Comments for Oxford City Council on the "Comments on Atkins Technical Note' (of 11 March 2015) submitted by Arup to Oxford City Council,

To: Fiona Bartholomew

From: Paul Buckley

27 March, 2015

Thank you for making public the Arup Comments on the final version (issue 4) of the Atkins Technical Note of 18 February[1]. It is very helpful, and in many ways reassuring, for us residents to see the independent expert advice that Arup are providing to the Council. We are especially grateful to see it, as we know this advice has been obtained at the Council's expense. I have consulted some of the track-side residents who have particular worries about the vibration levels from EWR, and we thought it would be helpful to you and your colleagues to know our reaction to the Arup Comments, indicating where we can follow the argument and where we are puzzled by their conclusions.

The comments and calculations are my own, but I know the views expressed are shared with a number of other track-side residents of the Oxford District portion of the EWR scheme – this is what is meant by 'we' and 'us' in the following. If at some stage Arup could reply to these comments, it would be a very constructive step in helping residents understand any decisions that are taken at OCC in relation to Condition 19, on the basis of advice from Arup.

The Arup Comments provide a helpful resumé of the history of the debate we have been having over the past year, all stemming from failings of the Atkins VSoA. The rest of the Arup Comments are then structured in five sections dealing with different aspects of the problem, and a sixth giving Arup's conclusions. For ease of reference, these comments follow the same pattern.

1. Discrepancy between EIA and VSoA in terms of vibration from the railway before the scheme was implemented

We agree with the Arup Comments that the Technical Note does not provide any evidence to support relying on vibration measurements for the current situation, given in the EIA. Atkins have failed to explain large discrepancies between the measurements in the EIA and predictions in the VSoA. We know from residents in whose homes the measurements were made that the positioning of the measurements was not appropriate for sensing feelable vibrations, and there was no attempt to quantitatively match measurements to the passage of particular trains. It is extremely disappointing for residents that these measurements are not suitable be used as a validation of the Atkins vibration prediction methodology. In our view it is

[1] In these comments this is the version intended when the 'Technical Note' is referred to.

unacceptable, for a project on this scale, that no serious attempt at all was made to validate the prediction methodology. Residents whose homes may be very badly affected by EWR vibrations are left having to rely entirely on the railway companies' claims that their prediction methods are sound, when the evidence of the past year is that they are not always reliable.

2. Justification of amplification factor for external to internal vibration

The earlier Arup Report made a convincing case that a multiplier of 4 should have been applied in the VSoA to open ground VDV predictions, in predicting vibration levels in track-side homes.

The VSoA assumed no amplification factor was necessary. But the Technical Note concedes that data in the ANC Guidelines[2], considered by Atkins to *'represent best practice in the field of vibration measurement'* suggest that a multiplier *is* needed if a *'reasonable worst case'* prediction is to be made. The Technical Note (Alternative 1) suggested factors of 1, 5.01 and 3.16 for Quadrangle, 2B Bladon Close and 3 Bladon Close, on the basis of data given in the ANC Guidelines. The high value of 5 is explained by their statement *'vibration amplification is most pronounced in residential wood-frame houses'* which is believed by Atkins to apply to 2B Bladon Close.

The Technical Note also considers an alternative approach (Alternative 2) using 'frequency-dependent' amplification factors taken from a book TNRB[3], and suggests values 1.6, 3.0 and 3.0 for the same three buildings respectively (and also 3.0 for 4 Bladon Close). The reason for using a factor of only 3.0 for 2B Bladon Close, in spite of its greater susceptibility being wood-framed, is not explained: presumably it is because there happens not to be any frequency-dependent data for wood-framed houses given in the TNRB.

We are puzzled by the view expressed in the Arup Comments' that 'Alternative 2', i.e. the second of the two approaches used by Atkins in the Technical Note, *'provides the best available estimate of the amplification factor for each building'*. There are two reasons we are puzzled. Firstly, it does not allow for the extra susceptibility of 2B Bladon Close. Secondly it seems to represent a mis-use of the data in the TNRB, in allowing neither for scatter in the responses of buildings of the same style of construction, nor for the known greater susceptibility of UK houses compared to the US buildings which form the data sets referred to in the TNRB – see Appendix 1 for further explanation of these misgivings. Available evidence suggests that use of the TNRB data in this way is incautious. It could easily lead to under-prediction of vibration amplification by at least 5dB (i.e. a factor of 1.8) – see Appendix 1.

A further complication is that the structure of Quadrangle House is unusual. It seems inaccurate to categorise its structure as the same as that of a USA 'typical 2-4 storey

[2] 'ANC Guidelines: Measurement & Assessment of Groundborne Noise and Vibration' 2nd Ed, Association of Noise Consultants, 2012.
[3] Chapter 16 of 'Transportation Noise Reference Book' Ed. P.Nelson, Butterworth, 1987.

masonry' building, as was done by Atkins in the Technical Note. As Arup will have seen if they visited it to verify what Atkins say about this building (and in any case it was designed by Arup, so maybe they were able to check this from their own records), it features exceptionally wide unsupported floor spans, that would lower the frequency of vibration considerably and make it unusually susceptible to vertical feelable vibrations. So we do not understand the Arup Comments' acceptance of the Technical Note's assignment of what seems in the circumstances to be an arbitrary amplification factor of 1.6 for this building.

Finally, we do not understand why the Arup Comments follow the VSoA and Technical Note in not considering it necessary to include the effect of the S&C on 3 Bladon Close. As is clearly visible in the lower drawing on p.13 of the Technical Note, 3 Bladon Close is only some 25.5m from the nearest crossing, and 38.3m from the furthest crossing, while the data on p.19 of the S&C VSoA show that at these distances significant amplification is expected from the crossings. The neglect of such amplification causes the 'open ground' VDV for this building to be seriously under-predicted in the VSoA.

It is true that the Technical Note claims that, for these three buildings and using the Alternative 2 amplification factors, predicted VDVs are below the Condition 19 thresholds. But in view of all the doubts about the data used in the Technical Note's predictions (some of which I refer to above, others have been expressed previously[4]), we do not understand why the Arup Comments conclude without qualification, in relation to these three buildings, that *'the vibration criteria in Condition 19 are achieved'*.

3. Inter train variability

One of the many problems of the VSoA is that one of its claims - that the vibration measurements collected and used to define baseline vibration values are adequate for assessing compliance with Condition 19 – is unconvincing. To be convincing, the measurements would need to be sure to capture, for each type of train (passenger, normal freight, and stone freight), the full spread of vibration levels to be encountered on the worst day in future on the Oxford-Bicester line after implementation of EWR Scheme 2B. In fact, they did not even sample the full spread of vibration levels encountered on a typical day on the current DCL line: the trains measured were a small sub-set of the trains running on three days[4]. Moreover, although given the opportunity (e.g. in responding to questions at the Wolvercote 'Technical Meeting' of 10 June 2014) Atkins have so far declined to justify why their particular selection of trains can be relied upon as being unbiased. Therefore residents were not at all surprised to learn from the Arup Report that the spread of vibration levels measured from freight trains was less than what is normal in Arup's experience. This injects a fundamental doubt about the robustness of the Atkins predictions.

We acknowledge that the VSoA does build into its choice of the baseline vibration values an element of compensation for the relatively small sampling size of their data set (given the wide scatter in measurements). It selects as baseline cases trains that

[4] See C.P.Buckley and K.G.Dancey 'Failures of the Atkins Report', June 2014.

gave vibrations levels near the upper limit of those sampled. I assume that the VSoA's measurements were obtained in good faith and do not contain deliberate bias, and therefore it is reasonable to further assume that they represent a random selection from the whole population of trains currently running on the DCL line. In this case, the values chosen can be shown to just give reasonable compensation for uncertainty in the average vibration level for each type of train running on the DCL line, *and* for the higher-than-average value needed to accommodate correctly the 4^{th} power averaging in the calculation of VDVs. The same applies to the approach used in the VSoA in determining amplification factors for the S&C. But it is important to recognise that the VSoA's use of above-average values for vibration baselines and for S&C amplification does *not* introduce sufficient caution to compensate for other sources of uncertainty in the data as well.

A particular uncertainty concerning the train-mix is: what is the likelihood of a higher proportion of freight trains in the future being of the vibration-intensive type: 'stone trains'? The Technical Note states *'there is no indication that there would be intensification in use of the stone train'*. But this is unconvincing, because the Technical Note does not explain why Atkins would necessarily be aware of any plans currently being developed by commercial freight operators to run more stone trains. Hence we are puzzled why the Arup Comments say that this clarification provides a *'reasonable degree of confidence'* that there are no plans to operate stone trains at night in future. We do not see what provides the confidence referred to here.

However we agree with Arup Comments' conclusion that, whether or not more stone trains will run, trains may run in future that *'could generate vibration levels which exceed the numerical criteria contained in Condition 19'.* We assume that, by implication, the Arup Comments mean *'..unless sufficient mitigation is introduced'*.

4. Track quality and train speed assumptions

We agree with the Arup Comments that the assumption made in the VSoA, that the new tracks will have the same vibration response as the tracks where the VSoA data used in the predictions were obtained (i.e. the current DCL line), is probably cautious. But this cannot be said to introduce a significant safety margin. The Technical Note itself concedes (p.10) that the difference in track quality *'is not expected to be overly significant'*.

We also agree with the Arup Comments that the VSoA claim - that train speeds may not reach the design speed (said to be 75mph in the Technical Note) - is plausible, in which case the use of the design speed in the vibration predictions is also a cautious assumption. In fact it appears to be the *only* significantly cautious assumption.

5. Switches and Crossings

As pointed out above, we are puzzled why the Arup Comments do not recognise 3 Bladon Close as suffering from amplification from the crossings associated with the S&C at Bladon Close. This property lies closer to the track than 4 Bladon Close, and

the combination of this fact and the proximity of the crossings gives it comparable, or even higher, predicted VDVs – see Appendix 2.

We agree with the Arup Comments that, if trains run at the design speed, 4 Bladon Close is likely to suffer VDVs above the Condition 19 thresholds. However we go further than the Arup Comments in that we find this applies also to 3 Bladon Close.

I am surprised by the precise numbers quoted in the Arup Comments. I believe the exceedance at 4 Bladon Close is greater than that given in the Technical Note, and quoted in the Arup Comments. If Arup's check of the numbers in the VSoA did confirm the VSoA's predicted VDVs for 4 Bladon Close, I would welcome confirmation. Based on my evidence I suspect they may be in error[5]: with the VSoA's VDV predictions for this building being too low by more than 13% (day) and 25% (night). Moreover the Technical Note shows (p.13) that the track layout has been re-designed since the VSoA, bringing the crossing on the nearest track a little nearer, and the crossing on the furthest track much nearer. Also relevant to both buildings, the Technical Note makes clear (p.14) that the design speed of the scheme has been increased since the VSoA, from 70 to 75 mph, giving a further increase in predicted VDV. As a result of all these effects, my spreadsheet shows that the predicted VDVs for 4 Bladon Close, using an amplification factor of 3, are (for the design conditions of the scheme) 38% (day) and 53% (night) higher than the Condition 19 limits – see data in Appendix 2. Thus I find it surprising that the Arup Comments accept the Technical Note's claim that the exceedance is only 20%. I find the corresponding exceedances for 3 Bladon Close are 38% (day) and 61% (night).

We agree with the Arup Comments that the predictions made in this way for buildings affected by the S&C are not over-cautious, as claimed in the Technical Note.

The exceedances found above are large. But we agree with the Arup Comments that, if trains actually run at speeds sufficiently far below the design speed, it *is* possible that the Condition 19 thresholds can nevertheless be satisfied.

The Arup Comments give some examples of effects of speed reductions on resulting VDVs. The Table in Appendix 2 below quantifies this more systematically, using my spreadsheet that implements the Atkins model (Approach 1 of the VSoA) and all the Atkins input data, including the amplification from S&C, and incorporating the Alternative 2 amplification factors, and the effects of small changes to the track layout given in the Technical Note. The figures in this Table, whose acceptance involves ignoring *all* the many misgivings about the input data from the VSoA and Technical Note, shows that the Condition 19 vibration thresholds can be met at 3 and 4 Bladon Close, but only if all trains speeds are restricted to no more than *ca* 40mph.

[5] Comparing open ground VDV predictions in the VSoA with those from my spreadsheet implementing the VSoA's prediction method Approach 1, agreement was excellent (error negligible) in all of the 22 cases (11 buildings, day and night), *except* for 4 Bladon Close – see EWR vibration scenarios including switches and crossings, C.P.Buckley, 7 October 2014. My checks have convinced me there is no special error in my 4 Bladon Close results, so I believe there is an error in the Atkins calculations for this building. It could be a rounding error (the VSoA uses only 2 significant figures), but it seems unlikely that the error should be so large for just one building.

6. Conclusions

(a) Plain line sections

We agree with the Arup Comments that with use of the VSoA (Approach 1) prediction method, together with the VSoA baseline vibration values, and the numbers, timings and speeds of passenger, freight, and stone freight trains proposed for EWR, and including the 'frequency-dependent' amplification factors proposed in the Technical Note, the VDVs at buildings not affected by S&C are predicted to lie within the Condition 19 thresholds (almost – there is one small exception – see Appendix 2).

However, we differ from the Arup Comments in that this seems to us an *unsafe* prediction that Condition 19 will be satisfied at these buildings, and all others on the plain line sections within Oxford District. If *all* the available evidence is taken into account, we do not understand why the Arup Comments judge, *'for the plain line sections of the Order Scheme within the Oxford District'*,*'the assessments presented in the VSoA, as clarified in the Technical Note, to be robust'*.

The reasons for the prediction seeming *not* robust are several.

1. The baseline data used in the VSoA were obtained at locations that were not geologically and topographically relevant (contrary to the Public Inquiry Inspector's specification), and the prediction model is one-dimensional, not accounting for the cutting or the complex three-dimensional topography of the Wolvercote tunnel entrances (where there are buildings close to the track). We do not understand why Arup do not mention these sources of uncertainty.

2. As the Arup Comments point out, there is no assurance that the train-mix in future on the Oxford-Bicester line will not produce a worse distribution of vibration levels than is represented in the VoSA vibration measurements.

3. The frequency-dependent amplification factors used seem to be unsafe: we are curious why the Arup Comments do not recognise this. They do not make any allowance for (a) the expected special susceptibility of 2B Bladon Close (believed to be a wood-frame building), for (b) the likely inconsistency between these factors (obtained for buildings in the USA) and the particular UK building types concerned, or for (c) the variation in responses between individual buildings of the same construction type.

4. No predictions have been made for the section of the Order Scheme south of Wolvercote, where, although the closest buildings are (marginally) further from the track than those worst affected in Wolvercote, there is the additional factor of background vibration from the low level (because of the further distance) but very frequent bursts of vibration from the DCL main line. It seems unreasonable to assume, without making any measurements or predictions at all, that VDVs there will not exceed Condition 19 thresholds. We are puzzled why the Arup Comments do not question this assumption made in the VSoA and by the IE.

Considering all these sources of uncertainty, there clearly needs to be a significant safety factor applied to the VDV predictions, to achieve a safe comparison with the Condition 19 thresholds. As is clear from above, in predictions made using the Atkins data for the EWR scheme as proposed, assuming trains run at the design speed, the *only* significant element of caution included is that this train speed is unlikely to be reached in practice. As shown in Appendix 2, without reduction of train speeds, the safety factor for 2B Bladon Close is only .4/.354=1.13. In my judgement this is too small to compensate adequately for all of uncertainties 1,2,3 listed above. However, if actual train speeds are *guaranteed* to be lower than the design speed, a more reasonable safety margin can be ensured. For example, a speed limit of 50 mph for all trains would provide safety factors of .4/.294=1.36 and .2/.15=1.33 for day and night at 2B Bladon Close. These are still modest, as compared to safety factors commonly used in engineering practice when human health and safety are at stake, but might be considered acceptable.

In view of these considerations, we are puzzled why the Arup Comments do not also conclude that a reduced speed limit is required, to ensure an acceptably robust prediction of compliance with Condition 19 on plain line sections of the scheme.

(b) Switches and Crossings

We agree with the Arup Comments that *'it is likely that planning criteria* (i.e. Condition 19) *will be exceeded at 4 Bladon Close with the current operational assumptions proposed by Network Rail'.* However, we would go further and add that 3 Bladon Close is similarly vulnerable, and as mentioned previously we are puzzled why the Arup Comments do not recognise this.

In addition there is the unresolved situation south of Wolvercote, where there will be additional S&C - e.g. at North Oxford Junction adjacent to the Waterways development. We do not know whether the track layout has been finalised yet, and if so whether Arup have examined it. But there is clear potential for properties there (only slightly further from the track than 4 Bladon Close, and suffering low but frequent background vibration from the DCL main line) to also suffer vibration levels above the Condition 19 thresholds because of amplification from the S&C – a fact ignored in the VSoA and the Technical Note, and by the IE. We are surprised that the Arup Comments do not consider this omission worthy of comment.

We agree with the Arup Comments that compliance with planning Condition 19 is likely only if lower train speeds are considered. The Arup Comments mention only lower *freight* train speeds as making compliance more likely: we do not understand why lower *passenger* train speeds would not also make compliance more likely.

The Arup Comments go no further on this topic than pointing out that train speeds lower than the design speeds would *'provide more reassurance that compliance with the planning criteria at 4 Bladon Close is likely'*. We agree.

However, we are puzzled why the Arup Comments do not go further. Our understanding is that the purpose of the VSoA and the clarifications in the Technical Note (and the primary object of the IE's scrutiny), was not to show that compliance with Condition 19 is merely '*likely'*. The intention of the TWA Order is surely that

compliance with the conditions such as Condition 19 is *certain* – i.e. beyond reasonable doubt.

Following up on the Arup Comments' suggestion that lower train speeds are a potential solution to meeting the vibration thresholds in Condition 19 near the S&C, the Table in Appendix 2 shows the effect of reduced speeds on predicted VDVs at all four of the most sensitive receptor buildings in Wolvercote. It is clear that, in terms of the speeds considered in the Table, **only by reducing all train speeds to 40 mph can all predicted VDVs satisfy Condition 19**.

However that would seem an unacceptable solution to impose on the worst affected residents. Appendix 2 shows that it would provide inadequate safety margins, to compensate for all the uncertainties 1,2,3 listed above: safety factors would be only 1.06 and 1.0 for day and night at 3 Bladon Close; 1.04 and 1.05 for day and night at 4 Bladon Close. But with an even greater reduction of train speeds, an acceptable solution could be reached. For example, reduction of all train speeds to 30mph would produce more acceptable (but still modest) safety margins: safety factors of 1.31 and 1.23 for day and night at 3 Bladon Close; 1.29 and 1.31 for day and night at 4 Bladon Close.

Hence our conclusion is that: **only by introducing a speed limit of 30mph for all trains could compliance with Condition 19 be assured with an arguably acceptable degree of certainty, throughout the Wolvercote section of EWR.**

What about the rest of the Oxford District portion of EWR? It is likely that a similar speed limit would also give an acceptable degree of assurance of compliance with Condition 19 at Waterways and onwards to Oxford station, but this needs to be checked by soundly based VDV predictions, when details of the new track layout are available.

Addendum

In principle, there is another route available for achieving compliance with Condition 19 with respect to vibration, avoiding such severe reduction in train speeds: introduction of a vibration-reducing trackform[6] in the most vulnerable sections of the track, such as through Upper Wolvercote. This was the approach proposed in the Noise and Vibration Mitigation Policy (NVMP), which promises (p.8) that *'Trackforms will be designed and installed adjacent to occupied vibration sensitive receptor buildings using Best Practicable Means to keep within the thresholds'*.

We are surprised that such a solution, discussed at some length in the penultimate version of the VSoA, seems not to have been considered further. We also do not understand why the Arup Comments do not comment on its omission from the VSoA and from the IE's report, given that it was the solution proposed by the applicant in the NVMP. However, from an engineering perspective, it does seem possible that introducing such a trackform is not practicable at the same location where there is also

[6] Numerous potential designs are available. Appendix D of the ANC Guidelines shows eight different potential trackforms, giving varying degrees of vibration reduction, and discusses their relative merits.

a set of points, as in Upper Wolvercote. In this situation, unless it is possible to move the set of points, there may be no alternative to mitigating vibration solely by means of reduced train speeds.

Appendix 1 – Application of building response transfer functions from TNRB to UK buildings

The vibration response of buildings is frequency dependent. It is clearly sensible to attempt to account for this in predicting the vibration of buildings in response to train-induced ground vibrations. The Technical Note does this by combining data from the TRNB for ground-building transmission, floor-floor transmission and floor resonance. The data given in the TRNB comes from the USA and Canada: primarily data published by J.T.Nelson and H.J.Saurenman in 1983. Their graphs show vibration levels in dB versus 1/3 octave bands for various types of building construction used in America. Each graph is represented as a band of finite width: in the case of ground-building and floor-floor responses it is only about 2dB wide. In the Technical Note, to obtain a so-called 'reasonable worst case', amplification factors from the upper edge of the band are used (the values 1.6 and 3 in the Table in Appendix 2). However, there are two problems with using the data in this way, that seem to make it *incautious.*

1. Different individual buildings, even when of the same style of construction, show a wider scatter in measured vibration levels than is represented by the width of the bands in the TRNB graphs. Recent UK data illustrating this clearly were presented by D'Avillez *et al*[7]. Presumably for this reason, Nelson and Saurenman did not intend their data to be used in this way, without application of any safety factor. In another of their publications[8] they make this clear. They say (on p.30): *'The predicted values are "best estimates" of the 1/3 octave band levels and no margin of error is included.* ***For design review and recommendation of noise and vibration control provisions some safety factor should be applied.*** *At this time, about 5 to 10dB should be added to the predicted levels to protect the major part of the potential receivers'* (my emphasis). Adding 5 - 10dB is equivalent to multiplying by a factor of between 1.8 and 3.2.

2. The second problem is: evidence from measurements on UK houses suggests that they systematically experience higher levels of feelable vibration amplification compared to their US equivalents represented in the TRNB graphs. This is demonstrated, for example, in the data of D'Avillez *et al*[7] referred to above. They show that their vibration amplification measurements for a number of UK detached, semi-detached and terraced houses on average lie about 5dB above the corresponding data from Nelson (the same data as reproduced in the TRNB).

[7] J.D'Avillez *et al* 'Issues and limitations on measuring building's transfer function' presented at the 15th International Conference on Experimental Mechanics, Porto, Portugal, 22-27 July 2012.

[8] J.T.Nelson and H.J.Saurenman 'A prediction procedure for rail transportation groundborne noise and vibration' Transportation Research Record 1143 (1988), 26-35.

Appendix 2 – Effect of reduced train speeds on VDVs in Wolvercote

These are results of calculations carried out with my spreadsheet, that implements the VSoA (Approach 1) method for predicting VDVs (in units of $ms^{1.75}$), with all input data taken from the VSoA, except where superseded by data in the Atkins Technical Note in which case this data is used. The amplification factors are the 'frequency-dependent' factors quoted in the Technical Note, intended to allow for building responses to groundborne vibrations from the railway.

Note: these predictions need to be viewed with caution. As explained above in the body of these Comments, some of the input data are subject to significant levels of uncertainty, meaning that these VDVs could be under-predictions.

					without amplification		with amplification	
Building	amplification factor	passenger speed mph	freight speed mph	stone freight speed mph	VDV day	VDV night	VDV day	VDV night
Quadrangle	1.6	75	75	60	0.149	0.097	0.239	0.156
	1.6	70	70	60	0.145	0.092	0.233	0.148
	1.6	60	60	60	0.139	0.082	0.222	0.132
	1.6	50	50	50	0.121	0.072	0.194	0.115
	1.6	40	40	40	0.102	0.061	0.164	0.097
	1.6	30	30	30	0.083	0.049	0.132	0.078
2B Bladon Close	3	75	75	60	0.118	0.068	0.354	0.204
	3	70	70	60	0.116	0.065	0.348	0.194
	3	60	60	60	0.113	0.058	0.339	0.173
	3	50	50	50	0.098	0.050	0.295	0.151
	3	40	40	40	0.083	0.043	0.250	0.127
	3	30	30	30	0.067	0.034	0.201	0.103
3 Bladon Close	3	75	75	60	0.184	0.107	0.553	0.321
	3	70	70	60	0.180	0.102	0.539	0.305
	3	60	60	60	0.171	0.091	0.513	0.272
	3	50	50	50	0.149	0.079	0.447	0.237
	3	40	40	40	0.126	0.067	0.379	0.201
	3	30	30	30	0.102	0.054	0.305	0.162
4 Bladon Close	3	75	75	60	0.184	0.102	0.551	0.305
	3	70	70	60	0.180	0.097	0.539	0.290
	3	60	60	60	0.173	0.086	0.519	0.258
	3	50	50	50	0.151	0.075	0.453	0.225
	3	40	40	40	0.128	0.064	0.383	0.191
	3	30	30	30	0.103	0.051	0.309	0.153

key to compliance with condition 19

compliant

non-compliant

Accompanying email from Professor Paul Buckley 27 March 2015

Dear Fiona

Thank you for making public the Arup Comments on the NR Technical Note.

I have now had a chance to consider these in detail, and to clarify where there is common ground with a resident's perspective, and where Arup's conclusions seem puzzling. I attach my comments and hope you and your colleagues will find them helpful in deciding what to do about discharge of Condition 19. These comments have been seen by a number of the other residents affected, and I understand there is considerable support for the views expressed.

The main conclusion from both the Arup Comments and my assessment is that the EWR scheme will need to be modified, by ensuring train speeds are significantly below the design speeds, in order to be sure Condition 19 will be satisfied with respect to vibration, unless NR can find an alternative solution such as moving the Bladon Close points and/or using a sufficiently vibration-mitigating track form (as proposed in the NVMP). To help with judging how much speed reduction is needed, I have included a table of figures showing the effects of speed reduction on predicted VDVs (calculated using the Atkins methods and data). I trust that too will be helpful.

I apologise for sending this to you direct instead of via the general planning comments email address, but other residents have impressed on me the importance of making sure you see this resident's-eye analysis of such a vitally important matter, without delay.

With best wishes
Paul

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