014 methodology, shall not exceed 35 dB L_{Aeq} or the background sound level plus 5 dB for both daytime and night-time periods at the nearest residential properties, whichever is the greater.

If a survey is considered necessary, the background sound levels at dwellings considered most sensitive to noise emitted by the site, shall be determined using the methodology outlined within BS 4142:2014.