REPORT REFERENCE:

IMP5180-1

ENVIRONMENTAL NOISE IMPACT ASSESSMENT

British Standard 8233: 2014

CLIENT:

Bere Regis Parish Council

SITE:

Land behind West Street, Bere Regis

(Longitude: 50.75’61.16°, Latitude: 2.22’23.70°)

SURVEY DATES:

11th – 16th October 2017

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Report by: Mr I. Broom AMIOA

1 EXECUTIVE SUMMARY

1.1 Instruction

Impact Acoustics have been instructed to undertake a background noise survey to ISO1996:2007 to determine the impact of existing noise sources on the proposed residential properties at Land behind West Street, Bere Regis in accordance with BS8233:2014.

1.2 Scope of Report

The measurements will be undertaken in accordance with ISO 1996 – Part 2: 2007 to determine the existing background noise levels and British Standard 8233:2014 will be used to determine the impact of existing traffic on the internal noise environment within the proposed residential properties. This report aims to establish the following:

- Existing background noise levels with reference to the A35 (North of site) in accordance with ISO1996-2:2007;
- A 3D working noise model of the site with reference to the entered and calibrated measured noise levels per position and noise source. This will allow an understanding of the resulting noise levels per daytime, night time and Lmax at any point within the site;
- Assess the potential internal noise levels on the proposed residential properties both with the BS8233:2014 calculation methodology as well as with a partially open window;
- Provide specifications for the ventilation and window glazing with the proposed residential properties; dependent on site location
- Assess the impact of environmental noise within external amenity space;

1.3 Summary of Results

1.3.1 Background Noise Levels

A background noise survey was undertaken from 11th – 16th October 2017 at the A road facing boundary to the proposed site in order to establish the underling background noise levels. The average measured daytime and night time noise levels will be used to form the noise assessment for control of environmental noise.

The average day time levels from the overall continual noise measurement at assessment position 1 were found to be $L_{Aeq,16hour}$ 81 dB and the maximum night time levels from the overall continual noise measurement were found to be $L_{Aeq,8hour}$ 73 dB. A representative modal analysis of the typical night time $L_{AMAX,\ 8hour}$ that is present at the assessment position was found to be L_{AMAX} 91 dB

The maximum day time and night time levels are summarised in the table below per assessment position:

1.3.1.1 Assessment Position 1

Date	LAeq	
	Day	Night
	(0700 - 2300)	(2300 -0700)
11/10/2016	-	74.0
12/10/2016	81.5	74.2
13/10/2016	81.7	72.3
14/10/2016	80.6	71.1
15/10/2016	80.0	74.1
16/10/2016	81.8	-
Arithmetical Average	**81.1**	**73.1**

1.3.2 Proposed Residential Façade Noise Levels

A detailed noise map was produced and calibrated to background noise measurements. The noise map indicated that the maximum noise levels that are likely to be present at the proposed residential façade will during the day time period be $L_{Aeq, 16\ hour}$ 76 dB and during the night time period be $L_{Aeq, 8\ hours}$ 69 dB (assuming a +3dB façade incident).

The L_{AMAX} has also been modelled within the noise map. The average maximum noise levels that are likely to be present at the proposed residential façade will during the night time period be $L_{AMAX,}$ 87 dB (assuming a +3dB façade incident).

Detailed calculations indicated that internal noise levels within the proposed residential properties would not comply with the requirements of British Standard 8233: 2014 for average daytime and night time noise and the requirements of the WHO Guidelines for LAmax Levels without substantial glazing or layout changes.

It was found that with the inclusion of a 10m earth bund running at the A road north boundary with a western return the reduced noise levels that are likely to be present at the proposed residential façade will during the day time period be $L_{Aeq, 16\ hour}$ 60 dB and during the night time period be $L_{Aeq, 8\ hours}$ 52 dB (assuming a +3dB façade incident).

The L_{AMAX} has also been modelled within the noise map. The average maximum noise levels that are likely to be present at the proposed residential façade will during the night time period be $L_{AMAX,}$ 70 dB (assuming a +3dB façade incident).

Detailed calculations indicated that internal noise levels within the proposed residential properties will now comply with the requirements of British Standard 8233: 2014 for average daytime and night time noise and the requirements of the WHO Guidelines for LAmax Levels.

1.3.3 Requirements for noise mitigation

In order to meet reasonable internal levels in accordance with BS8233:2014; all facades should implement the following mitigation measures (NOTE: measures are indicative of worst case first floor calculated noise level. Housing layout is still to be confirmed at time of report):

Construction of earth bund	10m road facing boundary including western return
Construction of Walls	Standard masonry construction
Construction of Ceiling	2 layer of 12mm Fireline plasterboard
Construction of Windows (South)	4mm glass / 16mm air gap / 4mm glass
Construction of Ventilation	MVHR

Detailed calculations indicated that internal noise levels within the proposed residential properties will comply with the requirements of British Standard 8233: 2014.

Time Period	Façade / Area	Specification	Room	Resulting Internal Level dB(A)	Criteria Limit
Day	North Facing highest noise level position	4/16/4 / MVHR	First Floor	25 dB LAeq,16hour	35dB
Lmax	North Facing highest noise level position	4/16/4 / MVHR	First Floor	32 dB LAmax	45dB
Night	North Facing highest noise level position	4/16/4 / MVHR	First Floor	15 dB LAeq, 8hour	30dB
Day	Garden Area	10m earth bund	Garden	All levels below 55dB LAeq	55dB
Resulting Internal Levels calculated in accordance with BS8233:2014 per time period					

1.4 Conclusions

It would be proposed that the development should be undertaken with glazing (4/16/4) with a mechanical ventilation system to alleviate the requirement for partially open windows to specified facades to ensure the internal noise levels are acceptable in terms of the assessment to British Standard 8233: 2014 and WHO Guidelines.

A requirement for a 10m earth bund at the road facing boundary with a western return is recommended to control both internal noise (façade levels) as well as external noise below the upper limit of 55dB LAeq,16hour in accordance with WHO Guidelines.

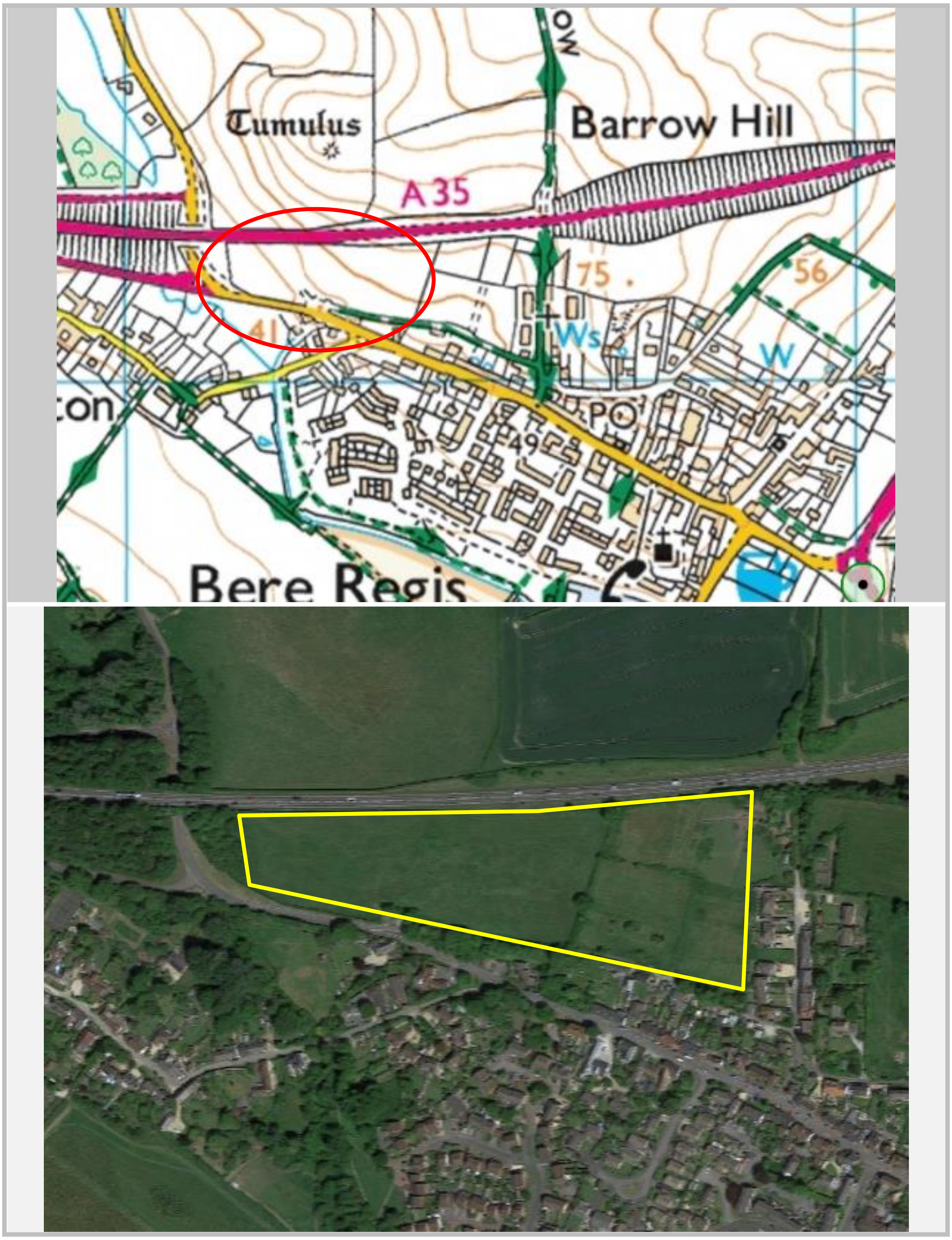
1.4.1 Uncertainty

It is expected that the reported expanded uncertainty with reference to the background noise measurement with a confidence limit of 95% and assuming a convergence of k=2 is likely to be +/- 3.6dB. Uncertainty, in this instance has been minimised by undertaking longer background noise measurements over a greater than 120-hour period. Background noise measurement uncertainty budget is shown in Appendix C.

2 SITE LOCATION AND RELEVENT NOISE SOURCES

2.1 Position of Site

The site is located in Bere Regis. The dominant noise source considered is road traffic noise from the A road. This has been confirmed by on site measurements and audible assessment.



3 BACKGROUND NOISE LEVELS

3.1 Location of Measurements

1	Latitude:	50.75'61.16°	Longitude:	2.22'23.70°	Elevation:	3m

Measurements were taken in accordance with ISO1996:2007 in the free field and in clear line of sight of the applicable sources. The detailed results are listed below and the results of the average levels are summarised below as 3D noise maps. The noise maps have been created and calibrated to the background noise data with the standard traffic flow rates adjusted and source levels (line) adjusted accordingly.

3.2 Background Noise Levels

Background noise levels are summarised below. Full measurement data is shown in Appendix B. The continuous measurement per location has been analysed to form the working daytime (0700 – 2300) and night time (2300 – 0700) time periods in accordance with BS8233:2014. The arithmetical average measured time period per day and night have been chosen for assessment and for input into the working noise model. This rationale will lead to a more robust conclusion when forming mitigation against the existing noise climate.

3.2.1.1 Assessment Position 1

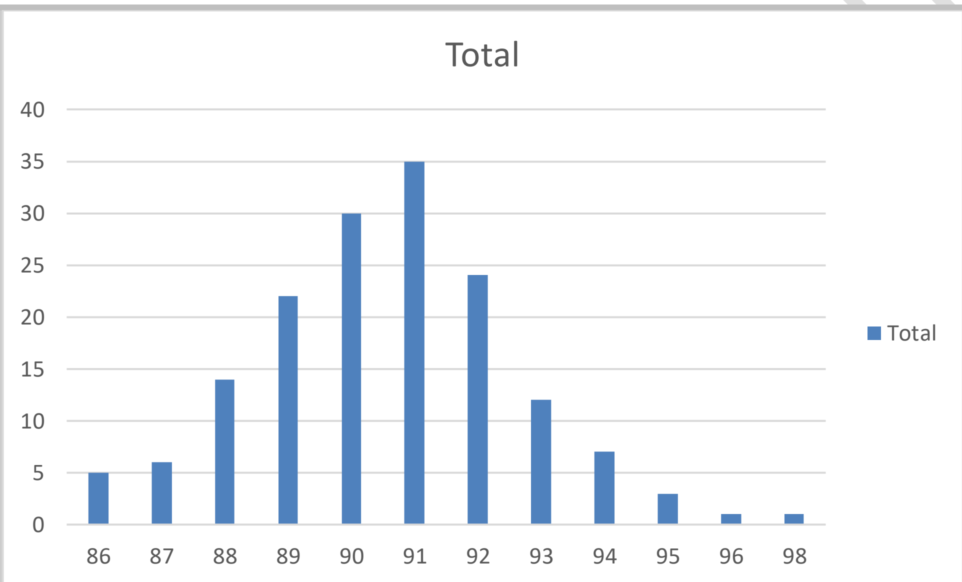
Date	**LAeq**	
	Day	Night
	(0700 - 2300)	(2300 -0700)
11/10/2016	-	74.0
12/10/2016	81.5	74.2
13/10/2016	81.7	72.3
14/10/2016	80.6	71.1
15/10/2016	80.0	74.1
16/10/2016	81.8	-
Arithmetical Average	**81.1**	**73.1**

Time	LAeq	Leq (63Hz)	Leq (125Hz)	Leq (250Hz)	Leq (500Hz)	Leq (1kHz)	Leq (2kHz)	Leq (4kHz)
Day	81.0	83.1	79.8	75.6	75.2	80.0	68.3	54.9
Lmax	91.0	93.1	87.9	81.8	84.9	90.1	78.4	63.8
Night	73.0	74.5	70.9	65.5	67.0	72.1	60.3	47.5

3.3 LAMax Assessment

In order to have an understanding of the existing noise climate with reference to the instantaneous maximum recorded noise levels per working time period (LAmax), a modal analysis of the recorded LAmax per measurement position has been analysed. By understanding the maximum noise (i.e LAmax,1hour rounded to the nearest 5dB(A)) that repeats itself most often during the measurement period we can increase certainty that the LAmax formed can be considered representative of the noise climate for the complete measurement period and can be used for input into the working 3D noise model as a controllable noise level. For clarity, the resulting LAmax levels will be controlled against the parameters set out for night time noise and sleep disturbance of 45dB LAmax internal.

3.3.1 Modal Analysis LAmax (Assessment Position 1)



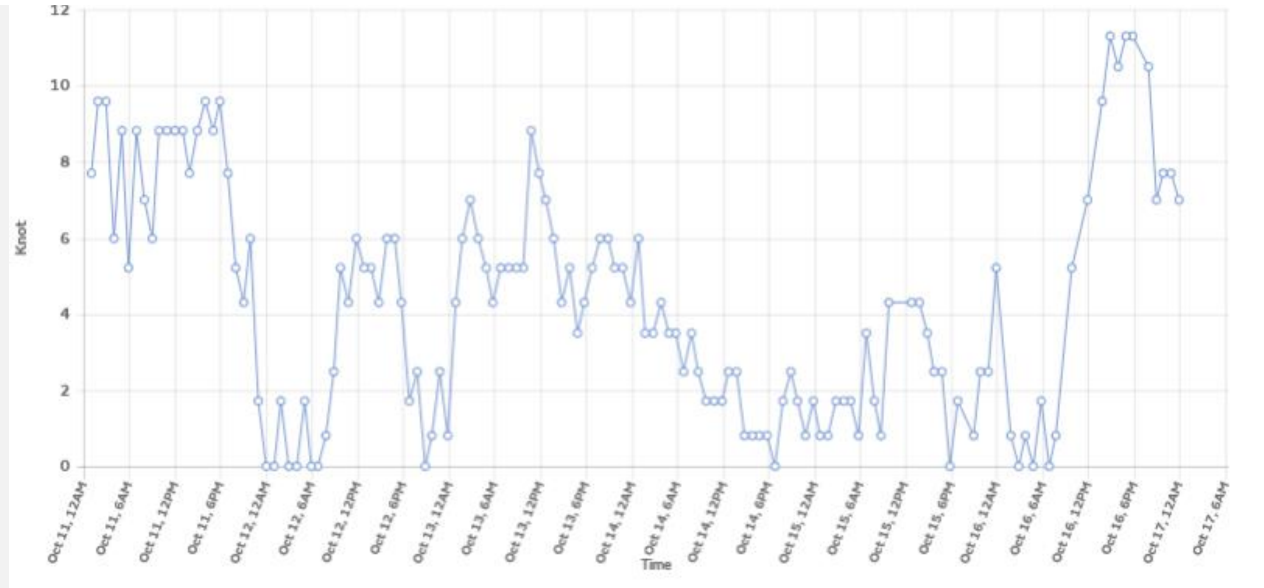
Modal Analysis LAmax

Equivalent Existing Background Noise Levels LAMAX	Measured Levels at Assessment Position	LAMAX 91 dB

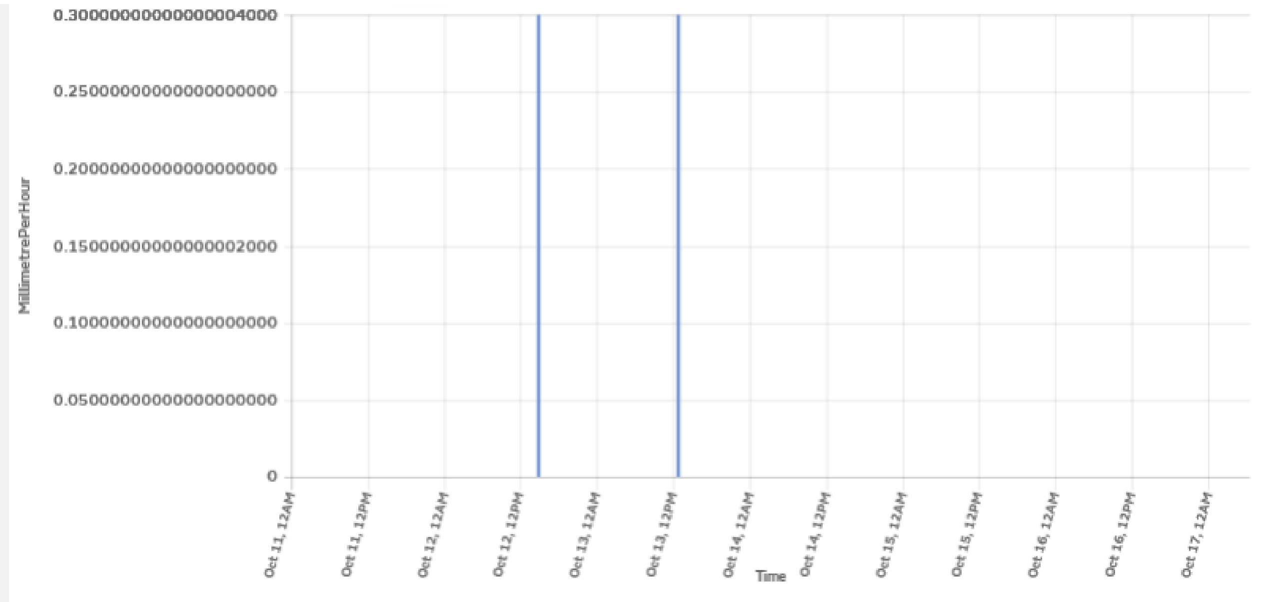
3.4 Weather Analysis[1]

Where periods of Weather exceeded 4m/s or there were periods of rainfall; measurements have been excluded from time history. Periods of unsettled weather not conducive to a representative baseline were as follows:

Date	Time Start	Time Finish	Reason
12/10/2017	1300	1600	Periods of Rainfall
13/10/2017	1000	1200	Periods of Rainfall
16/10/2017	1600	1900	Wind in excess of 4m/s



Wind Speed (knots) (knot conversion to m/s (0.5))

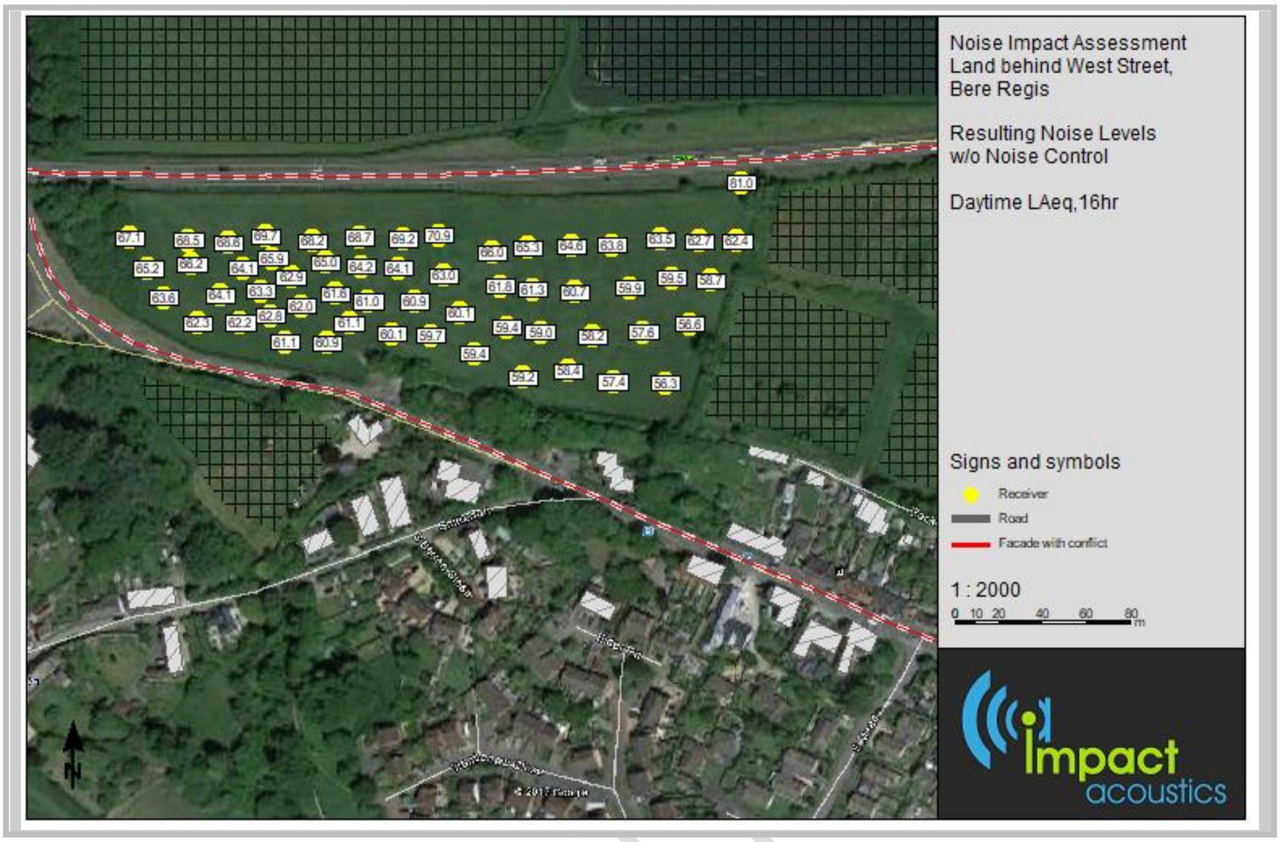


Rainfall Rate (mm/h)

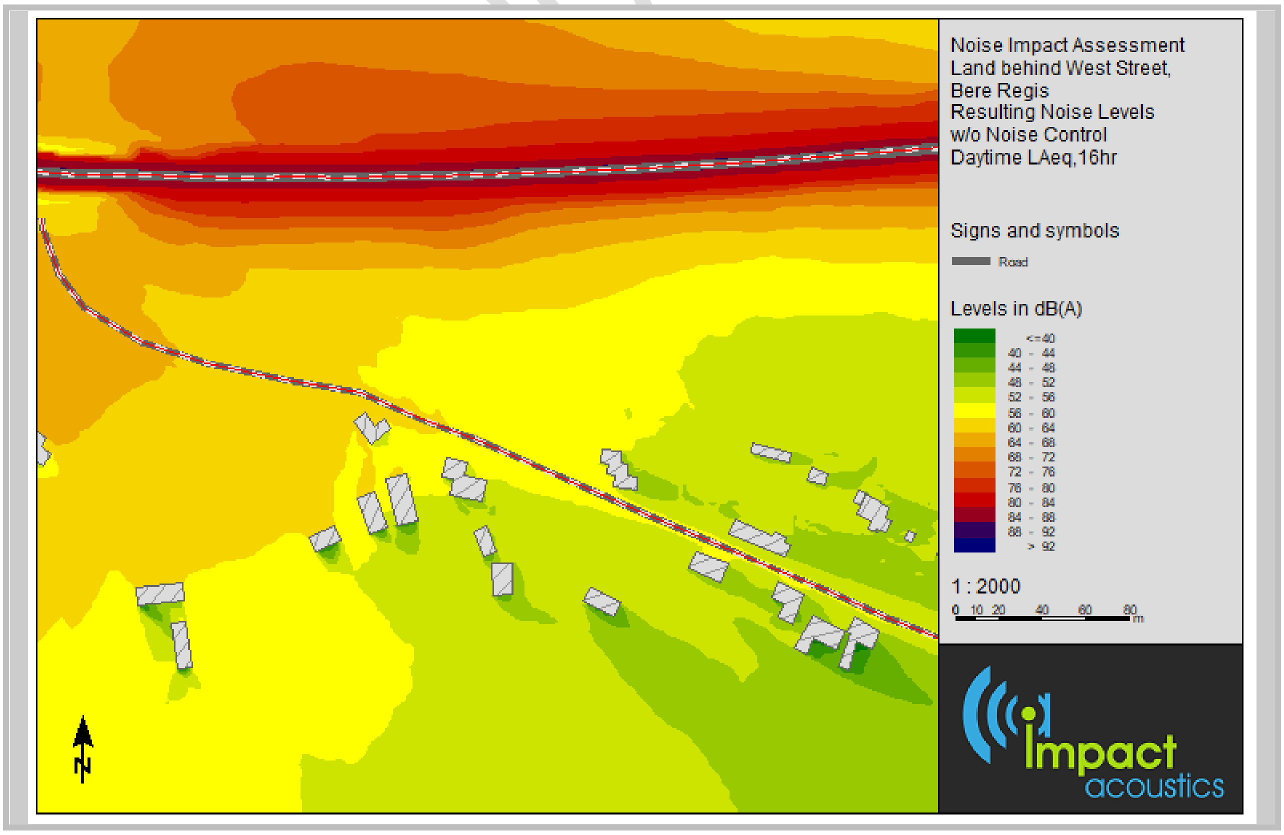
[1] Weather data obtained from Weather Observation Met Office Data (http://wow.metoffice.gov.uk/observations/)

3.5 3D Noise Maps of Background Noise Levels – Existing (Pre-Development)

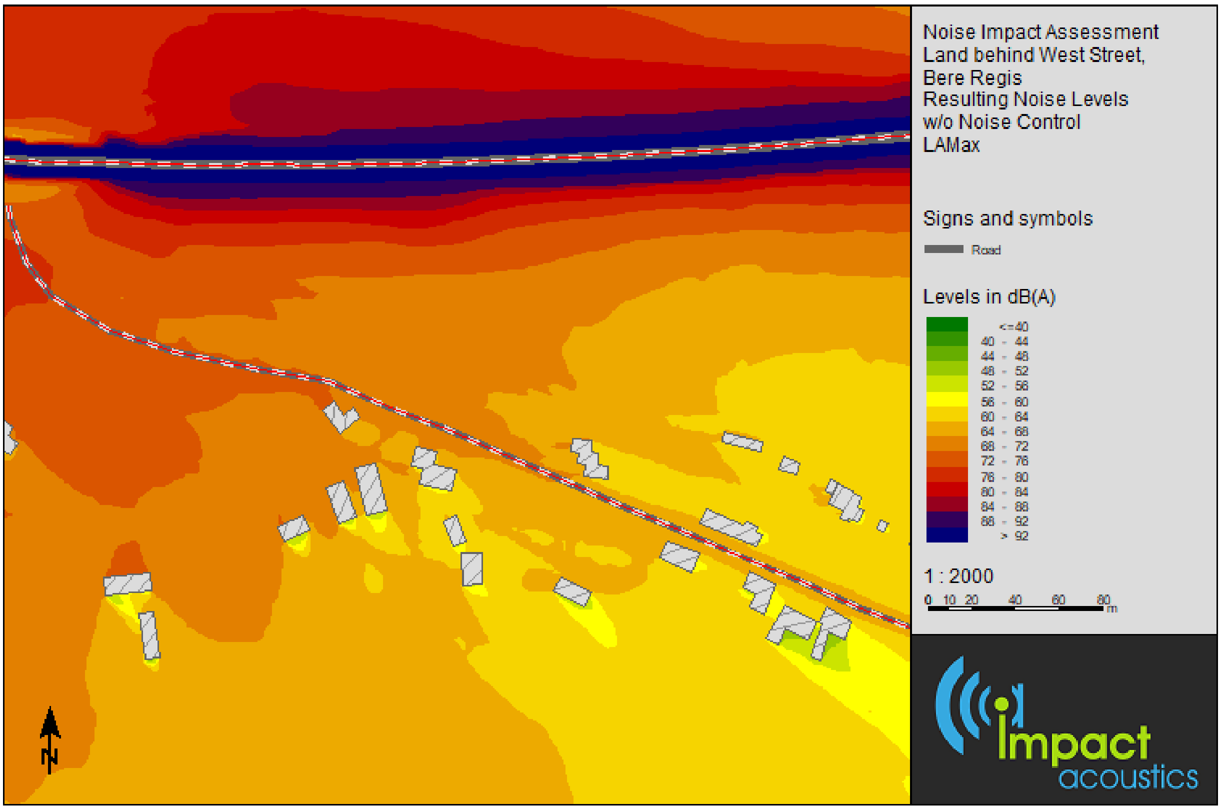
3.5.1 24 hour Levels



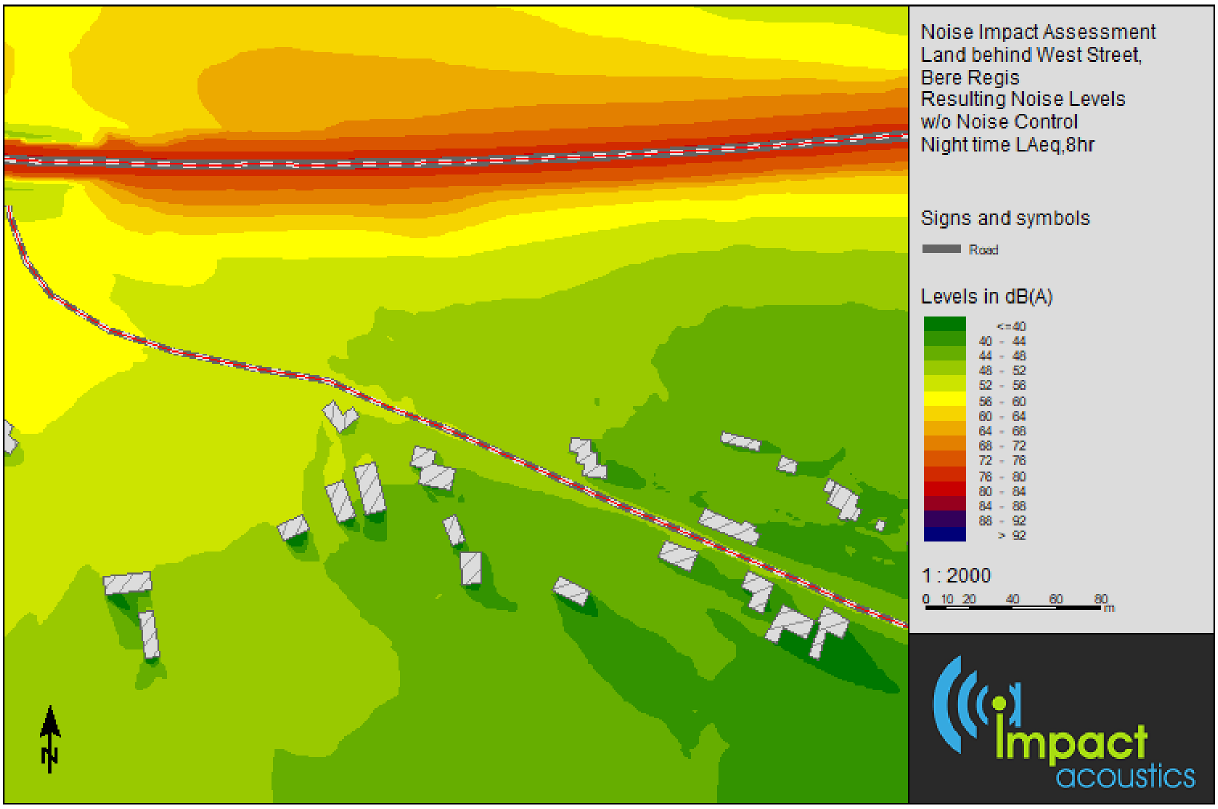
3.5.2 Day time (0700 – 2300)



3.5.3 LMax



3.5.4 Night Time (2300 – 0700)



4 NOISE CRITERION

4.1 British Standard 8233: 2014 ("BS8233")

4.1.1 Scope of Document

British Standard 8233:2014 provides guidance on the sound insulation and the reduction of noise in and around buildings and replaced the original 1999 standard in February 2014.

> *"This British Standard provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings….."*

The standard goes onto to provide details of the approach to be taken when assessing the design in terms of planning:

"a) Assess the site, identify significant existing and potential noise sources, measure or estimate noise levels and evaluate layout options.

b) Determine design noise levels for spaces in and around the building (s).

c) Determine sound insulation of the building envelope, including the ventilation strategy.

d) Identify internal sound insulation requirements.

e) Identify and design appropriate noise control measures.

f) Establish quality control and ensure good workmanship."

4.1.2 Internal Ambient Noise Levels for dwellings

British Standard 8233:2014 provides desirable internal ambient noise levels within different rooms and at different times for external noise sources that are considered steady within section 7.7.2.:

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	$L_{Aeq,\ 16\ hour}$ 35 dB	--
Dining	Dining Room	$L_{Aeq,\ 16\ hour}$ 40 dB	--
Sleeping (Daytime Resting)	Bedroom	$L_{Aeq,\ 16\ hour}$ 35 dB	$L_{Aeq,\ 8\ hour}$ 30 dB

4.1.3 External Amenity Space

British Standard 8233:2014 provides guidance on the acceptable noise levels for external amenity and gardens:

"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 $L_{Aeq,\ T}$ 50 dB with an upper guideline value of $L_{Aeq,\ T}$ 55 dB which would be acceptable in noisier environment…."In higher noise areas…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 , night be warranted."

4.2 ISO 1996 – Part 2:2007

4.2.1 Scope of ISO 1996 – Part 2:2007

Part 2 of ISO 1996 describes the determination and assessment of environmental noise levels through either direct measurement, by extrapolation of measurement results, or by means of calculation.

4.2.2 Measurement Time Interval

The selection of the measurement time interval has been chosen in accordance to this standard. The measurements have been taken over a continuous period and includes both the day and night time period.

4.2.3 Instrumentation

The instrumentation and all components associated with the instrument used to measure the sound levels comply with the instrumentation system given in section 5.1 of this standard.

4.2.4 Calculation Methods

Although there are no internationally recognised calculation methods other national standards have been used for this assessment.

4.3 WHO Guidelines for Community Noise

4.3.1 World Health Organisation

The document describes guideline levels that are "essentially values for the onset of health effects from noise exposure". A table of guideline values is included, relating to adverse health effects, referred to as any temporary or long term deterioration in physical, psychological, or social functioning that is associated with noise exposure. The following is an extract from the Table 4.1: Guideline values for community noise in specific environments, as stated in the document.

Specific Environment	Critical Health Effect(s)	L_{Aeq} (dB)	Time Base (hours)	$L_{Amax,F}$ (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-times	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

Guideline values for community noise in specific environments

4.4 Night Noise Guidelines ("NNGL")

The European Union and the World Health Organisation jointly published a document entitled "Night Noise Guidelines" in 2009 ("NNGL"). The overall goal of the document was detailed within the summary pages:

> *"The goal of the NNGL project was to provide and expand scientific advice to the European Commission and its Member States in developing future legislation in the area of night noise exposure, control and surveillance. The key objective of the project was to reach a consensus of experts and key stakeholders on the following subjects:*
>
> *a) Guideline values for night noise to protect the public from adverse health effects....."*

4.4.1 No Observed Adverse Effect Level (NOAEL)

The section entitled *"Threshold for Observed Effects"* within the executive summary of the NNGL a list of the absolute level at which there is sufficient evidence available for the no observed adverse effect level (NOAEL):

Effect of Noise	Description	Indicator	Threshold (NOAEL)
Biological Effects	EEG awakening	$L_{Amax,inside}$	35 dB
	Motility, onset of motility	$L_{Amax,inside}$	32 dB
	Changes in duration of various stages of sleep, in sleep structure and fragmentation of sleep	$L_{Amax,inside}$	35 dB
Sleep Quality	Waking up in the night and / or too early in the morning	$L_{Amax,inside}$	42 dB

4.4.2 Vulnerable Groups

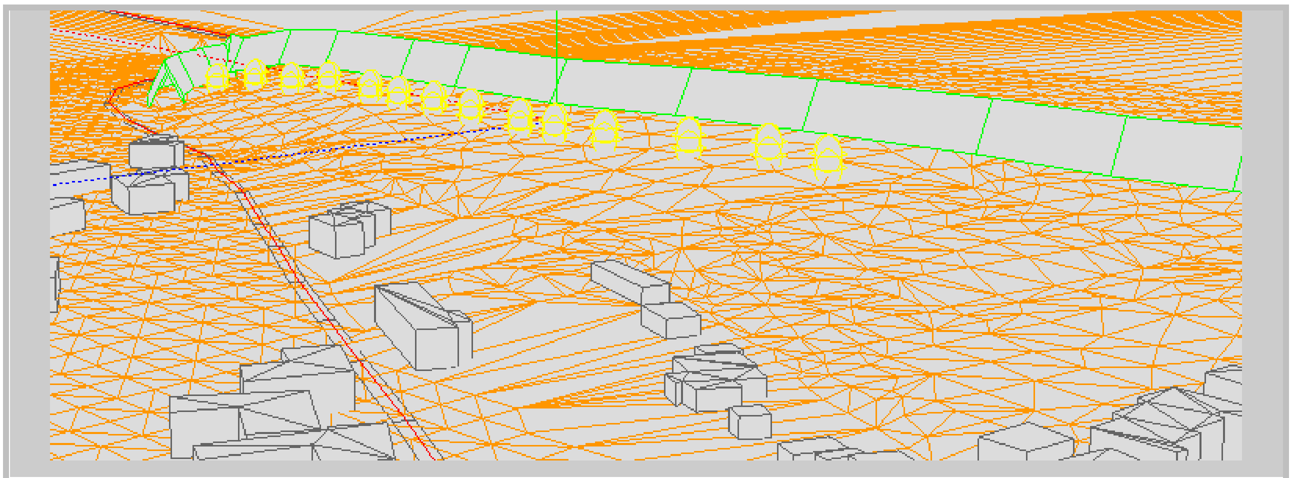
In setting the LOAEL and the SOAEL within the scope of the NPSE consideration has been made for the statement made under the title *"Vulnerable Groups"* which indicates that young children, elderly adults and shift workers should be considered vulnerable groups and more likely to be effected by unwanted noise.

4.4.3 Attenuation of an Open Window

The NNGL indicates an attenuation of around 10 – 15 dB(A) through an open window. It could therefore be appropriate to consider an overall reduction of 10 dB(A) through a partially open window.

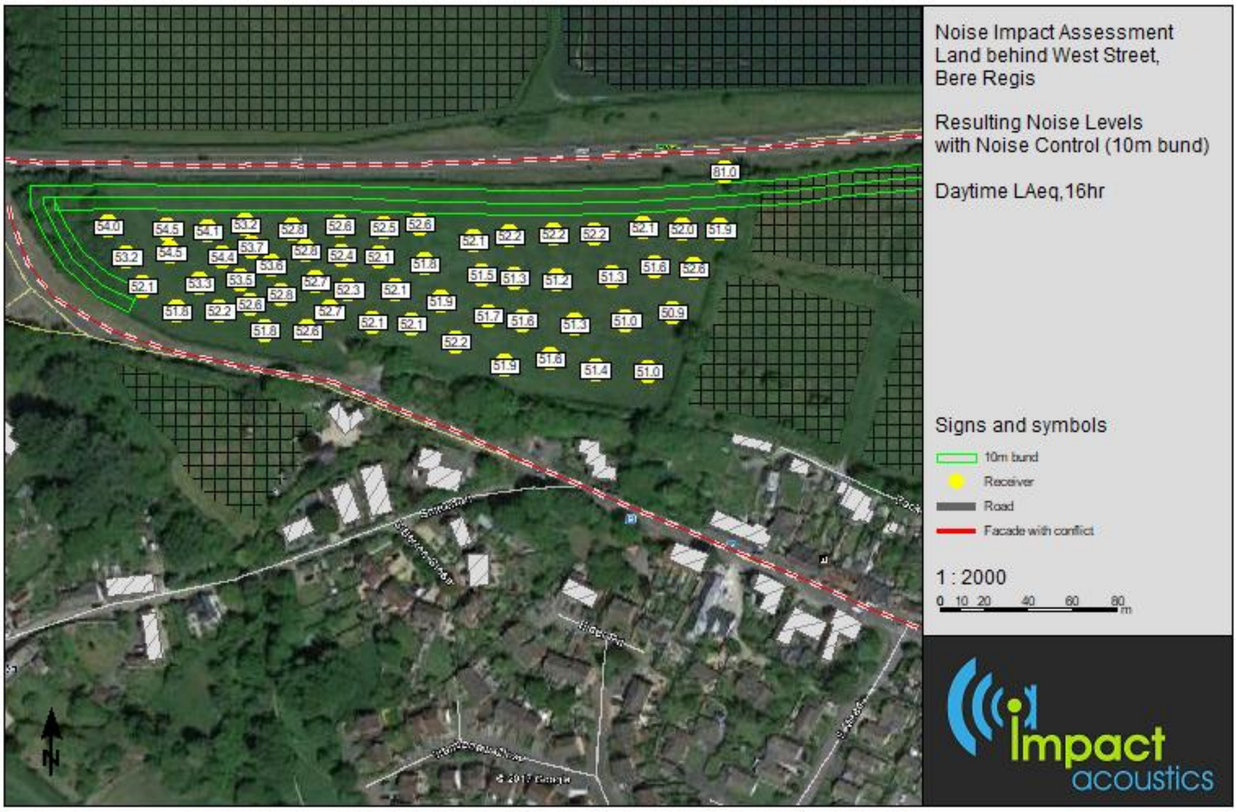
5 EXTERNAL NOISE ASSESSMENT

In order to control both the external and internal (façade level) noise environment; there is a requirement for an earth berm to the erected at the road facing (northern) boundary with a western return. Assessments of bund height has been made to the point that all recicver locations fall below 55dB LAeq at a height of 2m in accordance with WHO guidelines. The resulting external areas prior to development were calculated between 70 - 56 LAeq, 16hour. 10m earth bund placement has been recommended to reduce the potential disturbance in external areas of the site as defined in WHO criteria:



Noise Maps. Recciver points green and yellow.

5.1 Noise Maps



External Noise (55dB Limit Line) with 10m earth bund

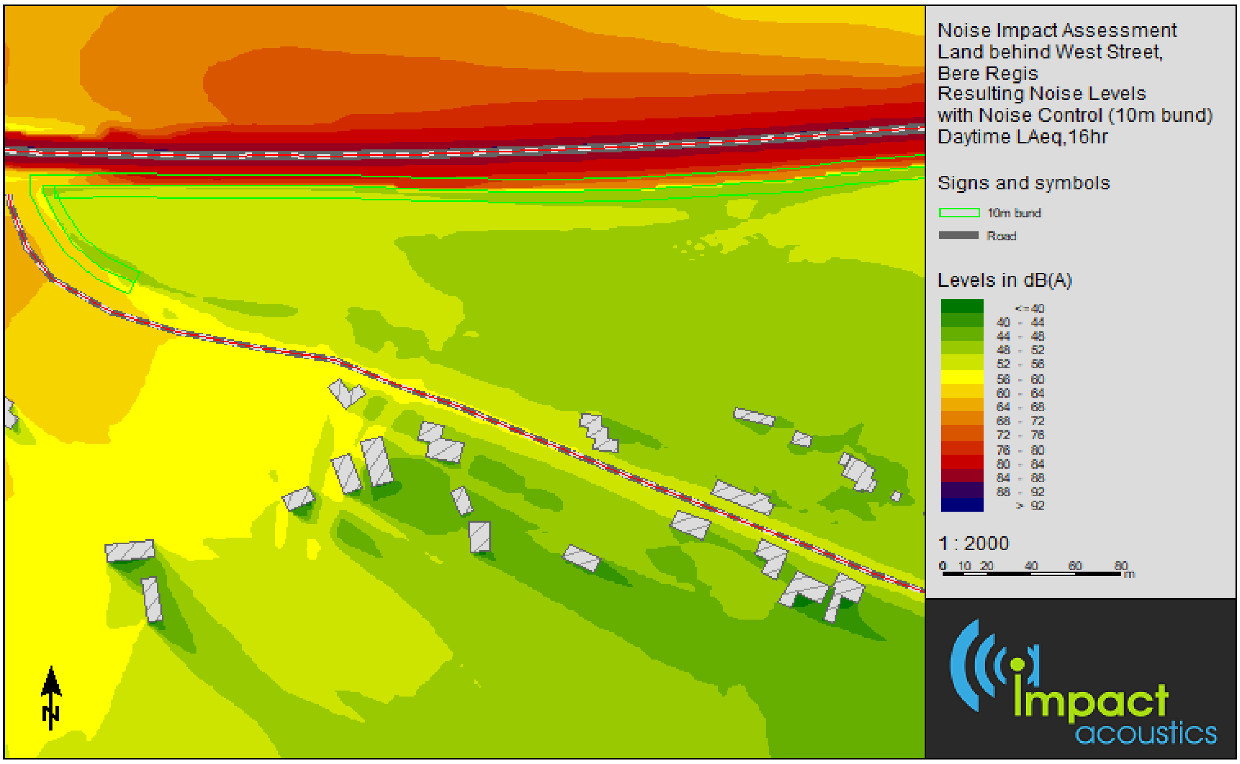
6 INTERNAL NOISE ASSESSMENTS

The proposed development has been added into the existing noise map and the resulting façade levels have been calculated. The modelling software used is SoundPLAN and the resulting levels have been predicted within the software in accordance with ISO9613-2 and Calculation of Road Traffic Noise.

6.1 Resulting Façade Levels (Post Development)

6.1.1 Single Point Results

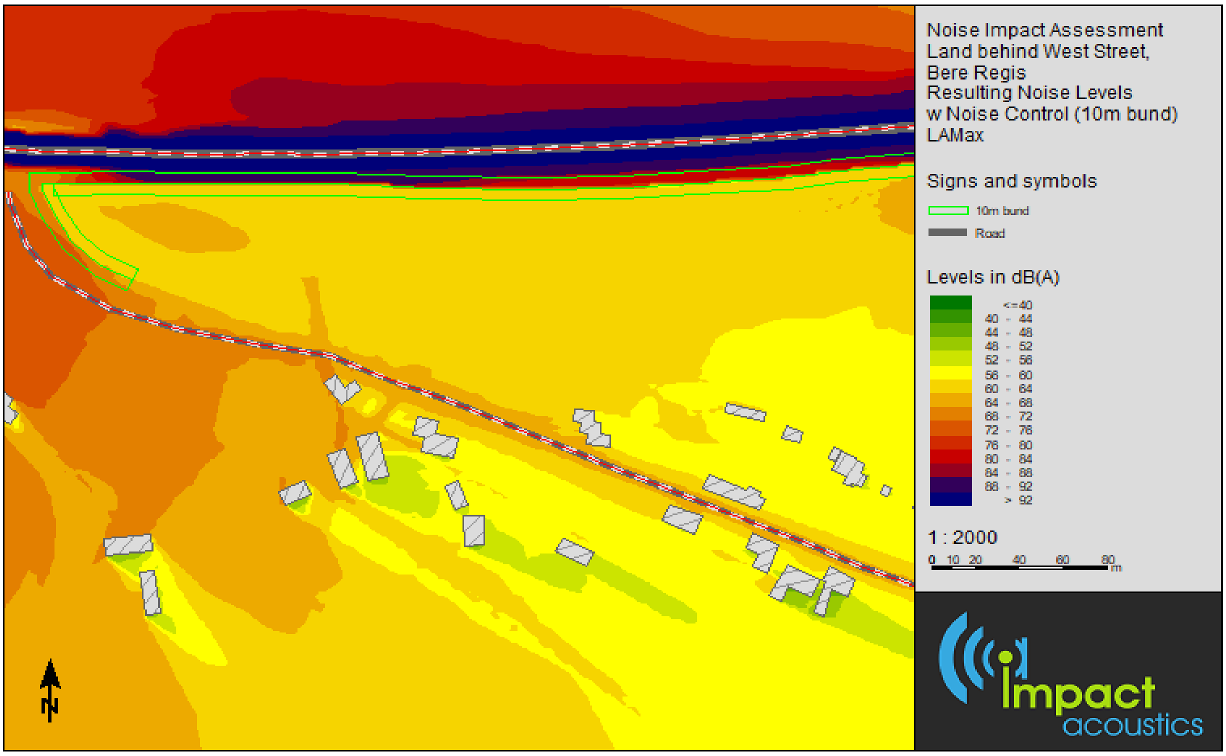
6.1.2 Day Time (07:00 – 23:00)



Octave Band Centre Frequency (Hz)						
63	125	250	500	1000	2000	4000
62.0	58.7	54.5	54.1	58.9	47.2	33.8
Resultant Maximum Sound Pressure Level at Façade – $L_{eq,\ 16\ hours}$, (dB) Reference 2 x 10^{-5} Nm^{-2}						

The above levels equate to an overall broad band level of $L_{Aeq,\ 16\ hours}$ 60 dB

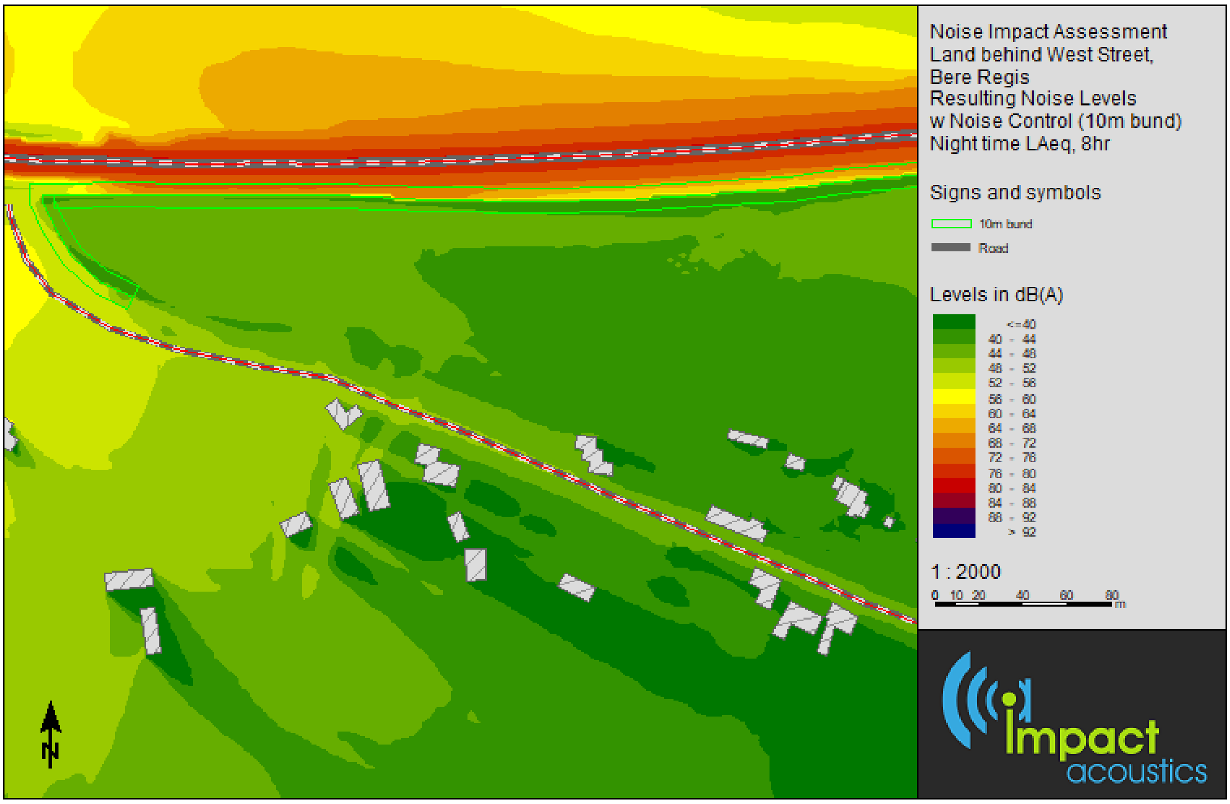
6.1.3 LAmax



Octave Band Centre Frequency (Hz)						
63	125	250	500	1000	2000	4000
72.1	66.9	60.8	63.9	69.1	57.4	42.8
Resultant Maximum Sound Pressure Level at Façade – $L_{MAX,\ 8\ hours}$. (dB) Reference 2 x 10^{-5} Nm^{-2}						

The above levels equate to an overall broad band level of L_{AMAX} 70 dB

6.1.4 Night Time (23:00 to 07:00)



Octave Band Centre Frequency (Hz)						
63	125	250	500	1000	2000	4000
53.5	49.9	44.5	46.0	51.1	39.3	26.5
Resultant Maximum Sound Pressure Level at Façade – $L_{eq, 8 hours}$, (dB) Reference 2 x 10^{-5} Nm^{-2}						

The above levels equate to an overall broad band level of $L_{Aeq, 8 hours}$ 52 dB.

6.2 Calculation Procedure

$$L_{eq,2} \approx L_{eq,ff} + 10.\log_{10}\left(\frac{A_0}{S}.10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}.10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}.10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}.10^{\frac{-R_{rr}}{10}} + \right) + 10.\log_{10}\left(\frac{S}{A}\right) + 3$$

$L_{eq,2}$ = Equivalent sound pressure level internally within the room (dB) – reference 2 x 10^{-5}Nm^{-2}.

$L_{eq,ff}$ = Equivalent sound pressure level externally outside the room under consideration (dB) – reference 2 x 10^{-5}Nm^{-2}.

A_0 = Reference absorption area within room of 10m^2 and independent of frequency.

S_f = Total façade area of room in question (m^2).

S_{wi} = Area of windows or glazing within the room (m^2).

S_{ew} = Area of external wall within the room (m^2).

S_{rr} = Area of the ceiling within the room (m^2).

S = Total area of elements through which sound enters the room (m^2). i.e. $S = S_f + S_{rr}$

$D_{n,e}$ = Sound insulation of the trickle vent measured to British Standard 20140 – Part 10: 1992 (Withdrawn)

R_{wi} = Sound reduction index of the window (dB)

R_{ew} = Sound reduction index of the external wall (dB)

R_{rr} = Sound reduction index of the ceiling (dB)

A = Equivalent absorption of the room under consideration (m)

6.3 Ventilation (D_{ne})

In accordance with Note 5 from BS8233:2014 below a mechanical ventilation system or MVHR is recommended:

NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the facade insulation or the resulting noise level.

Note 5 Page 25 BS8233:2014

Due to the façade levels at certain section of the site being in excess of 45dB LAeq, daytime; suitable mechanical ventilation is recommended that meets the requirements of Part F of the Building Regulations to alleviate the requirement for ventilation by open windows.

6.4 Glazing (R_{wi})

Octave Band Frequency	63	125	250	500	1000	2000	4000
Acoustic Glazing (4/16/4) 30dB Rw	24	18	26	40	45	39	38

6.5 Walls (R_{ew})

Octave Band Frequency	63	125	250	500	1000	2000	4000
Brick and Concrete Block	40	43	42	45	53	55	55

The above are minimum construction attenuation values and should alternative methods be selected; these should be equal to or greater than the above corresponding values. Calculations carried out have indicated the following specifications should be installed for this site

6.6 Assessments

6.6.1 Daytime (highest impinging level)

British Standard 8233: 2014 Assessment						
Day Time – 07:00 to 23:00 Hours						
Internal Noise Level from External Noise Sources						
Location of Measurements	Front Façade Proposed (FF Level)					
Construction of Walls	External Brick, 75mm cavity and 100mm internal concrete block					
Construction of Ceiling	1 layer of 12mm Fireline plasterboard					
Construction of Windows	4mm glass / 16mm air gap / 4 glass					
Construction of Ventilation	MVHR					
window height	1.2					
window width	1	S (window)	1.2			
Bedroom height	2.3	S (façade)	11.5			
Bedroom width	5	S (room)	66.8			
Bedroom depth	3	volume	34.5			
Rt	0.5	A	11.109			
		125	250	500	1000	2000
Leq,ff	Sound pressure Level outside	58.7	54.5	54.1	58.9	47.2
Dn,e	Insulation of the ventilator	44	51	61	71	76
Rwi	Window Sound reduction	24	18	26	40	45
Rew	Wall sound reduction index	44	51	61	71	76
Rrr	Roof ceiling sound reduction index					
A	Absorption area of the room	11.109	11.109	11.109	11.109	11.109
Sf	Façade Area (including window)	11.5	11.5	11.5	11.5	11.5
Swi	Window Area	1.2	1.2	1.2	1.2	1.2
Sew	Sf-Si	10.3	10.3	10.3	10.3	10.3
Srr	Area of Ceiling					
S	Sf + Srr	11.5	11.5	11.5	11.5	11.5
Ao	Given in BSEN 20140-10	10	10	10	10	10
Leq,ff	A	58.7	54.5	54.1	58.9	47.2
Dn,e		44	51	61	71	76
(Ao/S)*10^(-Dne/10)	B	3.4618E-05	6.9072E-06	6.9072E-07	6.9072E-08	2.18425E-08
Rwi		24	18	26	40	45
(Swi/Sf)*10^(-Rwi/10)	C	0.000415416	0.001653802	0.00026211	1.04348E-05	3.29977E-06
Rew		44	51	61	71	76
(Sew/Sf)*10^(-Rew/10)	D	3.56566E-05	7.11442E-06	7.11442E-07	7.11442E-08	2.24978E-08
Rrr		0	0	0	0	0
(Srr/Sf)*10^(-Rrr/10)	E	0	0	0	0	0
10*log(B+C+D+E)	F	-33.13640169	-27.77849986	-35.7919952	-49.75719673	-54.75719673
A						
10*log(S/A)	G	0.150228736	0.150228736	0.150228736	0.150228736	0.150228736
Leq,2 = A+F+G+3	A+F+G+3	28.7	29.9	21.5	12.2	-4.4
A weighting		-16	-9	-3	0	1
Leq,2 + Aweighting, freq		12.7	20.9	18.5	12.2	-3.4
Leq,2 + Aweighting		23.59				

6.6.2 LAmax (highest impinging level)

British Standard 8233: 2014 Assessment						
LMAx						
Internal Noise Level from External Noise Sources						
Location of Measurements	Front Façade Proposed (FF Level)					
Construction of Walls	External Brick, 75mm cavity and 100mm internal concrete block					
Construction of Ceiling	1 layer of 12mm Fireline plasterboard					
Construction of Windows	4mm glass / 16mm air gap / 4 glass					
Construction of Ventilation	MVHR					
window height	1.2					
window width	1	S (window)	1.2			
Bedroom height	2.3	S (façade)	11.5			
Bedroom width	5	S (room)	66.8			
Bedroom depth	3	volume	34.5			
Rt	0.5	A	11.109			
		125	250	500	1000	2000
Leq,ff	Sound pressure Level outside	66.9	60.8	63.9	69.1	57.4
Dn,e	Insulation of the ventilator	44	51	61	71	76
Rwi	Window Sound reduction	24	18	26	40	45
Rew	Wall sound reduction index	44	51	61	71	76
Rrr	Roof ceiling sound reduction index					
A	Absorption area of the room	11.109	11.109	11.109	11.109	11.109
Sf	Façade Area (including window)	11.5	11.5	11.5	11.5	11.5
Swi	Window Area	1.2	1.2	1.2	1.2	1.2
Sew	Sf-Si	10.3	10.3	10.3	10.3	10.3
Srr	Area of Ceiling					
S	Sf + Srr	11.5	11.5	11.5	11.5	11.5
Ao	Given in BSEN 20140-10	10	10	10	10	10
Leq,ff	A	66.9	60.8	63.9	69.1	57.4
Dn,e		44	51	61	71	76
(Ao/S)*10^(-Dne/10)	B	3.4618E-05	6.9072E-06	6.9072E-07	6.9072E-08	2.18425E-08
Rwi		24	18	26	40	45
(Swi/Sf)*10^(-Rwi/10)	C	0.000415416	0.001653802	0.00026211	1.04348E-05	3.29977E-06
Rew		44	51	61	71	76
(Sew/Sf)*10^(-Rew/10)	D	3.56566E-05	7.11442E-06	7.11442E-07	7.11442E-08	2.24978E-08
Rrr		0	0	0	0	0
(Srr/Sf)*10^(-Rrr/10)	E	0	0	0	0	0
10*log(B+C+D+E)	F	-33.13640169	-27.77849986	-35.7919952	-49.75719673	-54.75719673
A						
10*log(S/A)	G	0.150228736	0.150228736	0.150228736	0.150228736	0.150228736
Leq,2 = A+F+G+3	A+F+G+3	36.9	36.1	31.3	22.5	5.8
A weighting		-16	-9	-3	0	1
Leq,2 + Aweighting, freq		20.9	27.1	28.3	22.5	6.8
Leq,2 + Aweighting		31.75				

6.6.3 Night Time (highest impinging level)

British Standard 8233: 2014 Assessment						
Night Time (2300 - 0700)						
Internal Noise Level from External Noise Sources						
Location of Measurements	Front Façade Proposed (FF Level)					
Construction of Walls	External Brick, 75mm cavity and 100mm internal concrete block					
Construction of Ceiling	1 layer of 12mm Fireline plasterboard					
Construction of Windows	4mm glass / 16mm air gap / 4 glass					
Construction of Ventilation	MVHR					
window height	1.2					
window width	1	S (window)	1.2			
Bedroom height	2.3	S (façade)	11.5			
Bedroom width	5	S (room)	66.8			
Bedroom depth	3	volume	34.5			
Rt	0.5	A	11.109			
		125	250	500	1000	2000
Leq,ff	Sound pressure Level outside	49.9	44.5	46.0	51.1	39.3
Dn,e	Insulation of the ventilator	44	51	61	71	76
Rwi	Window Sound reduction	24	18	26	40	45
Rew	Wall sound reduction index	44	51	61	71	76
Rrr	Roof ceiling sound reduction index					
A	Absorption area of the room	11.109	11.109	11.109	11.109	11.109
Sf	Façade Area (including window)	11.5	11.5	11.5	11.5	11.5
Swi	Window Area	1.2	1.2	1.2	1.2	1.2
Sew	Sf-Si	10.3	10.3	10.3	10.3	10.3
Srr	Area of Ceiling					
S	Sf + Srr	11.5	11.5	11.5	11.5	11.5
Ao	Given in BSEN 20140-10	10	10	10	10	10
Leq,ff	A	49.9	44.5	46.0	51.1	39.3
Dn,e		44	51	61	71	76
(Ao/S)*10^(-Dne/10)	B	3.4618E-05	6.9072E-06	6.9072E-07	6.9072E-08	2.18425E-08
Rwi		24	18	26	40	45
(Swi/Sf)*10^(-Rwi/10)	C	0.000415416	0.001653802	0.00026211	1.04348E-05	3.29977E-06
Rew		44	51	61	71	76
(Sew/Sf)*10^(-Rew/10)	D	3.56566E-05	7.11442E-06	7.11442E-07	7.11442E-08	2.24978E-08
Rrr		0	0	0	0	0
(Srr/Sf)*10^(-Rrr/10)	E	0	0	0	0	0
10*log(B+C+D+E)	F	-33.13640169	-27.77849986	-35.7919952	-49.75719673	-54.75719673
A						
10*log(S/A)	G	0.150228736	0.150228736	0.150228736	0.150228736	0.150228736
Leq,2 = A+F+G+3	A+F+G+3	19.9	19.8	13.4	4.5	-12.3
A weighting		-16	-9	-3	0	1
Leq,2 + Aweighting, freq		3.9	10.8	10.4	4.5	-11.3
Leq,2 + Aweighting		14.54				

7 CONCLUSION

7.1 Summary of Results

7.1.1 Background Noise Levels

A background noise survey was undertaken from 11th – 16th October 2017 at the A road facing boundary to the proposed site in order to establish the underling background noise levels. The average measured daytime and night time noise levels will be used to form the noise assessment for control of environmental noise.

The average day time levels from the overall continual noise measurement at assessment position 1 were found to be $L_{Aeq,16hour}$ 81 dB and the maximum night time levels from the overall continual noise measurement were found to be $L_{Aeq,8hour}$ 73 dB. A representative modal analysis of the typical night time $L_{AMAX,\ 8hour}$ that is present at the assessment position was found to be L_{AMAX} 91 dB

The maximum day time and night time levels are summarised in the table below per assessment position:

7.1.1.1 Assessment Position 1

Date	LAeq	
	Day	Night
	(0700 - 2300)	(2300 -0700)
11/10/2016	-	74.0
12/10/2016	81.5	74.2
13/10/2016	81.7	72.3
14/10/2016	80.6	71.1
15/10/2016	80.0	74.1
16/10/2016	81.8	-
Arithmetical Average	**81.1**	**73.1**

7.1.2 Proposed Residential Façade Noise Levels

A detailed noise map was produced and calibrated to background noise measurements. The noise map indicated that the maximum noise levels that are likely to be present at the proposed residential façade will during the day time period be $L_{Aeq,\ 16\ hour}$ 76 dB and during the night time period be $L_{Aeq,\ 8\ hours}$ 69 dB (assuming a +3dB façade incident).

The L_{AMAX} has also been modelled within the noise map. The average maximum noise levels that are likely to be present at the proposed residential façade will during the night time period be $L_{AMAX,}$ 87 dB (assuming a +3dB façade incident).

Detailed calculations indicated that internal noise levels within the proposed residential properties would not comply with the requirements of British Standard 8233: 2014 for average daytime and night time noise and the requirements of the WHO Guidelines for LAmax Levels without substantial glazing or layout changes.

It was found that with the inclusion of a 10m earth bund running at the A road north boundary with a western return the reduced noise levels that are likely to be present at the proposed residential façade will during the day time period be $L_{Aeq,\ 16\ hour}$ 60 dB and during the night time period be $L_{Aeq,\ 8\ hours}$ 52 dB (assuming a +3dB façade incident).

The L_{AMAX} has also been modelled within the noise map. The average maximum noise levels that are likely to be present at the proposed residential façade will during the night time period be $L_{AMAX,}$ 70 dB (assuming a +3dB façade incident).

Detailed calculations indicated that internal noise levels within the proposed residential properties will now comply with the requirements of British Standard 8233: 2014 for average daytime and night time noise and the requirements of the WHO Guidelines for LAmax Levels.

7.1.3 Requirements for noise mitigation

In order to meet reasonable internal levels in accordance with BS8233:2014; all facades should implement the following mitigation measures (NOTE: measures are indicative of worst case first floor calculated noise level. Housing layout is still to be confirmed at time of report):

Construction of earth bund	10m road facing boundary including western return
Construction of Walls	Standard masonry construction
Construction of Ceiling	2 layer of 12mm Fireline plasterboard
Construction of Windows (South)	4mm glass / 16mm air gap / 4mm glass
Construction of Ventilation	MVHR

Detailed calculations indicated that internal noise levels within the proposed residential properties will comply with the requirements of British Standard 8233: 2014.

Time Period	Façade / Area	Specification	Room	Resulting Internal Level dB(A)	Criteria Limit
Day	North Facing highest noise level position	4/16/4 / MVHR	First Floor	25 dB LAeq,16hour	35dB
Lmax	North Facing highest noise level position	4/16/4 / MVHR	First Floor	32 dB LAmax	45dB
Night	North Facing highest noise level position	4/16/4 / MVHR	First Floor	15 dB LAeq, 8hour	30dB
Day	Garden Area	10m earth bund	Garden	All levels below 55dB LAeq	55dB
Resulting Internal Levels calculated in accordance with BS8233:2014 per time period					

7.2 Conclusions

It would be proposed that the development should be undertaken with glazing (4/16/4) with a mechanical ventilation system to alleviate the requirement for partially open windows to specified facades to ensure the internal noise levels are acceptable in terms of the assessment to British Standard 8233: 2014 and WHO Guidelines.

A requirement for a 10m earth bund at the road facing boundary with a western return is recommended to control both internal noise (façade levels) as well as external noise below the upper limit of 55dB LAeq,16hour in accordance with WHO Guidelines.

7.2.1 Uncertainty

It is expected that the reported expanded uncertainty with reference to the background noise measurement with a confidence limit of 95% and assuming a convergence of k=2 is likely to be +/- 3.6dB. Uncertainty, in this instance has been minimised by undertaking longer background noise measurements over a greater than 120-hour period. Background noise measurement uncertainty budget is shown in Appendix C.

8 APPENDIX A – INFORMATION TO BE REPORTED

8.1 a) Competency

	Name	Role	Competency
1)	I.Broom	Noise Consultant	IoA Diploma Acoustics Nosie Control Associate Member of the Institute of Acoustics (AMIOA)

8.2 b) Source under Investigation

	Description of Source	Source Location	Hours of Operation	Mode of Operation
1)	Road Traffic Noise	North of Site	24/7	Continuous
	Description of Premises	Land behind West Street, Bere Regis		

8.3 c) Subjective Impression of Source at Assessment Position

1)	Dominance	Sources are dominant at assessment positions
	Audibility	Sources are audible at assessment positions
2)	Residual Noise Sources	Traffic Noise

8.4 d) Existing Contexts

	Type of Receptor	Period	Sensitivity	Description
1)	Residential	Day	Moderate	Noise can disturb outside amenity space Noise can disturb inside living space
		Night	High	Noise can disturb sleeping

8.5 e) Relative Positions

3)	Background Measurement	At assessment positions in report		
	Justification		Details	Compliance with Criteria
			Measurement Height	1.5m
			Distance to Reflecting Surface	3.5m
4)	Topography, surfaces etc.	Hard		

8.6 f) Noise Measurement Equipment Calibration

8.6.1 Continuous Measurement

1)	Type	Sound Level Meter	Microphone	Calibrator
		CR:171C	MK:224	CR:515
2)	Manufacturer	Cirrus	Cirrus	Cirrus
3)	Serial Number	G067012	1920791	67239
4)	Verification Date	October 2018	October 2018	October 2018

8.7 g) Noise Measurement Equipment Operation Test

1)	Ref. Level of Calibrator	94 dB@1000Hz
2)	Meter Reading Before	94 dB – Meter operation checked. Meter in good working order.
	Meter Reading After	94 dB - Meter operation checked. Meter in good working order.

8.8 h) Weather Conditions

1)	Weather Conditions	Dry Measurement Period

8.9 i) Date and Time of Measurements

1)	Background Measurements	11th – 16th October 2017

8.10 j) Measurement Time Interval

1)	Background Measurements	Day Time	Night Time
		(07:00 – 23:00)	(23:00 – 07:00)
		T_m = 16 hours	T_m = 8 hours

8.11 k) Reference Time Interval

1)	Reference Time Interval	Day Time	Night Time
		(07:00 – 23:00)	(23:00 – 07:00)
		T_r = 1 hour	T_r = 1 hour

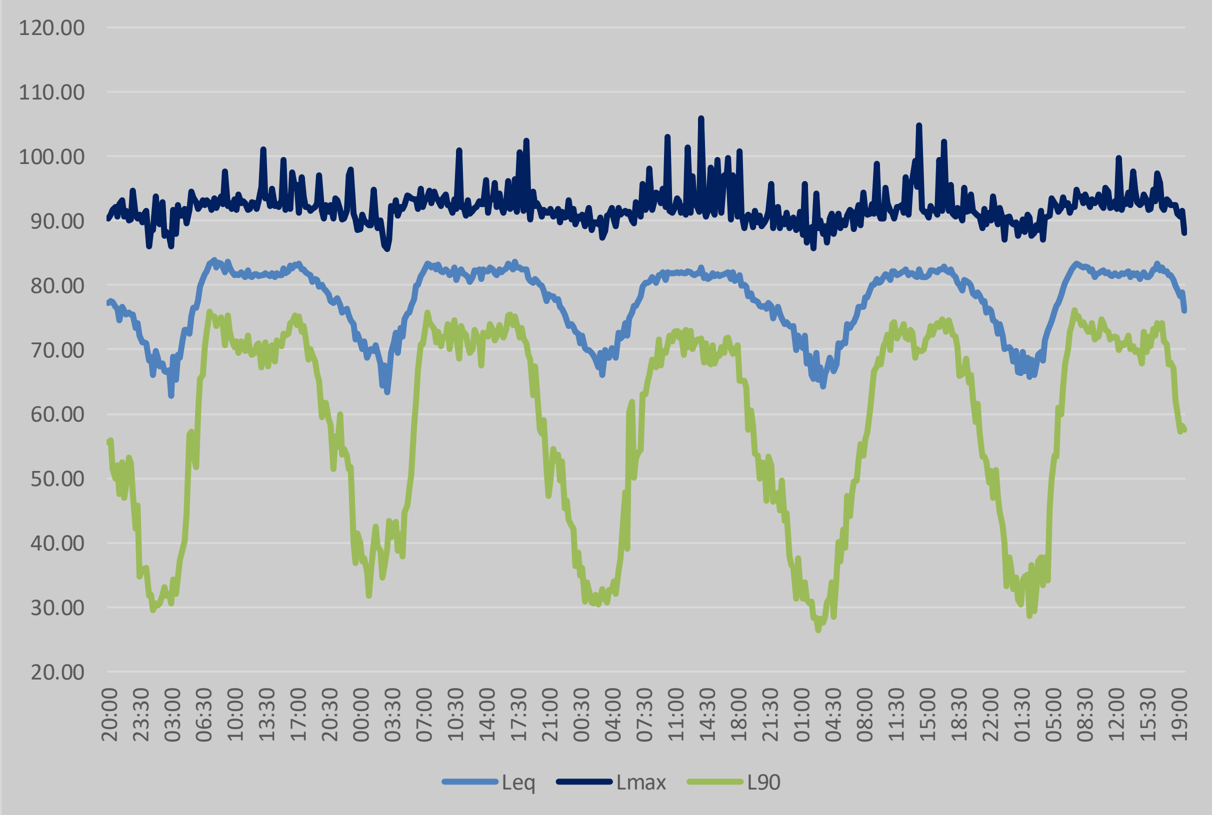
9 APPENDIX B – MEASUREMENT DATA

9.1 Baseline Assessment Position 1

Date	Time	Lmax	min LAeq	min LA90	Laeq,1hour	L90,1hour	L10, 1hour
11/10/2016	20:00	92.1	76.7	50.0	77.2	54.0	81.8
11/10/2016	21:00	93.2	74.6	47.0	76.0	50.5	80.5
11/10/2016	22:00	94.7	75.4	47.7	75.5	51.1	79.9
11/10/2016	23:00	91.0	71.1	34.7	72.8	41.8	76.5
12/10/2016	00:00	91.5	68.3	31.8	70.0	34.4	71.2
12/10/2016	01:00	93.8	66.1	29.5	68.2	30.2	65.0
12/10/2016	02:00	92.9	66.5	31.8	67.0	32.3	63.8
12/10/2016	03:00	92.4	62.8	30.6	67.3	33.2	65.8
12/10/2016	04:00	91.8	68.8	37.3	71.9	41.2	75.1
12/10/2016	05:00	94.5	72.4	51.8	75.4	55.4	79.2
12/10/2016	06:00	93.2	77.6	60.1	80.3	66.8	84.3
12/10/2016	07:00	93.5	82.2	72.7	83.3	74.9	86.8
12/10/2016	08:00	93.8	82.8	73.5	83.1	74.2	86.7
12/10/2016	09:00	97.7	82.0	70.6	82.7	72.9	86.3
12/10/2016	10:00	94.1	81.5	69.5	81.7	70.7	85.6
12/10/2016	11:00	93.0	81.3	69.7	81.6	70.6	85.5
12/10/2016	12:00	93.0	81.3	69.2	81.5	70.1	85.5
12/10/2016	13:00	101.1	81.5	67.3	81.6	69.1	85.6
12/10/2016	14:00	95.0	81.3	68.1	81.6	70.3	85.6
12/10/2016	15:00	99.4	81.5	70.5	81.9	71.6	85.7
12/10/2016	16:00	97.5	82.1	72.5	82.7	74.2	86.3
12/10/2016	17:00	96.7	82.4	72.8	82.8	74.0	86.4
12/10/2016	18:00	92.1	80.5	68.5	81.5	70.0	85.5
12/10/2016	19:00	97.1	79.8	59.5	80.4	65.7	84.9
12/10/2016	20:00	92.5	77.5	58.3	78.7	60.5	83.4
12/10/2016	21:00	93.5	76.9	51.4	77.4	56.7	82.3
12/10/2016	22:00	97.0	75.3	51.5	75.9	53.4	80.4
12/10/2016	23:00	97.9	71.6	36.8	73.3	46.5	77.0
13/10/2016	00:00	90.9	68.8	35.5	70.4	37.8	72.0
13/10/2016	01:00	94.8	69.4	31.8	70.0	39.1	68.9
13/10/2016	02:00	90.0	64.4	34.6	67.7	37.7	66.7
13/10/2016	03:00	92.3	63.4	39.1	68.5	41.9	68.2
13/10/2016	04:00	93.2	69.5	37.8	72.1	40.8	73.2
13/10/2016	05:00	93.9	74.7	44.7	75.8	47.9	79.6
13/10/2016	06:00	95.0	77.8	58.2	80.0	66.8	84.0
13/10/2016	07:00	94.6	81.8	70.8	82.7	73.7	86.4
13/10/2016	08:00	94.5	82.4	71.1	82.8	72.8	86.5
13/10/2016	09:00	94.1	82.0	70.5	82.2	72.2	85.9
13/10/2016	10:00	93.3	80.8	70.0	81.8	72.8	85.4
13/10/2016	11:00	100.9	81.6	68.6	82.0	72.2	85.7
13/10/2016	12:00	93.1	80.5	69.5	81.4	71.1	85.3
13/10/2016	13:00	93.0	80.9	67.6	82.0	71.3	85.8
13/10/2016	14:00	96.3	82.1	72.0	82.4	72.9	86.1
13/10/2016	15:00	95.9	81.6	71.4	82.0	72.5	85.6
13/10/2016	16:00	96.2	82.3	71.9	82.9	74.2	86.3

13/10/2016	17:00	100.7	82.5	71.8	82.9	73.9	86.5
13/10/2016	18:00	102.4	81.1	69.1	82.1	71.5	85.8
13/10/2016	19:00	94.5	80.4	62.9	80.7	66.2	85.0
13/10/2016	20:00	91.9	77.5	51.5	79.2	57.0	84.1
13/10/2016	21:00	91.8	77.7	47.2	78.2	51.9	83.3
13/10/2016	22:00	91.9	75.5	45.3	76.6	51.3	81.8
13/10/2016	23:00	93.1	73.5	42.2	73.9	44.1	77.7
14/10/2016	00:00	90.9	70.9	34.9	72.1	36.7	74.8
14/10/2016	01:00	92.0	69.4	30.7	69.9	32.2	70.3
14/10/2016	02:00	90.5	67.2	30.4	68.6	31.1	66.4
14/10/2016	03:00	91.0	66.0	30.7	68.6	31.9	67.8
14/10/2016	04:00	92.0	68.7	32.0	70.5	33.8	70.9
14/10/2016	05:00	91.6	71.7	37.5	72.6	43.6	75.8
14/10/2016	06:00	92.9	74.9	50.1	76.1	58.6	80.4
14/10/2016	07:00	95.7	77.7	54.1	79.1	60.6	83.9
14/10/2016	08:00	98.1	80.3	64.9	80.7	67.1	85.1
14/10/2016	09:00	95.0	80.4	67.2	81.4	69.4	85.4
14/10/2016	10:00	103.0	80.8	69.4	81.6	71.0	85.4
14/10/2016	11:00	93.5	81.8	71.8	81.9	72.5	85.7
14/10/2016	12:00	101.3	81.9	69.1	82.0	71.7	85.7
14/10/2016	13:00	96.9	81.5	70.0	81.8	71.0	85.6
14/10/2016	14:00	105.9	81.0	68.0	81.7	70.0	85.5
14/10/2016	15:00	99.4	81.3	67.7	81.6	69.0	85.6
14/10/2016	16:00	97.1	81.4	69.0	81.6	70.3	85.5
14/10/2016	17:00	99.8	80.6	69.3	81.4	70.4	85.4
14/10/2016	18:00	100.8	79.9	65.1	80.7	67.3	84.8
14/10/2016	19:00	90.9	77.6	57.6	78.6	60.9	83.3
14/10/2016	20:00	91.5	76.6	50.0	77.1	52.7	82.0
14/10/2016	21:00	95.7	76.4	46.5	76.8	51.7	81.3
14/10/2016	22:00	92.1	74.8	45.1	75.8	46.7	80.2
14/10/2016	23:00	91.3	73.6	37.9	74.2	45.7	78.3
15/10/2016	00:00	90.5	69.9	31.3	72.5	36.0	76.6
15/10/2016	01:00	95.7	67.9	31.2	70.5	32.6	72.3
15/10/2016	02:00	94.2	65.4	28.4	67.9	29.7	68.2
15/10/2016	03:00	90.0	64.3	26.4	65.9	27.7	62.7
15/10/2016	04:00	91.1	66.6	28.5	67.7	31.6	67.6
15/10/2016	05:00	91.1	67.7	34.7	70.2	39.3	72.1
15/10/2016	06:00	91.7	70.9	39.2	73.2	45.6	77.0
15/10/2016	07:00	92.5	74.2	49.5	75.8	52.5	80.3
15/10/2016	08:00	94.4	76.7	53.5	78.1	57.6	82.8
15/10/2016	09:00	98.8	80.0	63.6	80.4	66.9	84.6
15/10/2016	10:00	95.1	80.5	67.7	81.3	70.7	85.1
15/10/2016	11:00	92.2	80.8	69.9	81.7	72.8	85.4
15/10/2016	12:00	96.7	81.7	71.8	82.1	72.9	85.7
15/10/2016	13:00	99.3	81.4	68.8	81.7	71.8	85.5
15/10/2016	14:00	104.8	81.3	69.8	81.6	69.9	85.5
15/10/2016	15:00	92.3	81.3	71.6	81.9	72.5	85.7
15/10/2016	16:00	99.5	82.0	73.5	82.3	74.0	85.8
15/10/2016	17:00	102.3	82.0	72.8	82.4	73.8	86.0

15/10/2016	18:00	92.0	80.0	65.9	80.9	70.7	84.9
15/10/2016	19:00	95.1	79.2	64.9	80.3	66.9	84.6
15/10/2016	20:00	94.0	78.3	58.7	79.0	63.0	83.4
15/10/2016	21:00	91.8	75.8	52.7	77.3	54.5	81.9
15/10/2016	22:00	93.7	74.3	46.9	75.4	50.0	79.5
15/10/2016	23:00	92.0	70.0	39.8	72.4	44.4	76.3
16/10/2016	00:00	90.7	68.2	32.8	69.8	35.4	70.5
16/10/2016	01:00	90.2	66.3	30.4	68.4	32.9	66.6
16/10/2016	02:00	90.9	65.8	28.7	67.6	34.6	66.5
16/10/2016	03:00	91.5	66.1	29.4	68.3	35.3	69.8
16/10/2016	04:00	90.8	68.3	33.4	72.0	40.5	75.5
16/10/2016	05:00	93.4	74.4	49.8	76.2	56.5	80.1
16/10/2016	06:00	93.6	78.4	59.9	80.0	66.8	84.1
16/10/2016	07:00	94.8	81.9	72.7	82.7	74.5	86.2
16/10/2016	08:00	94.1	82.8	73.6	83.0	74.2	86.5
16/10/2016	09:00	93.3	81.2	71.5	82.2	72.9	85.8
16/10/2016	10:00	94.1	81.7	71.9	82.0	73.4	85.6
16/10/2016	11:00	95.1	81.4	71.6	81.7	72.3	85.4
16/10/2016	12:00	99.8	81.4	69.9	81.7	71.2	85.4
16/10/2016	13:00	94.4	81.3	70.1	81.8	71.1	85.5
16/10/2016	14:00	97.6	81.0	69.2	81.6	69.8	85.5
16/10/2016	15:00	94.0	81.2	67.9	81.5	71.0	85.5
16/10/2016	16:00	97.4	81.6	70.5	82.5	72.7	86.1
16/10/2016	17:00	95.8	82.2	70.8	82.4	72.5	86.1
16/10/2016	18:00	93.0	79.9	62.2	81.0	66.8	85.4
16/10/2016	19:00	91.5	76.0	57.3	78.3	58.5	83.0



Sound Pressure Levels, dB. Reference level of 2 x 10-5 Nm-2

10 APPENDIX C – UNCERTAINTY BUDGET

Sources of Uncertainty	Uncertainty Notes	Commentary	Value (half Width)	Convert to Same Units (dB)	Distribution Divisor			Standard Uncertainty (u) dB
					Normal	Rectangular	Other	
Measurement Position	Choice of position, ,	1m in 10m		0.2		rect(√/3)		0.13
	microphone orientation	Type 1 0 - 30deg	0.4		Normal			0.50
Instrumentation	Calibration	Calibration Drift	0.1		Normal			0.10
	Accuracy and precision (type 1)	Type 1 practical	1.9			rect(√/3)		0.50
Background Noise Level	Timing of Measurement							
Background Noise Level	Modal Analysis Day	Calculated Standard Deviation	3.7				s/√n	0.39
Background Noise Level	Modal Analysis Night	Calculated Standard Deviation	2.2				s/√n	0.16
Combined Uncertainty (root sum of squares)								1.78
Expanded Uncertainty U = Kuc (95% Confidence K =2)								3.56
Final Answer Expressed ads Value +/- U dB with a confidence Level of 95%								
REFERENCE: Uncertainty Budget Calculated in line with M3003: The Expression of Uncertainty and Confidence in Measurement Edition 3, Novemeber 2012 and A Good Practice Guide on the Sources and Magnitude of Uncertainty Arising in the Practical Measurement of Environmental Noise N J Craven, G Kerry Edition 1a – May 2007.								

##End of Report##