
**Proposed Residential Development
Croesnewydd Road, Wrexham**

Noise Assessment Report

Project: Proposed Residential Development, Croesnewydd Road, Wrexham

Client: Mr Paul Woollam

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Authorised by	Ryan Swales, BSc, MIOA Director & Principal Consultant
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RS Acoustic Engineering Ltd
76 Marple Road
Stockport
SK2 5QH
Tel: 0333 577 5152
Web: www.rsacoustic.co.uk
Email: info@rs-acoustic.co.uk

A company registered in England & Wales (No: 07604309)
Corporate Member of the Institute of Acoustics (MIOA)

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1. Introduction

- 1.1 RS Acoustic Engineering Ltd has been appointed by Mr Paul Woollam to undertake a noise assessment with regard to a proposed residential development on land to the north of Croesnewydd Road, Wrexham, LL13.
- 1.2 The proposed site is currently a vacant parcel of land that is approximately rectangular in shape. There are remnants of a demolished building in the centre of the site.
- 1.3 The site sits adjacent to the breast screening centre and probation centre offices and Ysbyty Maelor Hospital is approximately 90 metres south of the site.
- 1.4 The current proposals are to construct nine new dwellings with associated parking and amenity space (gardens).
- 1.5 A noise assessment has been undertaken with reference to the guidance contained within BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* and also Technical Advice Note (Wales) 11 *Noise*.
- 1.6 This assessment is based on the results of an environmental noise survey undertaken at the site by RS Acoustic Engineering. Continuous sound level monitoring was conducted over three days in August 2020 in order to establish the prevailing acoustic environment.
- 1.7 The measured sound level data has been used to determine the building envelope sound insulation requirements and to determine whether it will be suitable to naturally ventilate habitable rooms via opening windows alone.
- 1.8 An assessment of noise intrusion through the building envelope with windows open and closed has been undertaken and the resulting sound levels determined.
- 1.9 The survey and assessment was conducted by Mr Ryan Swales (BSc(Hons), MIOA), Principal Acoustic Consultant and Member of the Institute of Acoustics.
- 1.10 The results of the noise survey have been presented, along with the assessment criteria and a discussion of the results with respect to the appropriate guidance and targets.
- 1.11 Recommendations regarding sound insulation, ventilation and noise mitigation are also provided within the report.
- 1.12 This assessment is based on scheme drawings produced by Parry Davies Architects.

2. Assessment Guidance & Criteria

Technical Advice Note (Wales) 11: Noise

2.1 Paragraph 10 of TAN 11 states the following:

Local planning authorities should consider whether proposals for new noise-sensitive development would be incompatible with existing activities, taking into account the likely level of noise exposure at the time of the application and any increase that may reasonably be expected in the foreseeable future. Such development should not normally be permitted in areas which are, or are expected to become, subject to unacceptably high levels of noise and should not normally be permitted where high levels of noise will continue throughout the night.

2.2 With regard to mitigating the impact of noise, Paragraph 11 states the following:

Measures introduced to control the source of, or limit exposure to, noise should be proportionate and reasonable, and may include:

i. engineering: reduction of noise at point of generation (e.g. using quiet machines and/or quiet methods of working); containment of noise generated (e.g. insulating buildings which house machinery and/or providing purpose-built barriers around sites); protection of surrounding noise-sensitive buildings (e.g. improving sound insulation in these buildings and/or screening them by purpose-built barriers);

ii. lay-out: adequate distance between noise source and noise-sensitive building or area; screening by natural barriers, other buildings, or non-critical rooms in a building;

iii. administrative: limiting operating time of noise source; restricting activities allowed on the site; specifying an acceptable noise limit.

Noise Exposure Categories for Dwellings

2.3 When assessing a proposal for residential development near a source of noise, TAN 11 states that local planning authorities should determine into which of the following four noise exposure categories (NECs) the proposed site falls, taking into account both daytime and night-time noise levels.

Table 2.1 – Noise exposure categories

A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

2.4 A recommended range of noise levels is given in Table 2.2 for each of the NECs for dwellings exposed to noise from road, rail, air and mixed sources. However, in some cases it may be appropriate for local planning authorities to determine the range of noise levels they wish to attribute to the various NECs. Where there is a clear need for new residential development in an already

noisy area some or all NECs might be increased by up to 3 dB(A) above the recommended levels. In other cases, a reduction of up to 3 dB(A) may be justified.

Table 2.2 – Recommended noise exposure categories for new dwellings near existing noise sources

Noise Levels(1) corresponding to the Noise Exposure Categories for New Dwellings L_{Aeq,T} dB					
Noise Source		Noise Exposure Category			
		A	B	C	D
Road traffic	0700-2300	<55	55-63	63-72	>72
	2300-0700	<45	45-57	57-66	>66
Rail traffic	0700-2300	<55	55-66	66-74	>74
	2300-0700	<45	45-59	59-66	>66
Air traffic	0700-2300	<57	57-66	66-72	>72
	2300-0700	<48	48-57	57-66	>66
Mixed sources	0700-2300	<55	55-63	63-72	>72
	2300-0700	<45	45-57	57-66	>66

British Standard 8233:2014: Guidance on sound insulation and noise reduction for buildings

- 2.5 BS 8233 provides guidance regarding acoustic criteria and noise levels appropriate for various types of space that have different functions.
- 2.6 With regard to dwellings, appropriate internal ambient sound levels are given in Table 2.3 for bedrooms, living rooms and dining rooms. The guidelines take into consideration the effect of internal noise on sleep and also the effect of noise on resting, listening and communicating.

Table 2.3 – Indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB L _{Aeq,16hour}	---
Dining	Dining room/area	40 dB L _{Aeq,16hour}	---
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq,16hour}	30 dB L _{Aeq,8hour}

- 2.7 BS 8233 (Note 7) also suggests that in some circumstances, it may be appropriate to relax the indoor ambient noise level targets by up to 5 dB:

Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

Note 5 also states 'If relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level. If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment'.

2.8 The previous version of BS 8233 (1999) recommends that sound levels in bedrooms do not regularly exceed 45 dB L_{Amax} during the night-time period. The current standard does not give a specific limit with regard to L_{Amax} sound levels and it is therefore considered prudent in this instance to adopt the previous recommendation.

2.9 With regard to outdoor living areas (gardens), the following guidance is given:

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

World Health Organisation: Guidelines for community noise (1999)

2.10 The recently superseded guidance document states that to avoid serious annoyance during the daytime and evening period, the ambient L_{Aeq} sound level should not exceed 55 dB $L_{Aeq,16hour}$ in outdoor living areas (gardens and balconies). To avoid moderate annoyance, the L_{Aeq} sound level should not exceed 50 dB $L_{Aeq,16hour}$.

2.11 To help avoid sleep disturbance during the night-time, the ambient L_{Aeq} sound level should not exceed 30 dB $L_{Aeq,8hour}$ within bedrooms and the maximum level should not typically exceed 45 dB $L_{Amax,T}$ more than 10-15 times per night.

British Standard 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound

2.12 BS 4142 (amended June 2019) describes methods for rating and assessing sound of an industrial and/or commercial nature, such as sound from manufacturing processes and fixed mechanical plant/machinery.

2.13 Outdoor sound levels are used to assess the likely effect on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

2.14 BS 4142 is not intended to be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels.

2.15 The standard has three different methods (subjective, objective and reference) of applying a penalty to tonal, impulsive and intermittent noises, as separate entities.

2.16 The current standard no longer indicates significance of noise impacts as giving rise to a 'likelihood of complaint' but rather as an 'indication' of varying degrees of 'adverse impact'.

2.17 BS 4142:2014 states that a difference of around +10 dB or more (excess of rating level above the background sound level) is likely to be an indication of a significant adverse impact, depending on the context.

2.18 A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

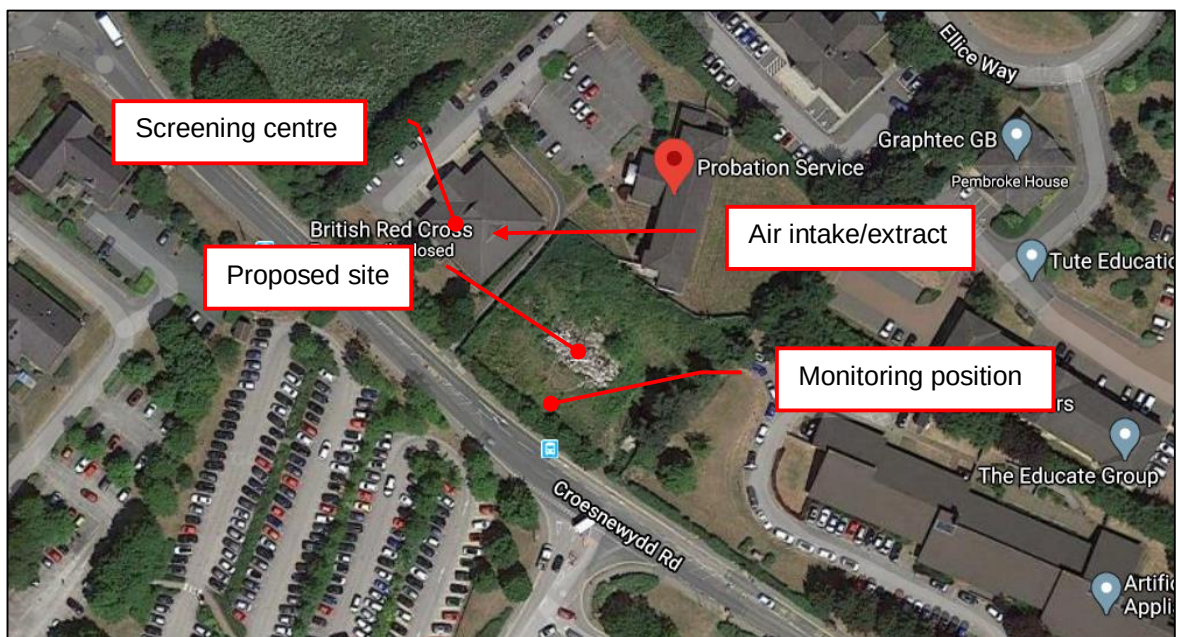
2.19 The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

3. Environmental Noise Survey

Survey methodology

- 3.1 Continuous sound level monitoring was conducted over a 67-hour period near to the site boundary, directly adjacent to Croesnewydd Road.
- 3.2 Measurements were performed from 20:30 hours on Wednesday 5th through to 15:30 hours on Saturday 8th August 2020. The microphone was tripod mounted and was approximately 7 metres from the carriageway edge.
- 3.3 Sample measurements were also conducted at the north west boundary in order to determine the sound levels emanating from an air intake/extract associated with the breast screening centre.
- 3.4 A measurement interval of 5 minutes was used during the survey and measurements were subject to free-field conditions (away from reflective surfaces). One-third octave band and A-weighted broadband sound pressure levels were recorded during the survey.
- 3.5 The site layout, surrounding area and survey measurement position are shown in Figure 3.1.

Figure 3.1 – Site location and survey measurement position (source: Google Earth)



Survey equipment

- 3.6 The survey was conducted using the following Class 1 specification equipment:
- Brüel & Kjaer 2250-Light data logging sound level meter, with microphone type 4189 and pre-amplifier type ZC0032.
 - CEL-120/1 acoustic calibrator.
- 3.7 Calibration of the sound level meter and microphone used for the measurements are traceable to accredited laboratories (UKAS calibration certificates are available on request).
- 3.8 The calibration of both sound level meter and microphone was checked using a 1 kHz tone at 94 dB prior to and following the measurements performed. The drift in calibration was less than 0.1 dB.

Weather conditions

- 3.9 The weather conditions during the survey were dry and fine with clear sunny spells. Wind speed measurements taken on site were less than 3 m/s⁻¹.
- 3.10 The air temperature during the survey ranged between 14°C and 26°C. The overall weather conditions were considered suitable to obtain representative measurements.

Subjective observations of the acoustic environment

- 3.11 The dominant sources of noise at the site were considered to be road traffic on Croesnewydd Road and also road traffic on the distant A483 (north westerly direction). The A483 was more notable with regard to the background noise, whereas intermittent vehicles on Croesnewydd Road were more noteworthy with regard to ambient noise.
- 3.12 The noise from intermittent vehicles on the business park and hospital access roads was considered negligible.
- 3.13 During the survey, no disruptions in traffic flow along the local road network were observed (due to road works etc) and therefore traffic conditions were considered to be typical.
- 3.14 Operational noise and intermittent noise from vehicle movements associated with the screening centre and probation centre were considered negligible. There was no activity observed during the late evening and night-time period at both centres (i.e. the buildings were closed).
- 3.15 There is an air intake/extract that generates steady-state continuous noise on the south east facing elevation of the breast screening centre. The intake/extract louvre is approximately 20 metres from the position of the nearest dwellings.
- 3.16 Other noted noise sources include high altitude aircraft, passing pedestrians and cyclists.

Measured indices

- 3.17 Although a wide range of statistical sound level data was recorded during the survey, the L_{Aeq} and L_{AFmax} indices are of most interest for this assessment:
- $L_{Aeq,T}$ - The A-weighted equivalent continuous sound pressure level over a period of time, T. Representative of the 'average' sound pressure level over a given period (used to describe the ambient sound level).
 - $L_{AFmax,T}$ - The A-weighted 'maximum' sound pressure level that occurred during a given period, T (used for the assessment of intermittent loud noises).
- 3.18 Sound pressure level measurements are taken with an A-weighting (denoted by a subscript 'A', e.g. L_{Aeq}) to approximate the frequency response of the human ear.

Results summary

- 3.19 Table 3.1 presents a summary of the continuously measured sound pressure levels. Measured values have been rounded to the nearest whole number.

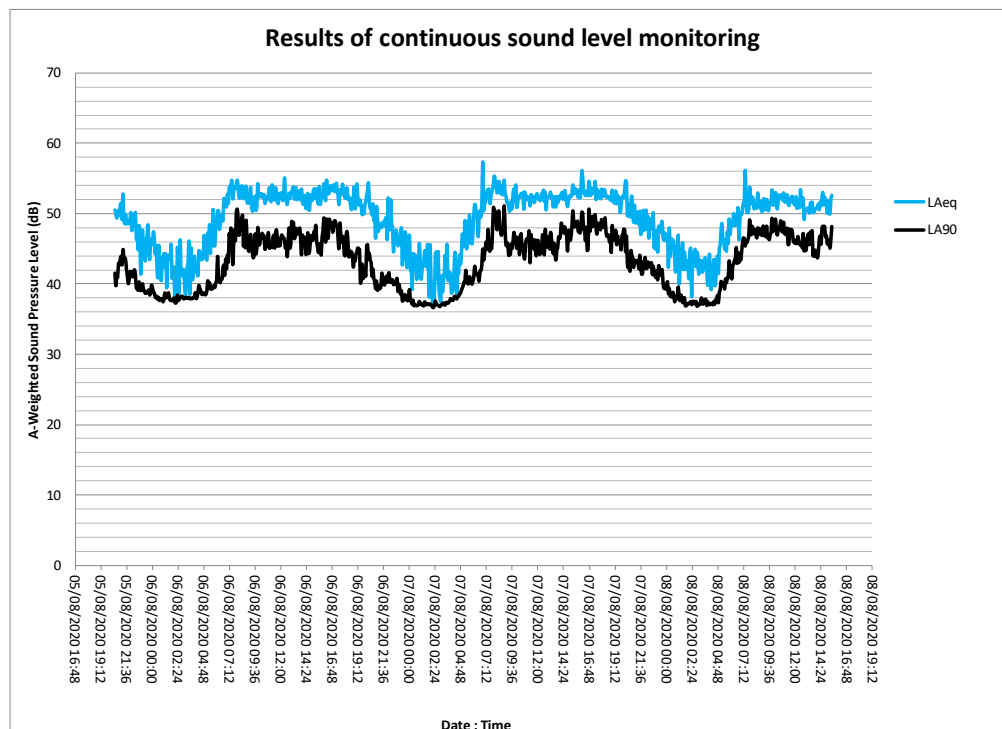
Table 3.1 – Summary of continuously measured sound pressure levels

Date	Period	Duration, T (hours)	$L_{Aeq,T}$ dB	Average ¹ $L_{AFmax,T}$ dB	10 th Highest ² $L_{AFmax,T}$ dB
Wednesday 05/08/2020 - Thursday 06/08/2020	Daytime (20:30-23:00)	2.5	49	---	---
	Night-time (23:00-07:00)	8	46	59	63
Thursday 06/08/2020 - Friday 07/08/2020	Daytime (07:00-23:00)	16	52	---	---
	Night-time (23:00-07:00)	8	46	58	63
Friday 07/08/2020 - Saturday 08/08/2020	Daytime (07:00-23:00)	16	52	---	---
	Night-time (23:00-07:00)	8	46	59	62
Saturday 08/08/2020	Daytime (07:00-15:30)	8.5	52	---	---

¹The arithmetical average L_{AFmax} sound level ²The 10th highest value from 96 measurement periods

- 3.20 The results of the continuous monitoring are presented graphically in Figure 3.2.

Figure 3.2 – Graph showing results of continuous sound level monitoring



4. Assessment & Discussion

Noise Exposure Category

- 4.1 The measurement results indicate an equivalent continuous sound pressure level of 52 dB $L_{Aeq,16hour}$ during the daytime and 46 dB $L_{Aeq,8hour}$ during the night-time.
- 4.2 Since the dominant source of noise is road traffic, this places the development site in Noise Exposure Category A for the daytime period and just over the threshold of Category B for the night-time period.
- 4.3 With regard to Category A, TAN 11 states '*Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable*'.
- 4.4 With regard to Category B, TAN 11 states '*Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection*'.

Building envelope construction and acoustic performance

- 4.5 The building envelope is expected to be of a timber frame construction, with brickwork external leaf, cavity insulation and plasterboard internal leaf. The sound insulation performance of such a construction is typically in the region of 40 to 50 dB R_w+C_{tr} .
- 4.6 A concrete tiled roof construction with mineral wool (loft) insulation and a plasterboard ceiling typically provides a sound insulation performance in the region of 39 to 43 dB R_w+C_{tr} .
- 4.7 Standard double glazing typically provides a sound insulation performance in the region of 25 to 30 dB R_w+C_{tr} .
- 4 mm glass / 16 mm - 20 mm cavity / 6 mm glass (28 - 30 dB R_w+C_{tr})
 - 6 mm glass / 16 mm - 20 mm cavity / 6 mm glass (27 - 29 dB R_w+C_{tr})
 - 4 mm glass / 16 mm - 20 mm cavity / 4 mm glass (25 - 27 dB R_w+C_{tr})
- 4.8 Laminated (acoustic) double glazing as is commonly used within dwellings provides a sound insulation performance in the region of 31 to 37 dB R_w+C_{tr} .
- 6 mm glass / 16 mm - 20 mm cavity / 10.8 mm acoustic laminate (35 - 37 dB R_w+C_{tr})
 - 6 mm glass / 16 mm - 20 mm cavity / 8.8 mm acoustic laminate (33 - 35 dB R_w+C_{tr})
 - 6 mm glass / 16 mm - 20 mm cavity / 6.8 mm acoustic laminate (31 - 33 dB R_w+C_{tr})
- 4.9 The glazing is therefore expected to be the weakest element with regard to the building envelope sound insulation (excluding ventilator units).
- 4.10 With standard double glazing, the composite sound insulation of the building envelope is expected to be in the region of 30 to 34 dB R_w+C_{tr} .
- 4.11 The quantity R_w is the weighted sound reduction index expressed in dB. It is a single number quantity for rating airborne sound insulation. The ' C_{tr} ' term is added to the single number rating R_w to take account of the characteristics of particular sound spectra (e.g. road traffic).
- 4.12 The acoustic performance of a particular construction may differ slightly between manufacturers and therefore the sound insulation performance should be verified where possible.

- 4.13 To achieve the optimum performance, external windows should be well sealed around the frame when installed. Large gaps between the frame and the brickwork and poorly sealed frames can notably reduce performance.

Noise intrusion with windows closed

- 4.14 Table 4.1 presents the calculation results for a bedroom adjacent to Croesnewydd Road (Plot 1).
- 4.15 Standard thermal double glazing consisting of 4 mm glass, 16 – 20 mm cavity, 4 mm glass has been assumed for habitable rooms.
- 4.16 The calculation takes into account the typical sound insulation performance of each building element, surface area and estimated room dimensions. The proposed floor plans and elevations are shown in Appendix A.
- 4.17 The highest measured daytime sound pressure level (52 dB $L_{Aeq,16hour}$) has been used in the assessment.
- 4.18 The measured free-field sound level has been corrected by +3 dB in order to represent a facade sound level.
- 4.19 The measured octave band sound levels and the typical reverberation time for a habitable room have also been taken into consideration.

Table 4.1 – Noise ingress calculation results for dwelling adjacent to Croesnewydd Road

Title: Croesnewydd Road, Plot 1 Noise Break In (ISO 12354-3)												
Formula/Comment	Single Value		63	125	250	500	1000	2000	4000	8000	R _w	(C ₁ , C _{tr})
L _{in}			22.5	20.7	28.2	36.7	40.0	34.9				
			34.5	29.3	20.8	16.3	5.0	-2.9				
Materials												
4mm glass/16 - 20 mm cavity/4mm glass	2.9		21.0	17.0	25.0	35.0	37.0	31.0			29	(-1,-4)
Brickwork, cavity insulation, plasterboard	12.0		35.0	37.0	40.0	45.0	54.0	58.0			45	(-1,-3)
Tiled roof, insulation, plasterboard ceiling	9.3		28.0	34.0	40.0	45.0	49.0	50.0			44	(-2,-5)
L _{out,t}												
L _{out,2m}		Add Element	57.0	50.0	49.0	53.0	45.0	32.0			55	
L _{out,free field}			54.0	47.0	46.0	50.0	42.0	29.0			52	
Element 1												
Plane facade	ΔL _p	24.1	22.5	20.7	28.2	36.7	40.0	34.9				
Visible	X _{vis}	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
			22.5	20.7	28.2	36.7	40.0	34.9				
L _{p,out,2m}			57.0	50.0	49.0	53.0	45.0	32.0			55	
L _{p,in}			34.5	29.3	20.8	16.3	5.0	-2.9			25	dBA

- 4.20 The calculation results indicate a daytime internal sound level of approximately 25 dB $L_{Aeq,16hour}$ with standard double glazing.
- 4.21 The daytime sound level target of 35 dB $L_{Aeq,16hour}$ will therefore be achieved with windows closed.
- 4.22 Since the night-time sound level is approximately 6 dB lower than the daytime sound level, the night-time target of 30 dB $L_{Aeq,8hour}$ will also be achieved.
- 4.23 With regard to maximum L_{AFmax} internal sound levels, for the majority of the night-time period the recommended target of 45 dB L_{AFmax} will also be achieved.
- 66 dB $L_{AFmax,5min}$ – 25 dB R_w+C_{tr} = 41 dB $L_{AFmax,5min}$ internally
- 4.24 On the basis of this assessment, additional noise mitigation for habitable rooms is considered unnecessary (i.e. installing acoustically laminated double glazing and/or thick heavy panes of glass).

Noise intrusion with windows open

- 4.25 The level of sound attenuation through an open window is dependent on the type and size of window, the extent of opening, the angle of sound incidence and the characteristics of the noise source in question.
- 4.26 It is considered reasonable to assume a sound attenuation performance of approximately 15 dBA for a partially open window. Partially open windows are expected to provide background ventilation only (as opposed to rapid/purge ventilation).
- 4.27 At approximately 7 metres from Croesnewydd Road, the measured free-field sound pressure level was 52 dB $L_{Aeq,16hour}$ during the daytime and 46 dB $L_{Aeq,8hour}$ during the night-time.
- 4.28 Free-field sound pressure levels are considered appropriate for assessing noise intrusion through an open window and therefore corrections for facade reflections are considered unnecessary.

Habitable rooms within plots no's 1 - 3

- 4.29 The internal sound level within habitable rooms adjacent to Croesnewydd Road is expected to be approximately 37 dB $L_{Aeq,16hour}$ during the daytime and approximately 31 dB $L_{Aeq,8hour}$ during the night-time.
- 52 dB $L_{Aeq,16hour}$ – 15 dB = 37 dB $L_{Aeq,16hour}$
 - 46 dB $L_{Aeq,8hour}$ – 15 dB = 31 dB $L_{Aeq,8hour}$
- 4.30 The recommended 35 dB $L_{Aeq,16hour}$ daytime and 30 dB $L_{Aeq,8hour}$ night-time sound level criteria will therefore be marginally exceeded with windows open.
- 4.31 The night-time target of 45 dB $L_{AFmax,T}$ will also be marginally exceeded with windows open.
- 4.32 It should be noted that BS 8233 suggests that 'reasonable' acoustic conditions can be achieved where the internal targets are relaxed by 5 dB.
- 'Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved'.*
- 4.33 The relaxed target levels will therefore be achieved within habitable rooms with windows open.
- 4.34 BS 8233 states where occupants rely on closed windows to meet the internal noise limits, there needs to be appropriate alternative ventilation that does not compromise the facade sound insulation or resulting internal sound level.
- 4.35 BS 8233 also provides the following comment with regard to ventilation:
- The Building Regulations' supporting documents on ventilation recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.*
- 4.36 Since the ideal sound level targets will be marginally exceeded, it is recommended that an alternative means of ventilation is provided to the bedrooms on the front elevation.
- 4.37 A suitable mitigation measure would be to install standard (non-acoustic) hit-and-miss trickle vents to the front bedrooms (in order to provide background ventilation).
- 4.38 However, since there is audible noise from the air intake/extract associated with the breast screening centre, it is also recommended that an alternative means of ventilation is provided to the single bedrooms on the rear elevation.
- 4.39 As a do-minimum mitigation measure, it is recommended that acoustic ventilator units are fitted to the rear elevation (e.g. acoustic trickle vents).

4.40 However, greater mitigation will be achieved by using a mechanically assisted ventilation system or air-conditioning system to serve the bedrooms on the rear elevation.

4.41 It is considered appropriate for windows to remain openable in order to provide rapid or purge ventilation (at the occupant's choice).

4.42 Further guidance regarding ventilation and noise mitigation is provided within Section 5.

Habitable rooms within plot no's 4 - 9

4.43 Taking into consideration the attenuation of sound with increased distance from the road, the internal sound level within habitable rooms of plot no's 4 to 9 is expected to be approximately 34 dB $L_{Aeq,16hour}$ during the daytime and approximately 28 dB $L_{Aeq,8hour}$ during the night-time.

- 49 dB $L_{Aeq,16hour}$ – 15 dB = 34 dB $L_{Aeq,16hour}$
- 43 dB $L_{Aeq,8hour}$ – 15 dB = 28 dB $L_{Aeq,8hour}$

4.44 The recommended 35 dB $L_{Aeq,16hour}$ daytime and 30 dB $L_{Aeq,8hour}$ night-time sound level criteria will therefore be achieved with windows open.

4.45 The night-time sound level target of 45 dB $L_{AFmax,T}$ will also be achieved with windows open.

4.46 Since it is anticipated that the recommended targets will be achieved with windows open, an alternative means of ventilation is considered unnecessary for the front elevation of plot no's 4 to 6 and the front and rear elevation of plot no's 7 to 9.

4.47 However, it is recommended that an alternative means of ventilation is provided to the single bedrooms on the rear elevation of plot no's 4 to 6.

4.48 Again, this can be in the form of acoustic ventilator units or alternatively mechanically assisted ventilation.

4.49 It is considered appropriate for windows to remain openable in order to provide rapid or purge ventilation (at the occupant's choice).

Ambient sound level in outdoor living areas

4.50 With regard to outdoor living areas (gardens), BS 8233 provides the following guidelines:

'For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited'.

4.51 It is appropriate to design a site so that at least one garden space to a dwelling will achieve the guideline values. It is assumed that the main garden area for resting and relaxation will be to the rear of the property.

4.52 The daytime sound pressure level was approximately 52 dB $L_{Aeq,16hour}$ at the site boundary adjacent to Croesnewydd Road.

4.53 The upper guideline value of 55 dB $L_{Aeq,T}$ will therefore be achieved within the rear gardens nearest to Croesnewydd Road (i.e. plot no's 1 to 3).

4.54 Taking into consideration the attenuation of sound with distance, it is anticipated that the daytime sound level will be below 50 dB within the rear garden of plot no's 4 to 9.

- 4.55 It is considered unnecessary to install a noise barrier (acoustic fencing) at the development site with regard to road traffic noise. However, such fencing will be beneficial with regard to attenuating noise from the air intake/extract associated with the adjacent breast screening centre.

Noise from fixed building services plant

- 4.56 The air intake/extract on the south east elevation of the breast screening centre is most audible at the north west boundary of the site. The noise emitted is continuous and steady-state.
- 4.57 The plant was observed to be running during the daytime and late evening period.
- 4.58 The measured equivalent continuous sound pressure level was 55 dB $L_{Aeq,60sec}$ on the pathway adjacent to the site boundary. At the position of the nearest dwellings, the sound pressure level reduces to approximately 49 dB $L_{Aeq,60sec}$.
- 4.59 From observations made on-site, a tonal sound component is clearly perceptible at the north west boundary and therefore a correction (penalty) of +4 dB to the measured sound level is considered appropriate (in line with the BS 4142 subjective assessment method).
- 4.60 On this basis, the corresponding sound 'rating' level is 53 dB $L_{Ar,60sec}$.
- Specific sound level of 49 dB $L_{Aeq,60sec}$ + 4 dB correction = 53 dB $L_{Ar,60sec}$.
- 4.61 The typical background sound level during the daytime period was 47 dB $L_{A90,5min}$.
- 4.62 The sound rating level is therefore 6 dB above the daytime background sound level.
- 4.63 BS 4142 states that adverse impacts are expected where the rating level is +5 dB above the background sound level and significant adverse impacts are expected where the rating level is +10 dB above the background sound level.
- 4.64 On this basis, it is recommended that a noise barrier is used to help protect the rear gardens of plot no's 1 to 6.
- 4.65 Indicative calculations have been undertaken to determine the potential sound attenuation from a noise barrier (acoustic timber fence) installed along the rear boundary.
- 4.66 The height of the air intake/extract louvre with respect to the site level is estimated to be approximately 4 metres. A barrier height of 3 metres and a receptor height of 1.9 metres above ground level have also been assumed in the calculations.
- 4.67 Table 4.2 presents a results summary for the noise barrier calculation. Octave-band sound level data has been used in the calculation since barrier attenuation is frequency dependent.

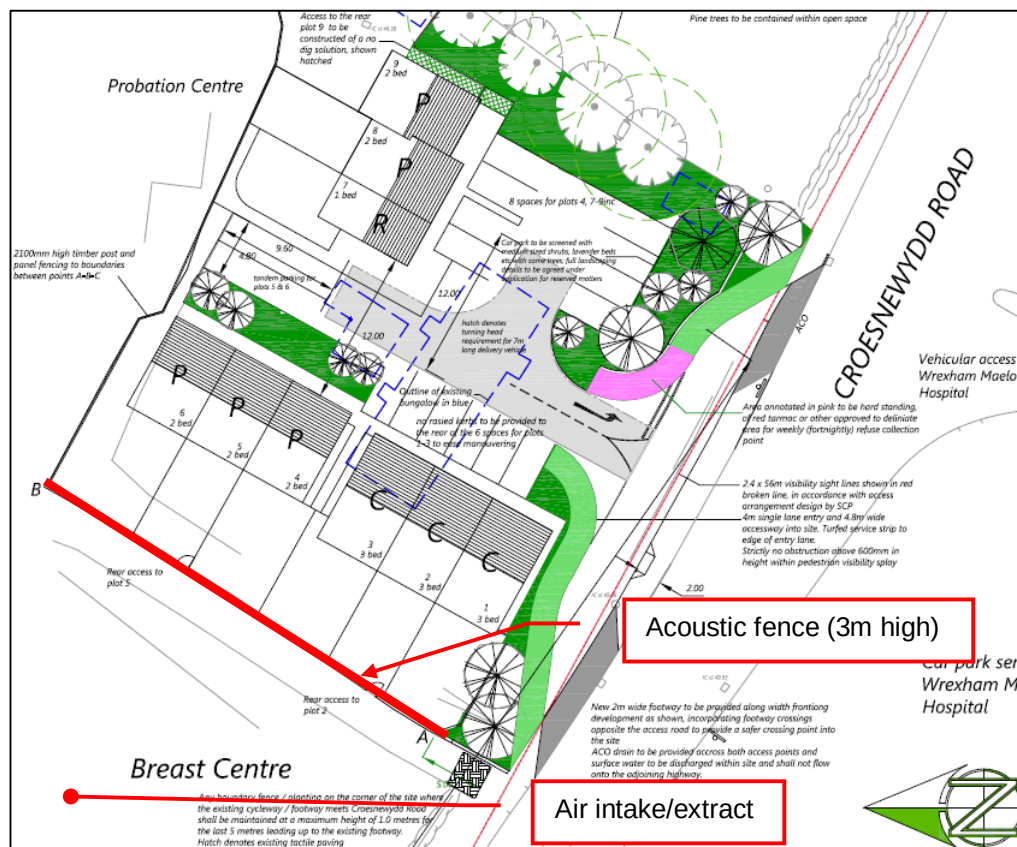
Table 4.2 – Predicted sound attenuation for a 3 metre high noise barrier

Frequency (Hz)	125	250	500	1000	2000	4000	L_{Aeq} dB
Source sound level dBA	45	48	49	50	44	37	55
Barrier attenuation dB	5	5	5	5	6	7	---
Receptor sound level dBA	40	43	44	45	38	30	50

- 4.68 The barrier calculation indicates that the specific source sound level can be reduced by approximately 5 dB with an effective barrier.
- 4.69 Taking into consideration the attenuation of sound with distance, the resulting specific sound level at the nearest dwellings is expected to be approximately 44 dB $L_{Aeq,60sec}$.
- 4.70 It is assumed that a tonal component may be just audible with the barrier erected and therefore a correction of +2 dB to the specific sound level is considered appropriate.

- 4.71 On this basis, the corresponding sound 'rating' level is 46 dB L_{Ar,60sec}.
- 4.72 In this instance, the predicted sound rating level is 1 dB below the daytime background sound level.
- 4.73 With regard to the likely impacts, BS 4142 states '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'.
- 4.74 It should be noted that the above calculation is based on the receptor being positioned near to the rear elevation of the dwellings. Greater sound attenuation and therefore a lower resulting sound level will be achieved where the receptor moves closer to the barrier.
- 4.75 Figure 4.1 shows the site layout and the recommended noise barrier. The current proposals are to install a timber fence approximately 2.1 metres high. However, it is recommended that the height of the fence is increased to at least 3 metres to the rear of the properties (as shown in red below).
- 4.76 The fence panels that are parallel to the road can reduce in height to approximately 2.1 metres.
- 4.77 Fence panels between dwellings can be of a standard timber construction if required.

Figure 4.1 – Site layout showing noise barrier location



- 4.78 An effective barrier can be constructed from timber panelling, masonry, or from a combination of the two materials. The barrier should be of a sufficient height, continuous, imperforate, sealed at the base, sealed between adjacent panels (no gaps) and have a mass per unit area of at least 10 kg/m².
- 4.79 Since the site level varies slightly, the contractor should ensure that the fence height at the rear of each plot is sufficient to eliminate the line-of-sight to the air intake/extract louvre.

5. Ventilation & Noise Mitigation

Acoustically rated ventilator units

- 5.1 Manually controlled trickle ventilators (the most common type of background ventilators) can be located over the window frames, in window frames, just above the glass or directly through the wall.
- 5.2 Sound attenuating ventilator units can be installed to habitable rooms, in order to allow background ventilation whilst maintaining a high sound insulation performance from the facade.
- 5.3 It is recommended that the ventilator unit provides a sound insulation performance of at least 32 dB $D_{n,e,w}$ (in the open position). Further guidance regarding ventilator performance can be provided in due course.
- 5.4 Example manufacturers of acoustically-rated ventilator units include:
 - www.aereco.co.uk/products-and-systems/
 - www.greenwood.co.uk/acoustic
 - <http://brookvent.co.uk/product/airvent-sm-acoustic/>

Mechanically assisted ventilation

- 5.5 A further option with regard to ventilating and cooling habitable rooms whilst achieving a high facade sound insulation would be to use a mechanical ventilation system, such as a heat recovery system (MVHR) or positive input ventilation system (PIV).
- 5.6 Example suppliers of MVHR and PIV systems include:
 - www.nuair.co.uk/residential/positive-input-ventilation
 - www.envirovent.com/specifier/products/heat-recovery-systems/
 - www.envirovent.com/specifier/products/positive-input-ventilation/
 - www.greenwood.co.uk/range/5/heat-recovery-mvhr.html
- 5.7 Appropriate ventilation rates depend on the number of bedrooms within the dwelling and the anticipated occupancy rate (refer to Approved Document F for guidance).

6. Conclusion

- 6.1 The proposed development site falls within Noise Exposure Category A for the daytime period and just over the threshold of Category B for the night-time period.
- 6.2 The recommended daytime and night-time sound level targets will be achieved within all dwellings with windows closed.
- 6.3 Standard thermal double glazing and traditional building envelope constructions will provide sufficient sound insulation for habitable rooms.
- 6.4 A suitable glazing construction would be 4 mm glass / 16 – 20 mm cavity / 4 mm glass or alternatively 6 mm glass / 16 – 20 mm cavity / 6 mm glass.
- 6.5 Additional mitigation such as installing acoustically laminated double glazing or thick/heavy panes of glass is considered unnecessary.
- 6.6 The recommended daytime and night-time sound level targets will be marginally exceeded within plot no's 1 to 3 with windows open. However, the relaxed target levels will be achieved with windows open.
- 6.7 Since the ideal sound level targets will be marginally exceeded, it is recommended that an alternative means of ventilation is provided to the bedrooms on the front elevation. A suitable mitigation measure would be to install standard (non-acoustic) hit-and-miss trickle vents to the front bedrooms (in order to provide background ventilation).
- 6.8 Since there is audible noise from the air intake/extract associated with the breast screening centre, it is recommended that an alternative means of ventilation is provided to the single bedrooms on the rear elevation of plot no's 1 to 3 and also plot no's 4 to 6.
- 6.9 Acoustic ventilator units could be fitted to the rear elevation (e.g. acoustic trickle vents). However, greater mitigation will be achieved by using a mechanically assisted ventilation system to serve the bedrooms on the rear elevation.
- 6.10 An alternative means of ventilation is considered unnecessary for the front elevation of plot no's 4 to 6 and the front and rear elevation of plot no's 7 to 9.
- 6.11 The resulting sound level within the rear gardens will achieve the guideline target, however it is recommended that a minimum 3 metre high noise barrier is constructed to the rear of plot no's 1 to 6 to provide additional protection from plant related noise.
- 6.12 On the basis of the measured sound levels and identified mitigation measures, the proposed site is considered suitable for residential development.

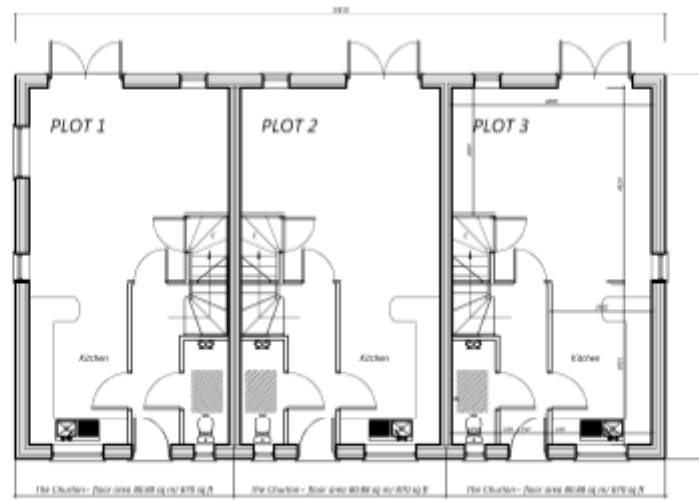
Appendix A

Proposed site layout, floor plans and elevations

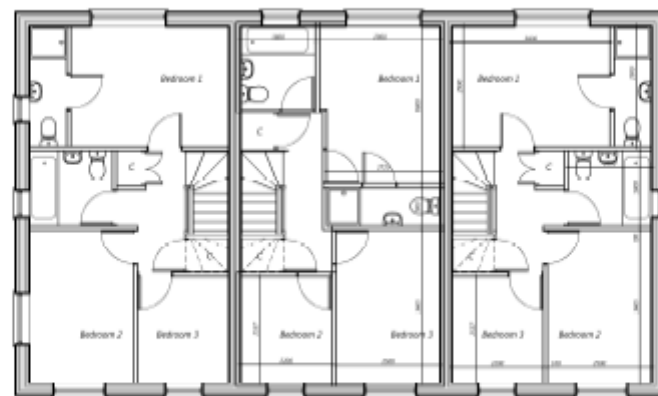
Figure A.1 – Proposed site layout



Figure A.2 – Proposed floor plans (plot 1 – 3)



Ground Floor Layout Plan



First Floor Layout Plan

Figure A.3 – Proposed elevations (plot 1 – 3)



Figure A.4 – Proposed floor plans and elevations (plot 4 – 6)



Figure A.5 – Proposed floor plans and elevations (plot 7 – 9)



Appendix B

Assessment terminology

Assessment 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 between the root-mean-square pressure of the sound field and a reference pressure ($2 \times 10^{-5} \text{Pa}$).
dB(A)	The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc, according to the parameter being measured.
Acoustic environment	Sound from all sources as modified by the environment.
Ambient sound level	The totally encompassing sound in a given situation at a given time; it is usually composed of sound from many sources, near and far.
Equivalent continuous sound level - $L_{Aeq,T}$	The A-weighted equivalent continuous sound pressure level over a period of time, T. Representative of the 'average' sound pressure level over a given period (commonly used to describe the 'ambient' sound level).
Maximum sound level - $L_{AFmax,T}$	The A-weighted 'maximum' sound pressure level that occurred during a given period, T (commonly used for the assessment of intermittent loud noises).
Background sound level - $L_{A90,T}$	The sound pressure level that is exceeded for 90% of the measurement time interval, T. $L_{A90,T}$ is often used to describe the 'background' sound level.
Habitable room	Any room used or intended to be used for sleeping, cooking, living or eating purposes (enclosed spaces such as bath or toilet facilities, service rooms, corridors, laundries, hallways, utility rooms or similar spaces are excluded from this definition).
R_w	The weighted sound reduction index expressed in dB. A single number quantity for airborne sound insulation rating.
Free-field level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other significant reflective surfaces. Generally as measured outside and away from buildings (>3.5metres).