Sorting out the Noise later

To understand the ongoing noise problem there are two main considerations:

1. Where does the noise come from and how will it vary over time
2. What can be done about it once the line has been built

1. HS2 Noise factors

The noise from HS2 trains depends on a combination of factors:

1. How the trains are designed
2. How the trains are operated
3. How the trains are maintained
4. How the line is designed
5. How the track is maintained
6. What the weather is like

These factors are all estimated in the Environmental Statement, but this is based on assumptions and we will not know the actual noise levels until there are real trains running on the completed track. There is a degree of variability for each factor described below.

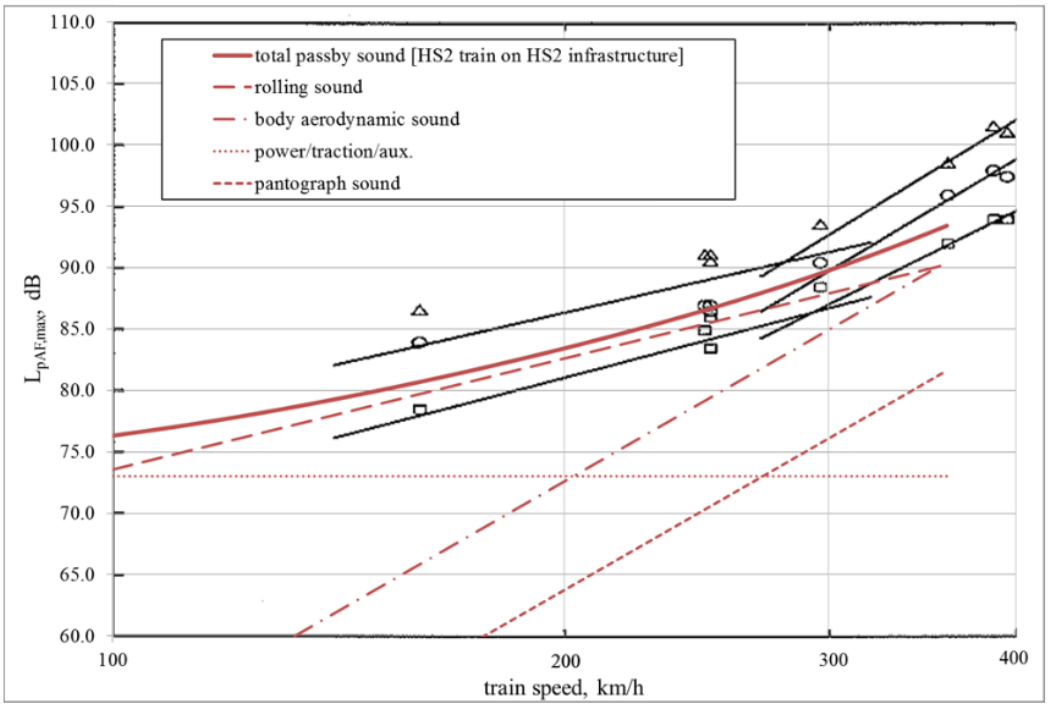
1.1 How the trains are designed

The Train Specification for HS2 is expected to be 3dB quieter than the European Standard for High Speed Trains, but the procurement has not been completed and the actual performance is yet to be determined.

1.2 How the trains are operated

The noise from the trains depends significantly on the operating speed as shown in the graph below from the ES.

Figure 5: LpAF,max vs speed for total and source component pass-by sound at 25m from the track predicted using the HS2 trains source terms.



The noise comes from four source components, which add up to the total 'pass-by' noise level shown by the solid red line. Note that the graph shows the numbers for 'HS2' trains, which are expected to be 1dB quieter than the "Conventional Compatible" units that are being procured.

The four sources are:
Rolling sound, being 'the interaction between the wheels of the train and the rail'
Starting sound, which 'includes the sound generated by the power, traction and auxiliary systems'; or roughly the engine noise which is constant with speed.
Body Aerodynamic sound, which comes from the passage of air around the train
Pantograph sound, which comes from the power collection equipment at the top of the train that contacts the overhead line equipment wire.

The graph shows how each of the sources vary with speed, with the Body Aerodynamic and Pantograph components dominating at 360 kph. Each source is expected to generate 90dB giving an overall noise level of 93dB measured 25m from the line.

The overall HS2 network is being configured with an expected normal operating speed of 330kph, but 1 in 10 trains is anticipated to pass at 360kph to allow time to be made up to ensure timetables service times following delays.

1.3 How the trains are maintained

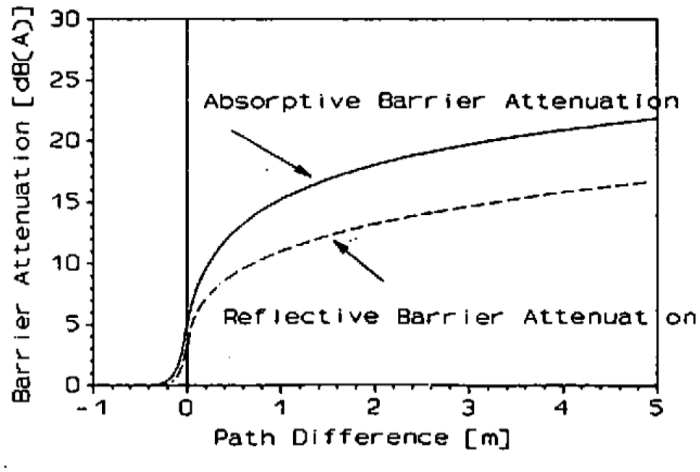
Wheel roughness develops over a period of time from train acceleration and braking, and results in both ground-borne vibration and airborne rolling noise. This can be rectified by using wheel lathes with 'an appropriate maintenance regime' at the Washwood Heath rolling stock maintenance depot.

1.4 How the line is designed

Noise barriers can be included in the design of the line, with their efficiency being a function of the path difference that is introduced compared to a line of sight between the source and receptor. Consequently a high barrier close to the track (or receptor) introduces the greatest path difference. The barrier performance is determined by acoustic dispersion at the edge of the barrier, and is dependent on the relationship between the path difference and the wavelength of the sound. The effect is generally that high frequencies are suppressed more than low. Within the ES there is a definition of the effective height of the four noise sources and path difference calculations can be made for each. For example pantograph noise emanating from the roof of a train 4 metres above the track will not be affected by a 1.4m trackside barrier. There is a good discussion of various barrier types given in the HS2 'Operational Noise Assessment' report submitted for the Colne Valley Viaduct.

Another factor is the surface finish of the actual barrier which is likely to reflect sound energy if smooth, and effectively absorb noise if rough.

The overall impact of a classic barrier is shown in the graph below showing how the attenuation varies with path difference and barrier type. This is reproduced from the 'Calculation of Railway Noise' paper referenced in the ES which studied French TGV trains to predict HS1 and now HS2 train noise mitigation.



Another factor is the reflection of sound from the track bed. The decision by HS2 to change from classic 'ballasted' sleepers to use of 'slab track' is generally accepted to increase the noise by 2dB in guidance issued by the DfT and this was included in the source terms initially used for the HS2 Phase 2a Noise Methodology. However HS2 now believe that this can be overcome by use of multiple measures.

One of these is the method of attaching the rails to the concrete slab so that they can flex as a train passes, rather than vibrate the track bed and create noise as a result.

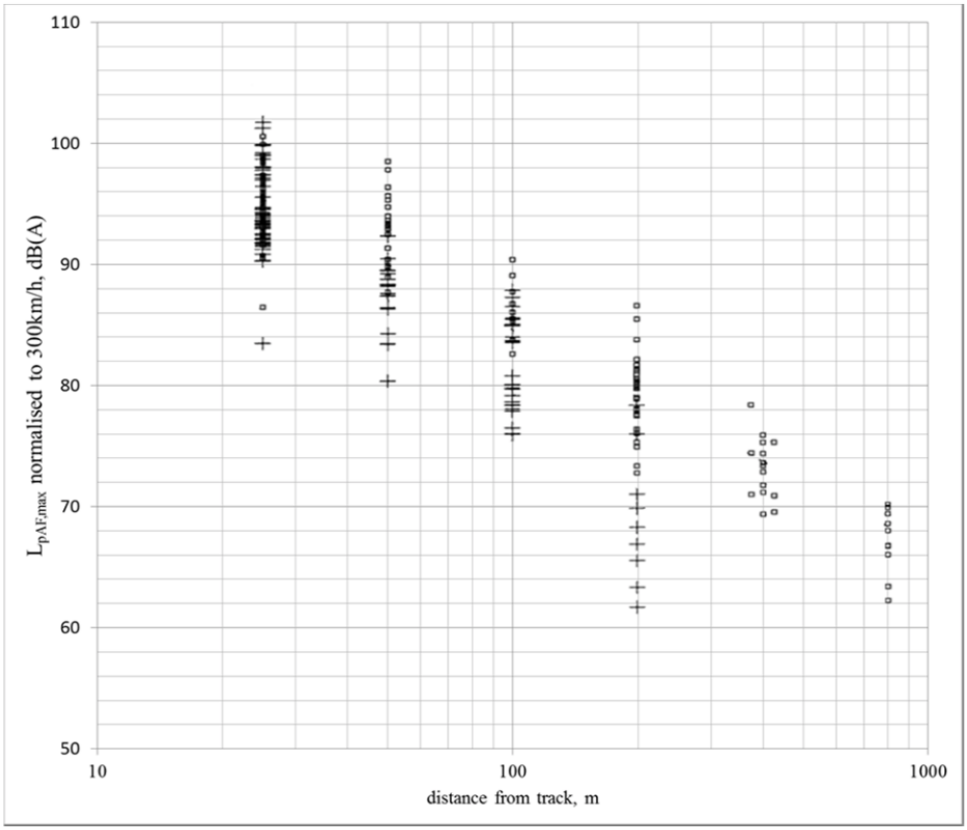
1.5 How the track is maintained

Rail grinding is becoming increasing used to ensure the surface of the track fits well with the profile of train wheels as a means of reducing ground borne vibration and cracking of the rails. Track maintenance trains can travel at up to 50 kph with associated noise and abrasive dust issues.

1.6 What the weather is like

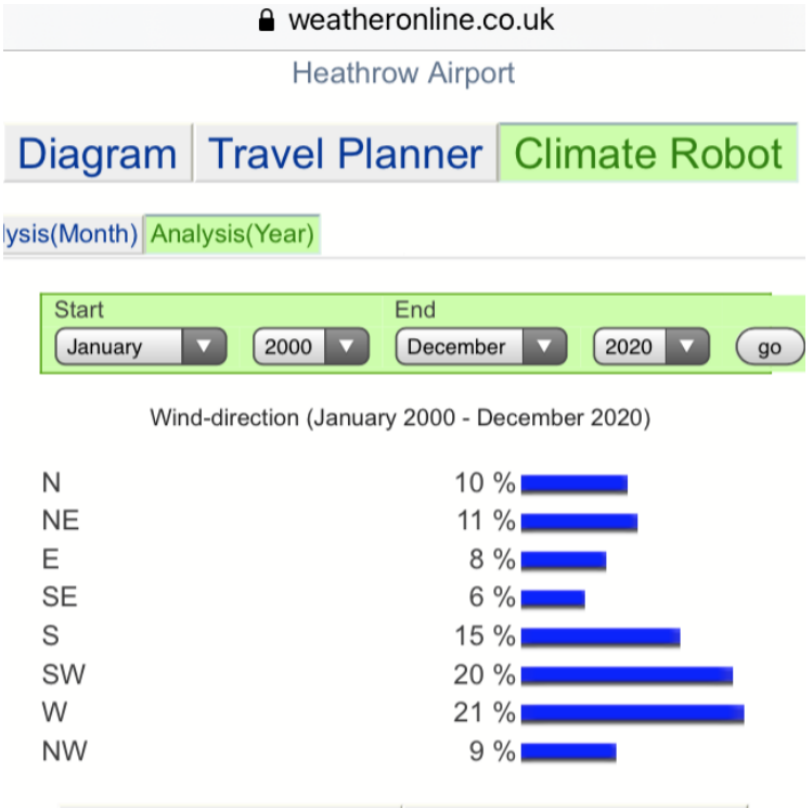
A critical issue for community noise is the wind direction, which (according to the ES) can affect the noise levels at a receptor to vary by up to 15 dB at 200m from the line as shown in the figure below. At the various distances there are a number of pass-by measurements shown, with the box and cross icons showing the wind direction. The spread of values in each wind direction is a result of other factors on the pass-by events.

Figure 16: Normalised maximum sound pressure levels of high speed train pass-bys in upwind (+) and downwind (□) measurement conditions



HS2's estimated noise figures are presented using 'downwind' values, so should provide a 'worst case' estimate. In the Wendover case the most significant impact is expected to be from a west wind accentuating noise from the North Cutting over the Lionel Avenue/Dobbins Lane area.

The likelihood of this occurring can be estimated from historical meteorological records over the last 20 years at Heathrow, with West, North West, and South West winds forming 50% of the daily results as shown below.



2. What can be done about it

There is a process defined by HS2 where their contractors design the line using various assumptions about how the train and track will perform. The Local Authorities have tried to introduce a means of sorting out issues once the trains can be tested; but the indications we have are that this future fix will not be effective and what we need is to get more noise mitigation included in the initial design that gets approved by Buckinghamshire Council during 2021.

When the HS2 Contractors undertake the design of a section of the line they need to submit a "Noise Demonstration Report" to the Local Planning Authority Environmental Health department as part of the requirements given in Schedule 17 Section 3 of the HS2 Act.

This report should demonstrate the expected noise levels at receptors in the local area, and how this differs from the values given in the ES as a result of a requirement to consider various design options to reduce the levels as described in the HS2 Information Paper E20 about the Control of Airborne Noise.

However we have seen that a number of factors that contribute noise are outside the control of the Contractor building the line, and in reality all the other components including the track and trains need to be integrated before the actual noise levels can be measured during commissioning tests for the complete system. This process is known as 'Bringing into Use'. HS2 Planning Forum Note 10 describes "Indicative Mitigation", which covers measures that could potentially be added to the system following the initial construction of the line to fix issues found in practice such as excess operational noise.

These future mitigation options are expected to be submitted to the Local Planning Authority as part of the information supporting their Schedule 17 Paragraph 3 (Sch17{3}) proposal. At the time of writing (December 2020) we have seen two Noise Demonstration Reports covering the Colne Valley Viaduct (produced by Align) and the West Ruislip Tunnel Portal (produced by SCS). These contain descriptions of various noise barrier options, supporting their claim to have addressed the requirement to look at ways of reducing the noise. They have been approved by Hillingdon Council, but they do not appear to include any future Indicative Mitigation options that could be deployed under the Schedule 17 Paragraph 9 (Sch17{9}) provisions.

These two Noise Demonstration Reports have also been considered by a new E20 Working Group established in June 2019 under the auspices of the HS2 Independent Planning Forum Environmental Health Sub-Group. Buckinghamshire Council, London Borough of Ealing, North Warwickshire Borough Council, and Solihull Metropolitan Borough Council are the core Local Authority members of the Working Group; who along with any other interested Local Authorities would "*have an opportunity to involve the Main Works Contractor and suppliers to discuss their design*" and "*run through examples of assessment methods and show how we are trying to be consistent across the contractors when presenting results*".

Having established the 'Bringing into Use' provisions in the Act the Local Authorities may be concerned about the lack of Indicative Mitigation included in the Sch17{3} submissions, and their inability to get HS2 to improve matters once the line is built. A key consideration is that future Indicative Mitigation for noise needs to be considered in line with Planning Forum Note 14 which requires additional mitigation to be considered on four dimensions:

- *Value for Money:*
  (a qualitative comparison of the health and environmental benefit of the noise reduction provided compared to the long-life cost of the mitigation);
- *Engineering and operational practicability:*
  (for example the practicability of a tall noise fence barrier on the shoulder of a tall railway embankment);
- *Impacts on other environmental disciplines;*
  (for example the potential for materially worsened landscape and visual impacts associated with taller noise fence barriers or landscape earthworks, or other conflict with the principles of the HS2 Design Vision); and
- *Stakeholder engagement:*
  (for example a stated preference for a noise barrier in the form of landscape earthworks rather than a fence, or reduced noise barrier heights to reduce visual impact).

A key point here is that the "Value for Money" which is assessed by applying the '*Government's Transport Analysis Guidance Unit A3*' which quantifies the impact of noise mitigation in terms of 'disability adjusted life years'. This in turn depends on an assessment of the night time noise impact in terms of LAeq over the 23:00 to 07:00 period and the size of the affected population.

Indications received from HS2 suggest that Indicative Mitigation is unlikely to ever achieve the required level of financial cost/benefit return; which implies that the Bringing into Use process may be fundamentally flawed. This may explain why the contractors have not included Indicative Mitigation in their proposals.

Consequently, our understanding is that any 'designed' mitigation needs to be incorporated in the initial Schedule 17{3} proposal.

2.1 What can the Councils do?

HS2 have agreed that there will be an ongoing Operational Noise Monitoring system established, and this is described in their Information Paper F4 . Regrettably this is currently a very high level framework document without details of what will be measured, how it would be analysed, and what action might result.

Indications received from HS2 suggest that developing this will be a work in progress for discussion with the Local Authorities for several years through the Independent Planning Forum Environmental Health Sub Group.

Once the monitoring system is available there remains the question about what action can be undertaken to resolve excess noise. This seems to boil down to three courses of action:

- Add design mitigation; which we think unlikely on the financial cost/benefit grounds
- Improve the operational maintenance regime; which would impact the rolling noise which is expected to be a significant component of the overall noise, and leave the body/aerodynamic source to dominate as it is similar in scale.
- Reduce the operational speed of the trains; which is considered very unlikely due to the number of trains that could then be run per hour and the associated commercial implications.

Consequently, our understanding is that any additional mitigation really needs to be 'designed' into the initial Schedule 17{3} proposal.