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Cogges Link Road Noise and Vibration

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Jacobs Engineering UK Ltd, Jacobs House, 427 London Road, Reading,
Berkshire, RG6 1BL UK
Tel 0118 963 5000 Fax 0118 949 1054

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Prepared by : Richard Woolley



Checked by : Robert Mansfield



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Executive Summary

Noise and Vibration Noise levels have been calculated at representative properties for the existing and proposed road network in the year of opening and the design year. These include properties on the secondary network where there is currently a proportion of traffic diverting from the route.

Construction Noise

The Control of Pollution Act 1974 gives local authorities powers to control noise from construction sites and other similar works. Section 61 of the 1974 Act provides for developers to approach the authority to agree control measures prior to commencement of work. Such an approach would be made in this case and the agreed measures would be provided for in the works contract. These measures would include setting restrictions on the hours of working, noise and vibration limits, the type of machinery employed on site together with the location of localised noise barriers.

Operational Noise

Residential properties in Oxford Hill and Newland currently experience noise levels in the high 60s to low 70s dB LA10,18hr, with the opening of the Cogges Link these properties would experience a reduction in noise levels, with 61 Oxford Hill experiencing a reduction in noise levels of 4 dB to 68 dB and Elm View, Newland experiencing a reduction of 3 dB to noise level of 71 dB.

Residential properties in Oxford Hill and Newland currently experience noise levels in the high 60s to low 70s dB. With the opening of the road, these properties will experience a reduction in noise levels, with 21 Oxford Hill experiencing a reduction in noise levels of 5 dB to 65 dB and 12/14 Newland experiencing a reduction of 5.5 dB to noise level of 65 dB.

Residential properties fronting on to Bridge Street and the High Street currently experience relatively high noise levels at their front facades, with the opening of the road, traffic noise levels will fall from the mid 70s dB. 27 Bridge Street experiencing a reduction in noise levels of 4 dB to 70 dB. 65 Woodstock Road which fronts directly on to the road network will experience noise levels of 68 dB at the ground floor and 68 dB, a reduction of almost 5 dB on existing levels.

The properties in the residential estate of Cogges, such as those properties in Manor Road and Eton Close will experience noise levels in the mid 50s to low 60s dB, with properties such as 108 Eton Close experiencing a noise level of 60 dB, a noise level increase of up to 10 dB on the current noise environment.

In mitigation extensive use would be made of earth bunding, running between the Cogges residential area and alongside the Cogges Link, providing substantial noise attenuation to the road traffic noise at the nearest residential housing.

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1 Introduction

- 1.1.1 Noise in its widest sense can be defined as unwanted sound. This definition embraces industrial and domestic noise as well as transportation noise sources. Noise impacts are related to increases or decreases in traffic or construction noise in relation to the pre-existing noise levels.
- 1.1.2 The main sources of noise from a traffic stream can be separated into two components. The first is generated by the engine, exhaust system and transmission and is the dominant noise source when traffic is not freely flowing. This is particularly apparent from heavy vehicles, when accelerating, braking or changing of gears, and this contributes to a significant proportion of low frequency noise. The second noise source component is generated from the interaction of tyres with the road surface. This is the dominant noise source under free flow traffic conditions at moderate to high road speeds and contributes a significant proportion of higher frequency noise.
- 1.1.3 The noise from a stream of traffic at a reception point is an aggregation of noise from each of many vehicles at various distances. There are a number of factors that influence the noise level experienced by the residents of a property and these can be separated into two categories. Firstly, are those factors affecting the noise emissions at source, such as volume of traffic, vehicle speed, composition of traffic (i.e., the percentage of Heavy Goods Vehicle, %HGVs), and the gradient and surface characteristics of the road. Secondly, are those factors affecting propagation characteristics, such as distance of the receptor from the source, the topography and characteristics of the ground between the source and receptor, the presence of any screening, wind strength and direction.
- 1.1.4 There are currently high volumes of traffic traveling through Witney, in particular through Bridge Street, Newland and the High Street and traffic noise is potentially an important issue for residents living close to the route. The proposed scheme will divert traffic around Witney and will, therefore, result in changes to traffic behaviour on the current road network and associated traffic flows. In doing so, this will affect noise levels and the level of perceived noise nuisance experienced by residents fronting onto the current road network. The changes in the levels of road traffic noise and perceived noise nuisance will increase or decrease, depending on the location of receptors in relation to the existing and new road link.
- 1.1.5 This chapter outlines the assessment undertaken to determine properties that may be subject to a change in noise levels or perceived noise nuisance during operation of the scheme. Predictions have been undertaken to determine noise levels at representative locations to assess where there are likely to be beneficial or adverse impacts.

- 1.1.6 Traffic-induced vibration is a low frequency disturbance, which can be transmitted through the air or ground. Air-borne vibration from traffic is produced by engines and exhausts, whereas ground-borne vibration is produced by the interaction between rolling wheels and the road surface.
- 1.1.7 There are two effects of traffic vibration that need to be considered, these being the effects on buildings and the disturbance caused to occupiers of properties. Extensive research has been carried out on a range of buildings of various ages and types, and no evidence has been found to support the theory that traffic-induced ground-borne vibration is a source of significant damage to buildings. Ground-borne vibration is also much less likely to be the cause of disturbance to occupiers than air-borne vibration (Baughan and Martin 1981, Watts 1984).
- 1.1.8 Neither is there any evidence that traffic-induced air-borne vibration can cause even minor damage to buildings. However, it can be a source of annoyance to local people, causing vibrations of doors, windows and, on occasions, floors of properties close to the route. This chapter, therefore, also addresses the issue of nuisance at properties caused by vibration.

2 Approach and Methodology

- 2.1.1 This assessment has been carried out with reference to the following documents:
- Design Manual for Roads and Bridges (DMRB)¹;
 - Calculation of Road Traffic Noise (CRTN)²; and
 - The Noise Insulation Regulations 1975³
- 2.1.2 The objective of the assessment is to establish the magnitude and significance of noise changes for all areas where existing traffic is likely to be increased by 25% or reduced by at least 20%, which is equivalent to a change in noise level of approximately 1 dB(A).
- 2.1.3 Where alterations or improvements are made to the existing road network the significance of the potential changes in traffic-generated noise has been assessed. In accordance with the requirements of DMRB Volume 11, this has been carried out by:
- identifying noise sensitive locations and calculating the ambient and proposed noise levels to determine possible noise changes. As stated above, locations should be assessed in areas where existing traffic increases by 25% or decreases by 20%;
 - identifying appropriate mitigation methods to reduce the impact of any adverse effects; and
 - undertaking a noise nuisance assessment for properties which experience a noise change of 1 dB(A) or more.
- 2.1.4 The traffic noise assessment has classified locations according to their ambient levels, in bands of below 50 dB(A), 50-<60 dB(A), 60-<70 dB(A) and ≥70 dB(A). For each ambient noise band, the number of properties and other locations subject to the following increases or decreases have been assessed: 1-< 3 dB(A), 3-< 5 dB(A), 5-< 10 dB(A), 10-<15 dB(A) and over 15 dB(A).
- 2.1.5 The DMRB methodology for the assessment of traffic noise is valid for properties and locations within 300 metres from the nearest point on the carriageway. Beyond 300 metres the varying effects of wind and temperature render forecasting difficult. The assessment of traffic noise has therefore been carried out for properties located within a distance of 300 metres of the proposed road and current road network.
- 2.1.6 The properties assessed were selected on the basis of the following principles:
- where it is considered that buildings may qualify for sound insulation;
 - where it is anticipated that properties will experience changes in noise level; and
 - where properties are representative of surrounding buildings and the effects of noise will be similar
- 2.1.7 Traffic noise levels have been calculated in accordance with the Department of

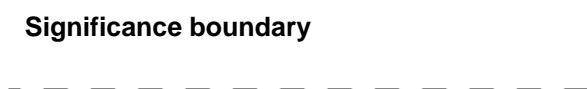
Transport publication 'Calculation of Road Traffic Noise' 1988 (CRTN). Using the method set out in this document, noise levels for both the existing and proposed road networks have been calculated for properties at a point 1 metre in front of the most exposed facade. All calculations are based on the maximum traffic flow expected on a normal working day during the first 15 years after opening using the highest traffic forecast.

- 2.1.8 Noise levels are expressed in terms of the Index $L_{A10(18 \text{ hour})}$ dB which is the arithmetic mean of the noise levels exceeded for 10% of the time in each hour between 6.00am and midnight. When considering noise levels it is important to note that doubling or halving of the otherwise similar traffic flow is equivalent to a change of approximately 3 dB whereas a subjective impression of a doubling in loudness corresponds to a 10 dB sound level increase. A description of the general terminology is given in Appendix A.
- 2.1.9 DMRB gives no guidance on assessing the significance of effects. For this scheme, the assessment of significance on noise impacts has been undertaken based on the predicted noise levels and magnitude of noise change at sensitive noise receptors. An approach has been used in the UK over the years in the assessment of noise from a new source based on the research studies of Mackie *et al*, that subjective response to noise from a new source is proportional to the change in overall noise level. This is considered to be the Noise Change methodology.
- 2.1.10 Noise change bands are therefore used for the rating of noise impact. It is generally accepted that for environmental noise a 3 dB change in noise level is noticeable in environmental assessment terms and this can be assumed as the threshold at which a noise impact becomes significant. This view has been confirmed with the TAG Noise Sub Objective Guidance, which states that a change of 3 dB or greater, is a significant noise change. An increase of 3 dB would occur when acoustic energy due to the proposal is equal to the baseline ambient noise level and is described as "low".
- 2.1.11 When considering two sounds of a similar acoustic nature, a change of more than 3 dB(A) is regarded as being perceptible to the human ear. The magnitude of impact can be based on this acoustic 'rule of thumb' supplemented with evidence contained within DMRB. The latter highlights that "people are more sensitive to abrupt changes in traffic noise associated with new road schemes than would be predicted from the steady state evidence. In the period following a change in traffic flow, people may find benefits or disbenefits when the noise changes are as small as 1 dB(A).
- 2.1.12 Considering these levels, the classification system shown in Table 1 has been used in this assessment to define the magnitude of noise impacts between the Do Minimum and the Do Something scenarios.

Table 1 Criteria for the Classification of Noise Changes Associated with Road Traffic Noise

Change in Noise Level	Magnitude of Impact
10 dB(A) and greater	High
5 to < 10 dB(A)	Medium
3 to < 5 dB(A)	Low
1 to < 3 dB(A)	Slight
0.1 to < 1 dB(A)	No impact

Significance boundary



Existing and Predicted Noise Levels

2.1.13 Traffic noise levels have been calculated using NoiseMap2000®, a digital model based on the DOT publication ‘Calculation of Road Traffic Noise’ 1988 (CRTN). Using the method set out in this document, noise levels have been calculated for the current road network 2005, as well as the ‘do-minimum’ and ‘with scheme’ road network in the year of opening, (2011) and the design year (2026) for properties at a point one metre in front of the most exposed facade. All calculations are based on the maximum predicted traffic flow expected on a normal working day and a high growth rate has been applied for future traffic flows. Details of the traffic flows used are given in the Traffic Assessment Appendix.

Noise Nuisance

2.1.14 DMRB defines a ‘steady-state’ relationship between noise exposure and noise nuisance. Nuisance here is measured as the percentage of people bothered by traffic noise (i.e., those who say they are ‘very much’ or ‘quite a lot’ bothered on a four point worded scale).

2.1.15 DMRB also shows a relationship between changes in noise nuisance (on the same nuisance scale) and changes in noise exposure. It shows the change in nuisance soon after a sudden change in noise is much greater than would be predicted from the steady state curve. This new level of nuisance appears to persist for several years at least but, in the longer term, nuisance levels tend towards those predicted by the steady-state relationship.

2.1.16 Noise nuisance predictions are based on the highest nuisance levels expected during the first 15 years after opening, i.e. for the years 2011 (immediate increase in nuisance levels apply) and 2026 (steady-state nuisance levels apply) and are compared to the do-minimum situation.

2.1.17 An assessment of noise nuisance is illustrated in Table 4 for a selection of properties in the vicinity of the scheme. In addition, an assessment of noise nuisance for properties within each of the ambient noise bands is contained within Tables a-d. These assessments have been undertaken in accordance with the predictive technique presented in DMRB, for all properties where the change is 1 dB(A) or more. However, the method has limitations as discussed in the following paragraphs.

2.1.18 The surveys on which the DMRB assessment method were based were conducted at sites where road traffic was the dominant noise source, noise levels ranged from 65 to 78 dB $L_{A10,18hr}$, the changes in traffic noise were up to 10 dB $L_{A10,18hr}$, and properties were up to 18 metres from the road. Therefore, it is only within these noise and distance ranges that the method is valid. The DMRB method is also valid only for noise changes caused by alterations in traffic flow. It will not necessarily give a good prediction if traffic noise changes are brought about by other means such as barriers or low noise road surfaces. DMRB, Volume 11, Section 3, Part 7, Chapter 8 Paragraph 5.10 states that “Strictly, the method should not be used outside the noise and distance ranges covered by the surveys, or when the ambient noise is not from traffic. However, it seems likely that the mechanisms underlying the survey results will operate outside these ranges. Until better information becomes available, it is recommended that the method is used to predict nuisance changes outside these noise and distance ranges, albeit with caution”.

Noise Insulation

2.1.19 The Noise Insulation Regulations 1975 place a duty to offer insulation to eligible properties affected by new roads or a road to which an additional carriageway is added. The Regulations refer specifically to residential properties within 300 metres of the new or altered road.

2.1.20 The Regulations require that noise is calculated for the most exposed window on the property façade in question based on the layout and traffic immediately before the road works commence.

2.1.21 Residential properties that are considered to be entitled to insulation against traffic noise must satisfy all the following requirements stipulated in the Regulations:

- They are situated within 300 metres of the new or altered carriageway;
- The use of the highway causes or is expected to cause noise at a level not less than 68 dB(A);
- They will experience noise levels exceeding the ‘prevailing noise level’ by at least 1.0 dB(A);
- The contribution to the increase in the relevant noise level from the new or altered highway must be at least 1.0 dB(A).

Vibration

- 2.1.22 Traffic-induced vibration is a low frequency disturbance, which can be transmitted through the air or ground. Air-borne vibration from traffic is produced by the drive-train of the vehicle, the engines and exhausts, whereas ground-borne vibration is produced by the interaction between rolling wheels and the road surface. There are two effects of traffic vibration that need to be considered, these being the effects on buildings and the disturbance caused to occupiers of properties. Extensive research has been carried out on a range of buildings of various ages and types, and no evidence has been found to support the theory that traffic-induced ground-borne vibration is a source of significant damage to buildings (Watts 1990) although minor cracking may occur at high exposure sites.
- 2.1.23 However, both ground-borne and air-borne can be a source of annoyance to local people, causing vibrations of flexible elements within the building, such as doors, windows and, on occasions, floors of properties close to the carriageway. Investigations have determined a relationship between the number of people affected by the traffic noise and those adversely impacted by air-borne vibration. It was found that the $L_{A10,18hr}$ index was among the physical variables most closely associated with average vibration disturbance ratings. The relationships between the percentage of people affected by largely air-borne vibration and this noise exposure index is similar to that for noise nuisance. However, it is recommended in DMRB that the percentage of people bothered by vibration is 10% lower than the corresponding noise nuisance figure, and that at noise levels below 58 dB $L_{A10,18hr}$, it should be assumed that 0% would be affected.
- 2.1.24 As the method for assessing vibration is similar to noise nuisance it is subject to the same limitations as discussed previously. In general, when using DMRB Volume 11 to predict disturbance caused by air-borne vibration it applies directly only to properties within 40 metres of the road which are un-screened. Outside these conditions, the results of the assessment are considered as only broadly indicative.

Construction Noise

- 2.1.25 The Code of Practice BS 5228 (1997)⁴ – ‘Noise and vibration control on construction and open sites’ provides guidance on the prediction of construction site noise and measures for its control. It recommends the use of the continuous equivalent noise level (L_{Aeq}) to define noise from such works. It falls short of recommending a limit for construction noise. However, an earlier version referred to a maximum daytime level of 75 dB $L_{Aeq (12 \text{ hour})}$ and this figure has been widely accepted as a reasonable limit for temporary works.
- 2.1.26 The Control of Pollution Act 1974⁶ gives local authorities powers to control noise from construction sites and other similar works. Section 61 of the 1974 Act provides for developers to approach the authority to agree control measures prior to commencement of work. Such an approach would be made in this case

and the agreed measures would be provided for in the works contract. These measures would include setting restrictions on; the hours of working, noise and vibration limits, the type of machinery employed on site together with the location of localised noise barriers.

2.1.27 The extent of noise and vibration impacts will vary throughout the construction period and will depend on the contractor's chosen method of working, as well as the timing and phasing of certain operations. Whilst transient noise levels may be relatively high, the longitudinal nature of the site will ensure that the working areas will constantly move. It is anticipated that the major construction period will last for 18 months. Exposure levels during this period at even the closest property would generally be below 75 dB L_{Aeq} (12 hour).

2.1.28 Vibrations, even at very low magnitude, may be perceptible to people. Vibration nuisance is frequently associated with the assumption that, if vibrations can be felt, then damage is inevitable; however, considerably greater levels of vibration than those that can be felt are required in order to cause damage to buildings or to cause computers and similar electronic equipment to malfunction. However by the appropriate selection of construction methods it is possible to restrict vibration at the closest property well below the cosmetic damage limits defined in BS 7385: 'Part 2 Guide to damage levels from ground borne vibration'. It is usual to define a safe limit in the contract for the construction works after consultation with the Local Authority.

3 Baseline Conditions

3.1.1 The number of properties that lie within 300 metres of the existing road network and the proposed route are identified in Table 2. It shows that there are currently some 1600 properties within 300 metres of the existing road layout. However, it should be noted that many properties are screened from road traffic noise by other properties. Nonetheless, it gives an indication of the numbers of properties (and the potential numbers of residents) affected by traffic noise.

Table 2 Number of Properties within 300 metres of the Road Network

Distance from Centreline	Existing Route	Proposed Route
0 – 50m	660	751
50 – 100m	361	529
100 – 200m	331	537
200 – 300m	251	296
Total	1603	2113

3.1.2 The property count above comprises largely of residential properties but also includes commercial properties in the assessment, including a small number of shops, cafes and public houses in Witney town centre and surrounding areas.

3.1.3 Table 3 shows details of the calculated traffic noise levels at both ground floor and 1st floor level for the existing road layout in 2005, and the do minimum levels for 2011 and 2026 for representative properties. Residential properties in Oxford Hill and Newland currently experience noise levels in the high 60s to low 70s dB $L_{A10,18hr}$, with 21 Oxford Hill experiencing noise levels of 70 dB $L_{A10,18hr}$ and 12/14 Newland experiencing a noise level of 70 dB $L_{A10,18hr}$.

3.1.4 Residential properties fronting on to Bridge Street and the High Street currently experience relatively high noise levels at their front facades, with traffic noise levels in the mid 70s dB $L_{A10,18hr}$. 27 Bridge Street currently experiences noise levels of 73 dB $L_{A10,18hr}$.

3.1.5 Properties such as 65 Woodstock Road which front directly on to the road currently experience noise levels of 72 dB $L_{A10,18hr}$.

3.1.6 The residential properties in the residential area of Cogges currently experience relatively low levels of background noise, with the aural environment being dominated by noise from the A40. Properties in Manor Road and Eton Close experience noise levels in the low 40s dB, with properties such as 108 Eton Close experiencing a noise level of 49 dB $L_{A10,18hr}$.

Vibration

3.1.7 Low frequency sound from heavy vehicle engines and exhausts can induce substantial vibrations in flexible building elements such as doors, windows and suspended floors. Research by Transport Road Research Laboratory (TRRL) indicated that the $L_{A10,18hr}$ index correlated closely with vibration disturbance

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ratings. This relationship, referred to previously, indicates that the majority of residential properties fronting onto the current road network may currently be affected by airborne vibration.

4 Predicted Impacts

- 4.1.1 As stated in previously, the assessment of noise impacts is carried out for all areas where existing traffic is likely to increase by 25% or decrease by 20%. This equates to a change in noise level of approximately 1 dB $L_{A10,18hr}$. In recent years evidence has been accumulating from surveys before and after sudden changes in noise exposure. It indicates that people are more sensitive to abrupt changes in traffic noise associated with the new road schemes than would be predicted from the steady state evidence. In the period following a change in traffic flow, people may find benefits or disbenefits when noise changes are as small as 1 dB $L_{A10,18hr}$. The assessment of traffic noise, therefore, takes into consideration those properties where an increase or decrease of 1 dB $L_{A10,18hr}$ or greater will occur as a result of the proposals.
- 4.1.2 Table 2 demonstrates that 1600 properties are located within 300 metres of the road centreline of the existing route that are likely to be affected to some degree by traffic noise. This is in comparison to 2100 properties that will be within 300 metres of the new road and the relieved local road network.
- 4.1.3 Table 3 gives details of the existing and future noise levels for selected properties on the existing route and proposed scheme. The calculated values for both the do-minimum and with scheme road layout are included for the opening year (2011) and the design year (2026) to determine the significance of noise impact. The figures shown are for the worst case for the property, in terms of façade, and are given for ground and first floor level.
- 4.1.4 Tables a-d (following this report) show the number of properties that will be affected by the proposed route. Locations are classified in accordance with their ambient noise levels in bands of below 50 dB(A), 50 - < 60 dB(A), 60 - <70 dB(A) and ≥ 70 dB(A). In accordance with DMRB Volume 11 the changes in noise levels are separated into bands of 1-<3 dB(A), 3-<5 dB(A), 5-<10 dB(A), 10-<15 dB(A) and over 15 dB(A). Also changes of nuisance are separated into bands of below 10%, 10-<20%, 20-<30%, 30-<40% and over 40%. Table e combines the ambient noise bands to give an overall summary of noise level and nuisance changes for all properties.

Table 3 Summary of Ground and First Floor Level Property Noise Levels

Ref No.	Property	Current Ambient Noise Level 2005 dB L _{A10,18hr}	Do-min Noise Level 2011 dB L _{A10,18hr}	With Scheme Noise Level 2011 dB L _{A10,18hr}	Significance of impact	Do-minimum Noise Level 2026 dB L _{A10,18hr}	With Scheme Noise Level 2026 dB L _{A10,18hr}	Significance of impact
1	39 Stanton Hardcourt Road	60.0 60.1	60.0 60.1	60.1 60.3	High	39.8 41.4	47.7 48.8	Medium
2	19 Blakes Avenue	38.1 39.7	38.2 40.0	49.8 50.9	Medium	45.7 47.5	50.0 51.4	Low
3	67 Blakes Avenue	44.7 46.5	44.8 46.7	51.4 52.8	Medium	41.9 43.2	48.5 49.3	Medium
4	109 Blakes Avenue	40.3 41.7	40.4 41.8	50.8 51.7	Medium	44.4 46.1	49.5 50.5	Low
5	53 Eton Close	42.7 44.5	42.8 44.5	52.4 53.7	High	46.6 47.7	54.6 56.9	Medium
6	115 Eton Close	45.5 46.5	45.4 46.4	56.4 58.6	High	49.2 50.4	56.5 58.9	Medium
7	108 Eton Close	48.3 49.4	48.2 49.3	58.3 60.5	Medium	57.6 58.0	61.3 62.7	Low
8	100 Eton Close	57.2 57.5	57.1 57.4	63.1 64.6	Medium	47.8 48.8	52.2 53.6	Low
9	73 Manor Road	46.5 47.4	46.3 47.2	55.0 56.4	Medium	51.1 51.5	53.7 54.6	Low
10	75 Manor Road	50.6 50.9	50.6 50.9	55.9 56.9	Medium	48.8 49.5	52.1 53.2	Low
11	147 Manor Road	47.7 48.3	47.7 48.3	54.7 55.8	Low	58.4 58.6	58.9 59.9	Slight
12	Farm Mill	56.6 56.8	56.4 56.6	59.8 60.9	Low	75.4 75.3	69.7 69.6	Medium
13	4 High Street	74.4 74.4	75.0 74.9	71.0 70.9	Low	75.9 75.6	70.1 69.8	Medium
14	20 High Street	75.0 74.7	75.5 75.2	71.5 71.2	Low	74.3 74.0	68.6 68.3	Medium
15	27 Bridge Street	73.4 73.1	73.9 73.6	69.9 69.6	Low	73.1 73.3	68.4 68.6	Low
16	65 Woodstock Road	72.2 72.4	72.7 72.9	68.1 68.3	Medium	72.1 72.2	64.6 64.7	Medium
17	12/14 Newland (Almhouses)	70.2 70.3	70.2 70.2	64.5 64.7	Medium	71.3 71.5	64.6 64.8	Medium
18	21 Oxford Hill	69.4 69.6	69.2 69.4	64.6 64.8	Low	74.4 74.8	66.7 67.1	Medium
19	138 Oxford Hill	72.5 72.9	72.5 72.9	66.7 67.1	Sub sig (+ve)	74.4 74.8	66.7 67.1	Sub sig (+ve)

4.1.5 Residential properties in Oxford Hill and Newland currently experience noise levels in the high 60s to low 70s dB L_{A10,18hr}. With the opening of the road, these properties will experience a reduction in noise levels, with 21 Oxford Hill experiencing a reduction in noise levels of 5 dB to 65 dB L_{A10,18hr} at the 1st floor and 12/14 Newland experiencing a reduction of 5.5 dB to noise level of 65 dB L_{A10,18hr}.

4.1.6 Residential properties fronting on to Bridge Street and the High Street currently experience relatively high noise levels at their front facades, with the opening of the road, traffic noise levels will fall from the mid 70s dB L_{A10,18 hr}. 27 Bridge Street experiencing a reduction in noise levels of 4 dB to 70 dB L_{A10,18hr} at the 1st floor window.

4.1.7 65 Woodstock Road which fronts directly on to the road will experience noise levels of 68 dB at the ground floor and 68 dB at the 1st floor, a reduction of almost 5 dB on existing levels.

- 4.1.8 The properties in the residential estate of Cogges, such as those properties in Manor Road and Eton Close will experience noise levels in the mid 50s to low 60s dB following the opening of the road, with properties such as 108 Eton Close experiencing a noise level of 6061 dB $L_{A10,18hr}$ at 1st floor level, a noise level increase of up to 1011 dB on the current noise environment.
- 4.1.9 Following the requirements of DMRB, all properties that experience a change in noise level of 1 dB(A) or more are classified into ambient noise level bands of below 50 dB(A), 50-<60 dB(A), 60-<70 dB(A) and ≥ 70 dB(A). For each band, the change in noise level is described, as can be observed in Tables a-d. From Table a it is observed that 53 properties that have ambient noise levels below 50 dB $L_{A10,18hr}$ will be subjected to an adverse impact with the scheme, compared to 0 for the do-minimum. Properties in Blakes Avenue and Eton Close, properties situated close to the Link Road experience noise level increases of up to 11 dB with the opening of the scheme.
- 4.1.10 From Table b it is observed that 179 properties that currently have ambient noise levels between 50 dB – 60 dB $L_{A10,18hr}$ will be subjected to an adverse impact with the scheme, compared to 0 for the Do-minimum. Properties in Eton Close and Manor Road, properties situated close to the Link Road experience noise level increases of up to 6 dB with the opening of the scheme.
- 4.1.11 From Table c it is observed that 102 properties that currently experience ambient noise levels between $L_{A10,18hr}$ 60 dB – 70 dB will experience a beneficial impact due to the introduction of the scheme as traffic is removed from Newland and Oxford Hill.
- 4.1.12 From Table d it is observed that 61 properties that currently experience ambient noise levels, $L_{A10,18hr}$ of over 70 dB will experience a beneficial impact due to the introduction of the scheme as traffic is removed from Woodstock Road, the High Street and Bridge Street.
- 4.1.13 The information provided in Tables a-d provides a summary of the impact from the scheme. It shows that for the With-Scheme option, approximate 160 properties will experience a beneficial impact compared to 0 for the Do-minimum option. Whereas 230 properties will experience an adverse impact for the With-Scheme option in comparison to 61 for the Do-Minimum option.
- 4.1.14 DMRB notes a correlation between the percentage of people bothered very much or quite a lot by vibration nuisance and $L_{A10,18hr}$ noise levels. It recommends that, for a given level of noise exposure, the percentage of those bothered by vibration is 10% lower than the corresponding figure for noise nuisance derived from tables contained within DMRB. Where noise levels are below 58 dB $L_{A10,18hr}$, it should be assumed that 0% would be bothered. The survey of vibration nuisance was restricted to properties within 40m of the carriageway where there were no barriers to noise.

Table 4 Noise Nuisance Assessment

Property	Current percentage bothered	With Scheme percentage bothered	Change in percentage bothered
39 Stanton Hardcourt Road	4 %	4 %	No change
19 Blakes Avenue	0 %	0 %	No change
67 Blakes Avenue	0 %	0 %	No change
109 Blakes Avenue	0 %	0 %	No change
53 Eton Close	0 %	0 %	No change
115 Eton Close	0 %	0 %	No change
108 Eton Close	0 %	2 %	Increase of 2%
100 Eton Close	0 %	7 %	Increase of 7%
73 Manor Road	0 %	0 %	No change
75 Manor Road	0 %	0 %	No change
147 Manor Road	0 %	0 %	No change
Farm Mill	0 %	3 %	No change
4 High Street	36 %	23 %	Decrease of 13%
20 High Street	38 %	24 %	Decrease of 14%
27 Bridge Street	33 %	20 %	Decrease of 13%
65 Woodstock Road	30 %	19 %	Decrease of 11%
12/14 Newland (Almhouses)	24 %	11 %	Decrease of 13%
21 Oxford Hill	22 %	11 %	Decrease of 11%
138 Oxford Hill	31 %	15 %	Decrease of 16%

Vibration

To determine the nuisance caused by vibration, DMRB suggests that this can be determined by reducing the noise nuisance figure by 10%. Furthermore, properties experiencing noise levels below 58 dB $L_{A10,18hr}$ will not experience nuisance from vibration. The change in vibration nuisance can be observed in Table 5 for selected properties. The Table highlights the general improvement in vibration nuisance levels at properties through Oxford Hill, Bridge Street, the High Street and Newland, as traffic is redirected as a consequence of the opening of the proposed scheme.

Table 5 Vibration Nuisance Assessment

Property	Current percentage bothered	With Scheme percentage bothered	Change in percentage bothered
39 Stanton Hardcourt Road	0 %	0 %	No change
19 Blakes Avenue	0 %	0 %	No change
67 Blakes Avenue	0 %	0 %	No change
109 Blakes Avenue	0 %	0 %	No change
53 Eton Close	0 %	0 %	No change
115 Eton Close	0 %	0 %	No change
108 Eton Close	0 %	0 %	No change
100 Eton Close	0 %	0 %	No change
73 Manor Road	0 %	0 %	No change
75 Manor Road	0 %	0 %	No change
147 Manor Road	0 %	0 %	No change
Farm Mill	0 %	0 %	No change
4 High Street	26 %	13 %	Decrease of 13
20 High Street	28 %	14 %	Decrease of 14
27 Bridge Street	23 %	10 %	Decrease of 13
65 Woodstock Road	20 %	9 %	Decrease of 11
12/14 Newland (Almhouses)	14 %	1 %	Decrease of 13
21 Oxford Hill	12 %	1 %	Decrease of 11
138 Oxford Hill	21 %	5 %	Decrease of 16

Mitigation

- 4.1.15 Extensive use will be made of earth bunding, running between the residential development of Cogges and alongside the proposed road, providing substantial noise attenuation to the traffic noise at the nearest residential housing. Noise mitigation measures will include the provision of noise insulation to residential housing, where the thresholds are met under the Noise Insulation Regulations 1975 (as amended). Eligible rooms such as living rooms and bedrooms can be provided with a noise insulation package comprising secondary glazing, ventilator units and venetian blinds for solar control which would substantially reduce internal noise levels. There are no properties that have been initially identified as being likely to be eligible for noise insulation.
- 4.1.16 Low noise road surfacing is proposed for all off-line sections of the new road scheme. The existing road surface for the on-line sections is currently Bitumen (Hot Rolled Asphalt). The use of a low noise surfacing such as Stone Mastic Asphalt (SMA) or pervious materials on the proposed road link would be likely to reduce noise levels by approximately 2.5 dB $L_{A10,18hr}$ compared with conventional bituminous surfacing; this correction has not been applied to the predicted noise levels to present a worse case scenario.

5 Conclusions

- 5.1.1 Properties fronting directly on to the current road network through Witney would experience a minor noise increase by 2011 in the Do minimum scenario. With the opening of the scheme, the majority of these 200 properties would experience a noise decrease of up to 5 dB, significantly reducing the percentage of people affected by noise and air-borne vibration.
- 5.1.2 The 240 residential properties in the Cogges residential estate will experience a noise increase of up to 11 dB at the rear façade compared to the Do minimum in the year of opening. Whilst the noise level increase is adverse, the noise levels at the rear façades are substantially below the criteria for noise insulation for eligibility.
- 5.1.3 Residential properties in Oxford Hill and Newland currently experience noise levels in the high 60s to low 70s dB, with the opening of the road these properties will experience a reduction in noise levels, with 21 Oxford Hill experiencing a reduction in noise levels of 5 dB to 65 $L_{A10,18hr}$ and 12/14 Newland experiencing a reduction of 5.5 dB to noise level of 65 dB $L_{A10,18hr}$. Residential properties fronting on to Bridge Street and the High Street also currently experience relatively high traffic noise levels at their front facades, with the opening of the road traffic noise levels will fall from the mid 70s dB $L_{A10,18hr}$ to the high 60s. 27 Bridge Street will experience a reduction in noise levels of 4 dB to 70 dB $L_{A10,18hr}$.
- 5.1.4 65 Woodstock Road which fronts directly on to the road will experience noise levels of 68 dB at the ground floor and 68 dB at the 1st floor with the opening of the proposed road, a reduction of almost 5 dB.
- 5.1.5 The properties in the residential estate of Cogges, such as those properties in Manor Road and Eton Close will experience road traffic noise levels in the mid 50s to low 60s dB with the opening of the scheme, with properties such as 108 Eton Close experiencing a noise level of 61 dB $L_{A10,18hr}$, a noise level increase of up to 11 dB on the current noise environment.

6 References

1. Design Manual for Roads and Bridges Volume 11
2. Department of the Environment (1988) Calculation of Road Traffic Noise
3. The Noise Insulation Regulations 1975
4. Code of Practice BS 5228 (1997) – ‘Noise and vibration control on construction and open sites’.
5. BS 7385: ‘Part 2 Guide to damage levels from ground borne vibration’.
6. Control of Pollution Act 1974

Tables a-d Noise Assessment Summary Table – Ambient Noise Band below 50 dB(A)

a) Noise Assessment Summary Table – Ambient Noise Band < 50dB(A)

All Noise Levels in L _{A10,18hr} dB		Residential		Commercial		Community Facilities		Comments
		Preferred Route	Do Minimum	Preferred Route	Do Minimum	Preferred Route	Do Minimum	
Ambient Noise Band < 50 dB(A)		2011	2011	2011	2011	2011	2011	
Increase in Noise Level	1<3	53						
	3<5							
	5<10							
	10<15							
	>15							
Increase in Nuisance Level In %	<10	53		N/A	N/A	N/A	N/A	
	10>20							
	20>30							
	30>40							
	>40							
Decrease in Noise Level	1<3							
	3<5							
	5<10							
	10<15							
	>15							
Decrease in Nuisance Level In %	<10			N/A	N/A	N/A	N/A	
	10>20							
	20>30							
	30>40							
	>40							

b) Noise Assessment Summary Table – continued Ambient Noise Band 50-60 dB(A)

All Noise Levels in L _{A10,18 hr} dB		Residential		Commercial		Community Facilities		Comments
		Preferred Route	Do Minimum	Preferred Route	Do Minimum	Preferred Route	Do Minimum	
Ambient Noise Band 50 -60 dB(A)		2011	2011	2011	2011	2011	2011	
Increase In Noise Level	1<3	134						
	3<5							
	5<10							
	10<15							
	>15							
Increase In Nuisance Level In %	<10	134		N/A	N/A	N/A	N/A	
	10>20							
	20>30							
	30>40							
	>40							
Decrease In Noise Level	1<3							
	3<5							
	5<10							
	10<15							
	>15							
Decrease In Nuisance Level In %	<10			N/A	N/A	N/A	N/A	
	10>20							
	20>30							
	30>40							
	>40							

c) Noise Assessment Summary Table (continued) – Ambient Noise Band 60-70 dB(A)

All Noise Levels in L _{A10 18 hr} dB		Residential		Commercial		Community Facilities		Comments
		Preferred Route	Do Minimum	Preferred Route	Do Minimum	Preferred Route	Do Minimum	
Ambient Noise Band 60-70		2011	2011	2011	2011	2011	2011	
Increase In Noise Level	1<3							
	3<5							
	5<10							
	10<15							
	>15							
Increase In Nuisance Level In %	<10							
	10>20							
	20>30			N/A	N/A	N/A	N/A	
	30>40							
Decrease In Noise Level	>40							
	1<3	102						
	3<5							
	5<10							
	10<15							
Decrease In Nuisance Level In %	>15							
	<10							
	10>20	102						
	20>30			N/A	N/A	N/A	N/A	
	30>40							
	>40							

d) Noise Assessment Summary Table (continued) – Ambient Noise Band >70 dB(A)

All Noise Levels in L _{A10 18 hr} dB		Residential		Commercial		Community Facilities		Comments
		Preferred Route	Do Minimum	Preferred Route	Do Minimum	Preferred Route	Do Minimum	
Ambient Noise Band >70		2011	2011	2011	2011	2011	2011	
Increase In Noise Level	1<3		61					
	3<5							
	5<10							
	10<15							
	>15							
Increase in Nuisance Level In %	<10		61					
	10>20							
	20>30			N/A	N/A	N/A	N/A	
	30>40							
Decrease In Noise Level	>40							
	1<3	61						
	3<5							
	5<10							
	10<15							
Decrease in Nuisance Level In %	>15							
	<10	61						
	10>20							
	20>30			N/A	N/A	N/A	N/A	
	30>40							
	>40							

Properties in High Street & Bridge Street assumed to have residential status

Appendix A Acoustic Terminology

dB Noise, or unwanted sound, is the sensation produced as a result of fluctuations in air pressure. It is usual to measure sound pressures relative to a reference value (the threshold of hearing). The ratios produced however have a very large range and so a more convenient unit, the decibel, was defined as:-

$$\text{Sound level (decibels)} = 20 \log_{10} p/p_0$$

Where p = observed sound pressure
 p_0 = reference sound pressure

The main difficulty to those not conversant with the term is that it is logarithmic rather than linear. It helps to remember that two equal sources produce a level 3 dB higher than either one separately. Further, a difference of 10 dB approximates to a subjective doubling or halving of the loudness sensation. A change of 3 dB is about the smallest which most people would think significant.

dB (A) As the human ear is not equally sensitive to noise at different frequencies, the decibel scale is adjusted to take this into account when dealing with subjective response. For traffic noise the frequency - weighting network denoted by the letter 'A' is generally used and the units are denoted by dB(A).

The 'A' weighting is an electronic filter having a frequency response approximating to that of the human ear. This reduces the effect of the low frequency and very high frequency noise. It results in a unit which gives a measure consistent with the subjective rating of many noise sources.

L_{A10} Traffic noise varies in intensity with time. It has been found that dissatisfaction varies in accordance with the peak noise levels. Hence the index known as the "10% level" (L₁₀) is used. L₁₀ is the level of noise in dB(A) exceeded for just 10% of a given period of time.

L_{A90,T} The 'background noise level' is represented by the A-weighted sound pressure level exceeded for 90% of a given time interval T.

L_{A50,T} The 'background noise level' is represented by the A-weighted sound pressure level exceeded for 50% of a given time interval T.

L_{Aeq,T} The equivalent continuous sound level L_{Aeq} is the level of a notional steady noise which at a given position and over a defined time period (T) would have the same A-weighted acoustic energy as the fluctuating noise.