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CRITERIA FOR THE ENVIRONMENTAL ASSESSMENT, PLANNING AND MITIGATION OF RAILWAY NOISE

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1 INTRODUCTION

For many decades in the United Kingdom the Railway network has been characterised by closure. Railway noise has primarily been an issue when considering new noise sensitive development on land adjacent to existing railways or indeed on former railway sidings and in the air above railway stations.

With renewed interest in new railways as diverse as the high speed Channel Tunnel Link, new freight depots and numerous light rail and tram systems, various criteria have been proposed for assessment, planning and mitigation of railway noise.

This paper reviews the various criteria and approaches that have been adopted in recent years and poses a number of questions in the light of experience in attempting to apply these to actual projects.

2 ASSESSMENT OF ENVIRONMENTAL EFFECTS

It is just ten years ago that the Town and Country Planning (Assessment of Environmental Effects) Regulations (Reference 1) came into force. These regulations required new railway projects to be the subject of an Environmental Assessment in two categories:

Schedule 1: "a line for long-distance railway traffic"
Schedule 2: "a tramway, elevated or underground railway, suspended line or similar line, exclusively or mainly for passenger transport."

The differentiation between the two categories is in essence that Schedule 1 developments always require an Environmental Assessment whereas Schedule 2 development only does if it is "likely to have significant effects on the environment by virtue of factors such as its nature, size or location."

Inevitably, as with all Statutory Regulations, there are a number of details and interpretations that only become defined by precedent. For example, what is "long-distance"; what is a "similar line"; what are the factors such as "nature", "size" or "location"? Some general guidance is contained in Department of the Environment Circular 15/88 (Reference 2) but this cannot answer the important question in terms of noise, "What constitutes a Significant Effect"?

CRITERIA FOR THE ENVIRONMENTAL ASSESSMENT, PLANNING AND MITIGATION OF RAILWAY NOISE

A number of new railway projects have now been the subject of Environmental Assessments and many of these have turned for guidance to the approach used for new road schemes. The guidance for this is contained in the Highways Agency Design Manual for Roads and Bridges (Reference 3). This is based on the reporting of numbers of houses in bands of increased noise levels with and without the scheme under consideration, for locations classified according to their ambient noise levels. The incremental bands are: 1 - < 3 dB(A), 3 - < 5 dB(A), 5 - < 10 dB(A), 10 - < 15 dB(A), and over 15 dB(A).

We should not of course forget that the effects of a scheme can be beneficial as well as adverse, for example a new by-pass can result in beneficial effects on residential properties adjacent to the original highway that has been by-passed. Negative noise effects may also be offset by other beneficial environmental effects.

It is important therefore to consider an overall framework for assessing the environmental effects of a scheme. One such framework has been developed by the Ove Arup Partnership based on discussions with statutory consultees and environmental specialists and is reproduced in Table 1.

Severe:	Only adverse effects are assigned this level of importance as they represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of national importance. However, a change in a regional or district scale site or feature may also enter this category. Typically, mitigation measures are unlikely to remove such effects.
Major:	These effects are likely to be important considerations at a district or local scale but, if adverse, are potential concerns to the project, depending upon the relative importance attached to the issue during the consents procedure. Mitigation measures and detailed design work are unlikely to remove all the effects upon the affected communities or interests.
Moderate:	These effects if adverse, while important at a local scale, are not likely to be key decision-making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or on a particular resource. They represent issues where effects will be experienced, but mitigation measures and detailed design work may ameliorate/enhance some of the consequences upon affected communities or interests, but some residual effects will still arise.
Minor:	These effects may be raised as local issues, but are unlikely to be of importance in the decision-making process. Nevertheless, they are of relevance in enhancing the subsequent design of the railway and consideration of mitigation measures.
None:	No effects or those which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

TABLE 1: Significance framework for environmental assessments

I should now like to consider some specific projects to illustrate the approaches adopted.

Channel Tunnel Rail Link (CTRL)

The Environmental Noise Assessment for this project was carried out by Ashdown Environmental Ltd and, whilst published in 1994, the Evaluative Criteria below were developed many years earlier; pre-dating the Mitchell Committee Report (Reference 4) and Planning Policy Guidance note 24 (Reference 5). This explains why the 24 hour L_{Aeq} was chosen as the noise index, though L_{Amax} was used for night time to allow for the potential occurrence of sleep disturbance.

For residential properties there was considered to be a noise impact where passage of trains on the CTRL gives rise to:

i a change of 3 $dBL_{Aeq,24hr}$ or more 1 m from the most affected appropriate facade of a dwelling (the noise change is defined as the difference between the normal weekday ambient noise level ($L_{Aeq,24hr}$) immediately before the opening of the CTRL and the corresponding to the period when the maximum level of rail traffic is expected in the first 15 years after the CTRL begins operation); or

ii 85 $dBL_{Amax,F}$ or more 1 m away from the most affected appropriate facade during the night time period (2300 hrs to 0700 hrs).

In addition to, facilitate the rating of impacts, a semantic scale was applied as shown in Table 2.

PREDICTED CHANGE IN $L_{Aeq,24hr}$	SEMANTIC SCALE RATING
Decrease of 3 dB or more	Significant Decrease
Decrease of less than 3 dB	No significant impact
No change in noise level	No significant impact
Increase of less than 3 dB	No significant impact
Increase of 3 - 5 dB	Slight increase
Increase of 6 - 10 dB	Moderate increase
Increase of 11 - 15 dB	Substantial increase
Increase of more than 15 dB	Severe increase

TABLE 2: Semantic scale for rating of noise impact: residential properties, CTRL

For non-residential noise sensitive properties noise impacts were considered to occur when there was a noise change of 3 $dBL_{Aeq,24hr}$ as defined above and a facade level of more than 80 $dBL_{Amax,F}$.

For open spaces a noise impact was considered to occur when there was an increase of 3 $dBL_{Aeq,18hr(0600-2400)}$ and the resultant level exceeds 60 $dBL_{Aeq,18hr}$.

The judgement of whether these impacts resulted in significant effects was considered to be beyond the scope of quantitative evaluation, and professional judgement was used taking into account the following factors:

Residential Properties:
- the number of impacts
- the severity of the impacts
- the proportion of residential properties within a community subject to the impacts
- comparison with effects of equivalent major infrastructure projects.

Non-Residential Properties:
- the severity of impact
- the quality of the resource
- the usage of the resource.

Strathclyde CrossRail

This project provides a strategic link between rail services north and south of the river Clyde. It comprises 3.5 km of track, part new and part existing, in the urban area of Glasgow where ambient noise levels are controlled by road traffic noise. Arup Acoustics carried out the Environmental Noise Assessment which was published in 1995.

Railway noise was assessed in terms of $L_{Aeq,18hr(0600\text{-}2400)}$ and $L_{Aeq,6hr(0000\text{-}0600)}$, though in practice there were no time tabled movements between 0000 and 0600 hours.

Reference was made to the Mitchell Committee (Reference 4) findings with respect to community reaction to road and rail noise and the "railway dividend" of 3 - 4 dB, which was subsequently allowed for when setting the qualifying levels under the Noise Insulation Regulations for new railways (Reference 8) effectively 3 dB higher than for roads.
The significance framework is as shown in Table 3, and the effects relate to a grouping of at least 5 residential units or a single noise sensitive non-residential location.

Levels of Significance	Change in Period Noise Level, L_{Aeq}
Not significant	Increase of less than 6 dB
Minor adverse	Increase of 6 - 8 dB
Moderate adverse	Increase of 9 - 13 dB
Major adverse	Increase of 14 - 18 dB
Severe adverse	Increase of more than 18 dB

TABLE 3: Significance framework, Strathclyde CrossRail, existing ambient controlled by road traffic noise

The significance framework is subject to threshold levels of predicted railway noise of 55 $dBL_{Aeq,18hr}$ by day and 45 $dBL_{Aeq,6hr}$ by night, ie train noise below these threshold values is not considered to have a significant effect irrespective of ambient noise levels.

Thameslink 2000

The Environmental Noise Assessment for this project was carried out by Rupert Taylor Ltd and was published in 1997. The main noise feature of the project is a new viaduct between Metropolitan Junction and London Bridge Station to enable increased through traffic north-south across London.

The assessment period is again divided into night and day but this time $L_{Aeq,16hr}$ day (0700 - 2300) and $L_{Aeq,8hr}$ (2300 - 0700). The evaluation criteria in Table 4 apply to residential buildings by day and night, and non-residential buildings by day only. Special buildings (churches, theatres, etc) are considered individually.

PREDICTED NOISE CHANGE $L_{Aeq,16hr\ day}$ or $L_{Aeq,8hr}$ night	SCALE RATING
Less than 3 dB	No significant impact
Increase of 3 - 5 dB	Slight increase)
Increase of 6 - 10 dB	Moderate increase) Significant effect
Increase of more than 10 dB	Substantial increase)
In addition, a significant effect will occur if the maximum baseline noise level due to trains is not more than 85 dB $L_{Amax,F}$ outside a habitable window between 2300 and 0700, and the maximum noise due to Thameslink 2000 trains exceeds 85 dB$L_{Amax,F}$ outside a habitable window between 2300 and 0700	

TABLE 4: Operational noise, Thameslink 2000

Sunderland Metro

The Environmental Noise Assessment for this project was carried out by Arup Acoustics. The project comprises an extension of the Tyne and Wear Metro to Sunderland utilising both new and existing tracks. Ambient noise levels vary along the route and are controlled by rail traffic, road traffic and no dominant noise sources in quiet areas. I therefore divided the assessment into three categories based on assessed ambient conditions as follows:

Category A: Ambient Noise Controlled by Road Traffic
Areas where the L_{A90} (the background noise level) > 50 dB, and the L_{Aeq} (the ambient noise level) > 55 dB and the ambient noise levels are controlled by road traffic noise.

Category B: Ambient Noise controlled by Rail Traffic
Areas where the rail lines are established and run daily services and the noise levels are controlled by rail traffic noise.

The threshold noise level for Categories A and B, above which the significance criteria apply, is the ambient (L_{Aeq}) level.

Category C: Areas Unaffected by a Dominant Traffic Noise Source
Areas where the L_{A90} < 50 dB, and the L_{Aeq} < 55 dB, and a distinct traffic noise source is not having a significant effect, significance criteria based on the impact upon the background noise are used. In this situation, a limit of L_{A90} + 10 dB is used to determine a threshold noise level before the significance criteria begin to take effect.

Table 5 gives a list of the corresponding significance criteria.

	Change in Period Noise Level, L_{Aeq}		
	A (Ambient Noise Levels Controlled by Road Traffic)	B (Ambient Noise Levels Controlled by Rail Traffic)	C (Areas Unaffected by a Traffic Noise Source)
Minor Beneficial	-	Reduction	-
Not Significant	Increase < 6 dB	Increase < 3 dB	Increase < 3 dB
Minor Adverse	Increase 6 - 8 dB	Increase 3 - 5 dB	Increase 3 - 5 dB
Moderate Adverse	Increase 9 - 13 dB	Increase 6 - 10 dB	Increase 6 - 10 dB
Major Adverse	Increase 14 - 18 dB	Increase 11 - 15 dB	Increase 11 - 15 dB
Severe Adverse	Increase > 18 dB	Increase > 15 dB	Increase > 15 dB

TABLE 5: Significance criteria on Sunderland Metro

In each case the effects relate to a grouping of five residential units or a single noise-sensitive resource.

The Sunderland Metro service is daytime only, 0600 - 2400, but it is felt that the above criteria could apply equally to night time rail traffic.

3 SUMMARY

The examples of Environmental Noise Assessment criteria that I have given have a common theme, with individual variations. It may be too much to expect at this stage for total consensus but I would advocate a number of elements.

- There is general agreement that the approach for road traffic is sensible when ambient conditions are controlled by existing rail traffic, ie one is assessing increments in a single dominant type of noise.
- Direct comparison of new railway noise with ambient road traffic controlled noise is inappropriate, unless some regard is had to the "railway dividend".

- In very quiet areas it is relevant to consider the impact of new railway noise on background rather than ambient, subject to some threshold capping.

- For night time services, an impact criterion including an absolute maximum component, such as 85 dBL_{Amax} at residential facades, would be recommended.

- For noise impacts to be regarded as significant effects, they must impact on a grouping of residential properties or a community not just a single dwelling. Conversely a noise impact on a single noise sensitive receptor, eg school, hospital, public park, can constitute a significant effect in its own right.

4 PLANNING GUIDANCE FOR NEW HOUSES CLOSE TO EXISTING RAILWAY

I should like to make a few observations on PPG 24 (Reference 5) in the light of the above approach to Environmental Noise Assessment for railways. It has come up when considering the effect on land zoned for future residential development. The noise levels corresponding to the Noise Exposure Categories of PPG 24 are absolute values and are measured for the site under consideration. It is possible however to predict what future noise levels would be from a new railway and hence identify the Noise Exposure Categories that would apply at a future date. NEC Category A, for which noise need not be a determining factor in granting planning permission equates to rail traffic free field noise levels of less than 55 $dBL_{Aeq,16hr}$ (0700 - 2300) and 45 $dBL_{Aeq,8hr}$ (2300-0700). Predicted noise levels up to these values may therefore be considered as not having a significant effect on the residential use of the land. It should be noted, and this is often overlooked by developers!, that noise levels at the high end of this NEC should not be regarded as desirable. Setting threshold values for the onset of significance 3 dB lower, or using the same values but regarding them as facade levels, would therefore seem appropriate. NEC B and C require additional mitigation in the property design to mitigate rail traffic noise, and this would equate to an impact on the property. NEC D, for which planning permission would normally be refused, is some 20 dB high than the NEC A threshold, an increment that is consistent with the Severe Adverse impact assessment categories.

5 NOISE INSULATION REGULATIONS FOR RAILWAYS

Whilst strictly not part of the Environmental Assessment process, identification of the number of residential properties that might qualify under the Noise Insulation (Railways and Other Guided Transport Systems) Regulations (Reference 8) has been included in some cases.

Surprisingly few properties have been identified [Sunderland Metro - none; Strathclyde CrossRail - one; Channel Tunnel Rail Link - 25] that it begs the question of whether the Mitchell Committee's brief "to recommend to the Secretary of State for Transport a national noise insulation standard for the operation of new railway lines which equitably relates to the standard 'set by regulations for new highways' has been fulfilled. Either the qualifying levels under the Regulations have been set too low, or perhaps railways really are an environmentally beneficial transportation mode as far as noise is concerned.

REFERENCES

1 Statutory Instrument No 1199. The Town and Country Planning (Assessment of Environmental Effects) Regulations 1988

2 Department of the Environment Circular 15/88 "Environmental Assessment". HMSO London

3 The Highways Agency (1993) Design Manual for Roads and Bridges, Volume II, Environmental Assessment. Section 3 Part 7 Traffic Noise and Vibration, HMSO London

4 Department of Transport 'Railway Noise and the Insulation of Dwellings' (The Mitchell Committee Report) 1991. HMSO London

5 Department of Environment, Planning Policy Guidance: PPG 24 "Planning and Noise" 1994

6 British Railways Board, Union Railways Limited. Channel Tunnel Rail Link, Final Specialist Study, Airborne Noise, 1994

7 RailTrack: Strathclyde Passenger Transport Executive: Strathclyde CrossRail Environmental Statement, March 1995

8 Statutory Instruments 1996 No. 428. Building and Buildings. The Noise Insulation (Railways and other Guided Transport Systems) Regulations 1996

9 Tyne and Wear Passenger Transport Authority: Sunderland Metro Environmental Statement May 1996

10 RailTrack: Thameslink 2000 Environmental Statement, November 1997