1.0 Noise effects of development on land to west of A1(M) and south of Stevenage Road, Todds Green Heading 2

1.1 Introduction

1.2 We have been asked by Stevenage Borough Council to independently assess using noise prediction software, the effects of the new development and especially its roadside barrier upon existing dwellings to the east of the A1M where people have complained of increased noise.

1.3 As part of this process we examined the model as constructed by the developer's acoustician in Sound Plan which used the Calculation of Road Traffic Noise (CRTN) methodology to generate its findings. We also then independently constructed a model in CadnaA using the CRTN methodology. Finally we transferred the model we had constructed into dBMap.net and re-evaluated the change produced using ISO9613-2 noise prediction software instead of CRTN and a typical road traffic noise spectrum.

1.4 The reason for using dBMap.net is we can automatically generate a detailed report of the inputs and outcomes and also produce a noise contour map of the differences in noise levels including spectrum differences at receiver points.

1.5 At MAS Environmental (MAS) we have concerns with the model created by the developer but in any event the known limitations with the CRTN methods meant we did not expect it to show any significant change as a result of introducing the noise barrier adjacent the A1M. Thus we found greater change than the developer but not as large as I consider clearly arises in reality.

1.6 It is to be noted initially there was a fault in our own modelling but this was identified through post completion checks and remodelled as a result. This change identified differences were greater than first indicated in some frequencies.

1.7 It is important to recognise human response to noise change is not just a factor of decibel or sound energy change as an 'A' weighted level but also is a factor of the change in content and spectrum of the noise, even in the case of road traffic noise. In simple terms a lorry rumble could generate the same sound energy level in terms of the 'A' weighted decibel level as a high revving two stroke motorcycle but both are separately identifiable with different impact upon people due to the differences in spectrum and character.

1.8 Concerns with the Developer's modelling.

1.9 These are summarised in brief as follows and I have not gone into detail as I have not relied on this modelling:

a) Their barrier is constructed as a very pointed earth mound which it is not. It is a vertical fence and that reflects directly back and less upwards.

b) The Sound Plan model does not appear to include any reflection as CRTN switches them off other than from buildings on the other side of the road. In other words it does not include reflections off the barrier.

c) The source of the road seems to be at ground level and not 0.5m above in one model and then at the sides of the road in the other.

d) Their source is shown as a single 500Hz value which is what the Sound Plan version of CRTN seems to create. This is incorrect. CRTN simply applies adjustments to an 'A' weighted decibel level.

e) The ground absorbency is unclear. We have used hard ground to apply a worst case scenario as found with a dry summer or waterlogged ground situation.

f) The height above ground for the model is 1.5m so it does not consider noise at first floor level.

g) The modelling looks like it only considers reflections up to 50m from screens. Whilst CRTN understates reflections the single reflection it does consider should be up to 300m.

h) The difference modelling calculation in Sound Plan, where you can map the change of one scenario versus another and as used in this report when using dBMap.net, shows much less than 1dB increase in front of the barrier. However, it also shows zero change behind the barrier which cannot be correct raising questions over the method applied. I have not looked at this in detail as I prefer to use our own independent modelling. I could not see, on initial examination, why the change map is incorrect but as CRTN fails to properly reflect noise change I have not investigated this further. Simply put it cannot be correct.

1.10 There may be other issues and answers to some of the above points but it is easiest and less costly that we compare our own model of the location with and without the barrier in place.

2.0 Some key considerations of modelling versus reality.

2.1 This site presents a complex sound environment, not so much due to the continuous source of road traffic noise but because of the existing screening of the road by an earth mound on the eastern side. This has minimal consequence for the modelling of road traffic noise using CRTN on the western side of the A1M but potentially significant consequence for the noise on the eastern side, especially as the barrier is much higher than the earth mound and will reflect some sound energy over it.

2.2 In simple terms sound energy radiating from a road reduces as a result of distance, directional effects, screening features and meteorological effects. A road presents a series of moving point sources of noise. Mathematically the effect of a line of moving points of noise results in a reduction of approximately 3dBA per doubling of distance. It is called a line source of noise. In simple terms a direct unobstructed sound ray travelling 50 metres to a receiver from a line source will be at least 3dBA higher than the same sound ray reflected off a barrier on the other side of the road (assuming the barrier is a perfect reflector) but has to travel a further 50m (twice the difference) due to the extra distance to the barrier and back again. The resulting level in this assumption is an overall rise of 1.8dBA (Eg. 47dBA + 50dBA = 51.8dBA). Clearly the barrier is not a perfect reflector and also some of the sound is scattered upwards. The true increase is much less than in this scenario.

2.3 In this A1M case the houses to the east of the road are already screened from the direct source of the road noise and the impact is from noise diffracted over the top of the grass mound. This diffraction reduces higher frequency sound energy more than low frequency noise. This means we are not comparing a direct sound ray and a reflected sound ray in this case but diffracted noise with the reflected noise. The circumstances are also far more complex than this already complex situation as a significant proportion of the noise reflected off the barrier is also screened by the grass mound. However, some noise is diffracted less as it is in effect higher off the ground and some reaches the houses with little diffraction as it is refracted downwards by the wind effects when those winds have a westerly component. The consequences of these factors and changes is that more of the higher frequency noise reaches houses on the eastern side although mid and lower frequency noise continue to dominate.

2.4 Averaging and approximations.

2.5 It is important to recognise modelling is an approximate tool that cannot take into account all circumstances and typically provides an average result. It cannot take into account all modifiers. CRTN is a much older prediction model, published in 1988 and is limited in its ability to address reflection effects. ISO9613-2 is also dated from 1996 but is better at addressing reflections and has the added ability to consider spectrum content of a noise source and their change.

2.6 Sound from different parts of the spectrum are differentially reduced by barriers / screening features. A sound of 80Hz (low frequency) as generated by diesel engines has a wavelength of around 4.2m in length and is reduced less by a barrier say of 4m height than 800Hz sound which has a wavelength of around 42cm. At 4KHz the wavelength is around only 8.5cm and highly directional. It is readily screened as a result. Thus the existence of a grass mound already serves to change the character of the noise experienced at the eastern dwellings.

2.7 The spectrum change is something humans can notice more than the decibel level change. This can be a temporary phenomenon where, progressively, human reaction is to ignore the noise change as it does not present any threat (flight or fright syndrome effect). Progressively over many months the human brain should ignore it. I would add there is a theoretical risk of slight change also due to stable atmospheric refraction effects downwind when winds are westerly but as this has been unusually increased and more significant in 2022 than normal it is impossible to judge how typical years would compare.

2.8 Ultimately human response to change is mainly to a noise character change unless level change is larger. However, this not recognised as relevant in any guidance nationally or internationally on road traffic noise impact. The normal human response is to habituate to this change over time and ultimately ignore it. This can also be complicated where there is already a high noise dose. In those circumstances smaller changes can be more significant. Unusual 2022 meteorological effects also serve to highlight the issue in this case and future summertime periods may not be so noticeable.

2.9 As road traffic noise is treated as a benign "anonymous" source of noise, to try to argue use of absorption on a barrier to prevent it is unlikely a sustainable argument at any appeal and so could not reasonably be required. In summary there will be changes but these are not recognised by the guidance used for development in the UK. In this case the existing screening serves to accentuate the change.

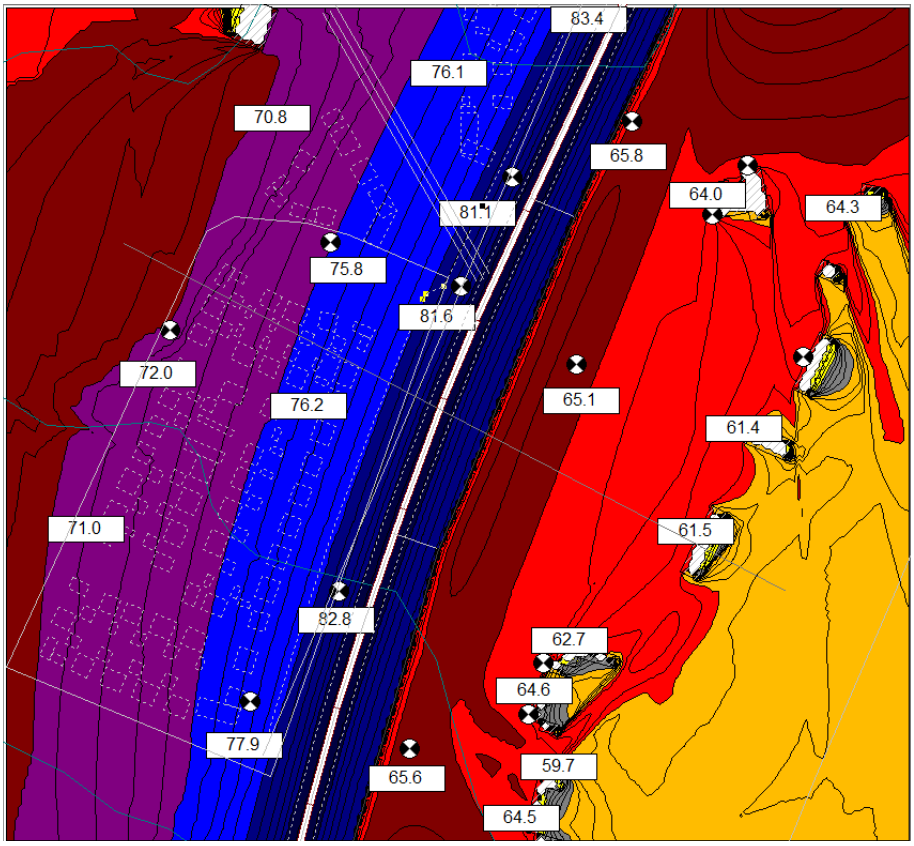
2.10 Modelling applied in this assessment of change.

2.11 Use of the Calculation of Road Traffic Noise 1988

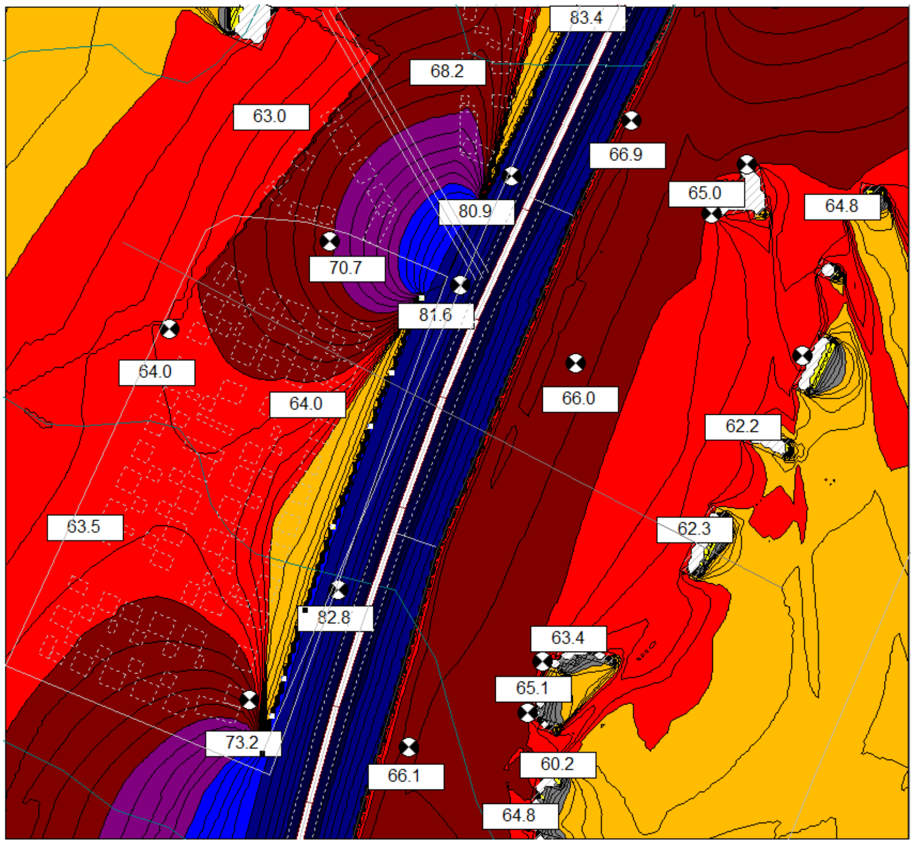
2.12 As identified, I have not relied upon the developer's modelling to evaluate noise change on the eastern side of the A1M.

2.13 I have also identified the UK method as set out in planning guidance is the use of CRTN. A model has been independently constructed by MAS using the CadnaA software platform, applying CRTN and formulated using national data for traffic flow for this stretch of road. To simplify assessment I have excluded the new houses which are insignificant in terms of their reflections. These can be included if challenged but they add little to the comparison compared to the addition of the barrier.

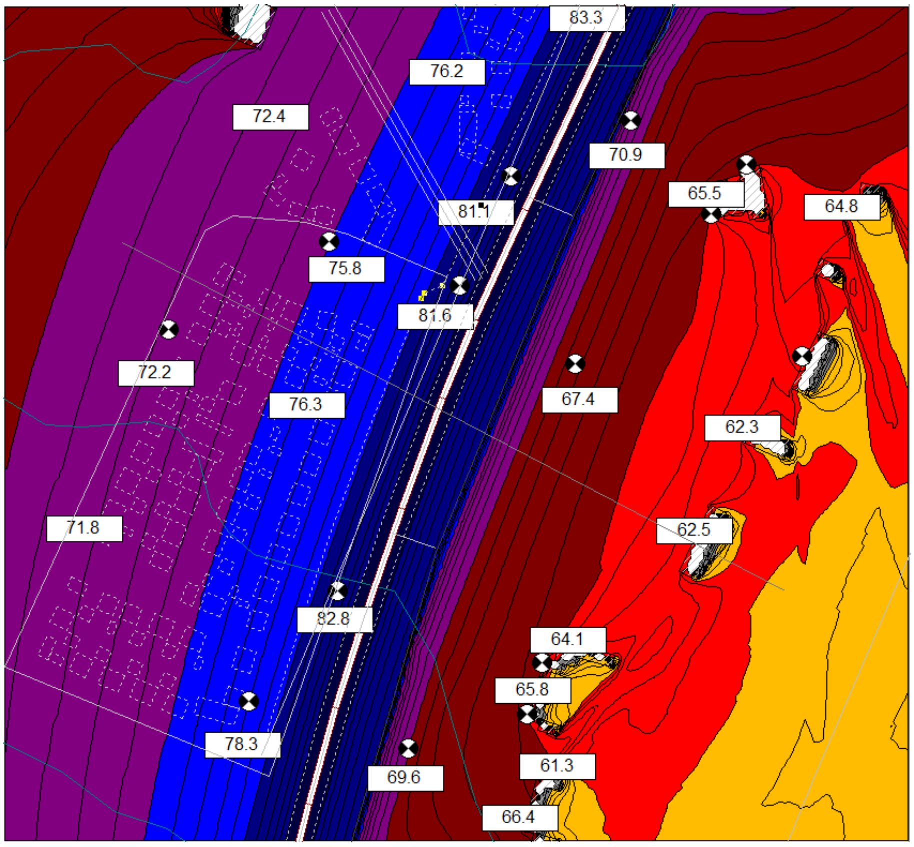
2.14 The first part of this assessment is therefore to compare the A1M road traffic noise impacting buildings to the east of the road without and with the new western barrier in place using CRTN. This is performed at ground (1.5m) and first floor (4.5m) levels as below.



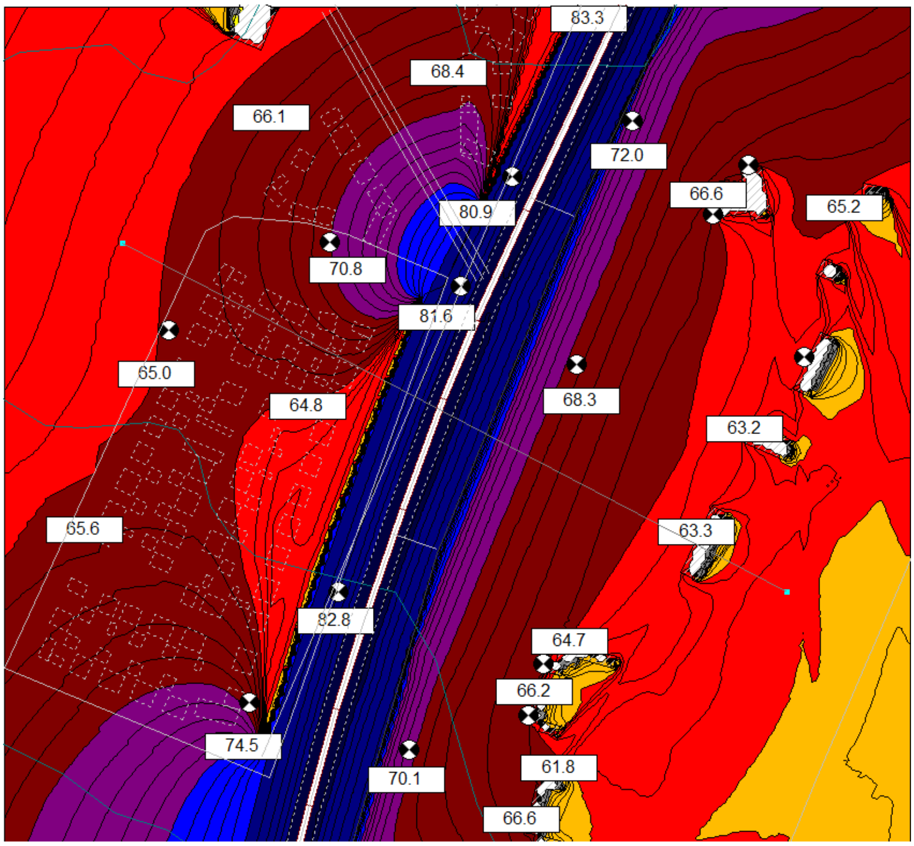
Noise Map 1 - CadnaA Ground Floor Historical CRTN method – No barrier or development.



Noise Map 2 - CadnaA Ground Floor – CRTN method with barrier - Ground Floor range of differences using CRTN = 0.3-1.1dBA.



Noise Map 3 - CadnaA First Floor – CRTN method without Barrier



Noise Map 4 - CadnaA First Floor – CRTN method with barrier - First Floor range of differences using CRTN = 0.2-1.1dBA

2.15 The figures in the rectangular boxes are receiver noise levels at some of the nearest buildings. The only change between one noise map and the second is the presence or absence of the new barrier.

2.16 It can be seen using the CRTN procedures as mandated by UK Government as the method of predicting and assessing road traffic noise impact, the introduction of the barrier results in a difference between 0.2-1.1dBA at buildings on the eastern side of the A1M. This change would be considered generally as not identifiable by people with normal reasonable hearing when ignoring spectrum change.

2.17 This change is a greater change than identified by the developer's acoustician but this arises due to a range of concerns over the inputs into their model which are considered to place their results further from reality than the MAS model here. It is also possible there are some limitations within Sound Plan that does not appear to follow CRTN precisely. Notwithstanding the differences both methods do not indicate a significant change and the use of this model to predict the benefits of the barrier at the new development are not overly of concern.

2.18 Part of the problem is the fact the prediction method is directed at impact at new development and not at existing development the latter of which may experience greater reflected noise. This problem is not properly addressed in guidance and is not commonly considered. This issue is potentially a greater problem where there is already screening of existing housing that may be undermined by the reflections and also where there is already a high noise dose (high level of exposure to noise) as found in this case. In those cases much smaller increases in noise level are potentially more noticeable.

2.19 Thus in the circumstances of this case, two unexpected problems arise; the levels of noise are already high to the east of the A1M meaning small increases can be of concern and the spectrum of the noise is changed meaning the change is more noticeable due to noise character change. The CRTN method is incapable of adequately assessing either of these factors but is the method set out in UK guidance.

2.20 In summary the CRTN method notably understates reflected noise change and ignores the change in the character or spectrum of the noise that can sometimes arise. This latter element is a critical aspect in cases such as this. To better evaluate this it is necessary to use a method that can consider spectrum content of noise. The most used programme and applied internationally is ISO9613-2. This has been applied by me in my assessment using dBMap.net in this case. This software is used as it can provide comparative mapping of different options at multiple heights simultaneously.

2.21 Use of ISO9613-2 and spectrum data.

2.22 It is sometimes common to use this standard to calculate road traffic noise impact as it can incorporate line sources of noise and spectrum data. It is not the recognised method in the UK for road traffic noise and its use therefore presents a risk of rejection. The benefit of using this standard is we can see spectrum change and better reflect the true change in levels as experienced by people as levels of reflection from surfaces can be adjusted.

2.23 Direct comparison cannot strictly be made between CRTN and ISO9613-2 as the latter requires detailed input of coefficients of reflections. In this case I have put in a value of p=0.8 which is closer to reality in terms of the level of reflection off barriers that is experienced. It is in effect a loss of 1dBA. Thus whilst the change can be less than produced using CRTN it may be more realistic as it better takes into account the degree of reflection off barriers and structures.

2.24 ISO9613-2 also has other limitations but not as extensive as the CRTN method. Examples include its assumption about ground effects on noise are removed where there is a barrier in place and also limiting its reductions to only two obstructions of any sound ray. Notwithstanding the limitations with this standard it provides a far more accurate assessment of change in this case. More recent guidance on modelling of noise permits consideration of other ground effects excluded in ISO9613-2.

2.25 Whilst I could have used CadnaA to model the results using ISO9613-2 it does not provide a map of differences and therefore I have imported the model into dBMap.net where scenario comparisons can be shown at a spectrum level for multiple heights and a detailed report of all inputs etc. provided where required. I have not attached this report at this stage.

2.26 The spectrum I have provided below for the road traffic source is taken from research papers into road traffic noise in combination with and reasonably closely following that presented historically in BS8233:1999.

2.27 Sound Power Level spectrum of road traffic noise used for modelling.

Octave Band	63	125	250	500	1KHz	2KHz	4KHz	8kHz	Total
dB Lin	102	100	98	94	94	91	87	86	105.9
dBA	75.8	83.9	89.4	90.8	94	92.2	88	84.9	98.7

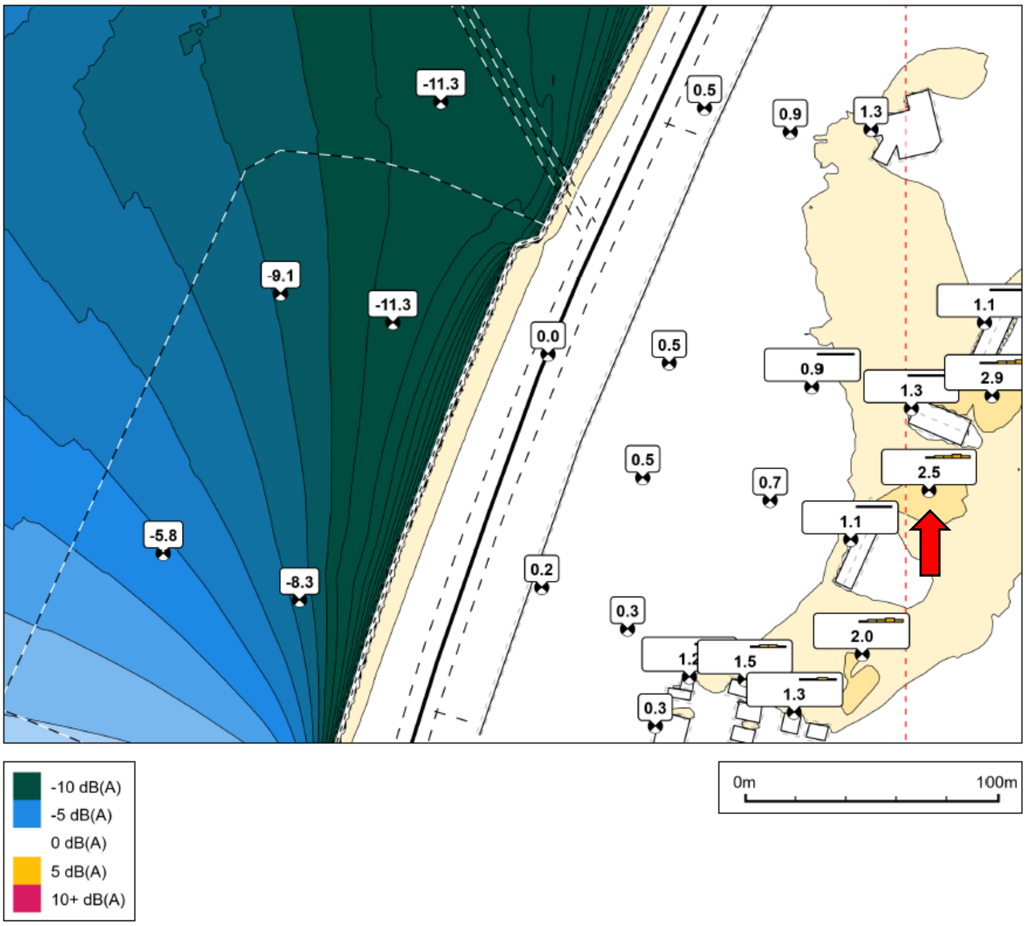
Table 1 – Spectrum data input into road traffic noise model following BS8233:1999 and research into measured levels.

2.28 It is important to recognise the actual levels are less important than the change that arises as the ratio will remain the same regardless of the source level identified.

2.29 Noise Map 5 below shows the change in levels with and without the new 8/4/8 metre high barrier in place. ISO9613-2 reflects a downwind scenario but does so on the basis all locations are downwind which is not realistic. However, despite this issue it does reasonably predict levels in any direction.

2.30 It can be seen from the table above that the highest ‘A’ weighted sound energy is at 1KHz and not 500Hz as used in the Sound Plan model. This is mainly tyre interaction noise. A more realistic reflection level for the barrier has been input as in reality a lot of sound is scattered and absorbed. Even a perfect glass reflector would lose some sound energy due to upward scatter. A reflection coefficient of p=0.8 has been used which equates to a loss of 1dBA on average.

Noise Map - Noise map height 1.5m (A-weighted) - Change between scenarios



Noise Map 5 – Shows 1.5m changes in decibel levels caused by introducing the development 8/4/8m barrier. There are significant reductions to the west of the barrier and slight increases to the east but which approach a 3dBA between some buildings further from the road. Contours are 1 decibel apart

2.31 Noise map 5 shows the difference at ground level (1.5m agl) but at receiver points (values in rectangular boxes) a more detailed set of differences are provided. These include the level at 4.5m (first floor level) and the difference in spectrum levels. These are reproduced in the table below.

2.32 It can be seen from Noise Map 5 that the ‘A’ weighted level now ranges 0.3-1.5dBA at ground floor level of those locations closest the road. At first floor level this ranges 0.4-1.7dBA. The true values will depend on the reflectivity of the barrier and the buildings but in any event it can be seen there is a greater change using this method than the UK Government method.

2.33 What is noted is that between some buildings further from the road, even with low coefficients of reflection, there is a greater change approaching 3dBA (see red arrow). This is a noticeable change regardless of the spectrum change and it reflects a perceptible change in a general sense. The true extent of this is almost impossible to predict due to the limitations of modelling and the precise differences in the buildings and their reflectivity. It is therefore indicative only. For example all buildings are assumed as 8m high and not with walls to around 6m and with a sloping roof on top of that. Adjustment for sloping roofs could be created but this is a further uncertainty. In any event the greater change which will be noticed is in terms of the character and spectrum of the noise. This is assessed further below.

2.34 Spectrum change which is greater.

2.35 The spectrum values provided in the table below for the main locations in noise map 5 at and around dwellings to the east of the A1M shows a greater change than reflected in the 'A' weighted change.

2.36 The 'A' weighted change is seen in column 3 with the height of assessment in column 2 and the spectrum in columns 4-11. There is no data for the lowest frequency band as is common for road traffic noise. This band would also be unaffected as indicated by the progressive change towards the highest 8KHz band where the change is greatest.

2.37 Change of significance is mainly observed from around 1KHz upwards. In simple terms the sound environment has shifted towards a higher frequency sound weighted environment. Whilst most road traffic noise after this shift remains low and mid frequency dominated, this change in the higher frequency bands is sufficient to reflect a change in the character of the noise that is a noticeable change. In practice most would perceive this as a slight change in character only when living with the noise long term.

2.38 Simply put the noise has increased slightly in some locations of the order of 1-2dBA and in a couple of hot spots potentially nearer 3dBA but this change is accompanied by a larger shift in the frequency content and therefore a change in the character of the noise where this renders the change more noticeable.

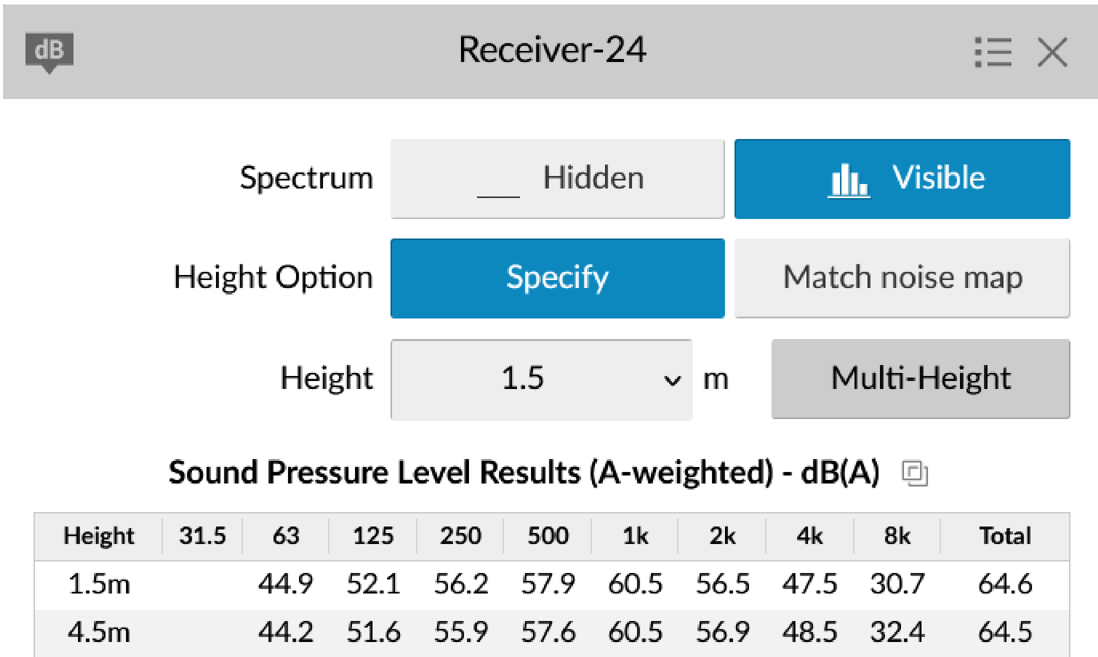
2.39 It is important to recognise whilst the table below shows a worst case increase for Receiver 7 in the 8KHz band of 4.7dB at first floor level and an average increase of 1.7dBA at this location, 8KHz sound is reduced far more when going inside and this change would be significantly less inside any bedroom. In any event it would remain a minority contribution. At ground floor level there is a change of 1.5dBA at Receiver 7 and 3.1-3.6dB in the 2-4KHz band. This may be slightly more noticeable as a change in noise character when outside. As above the change internally is not expected and lower frequencies continue to dominate.

Receiver Results - Summary - Change between scenarios

Receiver Name	Height (m)	Total dB(A)	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Receiver	1.5	1.3		0.0	0.0	0.1	1.0	1.9	2.2	2.4	2.6
Receiver	4.5	1.4		0.0	0.0	0.1	1.0	2.0	2.5	3.1	3.9
Receiver-2	1.5	1.1		0.0	0.0	0.0	0.9	1.6	2.0	2.0	1.6
Receiver-2	4.5	1.2		0.0	0.0	0.0	0.9	1.6	2.3	2.7	2.8
Receiver-3	1.5	1.1		0.0	0.0	0.5	1.0	1.5	1.6	1.7	2.0
Receiver-3	4.5	1.3		0.0	0.0	0.4	1.1	1.7	2.0	2.4	3.2
Receiver-4	1.5	1.3		0.0	0.0	0.9	1.2	1.6	2.0	2.4	2.1
Receiver-4	4.5	1.6		0.0	0.0	0.8	1.2	1.8	2.6	3.4	4.0
Receiver-5	1.5	1.2		0.0	0.0	0.0	0.5	1.9	2.7	3.4	2.5
Receiver-5	4.5	1.5		0.0	0.0	0.0	0.5	2.1	3.2	4.5	4.4
Receiver-6	1.5	0.3		0.0	0.0	0.0	0.0	0.4	0.5	0.7	0.4
Receiver-6	4.5	0.4		0.0	0.0	0.0	0.0	0.6	0.8	1.0	0.6
Receiver-7	1.5	1.5		0.0	0.0	0.0	1.0	2.2	3.1	3.6	2.8
Receiver-7	4.5	1.7		0.0	0.0	0.0	1.0	2.3	3.5	4.6	4.7
Receiver-8	1.5	1.3		0.0	0.0	0.0	0.7	1.8	2.9	3.5	2.8
Receiver-8	4.5	1.4		0.0	0.0	0.0	0.8	1.9	3.1	4.0	4.1
Receiver-9	1.5	0.3		0.0	0.0	0.0	0.2	0.5	0.6	0.5	0.3
Receiver-10	1.5	0.2		0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.4
Receiver-11	1.5	0.9		0.0	0.0	0.6	0.8	1.0	1.4	1.7	1.3
Receiver-12	1.5	0.5		0.0	0.0	0.3	0.5	0.6	0.6	0.7	0.4
Receiver-13	1.5	0.9		0.0	0.0	0.0	0.7	1.4	1.7	1.9	2.1
Receiver-13	4.5	1.2		0.0	0.0	0.0	0.7	1.6	2.1	2.7	3.6
Receiver-14	1.5	0.5		0.0	0.0	0.2	0.4	0.6	0.9	1.2	0.9
Receiver-15	1.5	0.5		0.0	0.0	0.0	0.6	0.6	0.8	1.1	0.9
Receiver-16	1.5	0.7		0.0	0.0	0.0	0.6	1.0	1.3	1.5	1.5
Receiver-17	1.5	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Receiver-18	1.5	-11.3		-6.7	-7.7	-9.0	-10.4	-12.1	-14.0	-16.5	-19.4
Receiver-19	1.5	-9.1		-5.7	-6.4	-7.4	-8.5	-9.7	-10.8	-13.4	-18.4
Receiver-20	1.5	-8.3		-5.2	-5.8	-6.6	-7.6	-8.7	-10.0	-12.0	-16.8
Receiver-21	1.5	-5.8		-3.9	-4.3	-4.8	-5.4	-6.0	-6.6	-7.7	-10.6
Receiver-22	1.5	-11.3		-6.6	-7.6	-8.9	-10.5	-12.4	-13.5	-16.6	-19.8
Receiver-23	1.5	2.9		0.0	0.0	1.0	2.9	4.2	5.0	5.3	4.1
Receiver-24	1.5	2.5		0.0	0.0	0.0	2.1	4.0	4.9	5.3	4.0
Receiver-25	1.5	2.0		0.0	0.0	0.0	1.9	3.0	4.6	5.3	3.9
Receiver-25	4.5	2.0		0.0	0.0	0.0	1.6	2.7	4.5	5.9	5.5

Table above - Receiver location change in spectrum and dBA level

2.40 The extract below (Figure 1) from the modelling shows the resulting levels at the worst case location rather than the change in levels for 1.5 and 4.5m heights. It can be seen the 4KHz and 8KHz sound energy bands contribute much less sound energy and the 2KHz band is also behind the 500Hz band.



Height	31.5	63	125	250	500	1k	2k	4k	8k	Total
1.5m		44.9	52.1	56.2	57.9	60.5	56.5	47.5	30.7	64.6
4.5m		44.2	51.6	55.9	57.6	60.5	56.9	48.5	32.4	64.5

Figure 1 – Levels at Receiver location24 show most noise in the 1KHz band followed by the 500Hz band then 2KHz band and 250Hz band then 125Hz band before 4KHz. The lowest band is 8KHz at 30dB below the 1KHz band and so effectively masked.

2.41 Thus increases in sound in higher frequencies will introduce slight change but unless within about 10-15dBA of the highest values making up the noise it will not be readily perceptible. In the example above, in Figure 1 (compare the table and chart below for Receiver 24) the change at 4KHz and 8KHz will not be noticeable despite their size but the 4dB change at 1KHz will be observed as it is the dominant 'A' weighted value. The 2KHz value change might just be identified and change character noticeable but they happen simultaneously.

2.42 Receiver locations 23-25 are between buildings in the open and reflect a slightly greater change with a ground floor level change of 2.9dBA. This would be noticeable without any change in the spectrum or character of the noise. However there is also a spectrum shift with a significant change in the region of 1KHz-8KHz. As before the 4-8KHz contribution is well below other bands. The combined spectrum shift and overall 'A' weighted decibel level rise would be distinct and recognisable where it is within 10-15dBA of the total noise. The main factor is the spectrum change of octave bands that are the main contributor to overall levels such as 1KHz meaning the road traffic noise would sound as if less screened by the existing mound or as if the existing mound no longer existed.

Receiver Charts - Change between scenarios

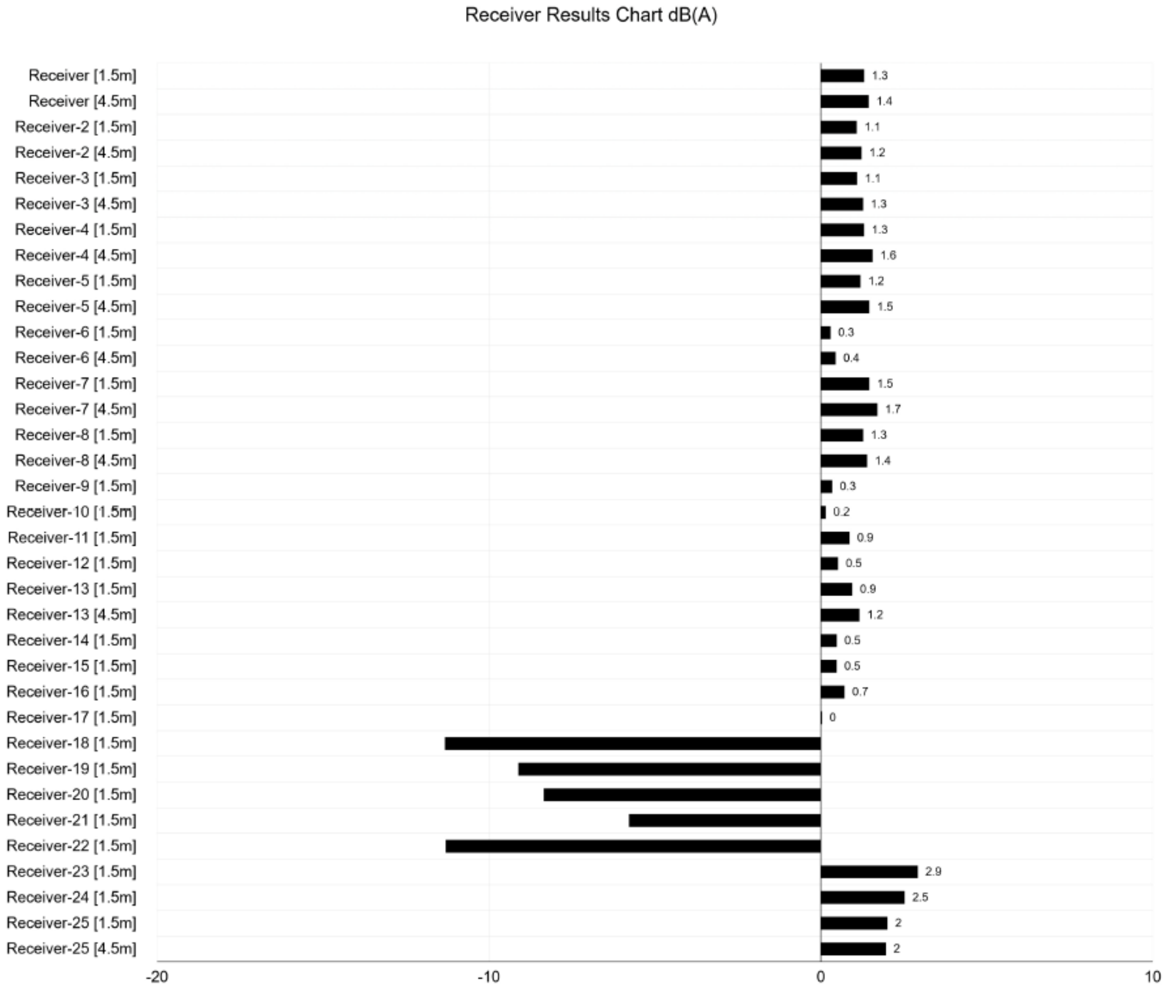


Chart 1 – Shows change in levels at receptor locations due to barrier introduction.

2.43 The mid frequency noise continues to dominate the resulting road traffic noise at the dwellings to the east of the A1M even with the extra higher frequency noise but the 1KHz band dominates much of the sound and this band is increased as well as the higher frequencies. The latter is less noticeable as they are well below overall levels and so masked better.

3.0 Summary findings and conclusions.

3.1 In this study we have analysed the noise predictions and modelling undertaken by the developer of the new housing; independently modelled and predicted the road traffic noise using the UK Government's preferred methods, as used by the developer but with some differences and separately modelled using ISO9613-2. The latter can better represent the changes due to reflections of sound and also include assessment of spectrum / character change caused in the resulting noise.

3.2 The UK method of assessing noise mitigation from road traffic noise, which is directed as to be used, CRTN inadequately addresses the effect of reflected noise and changes in noise character.

3.3 The use of CRTN by the developer was correct but inadequately considers the change at existing development, in part due to limitations due to the age of the prediction methods but also the unusual circumstances applicable in this case. Few would recognise the potential issues and it is only as I have direct experience of this issue at one other site that I was aware of the potential risk.

3.4 Using ISO9613-2 which can take the spectrum of the sound into account and also better assesses the effect of sound being reflected than CRTN, shows there is a noticeable increase in locations for two reasons; the overall levels in an already noisy sound environment which rise by a just perceptible amount can be identified and critically the increase is in the higher frequencies (1KHz upwards) which results in a clearly noticeable change in character of the noise. The exception is where these rises are well masked by higher noise levels.

3.5 The change in the character of the noise in sound energy terms is not high and the main change is not in the dominant part of the spectrum observed but the human perception of change with more higher frequency content. This is only relevant when within 10-15dBA of the overall level and when this is the case it will result in a noticeable alteration in the way the traffic noise sounds, especially for people with long term adjustment to the sound environment. It would be less noticeable to others.

3.6 The frequency band of greatest noticeable change, albeit still small in most locations is 1KHz followed by the 2KHz octave band. Larger changes at 4-8KHz are not noticeable as they are significantly below other sound energy bands that contribute.

3.7 Over time there should be adjustment to the change in sound character where humans progressively ignore the change as it does not present any threat warranting fight or flight innate responses.

3.8 Potentially the slight increase in 'A' weighted levels does equate to a slight change in noise burden, especially where the existing noise climate represents a high noise dose but it should not equate to any significant noticeable change or increased adverse impact internally and should not affect sleep as the higher frequencies are better attenuated when moving inside and this is the main part of the spectrum that is increased. The common problem with road traffic noise is the mid and lower frequencies.

3.9 Accurate determination of the change at any one dwelling is not possible as this is beyond the capability of modelling and the values provided in this report are indicative average ranges of change only. No individual should look at a particular location and equate this as the change whether average or otherwise as reflective effects are highly variable.

3.10 It is safe to conclude there is some increase at some locations that will be perceptible as it is primarily focussed in the 1KHz octave band range. This is accompanied with slight changes in the character of the noise. Both aspects of this phenomenon of change should diminish over time as the brain of those adjusted to this noise will normally and progressively ignore the perceived change as it offers no threat.

3.11 The CRTN method used for assessing the new development in this case accords with UK Government guidance as the appropriate method to apply but unfortunately there is a lacuna in guidance when considering the change at existing dwellings as the guidance underrates the potential changes. In this case there is a combination of factors leading potentially to a more noticeable change, at least in the short term than usually seen. This still remains relatively small and should not adversely affect dwellings internally. Human habituation should mean that over a period of months the change will be less consciously identified.

3.12 There is disagreement with the developer's results showing only a fraction of a decibel change and their model is considered incorrect in some respects.

However, even using CRTN as written and inputting data for the A1M, the worst case difference I obtained was 1.1dBA and this would not flag up any concern except when already very noisy. It is fair to conclude there could be some debate on the differences found in this case as CRTN is not clear on the inclusion of reflections off barriers. It appears to indicate they are not considered if reflected away from the proposed development.

3.13 The problem with CRTN is that it is looking at the housing you are protecting and not incidental effects upon others. CRTN is inadequate, being published in 1988 and excluding various issues now recognised as important such as orders of reflection. However, it remains the UK Government's preferred method.

3.14 In summary the situation is one where a small change / increase arises and effectively disregarded by the method UK Government dictate we use. The actual change is more than indicated by the developer's acoustician and there is a noticeable change in character at some locations as we humans are far more sensitive to character change than change in sound energy level. There are also likely some hot spots in open areas between buildings where increases are greater and should be expected to be perceived. This change is seen as an increase at mid and higher frequencies (1KHz-8KHz) leading to a slightly more course (raspier) sounding noise. In the view of Government guidance it is wholly insignificant and would be ignored.

3.15 Care is needed the change is not overstated as significant increases at 4-8KHz that are well below (20-30dB lower) the dominant 500-1KHz range would unlikely be identified. Change at 1KHz and 2KHz bands could result in perceptible audible change depending how great their contribution is with the consequence of a change in character plus a slight rise in overall level at some locations.

3.16 From a human perception point, there is a change but this is expected to become unconsciously and increasingly ignored over a period of months as the human brain will recognise this change introduces no new threat requiring "flight or fight" and will unconsciously adapt. The only exception to this adaptation is where an individual considers their environment has been harmed and they may link the noise character change with that negative response and so might sensitise to it by focussing on it as an issue of harm. This is unlikely over a time period of a year or more but possible.

3.17 The increase in the higher frequencies should lead to little change within screened gardens such as those screened by the building from the road or when transferring from outside to inside as they are better reduced by building facades. It should not get perceptibly worse inside.

3.18 Whilst recognisable mathematically and perception wise it will be recognised, the change in the sound environment is small.

3.19 Any judgement of existing noise dose change where already saturated by noise is not practically possible to judge not least as the range of variables and modelling can only indicate theoretical change.

3.20 It is perceived any increase is undesired but not practically avoided without an absorbent lined barrier at the new development. However even this may reduce but not eliminate the already perceived small change and may not prevent the perception of change. In perspective such changes are smaller than changes in tyre design changes and road surface design changes. The main change expected is habituation to the change in character of the noise over time. The small change would not provide a basis for refusing consent and protection of existing housing could not have been a basis of scheme approval unless specifically stated in the condition.

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