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The Transportation Noise Action Plan for Scotland

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ABSTRACT

In 2006 the Scottish Government published the Environmental Noise (Scotland) Regulations 2006. These required the Scottish Government and their partners to carry out the following.

- Determine environmental noise exposure of the population through strategic noise mapping.
- Publish environmental noise information to the public.
- Establish five year Action Plans, to reduce noise levels where necessary, and to preserve environmental noise quality where it is good.

To take these objectives forward the Scottish Government established a Steering Group and series of Working Groups. The Transportation Working Group is responsible for delivering the Transportation Noise Action Plan (TNAP).

A major first task for the Transportation Working Group was ensuring stakeholder involvement, engagement, and buy in. This has been achieved through team working, communication between the players, and ensuring information is disseminated at all levels.

A key feature of the TNAP is the identification of Candidate Noise Management Areas (CNMA), using a prioritisation process based on noise level, annoyance, and population affected.

The TNAP will, review the CNMA, identify those to be elevated to Noise Management Areas (NMA), and evaluate appropriate interventions.

The TNAP is now entering the delivery phase. This paper shall cover the following topics.

- The development and agreement of the prioritisation process, including a consideration of some of the surrounding issues elsewhere in Europe.
- The process of continuous engagement with stakeholders.
- Current research and design principles.
- The Cost Benefit Analysis process.
- Some appropriate interventions and examples of good practice.

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1. INTRODUCTION

It has been estimated that 55% of the UK population[1] live in dwellings where the outdoor environmental noise level exceeds a guideline value, suggested by the World Health Organisation WHO[2], above which some people become seriously annoyed.

Of course environmental noise is not a new issue, in 1935 a letter writer to the Scotsman newspaper[3] referred to a letter from his father from 1835 (one hundred years earlier), noting traffic noise in London being such that "with the number of omnibuses, cabs, and hansoms, the noise on the streets is so great you cannot hold a conversation with anyone without much difficulty''.

Again in 1935, a Scotsman article[4] noted that the Minster for Transport believed "rubber tyres for all vehicles would reduce the problem of traffic noise".

These early observations are perhaps a little subjective and transportation has developed significantly in the last fifty or more years. Today there are many more vehicles on the road however this has been balanced with significant improvements in quieter vehicles, quieter surfaces, and improved project design and control. New road and rail schemes are now designed using codes providing a greater focus on environmental issues, including noise.

However recently WHO findings, though preliminary, suggest that long-term exposure to traffic noise may account for 3 per cent of deaths from ischaemic heart disease in Europe - typically heart attacks[5]. They noted, given that 7 million people around the globe die each year from heart disease, this would put the toll from exposure to noise at around 210,000 deaths.

The main source of environmental (ambient) noise is transport: road, rail and air traffic. Road traffic is the most widespread source[6.]

The Environmental Noise Directive does not currently set any limit values, nor does it prescribe the measures to be used in the implementation of noise plans. However some organisations, such as Environmental Protection UK, have argued[7], a proper application of the precautionary principle is appropriate. This would include moving from the current guidelines to standards and targets. They believe this would afford some health protection from environmental noise. This example would draw on the existing body of knowledge, as has been done with air quality for many years.

This background was taken into account as the Steering Group and Working Groups, noted in the abstract above, developed the prioritisation process.

2. THE PRIORITISATION PROCESS

After detailed consideration, the Steering Group agreed the prioritisation process should seek to establish those locations where people are most likely to be annoyed by noise, where noise intervention or management may be required, and to determine the order and process of this intervention or management in line with the aim of Article 1 of the END.

The Steering Group gave considerable thought to the most appropriate technique to evaluate these areas and, after detailed discussion, agreed on an approach that would identify the noisiest locations that affect the most people.

The prioritisation process was developed to evaluate strategic noise levels within the first round noise maps, in terms of the road, railway, and aircraft source areas most likely to

cause annoyance to people potentially affected. This will enable appropriate actions to be determined on the basis of a consideration of noise levels, the number of people potentially affected, and the annoyance response to road, railway, and aircraft noise.

The prioritisation was developed in a transparent and consistent manner to inform all of the action plans being progressed and uses a strategic, computer based noise model to analyse the data. Although the prioritisation provides a focus for action planning, due to the strategic nature of the mapping, a check on the strategic noise levels, the matrix input data and any proposed interventions was clearly essential prior to the implementation of any suggested actions.

The ranking part of the Transportation Noise Action Plan involved three steps. Firstly, the road and rail corridors identified from the round one noise mapping were divided into individual 100 metre segments.

Secondly, using the strategic noise mapping information, each residential building within the corridor area was assigned a score based on the predicted noise level, the number of people living in the building, and the annoyance response of the occupants to the particular type of noise. These scores are known as the Building Prioritisation Scores (BPSs) and are unique to each residential building.

Thirdly, the BPS scores for each building were aggregated and logarithmically summed to their nearest 100 metre segment. This provided a resultant Source Prioritisation Score (SPS) for each segment or road or rail corridor. The SPS values (essentially a noise annoyance density index) provide a means of ranking the road and rail corridors.

The SPS values were then ranked and statistically assessed to determine the range of values and establish a prioritisation process. Early statistical assessment analysis revealed around half of the road length had a zero SPS value, because there were no nearby residential buildings. It was also noted the SPS values varied across the groups, with the agglomerations having the higher values.

Although those segments with the highest SPS scores were clearly of greatest priority, the Steering Group gave detailed consideration to a consistent approach, across the groups, to producing a prioritisation method from the ranked SPS scores.

A key question, currently under review for phase two of mapping, was “how high does the SPS have to be before consideration is given”. A basic statistical analysis of the SPSs found that the top one percent of SPSs (normally distributed) corresponded to the mean SPS plus two standard deviations. This range was agreed to be the most significant area to target in the first phase of mapping, and following detailed consultation with all END working groups it was decided to map the top three percent of the road and railway network for further review. In early 2008, a map was therefore produced for review, showing the top three percent of SPS values with a banded colour system. For example, the highest one per cent level was shown as red, the next one percent amber, and the last one percent green. The remainder was coded black.

This early mapping provided information to allow the Transportation Working Group to visit some of this top three per cent to evaluate whether the modelling and prioritisation process was valid, grounded, and aligned with local knowledge.

Early discussion and feedback from the Working Groups to the Steering Group allowed the appropriate corrections to be made to the modelling. For example some minor coding errors were noted, and some minor adjustments to some traffic flows were made. This grounding and validation, from the mapping, allowed an appreciation of the complexity and robustness of the modelling to emerge among the groups.

Finally, after the early grounding and truthing process was complete, the Steering Group agreed to identify the top one per cent as Candidate Noise Management areas. The action plans published in early 2008 in draft form denoted these areas and described a process to take them from CNMA to NMA[8].

As noted earlier in this paper, a check on the strategic noise levels, the matrix input data and any proposed interventions was clearly essential prior to the implementation of any suggested actions. This was described as the Candidate Noise Management Area (CNMA) Noise Management Area (NMA) process. In early 2009, to support stakeholders in the CNMA to NMA process, the Scottish Government, directed by the Steering Group, published the "Draft Technical Guidance for Candidate Noise Management Area (CNMA) to Noise Management Area (NMA)[9]".

The guidance describes a three stage review process which stakeholders could adopt and develop to determine whether a CNMA should become an NMA. Stage one suggested a comparison of the ground data used in the model and data from other sources, including a site visit. Stage two involved a check of the traffic data used in the model against data found from other sources. Finally stage three involved a check on any mitigation measures in place at the building locations.

Each stage of the CNMA to NMA process will be led by the various working groups, working with a range of partners and stakeholders to take forward the process and source data.

To assist in this process the Scottish Government provided a tool in the form of a layered Adobe Acrobat Portable Document Format (PDF) file to enable each of the stakeholders to view the attribute data used in the production of the strategic noise maps. A separate series of layered PDF files were made available for each of the various working groups with separate documents for road and rail CNMA.

At the conclusion of the CNMA to NMA process data and suggestions will be made to the Steering Group.

The areas defined on the maps as being CNMA do not define an absolute area for CNMA to NMA consideration. Instead the designated coverage of a CNMA is simply indicative of the likely area that should be considered as being a CNMA. It may be that following further analysis that the area will need to be extended or, perhaps decreased. The CNMA areas simply prioritise areas where people are most likely to be annoyed by either road or railway generated noise.

Finally, it is the intention of the Scottish Government to produce further guidance on mitigation measures for consideration during the noise management process.

3. SOME RELEVANT ISSUES IN EUROPE

In June 2005 Margreet Beuving of AEA Technology Rail (NL), a *Harmonoise* researcher noted[10] "For the Directive to be applied a standardised method is needed because if you can't compare results from different countries you can't draw up an EU-wide noise pollution map and can't effectively develop an EU-wide policy to specify what action needs to be taken." She also noted, "at present European states have differing noise prediction and assessment methodology, and noise maps from Germany cannot be compared to those in Holland, for example, because different methods are used to measure propagation and noise sources".

Environmental noise indicators used in Europe vary between countries and industries, and depending upon the type of sound that is being measured. The chosen indicator values of maximum sound level reached in a period of time, and average sound levels over a period of time differ from country to country.

In December 2008, Milieu Ltd, Risk and Policy Analysis Ltd and TNO were commissioned[11] by DG Environment of the European Commission to undertake a project to review the experiences of Member States in implementing Directive 2002/49/EC relating to the assessment and management of environmental noise. The project responds to Article 11 of the Directive, which requests an assessment of implementation. This report will appraise some of the issue mentioned above.

The main purpose of the noise mapping efforts of Europe is to provide relevant information for global and local action plans. The maps have thus to serve as tools for obtaining popular support for funding noise abatement projects in competition with other projects making claims for scarce municipal, regional and national resources and to disseminate results in a form that the public can understand.

One of the most cost effective and low cost ways of reducing traffic noise is to fit cars with quieter tyres. In May 2009 the European Parliament's industry committee voted for a comprehensive labelling system for tyres[12].

Some countries address noise abatement at source and by controlling noise propogation. The Dutch government's Noise Innovation Programme (IPG) is a particular example of this. Twenty-five million Euros will be used for low-noise road surfaces and modular acoustic screens will be installed along the A12 motorway (in the municipality of Leidschendam-Voorburg), the A20 Noord motorway (in the municipality of Rotterdam) and A59 motorway (in the municipality of Heusden)[13].

In 2008, the European Commission's Directorate-General for Health and Consumer Protection published a peer reviewed report[14] summarising the conclusions and recommendations on night noise guidelines for Europe of a group of experts coordinated by WHO. The report highlights that sleep disturbance is correlated with the maximum pass-by level of individual events such as a from a single lorry, plane or train. The experts found that biological effects are apparent for noise levels exceeding 32 dB L_{Amax} (inside the bedroom) and effects on sleep quality are evident for noise levels exceeding 42 dB L_{Amax}. The experts also reviewed the relations between noise levels and health effects. They concluded that no night effects were observed for L_{Amax} noise levels up to 30 dB (A) and recommended several L_{Amax} related target values for health protection. In the light of this work WHO intended to publish night noise guidelines for Europe in 2009.

In the UK, considerable noise reduction work is included in major projects at the planning

and design stage.

4. CONTINUOUS ENGAGEMENT WITH STAKEHOLDERS

Although noise is ultimately an environmental issue, the measuring, management, and mitigation of environmental noise acts across a wide range of professions including planning, building control, engineering, and policy making. Each of these professions have their own particular procedures, responsibility, and indeed unique language and form of communication. This provides a challenge for a holistic approach to dealing with environmental noise.

A further challenge involves linking the various transport organisations, both government and nongovernment, to work together to raise awareness of noise issues and solutions.

The communication, understanding, and linkage with these groups, particularly raising awareness of the Transportation Noise Action Plan, has been a clear focus for the Transportation Working Group. To assist in this the TNAP members have been involved in meetings and discussion with all local authorities, and other groups including green space planning groups, Environmental Protection UK, and the UK Noise Association.

An example of engagement with the public has been noted in the “Ask Bristol” campaign where the current topic is traffic noise pollution. Bristol City Council is currently holding a noise consultation campaign with the public. The campaign links the various local authority professionals in considering how they address environmental noise. An innovative public facing aspect of the campaign includes a series of YouTube videos of public response to questions on the local attitude to environmental noise. One YouTube interviewer for example noted “it was hard to concentrate on the questions because of the noise levels. Raised the focus on people thinking twice about using their cars.

This courageous raising of the debate is going some way to raising awareness of traffic noise and the possible solutions with the public.

5. CURRENT RESEARCH AND DESIGN PRINCIPLES

Transport Scotland has been trialling new Stone Mastic Asphalt (SMA) surfacing as part of a resurfacing contract on the M8 from Newhouse to Duntilland, where the existing Hot Rolled Asphalt (HRA) surfacing required replacing. The overall aim of the trial is to delver more sustainable and durable surfacing. Perceived benefits include longer service life, less traffic disruption, reduced carbon emissions, and reduced noise. Some of the surfacing was treated to ‘enhance’ early-life skid resistance. The specification of these surfacings included skid resistance but no texture depth specification was requirement.

The location of the trial was chosen carefully to maximise findings. The site chosen was a two lane non-event dual carriageway, of consistent geometry, and a section of minimum length of 1.6km.

The eight trial surfaces, each 150 metres long were located on the eastbound carriageway, and the construction work was completed during September 2008. The material specification of each surface was based on a new European Standard for Stone Mastic Asphalt (SMA), BS EN 13108-5 (CEN, 2006). Four nominal size aggregates of 14, 10, 8 and 6mm were used in the trial. Two panels of each size aggregate were laid, with the requirement that one panel be treated with grit. The purpose of the grit was to improve the .early life skidding performance of the surface by removing any excess binder produced during the laying process by the action of trafficking.

Transport Scotland commissioned AECOM to carry out a roadside noise survey of all eight panels to assess the acoustic performance of all trial surfaces. The Statistical Pass By method was used.

The objective of the noise survey was to assess the change in noise following the re-surfacing of the trial sections and to compare the acoustic performance of the different trial surfaces.

Preliminary results show that the change in traffic noise after re-surfacing, after removing uncertainties, ranges from a reduction of between -1.2 to -6.4 dB (A), with an average of around 3 dB(A), which corresponds to an equivalent reduction in traffic noise caused by halving the traffic flow. The largest reduction in noise level was achieved at site 4 where the HRA surface was replaced by a 6mm SMA which was not gritted. Traffic noise levels were estimated to have reduced by 6.4 dB (A), equivalent in noise terms to about a four-fold reduction in traffic flow.

Examining the influence of aggregate size on traffic noise levels for the trial surfaces showed the expected trend that noise levels increased with aggregate size. This trend was more noticeable for the surfaces which were not gritted. For the non-gritted surfaces the average reduction in traffic noise compared with a new 20mm HRA surface (i.e., the RSIH value) was 3.9 dB(A) compared with a corresponding value of 2.9 dB(A) for the gritted surfaces, giving an overall average RSIH value of -3.4 dB(A) as indicated above. The influence of gritting the SMA surfaces was therefore to increase traffic noise levels on average by about 1 dB(A).

Although materials such as SMA provide a significant noise reduction over traditional materials, their acoustic benefits may deteriorate over time over time. It is important any Cost Benefit analysis process takes these reductions, and increased maintenance into account. With this in mind, the Highways Agency[15] have begun research to evaluate the acoustic performance of low-noise surfacings over time.

The four objectives of this project are as follows.

- To evaluate the acoustic performance over time of different aggregate size low-noise surfaces.
- Determine appropriate corrections that can be used for assessments where noise from trafficked surfaces can be predicted, and inform future noise mitigation strategies to be included within END UK action plan.
- To examine the relationship between any changes in noise level with changes in texture and also traffic conditions.
- Evaluate the feasibility and practical implications of using the principles of the SILVIA acoustic classification systems.

The aim of the first report is to provide details of each of the surfacing sites to be included within this project.

Type-approval noise limits for new vehicles have improved in recent years and The Transportation Working Group are tracking this. As the car industry produces quieter vehicles, and the public move to electric and hybrid, legislation follows close behind and locks in these improvements. A part of delivering the Environmental Noise Directive will involve including the benefits of the quieter fleet in the traditional prediction, assessment, and evaluation techniques. These are issues to be address at a national level, however it

will be important to evaluate the implications of these future benefits before significant expenditure on intervention is made.

During late 2008 the Steering Group became aware of the need to assess appropriate interventions at source, and how choice of surfacing can provide a reduction in noise level. With this in mind they engaged TRL to undertake a review of the literature on road surface noise reduction methods and comment on the relevance and applicability of these studies to Scotland taking into account the factors of safety, durability, and value for money. The report is due for publication soon however early findings suggest, although it is important to strike a balance between policy, practical, and financial considerations, significant noise reductions can be achieved by choice of a quieter surfacing material.

In addition to these research steps Transport Scotland have been a contributor to the development of CIRIA guidance on Noise and Vibration Issues in Urban Development. CIRIA identified current guidance on the subject was fragmented and was more readily accessed by specialists in particular areas of technical expertise to those who need to reach agreement on the difficult and sometimes contentious matters involved. The knowledge needed to be pulled together from a wide range of sources and presented in a manner which will facilitate informed communication, discussion and decision-making by all parties.

The content of the guidance will therefore be practical advice on how to address the subject and come to sensible decisions. The discussion of methodology and of criteria (i.e. performance levels to be met) will be an essential part of the work and it is anticipated that the guidance will become a key reference for discussions on construction projects for both developments and infrastructure. The document is due for publication during 2009.

In early 2009 Transport Scotland engaged SIAS to take forward a research project to evaluate the feasibility of developing a software tool to allow the outputs from traffic microsimulation to be utilised in noise prediction software calculation.

The current noise prediction and assessment process in the Design Manual for Roads and Bridges, notes the Calculation of Road Traffic Noise (CRTN) methodology should be used for the prediction of noise. The CRTN document (currently under review by the DMRB Overseeing Organisations) was produced in 1975 and updated in 1988.

CRTN does not currently utilise the large range of detailed disaggregated data available from traffic microsimulation software. More detailed noise prediction, utilising the disaggregated outputs from microsimulation, has the potential to produce more accurate assessment of the impacts from road traffic noise. This improvement, if achieved, could lead to increased robustness of understanding of scheme specific noise issues, more accurate predictions of affected properties, and improved quality of interventions.

The research proposal includes a desk study of existing noise assessment and microsimulation software used in the UK and Internationally. It will review forthcoming updates and developments in relation to noise prediction techniques, including the CRTN methodology. The research will specifically consider how the outputs from traffic microsimulation software can be improved and aligned with respect to noise prediction software and whether there is potential for developing a software tool to improve noise prediction to provide a more reliable prioritised solution to noise action plans.

A major part of the research will include an attempt to trial the improved technique, either with a recent or current project, to determine benefits of using disaggregated data, or as stand-alone comparison of simulated information. The research will conclude by consideration of the possibility of establishing best practice standards and the potential use of any developed software tool.

6. THE COST BENEFIT ANALYSIS PROCESS

The evaluation of an appropriate intervention will require a methodology of balancing cost against benefit. Cost of an intervention is a relatively straightforward element to address and a library of estimated prices for key elements is useful in this regard. However it is important to consider whole life cost and allowance should be made for construction, use, maintenance and decommission

In relation to evaluating the benefit of noise reduction the concept of monetisation of noise has been well addressed however methods used and quantum established vary.

The TRL report commissioned by the Steering Group notes Countries in Northern Europe and about half in Eastern Europe have reported monetary values for noise. In most cases the monetisation is based on hedonic pricing (using house prices) but the actual values are different between the countries. The report notes the differences are not due to differences in the impacts considered or different valuation methodologies but due mainly to different values being applied to same impacts. Values vary significantly between countries.

At present the Steering Group and working groups are considering the appropriate approach to evaluating a cost benefit analysis process to rank and assess interventions

7. SOME APPROPRIATE INTERVENTIONS AND EXAMPLES OF GOOD PRACTICE.

Taking the source, transmission, receptor approach for considering interventions, there are a range of solutions available to reduce noise.

At source quieter vehicles and alternative forms of transport will provide part of the solution in the medium term. The move to electric vehicle and the legislation for quieter tyres will play a strong part in this. Similarly the investment in public transport infrastructure provides a real opportunity to reduce car use.

At transmission level the design of appropriate mitigation in schemes include the use of cuttings, noise barriers, and earth bunds all of which mitigate noise, Careful design, including choice of corridor where possible has a large part to play in reducing noise.

Finally at receptor level the location design and orientation of residential buildings can successfully mitigate against environmental noise. Planners, developers and architects have a large role to play here.

As part of the END objectives, the work, intended at improving each and every citizen's quality of life,

Environmental noise reduction should be an ongoing process and an integral part of the design of new schemes and maintenance. To achieve this implies that, following the implementation of the Action plans, each stakeholder should provide feedback on the effectiveness of measures taken to reduce noise pollution.

Rather than relist them in this paper a list of useful measures are provide in the Transportation Noise Action Plan[8].

8. CONCLUSION

In conclusion there is a journey ahead in delivering the Environmental Noise Directive. The TNAP group will discover this year, and early next, which of the areas they will define as Noise Management Areas. Thereafter solutions will be considered and a cost benefit system applied.

All practitioners in this field will need to recognise the difficult challenge, but should welcome the opportunity to develop systems to justify cost of appropriate interventions against the benefit of reducing noise.

Technical Guidance will require to be updated as new technology improves our ability to predict noise levels and as vehicle become quieter.

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