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LOCAL NOISE MAPPING. THE FUTURE?

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1. INTRODUCTION

Although for many years the European Union and others have developed and produced legislation to control the noise emitted by individual sources - most notably road vehicles - there is a belief that in many areas the noise levels experienced by communities from transportation sources is rising. Specifically it is generally believed that improvements in road vehicle noise emissions have been offset by the increase in the numbers of vehicles using the road network.

In their Green Paper of 1996 (Ref.1) the European Commission (EC) estimated that between 17% and 22% of the population of the European Union (EU) suffered from environmental noise levels it considered "unacceptable" (day time levels greater than 65 dB L_{Aeq}). It was also claimed that 90% of this problem was caused by road traffic.

It is against this background that the Commission is moving towards action on environmental noise, including the acquisition of data via noise mapping across the EU. Recent unofficial news from Directorate General Environment (DG–Env.) suggests that, the Commission intend to propose a Directive on the approximation of the laws of Member States relating to the Assessment and Reduction of Environmental Noise, in September 2000. All the drafts of this document, which have been produced over the last 2 years, have indicated that the requirements for the production of noise mapping information will figure highly in this Commission proposal. The initiative constitutes a prospective bid for the extension of EU competence into new areas, and the Government has, while offering technical co-operation, reserved its position with respect to subsidiarity.

From the outset Birmingham City Council has been actively involved in the development of this Directive through membership of the EUROCITIES organisation. As a consequence the City's Environmental and Consumer Services Department have recently completed a comprehensive city-wide noise mapping exercise, using sophisticated computer based calculation and modelling techniques. A description of Birmingham's project and a review of the results of the project are provided in a report that was commissioned, and recently published, by the Department of the Environment, Transport and the Regions (DETR) (Ref.2). The project and the report, which is available on DETR's web-site (Ref.3), have recently been the subject of a series of 5 seminars held across the United Kingdom (UK).

In this paper the authors provide a summary of Birmingham's project and attempt to identify what the project has achieved so far and what it may lead to in the near future. The authors also provide a brief summary of the 'mapping requirements' envisaged in the latest draft of the proposed EC Framework Directive (Ref.4). Finally some general advice is given to those local authorities which may be contemplating carrying out noise mapping of their own.

2. SUMMARY OF BIRMINGHAM'S NOISE MAPPING PROJECT

Birmingham's noise mapping exercise has resulted in the production of a series of databases that contain calculated noise levels for 3.3 million reception points across the entire City. These reception points are based on a 10m by 10m grid network that is "overlaid" across the City. For each reception point an output file contains information on the location (northing and easting), the ground height (above sea level) and the daytime and night-time free-field equivalent continuous sound immission levels (L_{Aeq} (16hr) and L_{Aeq} (8hr)). Separate databases have been produced for the various sources of environmental noise covered by Birmingham's maps, i.e. road traffic, rail traffic, commercial aircraft movements and some industries. In addition, a database has also been produced of the combined noise levels derived by logarithmically summing the contribution of all the sources. From these databases "intelligent" software algorithms have been used to determine the locations of the various noise contours. These contours are depicted in 5dB bands from <30dB to >80dB. Within these limitations these colour in-filled contour maps show quite clearly the calculated sound immission level outside all individual facades of the 180,000 plus buildings in Birmingham at a height of 4m above ground level.

3. PROJECT ACHIEVEMENTS

It is believed that, to date, Birmingham's noise mapping project achievements are as follows:

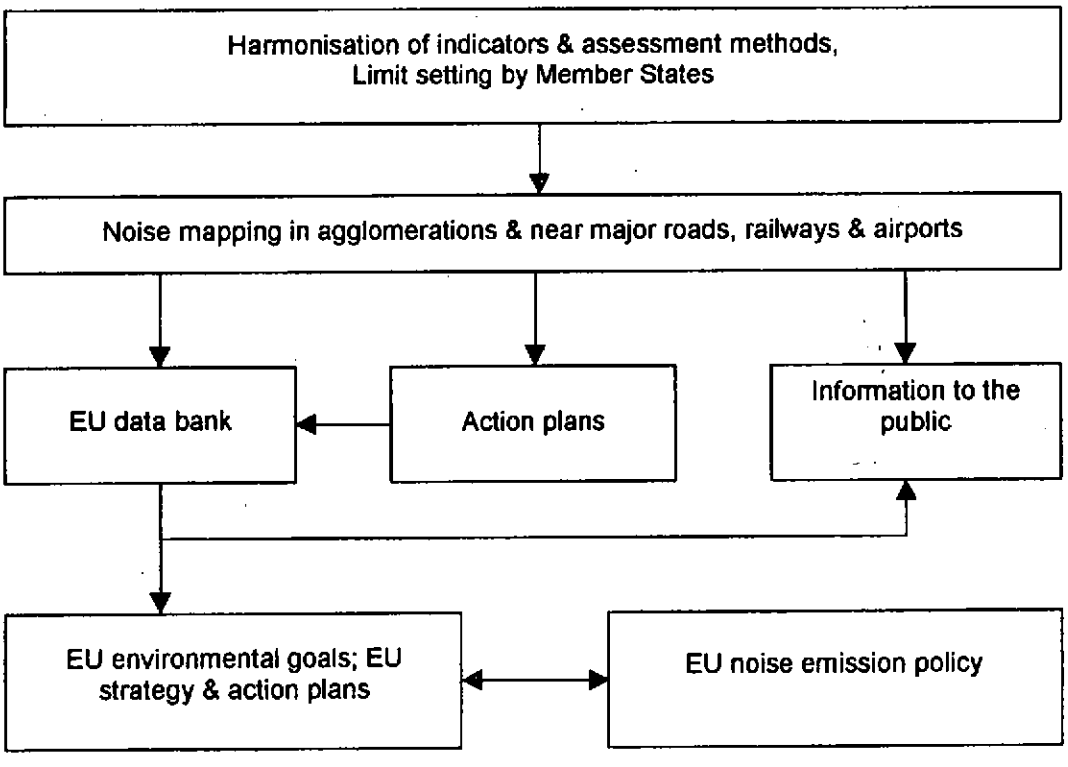
- It has shown that it is possible to produce sophisticated noise maps of a UK city, that give a detailed representation of the calculated prevailing environmental noise levels. All this has been achieved within a realistic timescale and with realistic costs;
- The report on the exercise identifies the problems that were encountered during the project and the compromises that Birmingham were forced to make;
- It has highlighted the importance of the quality and availability of the input data and identified some present shortcomings in this area;
- The resulting maps are physically impressive and provide information that is easily explained to and understood by the public and politicians;
- For the "noise professional" the maps provide additional information, in particular, by linking noise levels to building facades so that "hot-spots" of excessive noise pollution can be readily identified;
- The maps can be used as a general purpose noise zoning tool to assist planners and developers;
- The maps show planners and developers the areas where specialist acoustic advice may be needed if noise sensitive or noise producing developments are proposed;
- The maps can be used to identify areas of urban 'tranquillity' and where there may be a lack of such areas that are readily accessible to the general public;
- The maps create a 'watershed'. Publication of the maps will generate expectations of future improvements in noise levels.

The aforementioned are the achievements of the mapping exercise. However, the production of Birmingham's noise maps has not, and will not, automatically lead to the reduction of noise levels in the City. The maps are just the first step in a process leading to the development and subsequent implementation of co-ordinated and cost-effective action plans to reduce the environmental impact of noise from existing sources. In addition they constitute a significant step towards developing more effective policies and techniques to control and limit the noise impact of new developments.

4. THE PROPOSED EC FRAMEWORK DIRECTIVE

The overall approach contained in the latest proposals from the Commission is outlined in diagram 1.

Diagram 1



According to the latest version of the proposed Directive (Ref. 4), Member States would be required to adopt the necessary measures to undertake noise mapping and provide noise maps for agglomerations with more than 250,000 inhabitants, and for all major roads, railways and airports, within 3 years of the Directive coming into force. They would then be required to undertake similar exercises for agglomerations with more than 100,000 inhabitants within the 8 years of the Directive coming into force.

Member States would also be required to ensure that this noise mapping information is used for a number of purposes. The main purposes envisaged are summarised below:

- To produce information on the number of people living in properties exposed to the various 5dB bands of L_{den} and L_{night} as defined in Annex VI of the proposed Directive. The results of this exercise will have to be sent to the EU Databank;
- To develop and publish action plans for noise reduction in the mapped agglomerations and near to the mapped major roads, railways and airports. Copies of these plans will also have to be sent to the EU Databank and published for public information;
- To provided information on noise to the public in the form of published noise maps.

The noise mapping information and the noise maps would be produced initially by using temporary and then eventually using harmonised calculation or measurement procedures. If calculated using software, such software would have to comply with the minimum requirements outlined in Annex III of the proposed Directive. The noise maps themselves would have to meet the minimum requirements outlined in Annex IV of the Directive. The requirements of both these Annexes are likely to be supplemented by standards or guidelines drawn up with the help of EC Working Group 4 (WG4) Noise Mapping over the next 2 years or so.

5. FUTURE DEVELOPMENTS OF BIRMINGHAM'S NOISE MAPPING EXERCISE

In order to meet the proposed Directive's requirements for producing noise mapping information, noise maps and noise exposure data, a number of changes would have to be made to the input data and to the mapping software. These changes would include the following:

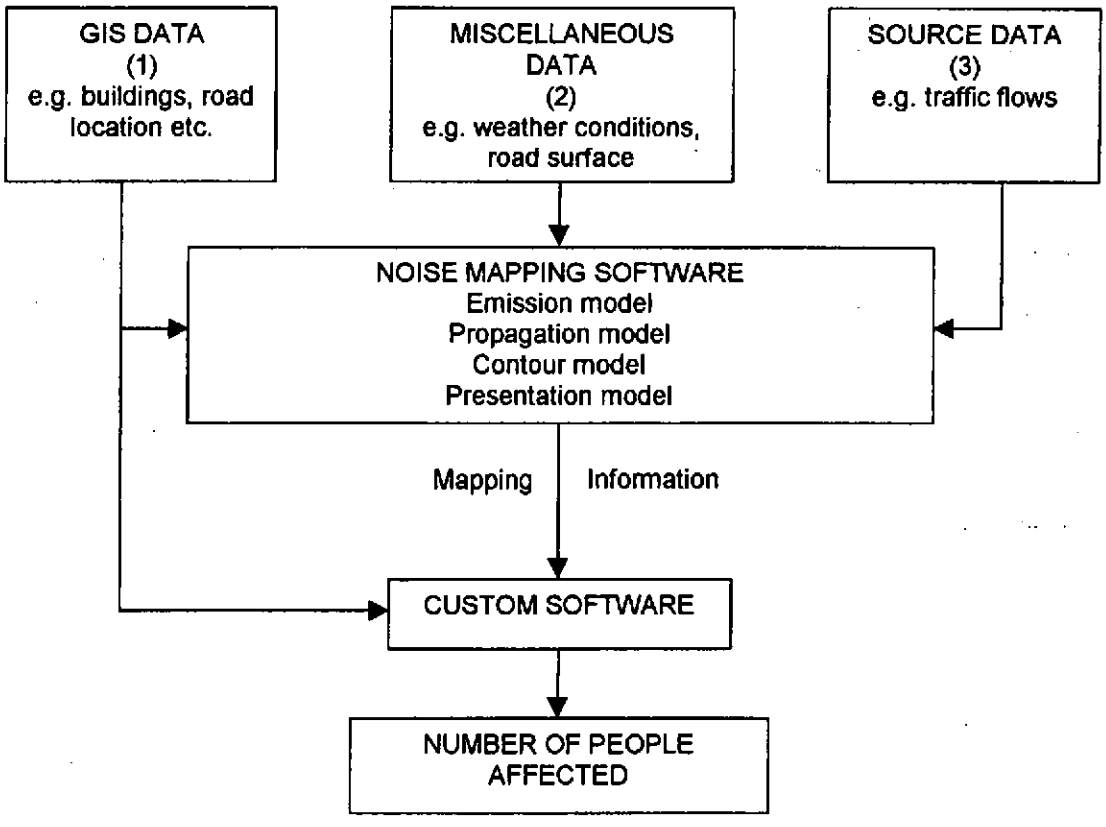
- The acquisition of the input data needed to calculate L_{den} ;
- The alteration of the software to calculate L_{den};
- The modification of the software to calculate the sound emission levels of the different sources and the sound propagation effects using firstly the temporary calculation procedures and eventually the harmonised procedures to be placed in Annex II of the proposed Directive,
- The alteration of the software to comply with the minimum requirements for mapping software in Annex III of the proposed Directive,
- The alteration of the software to present noise mapping information as recommended in Annex IV of the proposed Directive and eventually in accordance with subsequent guidance or standards produced by WG4;
- The alteration of the software and the associated development of systems to produce the data required for the EU Databank as outlined in AnnexVI of the proposed Directive.

In view of the relatively long timescale for the implementation of the proposed Directive's requirements on noise mapping (5 to 6 years), and the developments that will occur during this period, most of the above changes do not need to be dealt with as matters of urgency. Therefore, the main priority at the present time, is to develop the data already produced in Birmingham to determine the number of people living in properties that are exposed to the various noise contours. This could be carried out manually by identifying residential buildings, estimating the number of residents living in individual buildings or groups of buildings and then, by painstaking visual inspection, determining the numbers living in each band. However, a more satisfactory approach is to electronically link the existing mapping data with data on building location, building use and population distribution contained in a Geographical Information System (GIS). With the addition of custom software it should then be relatively easy to determine the required noise exposure data. At the time of writing this paper discussions between Birmingham and the DETR on such a 'second step' project are at a fairly advanced stage and it is reasonably certain that such a project will commence early in the 2000/2001 financial year. The project details have yet to be finalised. However, once completed it will then be possible to automatically model various noise reduction scenarios, simply by changing the noise mapping input data across the city and then producing new noise immision levels and contours. This process will help to determine the most effective mix of measures, which need to be taken at the appropriate level for each source, to control and ameliorate environmental noise from transportation sources in a major European city like Birmingham. Furthermore, it should be possible to examine the trade-offs involved in various policy options. For example, in setting the balance between the needs of the relatively small numbers exposed to very high noise levels and the larger numbers exposed to lower levels. In other words, where best to the target the resources available for mitigation at any one time.

Therefore, such a modelling/evaluation exercise will enable Birmingham to derive the action plans for noise reduction that are central to the EC's policy initiative. The project should also provide invaluable data for the development of action plans in other cities and agglomerations.

A very basic model for this project is shown in diagram (2).

Diagram 2



6. NEXT STEPS FOR UK LOCAL AUTHORITIES

It is hoped that as a result of the production of Birmingham's noise maps and the report on the experience, other local authorities will start to appreciate the benefits of producing noise mapping information and will be encouraged to follow suit. Even if authorities consider that, at the moment, there are more pressing priorities they should be left in no doubt that noise is moving up the national political agenda. Therefore, at the very least, the authors urge these authorities to start to examine the availability, quality and accuracy of the noise source data and the geographical data that will be needed to undertake noise mapping in their areas.

Some local authorities may, of course, take the view that it is not necessary to carry out mapping if and until the EC Directive becomes law, when funding for such tasks could become more readily available. However, mapping now offers distinct benefits. Firstly, it is likely to be at least 5 years before EU - wide maps are required by an eventual Directive, should one be agreed, yet public and political pressures to tackle environmental noise are already increasing. Secondly, through mapping now valuable insights and "hands-on" experience will be gained ahead of any legal requirements, which may come from the EC.

For interested local authorities the authors give the following advice and encouragement:

- Noise mapping software is not particularly expensive (£14,000 to £18,000);
- Mapping software is normally relatively user friendly;
- The 'hardware' is not particular expensive (around £2000 excluding a plotter);
- If is not necessary to map a large area in one go. Start with a small area to explore the advantages and challenges of mapping;
- It should be relatively easy for software houses to change their software to accommodate the EU's temporary and common mapping requirements, as they become available. However, would-be purchasers are advised to seek satisfactory guarantees before purchase.

7. CONCLUSIONS

Environmental noise levels are high in some areas of our cities/urban agglomerations and near to major transportation routes and airports outside these areas. Such noise levels often afflict those who suffer from other forms of social and economic deprivation and are least able to choose where they live.

Noise mapping in itself does not produce noise reduction for these members of our society or indeed the more privileged. However, experience with air quality data, contaminated land data, crime statistics and health statistics, shows that the presentation of such information to the public and politicians in the form of maps or league tables, more often than not, provides the spring board for future action.

Even if maps are not eventually required by European legislation, the production of such information across the UK is useful for the development of effective national and local strategies for the control and reduction of environmental noise.

Any views or opinions expressed in this paper are those of the authors and not necessarily those of their employers, Birmingham City Council and the Department of the Environment, Transport and the Regions.

Ref. 1: Future Noise Policy (European Commission Green Paper), COM (96) 540 final, Brussels 1996

Ref. 2: A Report on the Production of Noise Maps of the City of Birmingham. Department of the Environment, Transport and the Regions: London, February 2000

Ref. 3: www.environment.detr.gov.uk/noisemaps/birmingham/report/index.htm

Ref. 4: DG ENV Working Draft 'Proposal for a European Parliament and Council Directive on the approximation of the laws of Member States relating to the Assessment and Reduction of Environmental Noise'. Version ENDir 28. 03/03/00.