



CROSSRAIL INFORMATION PAPER

D10 – GROUNDBORNE NOISE AND VIBRATION

This paper explains the measures that will be put in place to control the effects of groundborne noise and vibration that might otherwise arise from the construction and operation of the railway in the Crossrail tunnels.

It will be of particular relevance to those in proximity to the Crossrail running tunnels.

This is not intended to replace or alter the text of the paper itself or any commitments contained in it, and it is important that you read the paper in order to have a full understanding of the subject. If you have any queries about this paper or about how groundborne noise and vibration from the Crossrail tunnels might affect you, please contact either your regular Petition Negotiator at CLRL or the Crossrail helpdesk, who will be able to direct your query to the relevant person at CLRL. The helpdesk can be reached at:

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APPROVED

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NOTE: An Information Paper on groundborne noise and vibration (IP D10) was published in January 2006 (Version 1 – 09/12/05). This revised Information Paper sets out an updated version of IP D10, reflecting discussions held with the London Borough of Camden, the lead local authority on the generic issue of groundborne noise and vibration, since January 2006, and replaces Version 1.

1. Introduction

1.1 This Information Paper explains the measures that will be put in place to control the effects of groundborne noise and vibration that might otherwise arise from the construction and operation of the railway in the Crossrail tunnels.

2. Groundborne Noise

2.1 Groundborne noise could arise from the movement of trains in Crossrail tunnels, during construction of the railway, during commissioning of the railway, or once the railway is operating passenger services.

2.2 There are no UK legislative standards or criteria that define when groundborne noise becomes significant. Crossrail has therefore drawn upon available experience in constructing new underground railways, e.g. the Jubilee Line Extension, Thameslink and the Channel Tunnel Rail Link. All of these projects adopted a threshold of significance for groundborne noise in residential properties of $40\text{dB}_{L_{A_{\text{max}},s}}$ ¹. This criterion was therefore adopted to assess the significance of potential groundborne noise impacts in residential properties during both construction and operation of Crossrail.

2.3 In the case of buildings lawfully used as reference libraries, lecture theatres, auditoria, theatres, hospitals, places of meeting for religious worship², schools and similar buildings, the use of which is particularly sensitive to noise or vibration, either the same or more stringent assessment criteria were adopted. The thresholds of significance used to assess the groundborne noise impacts of Crossrail are presented in Table 1 below.

¹ One of the properties of the simple time-varying sound level that is often of interest is the maximum level that it reaches, for example during the passage of a vehicle. This gives rise to the $L_{A_{\text{max}}}$ index. However, instruments set to measure the time-varying sound level can be switched to two settings, "slow" or "fast". These settings affect the way in which the sound pressure is averaged. The time constant in the averaging circuit is 1 second in the case of "slow" or 1/8 second in the case of "fast". To signify which time constant is used the letter "S" or "F" is added after $L_{A_{\text{max}}}$ to give either, $L_{A_{\text{max},s}}$ or $L_{A_{\text{max},f}}$. The slow setting gives more repeatable results.

Table 1: Construction^{1, 2} and Operational Groundborne Noise Criteria

Building	Level/Measure
Residential buildings	40dB L _{Amax,S}
Offices ³	40dB L _{Amax,S}
Hotels ³	40dB L _{Amax,S}
Theatres	25dB L _{Amax,S}
Large Auditoria/Concert Halls	25dB L _{Amax,S}
Sound recording studios	30dB L _{Amax,S}
Places of meeting for religious worship ⁴	35dB L _{Amax,S}
Courts, lecture theatres	35dB L _{Amax,S}
Small Auditoria/halls	35dB L _{Amax,S}
Schools Colleges	40dB L _{Amax,S}
Hospitals, laboratories	40dB L _{Amax,S}
Libraries	40dB L _{Amax,S}

Notes

1. Excluding the groundborne noise from the passage of the tunnel boring machine (TBM) (refer to section 2.4 in the main text below).
2. Significance with respect to the construction railway is assessed subject to paragraph 2.7.
3. Significance criteria not included in the Scope and Methodology set out in Appendix A2, Vol. 5 of the Crossrail Environmental Statement, added here for clarification.
4. Meaning a place the principal use of which is for people to come together as a congregation to worship God or do reverence to a deity.

2.4 These criteria will be adopted as the performance specification for the railway as the detailed design is developed. They do not apply to the noise of the tunnel boring machine (TBM) passage, including other tunnelling related activities, which is short-term and transitory and which was therefore qualitatively described in the Crossrail Environmental Statement³ and assessed as likely to have no significant impact.

2.5 The potential impact for construction and operation of the railway is set out in the Environmental Statement. The assessment assumes that where necessary, the potential impact is mitigated. For the temporary railway during construction the mitigation measures available were assumed to be:

³ The term 'Environmental Statement' refers to the Environmental Statement deposited with the Crossrail Bill in February 2005, the four Environmental Statements accompanying the Additional Provisions, the four Supplementary Environmental Statements submitted during the passage of the Bill, and their Non-Technical Summaries and errata, which together comprise the Crossrail Environmental Statement. The term 'the Main ES' refers specifically to the Environmental Statement produced (with its Non-Technical Summary) in February 2005. See <http://billdocuments.crossrail.co.uk/>.

- use of new rail (smooth track without corrugations or discrete irregularities) will be installed at the start of the works with joints achieving variation in rail height of not more than 2mm;
- where appropriate the use of resilient rail pads to fasten rails to the sleepers, or adequate elasticity to the support of the track system, between the rail foot and the sleeper, or tunnel invert, in order to reduce the transmission of vibration and groundborne noise from the passage of rail vehicles;
- a speed limit on construction trains of 15km/h;
- all diesel locomotives used will be fitted with efficient exhaust silencers; and
- a maintenance programme that ensures the condition of the track does not deteriorate over time thereby causing noise in breach of the agreed threshold.

2.6 The findings of the assessment (reported in the Environmental Statement) show that adoption of these measures is likely to result in the criteria for the performance specification for residential buildings, offices, hotels, schools, colleges, hospitals, laboratories and libraries not being breached at any location during the construction of Crossrail.

2.7 The nominated undertaker will endeavour to ensure that the groundborne noise from the operation of the temporary construction railway that is experienced by any theatre, large auditorium/concert hall, studio, place of meeting for religious worship, court, lecture theatre or small auditorium/hall, does not exceed the levels to which it is already subject by the presence of London Underground, other railway and road transport operations, or the levels listed in Table 1, whichever is the higher noise level, during the periods for which the buildings are in use.

2.8 During operation, the following measures were assumed to be available:

- standard trackform design to use continuously welded rail;
- the rails in tunnels will be supported on resilient track support systems, and track installation will be carried out using modern technology to achieve very much more accurately laid and smoother track than exists in traditional tube tunnels; and
- floating slab track or similar technology, including where it is predicted that standard trackform would result in the criteria in Table 1 being breached.

2.9 The nominated undertaker will be required to design the permanent track support system so that the level of groundborne noise near the centre of any noise-sensitive room is predicted in all reasonably foreseeable circumstances not to exceed the levels in Table 1. The nominated undertaker will be required to install the permanent track using a standard rail and/or track support system for the Crossrail tunnel sections. In any location where the standard system is predicted during detailed design to cause levels of groundborne noise exceeding the relevant assessment criterion an enhanced track support system will be installed.

2.10 The nominated undertaker will put in place measures that will ensure that the track of the underground sections and the wheels of the vehicles operating the Crossrail passenger service are maintained in a state which under all reasonably foreseeable circumstances will lead to adequate control of groundborne noise and vibration arising from the railway.

- 2.11 Prior to opening, the nominated undertaker will ensure that the rails of the underground sections of Crossrail are conditioned by grinding, or other suitable means, and are appropriately maintained thereafter. The nominated undertaker will be required, as part of the final track design development, to provide details to the local authorities addressing the frequency of routine maintenance regimes, and the criteria under which maintenance activities such as wheel turning and rail grinding will be triggered, to demonstrate that Best Practicable Means will be adopted during maintenance so far as relevant for the purpose of achieving the performance levels set out in Table 1 above.
- 2.12 The findings of the assessment (reported in the Environmental Statement) show that adoption of these measures is likely to result in the criteria for the performance specification not being breached at any location during the operation of Crossrail.
- 2.13 The nominated undertaker will provide to the local authorities, through which the Crossrail tunnels pass details of the type of rail and/or track support system proposed and its predicted performance with respect to vibration and groundborne noise.

3. Groundborne Vibration

- 3.1 The potential impact of Crossrail trains running through tunnels during construction and operation of the railway has been assessed and the findings reported in the Environmental Statement. The running of both the construction and permanent railways is not forecast to cause vibration impacts which will be felt by those occupying the buildings above.
- 3.2 Vibration from the passage of the tunnel boring machines may be perceptible. However, this will be a transient effect lasting only a few days at any one location and will not cause damage to buildings.