WHO GUIDANCE WITHIN ENVIRONMENTAL ASSESSMENT

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1 INTRODUCTION

The EIA is required by European Union Directive [1] and on the assessment of the effects of certain public and private projects on the environment (Directive 2011/92/EU) and Parliament's Private Business Standing Order 27A (SO27A) [2] which require the preparation of an ES to inform the decision maker of the likely significant effects of the Proposed Scheme on the environment and the envisaged mitigation to avoid or reduce any significant effects. An Environmental Statement (ES) must be prepared which presents the findings of the EIA at the time of submission. Amongst other things, the ES must describe the likely significant effects of the development on the environment.

When major transport infrastructure is proposed which may have the potential to give rise to significant noise and vibration impacts, such as High Speed 2, local communities understandably often express concern about the effect of the noise and vibration on their health and quality of life. Representations may include matters relating to the application of guidance from the World Health Organization (WHO). For example, there might be a call to use WHO guidance as a design aim for the proposed infrastructure.

The scope and purpose of the WHO guideline values are often misunderstood. This can lead to them being misapplied. Consequently, this paper aims to clarify the role and application of WHO guidance in the context of scheme appraisal or assessment.

2 WHO GUIDELINES

The WHO defines 'health' as: "A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". This broad definition of health embraces the concept of well-being. Consequently, impacts such as annoyance, interference with communication, and impaired task performance are encompassed as 'health' issues.

The WHO has published a number of documents [3 to 5] providing general guidance and guidelines / guideline values[1] above which people may be adversely effected by community noise (unwanted sound).

The following effects are considered in the WHO documents:

- noise-induced hearing impairment;
- interference with speech communication;
- sleep disturbance effects;
- cardio-vascular and psychophysiological effects,

[1] The majority of the guideline values are most easily identified via Table 1 in the executive summary of reference [3]. The Table, taken alone, is sometimes misunderstood and taken to mean that where levels exceed the guideline values there would be a 'critical health effect'. The text of the executive summary however sets out that the guideline values "…have been set for each health effect, using the lowest noise level that produces an adverse health effect" and this is reinforced at section 4.1 of Reference [3] as noted in this paper. Reference [3] also notes in respect of the guideline values "Almost all noise effects are undesirable, yet in many cases it is not definite whether these effects must be judged a harmful and thus as unacceptable or not. Ultimately this is a normative and societal decision."

- performance effects; and
- effects on social behaviour and annoyance.

Section 4.1 of the Guidelines for Community Noise [3] sets out that "In these *Guidelines for Community Noise* only guideline values are presented. These are essentially values for the onset of health effects from noise exposure. It would have been preferred to establish guidelines for exposure-response relationships. Such relationships would indicate the effects to be expected if standards were set above the WHO guideline values and would facilitate the setting of standards for sound pressure levels (noise immission [receptor] standards). However, exposure-response relationships could not be established as the scientific literature is very limited." (emphasis added).

The introduc*tory section to the guideline values* of reference [3] also notes "Guideline values typically correspond to the lowest effect level for general populations, such as those for indoor speech intelligibility. By contrast, guideline values for annoyance have been set at 50 or 55 dBA [outdoor noise level], representing daytime levels below which a majority of the adult population will be protected from becoming moderately or seriously annoyed, respectively." Page 144 of Community Noise offers an insight by what is meant by a majority. It states that "Available data indicate that daytime sound pressure levels of less than 50 dB LAeq cause little or no serious annoyance in the community". The corresponding dose response curves of the same document suggest about 5% of the population is annoyed at 55 dB". So, the majority referred to in the annoyance guideline value is about 95% of the population.

The Night Noise Guidelines for Europe (NNG) are something of a departure from the normal WHO guidelines. The stated purpose is that the "guidelines originated in part from the European Union Directive 2002/49/EC relating to the assessment and management of environmental noise (commonly known as the Environmental Noise Directive which compels European Union Member States to produce noise maps and data about night exposure from mid-2007. The work was made possible by a grant from the European Commission and contributions from the Swiss and German governments.

Considering the scientific evidence on the thresholds of night noise exposure indicated by $L_{night,outside}$ as defined in the Environmental Noise Directive (2002/49/EC), the 2009 Night Noise Guidelines recommend that an $L_{night,outside}$ of 40 dB should be the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. The 2009 WHO document notes that the NNG is a Lowest Observed Adverse Effect Level (LOAEL) and this is directly relevant to the UK Government's noise policy as discussed in the next section of this paper. The 2009 WHO document also defines the $L_{night,outside}$ value of 55 dB as a recommended Interim Target for the countries where the "NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach." Again with reference to the Government's noise policy (see next section) the Interim Target may be considered a Significant Observed Adverse Effect Level (SOAEL).

It is the role of each member state to decide what objective to set for the reduction of noise exposure, which no doubt will involve consideration of costs, social factors and other factors. This is a matter that we address in the following section. However, it is worth noting that the WHO recommendations did not attempt to evaluate costs or practical implications of achieving the recommended levels.

3 UK GOVERNMENT POLICY

The UK Government's noise policy can be found in the Noise Policy Statement for England (NPSE) [6].

The policy notes that "Noise is an inevitable consequence of a mature and vibrant society" and that "In reality, although it has not always been stated, the aim [of noise management] has tended to be to minimise noise 'as far as reasonably practical'."

The policy goes on to note "By describing clear policy vision and aims the NPSE provides the necessary clarity and direction to enable decisions to be made regarding what is an acceptable noise burden to place on society." Furthermore the "…application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular policy, development or other activity may not have been given adequate weight when assessing the noise implications". In this regard the policy goes on to note "The guiding principles of Government policy on sustainable development…should be used to assist in its implementation".

The aims of the Policy are:

Noise Policy Aims

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- **avoid significant adverse impacts on health and quality of life;**
- **mitigate and minimise adverse impacts on health and quality of life; and**
- **where possible, contribute to the improvement of health and quality of life.**

Note: The terms 'quality of life' and 'wellbeing' are often used interchangeably in the assessment of noise effects.

In its aims the Policy uses the key phrases ***"Significant adverse" and "adverse".*** In clarifying what these mean the Policy notes that "*….there are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the WHO. They are:*

NOEL – No Observed Effect Level
This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level
This is the level above which adverse effects on health and quality of life can be detected."

The Policy extends these concepts to include:

"*SOAEL – Significant Observed Adverse Effect Level*
This is the level above which significant adverse effects on health and quality of life occur."

The Policy notes that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times.

It can be seen that the test of significance in relation to government policy is a question of degree and that a significant noise and vibration level will be somewhere above a level where the onset of adverse effect might be expected - i.e. SOAELs will always be greater in magnitude than LOAELs and LOAELs are greater than NOELs. In other words as exposure to a new sound source increases there will start to be some level of effect on a receptor – the point perhaps at which sound becomes noise – and as the exposure increases to the severity of the effect or effects increase rise with further increase in exposure to the level where the effect becomes significant.

In this context, there are clear parallels between government policy on SOAEL – Significant Observed Adverse Effect Level - and the EIA process, which requires the likely significant effects to be identified.

4 ENVIRONMENTAL IMPACT ASSESSMENT

The term 'significant effect' is used in undertaking an Environmental Impact Assessment (EIA) where the EIA Regulations [7] require the identification of likely significant effects (both positive and negative), and the description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects.

This follows the intent of the first aim of the Government's noise policy, namely: "that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development."

Under the noise policy it becomes clear that defining SOAELs for the noise sources under consideration in the EIA is a key step and that any receptor forecast to an absolute 'end state' exposure from the source that exceeds the relevant SOAEL should be identified as being subject, in EIA terms, to a likely significant adverse effect. This would reflect the aim to avoid significant effects on health.

It is also worth noting that the second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. The aim is that "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

It is here that the term significance as used in the EIA process again links to the Government's noise policy but this time with regard to the policy's second aim. Under the EIA Regulations and Directive the identification of significant effects normally triggers the consideration of mitigation measures. Thus, the broader definition of significant effects in an EIA based on considerations such as noise change on communities provides a basis for identifying mitigation, mitigation that reduces the overall effects below those that are in themselves significant as an absolute 'end state'.

The WHO guidelines are valuable in informing the range of exposure levels between LOAELs and SOAELs.

The noise policy's third aim is to contribute to an improvement where possible. The promoters of some schemes have used opportunities provided by the development to tackle existing noise conditions. Where promoters are minded to use such principles, the EIA process can be used to achieve the third aim where it is possible to implement noise mitigation for the proposed scheme in such a way or at such a location that it also reduces the exposure at receptors to existing source of noise.

4.1 Importance of Change in Noise Levels

The WHO guidelines are representative of no and lowest observable adverse effect levels (i.e. NOELs and LOAELs). The WHO guidance suggests that there is some risk that effects on humans may occur in a percentage of the population where the noise levels being considered exceed the defined guideline / guideline-value. It follows that the higher the exposure to noise the greater the risk there is of affecting a greater percentage of the population.

It is relevant to note that the majority of the UK population is exposed to noise levels greater, and often considerably greater, than WHO guideline values [8 and 9]. This is also the case across Europe [3]. At a local level, noise exposure levels may vary considerably - some areas being exposed to relatively high levels of noise and others exposed to relatively low levels of noise.

The general purpose of the WHO guidance is to provide information on hazards of noise which can be used to inform policy decisions. It is the responsibility of member states to decide how to use this guidance in terms of setting policy objectives. The WHO guidelines refer to total noise exposure and so are not particularly relevant to assess noise impact from infrastructure proposals. This is the reason why it is widely established and accepted practice to assess the potential impacts and effects of noise from a scheme when added to an existing environment, by considering the change in noise exposure as well as other factors, including absolute noise levels. Considerations of a noise change are used to account for, amongst other things:

- The masking effects of noise, and
- Changes in amenity resulting from a noise change when compared to exiting baseline conditions.

Evaluating noise change also links to the Noise Policy Statement consideration of quality of life (wellbeing) which, for a new transport scheme, should encompass consideration of amenity.

This is the underlying reason why noise effects tend to be assessed using a combination of assessing effects and amenity considerations. It is the noise change that relates to impact on amenity as well as indicating change in any community effect, such as the existing incidence of annoyance or sleep disturbance. This is why the change in relation to baseline conditions is important as a primary indicator of impacts and effects. In making such an assessment an EIA must address the impact and effects of a specific noise by evaluating not just the change compared to the existing baseline noise levels but also the character of the existing baseline and the likelihood of pre-existing adverse effects.

4.2 Defining Significant Effects

There is currently no definitive advice on the derivation of significant noise adverse effects within the context of an EIA. This is a matter to be determined according to the particular circumstances of each case.

As noted above one clear basis for defining a significant effect in an ES is where the end state exposure to noise from a new source exceeds the relevant SOAEL based on available guidance and / or exposure response relationships.

More broadly, the Design Manual for Roads and Bridges (DMRB) [10] gives guidance on noise impact assessment for highway schemes. The DMRB (3.36 et seq) explains that in terms of road traffic noise, a methodology has not yet been developed to assign a significance according to both the value of a resources and the magnitude of an impact. However, it recommends that the magnitude of traffic noise impact be classified into levels of impact in order to assist with the interpretation of the road project. The impact classifications distinguish between short-term and long-term comparisons. It goes on to say that "A change in road traffic noise of 1 dB $L_{A10,18h}$ in the short term (e.g. when a project is opened) is the smallest that is considered perceptible. In the long

term (typically 15 years after project opening), a 3 dB $L_{A10,18h}$ change is considered perceptible. The classification of magnitude of impacts to be used for traffic noise in the long term is reproduced below."

Although the DMRB does not provide a technical definition of significance criteria, the Noise Summary Tables give emphasis to both the absolute level of noise and the noise change. The absolute level of noise and the noise change with the scheme is then used to perform a noise nuisance assessment. In essence, the pre-existing level of annoyance is considered in the steady state condition and the change in nuisance (annoyance) is determined from the change in noise level. Perhaps the closest DMRB gets to making recommendations on significance criteria is the advice to adopt mitigation measures when the predicted increase in noise level is greater than 3 dB(A). Section 4.2 recommends 4.2 In terms of permanent impacts, "in the long-term, a 3 dB(A) change is considered perceptible. Such increases in noise should be mitigated if possible."

The DMRB considers the relevance of WHO guidance in relation to the assessment. It recommends that:

"Research into the response to changes in road traffic noise is largely restricted to daytime periods. Until further research is available only noise impacts in the long term is to be considered and Table 3.2 should be used to consider the magnitude of noise change at night. However, given the caution with predicting night time noise levels as traffic flow fall (see 3.24), only those sensitive receptors predicted to be subject to a $L_{night,outside}$ exceeding of 55 dB should be considered. The $L_{night,outside}$ of 55 dB corresponds to the Interim Target level specified in the WHO Night Noise Guidelines for Europe."

In the absence of guidance for other types of transportation noise, it is important to consider precedent from previous schemes. This is in line with the advice from the ANC [11]. For railways, there is a reasonable degree of consistency of approach used for EIA. Consequently, valuable guidance can be obtained from significance criteria used for the environmental impact assessment of similar schemes, especially where schemes are now in operation and hence actual significant effects are at least qualitatively known. In this case High Speed 1 provides valuable guidance for a project such as HS2 both in terms of quantifying impacts based on the change in sound levels but also in terms of the maximum sound level from the new railway. It is relevant that similar assessment criteria to those used on HS1 have been adopted on other major rail schemes (e.g. Thameslink, Crossrail). Other guidance for absolute criteria that could indicate a SOAEL and hence significant effect may be the Noise Insulation Regulations and the WHO's night time Interim Target.

In the UK, WHO levels have also been used to inform decisions on the cut-off point for assessing noise effects. In other words, levels below WHO guideline values do not generally give rise to adverse effects. For example, in the previous National Planning Policy Guidance on noise, PPG24 Noise Exposure Categories, WHO Guideline Values were used to represent the point at which noise becomes a relevant consideration. However, noise exposure levels were not considered to be significant or harmful until they were significantly above the WHO Guideline Values.

This position is also reinforced by the WHO's Night Noise Guidelines for Europe [5] where the Night Noise Guideline is set at the NOEL or LOAEL and the Interim Target could be considered a significant observable adverse effect level.

5 SUSTAINABLE DEVELOPMENT

The Government's noise policy explains that effects of noise must be considered alongside other factors and must be considered in the context of sustainable development. The effects of the noise need to be balanced against the economic and social consequences of controlling or mitigating the noise. This is recognized by the WHO. For example, at 4.5.14 of the NNG, it states:

"In practice, it seems to be reasonable that noise policy should reduce noise, beginning with the highest exposures and ending with the lowest ones. Decision-making will have to find common standards of acceptable risks, which may vary according to the cost–benefit considerations within and between communities and countries. Such practical standards may, however, vary due to economic development and abilities, cost–benefit considerations and priority settings of a community or country."

The National Noise Incident Survey [8] found that the majority of the UK population is expose to noise levels above the WHO Guideline Values. In particular, it found "the proportion of the population of England and Wales exposed above the day-time level of 55 dB $L_{Aeq,16hr}$ to have decreased since 1990, whilst the proportion above the night time level of 45 dB $L_{Aeq,8hr}$ has increased (although this change is not statistically significant). The majority of the UK population is still exposed to noise levels exceeding these WHO guidelines."

It would simply not be economically or socially viable to achieve the WHO Guideline Values in the UK. This, no doubt, would also be true for many, if not most, of the other EU member states. Similarly, designing any new transport scheme to meet WHO guideline values at all receptors would not be sustainable and, as Government's policy sets out, exceeding the WHO guide values would not result in significant adverse effects.

This is why UK Government and other Governments have not, in the authors opinion, made any commitment to adopt WHO guideline values (e.g. noise action plans [ref 11, 12 and 13]) and no new transport project in the UK has ever made such commitments.

With regard to the sustainability of a scheme proposal, it therefore important to consider the number of people impacted by the scheme as part of the identification of mitigation which yields the best benefit for cost.

6 REFERENCES

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