Assessment of Acoustic Impact for the Coleshill Green Hydrogen Development

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Revision History

Issue	Date	Author	Nature & Location of Change
01	20 April 2023	Peter Brooks	First created

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1.0 INTRODUCTION & SCOPE

This report contains an assessment of the acoustic impact of the proposed Coleshill Green Hydrogen Development, hereafter referred to as 'the development'. Three Members of the Institute of Acoustics have been involved in its production. Details of their experience and qualifications can be found in Appendix A.

The scope includes determining the background sound levels and predicting the sound levels due to the operation of the development, in order to assess the level of acoustic impact in accordance with the relevant methodology.

The development is located to the west of the Kimberly-Clark industrial facility in Flint, centred on British National Grid coordinates 323365, 373283 (EPSG: 27700) in the county of Flintshire, Wales.

2.0 PLANNING GUIDANCE

2.1 Local Council Guidance

Flintshire County Council ('the Council') have provided pre-application advice for the development[1]. In relation to acoustics, noise and vibration the county's Environmental Health Department have given the advice that a BS 4142 noise assessment is required to assess if there is likely to be any adverse impact on nearby residents due to noise from the development.

3.0 METHODOLOGY

3.1 Overview

An assessment in accordance with BS 4142:2014[2] has been undertaken in order to determine the acoustic impact of the operation of the development. This approach is consistent with the guidance provided by the Council. The layout of the development used in this assessment is defined in the infrastructure layout drawing[3]. Assessment locations have been selected to represent all the nearby residents to the development.

3.2 Baseline Conditions

In order to complete a BS 4142:2014 assessment of the development, the background sound level at the times when the new sound source is intended to be operational should be measured. The background sound level is defined as the A-weighted sound pressure level that is exceeded for 90 % of the measurement time interval (T), denoted by the symbol $L_{A90,\,T}$.

Measurements should be made at a location that is representative of the assessment locations, the time interval should be sufficient to obtain a representative value, and the duration should be long enough to reflect the range of background sound levels over the period(s) of interest.

Precautions should be taken to minimise the influence on the results from sources of interference. Weather conditions that may affect the measurements should be recorded and an effective wind shield used to minimise wind turbulence at the microphone.

[1] Green Hydrogen Electrolyser Kimberley Clark. Flintshire County Council. Pre Application Advice. Reference PRE/00060/22. 16th January 2023.
[2] British Standard BS 4142:2014+A1:2019. Methods for rating and assessing industrial and commercial sound. The British Standards Institution. 2019.
[3] Coleshill Green Hydrogen Facility. Infrastructure Layout. RES drawing number 05040-RES-PRO-DR-PT-001. 2023-04-06.

A statistical analysis, following the guidance provided by BS 4142:2014, should be used to determine an appropriate background sound level for the required time periods from the range of results obtained.

3.3 Propagation Modelling

The ISO 9613-2[4] propagation model shall be used to predict the specific sound levels due to the development at nearby residential properties. The propagation model takes account of sound attenuation due to geometric spreading, topography and atmospheric absorption. The assumed temperature and relative humidity are 10 °C and 70 % respectively. All equipment with significant sound emissions are modelled as point sources positioned above the ground, using A-weighted sound power levels. The equipment is modelled as continuously operating at maximum capacity during the daytime and night-time when the development is operating typically.

As a conservative and simplified approach, the simplified method of calculation detailed in Note 1 of ISO 9613-2 has been used. A 1.5 metre (m) receiver height shall be used corresponding to the elevation of a human head above the ground. The effect of surface features such as buildings and trees are not included in the model. Ground terrain contours at 1 m resolution are included in the model.

ISO 9613-2 is a downwind propagation model. Where conditions less favourable to sound propagation occur, such as when the assessment locations are crosswind or upwind of the development, the sound levels at those locations would be expected to be lower and the downwind predictions presented here would be regarded as conservative.

3.4 Assessment

Once the specific sound levels due to the development have been calculated the rating level of the sound can be predicted, it is this which is compared to the existing background sound level to determine the level of impact. The rating level is obtained by adding character corrections to account for certain acoustic features that may be applicable to the specific sound level.

Table 1 details how the difference between the rating level and the background sound level is used to obtain an indication of the likely impact under BS 4142:2014, although it is noted that any assessment is dependent on the context in which the sound occurs.

Table 1 - BS 4142:2014 Assessment Criteria

Rating Level	Assessment Criteria
Equal to or below background	Likely to indicate a low impact
5 dB above background	Likely to indicate an adverse impact
10 dB above background	Likely to indicate a significant adverse impact

Depending upon the variation in the background sound level at different times during a day, and the times when the new sound sources are scheduled to operate, it is appropriate to undertake separate assessments for certain times of day, e.g. daytime and night-time.

[4] ISO 9613-2. Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation. International Organization for Standardization. 1996.

4.0 BACKGROUND SOUND LEVELS

Background sound level measurements were undertaken from Friday 3rd February 2023 to Tuesday 7th February 2023. The survey position was in the rear garden of 24 Royal Drive, a nearby noise sensitive residential receptor deemed to be representative of the nearest residential properties to the development, which are those along Royal Drive and Old London Road. Further details of the background sound survey are contained in a separate report[5].

A Rion NL-52 sound level meter was used which is certified as meeting IEC 61672-1[6] Class 1 precision standards. The microphone was approximately 1.2 m above ground level and an outdoor wind shield around the microphone was used.

The equipment was calibrated at the start and end of the survey and no drift in calibration was observed. All instrumentation had been subject to laboratory calibration traceable to national standards within the required periods as detailed in Table 2.

Table 2 - Instrumentation Records

	Sound Level Meter	Calibrator
Type	Rion NL-52	Rion NC-74
Serial No.	00331819	34172706
Calibration Date of Issue	11/01/2022	12/07/2022
Microphone Serial No.	10813	-
Preamp Serial No.	21770	-

The existing acoustic environment includes contributions from occasional road traffic from passage along Royal Drive and distant low level traffic from the surrounding local road network. Birdsong was also observed, as well as occasional sound from neighbourhood activity in the immediate area. Overall, the levels of sound observed were consistent with the nature of the local area.

Weather conditions during the survey were such that interference with the results would not be expected. The measurements took place during calm and dry conditions for the duration of the survey such that the wind speed at microphone height was unlikely to have exceeded 5 ms^{-1} and no rain occurred. The use of the statistical analysis method recommended by BS 4142:2014 serves to filter out any periods where the background sound levels were atypically affected by weather conditions.

The diurnal variation in the measured background sounds level is such that a clear distinction can be drawn between daytime and night-time periods. When split into daytime and night-time periods, the (typical lowest) background sound levels determined are 34 dB $L_{A90,\ 15min}$ during the day and 31 dB $L_{A90,\ 15min}$ at night. It should be noted that 15-minute periods were used for both daytime and night-time, as a more conservative approach than the 1-hour daytime periods specified in BS 4142:2014.

[5] Flint-Coleshill Hydrogen Gen. Coleshill, Flint. Baseline Noise Survey Report. Hoare Lea. 18th April 2023.
[6] IEC 61672-1. Electroacoustics - Sound level meters - Part 1: Specifications. International Electrotechnical Commission. 2002.

5.0 ASSESSMENT

Details of the residential properties included in the assessment are shown in Table 3.

Table 3 - Locations of Assessment Properties

House ID	Name	X	Y
H1	3 Royal Drive	323428	373066
H2	24 Royal Drive	323317	373012
H3	48 Royal Drive	323215	372965
H4	57 Old London Road	323471	373033
H5	43 Old London Road	323506	372957

British National Grid coordinates (EPSG: 27700)

The predominant sources of sound within the development are the hydrogen electrolysers, compressors, substations, pressure let down system, instrumentation air unit and water feed tank.

Acoustic emission data for the equipment is detailed in Table 4. The data corresponds to the maximum sound pressure level as advised by the equipment manufacturer or for similar representative equipment. The propagation modelling based on this data therefore represents the worst case scenario and the sound levels would be expected to be less when the site is not operating at maximum capacity.

Table 4 - Acoustic Emission Data

Equipment	Sound Power Level dB(A)
Hydrogen Electrolyser	93
Compressor	88
DNO Substation	83
Hydrogen Facility Substation	83
Pressure Let Down System	88
Instrumentation Air Unit	88
Water Feed Tank	88

Calculated specific sound levels (dB L_{Aeq}) at the assessment locations are detailed in Table 5 for daytime periods and Table 6 for night-time periods.

The sound emitted by the equipment is expected to be broadband in frequency character, with no perceivable tonality. The equipment is not expected to generate impulsive or intermittent sound, and the sound generated is not expected to be readily distinctive against the residual acoustic environment.

Under the subjective method described in BS 4142:2014, no rating penalties have been added to the specific sound level to determine the rating level (dB L_{Ar}). The rating levels are therefore the same as the specific sound levels. The rating levels for daytime and night-time periods are shown in Tables 5 and 6 and are compared to the background sound levels to initially assess the impact at each assessment location for each time period.

An illustrative sound footprint for the development showing the predicted specific sound level for daytime and night-time periods is provided in Figure 1 (Appendix B).

Table 5 - BS 4142:2014 Initial Assessment Results - Day

Assessment Location (House ID)	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Ar}	Rating Level vs Background Sound Level, dB	Impact
H1	29	29	-5	Low
H2	32	32	-2	Low
H3	35	35	1	Low
H4	30	30	-4	Low
H5	32	32	-2	Low

Table 6 - BS 4142:2014 Initial Assessment Results - Night-time

Assessment Location (House ID)	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Ar}	Rating Level vs Background Sound Level, dB	Impact
H1	29	29	-2	Low
H2	32	32	1	Low
H3	35	35	4	Adverse
H4	30	30	-1	Low
H5	32	32	1	Low

The initial estimate of the impact of the development is low where the rating level is equivalent to or below the existing background sound level, which is the case at all assessment locations during daytime and all locations except H3 during night-time. The initial estimate of the impact during night-time at H3 is assessed as adverse.

A level of conservatism has been built into the assessment to compensate for the potential impact of uncertainty. The calculated sound levels presented in this assessment, and the sound footprint shown in Figure 1, reflects this. The amenity of nearby residents can be further protected by the imposition of a planning condition relating to sound. A suggested appropriate form of wording for such a condition is provided in Appendix C.

BS 4142:2014 states that the significance of sound from the development also depends upon the context in which the sound occurs. The following contextual factors are therefore taken into account:

- The absolute level of the sound. BS 4142:2014 states that "*where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night*". Background sound levels below about 30 dB(A) and rating levels below about 35 dB(A) are considered to be very low, which is the case for all the assessment locations during the night-time. Therefore it is more relevant to consider the absolute level, i.e. the specific sound level only, during the night-time. The World Health Organization Night Noise Guidelines[7] recommend a maximum limit of 40 dB(A) $L_{night,\ outside}$ during night-time to protect the public from adverse effects from noise. This limit is met by a large margin at all assessment locations.
- The existing acoustic environment of the local area. There are a number of existing industrial facilities in the local area and therefore sound from the development is unlikely to be distinguishable from, and will not represent an incongruous sound in comparison to, the existing acoustic environment.
- The metrological conditions in the local area. The specific sound levels are calculated for downwind propagation, with wind blowing from the development site to the assessment locations, therefore with the wind direction from the north. However for the majority of the year the predominant wind direction will be from the west or south, therefore the assessment locations will be upwind or crosswind relative to the development, resulting in lower specific sound levels than those presented in Tables 5 and 6.

[7] Night Noise Guidelines for Europe. World Health Organization. 2009.

Taking the above context in to account, the initial estimate of the impact is modified to be low impact for all assessment locations during both the daytime and night-time.

6.0 CONCLUSIONS

An assessment of the acoustic impact of the Coleshill Green Hydrogen Development has been undertaken in accordance with BS 4142:2014. The assessment results demonstrate that the development would not have an adverse impact on nearby residents.

APPENDIX A – EXPERIENCE AND QUALIFICATIONS

Author:

Name	Peter Brooks
Experience	Senior Acoustic Analyst, Renewable Energy Systems, 2022-Present Acoustic Consultant, Arcus Consultancy Services, 2021-2022 Director, 343 Acoustics, 2019–2021 Lead Acoustic Engineer, Tymphany, 2017-2019 Research and Development Engineer, SEAS Fabrikker, 2014-2017 Acoustic Engineer, Premium Sound Solutions, 2011-2013
Qualifications	AMIOA, Associate Member of the Institute of Acoustics PGCert Environmental Acoustics, University of Salford BSc (Hons) Audio Technology, University of Salford

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Name	Mike Craven
Experience	Senior Acoustic Analyst, Renewable Energy Systems, 2023-Present Principal Acoustic Consultant, Hayes McKenzie Partnership Limited (HMPL), 2019-2022 Senior Acoustic Consultant, HMPL, 2013-2019 Acoustic Consultant, HMPL, 2011-2013 Acoustic Consultant, URS/Scott Wilson, 2008-2011 Acoustic Consultant, HMPL, 2004-2008
Qualifications	MIOA, Member of the Institute of Acoustics BSc Audio Technology, University of Salford

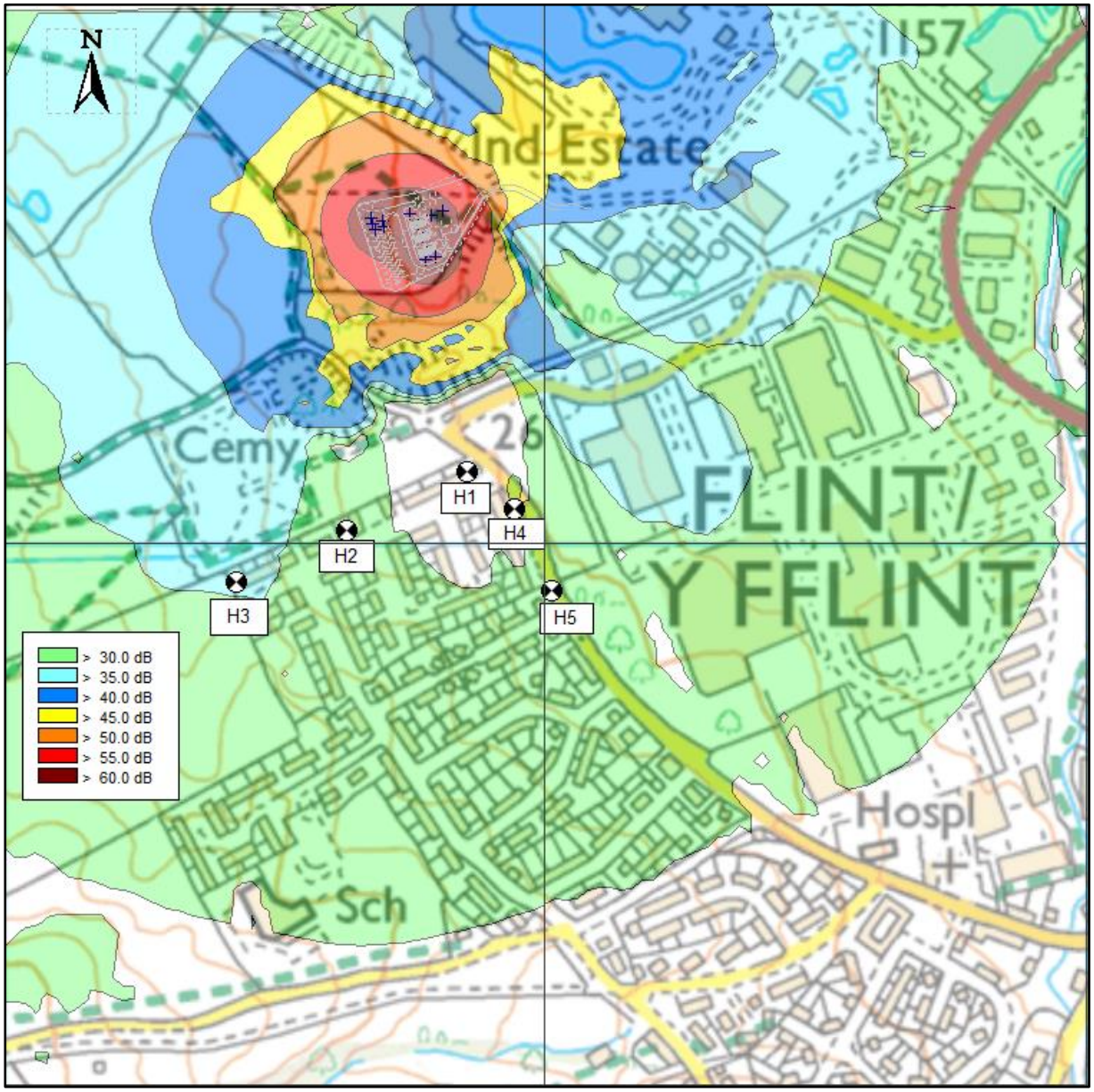
Approver:

Name	Dr Jeremy Bass
Experience	Head of Specialist Services/Senior Technical Manager, Renewable Energy Systems, 2000-Present Technical Analyst/Senior Technical Analyst, Renewable Energy Systems, 1990-2000 Foreign Exchange Researcher, Mechanical Engineering Laboratory, Tsukuba, Japan, 1989-1990 Research Associate, Energy Research Unit, Rutherford Appleton Laboratory, 1986-1989
Qualifications	MIOA, Member of the Institute of Acoustics MInstP, Member of the Institute of Physics PhD, The Potential of Combined Heat & Power, Wind Power & Load Management for Cost Reduction in Small Electricity Supply Systems, Department of Applied Physics, University of Strathclyde BSc Physics, University of Durham

APPENDIX B – FIGURES

Figure 1 – Predicted Specific Sound Level

The L_{Aeq} descriptor has been used. The figure shows the specific sound level during daytime and night-time. Grid intervals at 500 m.



APPENDIX C – 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 the background sound level plus 5 dB during daytime and night-time at the nearest residential properties (H1 – H5 as determined in the RES/HYRO report 05040-5493917 dated 20 April 2023).

The background sound levels shall be as detailed in the RES/HYRO report 05040-5493917 dated 20 April 2023, or those obtained in an updated survey, whichever are greater.