



Sanctuary Acoustics

Acoustic Consultancy

**NOISE ASSESSMENT FOR
ROSCONN GROUP**

**A NOISE ASSESSMENT CONDUCTED AS
PART OF A PROSPECTIVE PLANNING
PROPOSAL
TO
DEVELOP LAND
ADJACENT TO
OAKDENE CRESCENT & ANTROBUS CLOSE,
HATTON**

**DOCUMENT 001
REVISION 1**

BY

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EXECUTIVE SUMMARY

Sanctuary Acoustics was asked by Mr Nick Carr of Rosconn Group to assess the existing noise environment on the land adjacent to Oakdene Crescent & Antrobus Close, Hatton. The noise survey is required as part of a planning proposal to develop the land for residential use.

To summarise:

1. Noise measurements were undertaken on the land adjacent to Oakdene Crescent and Antrobus Close.
2. Noise measurements were taken at 1-hour intervals over three 3-hour periods from 7am to 10am, 3pm to 6pm and 11pm to 2am.
3. The noise measurements were referenced to the National Planning Policy Framework (NPPF), the former Planning Policy Guidance 24: Planning and Noise (PPG24) with additional reference to BS 8233:1999 Sound Insulation and Noise Reduction for Buildings – Code of Practice.
4. The site which is situated close to Hatton train station has been calculated as having a Planning Policy Guidance 24, Noise Exposure Category B.
5. NEC B states that *'Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise'*.
6. The existing site does sit back from the railway. The two nearest prospective dwellings to the railway are plot numbers 9 & 19 which have been sighted gable end on. This will remove direct line of sight between the habitable rooms of these dwellings and the railway. It is recommended that should glazing be installed to the gable end walls then this should be a fixed glazing type. Elsewhere on the development the glazing types recommended in this report or an alternate glazing specification with a minimum R_w 30dB should be installed.
7. A further reduction in train noise impinging onto the development would be achieved by erecting an acoustic fence or earth bund or both along the sites' northern perimeter with the railway. Such a device could attenuate as much as 10dB at low frequencies, over distance this would be greater when considering mid and high frequency noise which has shorter wavelengths and therefore would dissipate energy a lot quicker. Suitable designs are detailed in Annex B
8. PPG24 recommends internal noise levels in bedrooms of 35dB L_{Aeq} while BS 8233 recommends a Good Design Range in Bedrooms and Living Rooms of 30dB L_{Aeq} and a Reasonable Design Range of 35dB L_{Aeq} for Bedrooms and 40dB L_{Aeq} for Living Rooms.
9. Example double glazed units were modelled using the Building Research Establishment (BRE) Noise Ingress Calculator utilising the noise levels measured on site, specifically with 4/12/4, 6/12/6, 10/12/6, 6.4lam/10/6 and 6/100/4 glazed units and all were found to achieve a 30dB L_{Aeq} internal noise level.
10. It is also recommended to reduce any potential structure borne noise or vibration from passing trains that the concrete floor structure in the dwellings, particularly those that adjoin the northern perimeter with the railway utilise a floating screed as opposed to a bonded or unbonded screed.
11. Providing room layout, glazing and the floor structure is appropriately considered for the dwellings along with a consideration for an acoustic fence or earth bund, then this mitigation should provide the commensurate level of protection required against any resultant noise ingress from the railway.

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1. INTRODUCTION

Sanctuary Acoustics was asked by Mr Nick Carr of Rosconn Group to assess the existing noise environment on the land adjacent to Oakdene Crescent & Antrobus Close, Hatton. The noise survey is required as part of a planning proposal to develop the land for residential use.

The primary noise source impinging on the site is train noise from the railway which adjoins the site boundary along its northern perimeter. The railway line is used by local trains between Birmingham Snow Hill and Leamington Spa with further passenger trains travelling greater distances connecting the Midlands with London. Some freight traffic also operates on this line both day and night with night-time being more common for freight trains. Passenger trains begin passing the site after 05:00 hours through to midnight with additional freight trains operating on the railway after this point although overall rail traffic is less frequent between midnight and 05:00 hours.

Noise from rail traffic provides the most significant noise source in the vicinity with train passes providing the maximum noise events, (L_{Amax}). However, train passes are not continuous and therefore at times the dominant noise source is low to mid frequency traffic rumble from the M40 motorway some distance away. Other noted noise sources impinging on the site were airplanes overhead, early morning and evening birdsong with localised road traffic restricted to occupiers and visitors to neighbouring houses. Although passing trains at various intervals contribute to the continuous equivalent noise level (L_{Aeq}) it is the distant rumble of traffic from the M40 that determines the underlying background noise level (L_{A90}).

Noise is covered, although briefly, in the new National Planning Policy Framework (NPPF) which states that the planning system should contribute to and enhance the natural and local environment.

Planning policies and decisions should;

- aim to avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from the new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established;
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

The Department for the Environment, Food and Rural Affairs have issued an explanatory note to the *Noise Policy Statement for England (NPSE)* which states that the long term vision of Government noise policy is to “*promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.*”

The NPPF guidance however gives no objective, tangible standards or criteria to inform planning decisions. The framework does quote existing guidance to make reference to including WHO guidelines and BS 8233: 1999 Sound insulation and noise reduction for buildings – Code of practice.

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BS 8233 provides recommended noise criteria for unoccupied bedrooms and living rooms. Table 5 within this British Standard; *Indoor ambient noise levels in spaces when they are unoccupied*, details both a Good Design Range and a Reasonable Design Range. A Good Design Range is the more stringent of the two.

Table 1 details the BS 8233 noise criteria for habitable rooms when unoccupied.

Criterion	Typical Situations	Design range $L_{Aeq,T}$	
		Good	Reasonable
Reasonable resting/sleeping conditions	Living Rooms	30	40
	Bedrooms ^a	30	35
^a For a reasonable standard in bedrooms at night, individual noise events (measured with F time-weighting) should not normally exceed 45dB L_{Amax}			

Table 1: BS 8233 Indoor Ambient Noise Level Criteria

The introduction of the National Planning Policy Framework (NPPF) in March 2012 orchestrated the repealing of many planning documents including Planning Policy Guidance 24 (PPG24): Planning and Noise.

PPG24 divided as does other guidance the 24 hour clock into daytime and night-time segments with the daytime period from 07:00 to 23:00 hours and night-time from 23:00 to 07:00.

It was considered that noise measurements should coincide with anticipated daytime commuter traffic and the start or end of the night-time period which are generally the noisiest times of the night.

Therefore, noise measurement periods from 7am to 10am, 3pm to 6pm and either 11pm to 2am or 4am to 7am to cover the optimum train traffic time period were considered.

On commencement of the noise survey, the morning noise measurement period was composed of three separate noise measurements each of 1-hour duration to ascertain the prominent noise sources and any changes in such noise sources with time during the morning period impinging onto the site. The morning measurements highlighted that although traffic on the M40 was audible throughout, the prominent noise source is train noise albeit intermittently. Therefore for the two remaining measurement periods three 1-hour measurements were conducted between both 3pm to 6pm and again between 11pm to 2am.

In order to assess the existing noise climate, the following were investigated:

- Passing train noise levels on the site from the adjoining railway.
- Other noise sources impinging onto the site.
- The façade and floor construction for dwellings in particular those that will overlook the railway.

The noise survey began at 7am on the morning of Tuesday 12th November 2013 and finished at 2am on Wednesday 13th November 2013.

The continuous noise source impinging on the site was traffic noise from the M40 motorway with the most significant individual noise events occurring from passing trains along the sites northern boundary.

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A noise measurement location was chosen to assess noise impinging onto the site from the railway located at the northern boundary at a replicable location to proposed dwellings and free from any specular reflections.

The noise measurements taken at the location situated on land adjacent to Oakdene Crescent & Antrobus Close were undertaken using a Norsonics 132 Sound Level Meter (Serial Number 1322854) which was calibrated before and after the noise measurements were taken using a Cirrus CR:514 Acoustic Calibrator (Serial Number 60242). Both items of equipment have traceable calibration certificates and are designated as Type 2 instruments which are inline with IEC 60651 & 60804 and IEC 60942 respectively. The Sound Level Meter was mounted on a tri-pod 1.5m above ground level in a free field location. The results of the noise measurements and their acoustic parameters are detailed in section 2, Measurements and Observations.

2. MEASUREMENTS AND OBSERVATIONS

The nine measurements commenced on Tuesday November 12th and drew to a close on Wednesday November 13th 2013. Three 1-hour measurements were conducted in each of the morning, afternoon and night-time periods between 7am & 10am, 3pm & 6pm and 11pm & 2am to represent a 24-hr day on what is an easily accessible site to the general public.

It was noted that with minimal road traffic on Oakdene Crescent and Antrobus Close, the most significant contributing noise source to the equivalent continuous noise level (L_{Aeq}) was derived from passing trains which also provided most of the individual maximum noise events measured in the vicinity, (others being airplanes, birdsong and residents at various times), however it can be said that the background noise level (L_{A90}) which represents the noise level measured for 90% of the measurement duration together with the underlying level of the L_{Aeq} was determined by the distant rumble of traffic on the M40 motorway. Railway noise had been raised as the primary concern for noise impinging onto this site. Although the noise from passing trains is the most significant individual noise impinging onto the site, it is intermittent. Despite being audible albeit at a least significant level, noise from the M40 appears continuous during the day with only a decrease as the night progresses following a reduction in the volume of traffic using the motorway. The only other notable noise sources were airplanes overhead and birdsong.

For each of the noise measurements the results, 1/1 octave band data and observations are detailed in tabular form including descriptions of the weather conditions and location.

A glossary of the acoustic parameters/terms used can be found in the Annex.

Figures 1 and 2 depict the measurement location. Figure 1 shows the easterly view of the measurement location towards the centre of the development site. Figure 2 shows the measurement location facing the northern perimeter with the railway beyond.

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Figure 1: This depicts the position of the measurement location on the land adjacent to Oakdene Crescent and Antrobus Close as viewed into the proposed development site in a easterly direction.



Figure 2: This depicts the position of the measurement location as viewed towards the northern site boundary with the railway line beyond as a Virgin train passes.

The noise results obtained for measurement 1 at location 1 are detailed in table 1.

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Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	07.00 – 08.00 1 Hour Measurement
Weather & Site Conditions/Observations	Morning Mist and cloud clearing , No Wind, 7 ⁰ C, Sun Rising Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Train bypass provides L _{Amax} 70.8dB.
Measurement Parameter	Measurement Reading
L _{Aeq}	61.1dB(A)
L _{A10}	61.9dB(A)
L _{Amin}	57.9dB(A)
L _{Amax}	70.8dB(A)
L _{A90}	59.8dB(A)

Table 1: The results taken at Measurement Location 1 for 7am to 8am

Table 2 details the 1/1 octave band measurements for the measurement.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	07.00 – 08.00 1 Hour Measurement							
Site Conditions or Observations	Morning Mist and cloud clearing , No Wind, 7 ⁰ C, Sun Rising Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Train bypass provides L _{Amax} 70.8dB.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L _{eq} (Ambient Level)	61.3	49.5	45.2	51.3	55.9	41.4	37.4	30.8
L _{max} (Maximum Level)	85.0	72.2	60.6	68.5	63.9	55.5	65.1	57.8
L ₉₀ (Background Level)	53.5	43.7	41.1	48.8	54.6	39.8	19.9	19.8

Table 2: The 1/1 Octave Band Data taken at Measurement Location 1 for 7am to 8am

The observations noted during this measurement period are detailed in table 3.

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Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	07.00 – 08.00 1 Hour Measurement
Weather & Site Conditions/Observations	Morning Mist and cloud clearing , No Wind, 7 ⁰ C, Sun Rising Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Train bypass provides L _{Amax} 70.8dB.
Minutes Passed	Observations
0 - 60	Traffic rumble from M40
0 - 60	Intermittent Birdsong
0 - 60	Intermittent Train passes
0 – 1	Train bypass (67.7 dB L _{Amax})
3	Airplane overhead (69.2 dB L _{Amax})
13	Train bypass (70.8 dB L _{Amax})
15	Slow Chiltern Railways train bypass
20	London Midland train bypass
29	Airplane overhead

Table 3: The observations noted during Measurement 1

The noise results obtained for measurement location 1 between 8am and 9am are detailed in table 4.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	08.00 – 09.00 1 Hour Measurement
Weather & Site Conditions/Observations	A little cloud but clearing with clear sky and sunshine during second half of measurement. No Wind, 7 ⁰ C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Train bypass provides L _{Amax} 78.1dB during 6 th minute.
Measurement Parameter	Measurement Reading
L _{Aeq}	61.0dB(A)
L _{A10}	61.9dB(A)
L _{Amin}	54.9dB(A)
L _{Amax}	78.1dB(A)
L _{A90}	57.7dB(A)

Table 4: The results taken at Measurement Location 1 for 8am to 9am

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Table 5 details the 1/1 octave band measurements for the measurement.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	08.00 – 09.00 1 Hour Measurement							
Site Conditions or Observations	A little cloud but clearing with clear sky and sunshine during second half of measurement. No Wind, 7°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Train bypass provides L_{Amax} 78.1dB during 6 th minute.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L_{eq} (Ambient Level)	59.7	52.7	45.7	50.6	55.8	43.2	35.3	28.0
L_{max} (Maximum Level)	83.1	81.4	72.8	70.1	70.9	63.5	57.2	51.7
L_{90} (Background Level)	52.1	43.4	39.5	46.7	52.9	37.1	19.9	19.8

Table 5: The 1/1 Octave Band Data taken at Measurement Location 1 for 8am to 9am

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The observations noted during this measurement period are detailed in table 6.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	08.00 – 09.00 1 Hour Measurement
Weather & Site Conditions/Observations	A little cloud but clearing with clear sky and sunshine during second half of measurement. No Wind, 7°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Train bypass provides L_{Amax} 78.1dB during 6 th minute.
Minutes Passed	Observations
0 - 60	Distant rumble of road traffic noise from the M40
0 – 60	Intermittent Birdsong
0 – 60	Intermittent train passes
3 – 4	Slow moving London Midland train bypass (65.6dB L_{Amax}). Peak at 31.5Hz noted.
6	Slow moving southbound Chiltern train (68.7dB L_{Amax})
6	Faster moving northbound Virgin train (78.1dB L_{Amax})
16	Train bypass
17	Train bypass
27	Freight train bypass
33	Chiltern train bypass
35	Northbound slow moving Chiltern
36	Dog Walker
40	Chiltern train bypass
45	Chiltern train bypass
55	Freight train southbound
57	Virgin train northbound

Table 6: The observations noted during Measurement 2

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The noise results obtained for the third measurement at measurement location 1 are detailed in table 7.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	09.00 – 10.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky and sunshine. No Wind, 8 ^o C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Virgin train bypass provides L _{Amax} 77.5dB during 55 th minute.
Measurement Parameter	Measurement Reading
L _{Aeq}	56.7dB(A)
L _{A10}	58.2dB(A)
L _{Amin}	51.0dB(A)
L _{Amax}	77.5dB(A)
L _{A90}	53.3dB(A)

Table 7: The results taken at the measurement location 1 during 9am to 10am

Table 8 details the 1/1 octave band measurements for the measurement.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	09.00 – 10.00 1 Hour Measurement							
Site Conditions or Observations	Clear sky and sunshine. No Wind, 8 ^o C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Virgin train bypass provides L _{Amax} 77.5dB during 55 th minute.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L _{eq} (Ambient Level)	56.5	53.5	43.7	46.3	51.2	37.6	39.5	35.7
L _{max} (Maximum Level)	83.9	78.7	67.7	67.7	70.1	63.1	67.4	64.9
L ₉₀ (Background Level)	49.6	41.9	36.5	42.6	48.2	32.2	19.9	19.8

Table 8: The 1/1 Octave Band Data taken at Measurement Location 1 for 9am to 10am

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The observations noted during this measurement period are detailed in table 9.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	09.00 – 10.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky and sunshine. No Wind, 8 ^o C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Virgin train bypass provides L _{Amax} 77.5dB during 55 th minute.
Minutes Passed	Observations
0 – 60	Traffic rumble from M40
0 – 60	Intermittent train passes
0 – 60	Intermittent birdsong
0 – 2	Dog walker (63.2dB L _{Amax})
2	Birdsong (68.0dB L _{Amax})
3	Birdsong (69.0dB L _{Amax})
10	Virgin train bypass (71.6 dB L _{Amax})
13	Airplane overhead
18	Train bypass southbound
26	Airplane overhead
33	Chiltern train bypass
46	Chiltern train bypass
47	Airplane overhead
55	Virgin train northbound (77.5dB L _{Amax})
55	Virgin train southbound
59	Airplane overhead

Table 9: The observations noted during Measurement 3

The noise results obtained for the fourth measurement at measurement location 1 are detailed in table 10.

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Table 10: The results taken at Location 1 between 3pm and 4pm.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	15.00 – 16.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky and sunshine with some scattered cloud. No Wind, 9°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Virgin train bypass provides L_{Amax} 77.6dB during 27 th minute.
Measurement Parameter	Measurement Reading
L_{Aeq}	60.6dB(A)
L_{A10}	61.1dB(A)
L_{Amin}	55.8dB(A)
L_{Amax}	77.6dB(A)
L_{A90}	58.5dB(A)

Table 10: The results taken at the measurement location 1 during 3pm to 4pm

Table 11 details the 1/1 octave band measurements for the measurement.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	15.00 – 16.00 1 Hour Measurement							
Site Conditions or Observations	Clear sky and sunshine with some scattered cloud. No Wind, 9°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Virgin train bypass provides L_{Amax} 77.6dB during 27 th minute.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L_{eq} (Ambient Level)	59.2	52.3	46.4	51.8	54.7	41.1	31.6	28.0
L_{max} (Maximum Level)	81.6	79.3	68.5	74.0	69.5	63.9	58.3	55.6
L_{90} (Background Level)	53.1	42.5	41.0	49.1	52.7	36.4	19.8	19.8

Table 11: The 1/1 Octave Band Data taken at Measurement Location 1 for 3pm to 4pm

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The observations noted during this measurement period are detailed in table 12.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	15.00 – 16.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky and sunshine with some scattered cloud. No Wind, 9°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Virgin train bypass provides L_{Amax} 77.6dB during 27 th minute.
Minutes Passed	Observations
0 – 60	Traffic rumble from M40
0 – 60	Intermittent train passes
0 – 60	Intermittent birdsong
8	Birdsong (65.0dB L_{Amax})
10	Airplane overhead (67.3dB L_{Amax})
11	Train bypass (70.0 dB L_{Amax})
19	Nearby chicken coop door being shut (77.2 dB L_{Amax})
20	Train bypass
22	Chiltern train bypass northbound
27	Virgin train northbound (77.6dB L_{Amax})

Table 12: The observations noted during Measurement 4

The noise results obtained for the fifth measurement at location 1, 4pm to 5pm are detailed in table 13.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	16.00 – 17.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky and sunshine with some scattered cloud. No Wind, 8°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Freight train bypass provides L_{Amax} 82.1dB during 8 th minute.
Measurement Parameter	Measurement Reading
L_{Aeq}	62.4dB(A)
L_{A10}	61.4dB(A)
L_{Amin}	56.8dB(A)
L_{Amax}	82.1dB(A)
L_{A90}	59.1dB(A)

Table 13: The results taken at the above Location 1 for its fifth measurement.

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Table 14 details the 1/1 octave band measurements for the measurement.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	16.00 – 17.00 1 Hour Measurement							
Site Conditions or Observations	Clear sky and sunshine with some scattered cloud. No Wind, 8°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Freight train bypass provides L_{Amax} 82.1dB during 8 th minute.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L_{eq} (Ambient Level)	62.1	58.0	47.8	54.2	56.3	45.1	37.3	27.3
L_{max} (Maximum Level)	83.3	82.2	68.6	77.6	74.6	68.4	61.9	56.3
L_{90} (Background Level)	53.2	43.6	41.7	49.8	53.3	37.1	19.8	19.8

Table 14: The 1/1 Octave Band Data taken at Measurement Location 1 for 4pm to 5pm

The observations noted during this measurement period are detailed in table 15.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	16.00 – 17.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky and sunshine with some scattered cloud. No Wind, 8°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Freight train bypass provides L_{Amax} 82.1dB during 8 th minute.
Minutes Passed	Observations
0 – 60	Traffic rumble from M40
0 – 60	Intermittent train passes
0 – 60	Intermittent birdsong
5	Train bypass (63.8dB L_{Amax})
8	Freight train bypass (82.1dB L_{Amax})
14	Southbound train bypass
17	Northbound train bypass
19	Freight train bypass

Table 15: The observations noted during Measurement 5

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The noise results obtained for the sixth measurement at location 1, 5pm to 6pm are detailed in table 16.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	17.00 – 18.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky. No Wind, 7°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Train bypass provides L_{Amax} 75.5dB during 22 nd minute.
Measurement Parameter	Measurement Reading
L_{Aeq}	60.4dB(A)
L_{A10}	61.6dB(A)
L_{Amin}	55.4dB(A)
L_{Amax}	75.5dB(A)
L_{A90}	58.1dB(A)

Table 16: The results taken at the above Location 1 for its sixth measurement.

Table 17 details the 1/1 octave band measurements for the measurement.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	17.00 – 18.00 1 Hour Measurement							
Site Conditions or Observations	Clear sky. No Wind, 7°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Train bypass provides L_{Amax} 75.5dB during 22 nd minute.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L_{eq} (Ambient Level)	59.9	53.5	44.8	52.1	54.9	40.7	31.2	22.0
L_{max} (Maximum Level)	84.8	82.2	64.3	68.6	69.1	60.8	61.0	53.5
L_{90} (Background Level)	53.2	44.0	41.2	49.3	52.4	36.4	19.8	19.8

Table 17: The 1/1 Octave Band Data taken at Measurement Location 1 for 5pm to 6pm

The observations noted during this measurement period are detailed in table 18.

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Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	17.00 – 18.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky. No Wind, 7 ^o C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Train bypass provides L _{Amax} 75.5dB during 22 nd minute.
Minutes Passed	Observations
0 – 60	Traffic rumble from M40
0 – 60	Intermittent train passes
0 – 60	Intermittent birdsong
1	Airplane overhead (62.9dB L _{Amax})
4	Train bypass (70.1dB L _{Amax})
6	Train bypass (75.0dB L _{Amax})
17	Train bypass
22	Train bypass (75.5dB L _{Amax})
29	Airplane overhead

Table 18: The observations noted during Measurement 6

The noise results obtained for the seventh measurement at location 1, 11pm to 12am are detailed in table 19.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	23.00 – 00.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky. No Wind, 3 ^o C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Freight train bypass provides L _{Amax} 78.2dB during 8 th minute.
Measurement Parameter	Measurement Reading
L _{Aeq}	60.0dB(A)
L _{A10}	60.0dB(A)
L _{Amin}	49.9dB(A)
L _{Amax}	78.2dB(A)
L _{A90}	54.9dB(A)

Table 19: The results taken at the above Location 1 for its seventh measurement.

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Table 20 details the 1/1 octave band measurements for the measurement.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	23.00 – 00.00 1 Hour Measurement							
Site Conditions or Observations	Clear sky. No Wind, 3 ^o C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Freight train bypass provides L_{Amax} 78.0dB during 8 th minute.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L_{eq} (Ambient Level)	58.8	56.9	46.7	53.3	53.0	42.6	35.2	22.6
L_{max} (Maximum Level)	79.6	81.4	66.5	70.6	69.9	64.4	60.2	55.4
L_{90} (Background Level)	49.2	42.8	39.1	47.1	48.5	33.5	19.8	19.8

Table 20: The 1/1 Octave Band Data taken at Measurement Location 1 for 11pm to 12am

The observations noted during this measurement period are detailed in table 21.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	23.00 – 00.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky. No Wind, 3 ^o C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Some birdsong. Freight train bypass provides L_{Amax} 78.0dB during 8 th minute.
Minutes Passed	Observations
0 – 60	Traffic rumble from M40
0 – 60	Intermittent train passes
8	Freight train (78.0dB L_{Amax})
29	Passenger Train

Table 21: The observations noted during Measurement 7

The noise results obtained for the eighth measurement at location 1, 12am to 1am are detailed in table 22.

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Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	00.00 – 01.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky. No Wind, 0°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Train bypass provides L_{Amax} 74.2dB during 2 nd minute.
Measurement Parameter	Measurement Reading
L_{Aeq}	57.3dB(A)
L_{A10}	58.0dB(A)
L_{Amin}	52.0dB(A)
L_{Amax}	74.2dB(A)
L_{A90}	54.5dB(A)

Table 22: The results taken at the above Location 1 for its eighth measurement.

Table 23 details the 1/1 octave band measurements for the measurement.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	00.00 – 01.00 1 Hour Measurement							
Site Conditions or Observations	Clear sky. No Wind, 0°C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Train bypass provides L_{Amax} 74.2dB during 2 nd minute.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L_{eq} (Ambient Level)	56.0	50.2	44.4	48.2	51.6	40.0	32.9	29.4
L_{max} (Maximum Level)	77.6	79.6	67.0	67.5	66.4	61.1	56.6	55.5
L_{90} (Background Level)	48.2	40.7	38.6	44.6	49.0	33.2	21.6	19.8

Table 23: The 1/1 Octave Band Data taken at Measurement Location 1 for 12am to 1am

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The observations noted during this measurement period are detailed in table 24.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	00.00 – 01.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky. No Wind, 0 ^o C. Site Conditions – Intermittent train bypasses. Quiet residential road, neighbourhood traffic although the distant rumble of traffic from the M40 was just audible. Train bypass provides L _{Amax} 74.2dB during 2 nd minute.
Minutes Passed	Observations
0 – 60	Traffic rumble from M40
0 – 60	Intermittent train passes
2	Train (74.2dB L _{Amax})
3	Freight locomotive
5	Freight train

Table 24: The observations noted during Measurement 8.

The noise results obtained for the ninth measurement at location 1, 1am to 2am are detailed in table 25.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	01.00 – 02.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky. No Wind, 0 ^o C. Site Conditions – Perceived reduction in train traffic and road traffic volume from the M40 was just audible. L _{Amax} 62.5dB.
Measurement Parameter	Measurement Reading
L _{Aeq}	54.0dB(A)
L _{A10}	56.4dB(A)
L _{Amin}	44.3dB(A)
L _{Amax}	62.5dB(A)
L _{A90}	50.1dB(A)

Table 25: The results taken at the above Location 1 for its ninth measurement.

Table 26 details the 1/1 octave band measurements for the measurement.

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Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close							
Time & Duration	01.00 – 02.00 1 Hour Measurement							
Site Conditions or Observations	Clear sky. No Wind, 0 ⁰ C. Site Conditions – Perceived reduction in train traffic and road traffic volume from the M40 was just audible. L _{Amax} 62.5dB.							
Measurement Parameter	Frequency (Hz) Octave Bands							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
L _{eq} (Ambient Level)	55.2	44.0	39.0	47.6	48.2	32.9	19.8	15.0
L _{max} (Maximum Level)	72.7	60.9	51.7	57.3	60.0	50.3	48.7	46.5
L ₉₀ (Background Level)	46.0	38.4	34.9	42.8	43.0	27.9	19.8	19.8

Table 26: The 1/1 Octave Band Data taken at Measurement Location 1 for 1am to 2am

The observations noted during this measurement period are detailed in table 27.

Location	1. Proposed Development Site Overlooking the Railway on Land Adjacent to Oakdene Crescent and Antrobus Close
Time & Duration	01.00 – 02.00 1 Hour Measurement
Weather & Site Conditions/Observations	Clear sky. No Wind, 0 ⁰ C. Site Conditions – Perceived reduction in train traffic and road traffic volume from the M40 was just audible. L _{Amax} 62.5dB.
Minutes Passed	Observations
0 – 60	Traffic rumble from M40
0 – 60	Intermittent train passes
2	Train (74.2dB L _{Amax})
3	Freight locomotive
5	Freight train

Table 27: The observations noted during Measurement 9.

3. REFERENCE TO GUIDANCE

The previous planning guidance, PPG24, which is still referenced by many due to its valuable quantifying data categorised a site's suitability for residential development by its noise environment. Four noise exposure categories were used to describe the suitability of the proposed site and are labelled from A to D. Category A states the site is desirable from a noise perspective while category D would mean planning permission would normally be refused on grounds of noise.

Table 28 provides the complete description for all the categories.

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

Table 28: Description of Noise Exposure Categories

The noise levels and the range of noise associate with these noise categories are detailed in table 29.

Noise Levels Corresponding to the Noise Exposure Categories for New Dwellings				
$L_{Aeq,T}$ dB				
	Noise Exposure Category			
Noise Source	A	B	C	D
Road Traffic				
07.00 – 23.00	<55	55 – 63	63 – 72	>72
23.00 – 07.00	<45	45 – 57	57 - 66	>66
Rail Traffic				
07.00 – 23.00	<55	55 – 66	66 – 74	>74
23.00 – 07.00	<45	45 – 59	59 - 66	>66
Mixed Sources				
07.00 – 23.00	<55	55 – 63	63 – 72	>72
23.00 – 07.00	<45	45 – 57	57 - 66	>66

Table 29: Noise Exposure Categories by Equivalent Continuous Noise Levels $L_{Aeq,T}$

Rail traffic noise is the primary noise source within the vicinity outweighing any equivalent continuous noise produced by overhead airplanes or road traffic. Table 29 details the noise values for the rail traffic category which are slightly higher than the more stringent mixed source category.

The L_{Aeq} levels measured during the morning, afternoon and night-time periods were each averaged. The morning produced an average 59.6dB(A), afternoon 61.1dB(A) and the night-time 57.1dB(A) which puts the site into a Category B for both daytime and night-time.

The highest daytime L_{Aeq} 61.1dB places the site into a Category B;

The night-time L_{Aeq} 57.1dB also places the site into a Category B;

Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.

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PPG24 recommends the following internal noise criteria to which the conditions and commensurate levels of protection should achieve:

35dB L_{Aeq} in Bedrooms

45dB L_{Aeq} in Living Rooms

PPG 24 also makes reference to *BS 8233:1999 Sound Insulation and Noise Reduction for Buildings – Code of Practice*

Within *BS 8233 Sound insulation and noise reduction for buildings – Code of practice*, Table 5 of this standard gives both a Good and a Reasonable design range to provide for reasonable resting/sleeping conditions of 30dB in bedrooms and living rooms (Good) and 35dB $L_{Aeq,T}$ in bedrooms and 40dB $L_{Aeq,T}$ in living rooms (Reasonable).

This standard also states “*For a reasonable standard in bedrooms at night, individual noise events measured with F time-weighting) should not normally exceed 45 dB L_{Amax}* ”.

From the results obtained from the noise survey the following conclusions have been drawn with reference to guidance;

- A minimum glazing specification is required for the proposed development.
- To reduce potential vibration and/or structure borne noise within the proposed dwellings some attention to the floor detailing and the abutment with the external walls should be considered for those dwellings closest to the railway. For a concrete floor, either poured concrete slab or in-situ concrete planks, it is recommended that a floating screed be specified. The concrete base should be either poured concrete or concrete plank with a minimum mass of 300kg/m² with a resilient layer, minimum thickness of 25mm placed in-situ onto the concrete base with a further 65mm sand cement or calcium silicate screed with a minimum mass 80kg/m² placed above the resilient layer. At the abutment between floor and external wall, cavity stops/flanking strips should be used.
- Alternative floor structures would be a solid concrete floor consisting of reinforced concrete with or without shuttering, concrete beams with infill blocks and screed, hollow or solid concrete planks with screed of thickness and density to give a total mass of at least 365kg/m² with soft floor covering >5mm thick.
- A concrete floor 175 – 200mm thick with 40 - 65mm floating screed is recommended as detailed in the concrete floor sound insulation prediction graph attached. The concrete screed is laid upon a 2.5 - 4mm velophone layer.

A further recommended construction is Floor Type 2 from Building Regulations Approved Document E – Resistance to the passage of sound or an alternative Robust Detail.

4. RECOMMENDATIONS

The noise report provides recommendations for a suitable façade construction with potential glazing types having been modelled using the Building Research Establishments Noise Ingress Calculator. Glazed units are the weak link in a façade and may provide some internal structure borne noise during periods of train vibration as well airborne noise; therefore units with adequate frames such as glazed units with absorbent reveals reduce flanking transmission and sound transfer between panes. Lightweight aluminium frames ease the passage of sound compared to solid frames or frames that have been infilled with absorbent materials.

Figure 3 depicts a proposed layout for thirty seven dwellings on the site.



Figure 3: Proposed layout of a thirty seven dwelling development for the land adjacent to Oakdene Crescent and Antrobus Close.

Taking into consideration existing noise sources around the site and with an external wall construction of double leaf brick or brick/block cavity with an internal plaster skim and double glazed windows, the following recommendations for glazing have been made in table 30.

The volume for the bedrooms used was 28m³ and for the lounges 40m³ the external L_{Aeq} used in the macro spreadsheet was 61.1dB(A) which was the highest averaged measured noise level, L_{Aeq} which takes into consideration a worst case scenario.

Room	Glazing Type				
	4/12/4	6.4lam/10/6	6/12/6	10/12/6	6/100/4
Bedroom	29.3dB	24.7dB	28.7dB	23.3dB	20.5dB
Lounge	27.7dB	23.2dB	27.2dB	21.7dB	18.9dB

Table 30: Glazing Specifications

As detailed in table 30, any of the double glazing types modelled will provide adequate sound insulation to achieve the Good Design Range as detailed in BS 8233. As long as they are properly sealed, uPVC glazed units should provide adequate sound insulation.

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As depicted in figure 3, the proposed two dwellings nearest to the railway, plot numbers 9 and 19 do not face directly onto the railway but are situated side on with the gable end wall fronting the railway. It is therefore recommended that any glazing planned for these gable end walls should be fixed. By positioning habitable rooms which are bedrooms, lounges, living rooms, dining rooms and kitchen/diners in such away they are not in direct line of sight of the railway will in turn reduce the level of direct noise ingress within the dwellings. Similarly noise will be attenuated over distance and therefore dwellings further from the railway will be subject to a reduced level of noise ingress. For information here, non-habitable rooms are deemed as bathrooms, toilets, shower rooms, airing cupboards, landings, hallways, stairs and standalone kitchens and it is these rooms that should overlook the railway. Such non-habitable rooms facing the railway should have fixed glazing and were ventilation is required, mechanical ventilation through wall vents, acoustic vents etc., which should be fitted with a minimum specified noise criteria of $D_{n,e,w}$ 30dB.

A further recommendation to reduce train noise would be the installation of an acoustic fence and/or earth bund along the development sites' northern perimeter with the railway. With an earth bund and/or acoustic fence in place, this should as a minimum provide 10dB noise attenuation and therefore an alternative glazing specification such as 6/12/6, 10/12/6 or 6.4laminated/10/6 would more than suffice.

Annex B provides in some detail the methodology, types and ways to construct acoustic fences and earth bunds.

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5. SUMMARY.

Sanctuary Acoustics was asked by Mr Nick Carr of Rosconn Group to assess the existing noise environment on the land adjacent to Oakdene Crescent & Antrobus Close, Hatton. The noise survey is required as part of a planning proposal to develop the land for residential use.

To summarise:

1. Noise measurements were undertaken on the land adjacent to Oakdene Crescent and Antrobus Close.
2. Noise measurements were taken at 1-hour intervals over three 3-hour periods from 7am to 10am, 3pm to 6pm and 11pm to 2am.
3. The noise measurements were referenced to the National Planning Policy Framework (NPPF), the former Planning Policy Guidance 24: Planning and Noise (PPG24) with additional reference to BS 8233:1999 Sound Insulation and Noise Reduction for Buildings – Code of Practice.
4. The site which is situated close to Hatton train station has been calculated as having a Planning Policy Guidance 24, Noise Exposure Category B.
5. NEC B states that *'Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise'*.
6. The existing site does sit back from the railway. The two nearest prospective dwellings to the railway are plot numbers 9 & 19 which have been sighted gable end on. This will remove direct line of sight between the habitable rooms of these dwellings and the railway. It is recommended that should glazing be installed to the gable end walls then this should be a fixed glazing type. Elsewhere on the development the glazing types recommended in this report or an alternate glazing specification with a minimum R_w 30dB should be installed.
7. A further reduction in train noise impinging onto the development would be achieved by erecting an acoustic fence or earth bund or both along the sites' northern perimeter with the railway. Such a device could attenuate as much as 10dB at low frequencies, over distance this would be greater when considering mid and high frequency noise which has shorter wavelengths and therefore would dissipate energy a lot quicker. Suitable designs are detailed in Annex B
8. PPG24 recommends internal noise levels in bedrooms of 35dB L_{Aeq} while BS 8233 recommends a Good Design Range in Bedrooms and Living Rooms of 30dB L_{Aeq} and a Reasonable Design Range of 35dB L_{Aeq} for Bedrooms and 40dB L_{Aeq} for Living Rooms.
9. Example double glazed units were modelled using the Building Research Establishment (BRE) Noise Ingress Calculator utilising the noise levels measured on site, specifically with 4/12/4, 6/12/6, 10/12/6, 6.4lam/10/6 and 6/100/4 glazed units and all were found to achieve a 30dB L_{Aeq} internal noise level.
10. It is also recommended to reduce any potential structure borne noise or vibration from passing trains that the concrete floor structure in the dwellings, particularly those that adjoin the northern perimeter with the railway utilise a floating screed as opposed to a bonded or unbonded screed.
11. Providing room layout, glazing and the floor structure is appropriately considered for the dwellings along with a consideration for an acoustic fence or earth bund, then this mitigation should provide the commensurate level of protection required against any resultant noise ingress from the railway.

6. ANNEX A

Acoustics Glossary of Terms

$L_{Aeq,T}$ – Equivalent continuous sound pressure level. This is the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that within a specified time interval, T, has the same mean squared sound pressure as a sound that varies with time.

L_{A10} – The A-weighted mean square sound pressure level that is exceeded for 10% of the time.

L_{A90} – The A-weighted mean square sound pressure level that is exceeded for 90% of the time. Referred to as the background noise level.

L_{Amin} – The lowest A-weighted noise level recorded during a noise event.

L_{Amax} – The highest A-weighted noise level recorded during a noise event.

$L_{Ar, Tr}$ – The specific noise level plus any adjustment for the characteristic features of the noise.

7. ANNEX B

Acoustic Fence Design

An acoustic fence is designed to reduce traffic noise. The basic design of an acoustic fence (or barrier) is to cut, as far as practicable, "line-of-sight" from a road or rail noise source to a residential habitable area or amenity area. Cutting line-of-sight requires a fence with satisfactory height and length. The design needs to be robust and meet the requirements of good design, stability and reasonable life. The basic design goal is to reduce traffic noise by a minimum of 5dB(A). A very good design will achieve around 10dB(A) noise reduction. The basic design can be achieved with no gaps between panels / slats.

This appendix summarises designs for an acoustic fence standard. Infill panels can be timber, plywood, etc with a minimum density of 12.5 kg/m². An advisable thickness is 23 mm thick and will meet requirements. The posts can be 100mm minimum dimension (i.e. 100 x 100). (The design shows the use of 200mm diameter poles but this is not necessary for 2 metre high fences).

- Structural timber and cladding above ground needs to be treated with timber in contact with the ground needing to be treated to an improved standard.
- End battens and intermediate battens should be not less than 75mm by 38 mm;
- Maximum spacing for intermediate battens is 1100 mm;
- Timber should have a minimum 15 mm overlap so shrinkage does not affect the acoustic performance of the barrier.
- Structural plywood should be Stress Graded;
- Plywood panels above ground need to be treated to with panels in contact with the ground requiring an improved treatment.

Materials other than timber can be used, if required. An alternative to 100 mm timber posts are 75mm x 75mm galvanised square hollow section steel posts. Alternatives to timber panelling include concrete, glass fibre reinforced concrete, and steel sheet. Transparent materials are available, including glass and Plexiglas.

The size and location of openings under or through the barrier must be kept to a minimum. The effect of a continuous gap of approximately 50 mm at the base of the noise barrier will degrade the performance of the barrier by approximately 1 dB(A).

Landscaping is recommended, associated with changes in fence design or style to reduce the visual effect of the fence. The use of earth-mounds and landscaping has better acoustical properties than timber fencing alone. A 1.8 metre high fence, for example, designed as a landscaped 0.8 metre high earth-mound with a 1 metre high timber fence provides good noise reduction, is economic to construct and presents a good visual appearance. Designs that allow for plantings and lateral stability to assist in strengthening the fence are more visually acceptable than a long straight-line fence. The examples following, illustrate various designs of earth-mound and panel fencing. Fences 2 to 5 can also be used without an earth-mound base.

The acoustic fence must extend beyond the property it seeks to protect. This is because sound 'bends' around the ends of the barrier and reduces its effectiveness. The barrier should extend far enough to reduce potential noise by 8 - 10dB(A) at the site. For most practical situations this can be done by extending the barrier down the side boundaries of the affected property.

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Landscaped Earth Bund or Mound



Timber Fence or Combination of Earth Bund/Mound and Timber Fence



Figure 1: Earth mound and timber panel

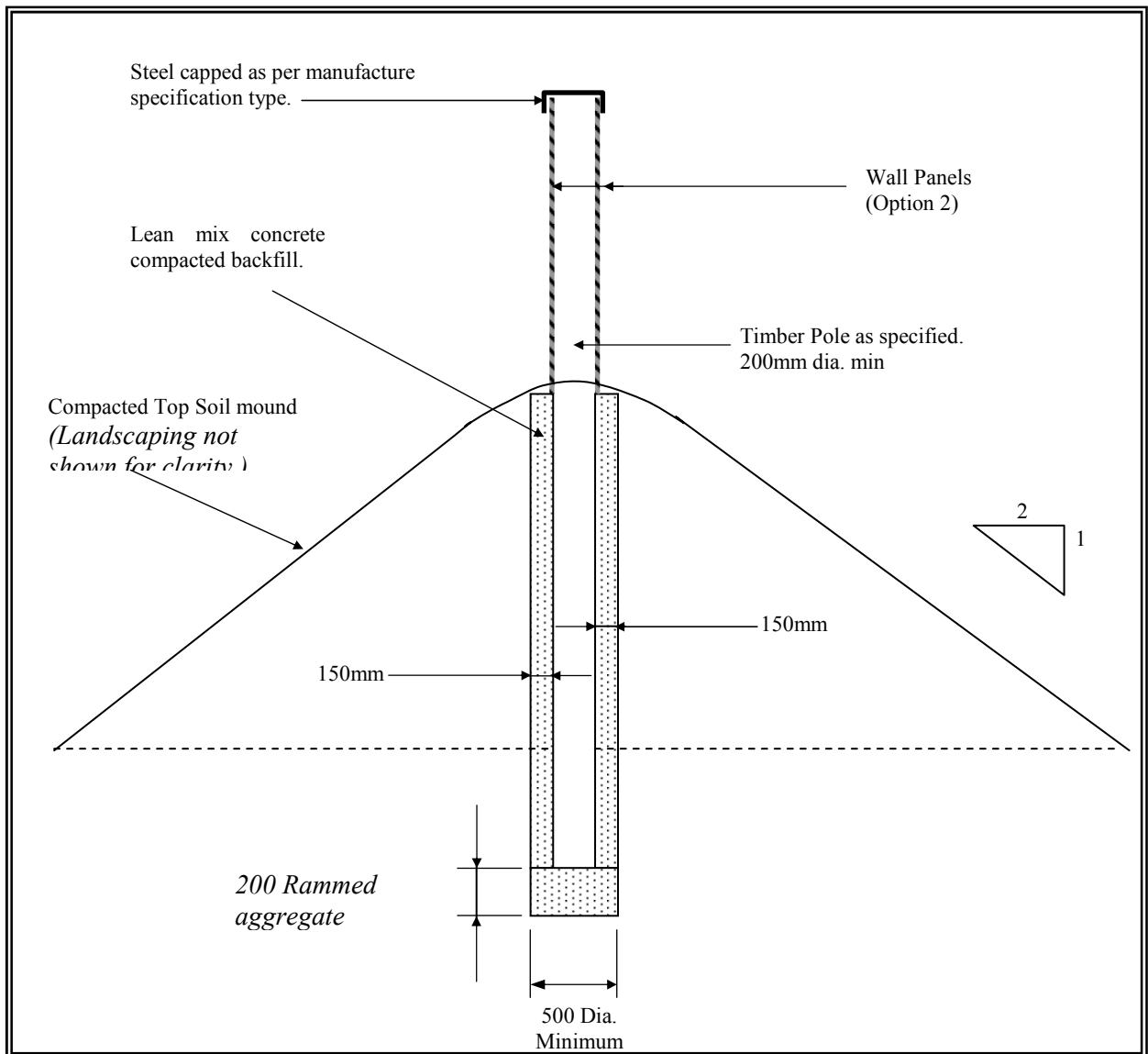
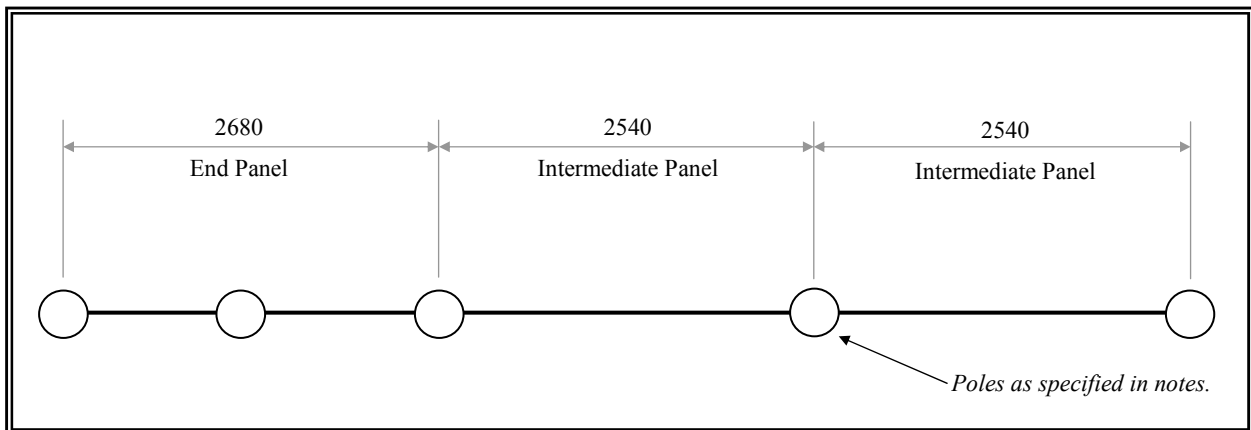


Figure 2: Straight Panelling



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Figure 3: Sawtooth Panelling

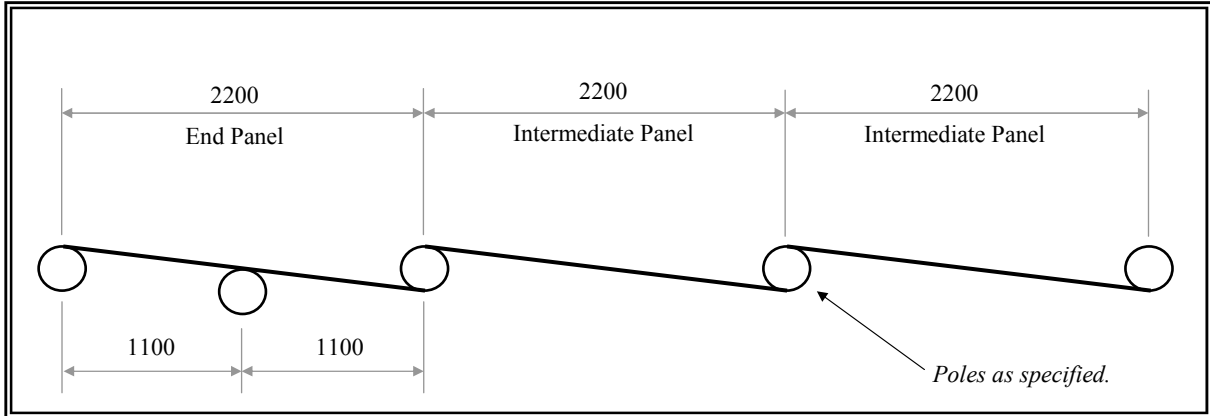


Figure 4: Stepped Panelling

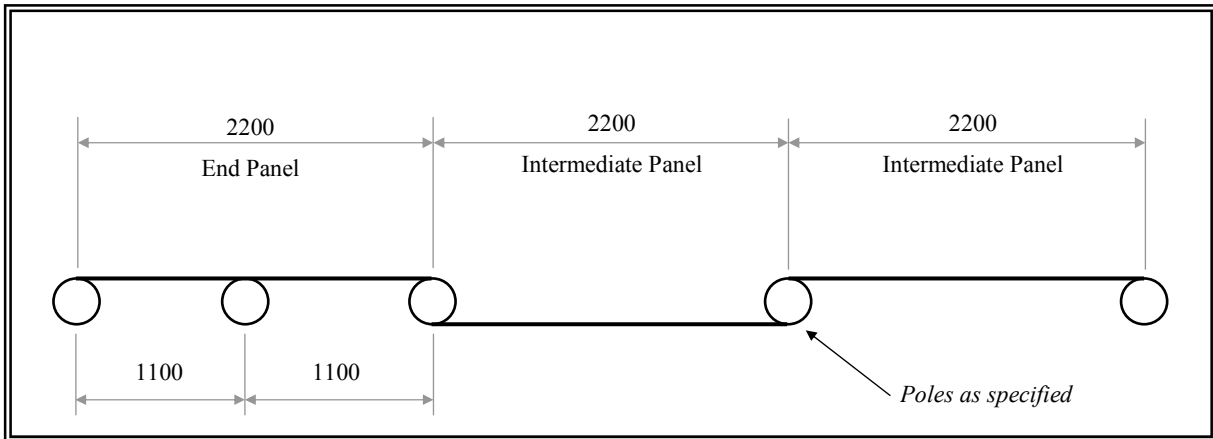


Figure 5: Castellated Panelling

