

Comments for Oxford City Council on Network Rail's recent revision of the EWR train operating assumptions: effects on vibration predictions for Wolvercote

To: Fiona Bartholomew

From: Paul Buckley

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1. Introduction

I should like to comment on the implications, for predicted EWR vibrations, of the letter of 2 April 2015 from Network Rail (NR) to Oxford City Council [1], released to the public on 17 April 2015. It revises the train operating assumptions employed in the two parts of the Vibration Scheme of Assessment VSoA for plain line [2] and switches and crossings (S&C) [3].

These comments give my assessment of the effect of the revised assumptions on predicted vibrations from EWR trains, and hence the likelihood of Condition 19 being met with respect to vibration in Wolvercote. In summary, I find that, although predicted vibration levels are reduced, they are still too high for the EWR scheme, as currently proposed, to comply with Condition 19. It remains the case that the scheme would need to be revised, for example by significantly reduced train speed limits, to achieve robust assurance of compliance with Condition 19.

I also add a comment on some predictions received recently from NR, making lower predictions of vibration and claiming compliance with Condition 19.

2. Revised vibration predictions for Wolvercote

2.1 Calculation of revised predictions

According to the track layout apparently planned¹ for EWR, the four Wolvercote properties closest to the track will be: Quadrangle House, and 2b², 3 and 4 Bladon Close. Since vibration levels decay with increasing distance from the track, it is

¹ As far as I am aware, at the time of writing this, there remains ambiguity concerning the precise positions of the new tracks. The NR Technical Note [4] shows a track alignment clearly different from that proposed in the VSoA at 3 and 4 Bladon Close: e.g. compare diagrams on P.59 of [2] and on P.25 of [3] (which are themselves inconsistent) with the lower diagram on P.13 of [4], or compare building distances from the track given in [2], [3] and [4]. But does this mean the track positions at nearby Quadrangle House have also changed from that given previously in [2]? This is not known, but I have assumed here the answer is 'no'.

² Inexplicably, 2b Bladon Close was not included in the VSoA, although it will be the second closest building to the new railway line in Wolvercote. The high resolution map given in Figure 5.1 of the Noise Scheme of Assessment shows it to be 0.65m nearer to the nearest rail than 3 Bladon Close.

reasonable to assume that these properties will suffer the highest levels of ground-borne vibration from EWR trains in this portion of the scheme. Although 3 and 4 Bladon Close lie further from the track than Quadrangle and 2b Bladon Close, Network Rail plans to locate both ‘crossings’, associated with the Woodstock Road Junction sets of points, immediately next to 4 Bladon Close. The crossings will amplify vibrations at this property, and to a lesser degree at the neighbouring property 3 Bladon Close. I believe no other properties will be significantly affected by the crossings. Therefore these four properties are the most appropriate choice for assessing compliance with Condition 19 within Wolvercote.

I have employed a spreadsheet created to implement, as accurately as possible from all the information given there, the calculation methods and input data used in the two parts of the VSoA³. The route followed is “Approach 1” of the VSoA, so that it can accommodate frequency-dependent amplification from the crossings. Modifying the input data from the VSoA *only* as necessary to reflect (a) the revised track layout given in NR’s Technical Note of 18 February 2015 [4], and (b) the revised train operating assumptions as detailed in NR’s letter to Oxford City Council of 2 April 2005 [1], this spreadsheet predicts the ‘open ground’ day (D) and night (N) vibration dose values (VDVs) for the four critical receptors in Wolvercote given in columns 3 and 4 of the following table. Applying the ‘reasonable worst case’ building factors⁴ proposed by Atkins in [4], vibration levels to be expected inside these properties can also be predicted, as shown in columns 5 and 6.

Table 1: Revised vibration predictions for Wolvercote

Property	Building factor	Open ground VDV ms ^{-1.75}		Internal VDV ms ^{-1.75}	
		D	N	D	N
Quadrangle House	1.6	0.140	0.110	0.224	0.176
2b Bladon Close	3.0	0.080	0.062	0.240	0.186
3 Bladon Close	3.0	0.143	0.096	0.429	0.288
4 Bladon Close	3.0	0.126	0.087	0.378	0.261

Key to compliance with Condition 19

compliant	* **
non-compliant	* **

³ This spreadsheet has been validated as thoroughly as possible, by comparison of its predictions with *all* those given in the VSoA. Perfect agreement is not expected because of the small number of significant figures used in many of the tables of input data in the VSoA, so there will be some inevitable rounding error. Nevertheless, across all 24 VDV predictions made in the VSoA, to within the 0.01 ms^{-1.75} resolution quoted in the VSoA, my spreadsheet is in perfect agreement in 21 cases, with only one case of +0.01 error, and two cases of -0.01 error. Details are given in the Appendix.

⁴ These are multipliers applied to the ‘open ground’ VDV_s predicted by the methods of the VSoA, to account for the net effect of vibration attenuation and amplification (from floor resonances) inside buildings.

The revision of train operating assumptions has clearly caused some reduction of predicted VDV: compare the VDV values above with those given in my earlier communication of 27 March [5], which implemented the change (a) above, but not (b). However, compared to the thresholds of Condition 19, there remain significant vibration exceedances predicted for 3 and 4 Bladon Close.

2.2 Even the values in Table 1 may be under-predictions

I reiterate here a point I have made previously, for example in [5], that even these predictions may not be suitably cautious. Residents have worries about several aspects of the data used by Atkins in the VSoA. I know that Arup have reassured residents about some of them. But there remain others that Arup also have acknowledged. One concerns the sampling of vibration measurements used to create the data set employed in the VSoA, acknowledged by Arup previously [6] in their comments on [4]. It appears that a fully representative set of measurements was not obtained, as required to capture the full spread of vibration levels likely from each type of train. Another concerns uncertainty about future train traffic on the EWR line. Arup pointed out that future traffic levels may exceed those in the train operating assumptions [6]. This has just become even more likely, with the recent revision downwards of the assumed number of passenger trains. Moreover, given the plans of HS2 Ltd⁵ for *all* supplies for construction and subsequent maintenance of HS2 to pass along the EWR line through Oxford, the assumptions made about the frequency of conventional freight trains and the frequency and speed of stone trains seem wholly implausible.

For all these reasons, there is a reasonable probability that the values in Table 1 are actually *under*-predictions of the worst case to be experienced by residents in future. Therefore, in modifying the EWR scheme to achieve robust assurance of compliance with Condition 19, sufficient mitigation is needed to bring predictions in Table 1 sufficiently far *below* the thresholds, to provide an appropriate compensating safety margin. As Arup have indicated [6], reduced train speeds would be helpful in achieving this.

2.3 The need for a publicly verifiable, independent, prediction of vibration levels

The values of VDV to be expected from EWR are obviously of crucial importance to the Council's decision on whether or not to discharge Condition 19 with respect to vibration. In view of the evidence in Table 1 that significant exceedances are still to be expected, I strongly recommend that the Council seeks in-depth independent advice on likely future vibration levels, from its consultants Arup. In their advice to the Council of 15 April 2015 [7] Arup say “..we have not checked the full prediction chain for 4 Bladon Close”. Also, they make clear in [7] that they have not considered the important effect of the crossings on 3 Bladon Close⁶. In view of the importance and urgency of this matter, I recommend the Council to ask Arup to carry out the full prediction chain for both 3 and 4 Bladon Close, *completely independently of NR and*

⁵ See HS2 Ltd High Speed Two Information Paper *F2: Infrastructure maintenance depot strategy*, 11 April 2014.

⁶ 3 Bladon Close is only some 25m from the nearest crossing. At this distance, data in the VSoA (decay factors from Figs 11 and 12, and amplification factors in Table 5 of [3]) show that in the middle of the relevant log(frequency) range, around 25Hz, there will be amplification of up to 8dB and 16dB for freight and passenger trains respectively.

Atkins, as I have done. At any point, if it would help the Council in arriving at a consensus on what EWR vibration levels really are likely to be, I would be very willing to share details of my calculations with Arup and the Council.

When Arup have completed their investigation, because of the significance for residents on the one hand and the railway companies on the other hand, and for consistency with the Council’s policy of transparency, I urge the Council to release full details of Arup’s calculations to the public without delay. I am sure the Council will be guided by Arup’s advice in making the decision on discharge, so it will be essential for public confidence in whatever decision is made for the full logic of Arup’s advice to be clear to all.

3. Recent vibration predictions from NR and Atkins

The need for an independent check by Arup is especially necessary because vibration predictions have been sent to the Council recently by the railway companies, conflicting with my conclusions above. The NR letter [1] and the most recent Atkins Technical Note [8] include revised vibration predictions, claimed to allow for the revised train operating assumptions in [1], and given in the table below.

Table 2: Revised vibration predictions received from NR and Atkins

Property	Building factor	Open ground VDV $\text{ms}^{-1.75}$		Internal VDV $\text{ms}^{-1.75}$	
		D	N	D	N
3 Bladon Close	3.0	0.09	0.06	0.27	0.18
4 Bladon Close	3.0	0.11	0.07	0.33	0.21

It is clear there are some huge discrepancies between the ‘open ground’ V DVs predicted *for the same property* in Table 1 and Table 2: up to $0.05\text{ms}^{-1.75}$. This is far greater than the $0.1\text{ms}^{-1.75}$ maximum discrepancy between my spreadsheet and *all* the 24 predictions in both parts of the VSoA. Thus the evidence suggests this difference does not arise from error in my spreadsheet, but instead arises from inconsistency between the methods and/or input data used by Atkins in the VSoA and in these recent predictions (beyond the changes (a) and (b) referred to above).

Again, in the interests of transparency and maintaining public confidence in the process of considering discharge of Condition 19, I urge the Council to ask Atkins to declare to you the changes they have made to the calculation method since the VSoA, and to justify them to you, and for you to make this information available to the public.

References

- [1] Letter from Andy Milne of Network Rail to Fiona Bartholomew of Oxford City Council, 2 April 2015.
- [2] Atkins report 5114534-ATK-VIB-RPT-80001 *Plain Line Vibration Assessment and Mitigation*, 16 January 2014.
- [3] Atkins report 5114534-ATK-VIB-RPT-80003 *Vibration from Switches and Crossings – Assessment and Mitigation*, 21 January 2014.
- [4] Atkins Technical Note *Condition 19 – Vibration Scheme of Assessment*, 18 February 2015.
- [5] C.P.Buckley *Comments to Oxford City Council on the ‘Comments on Atkins Technical Note’ (of 11 March 2015) submitted by Arup to Oxford City Council*, 27 March 2015.
- [6] Arup report ref. 237838-00/H01-OB *Comments on Atkins Technical Note – Condition 19 vibration scheme of assessment – 18 February 2015*, 11 March 2015.
- [7] Arup report ref. 237838-00/H02-OB *East West Rail Phase 1 – Arup responses to Paul Buckley’s correspondence dated 27 March 2015*, 15 April 2015.
- [8] Atkins Technical Note *Switches and Crossings in Wolvercote Area*, 24 April 2015.

Appendix

As a thorough validation check, the spreadsheet employed here in calculating the predictions in Table 1 has been used to make predictions for all 24 cases considered in the two parts of the VSoA, using input data for each case given in the VSoA. The following two tables compare the predictions produced with those given in the two parts of the VSoA. The colours highlight those cases where there is a small discrepancy between the spreadsheet and the VSoA at the level of $0.01\text{ms}^{-1.75}$. There are no discrepancies higher than this, indicating there is excellent consistency between the spreadsheet and the calculation procedures employed in the VSoA. This provides confidence that the predictions in Table 1 replicate faithfully what the VSoA would have predicted, had the revised operating assumptions been used in its calculations.

Key to discrepancies	VSoA exceeds spreadsheet	*.***
	Spreadsheet exceeds VSoA	*.***

Table 3: Spreadsheet validation check against plain line part of VSoA [2]

Property	Open ground VDV $\text{ms}^{-1.75}$ From VSoA		Open ground VDV $\text{ms}^{-1.75}$ From spreadsheet	
	D	N	D	N
53 London Road	0.16	0.11	0.159	0.109
Islip Crossing	0.22	0.16	0.215 ⁺	0.162
Oddington	0.18	0.13	0.178	0.132
Quadrangle House	0.15	0.09	0.150	0.091
3 Bladon Close	0.11	0.06	0.108	0.058
12 Whimbrel	0.13	0.09	0.131	0.087
21 Nuthatch Way	0.09	0.06	0.087	0.061
Alchaster House	0.09	0.07	0.092	0.066
5 Westholme Court	0.12	0.08	0.114	0.080

Table 4: Spreadsheet validation check against S&C part of VSoA [3]

Property	Open ground VDV $\text{ms}^{-1.75}$ From VSoA		Open ground VDV $\text{ms}^{-1.75}$ From spreadsheet	
	D	N	D	N
5 Westholme Court ^{7,8} (with S&C)	0.30	0.19	0.301	0.192
16 Whimbrel Close (with S&C)	0.26	0.17	0.258	0.160
4 Bladon Close (with S&C)	0.16	0.08	0.162	0.090

⁷ Westholme Court is mis-labelled as ‘21 London Road’ in the S&C part of the VSoA.

⁸ Westholme Court appears in both parts of the VSoA, but the assumed track positions in each case are slightly different.