Chartered Building Consultancy

Acoustic South East

Planning Condition
Acoustic Strategy

Client:	**Trinity Homes**
Site Address:	**Ropetackle Houses, Shoreham**
Reported By:	**George Orton BEng(Hons) MIOA**
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Report by: George Orton BEng(Hons) MIOA

Issue 1	27/05/2025	

1 Summary and Conclusion

Acoustic South East have been appointed to undertake an acoustic assessment of the proposed Ropetackle development (7 new houses).

The development has gained planning approval albeit with certain conditions. The planning condition, which relates to noise, can be seen below.

Ref: AWDM/2294/21

05. Construction work shall not commence until a scheme for protecting the proposed noise sensitive development from transport noise has been submitted to and approved by the local planning authority. All works, which form part of the scheme, shall be completed before any part of the noise sensitive development is occupied. The scheme shall have regard to the principles contained within the Pro PG: Planning and Noise - Professional Practice Guidance on Planning and Noise-New Residential Development 2017 and Calculation of Railway Noise 1995. The scheme should demonstrate good acoustic design, include full details of glazing, and a strategy to prevent overheating. The noise level of any ventilation units when in use should not exceed the levels specified in Pro PG: Planning and Noise - Professional Practice Guidance on Planning and Noise- New Residential Development 2017 and all duct work should be fitted on anti-vibration mounts. Following approval and completion of the scheme, a test shall be undertaken to demonstrate that the attenuation measures proposed in the scheme are effective and protect the residential unit from noise.

Environmental noise has been measured close to where the development will be built (at planning stage by another consultant and a more recent survey carried out at the end of 2024 by Acoustic Southeast)

The report assesses the following:

- Noise levels affecting the proposed development.
- Mitigation Measures to reduce internal noise levels so that the planning condition noise criteria can be achieved.

Mitigation measures have been recommended in the form of the required acoustic performce of glazing and window/façade ventilation elements . If the mitigation measures are implemented by the developer it is considered that the planning condition criteria will be achieved.

2 Context and Noise Criteria

2.1 Site Description

The new houses are adjacent to the A259 Old Shoreham Road and an elevated section of railway line. The first floor layout (no habitable rooms on ground floor) can be seen below:



Figure 1: 1st Floor Layout

2.2 Planning History

At the planning stage a noise impact assessment was completed by 7th Wave Acoustics. As the surveys were completed in 2021, when there were restrictions in place than may have affected the soundscape, additional surveys were carried out in 2024

2.3 ProPG Criteria

Basedon the wording of the condition the criteria for habitable rooms will be taken from the ProPG –Planning and Noise: new residential development document as shown in the following extract (Figure 2, Page 13):

ACTIVITY	LOCATION	07:00 – 23:00 HRS	23:00 – 07:00 HRS
Resting	Living room	35 dB $L_{Aeq,16\,hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16\,hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16\,hr}$	30 dB $L_{Aeq,8\,hr}$ 45 dB $L_{Amax,F}$ (Note 4)

NOTE 1 The Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The internal L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the internal L_{Aeq} target levels recommended in the Table.

NOTE 3 These internal L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

Figure 2: ProPG Criteria

The criteria for the day (07:00-23:00hrs) and nigh (23:00-07:00hrs) periods are clarified below:

2.3.1 Continuous Noise Levels

The maximum internal noise level for each area is as follows:

- Bedrooms 35/30dBA Day/Night
- Lounges 35dBA Day

2.3.2 Maximum Noise Levels

For a reasonable standard in noise sensitive rooms at night (e.g. bedrooms) individual noise events should not normally exceed 45dB L_{AFmax} more than 10 times a night.

3 Noise Survey Baseline Conditions & Results

A noise survey was carried out between the 3rd and 4th December 2024 to assess the existing road noise levels affecting the proposed development. A separate attended survey was also completed on the 4th December 2024 close to the railway line

3.1 Noise Survey Details

- Survey carried out by: George Orton BEng (Hons) MIOA
- Equipment used: LT1 Svantek 971 - Type 1 Sound Level Meter
  ST1 Norsonic NOR118 - Type 1 Sound Level Meter
- Weather conditions: Mixed wind speed average mostly under 5m/s

The meters were calibrated before commencing the noise measurements (@94dB). The calibration was re-checked at the end of the measurements to ensure that no calibration drift had occurred. After survey the calibration showed no significant drift (94dB)

3.2 Noise Survey Locations

The noise survey location can be seen on the marked up plan within the appendix.

All noise levels in this report will be free-field noise levels unless stated otherwise (including noise model predictions)

3.3 Noise Survey Results

3.3.1 Road Noise

The unattended survey results summary can be found below:

		$L_{Aeq,16/8Hr}$		11th L_{Amax}	
Day	**Date**	**Day**	**Night**	**1 min**	**2min**
Tue	03/12		63.4	82.4	82.4
Wed	04/12	70.4	-	-	-

Table 1: LT1 Sound Survey Results

3.3.2 Rail Noise

Attended measurements were also completed at the same location as the unattended long term survey. For the attended survey the sound measurements were started as a passing train was initially audible. The attended sound exposure results (average for each train type) can be seen below (full results and calculation can be seen in the appendix):

Notes	Freefield Level - dBA	
	$L_{AE\ West}$	$L_{AE\ East}$
3 Coach	79.9	85.5
4 Coach	81.4	86.2
8 Coach	86.1	88.7
12 Coach	86.2	88.3

Table 2: ST1 Sound Survey Results

4 Rail Noise Prediction

4.1 Rail Noise Measurement and Prediction Methodology

The noise levels for the day and night time periods have been predicted, using on site measurements, rather than measuring constantly for 24hrs or more. The predictions have been made using the following information:

- Current time table data (2024) which details the number of passenger trains that pass by the site (stopping and passing straight through Shoreham Station).
- Train Sound Exposure levels were measured on site during the day time. These individual measurements were then grouped into train types based on train length.

The individual measurements have been averaged for each train type in order to create a "typical" sound exposure level for each train type.

The above is in accordance with Calculation of Rail Noise 1995 which states the following in section 43 paragraph 2 and 3.

"In order to determine the LAeq,16h or LAeq,8h noise level it may be necessary to carry out SEL noise measurements of each train pass-by over the full-time period of interest. Exceptions to this may occur when the train mix and speed of individual train types remain reasonably constant over the relevant time period. For this situation, it is acceptable to measure a representative sample of individual train pass bys of each train type running on each track and determine an arithmetic mean value for the SEL for each case."

In paragraph 3 CRN goes on to say that having established by measurement the mean values for the SELs of each train type operating on the railway, the day and the night time noise levels ($L_{Aeq,16hr}$ and $L_{Aeq,8h}$ should be calculated using a formula that is also stated in CRN. The SEL to $L_{Aeq,day/night}$ formula is detailed below and implemented in section 4.

For each train type: $\mathbf{L_{Aeq}}$ **= SEL – 10Log T + 10Log N**

- *N = no. of events in period (For each train type based upon timetable information*
- *T = no. of seconds in period (57600 seconds for the day and 28800 for the night)*

It should be noted that a train SEL measured in the daytime is likely to be marginally higher than if an identical train SEL was measured at night time. This is due to the fact that in the daytime the background noise levels are generally higher than at night time and during the train SEL measurement background noise will be "captured" as well as the train noise.

4.2 Rail Noise Measurement and Prediction Methodology

The results summary can be seen below (Full details and results can be found in the appendix of the report):

- West
  - Daytime at ST1 = 52dBA
  - Night Time at ST1 = 48dBA
- East (closer rail)
  - Daytime at ST1 = 56dBA
  - Night Time at ST1 = 51dBA

5 Computer Noise Model

In order to see how noise varies at different positions around the proposed development it is possible to produce a noise contour map. A computer noise model has been completed using the computer package IMMI. Drawings of the proposed development have been used to complete the noise models. IMMI faithfully implements the propagation method of ISO-9613:1996; Acoustics – Attenuation of sound during propagation outdoors.

5.1 Noise Model Methodology

Reception points (RPs) for the survey positions were added in the correct locations. The RPs predict the noise level at a discrete position within the noise model.

The railway line sources (East and West) were added to the model. The sound power was adjusted until the day and night time levels equalled the levels detailed in 4.2 above.

The A259 was added to the model as a line source noise source. The sound power was adjusted until the day and night time levels equalled the levels as measured by ASE in 2024 (see section 3)

Once the sources had been added and adjusted, the buildings were added to the model. Additional reception points were positioned just outside where bedroom/lounge windows will be.

5.2 Noise Model Predictions

The table below shows the day and night time predictions (Colour plots can be found in the appendix):

Location	$L_{Aeq,16hr/8hr}$ dBA	
	Day	Night
H 6 7 Bed1	63	56
H 6 7 Lounge	64	57
H 6 7 Rear Beds	50	45
H 4 5 Bed1	63	56
H 4 5 Lounge	64	57
H 4 5 Rear Beds	47	43
H 3 Bed1/4	63	56
H 3 Lounge	63	56
H 3 Rear Beds	43	36
H 1 2 Bed1	65	58
H 1 2 Lounge	70	63
H 1 2 Rear Beds	46	40

Table 3: Model Prediction Summary

6 Required Sound Insulation of Building Envelope

6.1 Noise Criteria

6.1.1 Continuous Noise Levels – Anonymous Noise

The BS8233 2014 and WHO noise criteria will be used to specify the noise mitigation measures for all habitable rooms. The maximum internal noise level for each area is as follows:

- Bedrooms 30dBA Night
- Lounges 35dBA Day

6.1.2 Maximum Noise Levels

For LAmax events the ProPG noise LAmax criterion will be used to specify the noise mitigation measures for bedrooms only:

For a reasonable standard in noise sensitive rooms at night (e.g. bedrooms) individual noise events should not normally exceed 45dB LAFmax more than 10 times a night.

The above is similar to guidance in the WHO Guidelines for Community Noise 1999 document. However the ProPG criteria suggests limiting the number of LAmax events (over 45dBA) to less than 10 times a night as opposed to less than 10-15 times a night as stipulated by the WHO.

6.2 Location Specific Sound Reduction (SRI)

The sound reduction of the building envelope (SRI) quantifies how well the building fabric will attenuate noise created outside of the building. The required sound reduction (SRI) has initially been calculated so that the continuous noise level; criteria can be achieved within the development.

For bedrooms the L_{Amax} survey data has been used to predict the SRI required to limit L_{Amax} events to an average of no more than 10 per night. Based on the 11th highest L_{Amax} level the sound insulation required is 2dB higher than is required for the daytime continuous noise criteria

A summary of the required sound reduction, to be provided by the building envelope, can be seen below:

Location	$L_{Aeq,16hr/8hr}$ dBA		Sound Reduction - dB	
	Day	Night	Day	Night
H 6 7 Bed1	63	56	28	30
H 6 7 Lounge	64	57	29	
H 6 7 Rear Beds	50	45	15	17
H 4 5 Bed1	63	56	28	30
H 4 5 Lounge	64	57	29	
H 4 5 Rear Beds	47	43	12	14
H 3 Bed1/4	63	56	28	30
H 3 Lounge	63	56	28	
H 3 Rear Beds	43	36	8	10
H 1 2 Bed1	65	58	30	32
H 1 2 Lounge	70	63	35	
H 1 2 Rear Beds	46	40	11	13

Table 4: Sound Reduction Summary

7 Noise Mitigation Measures

7.1 Mitigation Measures

At this stage mitigation measures have been detailed in the form of acoustic performance targets for glazing and ventilation elements.

The above shows that the building envelope needs to achieve a sound insulation level of up to 32dB. This would more or less rule out a basic ventilation system with trickle vents and intermittent fans. The following strategies could be options that are considered at the detailed design stage:

7.1.1 Option 1 - Continuous mechanical extract ventilation

With a continuous extract system (bath/kitchen fan that run all the time then boost when room in use) a smaller EA of trickle vent is required as detailed in ADF (E.G. EA of 4,000mm^2 for a bedroom compared to 10,000 mm^2 for a bedroom with natural ventilation)

7.1.2 Option 2 - Mechanical ventilation with heat recovery

This system has a double fan unit that pulls in air from one grille and blows the air into the room. There is another fan that extracts air from bath/kitchens. The fans run all the time so no trickle vents are required.

For this option upgraded glass was not required due to the absence of trickle vents that act as a secondary noise ingress route (in addition to noise through the closed window)

7.1.3 Glazing and Ventilator Performace.

The required performce of glazing and ventilators can be seen below:

- Glazing performance is in terms of R_w+C_{tr}
- Ventilator performance is in terms of $D_{n,E,w}$ (assuming 2 vents are required)

Zone	Plots	Room	Target SRI	Option 1 MEV			Option 2 MVHR	
				Glazing	Vent	SRI	Glazing	SRI
H1	1&2	Bedroom	32	31	36	33	27	33
H1	3	Bedroom	30	31	36	30	27	32
H2	4to7	Bedroom	30	27	36	31	27	33
H1	1&2	Lounge	35	31	36	35	27	35
H3	3-7 Lounge	Lounge	29	27	33	30	27	35
H4	Rear	Bedroom	17	27	Basic	28	27	32

Table 5: Façade Acoustic Options

At the detailed design the specific glazing and ventilation products (MVHR fan and fan silencers etc.) will be selected so the required sound insulation level is achieved

Calculations were completed for a selection of lounge/bedrooms based on room volume and window size (see appendix for details). The calculation models were completed using proprietary software that follows the calculation methodology in BS12354

The calculation assumes that 2 vents will be required per room (MEV system option).

7.2 Mitigation Measures – Elevation Markup

To simplify matters the zones, for the MEV option detailed in the above table, have been added to the elevation drawings:

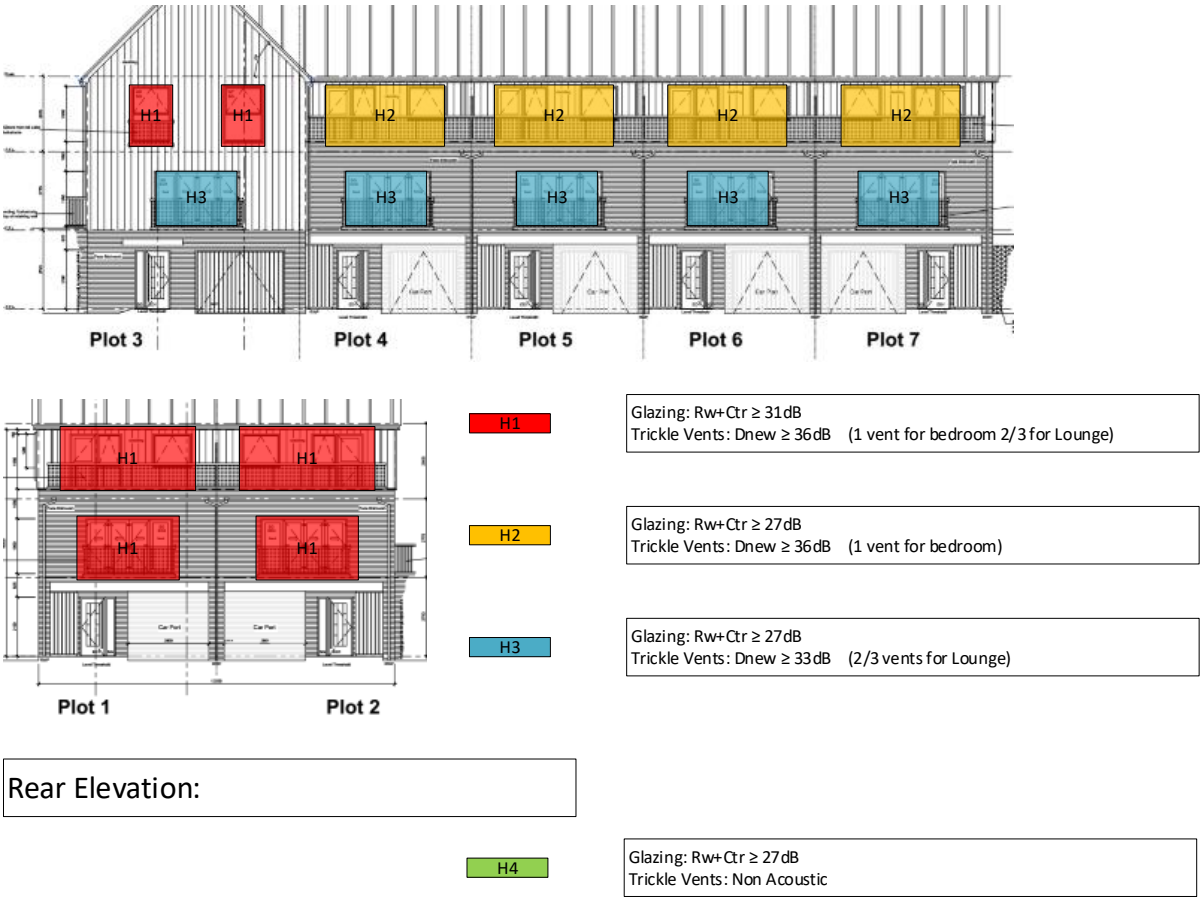

Figure 3: Mitigation Zones

8 Vibration

Although vibration was not detailed in the planning condition additional measurements of ground-borne vibration were also completed in December 2024. The levels measured for the day and night time period were similar to as measured during the initial planning phase assessment. The measured levels were all below the lower limit of the “low probability of adverse comment” range as defined in BS6472 (see appendix for details).

The vibration levels measured on the empty site were, at worst, 5 times lower than the lower end of the “Adverse comment possible” range.

Levels on upper floors would be higher than as measured at the base of the building, however given the building height/build the amplification factor would be lower than 5 (I.E. at worst vibration levels will be within the “low probability of adverse comment” range if not below.

9 Appendix



Figure 4: ASE Survey Locations 2024

Date	Duration		Status	LAeq	LAFmax	LAE
(2024/12/04 09:28:28.00)	(0:0:9.0)		N/A	72.4	77.9	82.1
(2024/12/04 09:33:48.00)	(0:0:25.0)		N/A	72.4	78.4	86.5
(2024/12/04 09:43:54.00)	(0:0:9.0)		N/A	70	76.5	79.9
(2024/12/04 09:44:13.00)	(0:0:9.0)		N/A	76.3	82.1	86.1
(2024/12/04 09:45:51.00)	(0:0:30.0)		N/A	60.4	66.1	75.2
(2024/12/04 09:48:14.00)	(0:0:25.0)		N/A	74.7	81.1	88.7
(2024/12/04 09:52:39.00)	(0:0:12.0)		N/A	76.9	83.9	87.9
(2024/12/04 10:07:55.00)	(0:0:16.0)		N/A	73.6	82.1	85.8
(2024/12/04 10:11:07.00)	(0:0:18.0)		N/A	72.6	79.3	85.3
(2024/12/04 10:13:33.00)	(0:0:9.0)		N/A	70.9	75.9	80.6
(2024/12/04 10:16:23.00)	(0:0:23.0)		N/A	75	81.8	88.7
(2024/12/04 10:17:44.00)	(0:0:30.0)		N/A	61.4	66.9	76.2
(2024/12/04 10:20:04.00)	(0:0:18.0)		N/A	71.7	78.2	84.4
(2024/12/04 10:23:20.00)	(0:0:8.0)		N/A	69.2	74.2	78.6
(2024/12/04 10:28:28.00)	(0:0:12.0)		N/A	71.3	77.4	82.2
(2024/12/04 10:30:29.00)	(0:0:12.0)		N/A	74	80.3	85.1
(2024/12/04 10:33:45.00)	(0:0:15.0)		N/A	71.2	77.6	83.1
(2024/12/04 10:34:38.00)	(0:0:23.0)		N/A	72.5	78.1	86.2
(2024/12/04 10:40:11.00)	(0:0:18.0)		N/A	74.1	78.2	86.8
(2024/12/04 10:44:08.00)	(0:0:6.0)		N/A	71.4	76.8	79.6
(2024/12/04 10:44:54.00)	(0:0:30.0)		N/A	58.7	65.6	73.5
(2024/12/04 10:52:31.00)	(0:0:12.0)		N/A	77	84.2	88
(2024/12/04 10:58:39.00)	(0:0:9.0)		N/A	70.7	75.5	80.5
(2024/12/04 11:02:14.00)	(0:0:15.0)		N/A	73.8	82	85.7
(2024/12/04 11:10:39.00)	(0:0:29.0)		N/A	74.7	78.4	89.4
(2024/12/04 11:18:14.00)	(0:0:8.0)		N/A	73.5	78.6	82.8
(2024/12/04 11:19:10.00)	(0:0:16.0)		N/A	75	82.9	87.2
(2024/12/04 11:28:10.00)	(0:0:6.0)		N/A	72.7	79.7	80.6
(2024/12/04 11:29:06.00)	(0:0:29.0)		N/A	61.9	65.1	76.6
(2024/12/04 11:30:33.00)	(0:0:9.0)		N/A	76.2	83.5	85.8
(2024/12/04 11:35:38.00)	(0:0:12.0)		N/A	74.9	78.9	85.8
(2024/12/04 11:43:56.00)	(0:0:8.0)		N/A	71.3	77.4	80.8
(2024/12/04 11:44:10.00)	(0:0:14.0)		N/A	75.5	79.5	87.2
(2024/12/04 11:48:28.00)	(0:0:13.0)		N/A	76	82.7	87.2
(2024/12/04 11:58:44.00)	(0:0:16.0)		N/A	71.2	79.2	83.3
(2024/12/04 12:00:34.00)	(0:0:14.0)		N/A	74.3	82.5	85.9
(2024/12/04 12:04:14.00)	(0:0:25.0)		N/A	73	76.1	87
(2024/12/04 12:04:59.00)	(0:0:11.0)		N/A	74	78.5	84.4
(2024/12/04 12:05:58.00)	(0:0:30.0)		N/A	61	66	75.8
(2024/12/04 12:10:04.00)	(0:0:17.0)		N/A	77	80	89.6
(2024/12/04 12:17:02.00)	(0:0:4.0)		N/A	64.8	71.5	71.6
(2024/12/04 12:19:48.00)	(0:0:15.0)		N/A	72.8	81.1	84.7
(2024/12/04 12:28:52.00)	(0:0:23.0)		N/A	71.6	79.2	85.4
(2024/12/04 12:39:31.00)	(0:0:15.0)		N/A	78.2	83	90
(2024/12/04 12:43:11.00)	(0:0:30.0)		N/A	56.8	61.3	71.7
(2024/12/04 12:44:05.00)	(0:0:15.0)		N/A	77	83.2	89
(2024/12/04 12:48:37.00)	(0:0:12.0)		N/A	75	80.9	86.1
(2024/12/04 12:51:41.00)	(0:0:9.0)		N/A	71	77.9	81
(2024/12/04 12:59:20.00)	(0:0:8.0)		N/A	70.2	76.5	79.7
(2024/12/04 13:00:34.00)	(0:0:12.0)		N/A	75.5	83.2	86.4
(2024/12/04 13:05:26.00)	(0:0:13.0)		N/A	74.3	79.3	85.4
(2024/12/04 13:09:30.00)	(0:0:15.0)		N/A	77	81.9	88.9
(2024/12/04 13:16:53.00)	(0:0:6.0)		N/A	69.1	74.8	77.3

Figure 5: Train Sound Exposure Survey Raw Data

		Timetable Train Count								WEST		
		Southhampton - Victoria (East)				Portsmouth - victoria (East)				3 Coach %	33.3	
		Monday-fri				Monday-fri	sat	sun		Day:	61.3	
										Night:	9.3	
shoreham by sea	day	92								Av SEL	79.9	
	night	12									LAeqDAY	50.2
											LAeqNigh	45.0
		Southampton -Victoria (west)				Victoria to Portsmouth (West)						
		Monday-fri				Monday-fri	sat	sun		4 Coach %	33.3	
										Day:	61.3	
shoreham by sea	day	92								Night:	9.3	
	night	16								Av SEL	81.4	
											LAeqDAY	51.6
											LAeqNigh	46.5
		TOTAL EAST										
	Day	92			TOTAL DAY	184				8 Coach %	28.6	
	Night	12			TOTAL NIGHT	28				Day:	52.6	
										Night:	8.0	
		TOTAL WEST								Av SEL	86.1	
	Day	92									LAeqDAY	55.7
	Night	16									LAeqNigh	50.6
										12 Coach %	4.8	
										Day:	8.8	
										Night:	1.3	
										Av SEL	86.2	
											LAeqDAY	48.0
											LAeqNigh	42.9
										Total East		
										LAeqDAY	52.3	
										LAeqNight	48.0	
										EAST		
										3 Coach %	26.1	
										Day:	48.0	
										Night:	7.3	
										Av SEL	85.5	
											LAeqDAY	54.7
											LAeqNigh	49.5
										4 Coach %	43.5	
										Day:	80.0	
										Night:	12.2	
										Av SEL	86.2	
											LAeqDAY	57.6
											LAeqNigh	52.5
										8 Coach %	21.7	
										Day:	40.0	
										Night:	6.1	
										Av SEL	88.7	
											LAeqDAY	57.1
											LAeqNigh	52.0
										12 Coach %	8.7	
										Day:	16.0	
										Night:	2.4	
										Av SEL	88.3	
												52.7
												47.6
										Total East		
										LAeqDAY	56	
										LAeqNight	51	

Figure 6: Rail Noise Predictions

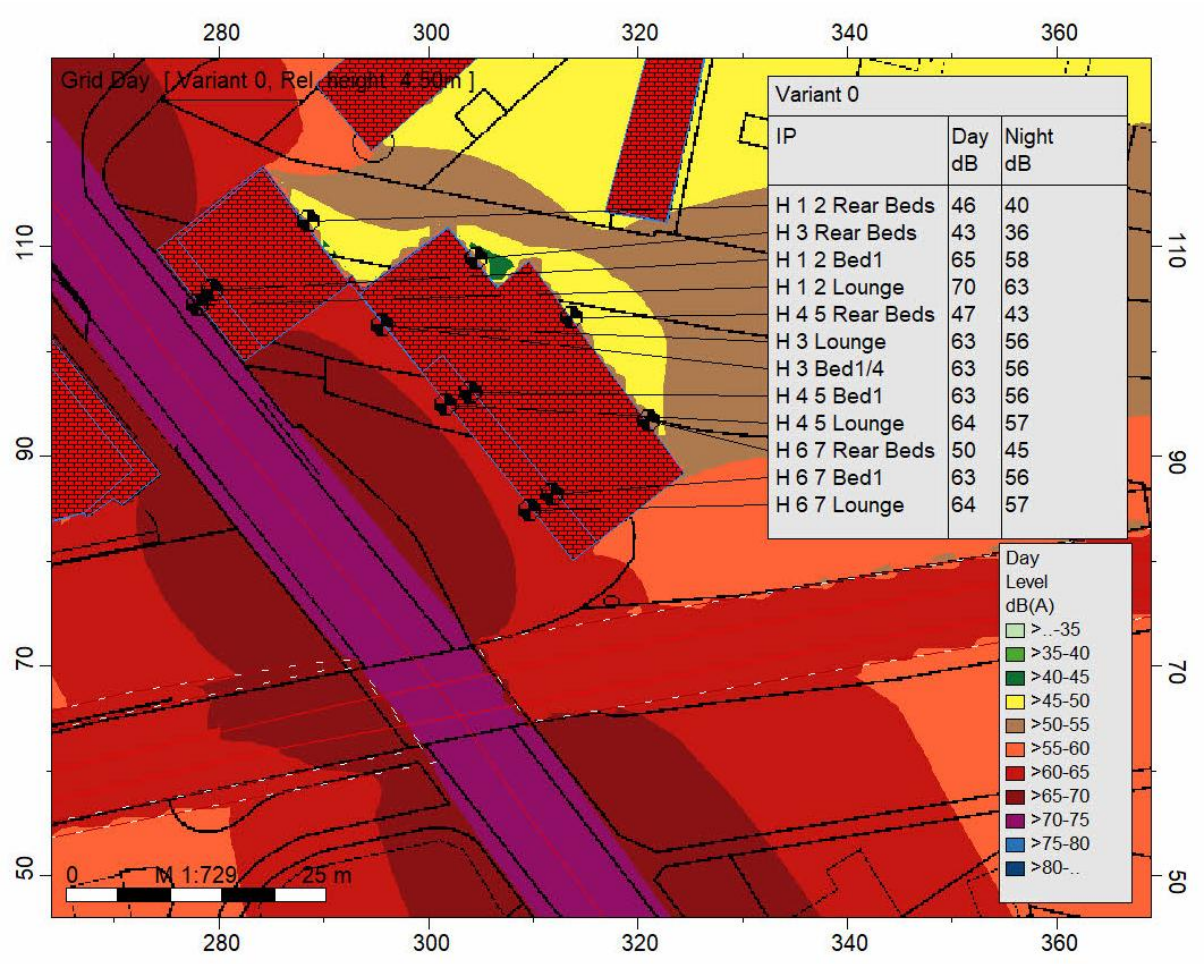

Figure 7: Daytime Noise Model

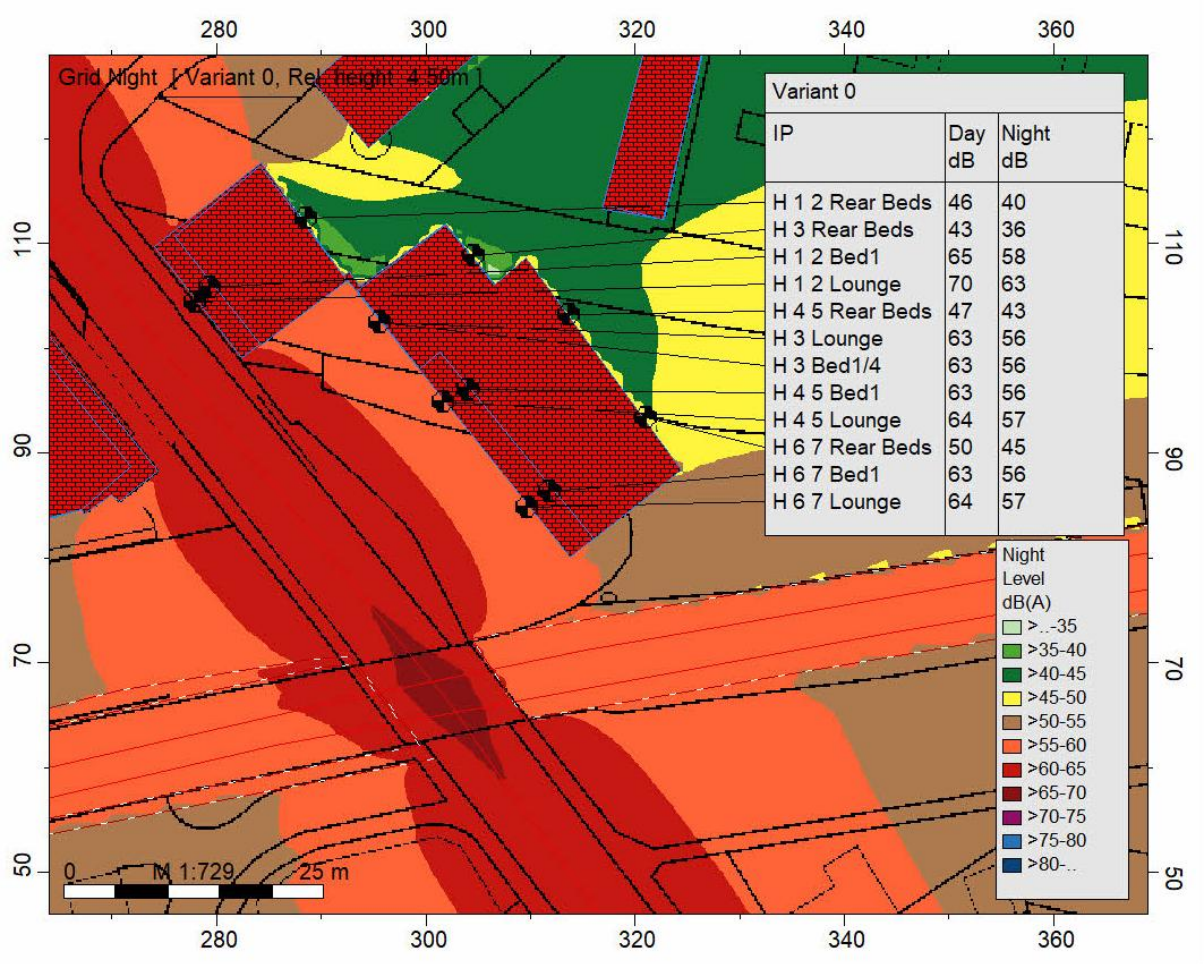

Figure 8: Night time Noise Model

	Octave Band Centre Frequency (Hz)							Overall dBA
Source	63	125	250	500	1k	2k	4k	
Incident sound level (freefield)	0	66	64	63	67	64	58	70
Path								
Element 1 ,W Rw +Ctr 31 STL	0	-23	-23	-33	-39	-39	-38	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [6.0 m2]	8	8	8	8	8	8	8	
Element sound level contribution	-3.8	39	37	26	24	21	16	32
Element 2 ,2 Dnew 38 STL	0	-36	-34	-35	-44	-40	-45	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [20 m2]	13	13	13	13	13	13	13	
Element sound level contribution	1.4	31	31	29	24	25	14	31
Receiver								
Room volume (-10Log V) [90 m3]	-20	-20	-20	-20	-20	-20	-20	
Reveberation time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
RT (+10Log T)	-3	-3	-3	-3	-3	-3	-3	
Equation Constant	11	11	11	11	11	11	11	
Room sound level	2.5	40	38	31	27	27	18	35

	Octave Band Centre Frequency (Hz)							Overall dBA
Source	63	125	250	500	1k	2k	4k	
Incident sound level (freefield)	0	66	64	63	67	64	58	70
Path								
Element 1 ,W Rw +Ctr 27 STL	0	-20	-19	-29	-38	-39	-35	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [6.0 m2]	8	8	8	8	8	8	8	
Element sound level contribution	-3.8	42	41	30	25	21	19	35
Receiver								
Room volume (-10Log V) [90 m3]	-20	-20	-20	-20	-20	-20	-20	
Reveberation time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
RT (+10Log T)	-3	-3	-3	-3	-3	-3	-3	
Equation Constant	11	11	11	11	11	11	11	
Room sound level	-3.8	42	41	30	25	21	19	35

	Octave Band Centre Frequency (Hz)							Overall dBA
Source	63	125	250	500	1k	2k	4k	
Incident sound level (freefield)	0	60	58	57	61	58	52	64
Path								
Element 1 ,W Rw +Ctr 27 STL	0	-20	-19	-29	-38	-39	-35	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [6.0 m2]	8	8	8	8	8	8	8	
Element sound level contribution	-3.8	36	35	24	19	15	13	29
Element 2 ,2 Dnew 33 STL	0	-35	-35	-31	-32	-35	-40	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [20 m2]	13	13	13	13	13	13	13	
Element sound level contribution	1.4	27	24	27	30	25	13	33
Receiver								
Room volume (-10Log V) [90 m3]	-20	-20	-20	-20	-20	-20	-20	
Reveberation time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
RT (+10Log T)	-3	-3	-3	-3	-3	-3	-3	
Equation Constant	11	11	11	11	11	11	11	
Room sound level	2.5	37	36	29	31	25	16	34

Figure 9: Lounge SRI Calculations

	Octave Band Centre Frequency (Hz)							Overall dBA
Source	63	125	250	500	1k	2k	4k	
Incident sound level (freefield)	0	55	53	52	55	52	42	58
Path								
Element 1 ,W Rw +Ctr 31 STL	0	-23	-23	-33	-39	-39	-38	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [4.2 m2]	6	6	6	6	6	6	6	
Element sound level contribution	-2.8	29	27	16	13	10	1.2	22
Element 2 ,1 Dnew 36 STL	0	-36	-35	-33	-37	-37	-39	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [10 m2]	10	10	10	10	10	10	10	
Element sound level contribution	0.93	20	19	20	19	16	3.9	23
Receiver								
Room volume (-10Log V) [50 m3]	-17	-17	-17	-17	-17	-17	-17	
Reveberation time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
RT (+10Log T)	-3	-3	-3	-3	-3	-3	-3	
Equation Constant	11	11	11	11	11	11	11	
Room sound level	2.5	30	28	21	20	17	5.8	25

1 2 Front Bed

	Octave Band Centre Frequency (Hz)							Overall dBA
Source	63	125	250	500	1k	2k	4k	
Incident sound level (freefield)	0	55	53	52	55	52	42	58
Path								
Element 1 ,W Rw +Ctr 27 STL	0	-20	-19	-29	-38	-39	-35	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [4.2 m2]	6	6	6	6	6	6	6	
Element sound level contribution	-2.8	32	31	20	14	10	4.2	25
Receiver								
Room volume (-10Log V) [50 m3]	-17	-17	-17	-17	-17	-17	-17	
Reveberation time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
RT (+10Log T)	-3	-3	-3	-3	-3	-3	-3	
Equation Constant	11	11	11	11	11	11	11	
Room sound level	-2.8	32	31	20	14	10	4.2	25

1-2 Front Bed MVHR

	Octave Band Centre Frequency (Hz)							Overall dBA
Source	63	125	250	500	1k	2k	4k	
Incident sound level (freefield)	0	55	53	52	55	52	42	58
Path								
Element 1 ,W Rw +Ctr 31 STL	0	-20	-19	-29	-38	-39	-35	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [2.2 m2]	3	3	3	3	3	3	3	
Element sound level contribution	-2.6	32	31	20	14	10	4.4	25
Element 2 ,1 Dnew 36 STL	0	-36	-35	-33	-37	-37	-39	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [10 m2]	10	10	10	10	10	10	10	
Element sound level contribution	4.1	23	22	23	22	19	7.1	26
Receiver								
Room volume (-10Log V) [25 m3]	-14	-14	-14	-14	-14	-14	-14	
Reveberation time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
RT (+10Log T)	-3	-3	-3	-3	-3	-3	-3	
Equation Constant	11	11	11	11	11	11	11	
Room sound level	4.8	33	32	25	23	20	8.9	29

30dB when using 1dP

	Octave Band Centre Frequency (Hz)							Overall dBA
Source	63	125	250	500	1k	2k	4k	
Incident sound level (freefield)	0	55	53	52	55	52	42	58
Path								
Element 1 ,W Rw +Ctr 27 STL	0	-20	-19	-29	-38	-39	-35	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [4.2 m2]	6	6	6	6	6	6	6	
Element sound level contribution	-2.8	32	31	20	14	10	4.2	25
Element 2 ,1 Dnew 36 STL	0	-36	-35	-33	-37	-37	-39	
Facade Shape Level diff.	0	0	0	0	0	0	0	
Area (+10Log A) [10 m2]	10	10	10	10	10	10	10	
Element sound level contribution	0.93	20	19	20	19	16	3.9	23
Receiver								
Room volume (-10Log V) [50 m3]	-17	-17	-17	-17	-17	-17	-17	
Reveberation time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
RT (+10Log T)	-3	-3	-3	-3	-3	-3	-3	
Equation Constant	11	11	11	11	11	11	11	
Room sound level	2.5	32	31	23	20	17	7.1	27

4 7 Front Bed

Figure 10: Bedroom SRI Calculations

		Measured VDV	BS6472	Factor
ASE	Day	0.053	0.2-0.4	4to8
ASE	Night	0.032	0.1-0.2	3to6
Planning	Day	0.051	0.2-0.4	4to8
Planning	Night	0.039	0.1-0.2	3to5

Table 1 **Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings**

Place and time	Low probability of adverse comment $m \cdot s^{-1.75}$ 1)	Adverse comment possible $m \cdot s^{-1.75}$	Adverse comment probable $m \cdot s^{-1.75}$ 2)
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Figure 11: Vibration Survey and Criteria Data