Report No: *1406067R03*

Dated: *12 August 2014*

Planning Application Ref: *n/a*

Noise Impact Assessment for Proposed Residential Development

Prepared for: *G.H.P.D.*
The Green House
Esperanto Way
Newport
NP19 0RD

Site address: *Herbert Road*
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NP19 7BH

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BRIEF FOR CONSULTANCY:

This report has been prepared by Acoustics & Noise Limited, Newport, South Wales, for G.H.P.D., The Green House, Esperanto Way, Newport, NP19 0RD under the instructions of Mr Darran Watts.

Order No: n/a

OBJECTIVES:

To investigate the potential noise impact from an adjacent joinery workshop on the proposed residential development at Herbert Road using CAD modelling techniques.

Where applicable recommend mitigation to meet the impact criteria.

NON TECHNICAL SUMMARY:

Full details of the proposed development are presented by others which set the basis against which this assessment has been conducted.

This report assesses the noise impact on a proposed residential development from activities associated with a joinery workshop.

This report assesses the impact using notional noise levels obtained from previous surveys, at similar facilities by Acoustics and Noise Ltd, with a methodology agreed with Ms. Claire Edwards, EHO with Newport City Council.

Noise levels from these activities have been modelled using advanced 3D acoustic modelling techniques and the impact these noise levels may have on the proposed development have been assessed against an existing condition attached to the development site, with additional consideration for night time maximum noise levels.

The results of the assessment indicate that noise levels across the majority of the proposed residential development will satisfy the criteria for external noise levels required by Newport City Council.

The results of the assessment indicate that, for the worse case scenario modelled, noise levels within the external areas at the rear of plots 242-249 are 7 - 14 dB above the criteria required by Newport City Council.

However, the external areas at the rear of these plots are utilised for car parking and are not considered as amenity areas and for these plots the outdoor noise criteria does not apply.

This "*worst case scenario*" represents the extremely unlikely conditions whereby the noise is generated continuously and without any breaks for the whole assessment period which is 16 hours for the daytime period and 8 hours for the night time period.

The results of this assessment indicate that the majority of the site will be exposed to noise levels, attributable to notional activities within Apex Joinery, that are below the criteria levels and that the internal noise criteria levels can be met whilst using an open window ventilation strategy.

Several plots have been identified where mitigation is required to satisfy the internal noise criteria levels.

To achieve the internal noise criteria levels, the rear of plots 236 - 241 (first floor) and the rear of plots 242 - 249 (ground and first floor) recommended mitigation is in the form of standard thermal 4/20/4 glazing units sealed closed and an agreed mechanical ventilation system to provide the necessary ventilation rates.

The conclusions of this report are based on a worst case scenario where the notional activities modelled for Apex Joinery are continuous throughout the assessment period.

1.0 DESCRIPTION OF SITE

1.1 The site is located at Herbert Road, Newport, NP19 7BH.

1.2 The Site is located on the eastern bank of the River Usk to the north of Newport city centre within a predominantly residential area.

1.3 The Site is approximately 5.83ha in area and is currently vacant land, bounded by the Glan Usk Primary School to the north, a railway with residential properties beyond to the east, an industrial area to the south and the River Usk to the west. No buildings currently exist on the Site.

2.0 DISCUSSION

2.1 It is proposed to develop the site for residential accommodation with 250 units.

2.2 Noise and Vibration impacts were assessed by Waterman Energy, Cardiff and are included in the EIS for the proposed development.

2.3 To the south of the proposed development there is an industrial area comprising several units.

2.4 Noise impact assessments were previously made for activities on the industrial area. Assessments were made for the existing J.S. Payne site [1] and an area of industrial land to the south of the main part of the proposed development that is currently vacant [2].

2.5 Ms C Edwards, Newport City Council Environmental Health, has raised further concerns about the potential impact on the southern most part of the proposed residential development from activities at Apex Joinery.

2.6 Acoustics and Noise Ltd were engaged to carry out a noise impact assessment for these activities.

2.7 A previous report 1406067R02 was prepared by Acoustics and Noise using criteria that did not satisfy all of Ms Edwards queries. This report uses additional criteria to address these queries.

3.0 ASSESSMENT METHODOLOGY

3.1 During a joint site visit with Ms Edwards, there was no observed noise creating activity from Apex Joinery. It was agreed with Ms Edwards, that a desk study should be used to assess the potential noise impact from Apex Joinery using the noise levels of notional woodworking equipment data as expected in a large joinery workshop.

3.2 This report uses the following criteria agreed by telephone conversation with Ms Edwards.

3.3 The glazing mitigation, where required, is to be assessed using the highest external façade noise level from either;

Night: L_{Amax} levels compared with WHO guidance for sleep disturbance [3] or

Day: $L_{Aeq,1hr}$ noise levels with an added 5dB penalty as per BS 4142 [4] compared with Newport CC Planning Conditions as below.

3.4 The application site currently benefits from a planning consent for an alternative residential development (outline planning permission 00/0768 and reserved matter 03/1531). The following condition was attached to the reserved matters consent:

"…full details of noise attenuation measures including external noise mitigation measures, acoustic glazing and

mechanical ventilation to ensure internal noise levels within the proposed residential units do not exceed 40 dB(A) Leq (16 hours) during the day and 35 dB(A) (8 hours) during the night and external noise levels do not exceed 50 dB(A) Leq during the daytime…"

3.5 This report uses the above, existing condition, to assess the day time impact at properties at the southern end of the proposed development, from notional joinery activities at Apex Joinery as agreed with Ms Edwards.

3.6 **Notional Noise Sources**

3.6.1 To represent the activities associated with a joinery workshop, this report utilises the results from a Noise at Work survey previously carried out by Acoustics and Noise Ltd at a large woodworking facility (see Appendix 3).

3.6.2 At this assessment nearfield measurements were made for various woodworking activities and were typical of the activities expected within a large joinery workshop.

3.6.3 For Apex Joinery the activity cycles, numbers and types of equipment are unknown, hence, this assessment adopts a worst case approach and describes noise levels in terms of a notional 'composite' spectrum. This 'composite' spectrum is determined from the maximum level within each octave band from all equipment (see Appendix 3).

3.6.4 This notional spectrum is assigned to the internal noise level within Apex Joinery.

3.6.5 The joinery building is assumed, from a visual inspection, to be constructed from standard Kingspan steel cladding.

3.7 **Noise Sensitive Properties**

3.7.1 The proposed residential layout presented in Appendix 1 indicates that there are several properties that will overlook or back onto the Apex Joinery unit.

3.7.2 This report assesses the noise impact at the following proposed properties:

- Plots 230-235
- Plots 236-241
- Plots 242-249

3.7.3 These properties are identified from the assessment as being the most exposed to the potential noise generating activities at Apex Joinery.

3.8 **Relevant Guidance**

3.9 As a matter of best practice, this assessment has been undertaken based on the relevant guidance on noise. This includes:

3.10 **ISO 9613 [5]**

3.10.1 Part 1 of this standard specifies an analytical method of calculating the attenuation of sound as a result of atmospheric absorption for a variety of meteorological conditions

3.10.2 Part 2 describes a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (as described in ISO 1996) under meteorological conditions.

3.11 **3D ACOUSTIC CAD MODELLING**

3.11.1 The proposed site is large and benefits from acoustic CAD modelling of the notional joinery noise levels across the whole of site using B&K Predictor Type 7810 V9.11 Software. This noise prediction software allows for the investigation of noise emissions in complex or large outdoor environments. The software can be used to analyse industrial noise sources and traffic measurements to the latest European and U.K. Standards.

3.11.2 A major advantage of using this method is the ability to remodel changes and alterations to the site and/or sources.

3.11.3 **CAD Model Construction**

3.11.3.1 A vector drawing of the proposed development, 'SW49 (04)_Site Layout', in addition to information on the relative ground heights was provided as part of the original assessment for main development.

3.11.3.2 The houses are modelled at 9.95m AOD and the adjacent industrial area is modelled at 7.0m AOD.

3.11.3.3 Using the vector drawing as a background, the proposed residential buildings are placed into the model with each building assigned a height of 8m.

3.11.3.4 A 2.8m barrier is positioned along the northern and western boundary of the industrial area. This barrier represents a 1.8m acoustic fence on top of the 1.0m retaining wall located at 7m AOD.

3.11.3.5 The height of the retaining wall will vary along the boundary. The barrier modelled in this case represents the lowest height for the wall/fence combination as worst case.

3.11.3.6 Apex joinery is located within a single unit which forms part of a larger double unit building. It is assumed that emissions will be produced by the rear façade, the end façade and the front façade along with the roof, and that at the sensitive properties, noise from the front façade of the Apex unit will be insignificant when compared with the other surfaces and has been omitted from the modelling.

3.11.3.7 The joinery activities were modelled as the significant emitting façades and an emitting roof. The emission levels for these emitting surfaces are calculated by the software using the notional internal noise spectrum for the joinery activities and the sound reduction of the building envelope (see Appendix 3).

3.11.3.8 The sound reduction from the joinery workshop was obtained from manufacturer's data for Kingspan KS1000 sheets which are typical for an industrial unit.

3.11.4 **CAD Model Prediction**

3.11.4.1 Receivers are placed as detailed in 'Sound Control for Homes' [6] 2.0m from the most exposed building façades within the proposed residential development.

3.11.4.2 The receivers were positioned at heights of 1.5m and 4.5m to represent the ground floor and first floor of each property.

3.11.4.3 A 1.5m high noise contour grid covering the area of interest is then constructed. The grid represents the free field noise levels throughout the site and is actually a collection of receivers set 1m apart.

3.11.4.4 This grid is used to display the predicted noise levels within the external areas of the proposed development.

3.11.4.5 Using the Predictor 9.11 software, calculations are made for each receiver position using the included noise sources. External free-field noise levels are calculated for the 1.5m high grid covering the proposed site.

3.11.5 **Day-time $L_{Aeq,1hr}$ Levels**

3.11.5.1 Calculations are made with activity noise assumed to be continuous throughout the assessment period to represent worst case. A 5dB penalty is included to account for tonal or impact type noise as per BS 4142 guidelines [4].

3.11.5.2 This, of course, is an extremely unlikely scenario given that in a typical joinery workshop there would have to be breaks in the activities over extended periods, usually to assemble the product from the machined parts.

3.11.6 **Night-time L_{Amax} Levels**

3.11.6.1 These are calculated by using the loudest L_{Amax} spectrum from the machine shop data, and assumes that the joinery will, in worst case, operate continuously throughout the night time period, again an unlikely scenario.

3.11.6.2 We have not combined L_{max} levels from different activities, or added a 5dB penalty, as in our opinion this would be technically incorrect.

3.11.6.3 The software calculations for noise propagation follow the procedures set out in ISO 9613, Part 2 [2].

3.11.6.4 The external noise levels for the assessment period are in the form of easily understood noise contour maps and are shown in Appendix 2.

3.12 **Internal Noise Criteria**

3.13 **Night**

3.13.1 If we assume that the noise reduction from outside to inside with the window partially open for ventilation is 15 dB as stated by the World Health Organization, then to satisfy the internal noise criteria of 45 dB L_{Amax} for the sensitive night time period, the external façade noise levels from the joinery should be no greater than 45 + 15 = 60 dB L_{Amax}.

3.13.2 All properties exposed to external operational noise levels from the joinery below this 60 dB L_{Amax} limit will satisfy the internal noise criteria with the window open for ventilation.

3.14 **Day**

3.14.1 As the extant Planning Conditions specify an internal level of 40dB $L_{Aeq,16hrs}$ then with an open window and a 5dB penalty the internal criteria can be satisfied with an external level of 40 + 15 - 5 = 50dB $L_{Aeq,16hrs.}$

3.14.2 All properties exposed to external operational noise levels from the joinery below this 50 dB $L_{Aeq,16hr}$ limit will satisfy the internal noise criteria with the window open for ventilation for the day.

3.14.3 Figure 3 and Figure 5 details the external noise levels for the habitable rooms at ground floor level and Figure 4 and Figure 6 details the external noise levels for the habitable rooms at first floor level.

3.14.4 The green areas indicate where the external noise levels are less than the above criteria. The red areas indicate where the external noise levels are greater than the above criteria.

3.14.5 For all properties that fall within the red areas the internal noise criteria for these properties cannot be satisfied with an open window ventilation strategy.

3.14.6 The calculated noise levels for the following plots indicate that an open window ventilation strategy would not meet the criteria at night.

- Rear of Plots 230 - 235, first floor only
- Rear of Plots 236 - 241, first floor only
- Rear of Plots 242 - 249, ground floor and first floor

3.14.7 For the above plots mitigation is required so that the internal noise level criteria can be satisfied during the relevant time period.

3.14.8 Calculations for suitable mitigation are detailed in Appendix 5 and have been made for plots 242-249 which are exposed to the highest external noise levels generated by the continuous notional activities at Apex Joinery (see Table 3).

3.14.9 It follows that the remaining plots that require mitigation will satisfy the internal noise criteria as they are exposed to lower noise levels.

4.0 CONCLUSIONS

4.1 External Noise Criteria - Daytime

4.1.1 External noise levels at the most exposed properties, attributable to the notional woodworking activities within the joinery, are presented in Appendix 2.

4.1.2 Figure 3 and Figure 5 details the noise levels at a height of 1.5m and Figure 4 and Figure 6 details the noise levels at a height of 4.5m. These levels represent the external free-field noise levels at the most exposed properties attributable to the notional activities within the joinery.

4.1.3 The noise contours detailed in Figure 3 show where the external criteria has been exceeded. These areas are indicated in red for clarity. The green areas indicate where the external noise criteria have been satisfied.

4.1.4 The proposed layout drawing is overlaid onto the contour map to aid the determination of all areas that exceed the external noise criteria of 50 dB $L_{Aeq,16hr}$.

4.1.5 The results of the assessment indicate that external noise levels generated by the joinery at plots 236 - 241 will satisfy the criteria for external noise required by Newport City Council. These areas are shown in green in Figure 3.

4.1.6 The results of the assessment indicate that external noise levels generated by the joinery at plots 242 - 249 will exceed the criteria for external noise required by Newport City Council by between 7 and 14 dB. These areas are shown in red in Figure 3.

4.1.7 It should be noted that the external areas at the rear of these plots are for car parking and are not considered to be amenity areas and therefore, for these plots, the outdoor noise criteria required by Newport City Council does not apply.

4.1.8 The calculations assume that the operations at the joinery are continuous throughout the assessment period which in practice would be extremely unlikely and actual noise levels would be lower than calculated.

4.2 **Internal Noise Criteria**

4.2.1 The noise contours in Figure 3 and Figure 5, and Figure 4 and Figure 6 indicate the external noise levels at heights of 1.5m (ground floor) and 4.5m (first floor) respectively.

4.2.2 If we assume that the noise reduction from outside to inside with the window open for ventilation is 15 dB as stated by the World Health Organization, then to satisfy the internal noise criteria of 35 dB $L_{Aeq,8hrs}$ using an open window ventilation strategy, the external façade noise levels from the joinery should be no greater than 35 + 15 = 50 dB $L_{Aeq,8hrs}$.

4.2.3 The green areas indicate the façades where the internal noise criteria can be satisfied with an open window ventilation strategy and the red areas indicates where mitigation is required to satisfy the internal noise criteria.

4.2.4 The majority of the proposed development falls within the green areas and the internal noise criteria for these properties can be satisfied with an open window ventilation strategy.

4.2.5 For all properties that fall within the red areas the internal noise criteria for these properties cannot be satisfied with an open window ventilation strategy.

4.2.6 The calculated noise levels for the following plots indicate that an open window ventilation strategy would not meet the criteria at night.

- Rear of Plots 230 - 235, first floor only
- Rear of Plots 236 - 241, first floor only
- Rear of Plots 242 - 249, ground floor and first floor

4.3 For the above plots mitigation is required so that the internal noise level criteria can be satisfied. Mitigation is only applicable to those habitable rooms that face Apex Joinery.

4.4 Calculations show that mitigation in the form of standard thermal glazing units comprising 4mm glass/20mm air gap/4mm glass when in the closed position will result in internal noise levels of 44 dB L_{Amax}.

4.5 This will satisfy the criteria required by Newport City Council.

4.6 As the windows will be sealed to control the internal noise levels, an alternative, agreed method of ventilation will be required to provide adequate ventilation rates.

5.0 RECOMMENDATIONS

5.1 Standard thermal 4/20/4 glazing should be fitted to all identified habitable rooms and sealed to control noise ingress.

5.2 The required ventilation rates should be provided by an agreed mechanical ventilation system that does not compromise the façade sound insulation or the resulting internal noise level.

P.A.T. 12/08/14
M.Sc., I.Eng., M.I.O.A.,
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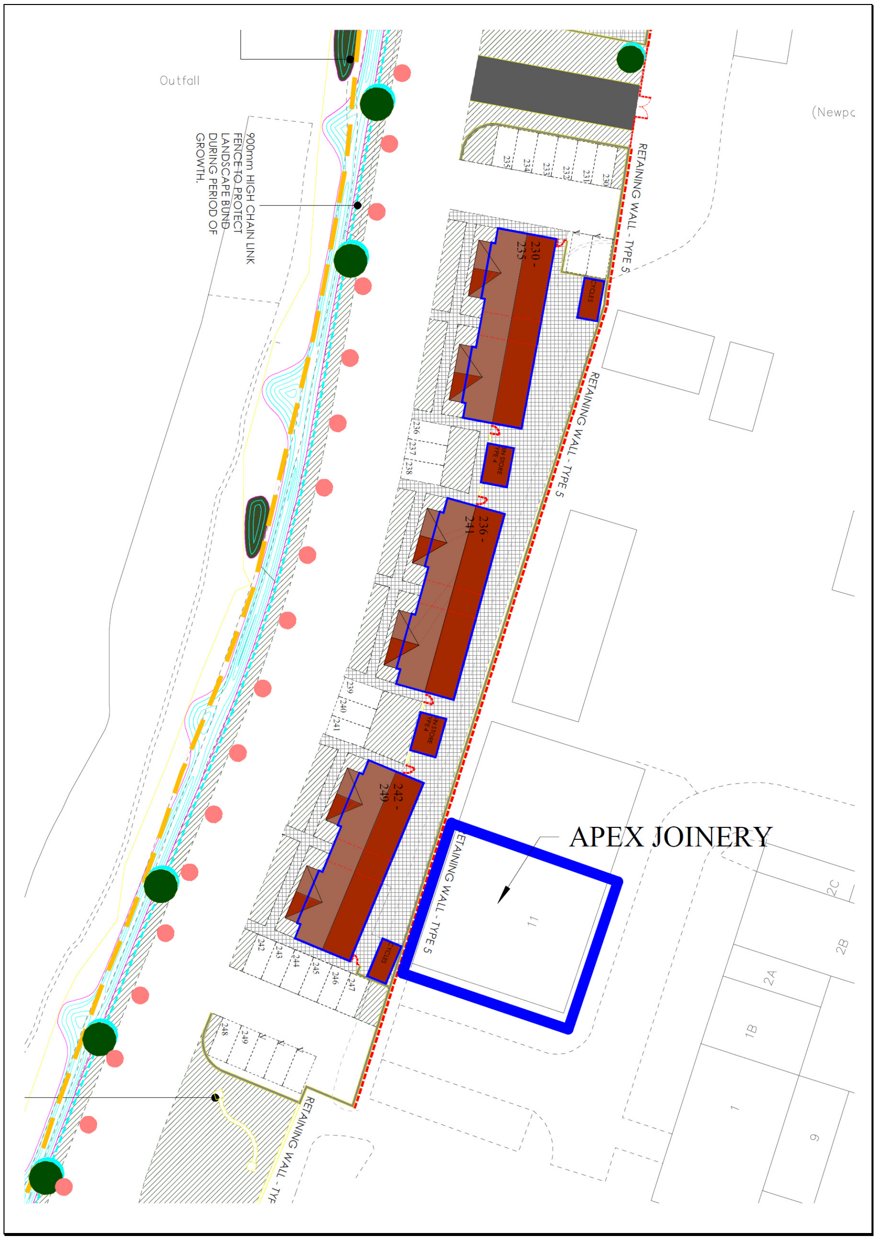
Appendix 1
Proposed Site Layout

A1.0 PROPOSED SITE LAYOUT

Figure 1 – Proposed Site Layout

Figure 2 – Close up of Assessment Area



Appendix 2
External Noise Contours

A2.0 EXTERNAL NOISE CONTOURS

Figure 3 – Calculated External Noise Contours LAeq,1hr @1.5m

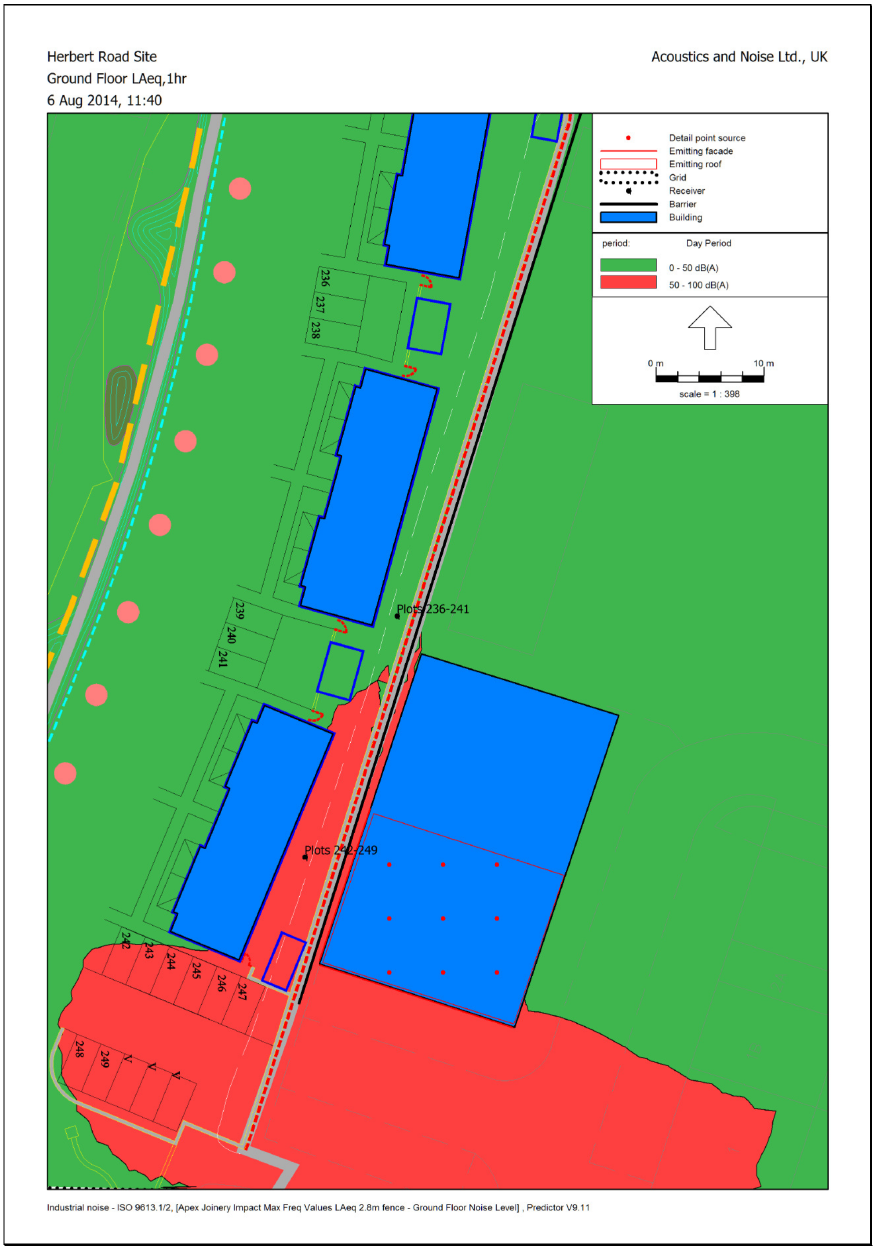


Figure 4 – Calculated External Noise Contours LAeq,1hr @4.5m

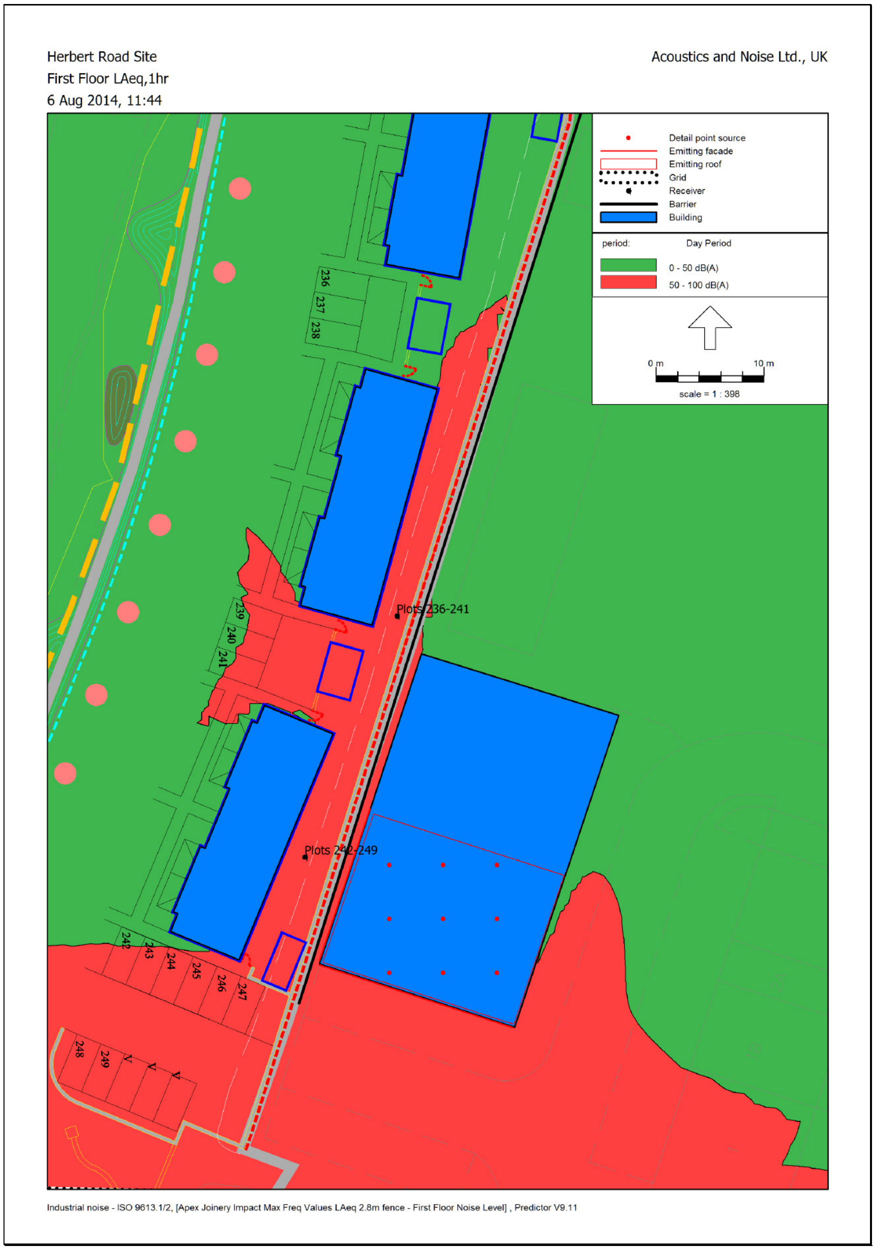


Figure 5 – Calculated External Noise Contours LAmax @1.5m

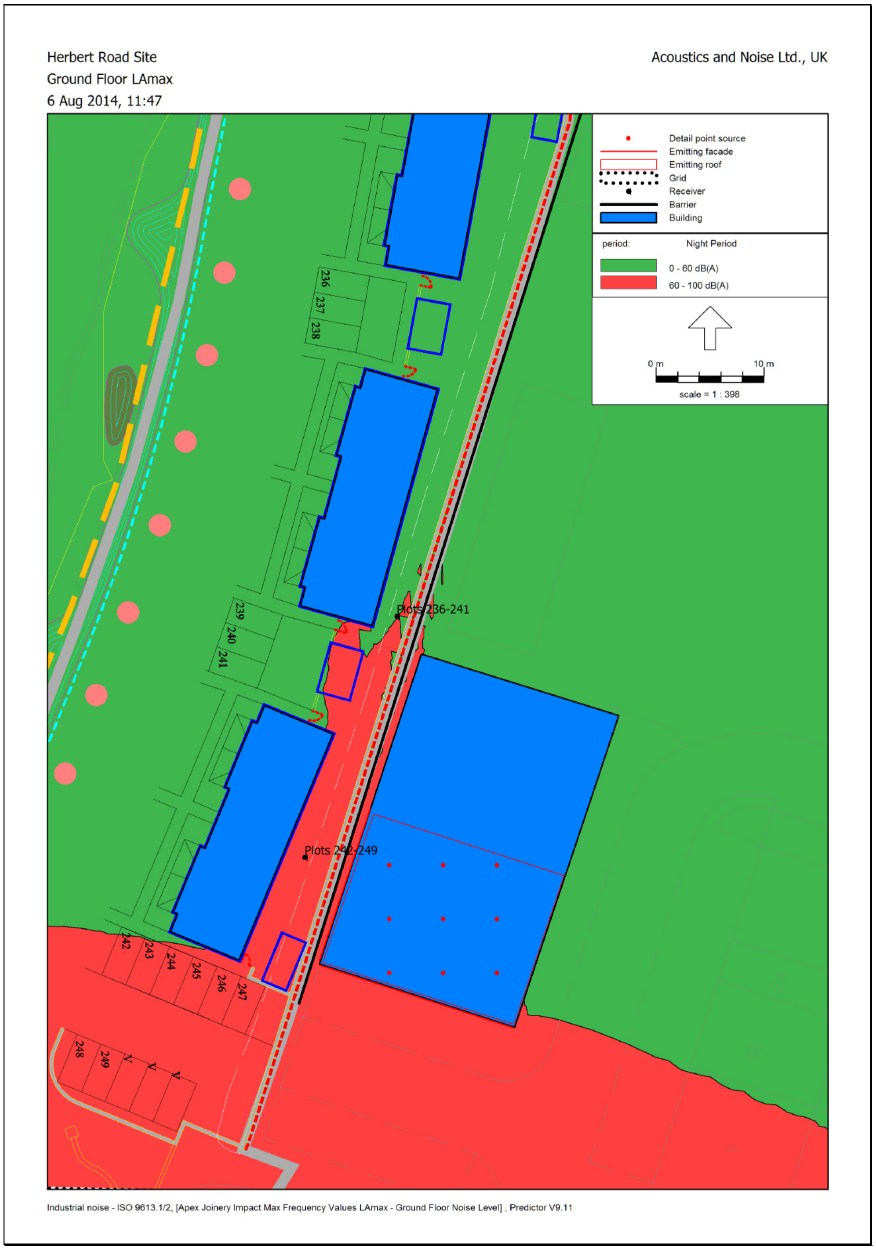


Figure 6 – Calculated External Noise Contours LAmax @4.5m

Appendix 3
Data and Calculations used in Model

A3.0 DATA AND ASSUMPTIONS USED IN MODEL

Table 1 – Sound Pressure Levels for typical woodworking activities (dBA)

	63	125	250	500	1000	2000	4000	8000
Shed 2 Press	40.0	56.2	67.3	71.9	78.0	78.3	72.0	65.0
Air Staple Gun	63.4	71.3	77.7	83.5	88.9	89.8	88.8	91.2
Truss Saw	55.3	60.4	71.6	75.6	76.1	77.3	74.2	69.8
I-beam Saw	50.4	61.4	76.8	80.3	77.0	76.8	73.9	69.1
Band Saw No2	40.0	58.4	75.0	81.9	85.5	91.6	90.2	84.1
Cross Cut Saw No8	50.4	62.2	71.4	75.9	74.6	76.1	73.3	65.4
Weinig Molder	40.0	65.8	73.5	77.4	87.5	89.8	83.3	71.6
Panel Saw	50.2	64.2	72.2	75.8	84.9	84.7	82.3	80.9
SpindlerNo9	40.0	66.4	75.7	81.9	84.3	84.4	77.6	68.7
SpindlerNo9 inc Feeder	50.5	66.6	78.8	82.8	84.6	86.5	82.0	74.1
Pinhero Planer	40.0	62.1	84.3	90.8	87.0	81.4	77.6	70.2
Spindler No1	51.7	61.5	73.9	81.3	81.0	79.6	74.3	67.6
Tennoner	53.5	65.8	78.8	80.4	79.9	79.1	76.2	73.1
Cross Cut Trencher	40.0	64.7	67.8	76.2	79.2	81.1	80.2	75.3
Maximum LAeq per Octave (dB)	**53.8**	**65.0**	**77.0**	**82.5**	**84.0**	**85.5**	**82.9**	**81.2**

Table 2 – LAmax levels for typical woodworking activities (dBA)

	63	125	250	500	1000	2000	4000	8000	Total
Weinig Molder	58.1	71.5	79.3	87.0	103.9	99.8	94.7	80.4	105.8
Truss Saw	61.4	72.1	82.2	87.9	91.8	93.9	85.8	82.8	97.3
Tennoner	56.9	68.8	82.9	86.2	85.1	86.2	85.1	83.2	92.8
Spindler No9	58.0	70.6	78.5	85.7	93.6	94.1	90.6	80.3	98.2
Spindler No9 Inc Feeder	**58.1**	**72.7**	**84.7**	**90.5**	**99.4**	**107.4**	**104.9**	**91.3**	**109.8**
Spindler No1	59.1	69.6	76.6	83.9	84.5	85.6	85.1	77.4	91.2
Shed2 Press	57.9	71.4	83.5	86.5	94.5	96.2	90.6	88.7	99.8
Pinhero Planer	53.3	65.9	87.1	93.4	95.9	91.1	87.4	81.7	99.3
Panel Saw	54.6	67.1	75.3	81.4	94.8	95.1	86.0	87.9	98.7
I Beam Saw	73.4	80.7	89.8	98.2	99.2	95.7	95.3	90.4	103.8
Crosscut Saw No8	66.9	73.1	82.7	88.7	92.5	90.8	89.1	84.6	97.0
Cross Cut (Trencher)	53.6	68.4	74.7	85.3	89.1	91.8	90.8	86.2	96.4
Band Saw No2	56.1	63.8	78.6	85.8	90.1	95.2	92.8	86.9	98.6
Air Staple Gun	68.0	76.6	84.9	90.6	96.0	95.8	94.3	98.2	102.7

A3.1 **Assumptions Made In Model and Effects**

A3.2 Octave band $L_{Aeq,t}$ measurements of typical processes expected within a joinery workshop are detailed in Table 1. The time, t for each measurement varies but is representative of each activity cycle. Measurements were made during a Noise at Work assessment carried out by Acoustics and Noise Ltd at a large woodworking facility.

A3.3 As the noise level is frequency dependent, the 'composite' noise level within the joinery workshop used in this assessment is estimated to be the maximum value from all the activities in each of the octave bands as detailed in Table 1.

A3.4 It is assumed that the composite noise level is continuous throughout the 1 hour assessment period.

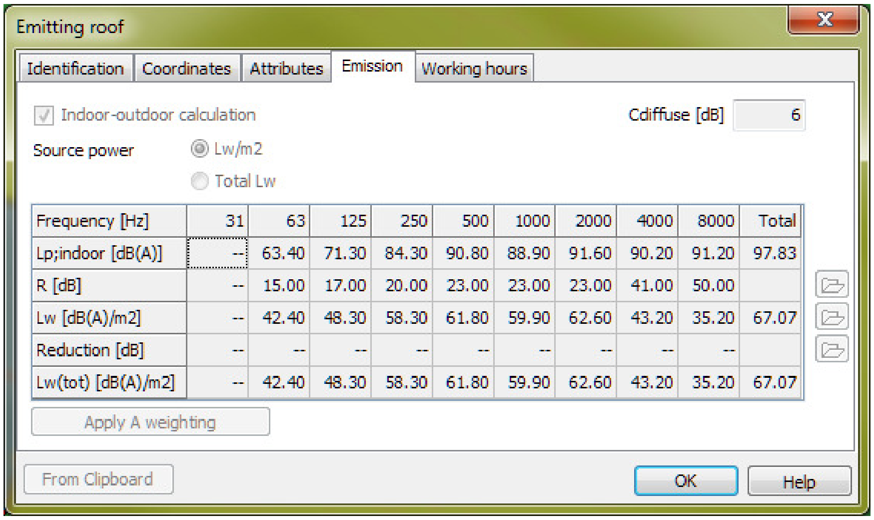
A3.5 To model the L_{Amax} levels, the process with the largest value of L_{Amax} is used to represent worst case. Table 2 indicates that this process is from the Spindler operation including Feeder which has a measured L_{Amax} = 109.8 dB

A3.6 The joinery workshop occupies 50% of a larger unit. The noise emissions from the joinery are modelled as an emitting roof, an emitting façade that faces the proposed development and the end façade. Noise from the front façade is assumed to be insignificant when compared to the other façades.

A3.7 The modelling software calculates the sound power level L_{wA}/m^2 for each of the emitting surfaces based on the internal noise level calculated in Table 1 and the sound reduction of the façade construction.

A3.8 Manufacturer's data for the sound reduction is used for Kingspan KS1000 cladding which is typical for these type of units (see Figure 7).

Figure 7 – Sound Power for Emitting Surfaces used in Model



Frequency [Hz]	31	63	125	250	500	1000	2000	4000	8000	Total
Lp;indoor [dB(A)]	--	63.40	71.30	84.30	90.80	88.90	91.60	90.20	91.20	97.83
R [dB]	--	15.00	17.00	20.00	23.00	23.00	23.00	41.00	50.00	
Lw [dB(A)/m2]	--	42.40	48.30	58.30	61.80	59.90	62.60	43.20	35.20	67.07
Reduction [dB]	--	--	--	--	--	--	--	--	--	
Lw(tot) [dB(A)/m2]	--	42.40	48.30	58.30	61.80	59.90	62.60	43.20	35.20	67.07

A3.9 There is a 2.8m barrier between the industrial area and the proposed residential development. This represents a 1.8m high acoustic barrier on top of the 1.0m retaining wall. The barrier has been placed on the industrial site at 7.0m AOD.

A3.10 The height of the retaining wall will vary along the boundary. The barrier modelled in this case represents the lowest height for the wall/fence combination as worst case.

A3.11 A ground factor of 0.0 has been used in the calculations to represent hard ground covering as worse case.

A3.12 No consideration of any attenuation due to atmospheric conditions has been made to represent worse case.

A3.13 The noise contour calculations are at a height of 1.5m and 4.5m to represent the external noise levels at ground floor and first floor levels.

Appendix 4
Calculated Noise Levels at Receptors

A4.0 CALCULATED NOISE LEVELS AT RECEPTORS

Table 3 – Calculated Noise Levels at Most Exposed Properties

Plot	Height (m)	$L_{Aeq,1hr}$ (dB)	LA_{max} (dB)
Plots 230-235	1.50	--	49.0
Plots 230-235	4.50	--	61.6
Plots 236-241	1.50	46.7	59.4
Plots 236-241	4.50	56.8	69.2
Plots 242-249	1.50	61.4	74.4
Plots 242-249	4.50	65.6	77.8

A4.1 The results in Table 3 are the calculated noise levels 2m in front of the most exposed façades as detailed in 'Sound Control for Homes' [6]. These levels are used in the internal noise level calculations.

A4.2 Calculations are made by the modelling software following the calculation methods of ISO9613-2 [5].

A4.3 The calculations assume that the activity noise is continuous throughout to represent worst case.

Appendix 5
Internal Noise Calculations

A5.0 INTERNAL NOISE CALCULATIONS

A5.1 Building Envelope

A5.1.1 The following calculations apply the procedures detailed in 'Sound Control for Homes' [6].

A5.1.2 These procedures require the following information for accurate calculation of the sound insulation requirements of the building envelope:

External noise level.
Maximum allowable sound level in the room.
Surface area of the relevant portion of the building envelope.
Area of sound absorption in the room.

A5.1.3 The following formula is used to determine the façade sound insulation against road traffic noise:

Level Difference = $L_1 - L_2 = R - 10 \log (S/A)$ or re-arranging we get:

$$L_2 = L_1 - R + 10 \log (S/A) \qquad (1)$$

Where L_1 *- Sound level 2m outside the façade (dB)*
L_2 *- Received sound level in the room (dB)*
R - Sound reduction index (dB)
S - Surface area, room façade element (m^2)
A - Absorption in the room (m^2)

A5.1.4 For housing design purposes a more simple approach is proposed by 'Sound Control for Homes':

The surface area and area of sound absorption can be ignored. In typically furnished domestic rooms they have little effect on the final result.

A typical external noise spectrum is adopted and the sound insulation of the building envelope described in terms of the difference between inside and outside levels in dB(A).

A5.1.5 This outside-inside level difference, denoted by $D_{2m,nT,Atr}$, is based on a typical urban road traffic noise spectrum.

A5.1.6 This term can also be represented by (R_w + C_{tr}) where R_w is the weighted sound reduction index and C_{tr} is the correction against low frequency performance and is based on urban road traffic noise as stated in BS EN ISO 717-1 [7].

A5.1.7 However, in this case the significant source of noise is from a factory emitting mainly medium and high frequency noise and therefore the correction term C is more appropriate as stated in BS EN ISO 717-1 [7] and the outside-inside level difference is represented by (R_w + C).

A5.1.8 Equation (1) can now be expressed as

$$L_2 = L_1 - (Rw + C) \qquad (2)$$

A5.1.9 Calculations have been made for the most exposed facades within the proposed development. These will be the facades that face Apex Joinery directly.

A5.1.10 If we assume that the glazing area is 30% of the total internal wall area for a typical habitable room then using the chart in Figure 49 presented in 'Sound control for homes' [6] we can calculate the composite sound insulation for the façade by adding a correction factor to the sound reduction for the glazing.

A5.1.11 Composite façade sound reduction calculations are shown in Table 4 below.

Table 4 – Composite façade sound reduction

Description	Term	Value	Comment
Total Glazing Area as percentage of Wall Area	%	30	Assumption for typical room
Walls, Rwall	$R_{A(Traffic)}$	47	Sound Control for Homes, Table 14, Timber frame, brick facing
Glazing, Rwindow	Rw + C	29	Saint Gobain Acoustic Database, 4/20/4
Rwall - Rwindow		18	
Add to Rwindow		5	from Figure 49
Composite Facade	Rw + C	34	

A5.2 **Internal Noise Calculations**

A5.3 The results of the 3D acoustic CAD modelling indicate that the highest external noise levels are predicted for plots 242-249 at first floor height (see Appendix 4).

A5.4 The determine the efficacy of the glazing, this assessment uses the maximum required sound reduction performance required to satisfy the criteria of Newport City Council as detailed in Table 5.

Table 5 – Maximum Required Glazing Attenuation

Term	Predicted Level @ 2m (dB)	Internal Noise Criteria (dB)	Required Sound Insulation Performance (dB)
$L_{Aeq,1hr}$	66	40	26
L_{Amax}	78	45	33

A5.5 Table 5 indicates that the sound insulation performance of the façade should achieve a minimum of 33 dB to satisfy the L_{Amax} criteria during the night time period.

A5.6 Using the calculated composite façade sound reduction and the L_{Amax} results from the 3D CAD model for external noise levels 2m in front of the façade, we have predicted the internal noise levels inside the first floor bedroom of Plots 242-249 using (2) as detailed in Table 6.

A5.7 Calculations assume that the activity noise is continuous throughout the assessment period.

Table 6 – Internal Noise Levels, Plots 242-249

Description	Value (dB)
Plots 242-249, L_1 @ 2m (L_{Amax})	78
Composite Sound Reduction, (Rw + C)	34
Internal Noise Level, L_2 (L_{Amax})	44

The above calculations assume that the glazing is sealed 4mm glass/20mm air gap/4mm glass glazing units.

Appendix 6
Glossary of Acoustic Terms

A6.0 GLOSSARY OF ACOUSTIC TERMS

(Adapted from Department of the Environment's Report of the Noise Review Working Party, 1990, HMSO)

A6.1 **Ambient Noise:**

Includes both the residual noise and specific noise (from site operations) when present.

A6.2 **Residual Noise:**

The ambient noise remaining at a given position in a given situation when the specific noise is suppressed to such a degree that it does not contribute to the ambient noise.

A6.3 **Specific Noise:**

Noise from the source under investigation.

A6.4 **A-weighting:**

Normal hearing covers the frequency (pitch) range from about 20 Hz to 20,000 Hz but sensitivity is greatest between about 500 Hz and 5,000 Hz. The 'A-weighting' is an electrical circuit built into noise meters to approximate this characteristic of human hearing.

A6.5 **Background:**

The underlying noise level in the absence of the specific noise resulting from the proposed mineral working, usually measured as $L_{A90,T}$ *(see below).*

A6.6 **Decibel (dB):**

The logarithmic measure of sound level. 0dB (A) is the threshold of normal hearing. 140 dB (A) is the level at which instantaneous damage to hearing is caused. A change of 1 dB is detectible only under laboratory conditions.

A6.7 **dB(A):**

Decibels measured on a sound level meter incorporating a frequency weighting (A-weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with an individual's assessment of loudness. A change of 3 dB (A) is the minimum perceptible under normal conditions and a change of 10 dB(A) corresponds roughly to doubling or halving the loudness of a sound.

A6.8 **Free Field:**

A sound field in which no significant sound reflections occur

A6.9 **$L_{A10,T}$:**

The 'A-weighted' noise level exceeded for 10% of the specified measurement period (T). It gives an indication of the upper limit of fluctuating noise such as that from road traffic. $L_{A10,18hr}$ is the arithmetic average of the 18 hourly $L_{A10,1hr}$ values from 06:00 - 24:00.

A6.10 **$L_{A90,T}$:**

The 'A-weighted noise level exceeded for 90 percent of the specified measurement period (T). In BS4142, this is used to define the background noise level.

A6.11 **$L_{Aeq,T}$:**

The equivalent continuous sound level - the sound level of a notional steady sound having the same energy as a fluctuating sound over a specified measuring period (T). This is used to describe many types of noise, and can be measured directly with an integrating sound level meter.

A6.12 **L_{Amax}:**

The maximum 'A-weighted' level of noise recorded during a noise event. The time weighting used (fast or Slow) should be stated.

A6.13 **Tonality:**

The degree to which a noise contains audible pure tones. Broadband noise (across a wider range of frequencies) is generally less annoying than noise with identifiable tones.

A6.14 **Frequency:**

The number of cycles per second of a vibration usually expressed in units of Hertz, Hz

A6.15 **Hertz:**

Unit of frequency, equal to one cycle per second. Frequency determines the pitch of a sound.

A6.16 **Peak Particle Velocity (PPV):**

A measure of ground vibration magnitude, which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second.

A6.17 **Vibration Dose Value (VDV):**

BS6472:1992 'Guide to evaluation of human exposure to vibration in buildings' gives base curves of vibration for minimum adverse comment and VDV's at which complaints are probable. VDV's may be used to assess the severity of impulsive and intermittent vibration, such as experienced from vibration at quarries.

Appendix 7
References

A7.0 REFERENCES

1 'Assessment of Environmental Noise, Herbert Road, Newport', Waterman Energy, November 2013

2 1404038R01RevAAA, 'Noise Impact Assessment for Proposed Residential Development', Acoustics and Noise Ltd, 8th April 2014

3 Guidelines for Community Noise - Berglund, Lindvall & Schwela 1999 World Health Organisation

4 **BS 4142** : 1997 "Rating Industrial noise affecting mixed residential and industrial areas"

5 ISO 9613 Acoustics – Attenuation of sound propagation outdoors Parts 1 & 2

6 "Sound Control for Homes", Building Research Establishment and Construction Industry Research and Information Association, 1993

7 BS EN ISO 717-1:1997, 'Acoustics - Rating of sound insulation in buildings and of building elements, Part 1: Airborne sound insulation', British Standards