

**Thames Tideway Tunnel**  
Thames Water Utilities Limited



# Application for Development Consent

Application Reference Number: WWO10001

## Noise and Disturbance

### Question 29.2 - Supplementary Information

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**Thames  
Tideway Tunnel**



Creating a cleaner, healthier River Thames

## 1 Question 29.2: Supplementary information

### 1.1 Summary response

- 1.1.1 This information supplements our response to the ExA's second written question 29.2 which we provided on 13 January 2014. We pointed out in that response that further information was being developed and would be submitted by 24 January 2014.
- 1.1.2 From the assessment methods that are based on noise change, the British Standard 5228 'example method 1' (the ABC method) has been preferred by noise assessors for use on a greater number of large, urban, infrastructure projects than the BS 'example method 2' (the 5dBA change method).
- 1.1.3 We concluded that an assessment using the BS ABC assessment method 1 was entirely appropriate for this project, and that an assessment using the BS assessment method 2 was less appropriate and a less reliable indicator of impact than the ABC method 1.
- 1.1.4 We consider that reassessment using BS 5228 assessment method 2, where the assessment outcomes would be different from those using BS 5228 assessment method 1, would not assist the examination process. It could also lead to confusion and, in any case, would result in no additional mitigation being identified or incorporated into the scheme above the mitigation now included in the *Code of Construction Practice*.
- 1.1.5 For those reasons, we have not undertaken a BS 5228 assessment method 2 for all of the sites. However, as an illustration, the BS 5228 assessment method 2 results have been determined for the main drive sites (Carnwath Road Riverside, Kirtling Street and Chambers Wharf) and three other sites where significant effects have been identified (King Edward Memorial Park Foreshore, Shad Thames and Bekesbourne Street).
- 1.1.6 It can be seen from the information provided that generally, the use of the BS 5228 assessment method 2 indicates a larger number of potential significant effects than BS 5228 assessment method 1. However, we would draw the ExA's attention to the following matters:
- This fact, on its own, does not provide evidence that BS 5228 assessment method 2 is a more accurate indicator of impact than BS 5228 assessment method 1.
  - The majority of apparent effects identified using BS 5228 assessment method 2 are in the daytime.
  - The BS 5228 ABC assessment method 1 identifies potential significant effects that the BS 5228 assessment method 2 would miss (see the effects at Kirtling Street and night-time effects on Riverlight).
  - No further mitigation at source would be (or could be) triggered using BS 5228 assessment method 2, as all practicable mitigation that can

be confirmed at this stage has already been incorporated into the scheme in our revised *Code of Construction Practice Part A* (Doc ref: APP72.1) and the site-specific Part Bs.

- e. Any mitigation effects owing to off-site mitigation which cannot be secured within the application have not been included in these results but would, nevertheless, mitigate effects.
- f. The use of BS 5228 assessment method 2 would not result in any additional properties meeting the qualifying criteria for noise insulation (or other off-site mitigation) than would be the case using the BS 5228 ABC assessment method 1. This is because the qualification for noise insulation is triggered by absolute noise levels (as per BS 5228 assessment method 1) and not noise change from ambient levels (as per BS 5228 assessment method 2) against trigger values that have been adopted on all equivalent scale projects and are as defined in BS 5228.
- g. BS 5228 assessment method 2 should not be relied on for the reasons set out in this response.
- h. Whether BS 5228 assessment method 1 or 2 is employed, it is necessary to consider noise levels and consequent impact within properties, as has been done in the *Environmental Statement (ES)*. This is because the basis of all construction noise impact assessments – since Wilson in 1963 – is whether people within properties would be impacted with windows closed (the assumed minimum mitigation for construction noise). The BS 5228 assessment method 1 is more useful in assessing impacts in this respect because guidance on reasonable internal noise levels are provided in terms of overall noise levels (BS 5228 assessment method 1) rather than changes in noise levels (BS 5228 assessment method 2).

## 1.2 Detailed response

- 1.2.1 This information supplements our response to the ExA's second written question 29.2, which we provided on 13 January 2014. At paragraph 1.1.5 of that response, it was explained that we were at the time in the process of undertaking a BS 5228 construction noise assessment method 2 for a sample site, Chambers Wharf, and would be submitting this to the ExA by 24 January. In the event, and as explained below, assessments have been carried out for each of the main drive sites (Carnwath Road Riverside, Kirtling Street and Chambers Wharf) and three other sites where significant noise effects have been identified (King Edward Memorial Park Foreshore, Shad Thames and Bekesbourne Street). This supplemental response provides the results of those assessments.

### Context

- 1.2.2 There are four significance assessment methods in BS 5228-1 Annex E (this annex is for information only so none of these assessment methods are a specific requirement of the standard). From those assessment methods that are based on noise change, the BS 'example method 1' (the

BS 5228 ABC assessment method 1) has been preferred by noise assessors for use on a greater number of large, urban, infrastructure projects than the BS 'example method 2' (the 5dBA change method – the BS 5228 assessment method 2).

### The ABC method (assessment method 1)

- 1.2.3 The BS 5228 (ABC) assessment method 1 allows an assessment of the effects from construction noise using a matrix of established noise threshold levels above which a potential significant effect is concluded. As described in the appendix to the response to first written question 11.1 (Doc ref: APP11), the provenance of these thresholds are the Wilson Report<sup>1</sup> and AL72<sup>2</sup>. The selected BS 5228 assessment method 1 'ABC' threshold levels are dependent on the existing ambient noise level at a given assessment receptor and the time of day, evening or night when the receptor may be potentially affected.
- 1.2.4 The matrix of the BS 5228 ABC assessment criteria 1 has its provenance in the noise limits in the Wilson report released in 1963. These limits were then incorporated within AL72. The criteria have been employed for the assessment and control of noise for many projects of an equivalent scale, intensity and duration to the Thames Tideway Tunnel project (the 'project') – from HS1 through to the current HS2. The BS 5228 assessment method 1 criteria reflect general experience, which is that people perceive the character of construction noise to be different to other ambient noise sources, and therefore the construction noise level alone is the best indicator of community response.
- 1.2.5 Community response is also influenced by:
- the knowledge that construction is a temporary source and is not, therefore, a permanent component of the noise environment in an area; and
  - the fact that construction noise varies substantially in level and character throughout the duration of a construction project.
- 1.2.6 A person's response to construction noise is, therefore, likely to be different to his/her response to permanent noise sources.

### The '5dB(A) change' method (BS 5228 assessment method 2)

- 1.2.7 Under the '5dB(A) change' method – BS 5228 assessment method 2 – noise generated by construction activities is deemed to be significant if the total noise (preconstruction ambient plus construction noise) exceeds the preconstruction ambient noise level at a given assessment receptor by

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<sup>1</sup> Committee on the Problem of Noise, *Noise Final Report*, HMSO (1963). Presented to the Parliament by the Lord President of the Council and Minister for Science by Command of Her Majesty July 1963.

<sup>2</sup> Department of the Environment (1976), Advisory Leaflet (AL) 72 (1976), *Noise control on Building Sites*, HMSO, first published 1968, Third edition 1976.

5dB or more, subject to lower cut-off values of 65, 55 and 45dB(A) for day, evening and night respectively, and a duration of one month or more.

- 1.2.8 The 5dB method – BS 5228 assessment method 2 – is first set out and ‘justified’ in a paper by Rupert Taylor which was included as Appendix D to the Crossrail Technical Report<sup>3</sup>. This paper is attached to this document as Appendix A.
- 1.2.9 The underlying justification for the use of the 5dB change method (BS 5228 assessment method 2), instead of the ABC method (BS 5228 assessment method 1), is an assumption that total noise (construction plus preconstruction baseline ambient noise level) is an appropriate indicator of community response. In our judgment, this is an illogical and ill-conceived assumption and one that is not supported by the results of social surveys. Indeed, as noted above, the empirical experience is that the level of construction noise on its own is the best indicator of community response to construction – not the ‘total’ construction plus preconstruction ambient noise level.

### **Selection of the ABC method (BS 5228 assessment method 1) for the project**

- 1.2.10 The assessment of construction noise effects of the majority of major infrastructure projects, particularly those in London, has been undertaken using the BS 5228 ABC assessment method 1. This method has been used to assess projects examined by government committees and at public inquiries. Major infrastructure projects which have been approved using the BS 5228 ABC assessment method 1 include the Channel Tunnel Rail Link, Forth Crossing, Stratford International Station and Thameslink Programme. The first two projects were approved through Acts of Parliament; the remainder through Transport and Works Act Orders. In no case has the Government or the Planning Inspectorate indicated any dissatisfaction with the use of the BS 5228 ABC assessment method 1 as an appropriate method for assessing construction noise effects of major infrastructure projects. A number of these approvals postdate Crossrail.
- 1.2.11 It is important to note that these projects have all been constructed, or are being constructed in the case of Forth Replacement Crossing, without any substantive or systemic community comment or complaint about construction noise.
- 1.2.12 In contrast, Crossrail is the only large London infrastructure project of a similar nature to the project to have selected the 5dB(A) change assessment method (BS 5228 assessment method 2). As discussed at paragraph 1.2.9 above, we do not believe that this assessment method is logical or appropriate for this assessment.
- 1.2.13 For the reasons summarised above, we concluded that an assessment using the BS 5228 ABC assessment method 1 was entirely appropriate for

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<sup>3</sup> Crossrail: Technical Report, *Assessment of Noise and Vibration Impacts*; Volume 1 of 8 - Introduction, Scope and Methodology: Appendix D – Construction Noise, Triggers for Significance, Noise Insulation and Temporary Rehousing.

the project. Conversely, we concluded that an assessment using the BS 5228 assessment method 2 is less appropriate and likely to provide a less reliable indicator of impact than the BS 5228 ABC assessment method 1, for the reasons already set out above.

- 1.2.14 In order to test the veracity of this choice, the use of the BS 5228 ABC assessment method 1 was proposed in the method statements and *Preliminary Environmental Impact Report* which were the subject of consultation in the early stages of the environmental impact assessment process. No concerns were raised regarding the use of the BS 5228 ABC assessment method 1 in the consultation responses.
- 1.2.15 Further, we have proactively engaged with the environmental health practitioners of the local authorities potentially affected by the project and we have met, on regular basis over a long period, to actively discuss assessment methods, mitigation, policies and other matters. At no point during these discussions have the local authorities raised any concerns about the adopted BS 5228 ABC assessment method 1.
- 1.2.16 The ABC method<sup>4</sup> used for the project assessment was also used for the assessment of noise effects from phase 1 of High Speed 2 (HS2). We consulted on our scope and methodology report before the HS2 environmental impact assessment was completed. Our report clearly sets out the use of the BS 5228 ABC assessment method 1. The HS2 environmental and health impact assessments were subject to peer review by an independent acoustic review group. This group raised no concerns regarding the use of the BS 5228 ABC assessment method 1 that was adopted. The records of the group's meetings are posted on the HS2 website.

### Use of internal noise levels

- 1.2.17 The assessment undertaken for the project extends the BS 5228 ABC assessment method 1 (which is based on construction noise levels only considered outside a property) to include consideration of the resulting internal noise levels. This is because it is principally inside a property where significant observed effects need to be avoided (eg, to avoid undue speech interference or to avoid sleep disturbance).
- 1.2.18 The submissions to the ExA made by the London Borough of Southwark, Temple Group and others on 13 January 2014 include an objection to this 'extension' of the BS 5228 assessment methodology. This includes a submission co-authored by Rupert Taylor.
- 1.2.19 In our judgment, this objection is not warranted. As Rupert Taylor noted in his paper supporting the Crossrail methodology (see attached):
- the provenance of the construction noise levels that should not be exceeded is the Wilson Report
  - "Wilson's recommendation ...was based on an **internal noise** level of 55 dB..."*

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<sup>4</sup> Using construction noise only as defined in the consultation draft of the revised BS5228-1

- c. closed but ill-fitting and 'leaky' single windows (that were prevalent at the time of the Wilson Report in 1963) give a 15dB reduction; and hence
  - d. "Wilson's recommendation was 70" dB(A) outside a property.
- 1.2.20 Rupert Taylor's Crossrail paper goes on to note a "large amount of window renewal has taken place since the 1960s and PPG 24 says that the typical noise reduction of a dwelling façade with windows set in a brick/block wall is 27-30 dB(A) depending on the source. So there is an argument for raising the upper cut-off by at least 7 dB". While not specifically stated at the time, this justifies why, in 1994, the Channel Tunnel Rail Link (CTRL) ES defined the threshold for noise insulation as 75dB(A) in terms of construction noise only and not the 70dB(A) noted in the Wilson Report. Mr Taylor's paper is attached.
- 1.2.21 In the 20 years since the CTRL assessment method was developed, window renewal has continued. Few properties now have single glazed windows. There have also been substantial improvements in the Building Regulations in terms of thermal insulation and the recognition of the need for sustainable design. The result of these measures is that modern property built over the last 15 years or so has glazing and ventilation with better sound insulation than earlier housing stock.
- 1.2.22 The property around the project worksites is varied and includes modern apartments with glazing and ventilation to modern standards. This is why the extension to the BS 5228 ABC assessment method 1 – to consider internal noise levels – was included. Otherwise, at most modern properties, the use of the BS 5228 ABC assessment method 1, in its simple form, which is based on external noise levels, would overestimate significant effects that, as explained above, are based on peoples' experience of construction noise inside their property.
- 1.2.23 This approach is also consistent with the National Planning Policy Framework that notes the importance of taking account of the local context when undertaking an assessment in support of planning applications (see, for example, NPPF paragraph 11 et seq).
- 1.2.24 Our response to the ExA's first written questions<sup>5</sup> sets out a full justification for the construction noise assessment method that we have adopted.
- Ongoing engagement and non-objection to the BS 5228 ABC assessment method 1**
- 1.2.25 We met with representatives of the London Borough of Southwark, Temple Group and Save Your Riverside, including Mr Taylor, on 16 December 2013, to discuss noise and vibration issues, particularly in respect of the Chambers Wharf site. A record of the meeting is included in our updated [Statement of Common Ground](#) with the London Borough of Southwark.

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<sup>5</sup> The response to first written question 11.1 sought to clarify these matters via an appended report, the *Noise Assessment Methodology* (Doc ref: APP 11.01.01).

- 1.2.26 The *Statement of Common Ground* states that the specialist acoustic advisors present at the meeting agreed: “*that there is no basis for challenging the ABC method assessment used in the Environmental Statement (ES) as it has successful precedence from other major London infrastructure projects*”.
- 1.2.27 In their 13 January 2014 submissions and in other correspondence, the parties involved in the 16 December 2013 meeting have sought to modify the meeting record. We reject these suggested modifications and note that a number of them have apparently been proposed by people who were not at the meeting, most notably the Managing Director of Temple Group. It is important to note, however, that none of the suggested changes seek to amend the fundamentals of the agreement at the meeting that the BS 5228 assessment method 1 is appropriate for this project (see paragraph 1.2.26, above).
- 1.2.28 We note that this proposed revised agreement effectively changes the position adopted by Mr Taylor on behalf of Save Your Riverside and advisors for Temple Group in their previous written submissions. In this respect, we noted in our submission of 2 December 2013 that Mr Taylor has recently given expert evidence on behalf of Transport for London in respect of its application for powers to construct and operate the Northern Line Extension. The BS 5228 ABC assessment method 1 was used in the assessment of construction noise for that scheme.

### **Comparing the BS 5228 ABC assessment method (method 1) and BS 5228 5dB assessment method (method 2) using external noise**

- 1.2.29 We have not carried out a BS 5228 (5dBA) method 2 construction noise assessment for all of the sites for the reasons set out in this response. However, as an illustration to give comfort to the ExA that method 1 is robust, BS 5228 assessment method 2 has been employed for the assessment of effects at main drive sites (Carnwath Road Riverside, Kirtling Street and Chambers Wharf) and three other sites where significant noise effects have been identified (King Edward Memorial Park Foreshore, Shad Thames and Bekesbourne Street). The results of these assessments are presented in the appended tables. The figures in these tables reflect the updated mitigation proposals set out in our 13 January 2014 submission. They do not allow for any effects from off-site mitigation measures which cannot be secured within the application.
- 1.2.30 It can be seen from the tables that generally, and as expected, BS 5228 assessment ‘example method 2’ presents an increased number of potential significant effects. However, we would draw the ExA’s attention to the following matters:
- a. Method 2 tends to identify a large number of potential significant effects. This appeared to be also the case with Crossrail<sup>1</sup>.
  - b. The majority of apparent effects using BS 5228 assessment method 2 are in the daytime.



- c. The BS 5228 ABC assessment method 1 identifies potential significant effects that the BS 5228 assessment method 2 would miss (refer to Kirtling Street and night-time effects on Riverlight).
  - d. No further mitigation would be triggered using the BS assessment method 2, as all practicable mitigation that can be confirmed at this stage has already been incorporated into the scheme in our revised *Code of Construction Practice Part A* (Doc ref: APP72.1) and the site-specific *CoCP Part Bs*.
- 1.2.31 The use of BS 5228 assessment method 2 would not result in any additional properties meeting the qualifying criteria for noise insulation (or other off-site mitigation) than would be the case using the BS 5228 ABC assessment method 1. This is because the qualification for noise insulation is triggered by absolute noise levels (as per BS 5228 assessment method 1) and not noise change (as per BS 5228 assessment method 2). As set out above, the results of an impact assessment using the BS assessment method 1 are different to those using the BS 5228 assessment method 2. In such cases, we believe that it is preferable to employ the assessment method that is less subject to assessment uncertainties. In this respect, BS 5228 assessment method 1 has a better provenance and pedigree than BS 5228 assessment method 2, has been tried and tested on many similar projects with proven good results, is better linked to the BS 5228 Table of Noise Insulation and Temporary Relhousing (NITR) limits, and can better reflect the effect within properties. In summary, we consider that reassessment using the BS 5228 assessment method 2 does not assist the examination process.
- 1.2.32 We have included Chambers Wharf in the comparison tables because Mr Taylor's evidence to the written responses of Save Your Riverside and Temple Group of 2 December 2013 appears to already present this information. What is important to note is that the information included in the Save Your Riverside and Temple submissions conflates several different considerations.
- 1.2.33 One of these is a suggestion that we overestimated the baseline levels and therefore underestimated the significant effects. On this point, it is relevant to note that, at the meeting of 16 December 2013, representatives of the London Borough of Southwark, Temple Group and Save Your Riverside agreed that "*baseline data used in the assessment at Chambers Wharf (CW) is not objected to, save ...*" for the baseline at Downings Roads Moorings and at Axis Court during the daytime only (see our *Statement of Common Ground* with the London Borough of Southwark). We will continue dialogue with the interested parties on these matters and report progress to the ExA ahead of the upcoming issue specific hearing on noise. However, in all other respects, we suggest that the concern about baseline conditions identified in the submissions regarding Chambers Wharf can now be set aside.
- 1.2.34 The attached tables report the potential significant effects for Chambers Wharf, using both the BS 5228 ABC assessment method 1 used in our *Environmental Statement* and the BS 5228 '5dB(A) change' assessment method 2. Both methods are based on the further mitigation measures

described in our document, *Response to issue specific hearing and written representations relating to Chambers Wharf and alternative drive strategy* (Doc ref: APP31.02), submitted on 2 December 2013.

## 1.3 Conclusion

- 1.3.1 Further to our response on 13 January, we have now provided a comparative assessment of the BS 5228-1 example assessment method 1 (ABC) and BS 5228 assessment method 2 (5dB change) for six of the key sites (in terms of noise) but, for the reasons we have given, we do not consider it appropriate to provide this assessment information for all sites.
- 1.3.2 In this response, we have discussed these assessment results, and the reasons why they do not lead to any different conclusions as to the appropriate mitigation to be provided either at source or off-site. We have also provided further explanation and evidence as to why we believe that the method used for the construction noise assessment for the project – the modified BS 5228 ABC assessment method 1 – is robust, and the most appropriate method to be adopted for the assessment.

## Carnwath Road Riverside

**Table 1a – CRR (residential only): Direct construction and total noise levels and significance decisions according to the BS 5228 ‘5dB(A) change’ assessment method (method 2) and the BS 5228 ‘pure ABC’ assessment method (worst month assessment) (method 1). Assessment including embedded mitigation as identified in the application (ES).**

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method*	ES ABC method*
CR1 89-101 Carnwath Road	(day)	61	48-69	65	70	9	Significant	Significant				
	(eve)	58	45-62	65	63	5	Significant					
	(night)	40	37-44	45	45	5						
CR2 81-87 Carnwath Road	(day)	61	47-63	65	65	4						
	(eve)	58	44-61	65	63	5						
	(night)	40	36-43	45	45	5						
CR4 The Piper Building	(day)	69	64-71	75	73	4						
	(eve)	66	54-61	66	67	1						
	(night)	48	49-54	55	55	7	Significant					
CR5 16-25 Philpot Square	(day)	69	59-69	75	72	3						
	(eve)	56	55-60	60	61	5	Significant					
	(night)	55	45-54	55	58	3						

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Receptor name	Period	Ambient	Construction noise range dB $L_{Aeq}$	ABC threshold level, dB $L_{Aeq}$	Total noise (ambient plus construction) dB $L_{Aeq}$	Increase in total noise dB $L_{Aeq}$	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method*	ES ABC method*
CR6 26-41 Philpot Square	(day)	69	57-71	75	73	4						
	(eve)	56	53-60	60	61	5	Significant					
	(night)	55	43-52	55	57	2						
CR7 1b Dymock Street	(day)	69	48-60	75	70	1						
	(eve)	56	42-51	60	57	1						
	(night)	55	32-41	55	55	0						
CR8 5 Carnwath Road	(day)	60	54-75	65	75	15	Significant	Significant				
	(eve)	53	47-58	60	59	6	Significant					
	(night)	41	37-44	45	46	5						
CR9 Riverside Quarter	(day)	60	45-61	65	64	4						
	(eve)	53	46-53	60	56	3						
	(night)	41	36-45	45	46	5						

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.  
 All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs  
 \*Construction noise only

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**Table 1b – CRR (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’, and ‘pure ABC’ methods (worst month assessment). Assessment including further mitigation identified since submission of the application.**

Receptor name	Period	Ambient	Construction noise range dB $L_{Aeq}$	ABC Threshold level, dB $L_{Aeq}$	Total noise (ambient plus construction) dB $L_{Aeq}$	Increase in total noise dB $L_{Aeq}$	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method*	ES ABC method*
CR1 89-101 Carnwath Road	(day)	61	48-69	65	70	9	Significant	Significant				
	(eve)	58	45-62	65	63	5	Significant					
	(night)	40	37-44	45	45	5						
CR2 81-87 Carnwath Road	(day)	61	47-63	65	65	4						
	(eve)	58	44-61	65	63	5						
	(night)	40	36-43	45	45	5						
CR4 The Piper Building	(day)	69	64-71	75	73	4						
	(eve)	66	54-61	66	67	1						
	(night)	48	49-54	55	55	7	Significant					
CR5 16-25 Philpot Square	(day)	69	59-69	75	72	3						
	(eve)	56	55-60	60	61	5	Significant					
	(night)	55	45-54	55	58	3						

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Receptor name	Period	Ambient	Construction noise range dB $L_{Aeq}$	ABC Threshold level, dB $L_{Aeq}$	Total noise (ambient plus construction) dB $L_{Aeq}$	Increase in total noise dB $L_{Aeq}$	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method *
CR6 26-41 Philpot Square	(day)	69	57-71	75	73	4						
	(eve)	56	53-60	60	61	5	Significant					
	(night)	55	43-52	55	57	2						
CR7 1b Dymock Street	(day)	69	48-60	75	70	1						
	(eve)	56	42-51	60	57	1						
	(night)	55	32-41	55	55	0						
CR8 5 Carnwath Road	(day)	60	54-75	65	75	15	Significant	Significant				
	(eve)	53	47-58	60	59	6	Significant					
	(night)	41	37-44	45	46	5						
CR9 Riverside Quarter	(day)	60	45-61	65	64	4						
	(eve)	53	46-53	60	56	3						
	(night)	41	36-45	45	46	5						

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.  
 All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs  
 \*Construction noise only

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**Kirtling Street**

**Table 2a – Kirtling Street (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’ and ‘pure ABC’ methods (worst month assessment). Assessment including embedded mitigation as identified in the application (ES).**

Receptor name	Period	Ambient	Construction noise range dB LAeq	ABC Threshold level, dB LAeq	Total noise (ambient) plus construction) dB LAeq	Increase in total noise dB LAeq	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method *
KS1 Shelley House	(day)	74	57-66	75	75	1						
	(eve)	73	50-63	73	73	0						
	(night)	68	44-63	68	69	1						
KS2 Nine Elms Pier Houseboats	(day)	67	56-78	70	78	11	Significant	Significant	Significant	NI**	NI**	NI**
	(eve)	67	48-77	67	77	10	Significant	Significant	Significant	NI**	NI**	NI**
	(night)	61	46-77	61	77	11	Significant	Significant	Significant	NI**	NI**	NI**
KS3 River Lodge	(day)	74	57-65	75	75	1						
	(eve)	73	50-62	73	73	0						
	(night)	68	44-62	68	69	1						

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Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method *
KS4 Elm Quay	(day)	68	41-60	75	69	1						
	(eve)	65	49-59	65	66	1						
	(night)	62	25-59	62	64	2						
KS5 Riverlight Block A	(day)	67	66-71	70	72	5	Significant					
	(eve)	67	58-66	67	70	3						
	(night)	61	56-65	61	66	5	Significant	Significant	Significant			
KS6 Riverlight Block B	(day)	67	74-80	70	80	13	Significant	Significant	Significant	NI	NI	NI
	(eve)	67	67-71	67	72	5	Significant	Significant				
	(night)	61	67-71	61	71	10	Significant	Significant	Significant	NI	NI	NI
KS7 Riverlight Block C	(day)	67	62-81	70	81	14	Significant	Significant	Significant	NI	NI	NI
	(eve)	67	59-63	67	68	1						
	(night)	61	57-62	61	65	4	Significant	Significant	Significant			
KS8 33 Nine Elms Lane/New Covent Garden Market Site Entrance	(day)	73	64-74	75	77	4						
	(eve)	74	54-60	74	74	0						
	(night)	68	47-59	68	69	1						



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Receptor name	Period	Ambient	Construction noise range dB LAeq	ABC Threshold level, dB LAeq	Total noise (ambient plus construction) dB LAeq	Increase in total noise dB LAeq	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method*	ES ABC method*
KS9 Battersea Power Station – PS	(day)	60	65-72	65	72	12	Significant	Significant				
	(eve)	57	54-63	60	64	7	Significant	Significant				
	(night)	58	50-63	58	64	6	Significant	Significant	Significant			
KS11 Battersea Power Station – RS4	(day)	60	65-68	65	69	9	Significant	Significant				
	(eve)	57	52-61	60	62	5	Significant	Significant				
	(night)	58	29-60	58	62	4		Significant	Significant			

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.

All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs

\*Construction noise only

\*\* Noise insulation is unlikely to be a viable option for the preserving the amenity of households owing to the dwelling construction. For this reason, temporary rehousing may be offered to these residents.

Question 29.2: Supplementary information

**Table 2b – Kirtling Street (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’, and ‘pure ABC’ methods (worst month assessment). Assessment including further mitigation identified since submission of the application.**

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification			
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*	
KS1 Shelley House	(day)	74	57-66	75	75	1							
	(eve)	73	50-63	73	73	0							
	(night)	68	44-63	68	69	1							
KS2 Nine Elms Pier Houseboats	(day)	67	56-78	70	78	11	Significant	Significant	Significant	N/I**	N/I**	N/I**	
	(eve)	67	48-68	67	71	4		Significant	Significant				
	(night)	61	46-63	61	65	4		Significant	Significant				
KS3 River Lodge	(day)	74	57-65	75	75	1							
	(eve)	73	50-62	73	73	0							
	(night)	68	44-62	68	69	1							
KS4 Elm Quay	(day)	68	41-60	75	69	1							
	(eve)	65	49-59	65	66	1							
	(night)	62	25-59	62	64	2							

Question 29.2: Supplementary information

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*
KS5 Riverlight Block A	(day)	67	66-71	70	72	5	Significant	Significant				
	(eve)	67	58-66	67	70	3						
	(night)	61	56-65	61	66	5	Significant	Significant	Significant			
KS6 Riverlight Block B	(day)	67	74-80	70	80	13	Significant	Significant	Significant	NI	NI	NI
	(eve)	67	67-71	67	72	5	Significant	Significant				
	(night)	61	67-71	61	71	10	Significant	Significant	Significant	NI	NI	NI
KS7 Riverlight Block C	(day)	67	62-81	70	81	14	Significant	Significant	Significant	NI	NI	NI
	(eve)	67	59-63	67	68	1						
	(night)	61	57-62	61	65	4		Significant	Significant			
KS8 33 Nine Elms Lane/New Covent Garden Market Site Entrance	(day)	73	64-74	75	77	4						
	(eve)	74	54-60	74	74	0						
	(night)	68	47-59	68	69	1						
KS9 Battersea Power Station – PS	(day)	60	65-72	65	72	12	Significant	Significant	Significant			
	(eve)	57	54-63	60	64	7	Significant	Significant				
	(night)	58	50-63	58	64	6	Significant	Significant	Significant			

Question 29.2: Supplementary information

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*
KS11 Battersea Power Station – RS4	(day)	60	65-68	65	69	9	Significant	Significant				
	(eve)	57	52-61	60	62	5	Significant	Significant				
	(night)	58	29-60	58	62	4	Significant	Significant	Significant			

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.

All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs

\*Construction noise only

\*\* Noise insulation is unlikely to be a viable option for the preserving the amenity of households owing to the dwelling construction. For this reason, temporary rehousing may be offered to these residents.

Question 29.2: Supplementary information

**King Edward Memorial Park Foreshore**

**Table 3a – King Edward Memorial Park Foreshore (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’ and ‘pure ABC’ methods (worst month assessment). Assessment including embedded mitigation as identified in the application (ES).**

Receptor name	Period	Ambient	Construction noise range dB $L_{Aeq}$	ABC Threshold level, dB $L_{Aeq}$	Total noise (ambient plus construction) dB $L_{Aeq}$	Increase in total noise dB $L_{Aeq}$	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*
KE1 Prospect Wharf	(day)	57	52-67	65	67	10	Significant	Significant				
	(eve)	52	33-51	55	55	3						
KE4 4 Shadwell Pierhead	(day)	57	39-57	65	60	3						
	(eve)	52	30-45	55	53	1						
KE5 35 Peartree Lane	(day)	57	39-56	65	60	3						
	(eve)	52	29-44	55	53	1						
KE6 The Highway	(day)	78	50-65	78	78	0						
	(eve)	76	36-52	76	76	0						
KE7 Free Trade Wharf North	(day)	78	57-70	78	79	1						
	(eve)	76	42-56	76	76	0						

Question 29.2: Supplementary information

Receptor name	Period	Ambient	Construction noise range dB $L_{Aeq}$	ABC Threshold level, dB $L_{Aeq}$	Total noise (ambient plus construction) dB $L_{Aeq}$	Increase in total noise dB $L_{Aeq}$	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*
KE8 Free Trade Wharf Middle	(day)	64	59-72	70	73	9	Significant	Significant				
	(eve)	60	42-57	65	62	2						
KE9 Free Trade Wharf South	(day)	62	63-80	65	80	18	Significant	Significant	Significant	NI	NI	NI
	(eve)	60	44-61	65	64	4						
KE10 Abbotshade Road	(day)	57	49-64	65	65	8						
	(eve)	52	38-53	55	56	4						

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.

All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs

\*Construction noise only

Question 29.2: Supplementary information

**Table 3b – King Edward Memorial Park Foreshore (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’, and ‘pure ABC’ methods (worst month assessment). Assessment including further mitigation identified since submission of the application.**

Receptor name	Period	Ambient	Construction noise range dB $L_{Aeq}$	ABC Threshold level, dB $L_{Aeq}$	Total noise (ambient plus construction) dB $L_{Aeq}$	Increase in total noise dB $L_{Aeq}$	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*
KE1 Prospect Wharf	(day)	57	52-67	65	67	10	Significant	Significant				
	(eve)	52	33-51	55	55	3						
KE4 4 Shadwell Pierhead	(day)	57	39-57	65	60	3						
	(eve)	52	30-45	55	53	1						
KE5 35 Peartree Lane	(day)	57	39-56	65	60	3						
	(eve)	52	29-44	55	53	1						
KE6 The Highway	(day)	78	50-65	78	78	0						
	(eve)	76	36-52	76	76	0						
KE7 Free Trade Wharf North	(day)	78	57-70	78	79	1						
	(eve)	76	42-56	76	76	0						
KE8 Free Trade Wharf Middle	(day)	64	59-72	70	73	9	Significant	Significant				
	(eve)	60	42-57	65	62	2						

Question 29.2: Supplementary information

Receptor name	Period	Ambient	Construction noise range dB $L_{Aeq}$	ABC Threshold level, dB $L_{Aeq}$	Total noise (ambient plus construction) dB $L_{Aeq}$	Increase in total noise dB $L_{Aeq}$	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method*	ES ABC method*
KE9 Free Trade Wharf South	(day)	62	63-80	65	80	18	Significant	Significant	Significant	NI	NI	NI
	(eve)	60	44-61	65	64	4						
KE10 Abbotshade Road	(day)	57	49-64	65	65	8						
	(eve)	52	38-53	55	56	4						

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.  
 All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs  
 \*Construction noise only



### Chambers Wharf

**Table 4a – Chambers Wharf (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’ and ‘pure ABC’ methods (worst month assessment). Assessment including embedded mitigation as identified in the application (ES).**

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method *
CW1 Luna House	(day)	64	50-79	70	79	15	Significant	Significant	Significant	NI	NI	NI
	(eve)	54	35-61	60	62	8	Significant	Significant	Significant			
	(night)	44	35-57	50	57	13	Significant	Significant	Significant	NI	NI	NI
CW2 Axis Court	(day)	62	52-75	70	75	13	Significant	Significant	Significant			
	(eve)	57	36-57	60	60	3						
	(night)	47	36-53	45	54	7	Significant	Significant	Significant	NI	NI	NI
CW3 10-28 Chambers Street	(day)	57	50-63	65	64	7						
	(eve)	53	34-51	60	55	2						
	(night)	45	36-47	50	49	4						
CW5 Chambers Wharf	(day)	58	52-65	65	66	8						
	(eve)	55	35-56	60	59	4						
	(night)	50	36-47	55	52	2						

Question 29.2: Supplementary information

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method *
CW6 1-13 Loftie Street	(day)	58	49-65	65	66	8						
	(eve)	55	33-56	60	59	4						
	(night)	50	36-43	55	51	1						
CW7 210-212 Bevington Street	(day)	55	50-65	65	65	10						
	(eve)	55	35-56	60	59	4						
	(night)	42	35-45	45	47	5						
CW8 8-14 Fountain Green Square	(day)	55	48-63	65	64	9						
	(eve)	55	33-51	60	56	1						
	(night)	42	35-44	45	46	4						
CW9 35 Wapping High Street	(day)	60	39-55	65	61	1						
	(eve)	57	23-44	60	57	0						
	(night)	50	26-45	55	51	1						
CW10 Houseboats	(day)	64	40-60	70	65	1						
	(eve)	54	27-47	60	55	1						
	(night)	44	30-43	50	47	3						

Question 29.2: Supplementary information

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method *
CW11 33 East Lane	(day)	64	48-70	70	71	7	Significant					
	(eve)	54	36-47	60	55	1						
	(night)	44	37-46	50	48	4						

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.

All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs

\*Construction noise only

Question 29.2: Supplementary information

**Table 4b – Chambers Wharf (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’, and ‘pure ABC’ methods (worst month assessment). Assessment including further mitigation identified since submission of the application.**

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method*	ES ABC method*
CW1 Luna House	(day)	64	50-77	70	77	13	Significant	Significant	Significant	NI	NI	NI
	(eve)	54	35-60	60	61	7	Significant					
	(night)	44	35-47	50	49	5						
CW2 Axis Court	(day)	62	52-74	70	74	12	Significant	Significant	Significant			
	(eve)	57	36-57	60	60	3						
	(night)	47	36-45	45	49	2						
CW3 10-28 Chambers Street	(day)	57	50-61	65	62	5						
	(eve)	53	34-50	60	55	2						
	(night)	45	36-40	50	46	1						
CW5 Chambers Wharf	(day)	58	52-65	65	66	8						
	(eve)	55	35-53	60	57	2						
	(night)	50	36-45	55	51	1						

Question 29.2: Supplementary information

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method *
CW6 1-13 Loffie Street	(day)	58	49-64	65	65	7						
	(eve)	55	33-53	60	57	2						
	(night)	50	36-42	55	51	1						
CW7 210-212 Bevington Street	(day)	55	50-65	65	65	10						
	(eve)	55	35-49	60	56	1						
	(night)	42	35-44	45	46	4						
CW8 8-14 Fountain Green Square	(day)	55	48-63	65	64	9						
	(eve)	55	33-52	60	57	2						
	(night)	42	35-41	45	45	3						
CW9 35 Wapping High Street	(day)	60	39-54	65	61	1						
	(eve)	57	23-48	60	58	1						
	(night)	50	26-40	55	50	0						
CW10 Houseboats	(day)	64	40-58	70	65	1						
	(eve)	54	27-50	60	55	1						
	(night)	44	30-43	50	47	3						

Question 29.2: Supplementary information

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method*	ES ABC method*
CW11 33 East Lane	(day)	64	48-68	70	69	5	Significant					
	(eve)	54	36-48	60	55	1						
	(night)	44	37-46	50	48	4						

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.  
 All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs  
 \*Construction noise only

Question 29.2: Supplementary information

**Shad Thames Pumping Station**

**Table 5a – Shad Thames Pumping Station (residential only): Table 2a – CRR (residential only): Direct construction and total noise levels and significance decisions according to '5dB(A) change' and 'pure ABC' methods (worst month assessment). Assessment including embedded mitigation as identified in the application (ES).**

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*
ST1 Vanilla and Sesame Court	(day)	56	23-63	65	64	8						
ST2 Tamarind Court (Rear)	(day)	56	29-63	65	64	8						
ST3 Wheat Wharf (residential)	(day)	56	24-72	65	72	16	Significant	Significant	Significant			
ST4 Tamarind Court (Front)	(day)	61	59-83	65	83	22	Significant	Significant	Significant	NI	NI	NI
ST6 Coriander Court, Maguire Street	(day)	61	62-79	65	79	18	Significant	Significant	Significant	NI	NI	NI
ST7 Coriander Court, Gainsford Street	(day)	61	63-81	65	81	20	Significant	Significant	Significant	NI	NI	NI

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.

All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs

\*Construction noise only

Question 29.2: Supplementary information

**Table 5b – Shad Thames Pumping Station (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’, and ‘pure ABC’ methods (worst month assessment). Assessment including further mitigation identified since submission of the application.**

Receptor name	Period	Ambient	Construction noise range dB L <sub>Aeq</sub>	ABC Threshold level, dB L <sub>Aeq</sub>	Total noise (ambient plus construction) dB L <sub>Aeq</sub>	Increase in total noise dB L <sub>Aeq</sub>	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method*	ES ABC method*
ST1 Vanilla and Sesame Court	(day)	56	23-63	65	64	8						
ST2 Tamarind Court (Rear)	(day)	56	29-63	65	64	8						
ST3 Wheat Wharf (residential)	(day)	56	24-72	65	72	16	Significant	Significant				
ST4 Tamarind Court (Front)	(day)	61	59-83	65	83	22	Significant	Significant	Significant	NI	NI	NI
ST6 Coriander Court, Maguire Street	(day)	61	62-79	65	79	18	Significant	Significant	Significant	NI	NI	NI
ST7 Coriander Court, Gainsford Street	(day)	61	63-81	65	81	20	Significant	Significant	Significant	NI	NI	NI

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.  
 All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs  
 \*Construction noise only



Question 29.2: Supplementary information

**Bekesbourne Street**

**Table 6a – Minor works sites (Bekesbourne St) (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’ and ‘pure ABC’ methods (worst month assessment). Assessment including embedded mitigation as identified in the application (ES).**

Receptor name	Period	Ambient	Construction noise range dB LAeq	ABC Threshold level, dB LAeq	Total noise (ambient plus construction) dB LAeq	Increase in total noise dB LAeq	Significant?			Noise insulation or temporary rehousing qualification			
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*	
BK1 12 Ratcliffe Lane	(day)	66	64-70	70	71	5	Significant						
BK2 John Scurr House	(day)	58	74-78	65	78	20	Significant	Significant	Significant	NI	NI	NI	NI
BK3 10-14 Bekesbourne Street	(day)	58	61-67	65	68	10	Significant	Significant	Significant				
BK4 1-11 Bekesbourne Street	(day)	58	61-67	65	68	10	Significant	Significant	Significant				
BK5 8 Bekesbourne Street	(day)	58	68-77	65	77	19	Significant	Significant	Significant				

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.

All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs

\*Construction noise only

Question 29.2: Supplementary information

**Table 6b – Minor works sites (Bekesbourne St) (residential only): Direct construction and total noise levels and significance decisions according to ‘5dB(A) change’, and ‘pure ABC’ methods (worst month assessment). Assessment including further mitigation identified since submission of the application.**

Receptor name	Period	Ambient	Construction noise range dB LAeq	ABC Threshold level, dB LAeq	Total noise (ambient plus construction) dB LAeq	Increase in total noise dB LAeq	Significant?			Noise insulation or temporary rehousing qualification		
							5dB change method	Pure ABC method*	ES ABC method*	5dB change method	Pure ABC method *	ES ABC method*
BK1 12 Ratcliffe Lane	(day)	66	64-70	70	71	5	Significant					
BK2 John Scurr House	(day)	58	74-78	65	78	20	Significant	Significant	Significant	NI	NI	NI
BK3 10-14 Bekesbourne Street	(day)	58	61-67	65	68	10	Significant	Significant	Significant			
BK4 1-11 Bekesbourne Street	(day)	58	61-67	65	68	10	Significant	Significant	Significant			
BK5 8 Bekesbourne Street	(day)	58	68-77	65	77	19	Significant	Significant	Significant			

Note that the associated written response recommends that the ExA should disregard the apparent findings in this table.  
 All NITR qualifications are subject to confirmation in line with the *Non statutory off-site mitigation and compensation policy* and relevant TAPs  
 \*Construction noise only

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## **Appendix A – Crossrail Technical Report: Appendix D – Construction noise, triggers for significance, noise insulation and temporary rehousing \***

\* Crossrail Technical Report, Assessment of Noise and Vibration Impacts; Volume 1 of 8 – Introduction, Scope and Methodology: Appendix D – Construction Noise, Triggers for Significance, Noise Insulation and Temporary Rehousing

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**APPENDIX D**  
**CONSTRUCTION NOISE, TRIGGERS FOR SIGNIFICANCE, NOISE INSULATION AND**  
**TEMPORARY RE-HOUSING**

**CROSSRAIL****CONSTRUCTION NOISE****Triggers for significance, Noise Insulation and Temporary Re-housing****Note by Rupert Taylor**

14 June 2004

Revised 6 July 2004 and 16 February 2005 (PSE)

This paper considers the appropriateness of the system developed for triggering “significance” and noise insulation and temporary re-housing in the noise for the noise and vibration assessment.

The system of determining significance originated in the construction noise specialist report prepared by Arup Acoustics for the Channel Tunnel Rail Link ES. It is as follows:

Assessment Category and threshold value period $L_{Aeq}$	A	B	C
NIGHT-TIME (2300-0700)	45	50	55
Evening and weekends*	55	60	65
Daytime (0700-1900)	65	70	75

\*1900-2300 weekdays, 1300-2300 Saturdays and 0700-2300 Sundays

1. Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
2. Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
3. Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.
4. The category (A, B, or C) is to be determined separately for each time period and the lowest category is then used throughout the 24-hour cycle. (E.g. a site which is category A by day and category B or C in the evening and night will be treated as category A for day, evening and night)

Note 4 was added by Thameslink 2000 to deal with anomalies caused by sites near main line railways that had high whole-night ambients due to rail traffic during operating hours, but low ambients between operating hours.

The triggers for the determination of NI and TRH, which originated in preparation of the first Crossrail Bill, were as follows:

- 4.7 Noise insulation (or grant) will be offered to eligible buildings where the predicted total noise level exceeds either the trigger level for insulation set out in the Table, or a figure 5 dB above the existing airborne noise level for the corresponding times of the day, whichever is the higher, for more than of 10 out of 15 consecutive working days or for a total of days exceeding 40 in any six month period.
- 4.8 In the exercise of its discretion under Section 28 of the Land Compensation Act 1973, CLRL will offer temporary re-housing where the predicted total noise level exceeds either the trigger level for temporary re-housing, or a figure 10 dB above the existing airborne noise level for the corresponding times of the day, whichever is the higher, for more than 10 out of 15 consecutive working days or for a total of days exceeding 40 in any six month period.”

**TABLE 4.7 AIRBORNE NOISE TRIGGER LEVELS FOR NOISE INSULATION AND TEMPORARY RE-HOUSING**

Time	Relevant Time Period	Averaging Time T	Noise Insulation Trigger Level $L_{Aeq,T}$	Temporary Re-housing Trigger Level $L_{Aeq,T}$
Monday to Friday	07.00 - 08.00	1 hr	70	80
	08.00 - 18.00	10 hr	75	85
	18.00 - 19.00	1 hr	70	80
	19.00 - 22.00	3 hr	65	75
	22.00 - 07.00	1 hr	55	65
Saturday	07.00 - 08.00	1 hr	70	80
	08.00 - 13.00	5 hr	75	85
	13.00 - 14.00	1 hr	70	80
	14.00 - 22.00	3 hr	65	75
	22.00 - 07.00	1 hr	55	65
Sunday and Public Holidays	07.00 - 21.00	1 hr	65	75
	21.00 - 07.00	1 hr	55	65

Both the significance thresholds and the NI/TRH triggers are plotted in Figures 1. and 2. for daytime. The plots ignore the fact that daytime for the significance thresholds is 0700-1900 while the daytime NI/TRH trigger are for 0800-1800. If the lower triggers for the two shoulder hours are taken into account, it lowers the trigger levels by 0.5 dB. In addition to the above, the relative attenuations provided by various glazing types/window states relative to external levels and effects are described in the table at the end of this paper.

The primary discussion which follows is about daytime. The considerations for other periods including night-time are addressed subsequently. All levels referred to are façade levels.



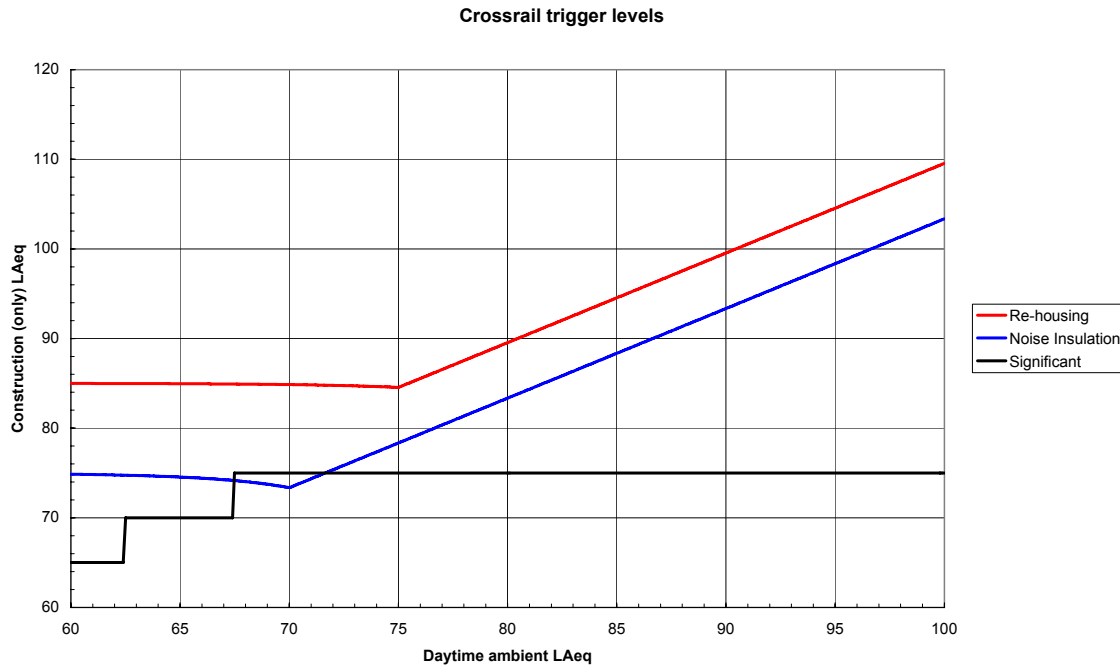


Figure 1. Significance triggers and NI/TRH thresholds plotted in terms of absolute construction noise levels

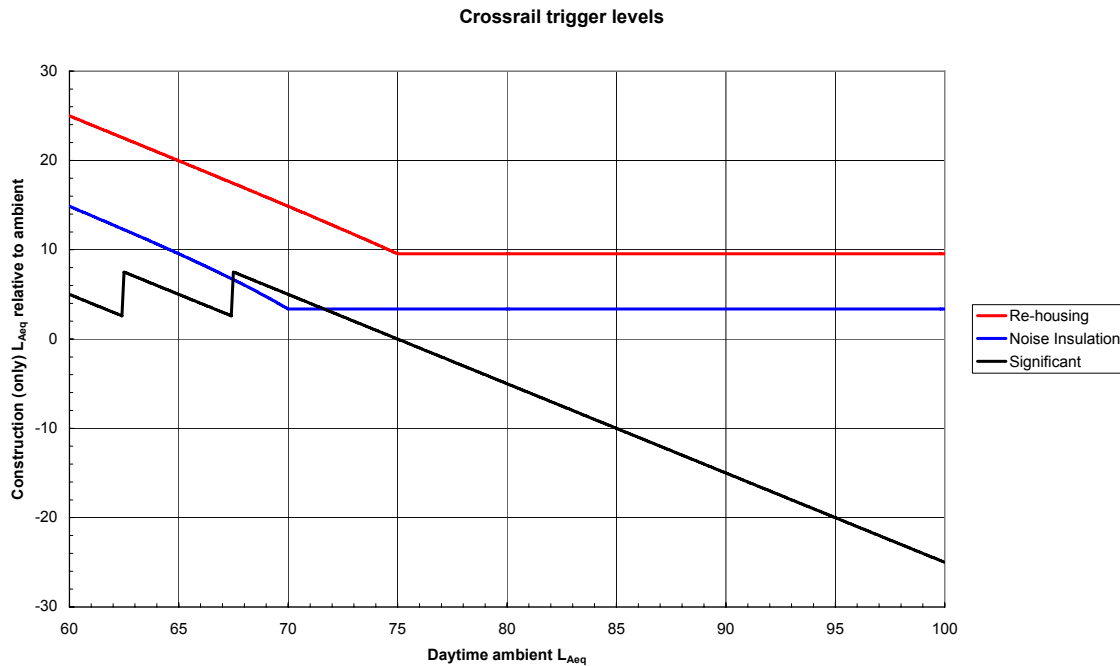


Figure 2. Significance and NI/TRH thresholds plotted in terms of difference between construction noise levels and ambient

There are four notable features about Figures 1. and 2. Firstly, the significance threshold is saw-tooth in shape at the lower end. This is a consequence of the 5dB rounding that is required, and it is an advantage when assessing large schemes for which measured ambient data are not universally available. It reduces the uncertainty which results when estimates of ambient noise category are made. However, when measured data are available, it produces the saw-tooth effect which is otherwise unjustifiable.

The second feature of the figures is that the Noise Insulation trigger is lower than the significance threshold when the ambient is from 67.5 to 71.6  $L_{Aeq}$ . This is a consequence of the fact that the significance thresholds are written in terms of levels of **construction noise only**, whereas the NI/TRH triggers are written in terms of the **total noise level**, i.e. construction noise and ambient  $L_{Aeq}$  levels combined. This is anomalous.

The third feature is the fact that the pure construction noise trigger actually dips down in the region of 70 dB (NI) and 75 dB (TRH). This has rather impracticable consequences. The fourth feature is that the significance trigger is a flat-line above 75  $L_{Aeq}$  even when the ambient rises to much higher levels. There is some logic behind this if the ambient  $L_{Aeq}$  is caused by discrete noise events, e.g. train passages, and conceals a reasonably low background noise between events, whereas construction noise tends to be fairly continuous throughout the day. Construction noise could in those circumstances cause greater intrusion than simple  $L_{Aeq}$  comparisons would suggest. Against this, it must be noted that more sophisticated environmental noise indicators, now disused in favour of simpler indices, such as Noise Pollution Level (NPL) and Traffic Noise Index operate in the opposite direction, weighting the result upwards, if there is a large difference between the peaks and the troughs in ambient noise. If construction noise were assessed using NPL, in some circumstances it could reduce the resulting level by smoothing out the peaks and the troughs (filling in the troughs).

If the CTRL significance system had not already been established by the process of the passage of the CTRL Bill, it is possible it would not be in use. Its use persists because of the power and convenience of precedent.

In much earlier schemes, there was a tendency to assess construction noise based on the recommendation of the Wilson Report repeated in Advisory Leaflet 72 (still technically a current document) and have a simple threshold of 75  $L_{Aeq}$  for busy urban areas and 70  $L_{Aeq}$  for other areas. The CTRL system is an advance on that approach, at the lower end of the ambient noise range.

If there were no precedents, a fresh system of assessment would probably look at the marginal increase of total noise over baseline, with a lower cut-off and possibly an upper cut-off as well. The question would be what should the margin be? The figure of 5 dB appears in the NI/TRH triggers largely for enforceability reasons. Any small margin would be much more difficult to measure, given that a NI/TRH policy can be enforced after construction begins. By contrast, environmental assessments are completed before construction begins and are based on prediction alone. Where there are deterministic prediction methods, such as CRTN for highway noise, it is possible to look at quite small margins, like 1 dB, as in the Design Manual for Roads and bridges (that is not to say that CRTN is accurate to within 1 dB – its standard error has been calculated by one authority at 2.8 dB, but the prediction algorithm is repeatable to an accuracy of 0.1 dB). By contrast, because of plant uncertainties, and construction working method uncertainties, construction noise predictions made by two different competent predictors can easily differ by +2.5 dB or so. Consequently the margin should be no less than about 3 dB and 5 dB is not unreasonable. Actual 5 dB increases in  $L_{Aeq}$  levels for, for example, airport noise, are regarded as significant.

The lower cut-off needs to be at a point where, though there is a 5 dB increase, the resulting ambient noise level is still below significance in impact terms. At the upper end, the cut-off argument would certainly need to take account of the fact that if outdoor noise levels already exceed the “limit of the acceptable”, then any material increase is significant unless there is noise insulation in place. The term “limit of the acceptable” underlies the setting of the noise insulation limits for highways and railways, and the original written parliamentary answer that presaged the introduction of the original highway noise insulation regulations said that 70 dB  $L_{A10\ 18h}$  was the limit of the acceptable (the reason why the NI trigger was set at 68 is to allow for 2 dB measurement uncertainty). The equivalent in terms of  $L_{Aeq\ 16h}$  is about 68 dB according to PPG 24. This makes the Crossrail significant threshold system, flatlining at 75 dB, supportable, not to say a little generous, which is justified by the finite duration of construction noise.

When the first NI/TRH policy was introduced during the passage of the Jubilee Line Extension Bill, it was explicitly stated that its purpose was to fill the gap left by the presence of Statutory NI schemes for operating roads and railway but the absence of other than a discretionary scheme for construction noise. It is really intended to sit alongside the other statutory schemes for operational transportation. (There are, of course NI schemes for airports, but they differ among different airports).

The statutory NI schemes use, as a margin, 1 dB (with other caveats as well). As explained above, such a small margin would be unworkable for construction noise because of the inherent uncertainty in the prediction process.

The Wilson recommendation was explicitly made on the basis that the sound reduction of a closed single window was 15-20 dB. He talks about “ill-fitting windows”. A large amount of window renewal has taken place since the 1960s, and PPG 24 says that the typical noise reduction of a dwelling façade with windows set in a brick/block wall is 27-30 dB(A) depending on the source. So there is an argument for raising the upper cut-off by at least 7 dB. However, Wilson’s recommendation was 70, not 75. This was based on an internal noise level of 55 dB and windows giving a 15 dB reduction.  $L_{Aeq}$  did not exist in Wilson’s time, but he appeared to be assessing a more or less continuous noise level.

In fact, current practice is to assume a 15 dB reduction for a partially open window. The figure of 75 was introduced to prevent the setting of construction noise limits below those of existing ambients in urban areas near main roads and heavy industrial areas. So an increase in the upper cut-off of the significance thresholds would take us to at least 82 dB ( $70+27-15=82$  or  $82-27=55$ ).

An aspect of significance which has to be mentioned is the significance of not being able to open the windows that face the noise source.

There is a step in the curve of significance that occurs at the point where people close their windows against external noise. If they have to do this because of ambient noise in any event, then construction noise will not take them back to the point just before they closed the windows until it is 82 dB or perhaps a little more. There is therefore an argument for adding another category that causes the flatline to be at 80 dB rather than 75 dB.

If the dwelling already has secondary glazing, or even double glazing, then there is an analogous argument for adding yet another category, taking the flatline up to 85 dB.

However, with an ambient above 77.5 (as would be the case to cause a trigger of 85), the total noise level would exceed the upper exposure action value of the proposed Control of Noise at Work Regulations 2005.

A cut-off at the low end of the range of ambient noise levels is required to avoid significance occurring at unreasonably low noise levels. For a permanent noise source, to allow partially open windows, there is an argument that the cut-off should be an external noise level of 55 dB  $L_{Aeq}$  in line with the World Health Organization's guidelines "Guidelines for Community Noise" (1999)<sup>1</sup>.

For construction noise, which is of limited duration and subject to a balance between ideal objectives and reasonably practicable achievement, the assumption of a closed window in the façade facing the source would raise the cut-off from 55 to a figure at least 12 dB higher (taking the difference between 15 dB for a partially open window as assumed by WHO and the minimum of 27 dB for windows set in brick/block wall as per PPG24). The historical position in fact leads to the conclusion that the lower cut-off should be the cut-off for category A in the CTRL/TL2K system, i.e. 65 dB  $L_{Aeq}$  for daytime.

### *Evening and night*

The arguments for daytime need to be considered anew for night, as the effects are different – being sleep disturbance and annoyance while awake (for any reason) rather than interference with activities. The WHO guidance suggests that sound pressure levels during the evening and night should be 5-10 dB lower than during the day. In fact, the CTRL/TL2K categories go down in 10 dB steps from day through evening to night.

There is more specific guidance for night-time than for evening, and it is helpful to consider night-time first, and then to consider evening. While BS 5228 no longer gives guidance on acceptable daytime noise levels, it is more specific about evening and night: "*Hours of work*. For any noise sensitive premises some periods of the day will be more sensitive than others.

For example levels of noise that would cause speech interference in an office during the day would cause no problem in the same office at night. For dwellings, times of site operation outside normal weekday working hours will need special consideration. Noise control targets for the evening period in such cases will need to be stricter than those for the daytime and, when noise limits are set, the evening limit may have to be as much as 10 dB(A) below the daytime limit. Very strict noise control targets should be applied to any site which is to operate at night. The periods when people are getting to sleep and just before they wake

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<sup>1</sup> The guidance advises that, during daytime, few people are seriously annoyed by activities with  $L_{Aeq}$  levels below 55 dB; or moderately annoyed by activities with  $L_{Aeq}$  levels below 50 dB. Sound pressure levels during the evening and night should be 5-10 dB lower than during the day. Noise with low-frequency components requires even lower levels. It is emphasized that for intermittent noise it is necessary to take into account the maximum sound pressure level as well as the number of noise events. Inside bedrooms the effect considered is sleep disturbance and the guidance values representing the level at which there is no effect, are 30 dB  $L_{Aeq,8h}$  45 dB  $L_{Amax}$ , fast, for night time, with corresponding outdoor values, window open, of 45 dB  $L_{Aeq,8h}$ , and 60 dB  $L_{Amax}$ , fast.

appear to be particularly sensitive. Site noise expressed as  $L_{Aeq(1h)}$  at the facade of noise-sensitive premises may need to be as low as 40 dB(A) to avoid sleep disturbance.”

The WHO guidelines are generally regarded as the most stringent, and while the BS 5228 figure of 40 dB(A) is consistent with an assumption of a wide open window, it is reasonable to take the WHO assumption of a partially open window in which case the external guideline figure is 45 dB  $L_{Aeq}$ . In contrast to BS 5228, the WHO guidance uses a time base of 8 hours for night-time, but it is coupled to a maximum noise limit equivalent to 60 dB  $L_{Amax, F}$  external. There thus is support for the cut-off for evening and night being the same as the category “A” figures in the CTRL/TL2K system. The next matter for consideration is the case where the pre-existing ambient modifies the position.

If the pre-existing ambient is higher than the category “A” triggers, it is likely that the resident concerned does not use open windows facing the source of the noise for ventilation. Thus, up to about 55 dB  $L_{Aeq 8h}$  external (and 70 dB  $L_{Amax, F}$ ), internal noise levels would achieve the WHO guidelines with windows closed. Above this figure, noise insulation would be required. The question becomes one of determining the marginal increase caused by the construction noise that triggers eligibility for noise insulation. For night-time, it could be argued that a 5 dB margin is too great, and whereas a resident may have undisturbed sleep with closed windows and ventilation from another façade in the house at an external  $L_{Aeq}$  of 55 dB, disturbance would occur at an external  $L_{Aeq}$  of 59 dB, but noise insulation would not be triggered. One of the main justifications for the 5 dB margin is the accuracy of prediction and the practicality of enforcement/verification and it remains as true for night as for day so that narrowing of the 5 dB margin for night is not appropriate.

However, while the WHO guidance is assessed in terms of  $L_{Aeq 8h}$ , the noise insulation and temporary re-housing trigger is expressed in terms of  $L_{Aeq 1h}$ . Since the night-time ambient will in most cases vary significantly hour-by-hour such that the early hours of the morning are often considerably quieter than the adjacent periods, this overcomes the problem of the need for a narrower margin at night since the adoption of a 1-hour time base rather than an 8 hour time base makes the system more sensitive. While it does not explicitly deal with the WHO  $L_{Amax, F}$  recommendation,  $L_{Aeq 1h}$  is much more sensitive to maximum noise levels than  $L_{Aeq 8h}$ . The significance triggers need to be in line with the NI/TRH triggers, so if the “saw tooth” framework is to be replaced with a continuous curve, as is appropriate for daytime, the time base needs to be changed to 1 hour for night and 3 hours for evening.

## RECOMMENDATIONS

It is recommended that the “saw-tooth” significance threshold system be replaced by a simple test that significance occurs if the total of construction noise combined with ambient noise is 5dB or more greater than the ambient  $L_{Aeq}$  for the corresponding period. The periods for significance assessment should coincide with the periods in the NI/TRH policy. There should be a lower cut-off corresponding to the Category “A” figures, but to avoid a dip in the limit for construction noise limit as it approaches the ambient, the cut-off should be stated in terms of the level due to construction noise only, not the combined level due to construction noise and ambient.

The noise insulation trigger should be restated to remove the downward dip as the ambient tends towards 70 dB, as set out below.

Also to remove the dip as the ambient tends towards 75, the TRH trigger should be rephrased in terms of the level of construction noise, not total noise, as set out below. For construction noise levels below the NI trigger, the reported significance becomes the effect of having to close windows facing the source.

For construction noise levels above the NI trigger, the reported significance becomes the effect of having noise insulation rather than the direct effect of noise.

Where total noise levels exceed 85 dB, this should be reported in terms of the effect of causing potential hearing impairment risk for dwellings with balconies or gardens or that people are prevented from being outside for extended periods.

Appropriate wording for the determination of impact is therefore considered to be as follows:

- Noise insulation (or grant) will be offered to eligible buildings where the predicted noise level due to construction exceeds the trigger level for insulation set out in the Table, or the total noise exceeds a figure 5 dB above the existing airborne noise level for the corresponding times of the day, whichever is the higher, for more than of 10 out of 15 consecutive working days or for a total of days exceeding 40 in any six month period.
- In the exercise of its discretion under Section 28 of the Land Compensation Act 1973, CLRL will offer temporary re-housing where the predicted construction noise level exceeds either the trigger level for temporary re-housing, or a figure 10 dB above the existing airborne noise level for the corresponding times of the day, whichever is the higher, for more than 10 out of 15 consecutive working days or for a total of days exceeding 40 in any six month period.”

The consequential thresholds and triggers are shown in Figures 3. to 8. As far as the shoulder periods in the NI/TRH policy either side of the core working day are concerned, it is inappropriate to devise significance thresholds for them as construction planning detail would not be available in sufficient detail.

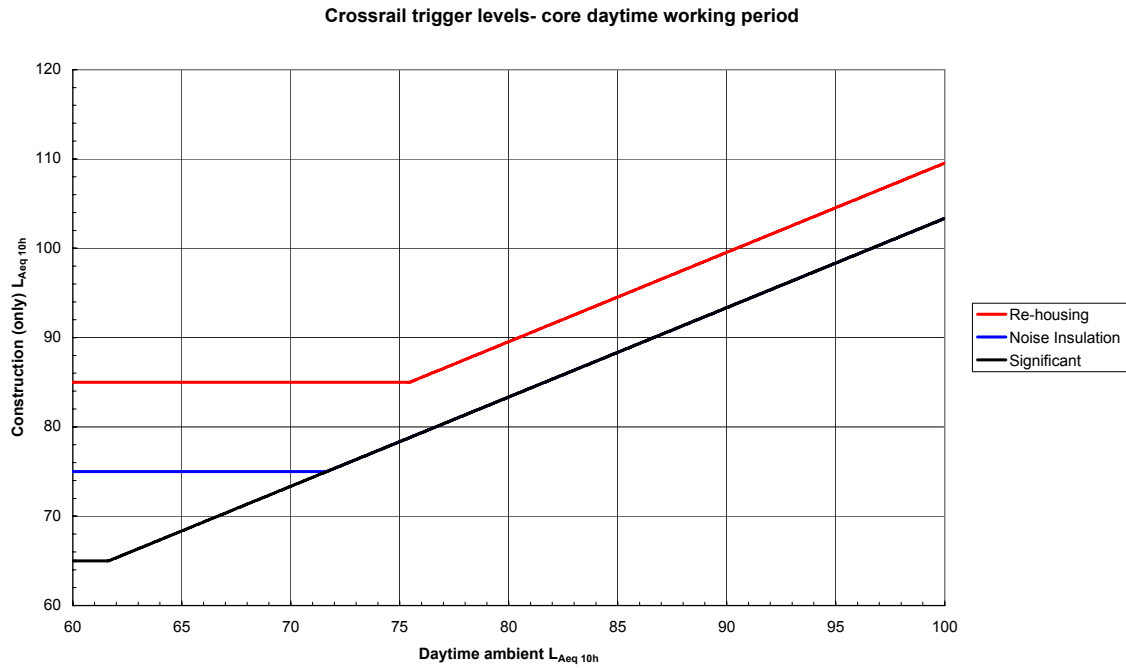


Figure 3. Recommended revised significance triggers and NI/TRH thresholds – core daytime working period

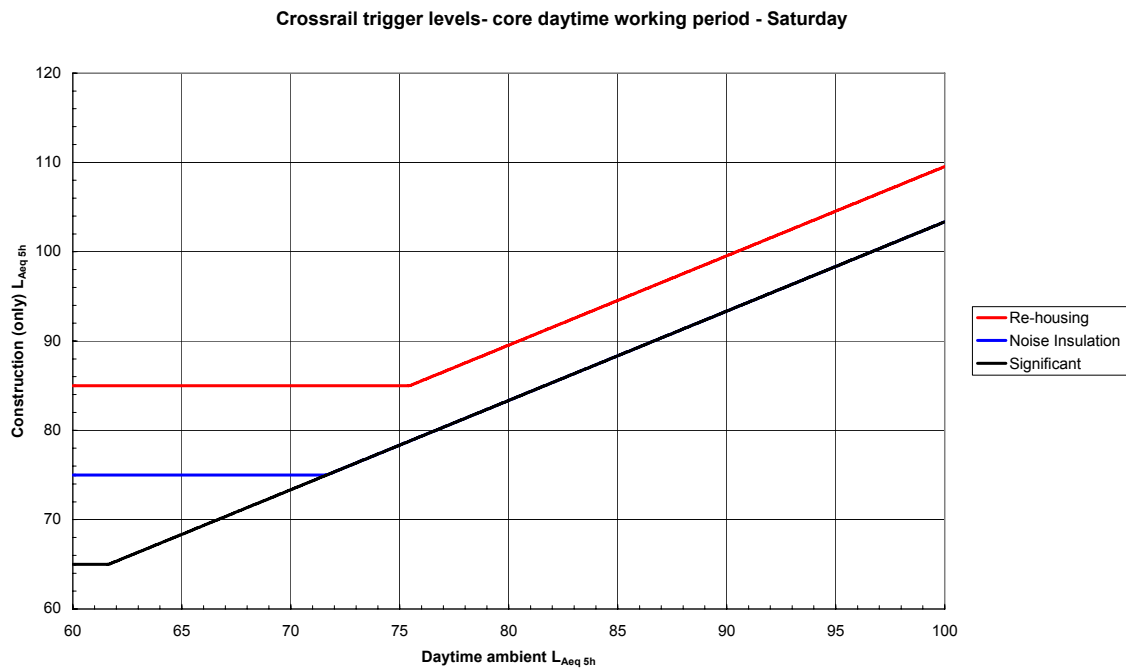


Figure 4. Recommended revised significance triggers and NI/TRH thresholds –Saturday core daytime working period

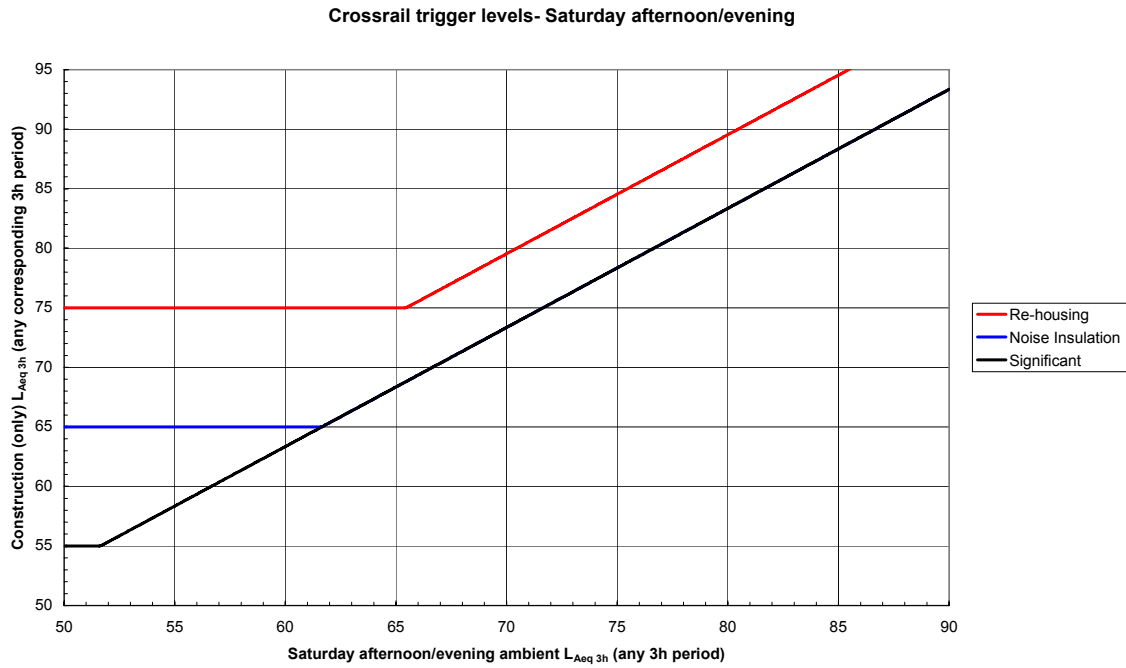


Figure 5. Recommended revised significance triggers and NI/TRH thresholds –Saturday afternoon/evening

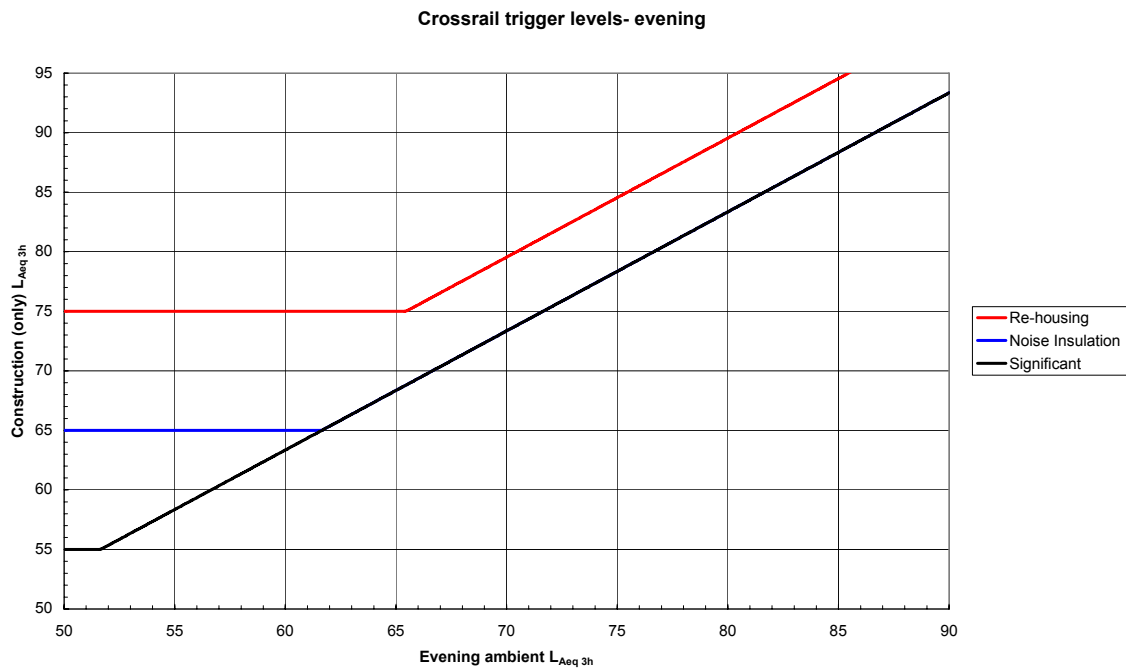


Figure 6. Recommended revised significance triggers and NI/TRH thresholds – evening



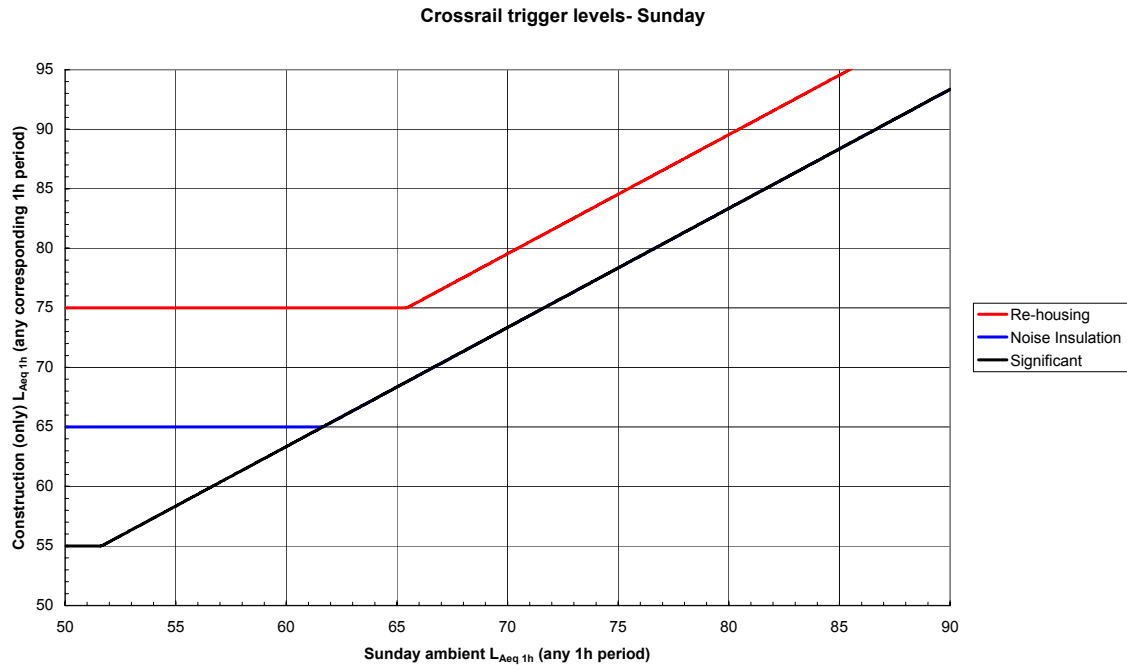


Figure 7. Recommended revised significance triggers and NI/TRH thresholds – Sunday

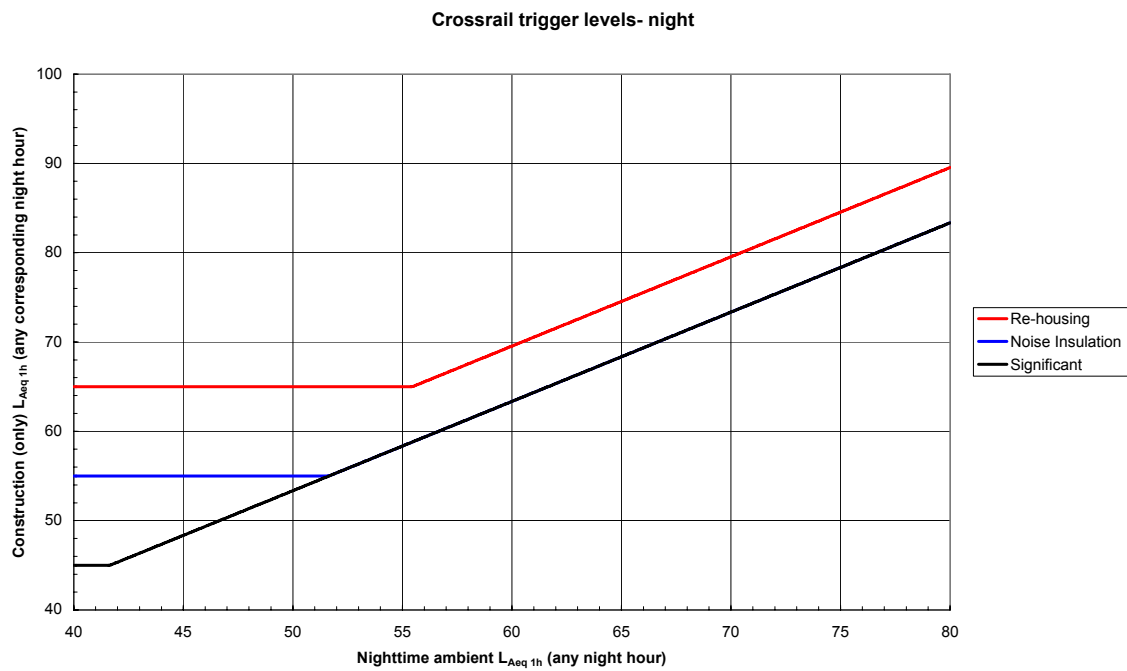


Figure 8. Recommended revised significance triggers and NI/TRH thresholds - night

External daytime noise level: (Notes 2,3 and 4)	Window state	Ventilation state	Internal Noise Level (Note 5)	Effect: (Notes 1 and 3)	Category
≤55	Open	natural	≤40	Few people seriously annoyed per WHO	0
55-65	Partially Open	natural	40-50	Some people seriously annoyed per WHO - at least 5dB better than Wilson/AL72	1
65-75	Closed single	from another facade if available	35-48	Some people seriously annoyed at upper end - at least 7dB better than Wilson/AL72 -ventilation problems	2
75-85	Noise Insulation	Forced noise-attenuated ventilator unit	36-51	Some people seriously annoyed at upper end - at least 4dB better than Wilson/AL72 -ventilation problems	3
>85	House unoccupied through TRH	Not relevant	Not relevant	Dislocation	4

**Note 1:**

WHO recommends 40 dB to achieve few people seriously annoyed; 35dB to achieve few people moderately annoyed. The latter figure appears in their table of guideline values for community noise in dwellings except bedrooms. WHO guidance is about characterless noise such as traffic noise, but is in terms of  $L_{Aeq, 16hours}$ .

**Note 2:**

External noise level triggers are the minimum thresholds for daytime. They rise in areas of high pre-existing noise level to the point where construction noise (only) is 5 dB more than the pre-existing ambient. This can cause WHO/Wilson/AL72 guidance to be well exceeded, but if it were not introduced would result in the project having to insulate properties on account of not caused by the project. A smaller margin than 5 dB would be impracticable.

**Note 3:**

All levels reduced by 10 dB at night. This gives up to around 10 dB above WHO's guideline value of 30 dB in bedrooms, but for an 8-hour averaging time, whereas the Crossrail night time averaging time is 1h.

**Note 4:**

Noise levels are dB  $L_{Aeq, 10hours}$  for daytime, this becomes 1h for night (see Notes 1 and 3)

**Note 5:**

Noise reductions for single glazing and secondary glazing are taken from PPG 24, which does not list construction noise as a source, so the range for the sources given is used above.

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### **Thames Water Utilities Limited**

Clearwater Court, Vastern Road, Reading RG1 8DB

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