Appendix C: Noise and Vibration

South Wokingham Distributor Road Options Appraisal – Noise and Vibration Technical Note

October 2013

Introduction

This technical note sets out the likely noise and vibration constraints associated with three aspects of the proposed South Wokingham Distributor Road scheme which comprise the following:

- Three proposed route options for the Proposed South Wokingham Distributor Road: Route Option A, Route Option B and Route Option C;
- Six Local Study Areas where improved access across the railway is proposed; and
- Proposed improvements to Waterloo Road / Peacock Lane (Route D).

Figures A1a 'Overall Study Area Context and Environmental Constraints Plan' and A1b 'Aerial Photography View' present the three aspects of the scheme in relation to environmental designations and general context. Figure A5 specifically relates to the study area of the Waterloo Road / Peacock Lane improvements.

These three aspects to the scheme are described in further detail below:

Proposed South Wokingham Distributor Route Options

- Route Option A – Route Option A starts at the A321 Finchampstead Road at the junction with Oakley Drive. It runs approximately west to east, immediately south of the railway and ends just North of the railway line, approximately 300m east of the crossing of Waterloo Road. The proposed route will cross Emm Brook, Public Rights of Way 9 and 10, Easthampstead Road and Waterloo Road.
- Route Option B – Route Option B begins in the same location as Route Option A, on the A321 Finchampstead Road at the junction with Oakley Drive, and runs broadly east, diverting south round the existing detention pond. The route also ends in the same location as Route Option A, just north of the railway line, and crosses the Emm Brook, Public Rights of Way 9 and 10, Easthampstead Road and Waterloo Road.
- Route Option C – This route runs broadly west to east, south of Route Options A and B. It also begins in the same location, on the A321 Finchampstead Road at the junction with Oakley Drive. Route Option C ends north of the railway, in the same location as Route Options A, B and the alternatives. Route Option C crosses the Emm Brook east of Chapel Green, Public Rights of Way 9 and 10, Ludgrove School private access, Heathlands Road, Easthampstead Road and Waterloo Road.

Alternative Alignments in relation to the Route Options

- Route Option A Alternative Link 1 – A link between Route Option B and Route Option A at Knoll Farm. This link provides an alternative route for Route Option A which does not require land from Knoll Farm.
- Route Option A Alternative Link 2 - Link between Route Option A and Route Option B to the west of the existing detention pond. This link provides an alternative route for Route Option A to the south of the detention pond which enables the Easthampstead Road junction to be located further south at the proposed Route Option B Easthampstead Road crossing.
- Route Option A Alternative Link 3 - Link between Route Option A and Route Option B. This link provides an alternative route from Route Option A passing through the existing detention pond to the proposed Route Option B Easthampstead Road crossing.
- Route Option B Alternative Link B1 –This link provides an alternative more southern and straight alignment for Route Option B east of Tesco which does not require land acquisition from Knoll Farm.
- Route Option C Alternative Link C1- Link between Route Option C to the south of the existing detention pond to Easthampstead Road, traveling down Easthampstead Road to re-join Route Option C. This link

provides an alternative route for Route Option C to access Easthampstead Road which avoids the Ludgrove School private access and Heathlands Road crossings.

It should be noted that the eastern end of all of the proposed route options considered in this assessment terminate east of Waterloo Road just north of the railway line (see Figure A1b). From here the route will continue through the future Montague Park development to join London Road (A329) which has already been granted planning permission. It is understood that the Montague Park section of the route was part of the original WBC Strategic Development Locations (SDLs) and therefore the South Wokingham Distributor Road running through Montague Park was taken into account during the planning application. It is expected that the route section through Montague Park will be in place by the time the South Wokingham Distributor Road becomes operational.

Ultimately, the constraints arising during construction and subsequently once the road improvements are complete and open to traffic will require detailed consideration in terms of an environmental impact assessment (EIA), with the aim of determining the significance of effects, and also in a regulatory sense, to discharge the obligations under the Noise Insulation Regulations (NIR) 1975 [1], as amended. These issues are considered further in Annex 1.

It should be noted that details on the proposed Distributor Road options are limited at this stage and this has dictated the scope of this assessment. Therefore, the findings presented in this appraisal of the various route options have to be considered both generic and preliminary at this stage and will require updating once more information comes to light regarding the likely route options.

Whilst the noise and vibration effects arising from any new sections of road (as described above) will need to be carefully considered, whichever option is eventually selected, it will also be necessary to identify and assess any significant changes in road traffic noise and vibration across the wider existing highway network.

Local Study Areas

Six local study areas (A to F) have also been considered within this note and are identified on Figure A1b.

Footbridges across the railway are proposed at each location. These are likely to have steps and lifts/ramps to provide disabled access. For the purpose of this assessment, at each local study area potential constraints within the highway boundary for minimum of 150m north of the railway and 150m radius south of the railway have been identified.

- Local Study Area A is centred over the A321 Finchampstead Road, over the roundabout intersection with Oakley Drive, and is approximately 140m long.
- Local Study Area B is centred at the Knoll Farm, to the south of Gipsy Lane, and is approximately 60m long.
- Local Study Area C is centred at an existing footbridge over the railway line, to the south of Gipsy Lane, to the east of Local Study Area B, and is approximately 60m long.
- Local Study Area D is centred on the Easthampstead Road Level Crossing, and is approximately 70m in length.
- Local Study Area E is centred over the Waterloo Road Level Crossing, and is approximately 80m in length.
- Local Study Area F is approximately 340m in length, at the point of the South Wokingham Distributor Road roadbridge over the railway line, from below to a point approximately 150m north of the railway line.

Waterloo Road / Peacock Lane Proposed Improvements (Route D):

The proposed improvements commences on the corner of Waterloo Road, just north of the woodland parcel to the west, and continues east along Waterloo Road and Peacock Lane until its cessation approximately 300m east of Easthampstead Park, as shown on Figure A5. All works are due to be completed within the highway boundary with the exception of works at the junction between Waterloo Road, Old Wokingham Road and Peacock Lane, where some additional land would likely be needed to the south west.

[1] Statutory Instrument 1973 Building and Buildings – The Noise Insulation Regulations 1975.

Definitions

Given the relative proximity of the proposed Distributor Road routes, six local study areas and improvements to Waterloo Road / Peacock Lane, which share some of the same existing baseline, they are herein collectively termed '**the overall study area'**. Where there are differences, they will be referred to as Route Option A, Route Option B, Route Option C, Local Study Area (A – F) and Waterloo Road / Peacock Lane improvements (Route D) respectively.

In relation to the three Route Options (A, B and C) where they share the same existing baseline, they will herein be referred to as '**the Site'**.

The term '**Local Study Areas'** will be used to refer to the six areas where work is proposed to improve access across the railway.

The advice presented within the summary of constraints at the end of this technical note must be considered both generic and preliminary at this stage and will need updating when more information becomes available regarding the likely infrastructure scenarios. For ease of reading, the constraints identified within this technical note are colour coded in relation to a 'traffic light system' according to their significance on the scheme. Below identifies the colour coding:

- Red – Constraint to Development.
- Amber – Constraint to Planning/Major Cost Implication.
- Green – Manageable constraint through scheme adaptation/mitigation measures/surveys (some cost implications).

Text left in black is not considered to represent any form of constraint and provides background information and/or recommendations to further avoid environmental impacts and/or to enhance the existing environment.

Methodology

Please note that the findings of the assessment do not consider the effect of the route options on future residents within Wokingham and only assess effects in relation to existing sensitive receptors. It is anticipated that effects on future residents will be considered, and mitigation measures incorporated, as part of separate environmental studies for individual developments.

Distributor Road Options – Construction

A brief qualitative review of the potential noise and vibration constraints during the construction phase of the route options has been undertaken.

Distributor Road Options– Operation

Noise effects in relation to the proposed routes during operation have, where feasible, been predicted and appraised following the Calculation of Road Traffic Noise (CRTN [2]) methodology presented within Annex 2.

Traffic data have been made available for the road network surrounding the Distributor Road route options. These data have been used to quantify the magnitude of the likely change in road traffic noise resulting from each proposed scheme.

The CRTN sets out a step-by-step method for predicting road traffic noise levels in terms of L_{A10} for both a 1-hour period and an 18-hour period (between 06:00 hours and midnight) at any distance up to 300m from a highway. The prediction method takes into account the following factors to generate a Basic Noise Level (BNL) at a notional distance from the kerb: traffic flow, mean speed, the percentage of heavy vehicles, along with the road surface and gradient.

Although not employed in this options appraisal, the CRTN also includes procedures that enable the noise level at specific receptors to be determined by taking the BNL and applying corrections for distance, the presence of screening (barriers, buildings and topography), the type of intervening ground cover between the road and receiver, the angle of view of the road and reflections from façades.

At this stage the focus is on determining whether a change in road traffic noise of more than 1 dB in the short term is expected as a result of the Distributor Road options in line with the guidance for a scoping

[2] Calculation of Road Traffic Noise (CRTN), published by the Department of Transport and Welsh Office in 1988.

assessment contained within The Design Manual for Roads and Bridges (DMRB) guidance HD 213/11 [3]. HD 213/11 notes that "*if sufficient traffic flow information is available then it is acceptable to use this to determine whether there is likely to be a change of 1 dB $L_{A10,18h}$ in the short term…..which will result from a combination of traffic flow, speed and composition*…"

Whilst noise levels at individual receptors will eventually need to be determined and assessed for the preferred option, for now an assessment has been undertaken comparing the BNL calculated on a link-by-link basis for each scenario. For this options appraisal, the BNL in 2026 (by which year the proposed Distributor Road is expected to be fully operational) has been determined for each of the three route options. No do-minimum scenario is applicable, so the results for each scenario have been compared as described below:

- Route Option A vs. Route Option B;
- Route Option A vs. Route Option C; and
- Route Option B vs. Route Option C.

As the Distributor Road route options do not follow the line of existing roads it is not possible to determine the likely change in BNL along each route option. So instead, constraints along the line of each route have been considered qualitatively based on the number and proximity of noise sensitive receptors to the proposed route alignments. In particular, the number of properties lying within 100m of the route has been estimated as it is these receptors that are likely to be most adversely affected by the proposed scheme, although this does not preclude significant adverse effects arising at more distant locations.

As noted above, for all other roads in the vicinity, the difference in BNL has been determined by comparing the situation in 2026 under the various route options. When considering the significance of the predicted differences in BNL, the guidance contained in HD 213/11 has been adopted. HD 213/11 makes a distinction between short-term changes and longer term changes. HD 213/11 presents a table classifying the magnitude of impact for both short and long-term changes. The table relating to short-term changes is reproduced below.

Table 1: Classification of Magnitude of Noise Impacts

Noise change, $L_{A10,18h}$	**Magnitude of impact**
0 dB	No change
0.1 – 0.9 dB	Negligible
1.0 – 2.9 dB	Minor
3.0 – 4.9 dB	Moderate
5+ dB	Major

The options appraisal methodology described above is based on the likely perception of residents living close to the proposed Distributor Road routes and does not consider potential effects on flora, fauna or on amenity areas.

Local Study Areas (A-F)

The provision of footbridges in six locations would not be expected to generate significant noise effects once operational, notwithstanding the presence of motors to propel any lifts.

Where lifts are located *within* residential buildings there is potential for noise disturbance to residents to arise from the use of the lift (e.g. from the lift motor, switchgear, cage guide rollers and even lift doors). However, for a lift servicing a railway over-bridge such constraints do not exist. Nonetheless, the lift shaft, motor room and lift itself would need to be carefully designed and constructed to avoid any noise disturbance arising to those living nearby. Any lift would need to be of quiet design and be maintained regularly to ensure continued quiet operation.

However, there would be potential for significant adverse effects to arise during construction. This is particularly so, since works alongside (and above) railways may well necessitate some weekend and night working so as to avoid activities (e.g. lifting) being conducted during times when the line is live and trains are operating.

[3] Design Manual for Roads and Bridges (DMRB), Volume 11 'Environmental Assessment', Section 3 'Environmental Assessment Techniques', Part 7 'Noise & Vibration', HD 213/11, revision 1.

At this stage, there are no details on the construction works that would be required, the plant that would be utilised, nor the time or duration of such work. Therefore, the constraints in the vicinity of each footbridge have been considered qualitatively based on the number and proximity of noise sensitive receptors to the works at each location. In particular, the number of properties within 100m of the centre of the works has been identified, as it is these receptors that are likely to be most adversely affected during the proposed works, although this does not preclude the possibility that significant adverse effects might arise at more distant locations.

Waterloo Road / Peacock Lane Improvements (Route D)

Most of the carriageway improvements will be contained within the existing road corridor (the exception being a proposed new roundabout at the junction of Peacock Lane, Waterloo Road and Old Wokingham Road). There are no sensitive receptors located in proximity to the improved junction. Therefore, the works should not result in traffic noise sources being located significantly closer to any particular receptor.

Traffic data in this area are shown in the table below:

Table 2: Traffic Data in the Vicinity of the Proposed Waterloo Road / Peacock Lane Improvements (Route D)

Link description	Link ID	Route option	Traffic data		
			Flow	% HDV *	Speed (kph)
Waterloo Road (between Distributor Road and Public Byway)	80021105	A	5436	01	50
	70261105	B	5345	01	50
	80151105	C	5335	01	50
Waterloo Road (between Public Byway and Old Wokingham Road/ Peacock Lane)	11131105	A	6140	01	50
		B	6048	01	50
		C	6054	01	50
Old Wokingham Road (south of Waterloo Road)	11141113	A	19229	02	60
		B	19124	02	60
		C	19732	02	60
Peacock Lane (east of Old Wokingham Road)	23211113	A	18526	02	60
		B	18601	02	60
		C	18481	02	60
* % HDV = percentage of heavy duty vehicles					

It can be seen that on a link-by-link basis the traffic data vary little between the three route options.

Different sets of traffic data have not been supplied for the situation with and without the improvements, so it is assumed that a similar number, mix and speed of vehicles will be present whether or not the works are undertaken. Therefore, operationally (i.e. post construction) it is concluded that there would be very little variation in noise with or without the proposed improvements, whichever Distributor Road option is selected.

However, as for the Local Study Areas, there would be potential for significant adverse effects to arise during construction. Therefore, the constraints along the line of each route have been considered qualitatively based on the number and proximity of noise sensitive receptors to the line of the proposed works. In particular, the number of properties lying within 100m of the proposed works has been estimated as it is these receptors that are likely to be most adversely affected during the proposed works, although this does not preclude the possibility that significant adverse effects might arise at more distant locations.

Desk Study

Baseline Conditions – Overall Study Area

All the proposed Distributor Road route options would pass through predominantly agricultural land and as such the area would be described as being essentially rural in nature, albeit that the Site is only separated from the main Wokingham settlement by a railway line.

The noise climate is anticipated to be typical for the area, which whilst currently open land is still well-connected to the major highway network, in particular the A321 and A329 to which the Distributor Road would link to the west and north respectively. The busy A329 and A329(M) lie only a short distance to the east of the eastern-end of the scheme, whilst the M4 lies about 3km to the north-west, on the far side of Wokingham.

The railway between Bracknell and Wokingham effectively forms the northern boundary of the Overall Study Area, whilst a different railway line (that between Crowthorne and Wokingham) runs in a north-south direction past the western end of the scheme.

The area generally is dominated by road traffic noise from local and more distant roads (the extent to which the latter affects the noise climate depends upon the wind direction), although individual train movements will be noticeable to those living and working nearby.

The area is unlikely to be unduly affected by aircraft noise, notwithstanding the presence of London Heathrow Airport some 23 km to the east-north-east and Farnborough Airport some 14 km to the south-south-east.

There is no major industry within or close to the study area. A large Tesco store is located at the western end of the scheme. The only other commercial/retail uses within 100m of the study area are located in this region – including the Bridge Retail Park and Esso Service Station on the A321 Finchampstead Road and commercial/retail units on Molly Millar's Lane to the north and west of the Tesco roundabout respectively.

The baseline noise climate will need to be determined by measurement and/or prediction during the planning stage.

The only obvious source of significant vibration affecting the corridor of the proposed Distributor Road is from trains passing along the railway track between Bracknell and Wokingham. Consequently, it is possible that for the very closest receptors to the railway, some transient vibration might be perceptible when a train passes-by. Otherwise, levels of ambient vibration are expected to be low.

Notwithstanding the potential for some train induced vibration, ambient vibration in the study area is not anticipated to be significantly different to that which is typically found on the edge of similarly sized towns served by a railway.

Summary of Noise and Vibration Constraints

Potential Environmental Effects

Route Options A, B and C - Construction

Temporary noise and vibration effects can occur between the start of advance works and just before the road is first opened to traffic. Although construction-related effects are temporary, they may nevertheless be sufficient to require mitigation.

Disruption due to construction tends to be a more localised phenomenon than the effects of a scheme once it has opened to traffic. One study has shown that at least half the people living within 50m either side of the boundary of a construction site were seriously bothered by construction nuisance in one form or another, but that beyond 100m less than 20% of the people were seriously bothered (see TRRL Supplementary Report 562 [4]). Where significant quantities of materials need to be transported to/from the construction site, the effects of additional traffic along access routes should be considered.

[4] Baughan CJ (1980). Nuisance from road construction: A study at the A31 Poulner Lane diversion, Ringwood. TRRL Report SR562, Transport and Road Research Laboratory, Crowthorne.

The disturbance caused by construction noise and vibration to those living and working in affected locations will depend on a number of factors including:

- The existing ambient noise/vibration level;
- The noise/vibration from the construction works in terms of both the absolute level and relative to the existing ambient level;
- The type of noise/vibration (for example, it's character and intermittency);
- The duration of the works (for example, the number of consecutive days with high levels); and
- The time of day/week it occurs.

It is extremely unlikely that construction noise for any resident would reach a level where there would be a chance of hearing damage, although this would be a concern for the workforce constructing the Distributor Road. It will, therefore, be important that the contractor is fully aware of the requirements and obligations within The Control of Noise at Work Regulations 2005 [5]. Similarly, the risk of construction vibration posing any hazard to the health of residents is extremely slight but the requirements of The Control of Vibration at Work Regulations 2005 [6] would be applicable to the workforce for which there are risks.

Ground-borne vibration caused by the activities of heavy construction plant can become perceptible in dwellings and cause disturbance. People often express concern that vibrations they feel will cause structural damage to their dwelling. However, it has been shown that vibrations which can be felt indoors and thus cause anxiety are normally an order of magnitude smaller than would be needed to activate pre-existing strains and cause cracks to propagate.

Route Options A, B and C - Operation

Operationally, the proposed Distributor Road has the potential to affect noise levels not only in those areas immediately adjacent to the route, but also along surrounding roads as a result of the changes in traffic patterns.

For receptors close to the line of the yet to be constructed Distributor Road, it will ultimately be necessary to predict the likely noise level in terms of the $L_{A10,18h}$ using the methodology presented in the CRTN. The primary objective of the assessment would be to determine the likely change in noise level at key receptors, although absolute levels of noise are also of interest. The prediction methodology set out in the CRTN is described in further detail in Annex 2.

For receptors adjacent to existing roads in the area and currently exposed to varying degrees of road traffic noise, it is the change in noise level as a result of the scheme that is important when assessing the significance of potential effects. For these roads the change in traffic volume, speed and mix brought about by the proposed scheme can be used to determine the likely change in noise in accordance with the CRTN.

Clearly, there is potential for significant adverse noise effects to arise at receptors situated close to the line of the proposed Distributor Road. However, for receptors fronting existing roads where traffic flow may increase or decrease, noise effects could be adverse or beneficial. The guidance contained in HD 213/11 [7] should be used to assess the potential effects arising from road traffic noise.

As the highest levels of groundborne vibration are generated by irregularities in the road surface and there are few properties that lie close to the line of proposed new sections of road, significant levels of groundborne vibration are considered unlikely to arise. Where appropriate, the guidance contained in HD 213/11 should be used to assess the potential effects arising from traffic induced airborne vibration.

Potential Noise Constraints

The potential post-construction noise constraints identified in relation to the various route options are set out below and follow the methodology described above.

[5] Statutory Instrument 1643. Health and Safety – The Control of Noise at Work Regulations 2005.
[6] Statutory Instrument 1093. Health and Safety – The Control of Vibration at Work Regulations 2005.
[7] Design Manual for Roads and Bridges (DMRB), Volume 11 'Environmental Assessment', Section 3 'Environmental Assessment Techniques', Part 7 'Noise & Vibration', HD 213/11, revision 1.

Wider Road Network

The BNL has been determined for 3,285 links in the wider road network surrounding the Overall Study Area. As 1 dB is considered to be the smallest change in noise that is perceptible in the short-term, road links have been identified where there is a difference in BNL of 1.0 dB or more when comparing scenarios. The location of those links is identified on Plate 1. It can be seen from Table 1 above that differences of between 1.0 dB and 2.9 dB would be described as 'minor'.

Plate 1: Wider Road Network Links where the BNL Difference is 1.0 dB or more

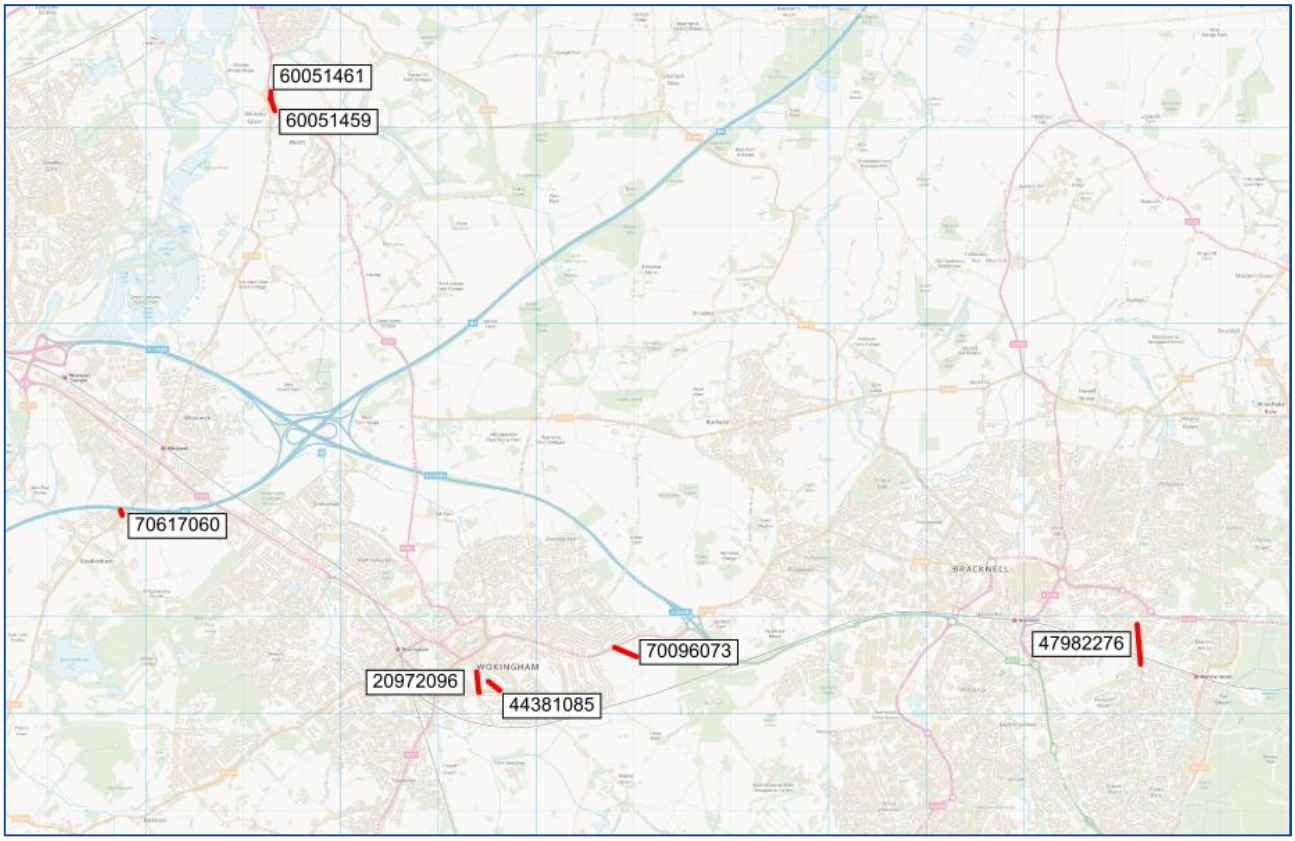


Table 3 to Table 9 below present further detail on the traffic data for each link and the predicted difference in BNL.

Table 3: Link ID 20972096 – Crescent Road, Wokingham (between Sturges Road and Murdoch Road)

Route Option	Flow	HDV (%)	Speed (kph)	BNL (dB)	Difference in BNL (dB)		
A	1,615	0.3	31	54.7			
B	1,666	1.6	31	55.7	**1.0**	0.9	0.1
C	1,645	1.5	31	55.6			
Summary: The BNL source noise level is higher under Route Option B than under Route Option A by 1.0 dB. This is an established residential road in South Wokingham approximately 325m north of the Bracknell to Wokingham railway line.							

Table 4: Link ID 44381085 – Sturges Road, Wokingham, north of Murdoch Road

Route Option	Flow	HDV (%)	Speed (kph)	BNL (dB)	Difference in BNL (dB)		
A	1,138	2.5	32	53.7			
B	1,088	0.5	32	52.3	**1.4**	n/a	n/a
C	943	0.4	32	n/a			
Summary: The BNL source noise level is higher under Route Option A than under Route Option B by 1.4 dB. This is an established residential road in South Wokingham approximately 375m north of the Bracknell to Wokingham railway line.							

Table 5: Link ID 47982276 – Ralphs Ride, Bracknell (between Broad Lane and Whistley Close)

Route Option	Flow	HDV (%)	Speed (kph)	BNL (dB)
A	1,705	0.0	43	56.0
B	1,712	0.0	43	56.1
C	1,477	0.0	43	55.1
Summary: The BNL source noise level is higher under Route Option B than under Route Option C by 1.0 dB. This is an established residential road in east Bracknell over 5.3km east of the Waterloo level crossing.				

Difference in BNL (dB)		
0.1	0.9	**1.0**

Table 6: Link ID 60051459 – Broadwater Lane at Whistley Green

Route Option	Flow	HDV (%)	Speed (kph)	BNL (dB)
A	1,155	6.0	44	55.8
B	1,138	5.7	44	55.6
C	1,115	3.4	44	54.7
Summary: The BNL source noise level is higher under Route Option A than under Route Option C by 1.1 dB. This road link (part of the A321) is over 6.8km north of the Starlane level crossing and runs along the rear of properties located in Whistley Green.				

Difference in BNL (dB)		
0.2	**1.1**	0.9

Table 7: Link ID 60051461 – Broadwater Lane at Whistley Green

Route Option	Flow	HDV (%)	Speed (kph)	BNL (dB)
A	1,156	6.0	44	55.8
B	1,139	5.7	44	55.6
C	1,117	3.4	44	54.8
Summary: The BNL source noise level is higher under Route Option A than under Route Option C by 1.0 dB. This road link (part of the A321) is over 6.8km north of the Starlane level crossing and runs along the rear of properties located in Whistley Green.				

Difference in BNL (dB)		
0.2	**1.0**	0.8

Table 8: Link ID 70096073 – New North-West Link from Southern Distributor Road to London Road

Route Option	Flow	HDV (%)	Speed (kph)	BNL (dB)
A	1,706	0.1	29	54.8
B	1,606	0.1	29	54.4
C	2,088	0.2	29	56.1
Summary: The BNL source noise level is higher under Route Option C than under Route Option A and Route Option B by 1.3 dB and 1.7 dB respectively. This is a new section of road at the northern end of the South Wokingham Distributor Road and, so it follows that no buildings currently front this road.				

Difference in BNL (dB)		
0.4	**1.3**	**1.7**

Table 9: Link ID 70617060 – Part of new junction at King Street Lane (B3030) and the Winnersh Southern Bypass

Route Option	Flow	HDV (%)	Speed (kph)	BNL (dB)
A	2,288	2.6	26	58.0
B	2,538	4.2	26	59.4
C	2,367	2.9	26	58.4
Summary: The BNL source noise level is higher under Route Option B than under Route Option A and Route Option C by 1.4 dB and 1.0 dB respectively. This road link is 4.9km north-west of the Starlane crossing. It is a new section of road and so it follows that no buildings currently front this road, although there are existing dwellings present in the vicinity.				

Difference in BNL (dB)		
1.4	0.4	**1.0**

Based on the above tables the following conclusions may be drawn:

- For 3278 out of 3285 links the difference in traffic data across the three route options generates negligible differences in noise of less than 1.0 dB.
- For just seven links the difference in traffic data across the three route options generates differences in noise of between 1.0 dB and 1.7 dB. Such differences would be described as minor negative.

- All seven affected links are 'low flow' roads with 18-hour flows ranging from 1,088 to 2,538. The proportion of heavy vehicles ranges from zero to 6% with speeds ranging from 26 to 44 kph (approximately 16-28 mph). These lightly trafficked, minor roads would not influence the noise climate except at receptors located immediately adjacent.
- Two of the seven links do not exist yet as they are associated with the proposed South Wokingham Distributor Road.
- Only three of the links lie within 500m of the scheme (at the nearest point), the other four links lie over 4km away.
- In two cases (links 47982276 and 70096073) it is the difference in traffic flow that is the primary reason for the difference in noise being greater than 1.0 dB. For the other five links, it is the change in the proportion of heavy vehicles that gives rise to the changes of 1.0 dB or more.

Overall, when considering all the points noted above, the noise differences identified across the wider road network can be considered inconsequential and should not be taken as a significant differentiator between the three route options.

The links forming the proposed Distributor Road are considered in the following section.

Route Corridor

Although the Distributor Road route options cannot directly be compared because they follow different alignments, it is possible to match-up the road links to compare the traffic volumes and determine whether any of the three options is likely to carry more or less traffic than the others. The greater the traffic volume, the greater will be the potential for adverse noise effects, all else remaining equal. Table 10 shows the traffic flows and speeds and percentage of heavy duty vehicles associated with links for each of the three route options. The BNLs associated with these links are presented in Table 11.

Table 10: Traffic Data Relating to the Proposed Distributor Road

Route Option A				Route Option B				Route Option C			
Link ID	Flow	%hdv	kph	Link ID	Flow	%hdv	kph	Link	Flow	%hdv	kph
80066073	17005	1.2	40	70626073	16575	1.2	40	80166073	15247	1.2	41
80068002	15874	1.3	40	70627026	15436	1.3	40	80168015	13990	1.2	40
80058002	13835	1.3	41	70307026	13573	1.3	41	80158014	10562	1.3	42
80058001	13493	1.3	40	70302312	13386	1.3	40	80148013	9899	1.3	41
80048001	15182	2.8	39	70182312	13771	3.0	39	80138012	12308	3.2	40
80048003	14610	2.9	41	70207018	13127	3.1	41	80128011	11686	3.3	41
80078003	14008	3.0	41	70227020	12507	3.2	41	80118010	11104	3.4	42
80088007	14090	2.9	40	70226078	12624	3.1	40	80108009	11281	3.3	40
80081440	17632	2.6	35	60781440	16458	2.7	36	80091440	15171	2.8	37

Table 11: Calculated BNLs along the Proposed Distributor Road

Route Option A		Route Option B		Route Option C		Difference in BNL (dB)		
Link	BNL dB	Link ID	BNL dB	Link	BNL dB	Option A vs. Option B	Option A vs. Option C	Option B vs. Option C
80066073	67.1	70626073	67.0	80166073	66.7	0.1	0.4	0.3
80068002	66.8	70627026	66.7	80168015	66.2	0.1	0.6	0.5
80058002	66.3	70307026	66.3	80158014	65.3	0.0	1.0	1.0
80058001	66.1	70302312	66.1	80148013	64.9	0.0	1.2	1.2
80048001	67.2	70182312	66.9	80138012	66.5	0.3	0.7	0.4
80048003	67.3	70207018	66.9	80128011	66.4	0.4	0.9	0.5
80078003	67.1	70227020	66.7	80118010	66.3	0.4	0.8	0.4
80088007	67.0	70226078	66.6	80108009	66.2	0.4	0.8	0.4
80081440	67.5	60781440	67.3	80091440	67.1	0.2	0.4	0.2

Based on the above tables, the following conclusions may be drawn:

- Route Option A (the most northerly route alignment) does carry slightly higher traffic flows on all links;
- Route Option A and Route Option B carry very similar levels of traffic, resulting in a maximum variation in the BNL of 0.4 dB; and
- Route Option C (the most southerly route alignment) carries the least traffic, to the point between Waterloo Road and Easthampstead Road where the source BNL is about 1 dB lower than the two more northerly options.

The source noise level forms only part of the consideration, proximity to noise-sensitive dwellings is also very important. This is considered in the following sections.

Route Option A

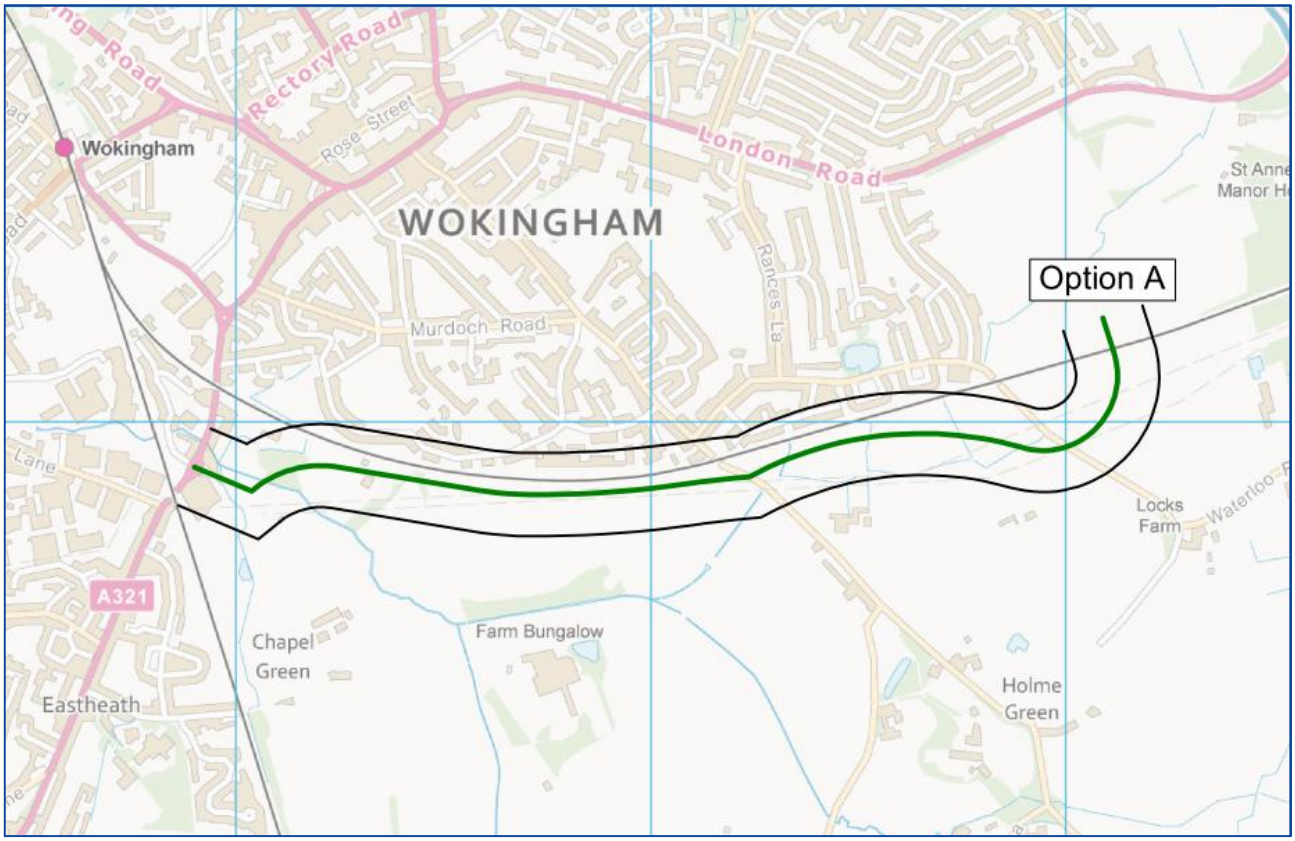
Table 12 below presents potential noise constraints associated with Route Option A, which should be considered, along with the other constraints, when selecting the preferred route. The discussion considers the effects along the line of the route; the wider effects have been addressed above.

The alignment of Route Option A, along with a 100m buffer zone either side, is shown on the Plate 2.

Table 12: Potential Noise Constraints along the Distributor Road – Route Option A

Distributor Road Route Option A
To the south of the railway, three dwellings lie within 100m. Nos.58 and 58A Finchampstead Road and Knoll Farm, the latter property lying within 10-15m of the route alignment. North of the railway, along the southern fringe of Wokingham, approximately 125 dwellings lie within 100m of the route alignment (although none closer than 50m). Approximately half of these properties lie west of the Starlane level crossing (in Gipsy Lane, Southlands Road, Southwood, Green Drive and Easthampstead Road) with the remainder lying between the Starlane and Waterloo level crossings (in Waterloo Crescent and Waterloo Road).

Plate 2: Route Option A with a 100m Buffer Zone Either Side



Route Option B

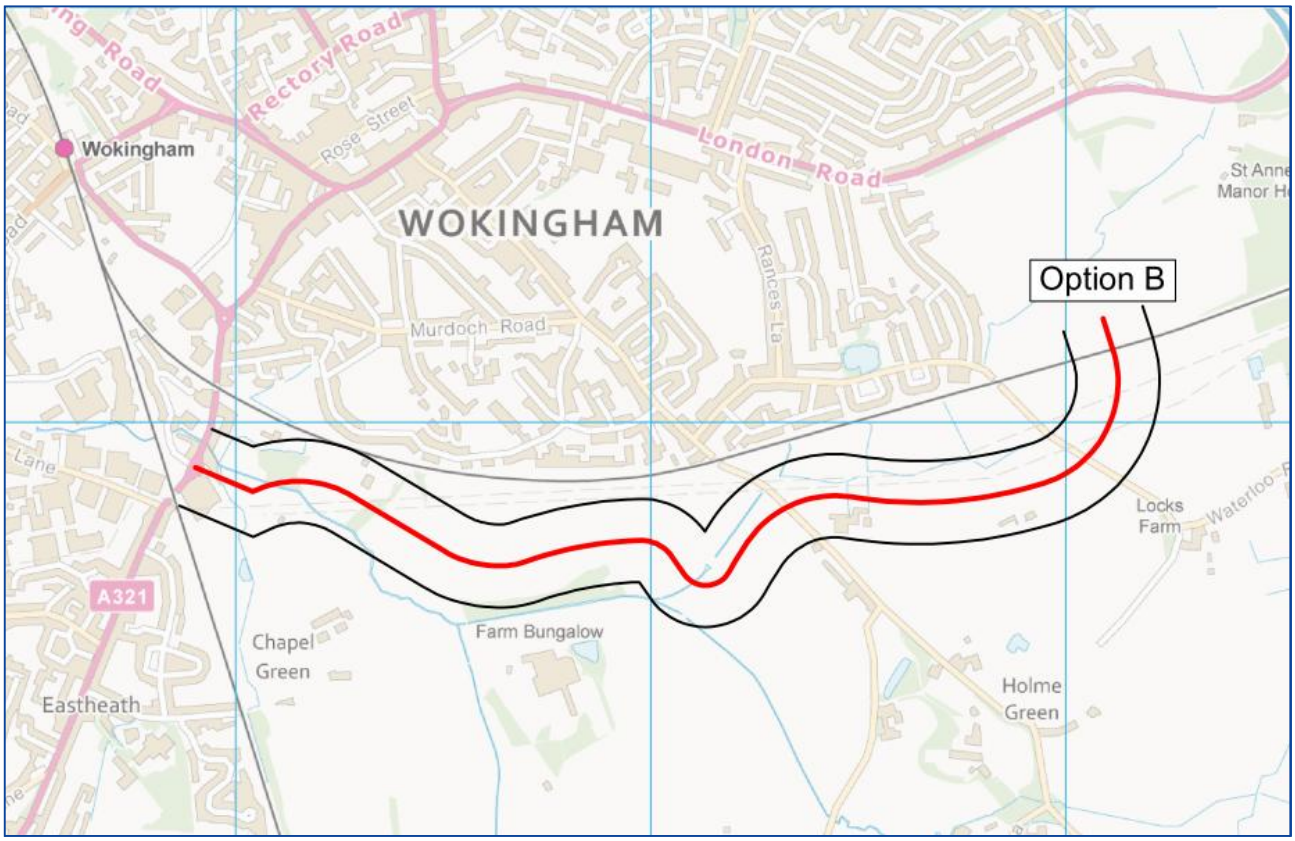
Table 13 below presents potential noise constraints associated with Route Option B, which should be considered, along with the other constraints, when selecting the preferred route. The discussion considers the effects along the line of the route; the wider effects have been addressed above.

The alignment of Route Option B, along with a 100m buffer zone either side, is shown on Plate 3.

Table 13: Potential Noise Constraints along the Distributor Road – Route Option B

Distributor Road Route Option B
Three individual dwellings lie within 100m of the centreline of Route Option B: ■ Knoll Farm located just to the south of the railway towards the west end of the scheme, would lie approximately 75-80m north of the route alignment. ■ Woods Farm, a Grade 2 listed building, located a short distance east of Easthampstead Lane, would lie approximately 70-75m south of the route alignment (the farmhouse would be well-screened by existing farm buildings and commercial units). ■ Brittons Farm, another Grade 2 listed building, located between Easthampstead Road and Waterloo Road, would lie approximately 60-65m to the south of the route alignment.

Plate 3: Route Option B with a 100m Buffer Zone Either Side



Route Option C

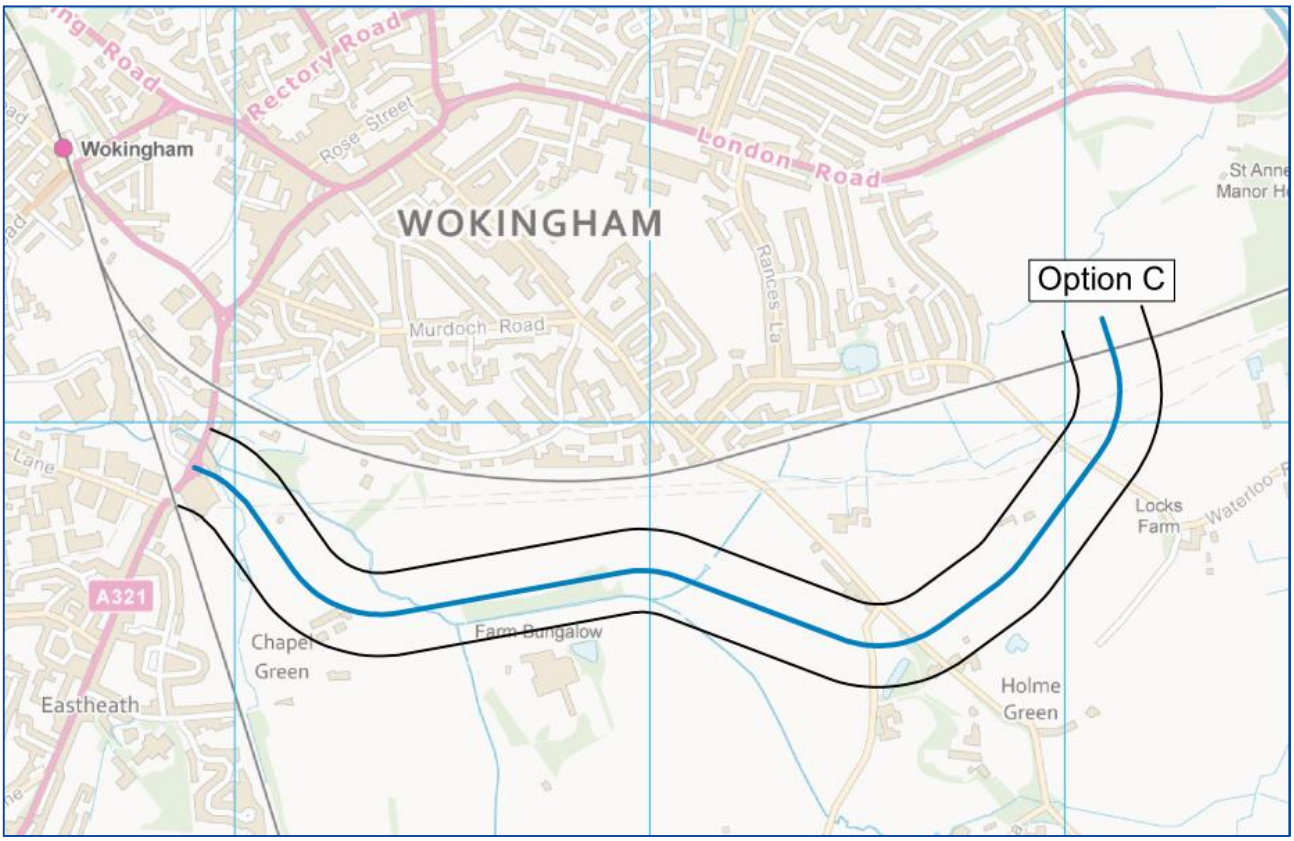
Table 14 below presents potential noise constraints associated with Route Option C, which should be considered, along with the other constraints, when selecting the preferred route. The discussion considers the effects along the line of the route; the wider effects have been addressed above.

The alignment of Route Option C, along with a 100m buffer zone either side, is shown on the Plate 4.

Table 14: Potential Noise Constraints along the Distributor Road – Route Option C

Distributor Road Route Option C
Near its western end, the route passes close to Chapel Green where the Wokingham Equestrian Centre is located. In addition to the equestrian centre there are five dwellings within this cluster of buildings – including Chapel Green House and nos.1-2 Chapel Green Cottages, all three of which would lie within 25m of the route alignment. At Holme Green on the Easthampstead Road, three dwellings lie to the north of the route alignment, the nearest of which (Long Patch) lies within 25m. A further three dwellings lie to the south of the route alignment, although none closer than 65m. Further east, Brittons Farm lies approximately 85m to the north of the route alignment.

Plate 4: Route Option C with a 100m Buffer Zone Either Side



Distributor Road Western Termination Point

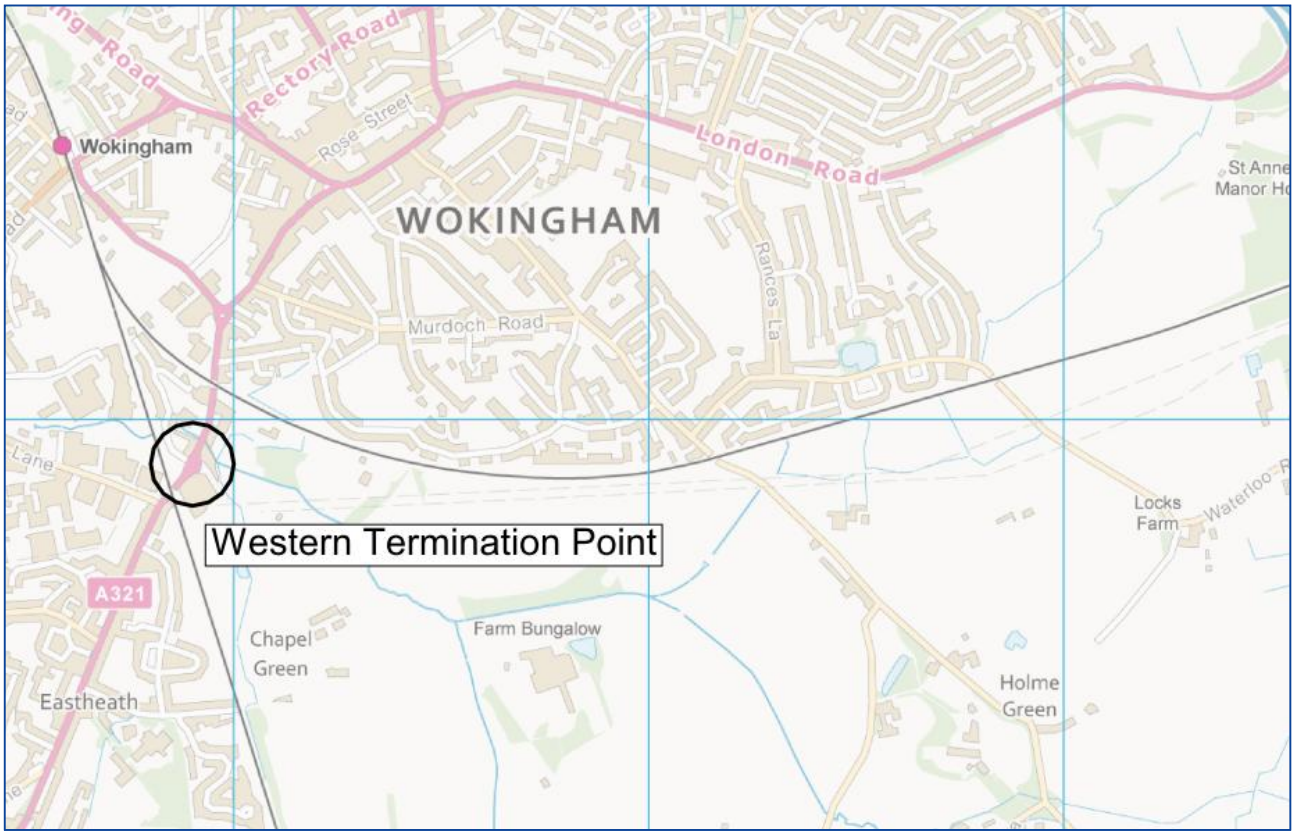
The western termination of the Distributor Road is the Tesco roundabout at the junction of Oakey Drive and the A321 Finchampstead Road. Plate 5 identifies a 100m radius buffer zone centred on the roundabout.

Table 15 below describes the noise sensitive receptors within 100m of the centre of this roundabout junction.

Table 15: Potential Noise Constraints at the Western Termination Point of the Distributor Road

Distributor Road Western Termination Point
55 properties lie within 100m of the centre of the Tesco roundabout on the A321, as follows: ■ nos.1-12 Oakview, Finchampstead Road to the west (in four groups of three); ■ nos.1-40 at Landen Court, Finchampstead Road to the north (in six groups of between six and nine units); and ■ three detached houses nos. 76, 76A and 76B Finchampstead Road to the north-east. This last group of three (and especially nos. 76A and 76B) would be particularly vulnerable to noise, during and following construction of the new Distributor Road. A public footpath leads south-east away from the roundabout towards Chapel Green.

Plate 5: Distributor Road Western Termination Point with a 100m Buffer Zone



Summary

Route Option A (the most northerly route) is not favoured because of its proximity to the southern fringes of Wokingham where some 125 dwellings would fall within the 100m buffer zone. Whilst the vast majority of these dwellings would lie in excess of 50m from the route alignment (with the railway in between) the sporadic nature of the train movements and the number of properties potentially affected means this is not a favoured option.

Route Option C (the most southerly route) is also not favoured. Despite there being far fewer properties within 100m of this route option compared to Route Option A (12 against 125), a number of these lie close to the route alignment. Chapel Green House and nos. 1-2 Chapel Green Cottages all lie within 25m of the route alignment, as does Long Patch in Holme Green, immediately west of Heathlands Road.

Route Option B (the central alignment) is favoured, since there are only three individual properties – Knoll Farm, Woods Farm and Brittons Farm – located within 100m, None of these dwellings lies closer than 60m to the route alignment and Woods Farm would be well screened by existing farm buildings and commercial units.

It should be noted that all three route options have the potential to affect properties in the vicinity of Tesco roundabout; two properties nos. 76A and 76B Finchampstead Road are particularly vulnerable to noise as both lie close the proposed line of the Distributor Road as it approaches the Tesco roundabout.

Local Study Areas (A-F)

As mentioned in the Introduction above, there are six local study areas where new footbridges are to be constructed. These areas and a 100m buffer zone around them are depicted on Plate 6. The buffer zone for the study areas B-E [8] is based on a single point on the railway line at the existing crossing point (be that a level crossing or footbridge). For the two larger buffer zones (A and F) a 100m buffer has been drawn around the perimeter of the identified zone. Below, the tables describe the sensitive receptors within 100m of each of the six Local Study Areas.

[8] Local Study Area B is an existing level crossing without barriers. Local Study Area C is an existing footbridge. Local Study Area D is an existing level crossing with automated barriers (the Starlane crossing). Local Study Area E is an existing level crossing with automated barriers (the Waterloo crossing).

Noise sensitive receptors within 100m have been identified, although those lying outwith the 100m buffer zone may still experience some disturbance. The receptors nearest to the works are likely to be the most adversely affected, although screening by other buildings may serve to lessen the adverse effects.

Plate 6: Local Study Areas with a 100m Buffer Zone

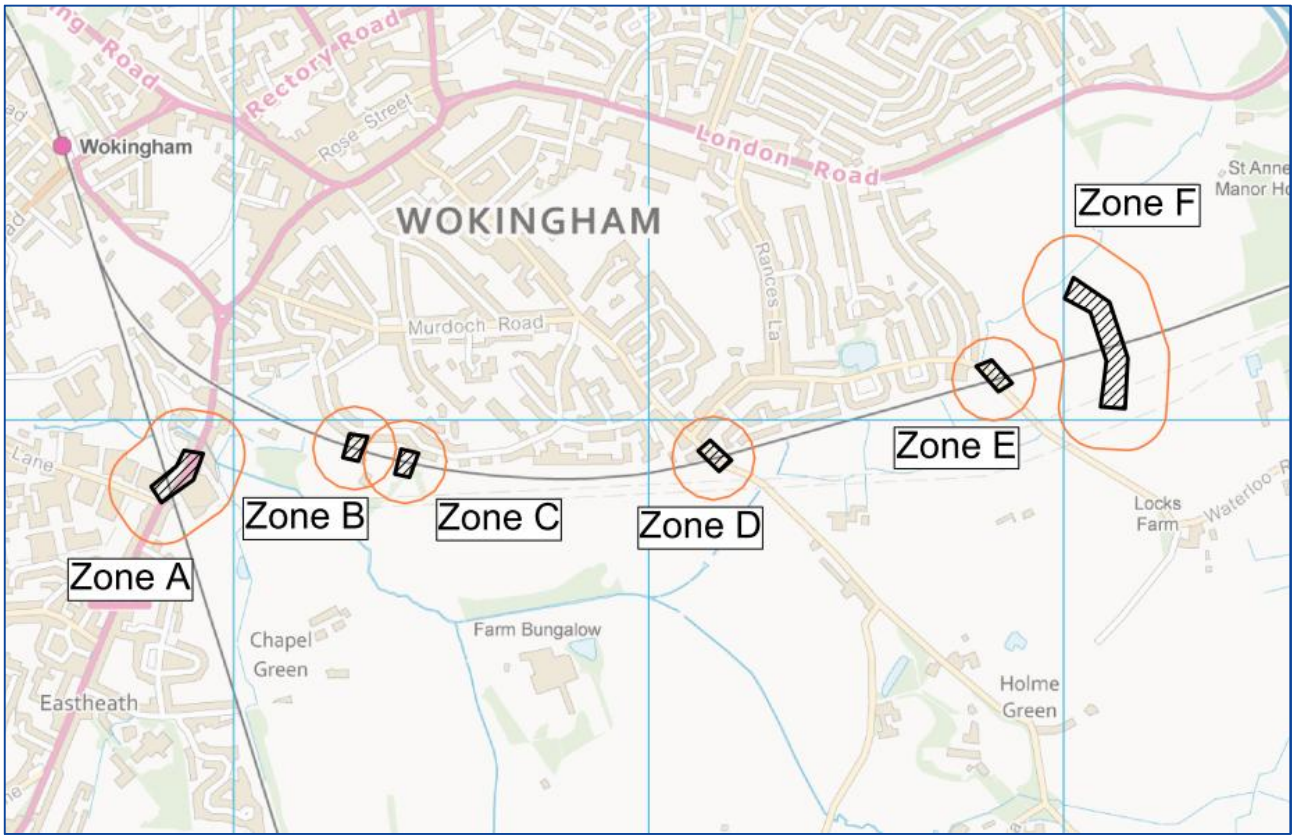


Table 16: Potential Noise Constraints at the Local Study Area Zone A

Local Study Area – Zone A
76 properties lie within 100m of Local Study Area Zone A, as follows: ■ nos.1-12 Oakview, Finchampstead Road to the west (12no.); ■ nos.1-40 at Landen Court, Finchampstead Road to the north (40no.); ■ no.2-4 Oakey Drive to the west-north-west (3no.); ■ three detached houses, 76, 76A and 76B Finchampstead Road, to the north-east (3no.); ■ an estimated five of the nine flats in Eyre Court, Finchampstead Road to the north-east (5no.); ■ nos.81-93 (odd numbers only) Finchampstead Road (7no.) to the south; and ■ nos.92-100 (even numbers only) Finchampstead Road to the south (6no.). A public footpath leads south-east away from the Tesco roundabout towards Chapel Green.

Table 17: Potential Noise Constraints at the Local Study Area Zone B

Local Study Area – Zone B
29 properties lie within 100m of Local Study Area Zone B, as follows: ■ Knoll Farm to the south of the railway (1no.); and ■ 28 dwellings in Gipsy Lane to the north of the railway. Of these properties, five are located on the north side and 23 on the south. The majority of those to the south lie to the east of the Knoll Farm access (28no.).

Table 18: Potential Noise Constraints at the Local Study Area Zone C

Local Study Area – Zone C
20 properties lie within 100m of Local Study Area Zone C, as follows: ■ Knoll Farm to the south of the railway just falls within the 100m buffer zone (1no.); ■ 14 dwellings in Gipsy Lane to the north of the railway, the majority of which lie to the west of the existing footbridge access (14no.); and ■ Five dwellings in South Close north of Gipsy Lane (5no.). Knoll Farm and eight of the properties in Gipsy Lane lying west of the existing footbridge access also fall within Local Study Area Zone B. The existing footbridge carries a public footpath over the railway. On the south side of the footbridge, the footpath divides, with one branch heading south-west towards Chapel Green and the other heading south-east, eventually passing Ludgrove School buildings to the west.

Table 19: Potential Noise Constraints at the Local Study Area Zone D

Local Study Area – Zone D
28 properties lie within 100m of Local Study Area Zone D, all to the north of the railway, as follows: ■ nos.143-151 (odd numbers only) and no.159 Easthampstead Road on its west side (6no.); ■ no.160 Easthampstead Road on its east side (1no.); ■ nos.1-19 Waterloo Road (odd numbers only and excluding no.13) (8no.); and ■ nos.1-25 Waterloo Crescent (odd numbers only) (13no.).

Table 20: Potential Noise Constraints at the Local Study Area Zone E

Local Study Area – Zone E
11 properties lie within 100m of Local Study Area Zone E, as follows: ■ nos.62-66 (even numbers only) Priest Avenue (3no.); ■ no.63 Priest Avenue (1no.); ■ nos.185-195 (odd numbers only) Waterloo Road (6no.); and ■ Waterloo Crossing Cottage (1no.) The unmade Clay Lane, which runs past the rear of properties on the east side of Priest Avenue to alight onto Waterloo Road by the Waterloo Crossing Cottage, is a designated Public Byway.

Table 21: Potential Noise Constraints at the Local Study Area Zone F

Local Study Area – Zone F
No properties lie within 100m of Local Study Area Zone F. The nearest properties, on the east side of Priest Avenue are more than 220m away.

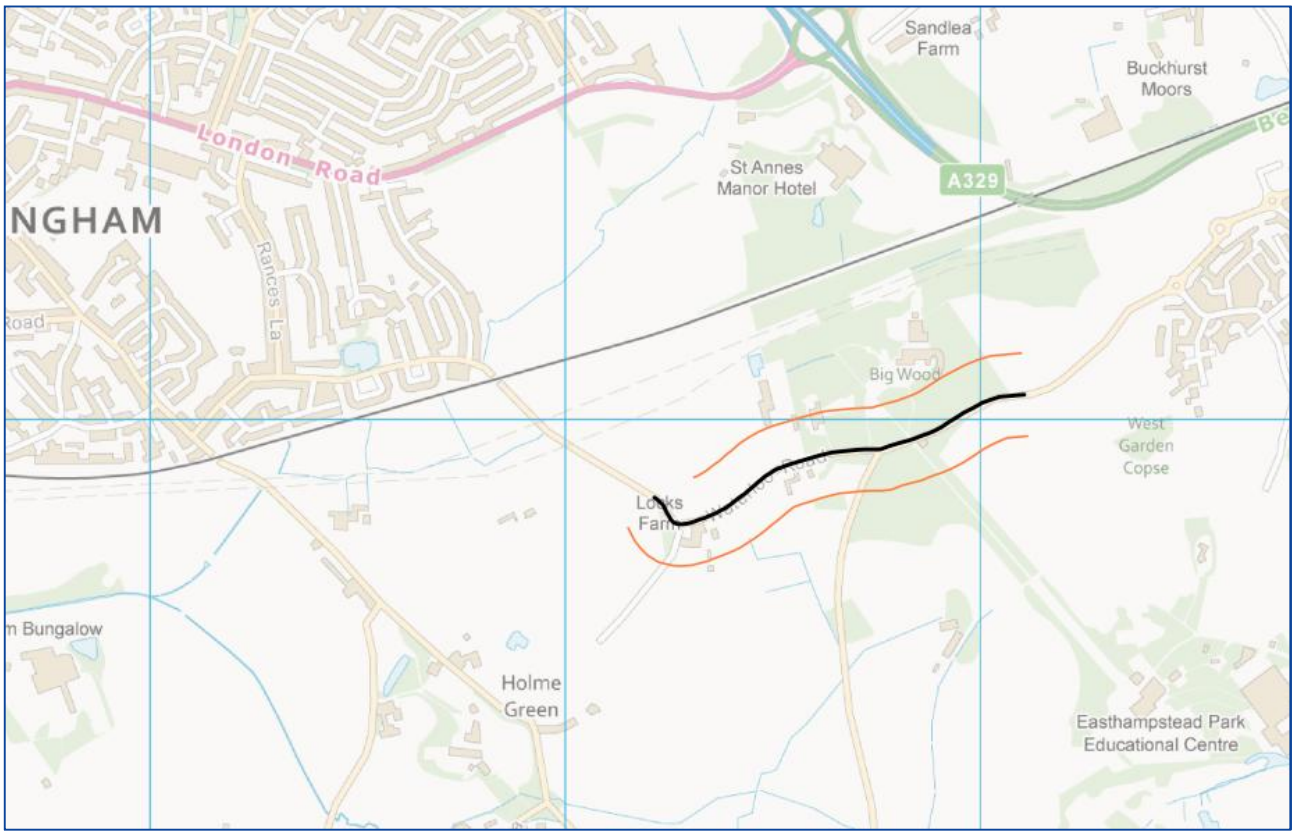
Waterloo Road / Peacock Lane Improvements (Route D)

Waterloo Road / Peacock Lane Improvements area and a 100m buffer is identified in Plate 7 below. At the eastern end of the improvements scheme, just east of the Public Byway to Holme Green lie four residential properties, two of which lie within 15-20m of the road centreline, with the other two set further back (approximately 30-35m from the road centreline).

Further east, on the south side of Waterloo Road and within 100m of the centreline, lies Oakwood Youth Challenge, an outdoor activity centre with a stable yard and residential accommodation.

To the north of Waterloo Road and Peacock Road lie a number of commercial uses set back from the road. From west to east these are: Bigwood House, Bennetts Commercial, Haughtons Folly and Oakwood Park Kennels. It is unclear from the mapping information available whether there are any residential elements, but Ivydene at Oakwood Park Kennels (c75m from the road centreline) appears to be residential. Bigwood House and Haughtons Folly lie a little closer to the road than this, but still beyond 50m.

Plate 7: Waterloo Road / Peacock Lane Improvements with a 100m Buffer Zone Either Side



Summary and Recommendations

This technical note sets out the likely noise and vibration constraints and issues affecting the proposed South Wokingham Distributor Road. At this early stage, three different route options for the Distributor Road are being considered.

The likely constraints along each route alignment have been considered qualitatively based on the number and proximity of noise sensitive receptors to the proposed line.

Route Option A (the most northerly route) is not favoured because of its proximity to the southern fringes of Wokingham where some 125 dwellings would fall within the 100m buffer zone. Whilst the vast majority of these dwellings would lie in excess of 50m from the route alignment (with the railway in between) the sporadic nature of the train movements and the number of properties potentially affected means this is not a favoured option.

Route Option C (the most southerly route) is also not favoured. Despite there being far fewer properties within 100m of this route option compared to Route Option A (12 against 125), a number of these lie close to the route alignment. Chapel Green House and nos. 1-2 Chapel Green Cottages all lie within 25m of the route alignment, as does Long Patch in Holme Green, immediately west of Heathlands Road.

Route Option B (the central alignment) is favoured, since there are only three individual properties – Knoll Farm, Woods Farm and Brittons Farm – located within 100m, None of these dwellings lie closer than 60m to the route alignment and Woods Farm would be well screened by existing farm buildings and commercial units.

It should be noted that all three route options have the potential to affect properties in the vicinity of Tesco roundabout at the western termination point; two properties nos. 76A and 76B Finchampstead Road are particularly vulnerable to noise as both lie close the proposed line of the Distributor Road on its approach to the Tesco roundabout.

Along the wider road network, a quantitative assessment has been undertaken based on the likely difference in the Basic Noise Level for the three route options, which has been calculated on a link-by-link basis using supplied traffic data. Overall, the noise differences identified can be considered inconsequential and should not be taken as a significant differentiator between the three route options.

In addition to the assessment of the Distributor Road route options, the constraints affecting two other aspects associated with the proposals have been considered – the works associated with the construction of railway bridges at six Local Study Areas and the improvements of Peacock Lane and Waterloo Road (Route D).

In each case there are no details of the works that would be required, the plant that would be utilised, nor the time or duration of such work. Therefore, the constraints in the vicinity of the works have been considered qualitatively based on the number and proximity of noise sensitive receptors at each location. In particular, the number of properties within 100m of the works has been identified, as it is these receptors that are likely to be most adversely affected during the proposed works, although this does not preclude the possibility that significant adverse effects might arise at more distant locations.

Local Study Area Zone A has by far the largest number of dwellings (in excess of 70) located within 100m, however, many of these residential receptors are also subject to the highest ambient noise levels primarily arising from road traffic on the A321, but also from the Crowthorne to Wokingham railway and commercial uses in the area.

Between 20 and 30 dwellings lie within 100m of Zones B, C and D. These receptors would be subject to relatively low ambient noise levels from local road traffic and sporadic train movements. As a result of its more remote location on the very edge of Wokingham, fewer properties lie within 100m of Zone E, whilst no residential receptors at all lie within 100m of Zone F. The nearest properties to Zone F are to be found on the east side of Priest Avenue more than 220m away.

Only a handful of sensitive receptors have been positively identified as lying within 100m of the proposed scheme to widen Peacock Lane/Waterloo Road.

Where properties are adversely affected by any of the proposals, consideration should be given to the use of mitigation measures as described in the preceding section.

Opportunities to Avoid or Minimise Effects

Construction

Noise effects arising during construction can be mitigated to an extent through contractual means. Contract conditions can be used to limit noise from a construction site, to control working hours (especially for potentially disruptive operations), to prevent access to sensitive areas and to restrict construction traffic to suitable haul routes etc. It is important that contractual working restraints are discussed in advance with the local authority Environmental Health Officer. Monitoring of noise and vibration may be required during construction.

The Control of Pollution Act (CoPA) 1974 Section 61 sets out procedures for those undertaking works to obtain ‘prior consent’ for construction works if they wish to do so. Applications for such consent are made to the relevant local authority and contain a method statement for the works and the steps to be taken to minimise noise and vibration. Under Section 60 of CoPA, the local authority has powers to serve a notice imposing requirements as to the way in which the works are to be carried out and may specify plant or machinery which is (or is not) to be used, the hours during which the works may be carried out and the level of noise or vibration which may be emitted at any specified point. Although it is generally for those undertaking the works to decide whether or not to seek a Section 61 consent, this is also dependent on the custom and practice of the local authority. Some local authorities request demonstration of ‘best practicable means’ (as defined in CoPA Section 72) rather than a formal ‘prior consent’ application.

In considering possible methods of mitigating adverse effects during the construction period, it will be necessary to balance the severity of an effect and its duration. For example, it may be acceptable if greater disruption occurs over a short period, than lesser disruption over an extended period.

For the control of noise and vibration at construction sites, BS 5228: 2009 (Code of practice for noise and vibration control on construction and open sites – Part 1: Noise and Part 2: Vibration) provides guidance for measuring, predicting and assessing construction noise and vibration. Advice on noise and vibration control techniques is also included.

Operation

A number of techniques are available that can be applied either in isolation or in combination, to mitigate the adverse effects of road traffic noise during the operational stage. Some scheme-related measures are set out below.

- *Horizontal alignment* – moving a route away from sensitive receptors;
- *Vertical alignment* – keeping a route low within the natural topography can exploit natural screening;
- *Environmental barriers* – in the form of earth mounding or acoustic fencing of various types, or a combination of the two;
- *Low noise road surface* – effective for noise generated by tyres of vehicles travelling at speeds in excess of 75 kph (c47 mph); and
- *Restriction on vehicle speed and numbers* – above about 40 kph, noise level increases with the speed of the vehicle; the volume and composition of traffic also have a direct effect on noise level.

The measures set out in the first two bullet points above should be the primary objective when determining the alignment of the Distributor Road. However, it is acknowledged that it may not always be possible to apply some of these techniques to the proposed road as there will be competing constraints. For example, there may be good engineering, environmental or safety considerations why the route cannot be aligned further away from the nearest dwellings or positioned so as to maximise screening.

The potential benefit of applicable mitigation measures can vary widely according to local circumstances and it is to provide some indication of the potential benefits that the tables in Annex 3 have been included.

Table E, Annex 3 demonstrates that environmental barriers can provide reductions of 10 dB or more for well-screened locations relatively close to the source. But at further distances and particularly where the barrier provides only a small deflection of the transmitted sound, actual reductions may only be 1 dB or 2 dB. Beyond 200m to 300m the effects are often zero as the attenuation of absorbent ground cover becomes a significant factor [9]. Other considerations with respect to barriers are:

- The primary objective of any barrier should be to prevent a direct line of sight between the receptor and the noise source;
- The higher the barrier, the greater the sound reduction, although, there will come a point where the additional benefit will not be cost-effective;
- The closer a barrier is to the source or receptor, the greater will be the sound reduction;
- Where a road is located on an embankment, the most efficient location for the barrier will usually be on the embankment as close to the carriageway edge as possible;
- Where a road is located in cutting, there will be less need for a barrier;
- A barrier will usually be less effective at screening upper floors; and
- Unless they are specifically designed and constructed to prevent this, a barrier can reflect sound, increasing noise levels at certain receptors located opposite barriers.

The benefits likely to accrue from a low noise road surface will vary according to traffic speed and the type and age of surface. HD 213/11 notes that compared with a standard hot rolled asphalt surface, the maximum allowable surface correction that can be claimed from using a thin surfacing system would be -3.5 dB. Such a difference is significant in that to achieve a comparable reduction in noise by reducing traffic flow would require at least a halving of the traffic, for example. However, HD 213/11 also advises that a low noise road surface is much less effective where traffic speeds are below 75 kph (c47 mph).

[9] The CRTN states (in paragraph 22.3) that "*the additional attenuation referred to as ground absorption….is ignored when calculating the effects of barriers since the near ground rays are obstructed. However, under certain circumstances (e.g. with low barriers erected on grassland) it is possible for these ground absorption effects to exceed the calculated screening provided by the barrier. The barrier will not raise the noise level in the screened zone, and in these circumstances the noise levels with and without the barrier should be calculated and the lower of the noise levels used*".

The reason for this is that a thin surfacing system will influence noise emissions from the interaction of tyres with the road surface. Where vehicle speeds are lower, noise from the engine, transmission and exhaust becomes more significant, therefore it would be cautious to claim less benefit from a thin surfacing system where vehicle speeds are less than 75 kph and the advice from HD 213/11 (paragraph A4.27) is as follows: "*where the mean traffic speed is <75 km/hr, a -1 dB(A) surface correction should be applied to a low-noise surface…..Although it is likely that thin surfacing systems will provide more acoustic benefit at lower speeds, until further research is carried out to provide reliable estimates, it is advised that a qualitative statement highlighting the possible acoustic benefits is also included in the assessment.*"

Reference to Table 10 reveals that the traffic speed on the proposed Distributor Road is likely to be less than 50 kph, so based on the DMRB guidance there would be little benefit to be had from the inclusion of a low noise road surface.

Vehicle speed and the proportion of heavy duty vehicles combine to form a correction that is applied to the noise level determined from the vehicle flow. Above about 40 kph, the higher the speed and the higher the proportion of heavy duty vehicles, the greater will be the correction. This correction can be significant. For example, with 6% heavy duty vehicles, reducing vehicle speed from 80 kph to 64 kph (50 mph to 40 mph) would result in a 1.5 dB reduction in road traffic noise, all else remaining equal. This is equivalent to a reduction in overall traffic flow of approaching 30%.

Recommendations

At the appropriate time the proposed scheme will require consideration in terms of an Environmental Impact Assessment (EIA) and also in a regulatory sense, through the obligations under the Noise Insulation Regulations (NIR) 1975, as amended. Further thoughts on EIA, the consideration of significance and the NIR are provided in Annex 1, whilst factors that influence levels of road traffic noise are described in Annex 2 and Annex 3.

As a new road is proposed, the requirement to undertake an assessment that is compliant with the methodology set out in DMRB advice note HD 213/11 will need to be determined in discussion with the Local Planning Authority.

Annex 1

EIA and the Consideration of Significance

A noise and vibration assessment should be undertaken at the appropriate time during the planning stage. As affected receptors are currently exposed to a certain level of road traffic noise, it is the likely change in noise level as a result of the infrastructure works that is important when assessing the significance of potential effects.

The scope of the noise and vibration assessment would be confirmed through consultation with the Local Planning Authority using the principles set out in HD 213/11 [10], but the following elements are likely to be required:

- determination of baseline noise/ vibration conditions, whether by prediction or measurement or most likely a combination of the two;
- the assessment of noise/ vibration generated during the construction of the proposed Distributor Road and any associated improvements;
- an assessment of the change in road traffic noise/ vibration at sensitive locations adjacent to the proposed Distributor Road and any associated improvements;
- an assessment of the change in existing road traffic noise/ vibration levels at sensitive locations adjacent to existing roads (i.e. to assess the change in traffic distribution on the surrounding highway network);
- identification of the measures to mitigate any significant adverse effects identified (for example, roadside barriers, a low noise road surface and/ or reduced speeds); and
- an assessment of residual effects.

As a last resort, residential properties may receive sound insulation measures under the terms of the NIR [11] as described in the following section.

The Land Compensation Act

The NIR were made under Part II of the Land Compensation Act (LCA), 1973. Regulation 3 of the NIR imposes a mandatory duty on Highway Authorities to undertake (or make a grant in respect of the cost of undertaking) noise insulation work in or to eligible buildings. All of the following criteria would need to be met:

- the building has to be in residential use;
- the building has to be within 300m of a new or altered highway;
- the building has to be occupied before the new or altered road is first opened to the public;
- the traffic noise level at one or more façades has to increase by at least 1 dB and be not less than 68 dB; and
- the noise from traffic using the new road has to contribute at least 1 dB to the overall noise level.

All noise levels are in terms of the $L_{A10,18h}$ and should be determined externally at one metre from the façade of the dwelling.

Regulation 4 of the NIR provides Highway Authorities with discretionary powers to undertake (or make a grant in respect of the cost of undertaking) noise insulation work in or to eligible buildings.

Regulation 5 of the NIR provides relevant Highway Authorities with discretionary powers to undertake (or make a grant in respect of the cost of undertaking) noise insulation work in or to eligible buildings with respect to construction noise. In this case eligibility hinges on whether the relevant authority considers the construction of the new road is causing (or will cause) noise at a level which is seriously affecting (or will seriously affect) for a substantial period of time the enjoyment of an eligible building adjacent to a site. Neither 'seriously affect' nor 'substantial period of time' is defined in the NIR.

[10] Design Manual for Roads and Bridges (DMRB), Volume 11 'Environmental Assessment', Section 3 'Environmental Assessment Techniques', Part 7 'Noise & Vibration', HD 213/11, revision 1.

[11] Statutory Instrument 1973 Building and Buildings – The Noise Insulation Regulations 1975.

Where a façade is eligible for sound insulation, the treatment may include:

- secondary glazing and double doors;
- supplementary ventilation; and
- venetian blinds (to help control solar-gain).

Where insulation work is anticipated, the Highway Authority must prepare a map or list of every eligible building and make it available for public inspection within six months of the opening to traffic of the new or altered road. The formal offer of insulation has to be accepted within six months of its receipt or within the first twelve months after the new or altered road has been opened to traffic, if this period is later.

Finally, Part I of the LCA provides a means by which compensation can be paid to owners of land or property which has experienced a loss in value caused by the use of public works, such as new or improved roads. Noise and vibration are but two of a number of factors which would be considered in any claims for compensation, although the LCA includes no further guidance on the noise or vibration level (or indeed the change in level) that might result in a loss in value. Claims can be made under Part I of the LCA from 1 year to 7 years after the opening of the road project.

Annex 2

Calculation of Road Traffic Noise [12] (CRTN)

Noise from a stream of traffic is not constant but varies from moment to moment and so it is necessary to use an index to arrive at a single-figure estimate of the overall noise level for assessment purposes.

The CRTN describes procedures for predicting and measuring noise from road traffic in terms of the L_{A10} – the level exceeded for 10% of the time. A step-by-step method is presented for predicting road traffic noise levels in terms of L_{A10} for both a 1-hour period and an 18-hour period, between 06:00 hours and midnight, (the $L_{A10,1h}$ and $L_{A10,18h}$ respectively) at any distance up to 300 m from a highway. The prediction method takes into account the following factors to generate a Basic Noise Level (BNL) at a notional distance from the kerb: traffic flow, mean speed, the percentage of heavy duty vehicles (HDVs), along with the road gradient and surface.

The procedures also enable the noise level at specific receptors to be determined by taking the BNL and applying corrections for:

- distance;
- the type of intervening ground cover between the road and receptor;
- the presence of screening (barriers, buildings and topography);
- the angle of view of the road; and
- reflections from façades.

A flow chart for predicting noise from road schemes is presented at the end of this annex.

The assessment undertaken for this route options appraisal is not receptor specific, instead relying primarily on a comparison of BNLs along individual road links. Hence, the procedures which influence propagation have not been utilised and have been considered no further. However, any future assessment in line with HD 213/11 [13] (i.e. a simple or detailed assessment) should consider the noise level at specific receptors and so take into account the effects of propagation.

Basic Noise Level (BNL)

The CRTN algorithms have been adopted to determine the BNL, in terms of $L_{A10,18h}$, at a notional distance from individual road segments or links. The CRTN utilizes a notional kerb to receptor distance of 10 metres and so this distance has also been adopted for this assessment.

The factors which influence the BNL can conveniently be divided into two groups:

- road related factors – gradient and surface type; and
- traffic related factors – flow, speed, and proportion of heavy duty vehicles.

These factors are considered in further detail below.

Road Related Factors

Road Gradient

According to CRTN the road gradient can influence noise levels in one of two ways. Firstly a correction can be applied for road gradient in isolation and secondly, the gradient can influence the mean traffic speed where this has been estimated from the class of road. This correction is variable, depending on the gradient and proportion of heavy duty vehicles and should not be applied to the downhill direction of one-way flows.

However, in this case, modelled traffic speeds have been supplied for each individual link (see below) and, therefore, the traffic speed does not require adjustment. Furthermore, it has been assumed that there is no significant change in gradient on any road link between the scenarios being compared. Therefore, road gradient has effectively been omitted from the BNL calculations.

[12] Calculation of Road Traffic Noise. Department of Transport and the Welsh Office. 1988
[13] Design Manual for Roads and Bridges (DMRB), Volume 11 'Environmental Assessment', Section 3 'Environmental Assessment Techniques', Part 7 'Noise & Vibration', HD 213/11, revision 1.

Road Surface Type

For this preliminary options appraisal a basic assumption has been made that the road surface on any particular link does not change between scenarios. However, as the road surface correction is also linked to traffic speeds (and traffic speed is an important variable in this assessment) a further assumption regarding the type of road surface is necessary.

It is considered that the majority of roads in the study area will have a hot rolled asphalt surface, so a bituminous, impervious surface is assumed throughout on all roads. The CRTN correction for such a surface is dependent on both speed and texture depth. Below a speed of 75 kph, the correction is constant, whilst above 75 kph, the correction is variable, depending on texture depth.

To avoid a 'step-change' in the correction where speeds fall either side of the 75 kph threshold, a texture depth of 1 mm has been assumed. On this basis the correction becomes -1 dB(A) for all road links in both scenarios and so road surface has also effectively been omitted from the BNL calculations.

Assumptions regarding road gradient and surface have been adopted to ensure that these factors are benign in the derivation of the BNL and that effects arising from changes in flow, proportion of heavy duty vehicles and speed are assessed.

Traffic Related Factors

Traffic Flow

Traffic flow forms the basis of the Basic Noise Level (BNL); the higher the flow the higher the source noise level. The relationship is logarithmic, so a doubling of flow is required to generate a 3 dB(A) uplift in noise. A 25% increase (and 20% decrease) in flow equates to a change of 1 dB(A).

The 18-hour annual average weekday traffic (AAWT) flows provided by WSP Property and Development have been used for this BNL analysis.

Because the $L_{A10,18h}$ is a statistical parameter there is a minimum flow required to generate a valid noise level and the CRTN prediction methodology requires that the 18-hour flow is 1000 or more. Therefore, it is reasonable to reject links where flows are below 1000 in one or more scenarios. It should also be borne in mind that lightly trafficked road links with flows of less than 1000 are unlikely to contribute significantly to the overall road traffic noise levels at individual receptors.

Where a relatively low flow is present (between 1000 and 4000 18-hour AAWT) a correction has been applied. This correction is dependent on both vehicle flow and distance from the road link. In this case, for consistency, a distance of 10 metres from the nearside kerb has been assumed.

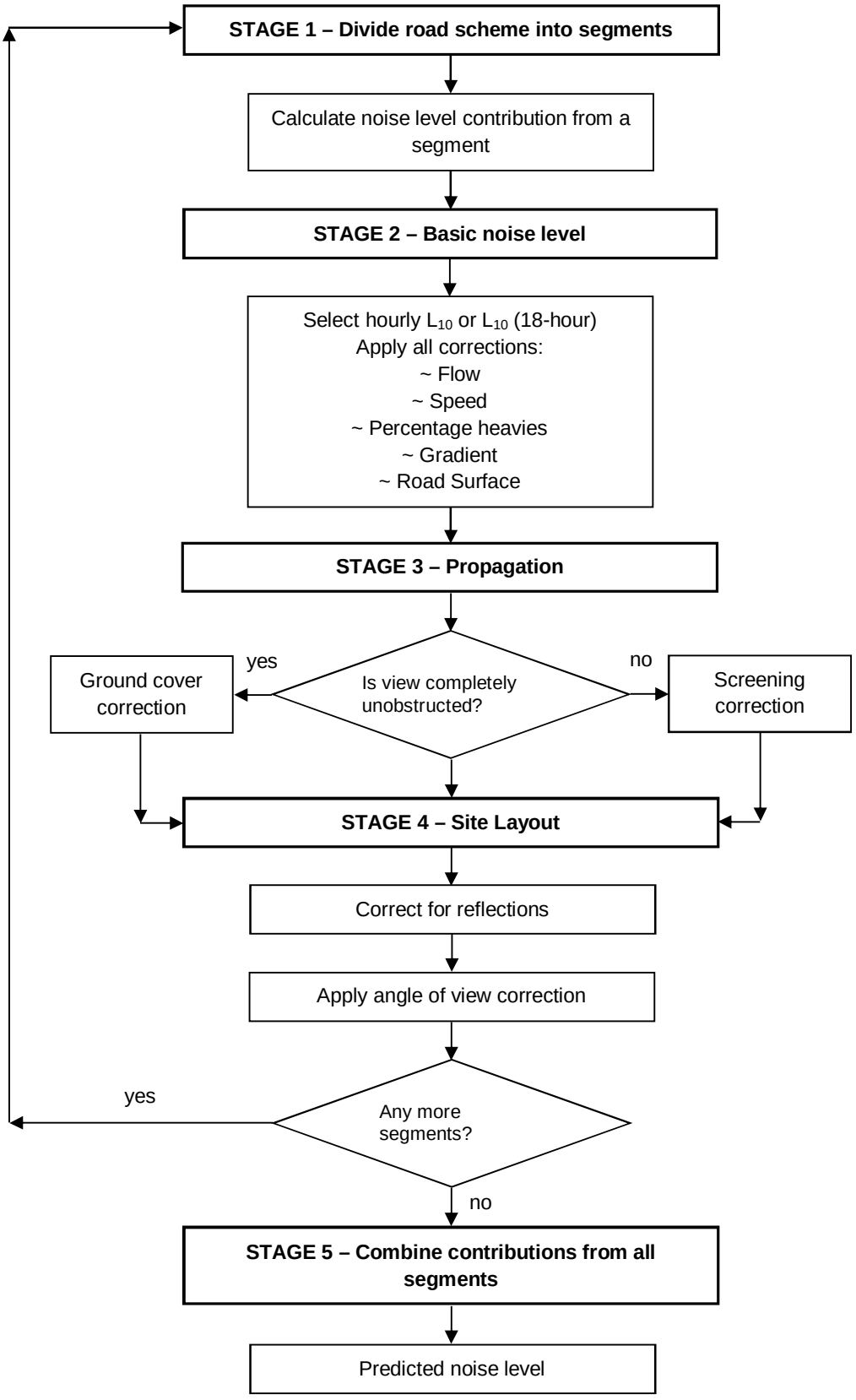
Proportion of Heavy Duty Vehicles and Mean Traffic Speed

Vehicle speed and the proportion of heavy duty vehicles combine to form a correction which is applied to the BNL. Above about 40 kph, the higher the speed and the higher the proportion of heavy duty vehicles, the greater will be the correction. This correction can be significant. For example, with 20% heavy duty vehicles, reducing vehicle speed from 96 kph to 80 kph (60 mph to 50 mph) would result in a 1.2 dB(A) reduction in road traffic noise, all else remaining equal.

WSP Property and Development has provided the proportion of heavy vehicles for each link, along with two speeds relating to peak hour and free-flow conditions. To obtain an estimate of the average speed for use in the calculations, an average time-weighted speed has been calculated, based on six peak hours and twelve free-flow hours within the 18-hour period.

FLOW CHART FOR PREDICTING NOISE FROM ROAD SCHEMES

[CRTN CHART 1]



Annex 3

Factors Influencing Levels of Road Traffic Noise

This annex gives further consideration to the extent to which changing certain variables can influence the received noise level. The tables below consider the following variables:

- vehicle flow;
- vehicle speed and the proportion of heavy vehicles;
- road gradient;
- distance and type of ground cover;
- distance and screening; and
- angle of view.

In each table below, the predicted change in noise level (dB) is given based on a defined reference point as identified in the main body of the table by 'Ref' and in the footnote to each table.

At this point it is important to bear in mind the guidance contained in HD 213/11 [14] regarding the change in noise that is worthy of consideration: "*the threshold criteria used for traffic noise assessment during the day is a permanent change in magnitude of 1 dB $L_{A10,18h}$ in the short term (i.e. on opening) or a 3 dB $L_{A10,18h}$ change in the long term (typically 15 years after project opening)*." These changes are the smallest that are considered perceptible in each situation.

Table A: Vehicle Flow

	18-hour vehicle flow				
	4,000	**8,000**	**12,000**	**16,000**	**20,000**
dB change	Ref	+3.0 dB	+4.8 dB	+6.0 dB	+7.0 dB
Note: The table presents the dB change based on a reference point of 4000 vehicles in the 18-hour period 06:00 to midnight.					

Table B: Vehicle Speed and the Proportion of Heavy Duty Vehicles

Vehicle speed (mph / kph)	**Proportion of heavy duty vehicles**				
	3%	**6%**	**9%**	**12%**	**15%**
30 / 48	Ref	+0.9 dB	+1.7 dB	+2.3 dB	+2.9 dB
40 / 64	+1.6 dB	+2.3 dB	+3.0 dB	+3.5 dB	+4.0 dB
50 / 80	+3.1 dB	+3.8 dB	+4.3 dB	+4.8 dB	+5.3 dB
60 / 96	+4.6 dB	+5.2 dB	+5.7 dB	+6.1 dB	+6.5 dB
70 / 112	+6.0 dB	+6.5 dB	+6.9 dB	+7.3 dB	+7.7 dB
Note: The table presents the dB change based on a reference point of 3% heavy vehicles and a vehicle speed of 30 mph.					

Table C: Road Gradient

	Road gradient				
	0%	**1%**	**2%**	**3%**	**4%**
dB change	Ref	+0.3 dB	+0.6 dB	+0.9 dB	+1.2 dB
Note: The table presents the dB change based on a reference point of 0% road gradient.					

[14] Design Manual for Roads and Bridges (DMRB), Volume 11 'Environmental Assessment', Section 3 'Environmental Assessment Techniques', Part 7 'Noise & Vibration', HD 213/11, revision 1.

Table D: Distance and Type of Ground Cover

Type of ground cover	Distance from the road kerb to receptor				
	10m	20m	40m	80m	160m
Reflective	Ref	-2.4 dB	-5.1 dB	-7.9 dB	-10.8 dB
Absorptive	-2.5 dB	-6.1 dB	-10.2 dB	-14.5 dB	-18.9 dB
Note: The table presents the dB change based on a receptor position 1.5m high and a reference point 10m from the nearside kerb with the intervening ground cover being reflective. To determine the additional benefit of absorptive ground cover, the figure for reflective ground cover should be subtracted from the figure for absorptive ground cover. For example at 160m, the additional benefit would be -8.1 dB.					

Table E: Distance and Screening

Type of ground cover and barrier height	Distance from the kerb				
	10m	20m	40m	80m	160m
Reflective	Ref	-2.4 dB	-5.1 dB	-7.9 dB	-10.8 dB
1.5m high	-7.2 dB	-10.2 dB	-13.2 dB	-16.2 dB	-19.2 dB
2.5m high	-11.7 dB	-13.6 dB	-16.2 dB	-19.0 dB	-21.9 dB
3.5m high	-14.9 dB	-16.2 dB	-18.6 dB	-21.2 dB	-24.1 dB
Note: The table presents the dB change based on a receptor position 1.5m high and a reference point 10m from the nearside kerb with the intervening ground cover being reflective. For all calculations the barrier to kerb distance is taken to be 5m. To determine the additional benefit of a barrier, the figure for reflective ground cover should be subtracted from the relevant 'with barrier' figure. For example at 160m, the additional benefit of a 1.5m high barrier would be -8.4 dB.					

Table F: Angle of View

	Angle of view (degrees)				
	180°	140°	100°	60°	20°
dB change	Ref	-1.1 dB	-2.6 dB	-4.8 dB	-9.5 dB
Note: The table presents the dB change based on a reference point of a 180 degree angle of view.					