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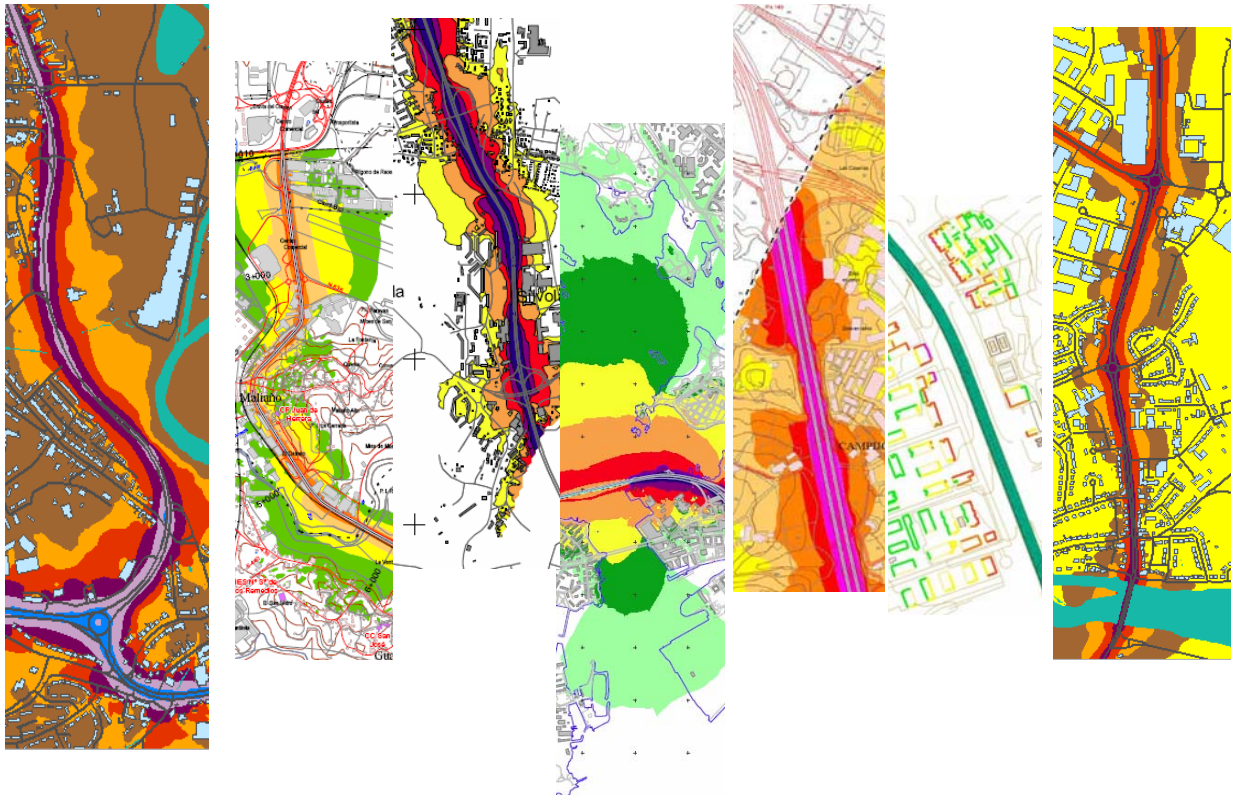
Best practice in strategic noise mapping



August 2013

REPORT BEST PRACTICE IN STRATEGIC NOISE MAPPING

Final Report, 28 August 2013

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Executive summary

On the 25th June 2002, Directive 2002/49/EC of the European Parliament and Council (Environmental Noise Directive (END)), was adopted. This was a significant step forward in developing EU noise policy. The purpose of the END Directive is to “define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to the exposure to environmental noise”.

Environmental noise is a significant environmental problem across the EU. As stated in the report from the Commission to the European Parliament and the Council (COM 2011.321), traffic-related noise may account for over one million healthy years of life lost annually in EU Member States and other Western European countries. Noise pollution has, besides negative health effects, economic costs. The social costs of traffic, rail and road noise across the EU were recently estimated to amount to EUR 40 billion a year, of which 90 % is related to passenger cars and heavy goods vehicles.

Member States have a number of obligations under the END. One of these is to undertake strategic noise mapping for major roads every five years. First round of strategic mapping was carried out in 2007, and the second round is to be completed by June 2012.

The estimated costs for strategic noise mapping presented in this current report vary between EUR 0.33 to EUR 1.16 per inhabitant, and despite the improvements of comparability of strategic noise maps, the situation is far from ideal.

Aware of the need to share experiences obtained from the first round of strategic noise mapping, CEDR Project Group Road Noise 2 created a subgroup with the aim of collecting information about mapping procedures, difficulties encountered and decisions taken during the first round, and to make recommendations based on best practices used by the different National Road Authorities (NRAs). This subgroup conducted a survey to ascertain directly exactly the work carried out by each road administration. Replies from 19 road administrations were received and based on the responses received the existence of many difficulties in making maps was evident. The time and cost invested in producing maps was quantified, confirming the existence of a large spread between different member states.

An important requirement for strategic noise maps is that they have to be reliable, clear and comparable, and they should be of a consistent quality. In an effort to achieve this goal, this report provides recommendations on a range of issues such as the input data used, the modelling processes, and the presentation and dissemination of the mapping results.

The recommendations are based on NRAs’ actual experiences in undertaking strategic noise mapping. Specific analysis and some examples have been described in order to develop and refine the recommendations.

It is hoped that these recommendations will prove useful in preparing procedures for a common approach to strategic noise mapping, and to generate resource savings in the work of the NRAs without compromising the quality of the final output.

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1 Noise mapping according to the EU Environmental Noise Directive (END)

In June 2002, the European Parliament adopted Directive 2002/49/EC relating to the assessment and management of environmental noise. The aim of this Directive was to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise. To that end the following actions were implemented:

- the determination of exposure to environmental noise, through noise mapping, by methods of assessment common to the Member States;
- ensuring that information on environmental noise and its effects is made available to the public;
- adoption of action plans by the Member States, based upon noise-mapping results, with a view to preventing and reducing environmental noise where necessary and particularly where exposure levels can induce harmful effects on human health and to preserving environmental noise quality where it is good.

All Member States transposed the END into their national legislation before July 2004.

As for the END noise mapping by the National Road Authorities (NRAs), no later than 30 June 2007, Member States had to make their first strategic noise maps for all major roads. Also Member States had to adopt the measures necessary to ensure that no later than 30 June 2012, and thereafter every five years, strategic noise maps will be made for all major roads within their territories.

A strategic noise map is the presentation of data on one of the following aspects:

- a noise situation in terms of the noise indicators L_{den} and L_{night};
- the exceeding of a limit value;
- the estimated number of dwellings that are exposed to specific values of a noise indicator;
- the estimated number of people exposed to noise.

Strategic noise mapping will be used as a source of information for citizens and as a basis for the END action plans. It will be used to provide the European Commission of data on the number of dwellings and people exposed to noise from traffic on major roads for instance.

2 Objectives of the subgroup END Noise Mapping

Road traffic noise is a sensitive issue when it comes to developing, upgrading, and maintaining national road networks in Europe. It is for this reason that the Conference of European Directors of Roads (CEDR) included the task 'to reduce road traffic noise' in their 2005-2009 Strategic Plan. The main objective was to facilitate knowledge sharing on noise management and abatement issues among European National Road Authorities (NRAs).

Following this objective, a report was published in 2010 containing the findings of a survey undertaken in 2006-2007. The primary aim of this report was to promote knowledge sharing on noise abatement and practical management of noise-related issues between the NRAs, in order to adopt a more advanced approach to the treatment of noise and noise abatement measures in Europe. Stemming from that it was anticipated that people who live in close proximity to road networks and are impacted by noise, would benefit from such improved innovations.

The second Strategic Plan 2009-2013 (SP2) published by CEDR also included “Road Noise” as a primary task. The new CEDR Project Group Road Noise focussed on four relevant topics for NRAs: noise mapping, action planning, tyre/vehicle noise and the European noise model. As many subgroups were formed within the CEDR Project Group Road Noise 2 to analyse the aforementioned matters. The subgroup END noise mapping focused its activities on acquiring information to put the basis for a common noise mapping procedure to be developed according to the European Noise Directive. With this target in mind, the following objectives have been pursued:

- collect information to identify mapping methods applied by NRAs;
- document constraints and difficulties encountered in noise mapping the national road network;
- provide recommendations to enhance noise mapping procedures.

To achieve these objectives the subgroup END noise mapping analyzed the way the NRAs in Europe approached the first round of noise mapping in 2007. A review of relevant literature was undertaken in order to collect additional information (see chapter 3). A questionnaire among CEDR’s NRAs was used to gather information relevant to strategic noise mapping (see chapter 4). The findings are summarized in terms of conclusions and recommendations (see chapter 5).

3 Literature review

In the past few years, many European working groups and experts have analyzed the different aspects relating to the implementation of the END. There are many publications addressing the approach and the criteria used to produce strategic noise maps. Primarily, they focus on difficulties in providing consistent results due to the lack of reliable input data and the development of a future European method to solve harmonization problems. Their work and publications have increased as the deadline for the second round of the END noise mapping approaches.

Specific seminars have been held by DG Environment, WG-AEN, JRC, EEA, IHCP, Expert Panel on Noise (EPoN), etc., in addition to regular conferences in acoustics, on topics dealing with various aspects related to the achievement of accurate, clear and comparable maps. Methodological acoustic issues, difficulties with available basic data, timing, annoyance indicators, accuracy, public information, have been analysed.

This 'external' source of information is of great interest for CEDR MS, whose task is to carry out noise mapping. It provides all kind of proposals that can be applied in the second round of the END, in order to simplify the task of noise mapping for the NRAs. CEDR Project Group Road Noise 2 concentrated its efforts on optimizing mapping activities and simplifying data processing.

A summary of the literature review dealing with strategic noise mapping is available in Annex 1. As a user of common European policies like the END, CEDR Project Group Road Noise has focused its interest on information that gives practical solutions and recommendations to ease future noise mapping activities.

For this reason the summaries outlined in Annex 1 do not attempt to summarize the content of these documents, nor highlight the most absolute important items. Only those elements that were expected to be relevant to reach our goals are reported, such as practical suggestions or, problems encountered in finishing the first round of strategic noise mapping for major roads, so that recommendations useful to approach next noise mapping activities could be provided.

All documents can be found online: http://www.cedex.es/egra/EGRA-ingles/I-Informacion.htm

4 CEDR survey on END noise mapping

4.1 General information

In recent years, several surveys on road noise and END noise mapping were undertaken. The results of the most recent survey are documented in the report from the European Commission to the European Parliament on the implementation of the Environmental Noise Directive (European Commission, 2011). Also the report "Review of the implementation of Directive 2002/49/EC on Environmental Noise" contains plenty of information about the key provisions of the END (Milieu, RPA & TNO, 2010). This report describes the main problems and difficulties experienced by member states and their competent authorities in implementing the key provisions of END. However, all these documents do not focus on the specific circumstances for major roads. Conscious of the need for more detailed information about the relevant aspects of the END noise mapping activities for major roads, the CEDR subgroup END noise mapping decided to undertake a new survey on this subject area and sent a questionnaire to the European National Roads Authorities in July 2010.

The CEDR questionnaire contains administrative and technical questions dealing with crucial topics such as cost and processing time, quality and quantity of input data, modelling configuration and calculation procedures. The subgroup noise mapping received 19 responses from 18 (out of 24) CEDR member states (MS). In the following paragraphs the main results of this survey are discussed.

4.2 Results

In this paragraph the results that emerged from the survey are outlined. The results were split in two parts, as a function of the context they belong to: input data and processing information.

4.2.1 Input Data

* *Digital terrain model*

The first question on input data dealt with type, resolution and accuracy of the cartography used to model the elements present in the environment to be noise mapped. Almost all MS have used a 3D digital terrain model with a scale varying from 1:4 000 to 1:25 000. The vertical accuracy of the digital terrain model was quite high: better than 2.5 m. As for the horizontal accuracy, 40 % of the respondents used very detailed data, with an accuracy better than 0.5 m, while the remaining 60 % settled for data with values better than 8 m. Digital terrain model data were collected in a corridor with a width of 200 m up to 6000 m. Many MS used a regional or national digital terrain model.

* *Traffic and speed data*

Traffic data were collected referring to a year included in a time span between 2003 and 2008. 60 % of the respondents classified traffic data in different vehicle categories, ranging from two to five (one member state used 10 vehicle categories). Five MS had no different categories. Traffic data were assigned to road sections by road type in eight countries, by direction also in eight countries and with mixed methods in one country.

Most of the countries used legal signposted speed data, instead of actual speeds. Actual speeds were collected only by three countries.

* *Pavement data*

The number of different pavements used to take rolling noise into account varies from one to eleven. However, about 40 % of the countries did not diversify pavement type in noise modelling and referred to standard pavement characteristics.

* *Building data*

As for buildings, different approaches were used depending on available data. In particular, 30 % of the respondents used 3D data and 15 % used 2D cartography with building heights; 40 % applied default building height, while the remaining countries acquired accurate data or estimated height from the number of storeys in a building.

* *Special elements (input as specific or independent items in the model)*

The survey also included questions on how MS mapped special elements such as viaducts, tunnels, junctions and noise barriers. The answers on this subject are reported in Table 1.

Table 1 Questions and answers provided by MS for special elements

	Yes	No	n/a
Are viaducts considered to be special elements?	12	7	0
Are tunnels considered to be special elements?	13	6	0
Are junctions considered to be special elements?	8	11	0
Are noise barriers considered to be special elements?	16	2	1

To define noise barriers, about 70 % of MS have completed the data extracted from digital terrain model with information coming from specific field inventories.

* *Population data*

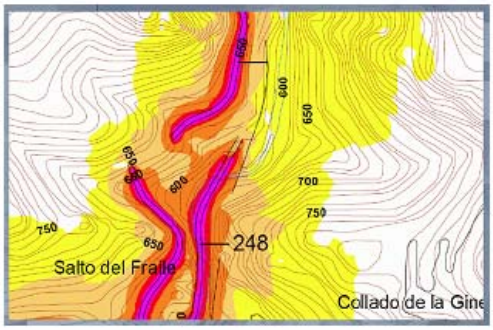
Collecting and assigning population data to buildings is one of the most difficult tasks required by END. Many solutions were suggested by the “Good practice Guide on noise mapping”, depending on available data (population distribution on buildings floors, population by street number, population density, and so on). In Table 2 the answers given by the various member states on this matter are reported.

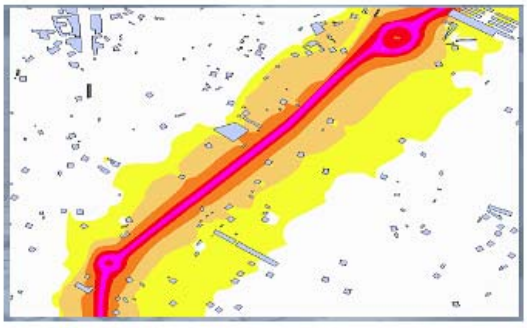
Table 2 Questions and answers provided by MS for population data

	Yes	No	n/a
Is population assigned to each building?	13	3	3
Are all residents assigned to the most exposed façade?	11	4	4
Are all residents evenly distributed on all façades?	5	10	4
Did you assign residents to second residences, tourist buildings, empty houses and office buildings?	1	14	4
In case of buildings that are exposed to noise from multiple roads, is the population occupying those buildings counted several times?	1	15	3

About 75 % of the respondents tried to simplify the task assigning all residents to the most exposed façade, so providing an overestimate of people exposed to noise. The remaining 25 % of the respondents used a more detailed approach, evenly distributing people on all façades.

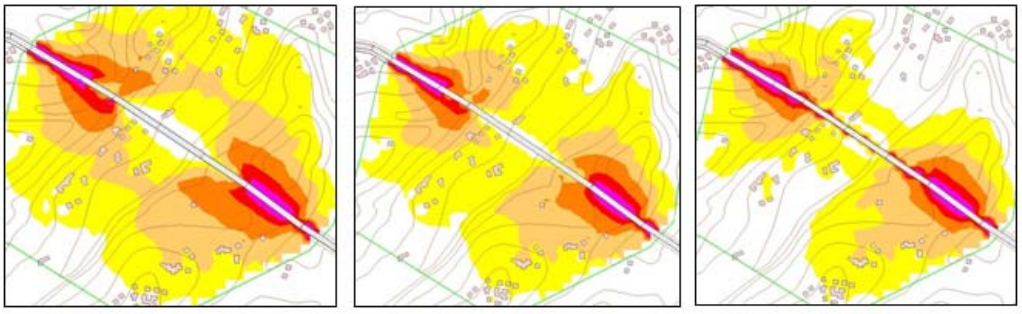
Great junctions with platforms at various levels can occupy vast areas, sometimes of the same order or greater than the distance from the road to the nearest dwellings. Modelling the road as a single line ignoring the junctions can lead to errors in the calculation of noise levels in the façade of these buildings.





The singular elements may be considered when modelling in different ways. We can model a noise barrier and ignore a big junction (a); consider two traffic lines in order to model roundabouts (b), or model a two separate platforms road with different tunnels in each direction (c).

The way of introducing these elements in the model can have a great influence in the results of the maps.



Most software packages have problems when modelling a viaduct. In order to model properly the viaduct and the terrain beneath it, the user has different options. Depending on the decisions taken by the user of the software, the results of noise levels and noise contours in the vicinity of the viaduct may vary significantly.

Figure 1 Singular elements: big junctions, tunnels, viaducts

* *Meteorological data*

Meteorological data is another important issue that influences noise levels, especially in windy zones. Those data are usually locally difficult to retrieve, so as suggested by the “Good Practice Guide” it is advisable in many cases recurring to default values or national datasets.

Responses from MS highlighted that only 10 % of the respondents used local meteorological data in noise mapping, 48 % made use of national meteorological datasets, 21 % used the default values reported in toolkit 17 of the Good Practice Guide, while the remaining 21 % used other methods.

* *Number of kilometres mapped*

MS were asked to undertake their first round END noise mapping for major roads which has more than six million vehicle passages a year. So the length of roads mapped differed significantly among MS, ranging from 11 km to 17 000 km (see Table 3)

Table 3 Kilometres road network that has been noise mapped in the first round

Number of kilometres	Number of MS
< 100	3
100 to 500	1
500 to 1000	4
1000 to 2000	3
2000 to 5000	4
> 5000	3
n/a	1

4.2.2 Calculation process

* *Calculation method*

A variety of calculation models were used during the first round of END. In total, nine different calculation methods were counted. The French NMPB-method was the most widely used calculation method with 8 out of 19 MS using it. NORD1996 and NORD2000 were used by Scandinavian countries (4 out 19), while Dutch RMW was applied by Belgium and the Netherlands. Ireland used the UK CRTN method while the other four MS had their own calculation method. Figure 2 shows the distribution of the different noise calculation models used by MS.

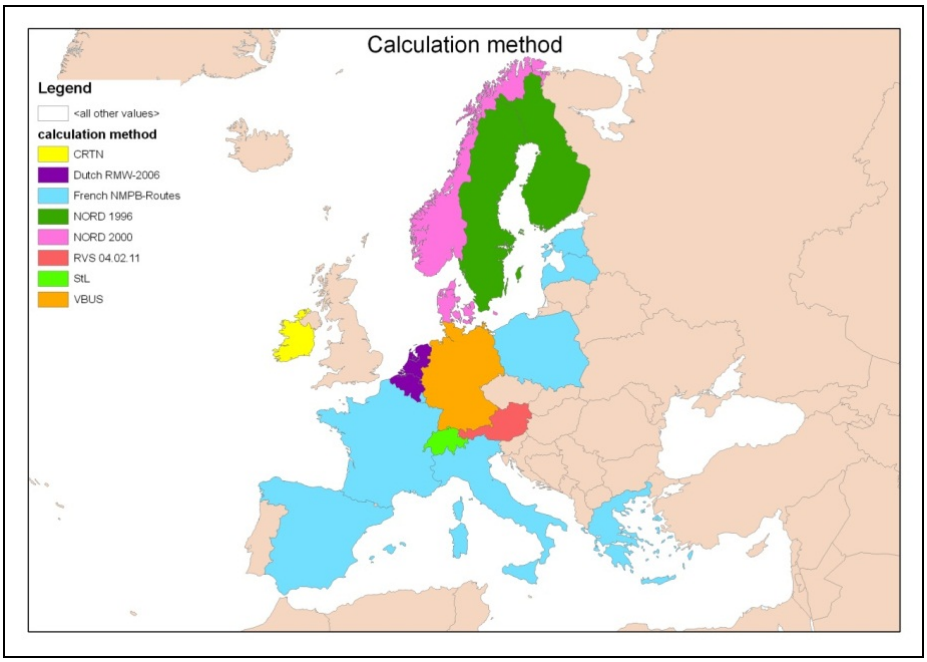


Figure 2 Noise mapping calculation methods distribution among MS

* *Software packages for calculation methods*

The noise mapping calculation models chosen by MS were found to be implemented in different software packages. In total, seven different versions were used. SoundPLAN was the preferred software with six MS using it. Four MS undertook their calculations with CadnaA and two with IMMI and one with LIMA. Two MS used a combination of several software packages. The remaining three MS used their own software. Figure 3 shows the distribution of the different noise calculation software packages used by MS.

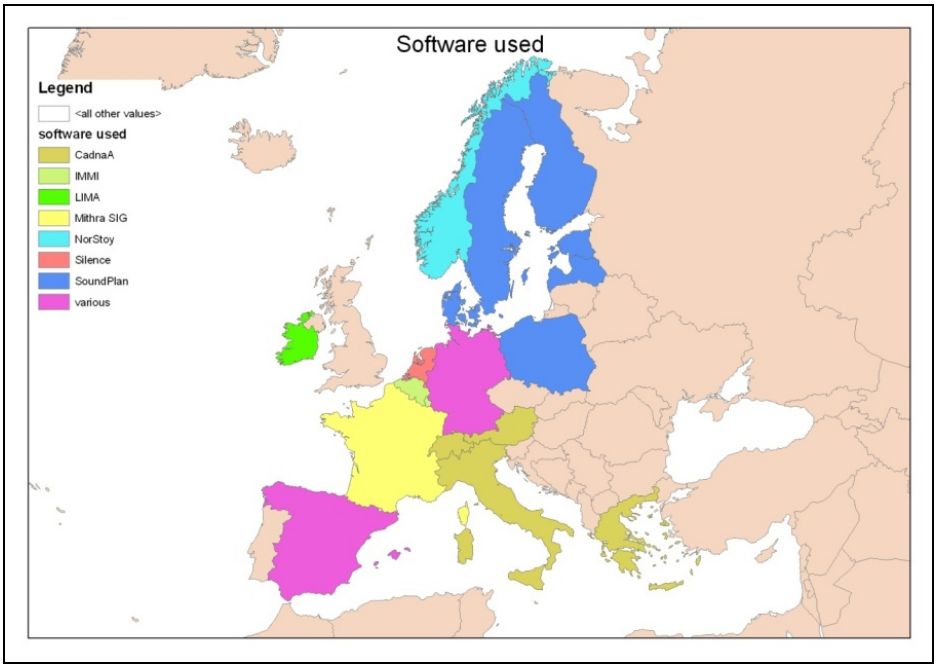


Figure 3 Noise mapping calculation software packages distribution among MS

* *Outsourcing calculations*

Noise level calculations have been generally outsourced completely. Only 3 NRAs out of 19 mapped road noise levels in-house using either commercial software packages or their own software.

* *Costs*

Data on costs were distinguished in two classes: internal and external (outsourced work). 6 MS provided information on internal costs, and 11 on external. The highest internal cost was EUR 600 000, and the average cost was EUR 160 000. Outsourced costs ranged from EUR 6500 for mapping 11 km to EUR 8 000 000 for mapping 17 000 km. If costs per kilometre are calculated, MS can be grouped in 3 categories: 20 % of the respondents have spent more than 1500 EUR/km, about 27 % between 500 and 800 EUR/km and the remaining 62 % less than 100 EUR/km. An approximate estimation of the average total costs per km mapped is EUR 604.

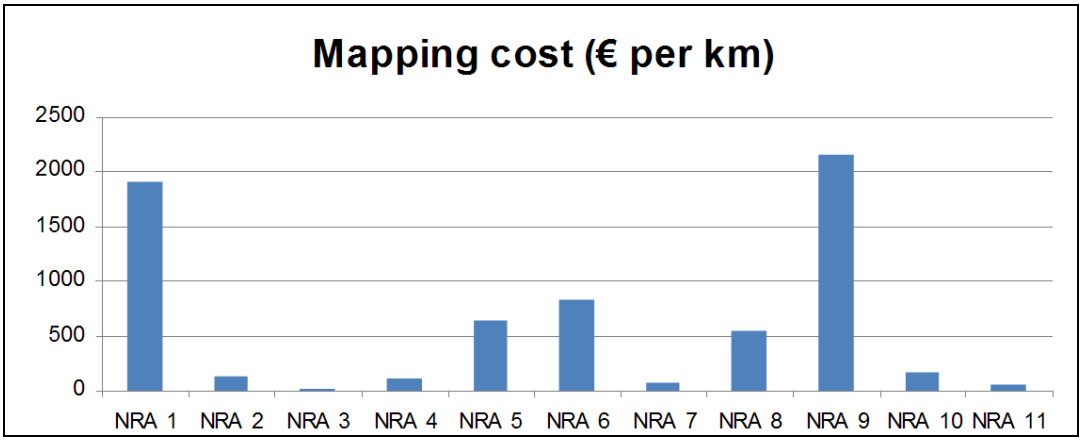


Figure 4 Mapping cost per kilometre

* *Number of reflections*

The number of reflections used in calculations is a balance between accuracy and calculation time (and costs). Most MS undertook their calculations with one reflection.

Table 4 Number of reflections

Number of reflections	Number of MS
0	2
1	11
2	3
3	1
n/a	2

* *Grid size*

In Table 5, the grid size inside and outside urban areas chosen by NRAs is shown. As can be seen, many MS used a grid size of 10 m inside urban areas. Outside urban areas grid size ranged mainly from 10 to 30 m. Only four NRAs used a different grid size inside and outside agglomerations, as suggested by “The Good Practice Guide”: a

larger grid size for long road networks and extended inhabited areas and a smaller one for relatively short road stretches.

Table 5 Grid size inside and outside urban areas

Grid size used	Number of MS	
	Inside urban area	Outside urban area
< 10 m	2	2
10 m	9	6
20 to 30 m	3	5
50	0	1
100 m	0	0
> 100 m	1	1
combination	2	2
n/a	2	2

* *Receivers on façade*
Approximately 60 % of the MS who responded to this particular question used a narrow spatial frequency on building façades to assess noise levels at receivers. The common horizontal spacing among façade receivers applied by around 40 % of the respondents ranged between 3 and 5 m. Two MS used 10 m and one used 30 m. The remaining MS used a simplified approach with just one point per façade.

* *Reference height of 4 m*
All MS calculated noise levels at the reference height of 4 m. Four MS also calculated noise levels at different heights. Finland undertook calculations at 2.5 m heights in order to compare L_{Aeq} day/night values to noise limits, to assess compliance with national regulations. Denmark calculated noise levels initially at a height of 1.5 m to take into account the noise exposure at single story residential buildings. For Austria calculations, heights of 2.4 m were also important. Switzerland started calculations at 1.5 m height and then at every 2.8 m.

* *Calculation time*
Calculation time depends on many factors: type of approach (more or less detailed), cartography resolution, building density, reflections number, width of the area to be mapped, calculation power of the system. So many different answers were expected for this question. The collected data showed that inside and outside agglomerations calculation time ranged from between 5 and 10 hours per 10 km of road, with a minimum of 0.34 h. As expected, the largest computation time was inside agglomerations (175 h), while outside agglomerations the maximum value was 50 h.

Table 6 Calculation time

Calculation time (in hours per 10 km of major road)	Number of MS	
	Inside urban area	Outside urban area
≤ 1 h	2	2
1 - 5	2	3
5 - 10	4	3
10 - 50	1	2
50 - 100	0	3
> 100 h	1	0
n/a	9	6

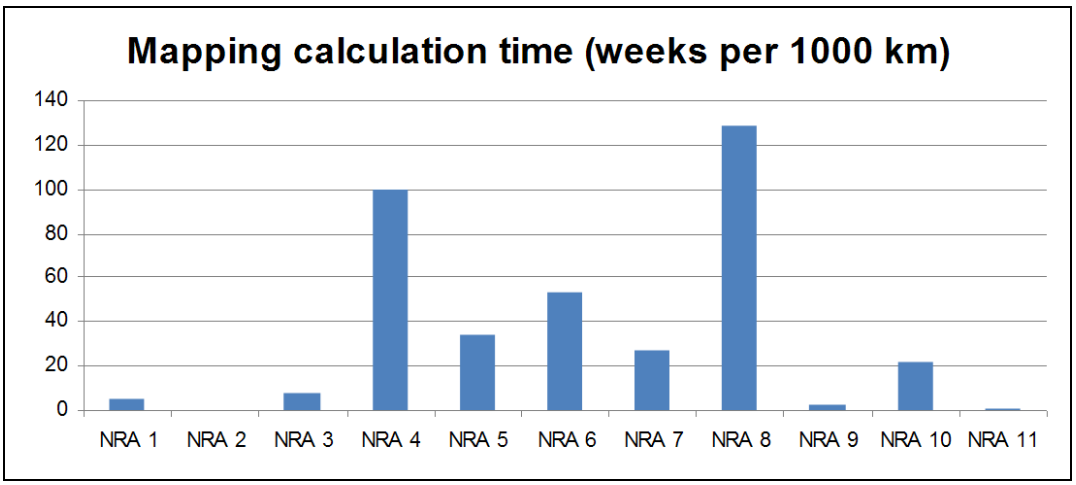


Figure 5 Mapping calculation time

With respect to the total time taken for MS to map their respective road networks, including data preparation, computer modelling and calculation time, it took 34.4 weeks of work to map 35 kilometres of road as minimum and 900 weeks for a network containing 4799 kilometres as maximum (1 week of work equates to 1 person working for 1 week or 1 week of computer running).

Nevertheless, it appears that there is no relationship between the time invested in undertaking the mapping and the number of kilometres mapped. Data on total time per kilometre show that two MS had spent more than a week of work per km, four MS between 0.2 and 0.5 weeks per kilometre and five MS less than 0.1 weeks/km.

Based on reported data, it can be assumed that calculation time varies between 0.003 weeks and 1.3 weeks per 10 kilometres. One respondent dedicated 1 week for calculating 3500 km and another required 20 weeks for only 750 km. Similar differences are found when comparing data collection and model preparation time. Differences can depend on building density, spread of urban areas, and surrounding terrain, but comparing the time spent in calculation, it can be concluded that technical criteria used for mapping related with accuracy and detail of input data and results were not the same.

4.3 Issues in first and second round of END noise mapping

Based on the results provided by the respondents, it can be assumed that all CEDR MS experienced problems in collecting reliable input data. In particular, some MS reported that there was lack of and errors in data related to terrain, traffic and buildings with the result that some datasets were incomplete. Other MS cited problems with the collection of data related to geometrical and functional aspects of the propagation environment. Spain also referred to the use of meteorological conditions as a critical issue and added that managing the final data on noise levels and the number of people exposed was a serious problem. Switzerland and Ireland highlighted that determining building heights, walls and barriers, as particularly problematic.

As for receiver noise exposure calculations, it was found that in most cases, it was impossible to associate population data to buildings with sufficient accuracy. Reliable data, in terms of quantity and distribution among buildings, were not available in many cases. Greece and Italy used the most recent census data, however, that referred to the year 2001 because the census in these respective countries is undertaken every 10 years.

Also, the lack of experience in calculating noise maps on such a large scale was never tested, so errors in the results from the calculation process were expected, however, the nature of such errors was unknown. Italy, like other countries having their own legislation, cited the problem of double mapping with different noise indicators in order to make sound pressure levels comparable to their national noise limits and discriminate critical areas. That was found to be time consuming and quite costly. Belgium too used two methods to calculate the amount of people and dwellings exposed to noise. The first approach put all people and dwellings at the most exposed façade (overestimate), while the second one distributed people and dwellings on all façades, resulting in different outputs, as expected. Also Finland found it difficult to assign inhabitants to noise buildings.

The timescale to produce noise maps was also highlighted as a problem by many respondents including the lack of public and political awareness, which was raised by the Dutch Road Administration.

Some MS highlighted as a problem, the lack of guidelines or clear information on noise mapping methodologies, underlining that when guidelines were finally produced, there was not enough time to fulfil the mapping tasks. Unclear definitions of some elements included in the END, such as agglomerations, acoustical characteristics like absorption/reflection on buildings etc., were also highlighted.

Finally, many MS cited the lack of national guidelines, with the exception of Spain, Finland, Austria, Switzerland, Italy, Denmark and Ireland.

In conclusion, all CEDR MS encountered similar problems, albeit with different degrees of significance.

The expectations for the second round of END noise mapping generally seem to be good. Some of the problems encountered in the first round of the END have already been or partially resolved. Most of the MS commenced the second round of mapping in 2011. The number of kilometres of roads to be noise mapped in the second END round varies from country to country. Due to the definition for major roads in the second round, roads which have more than three million vehicle passages a year, the total

length will increase. More than 3000 km are expected to be mapped by many countries. As for roads having more than 6 million vehicles passages per year, that have been mapped in the first round, no specific methodologies to update maps are reported.

It was noticed that 5 out of 19 of the respondents will change their computation method. 10 out of 19 MS have already set the time line for tendering the work to be outsourced. Different views were cited about the time needed to noise map the enlarged road network. Many respondents pointed out that the second round will take more time while Austria and the Netherlands feel that the second round will be less time consuming. However, it was generally asserted that the second round will be completed by June 2012.

4.4 Conclusions

The survey results have highlighted that different resources, both in terms of cost and time, have been required by MS for the provision of noise maps complying with the END. These differences are not only due to diverse road network lengths, but also to a different interpretation of the Directive.

The adoption of common calculation methods and procedures would probably narrow the range of cost and time. Furthermore, a quality system for defining input and output data accuracy, as well as model configuration would be necessary to achieve homogeneous results with similar ratios of cost and time.

Some shared decisions could be taken even before the final version of the new European common method CNOSSOS-EU will be published, such as the elimination of noise façade maps; the use of homogeneous meteorological conditions instead of favourable conditions and the restriction to only one reflection in calculations.

Figure 6 Façade map

5 Recommendations

5.1 Introduction

This chapter aims to highlight those aspects of strategic noise mapping procedures that have presented major difficulties in the first round of the implementation of the END. It focuses on issues that are of great relevance for CEDR NRAs in order to fulfil their task in END noise mapping.

During the first round, NRAs have taken all kind of decisions that had a dramatic impact on noise mapping costs, time to produce the maps and the accuracy of the final results. These decisions also affected the comparability of the output of END noise mapping at a European level.

CEDR member states have in general approached the noise mapping process with a different perspective, depending on consistency and accuracy of input data. Their national methods have shown to differ in technical requirements. This had significant effect on the outcome of noise calculations and assessment procedures of population exposure. The availability of traffic, population and geographical data imposed conditions on the process of noise mapping. Some countries have used many default input data and a simple definition of roads, terrain, buildings and exposed population, while others have implemented more detailed procedures.

In the near future, noise calculation procedures will be harmonised thanks to the introduction and the use of the new European model CNOSSOS-EU. The introduction of CNOSSOS-EU will also include a user's guide with recommendations on data quality and accuracy. However, it seems reasonable that institutions responsible for noise mapping still provide their own views and suggestions coming from their past experience, and taking into account not only technical problems, but also actual administrative and economic constraints.

A balance should be found between the effort required in producing noise maps and the quality of the results in terms of their accuracy and comparability. Therefore, a series of recommendations are provided. These recommendations are based on NRAs experiences in undertaking the first round of noise mapping and they are also based on information received from external sources. It is anticipated that the use of these recommendations should simplify the noise mapping process in the next round of END noise mapping for the CEDR NRAs.

5.2 Recommendations: input data

* *digital terrain model (DTM)*

The digital terrain model to be used in noise mapping must be accurate and updated to the reference year. It must include all the major roads noise sources present in the area and the surfaces and objects influencing noise propagation from traffic on these roads (building, noise barriers, walls, bridges, etc.). However, it should be noted that too detailed information could increase calculation time, so a compromise between accuracy and calculation time should be found. A good compromise could be DTM based on 5 x 5 m grid, corresponding approximately to the specifications reported for digital terrain model in the Good Practice Guide, Group C. For such a group, an uncertainty ranging from 1 to 3 dB is estimated and these results are considered to

have a good quality for noise mapping. Recent evidence (second round of mapping) has shown that aerial LiDAR (Light Detection And Ranging) can be used to generate the digital terrain model for a reasonable cost, however, a compromise must again be struck between the detail of the contour data and the ability of the noise modelling software to handle such data.

* *traffic and speed data*

Traffic data should be related to the reference year. For practical reasons, noise mapping needs to be started well in advance with respect to the deadlines fixed by END so traffic data could be predicted or updated, if real data are available, using traffic models.

Despite the fact that CNOSSOS-EU is going to recommend five vehicle categories (light, heavy 1, heavy 2, motorcycles and an open category), it could, in many cases, be very expensive to collate such detailed information.

As for vehicle speeds, it is recommended to use legal speed limits related to light and heavy vehicles respectively, if they differ.

* *pavement data*

With regard to road pavements, a discussion about open categories in which each country would use their own pavement data is still ongoing. It is envisaged that common categories, in which each country could adapt their national categories with the possibility of adding new or special ones would be preferable. The dispersion of number of pavements used in the first round of the END suggests that national categories should be maintained for the second round.

* *building data*

Building definition should include height and number of floors.

* *special elements (input as specific or independent items in the model)*

It is recommended that large junctions (grade separated interchanges), as well as tunnels and viaducts, would be considered as special elements. Care should be taken when assessing their acoustical characteristics as input parameters.

* *noise barrier data*

Noise barriers must be included in the noise model with their correct intrinsic and extrinsic parameters, such as sound absorption and geometrical figures. When intrinsic characteristics are not known, average values, usually available in noise modelling software packages, can be used.

* *population data*

Each building should have the population assigned in GIS. Assignment of population inside the buildings depends mainly on the input data, and recommendations recently prepared by CNOSSOS-EU should be enough to guarantee accuracy and avoid overestimating population exposure.

* *meteorological data*

In many member states, local meteorological data are not available. The use of default values as suggested by the Good Practice Guide could lead to noise levels that are 3 or more dB higher than average noise levels. In order to avoid overestimation of noise levels, average meteorological conditions should be applied instead of favourable conditions.

5.3 Recommendations: calculation process and noise maps results

With regard to the calculation process, survey's results show clearly that two different approaches have been used by CEDR MS to noise map their respective road networks: a strategic approach, with more simplified parameters, and an advanced approach based on detailed data and a detailed calculation process. The difference was found mainly in the number of reflections, grid size and calculation of noise levels at receiver façades. These differences may explain the varying costs reported by the various member states. In the following paragraphs some recommendations on calculation configuration and parameters can be found.

* *calculation method*

As for the calculation method, it seems advisable to continue with the noise model used for the first round of the END until the common European assessment method CNOSSOS-EU is available.

* *software calculation method*

Any software package complying with END specifications can be used.

* *number of reflections*

Only one reflection is necessary to guarantee sufficient noise map accuracy for strategic noise mapping purposes.

* *calculation grid size*

The calculation grid size defines the detail level of noise maps. Narrowing the grid size improves the accuracy of the maps, but at higher costs, in terms of calculation time, hardware and human resources.

The calculation time when using 5x5 m grids is estimated to more than double than when using a 10x10 m grid. In a Norwegian example, using the Nord2000 method, the time needed when using a 5x5 grid is 125 % greater, and the effect of the more accurate calculation grid is minimal.

Based on responses given by respondents to the questionnaire, it seems reasonable to recommend a grid size of 10 m inside an urban area and 25 m outside agglomerations.

* *receivers on façade*

The number of people exposed to noise was calculated by CEDR MS in two ways: (1) indirectly from noise contours, assigning to buildings the noise levels corresponding to the noise band in which buildings resides, or (2) directly calculating sound pressure levels at receivers with a horizontal spacing ranging from 3 m to 10 m.

As two thirds of the NRAs have calculated noise levels at receivers this is recommended as the correct way to estimate incident noise level at façade as stipulated by END Directive.

* *reference height of 4 m*

Almost all MS carried out their calculations at the reference height of 4 m, except Switzerland that fixed a height of 4.3 m. However, it is important not to overlook the fact that some buildings are one-storey houses, and if the building is lower than 4 m it will not have receivers assigned in its façades. To avoid this, it is recommended to use a minimum height of 4 m for one-storey houses.

In accordance with END for strategic purposes, the total population is placed at a 4 m height level. However, for other purposes, as for definition of some noise control measures, different calculation heights will be necessary to correctly determine the noise impact affecting buildings that have more than one storey.

* *calculation time*

Calculation time depends on the resources available: hardware, software, data and human resources. To limit calculation time, it is suggested to comply with the recommendations reported in this chapter on grid size, number of reflections and cartographic resolution. To speed up calculations, tiling of the areas to be noise mapped and parallel calculation process is recommended. As an indication, a time ranging from 5 to 10 hours per 10 km of road is necessary on average.

* *last noise contour*

Based on CEDR MS responses, it has been seen that the distance from the road of the noise contour L_{den} 55 dB ranges from 500 m up to 1000 m. Seven countries have this noise contour at a distance of more than 1000 m and only one country has it at a distance of between 250 and 500 m. According to END, the mapping area is defined by the noise contour 55 dB L_{den}. This contour determines the extent of the input data required and the population potentially exposed to noise should be determined. Calculated noise levels at extended distances from the source have a very high degree of uncertainty and usually provide a miscalculation of the noise levels at receivers. It is therefore advisable to check the validation of the calculation, especially when the last contour is located more than 1000 m from the road axis.

* *exposed population*

When presenting data on noise exposed population for major roads, the European Commission requested figures for exposed people living outside agglomerations. However, most NRAs have used in public information the total number of exposed population both inside and outside agglomerations. This different approach has produced some confusion in the first round, so it is recommended to point out clearly which population has been considered when providing data of people exposed to noise coming from traffic on major roads, and explaining that these two sources may present different figures due to this reason.

* *colour proposal*

END does not fix a range of colours to be used in noise maps, so different approaches were applied by NRAs in the first round of the END. In order to make noise maps comparable and more readable, it seems advisable to fix a colour palette for the next round of END noise mapping. A common colour chart is proposed by CEDR Project Group Road Noise 2 in the Report Factsheets ‘Colour proposal END noise mapping’.

Table 7 Colour code proposal

Noise band [dB]	Colour	RGB code	HEX code	Name
less than 35	none	-	-	-
35-39		R: 35 G: 132 B: 67	#238443	Moderate sea green
40-44		R: 120 G: 198 B: 121	#78C679	Greyish green
45-49		R: 194 G: 230 B: 153	#C2E699	Light greyish chartreuse green
50-54		R: 255 G: 255 B: 178	#FFFFB2	Pale yellow
55-59		R: 254 G: 204 B: 92	#FECC5C	Light brilliant amber
60-64		R: 252 G: 141 B: 60	#FD8D3C	Brilliant tangelo
65-69		R: 255 G: 9 B: 9	#FF0909	Light brilliant red
70-74		R: 179 G: 6 B: 34	#B30622	Moderate amaranth
75-79		R: 103 G: 3 B: 59	#67033B	Dark rose
80 and more		R: 28 G: 0 B: 84	#1C0054	Deep blue violet

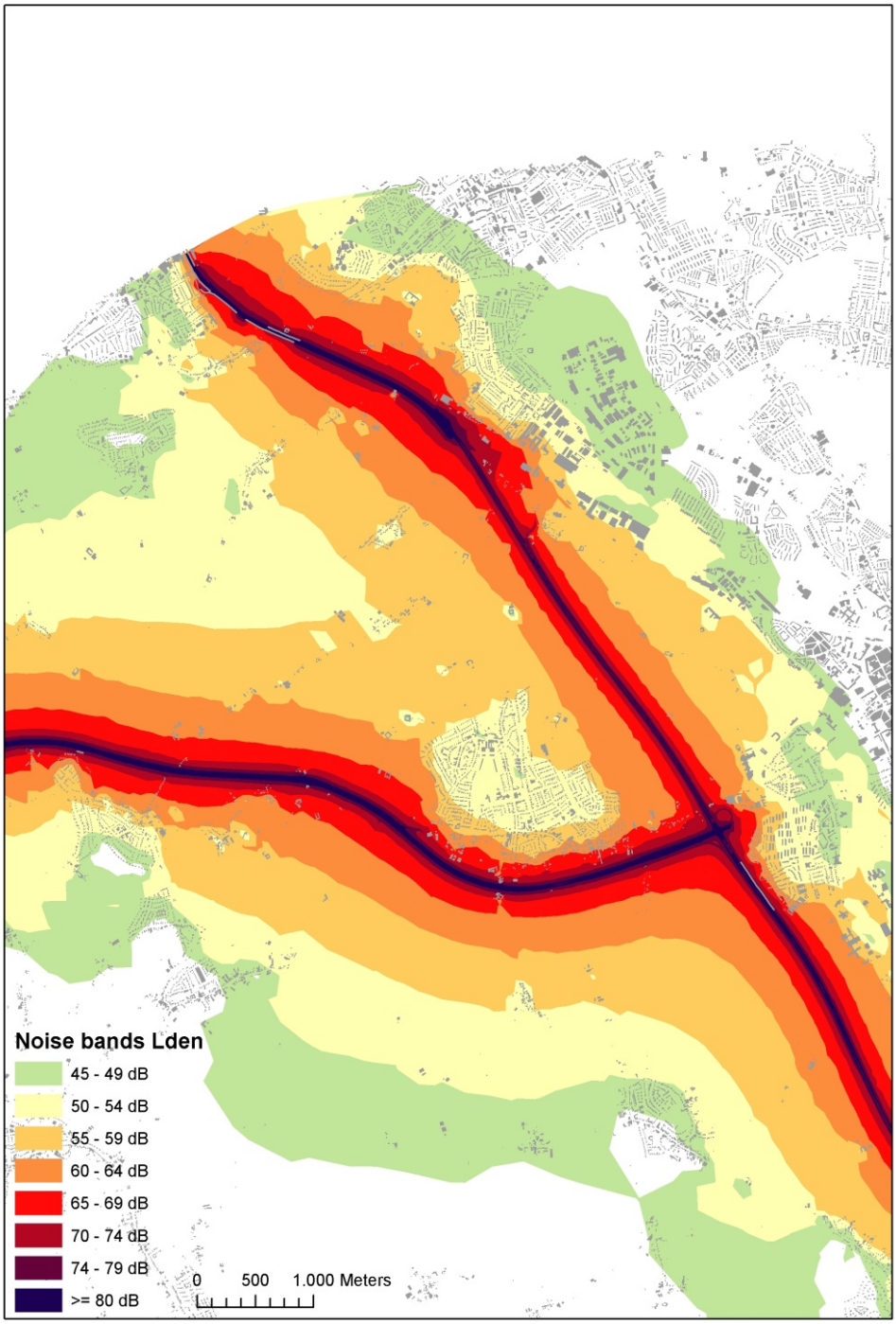


Figure 7 Proposed common colours example

5.4 Internal and synergic actions to reduce cost in noise mapping. Coordination between Administrations.

Costs reduction of noise mapping is a significant challenge for NRAs. Coordinating efforts with other administrations may be helpful. Some Member States must also prepare noise maps for the major railways which have more than 30 000 train passages per year. In order to reduce costs for the calculation of noise maps, a possible option is to work together with other administrations responsible for the preparation of noise maps for the other sources such as railways, airports or other roads (e.g. railway agencies, agglomerations).The input data sets that are not specific for a particular source, e.g. digital terrain model, building data, population data or land use in some cases can be used for mapping different noise sources. So the costs for the collection of the data and preparation of the input model can be shared.

Using higher quality terrain models within short distances from the road, may have a significant impact on the costs of noise mapping. In Finland laser scanned material has been used for second round mapping within 500 m on both sides of the road, outside this area 3D map data is used.

Based on the Finnish experience, limiting the size of the digital terrain model saved costs in two ways: the terrain model is cheaper and the noise mapping time is shorter.

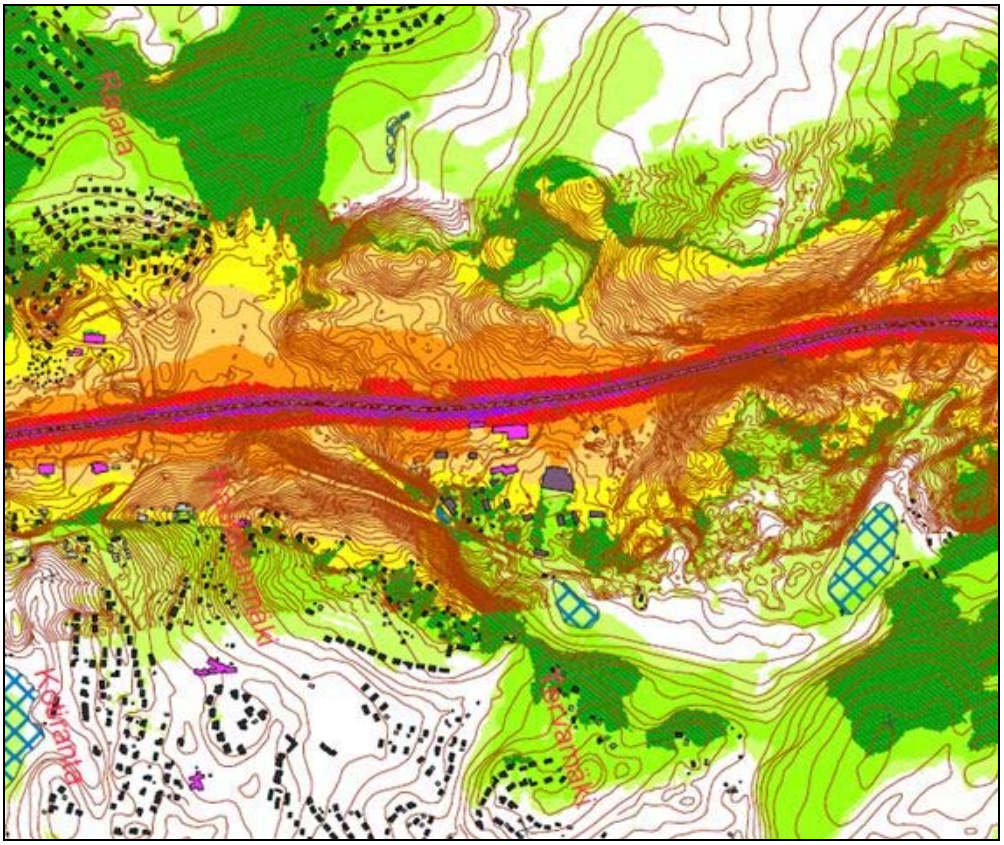


Figure 8 Different accuracy of the digital terrain models used in Finland

Substantial reductions in costs are expected in the third round, in which updating the data will be done starting from input data prepared in the second round.

5.5 Issues related to the second and third round of the END

Maps should be adequate for the purpose to which they will be used. For this reason, there is a need for two different types of maps: strategic maps and more detailed local noise maps.

Strategic noise maps are descriptive. They should be reliable and comparable with strategic maps from other administrations, all over Europe. A common procedure is required in sufficient detail to allow homogeneous formats and understandable data and figures. More detailed noise maps are, instead, intended to be used to specify, develop and discuss concrete actions to mitigate noise along major roads.

It is anticipated that in the next round of END, the European Commission intends to propose the collection of data on people exposed to noise bands lower than those established in the END: L_{den} 50-54 dB and L_{night} 40-44 dB. Even if it is not mandatory, this will likely be perceived as strongly recommended. This decision has important consequences, not only increasing efforts, time and cost in the mapping process, but also in the process of providing information to the public. It also seems quite unreasonable to give the impression to European citizens that such a low noise level can be achieved in close proximity to major roads. This has the potential to divert attention away from issues that are attainable. To calculate such low levels, it would be necessary to map areas up to 2 km either side of a road. Calculations at such distances from the source have a very poor accuracy leading to inaccurate sound pressure levels and the number of people exposed to noise. Most calculation methods have a validation distance that is limited to less than 1000 metres. Also, the increase in computation time and costs of the mapping process would be very significant. Due to the expanded mapping, increased resources would be necessary in order to collate input data, cartography data, demographic information and building properties. It is common opinion among the members of CEDR Project Group Road Noise 2 that this would be too challenging, from both technical and costs perspective.

Furthermore, a common quality control system is also needed in order to check the reliability of the output data before a CEDR NRA reports their figures to their national competent authority. In their factsheet ‘Anomalous data of END noise mapping for major roads on the website of the European Environment Agency’ CEDR Project Group Road Noise 2 has formulated several recommendations. As for the quality control system, it is recommended that the NRA should assess the quality of their data by using variables like household size, residential density and distance of noise contours, before they report their END data to the competent authority. Only when the output of these calculations is within the range of what one would expect, the accuracy is assured.

The Environmental Noise Directive requires preparing strategic noise maps every five years. The first round, finished in 2007 was predominantly experimental, both at national and European level. The second round, to be finished in 2012, is going to be undertaken by the NRAs with the same methodologies and it will cover more than 120 000 km of European national roads. In the second round some administrations are going to simplify what has been done in the first one, benefiting from the previous experience.

For noise mapping events after 2012, it is anticipated that the new harmonised noise mapping methodology known as CNOSSOS-EU will be used. It will start with a period in which both CNOSSOS-EU and national methods have to be compared. A number of different technical, methodological and legal issues will initially have to be resolved before the use of CNOSSOS-EU will be common practice. It is expected that noise levels resulting from the new calculation model could somewhat differ from those estimated with the previously adopted methods, so care should be taken in this phase, especially when noise levels have legal implications. After solving these problems, in 2017, a common mapping procedure could be established.

CNOSSOS-EU is more than just a common European method for noise mapping. During the process of developing CNOSSOS-EU, a significant number of decisions were made to solve acoustic topics. The future Good Practice Guide on CNOSSOS-EU will be essential to explain the details of the new calculation model.

The future simplified method for strategic noise mapping is considered now to be mandatory, assuming that local maps will take into account different national needs. The experience of the groups of European experts should come close to the experience of the NRAs responsible for the maps, and specifically take into consideration the difficulties found in the first round of the END in order to simplify data processing and optimize mapping activities, with the final objective of achieving reliable, understandable and useful strategic noise maps. As a consequence, not only the NRAs will benefit from this approach, but also people living in close proximity to major European roads.

All NRAs should closely monitor or actively participate (trough relevant channels in their country) in the development of the proposed new calculation methodology (CNOSSOS-EU)

Annex 1: Relevant literature on noise mapping

1. Noise mapping: the art of -

European Commission Working Group Assessment of the Exposure to Noise (WG-AEN). Good Practice Guide for Strategic Noise Mapping and the Production of Associated Data on Noise Exposure. Version 2. August 2007.

The Good Practice Guide (GPG) is a document produced by the European Commission's Working Group "Assessment on Exposure to Noise" (WG-AEN). The purpose of this GPG is to help Member States and their competent authorities to undertake noise mapping and provide the associated data as required by the END. Although it is not meant to be a manual for strategic noise mapping, it provides advice on specific issues that were raised initially by Member States. Some of these issues are quite complicated and have been dealt with in detail (toolkits). Other issues are less complicated and have been addressed accordingly.
The content of the GPG is as follows:

- chapter 1: introduction
- chapter 2: discussion and recommendations on general issues, noise sources, propagation and receiver related issues that have been raised by the END (see also chapter 4);
- chapter 3: introduction to and discussion on implications for accuracy related to the use of the toolkits provided in chapter 4.
- chapter 4: toolkits integrating the recommendations given in chapter 2. Six of these toolkits are new having been produced through the Accuracy Study 1; and
- A series of appendices, most notably Appendix 4 and Appendix 5, based on the results of the Accuracy Study 1 and dealing with the sources of uncertainty in noise modelling and the importance of data for strategic noise mapping.

The GPG strongly recommends that every effort should be made to obtain accurate real data on noise sources. However, where data has to be estimated because accurate real data cannot be obtained, the methods/solutions (the tools), provided in toolkits in chapter 4, can be used.

Environmental Protection Agency (EPA). Guidance Note for strategic noise mapping for the Environmental Noise Regulations 2006. Ireland. July 2009.

The objective of this guidance note is to provide practical information, advice and guidance to designated Noise Mapping Bodies on the development of strategic noise maps under the Environmental Noise Regulations. This guidance note is issued as applicable only to the development of strategic noise maps as currently envisaged for delivery to the EC during 2012 with reference to the second round of the Regulations. It is currently envisaged that a revised guidance document will be issued ahead of the second round of strategic noise mapping during 2011/2012 following the expected report from DG Environment to the Commission, and any resulting amendment to the Directive. This guidance note provides a review of the background, aims and objectives of the Regulations. It also sets out a recommended approach for the development of strategic noise maps and a framework process for the assessment of exposure to environmental noise and presentation of information to the public.

2. Noise mapping: examples major roads

Rubio, J. and Segués, F. Results of the first round of the strategic noise maps in Spain and actions derived. EURONOISE; Edinburgh, October 2009.

This article reports the main results related to noise mapping activities undertaken in compliance with END. Noise maps were carried out by the Spanish Road Directorate on 4779 km of the National Road Network. The Spanish Noise Action Plan (SNAP 2008-2012) has also been accomplished and the legal demands of public information of both the studies and the Plan have been fulfilled, with the Plan being approved in 2009. In order to facilitate the access to the more relevant information, a web page has been published (www.cedex.es/egra), including the results of the 20 studies done in the past four years (90 000 maps approximately), the SNAP with the projects and other actions derived from it. Some of the measures designed to abate noise in the SNAP have been already started.

3. Noise mapping: second round

De Vos, P. Environmental noise directive: do's and don'ts for the second round. EURONOISE, Edinburgh, October 2009.

In July 2008, the first round of noise mapping, requested under the European Environmental Noise Directive, should have come to an end. Although many member states have not quite finished yet, first conclusions can be drawn from the available results. The process of strategic noise mapping and action planning has raised discussions about the principles of the Directive. The quality of the results has been seen to be strongly affected by the application of a large variety of assessment methods. Often, basic approaches requested by the Directive, such as a dialogue with the affected citizens, have not been successful or even not implemented at all. Action plans in general show little ambition and will most likely have little effect. The European Commission, responsible for the control of noise at the source, is committed to interpret the results as an incentive for their future policy. Therefore, it is essential that a better quality be achieved in the second round. Suggestions for improvement are presented.

4. Noise mapping: results first round

Van den Berg, M. and Licitra, G. EU-Noise Maps: analysis of submitted data and comments. EURONOISE, Edinburgh, October 2009.

Nearly all EU member states have submitted noise map data as required by EU Directive 2002/49. All the submitted data were published on the EU-web site, making their compilation and analysis possible. As could be expected, not all data were usable as published. Even when the EU-data format was used (which most did), confusion could arise on the figures. After scrutiny, it has been seen that 64 million people were affected by road traffic noise in agglomeration, and a significant lower part of the population by other noise sources. Of the total amount of data, a low percentage, namely 13 %, referred to EU-27 population. Apart from some unexpected glitches, the overall impression is that the quality of the data is fair and yields important information on the exposure of the EU-population to noise. The rough estimates from the Greenpaper on Noise from 1996 are largely confirmed.

Nugent, C. Reportnet for noise: Feedback from member countries. EIONET National References Centres of Noise meeting, Copenhagen, October 2009.

Reporting in accordance with the European Directive 2002/49/EC is an essential information flow for environmental noise data in Europe. For this reason quality assessment is of great importance. It could be further improved if the data forms of Reportnet are made mandatory. Therefore, we suggest that the EC stipulates in a decision that these forms have to be used by the member states.

5. Noise mapping: information to the public

Working Group Assessment of the Exposure to Noise (WG-AEN). Presenting Noise Mapping Information to the Public. A Position Paper from the European Environment Agency Working Group on the Assessment of Exposure to Noise. March 2008.

The END (Article 9) establishes two distinct aspects related to public information: (1) the availability of information upon request, and (2) the active and systematic dissemination of information to the public. This Position Paper focuses on the second of these aspects.
The END requires that everybody should have access to noise mapping information. However, it is up to member states to decide on the type and level of detail of this mapping information and how to explain the meaning of the information. A key issue is to provide information as simply as possible with appropriate summaries.
WG-AEN suggests that two levels of information and accompanying explanations should be made available locally: a basic (simplest) level, reporting a summary of the results achieved and a higher level for those who wish more detailed information.
Coloured maps showing noise contours in 5 dB bands should be provided in accordance with Annex IV paragraph 7 of the END. These maps should at least cover the range required by Annex VI of the END, i.e. from < 55 dB to ≥ 75 dB for L_{den} and < 50 dB to ≥ 70 dB for L_{night}.

6. Review END implementation

Justice & Environment (European Association of Environmental Law Organizations). Make some noise: shadow report on implementation of the Environmental Noise Directive in Austria, Czech Republic, Estonia, Hungary, Slovakia and Slovenia. 2009.

In order to share their experience with the implementation of the END, some J&E member organizations involved in noise protection issues have decided to compile this report. Their aim was to:

- summarize the experience in implementing the END gained by Austria, Czech Republic, Estonia, Slovenia and Slovakia, particularly from the perspective of NGOs and citizens;
- draw attention to problematic phases and issues of the implementation process in these countries;
- identify elements of the implementation process showing identical or similar elements in these countries;
- contribute towards the Commission's review of the END.

Milieu, RPA, TNO for DG Environment. Final Report on Task 1. Review of the Implementation of Directive 2002/49/EC on Environmental Noise. May 2010

Milieu, RPA and TNO were contracted by the European Commission to deliver a project reviewing the implementation of the END. The project's objectives for task 1 were:

- to review the implementation of the key provisions of the Directive with the aim of identifying the main problems and difficulties experienced by the MS and their competent authorities in the first round of END;
- to provide the Commission with an accurate overview of the risk of non-compliance with the key provisions of the Directive;
- to propose amendments to the Directive and solutions ensuring a more efficient and secure implementation, suiting the objectives of the Directive.

Furthermore, in Task 1 a first a survey aiming at gathering information on how the 27 Member States have implemented the END, was undertaken. The emphasis of the research fell upon identifying the challenges experienced by Member States in carrying through the mapping process.

Murphy, E. and King, E. A. Strategic environmental noise mapping: methodological issues concerning the implementation of the EU Environmental Noise Directive and their policy implications. Environment International 36 (3):290-8 2010,

This paper explores methodological issues and policy implications concerning the implementation of the EU Environmental Noise Directive (END) across Member States. Methodologically, the paper deals with two relevant key thematic issues: (1) calculation methods and (2) mapping methods. As for the first one, the paper focuses, in particular, on how differing calculation methods influence noise prediction results as well as the value of the EU noise indicator L_{den} and its associated implications for comparability of noise data across EU states. With regard to the second one, emphasis is placed on identifying the issues affecting strategic noise mapping, estimating population exposure, noise action planning and dissemination of noise mapping results to the public. The implication of these issues for future environmental noise policy is also examined.

European Commission (2011) Report from the Commission to the European Parliament and The Council. On the implementation of the Environmental Noise Directive in accordance with Article 11 of Directive 2002/49/EC. COM(2011) 321 final. Brussels.

The implementation of the END has just recently entered into an active phase regarding noise mapping and action planning. This first implementation report identifies significant achievements but also several difficulties and areas for improvement. However, the full potential of the END has not been harvested yet. The action plans are only now being implemented and have often not created the envisaged effects (yet). The Commission will consider further actions as described in this report in relation to implementation improvements and possible measures on noise source reduction. In addition, harmonisation of the assessment methodological framework is under preparation. As part of the review, the preparatory work looked also into elements such as indicators and strengthened enforcement mechanisms that might need to be addressed in the future to achieve effective and efficient legislation on environmental noise. This report will be the basis for further discussions with Member States and

other interested stakeholders to explore the possibilities of improving the effectiveness of the noise legislation. Independently of this consultation process, it needs to be borne in mind that a more comprehensive and realistic assessment of the effectiveness of the END can only be made after the second round of noise mapping when the knowledge on noise pollution will have improved further.

7. CNOSSOS- EU

JRC. Final report on assessment of the equivalence of national noise mapping methods against the interim methods. December 2008.

A survey on noise mapping methods used by MS was undertaken by JRC. The results achieved are summarized in the following points:

- 7 MS provided partial or no information about the methods used;
- 8 MS used either their national methods or the interim ones depending on the noise source (i.e., road traffic, railway traffic, aircraft, industrial);
- 5 MS used their own national methods for all four noise sources;
- 7 MS used the interim noise assessment methods as established in Annex II of the European Noise Directive 2002/49/EC for all four noise sources.

Concerning the compliance of the EU MS to Art. 6 of the END it was observed that:

- 7 MS were assessed to be compliant with Art. 6 of the END for all noise assessment methods used;
- 5 MS were assessed to be non-compliant with Art. 6 of the END for at least one noise calculation method;
- For 15 MS it was impossible to determine their compliance with Art. 6 of the END for at least one noise assessment method, due to lack of information. Two of them stated their intention to provide some more information through JRC protocols within December 2008.

Kephalopoulos, S.et al."Towards common noise assesment methods in EU" Meeting of the EIONET National Reference Centres for Noise. October 2009, Copenhagen.

Ending 2008 and during 2009, DG JRC in co-operation with the European Environment Agency elaborated requirements on input values and their associated quality in view of the next round of the European noise mapping. Noise assessment methods complying with END requirements were scrutinised and identified. The preselected methods were then proposed to DG ENV for further consideration before reaching a choice. In a second step, those parts of the selected methods that fulfilled at best END criteria were used to produce a 'fit for purpose' framework for common European noise assessment method(s).

A technical evaluation of the existing noise calculation methods, based on appropriate criteria able to provide a clear understanding of the capabilities, strengths and weaknesses of the candidate methods was performed in the period of July-August 2009. A screening and rating of the candidate methods (more methods for each of the four major noise sources) identified by DG JRC and agreed upon by DG ENV was performed on the basis of specific criteria developed in conjunction with a team of EU noise experts, including the European Environment Agency's Experts Panel on Noise (EPoN) group. Following these criteria, the methods complying with END requirements were identified, scrutinized and finally further discussed during the Workshop on "Selection of common noise assessment methods in EU", that took place on 8 and

9 September 2009 in Brussels. The main aim of this Workshop was to reach consensus about the elements the common noise assessment method(s) should be composed of. The Workshop was performed in the context of the roadmap outlined to prepare common noise assessment methods in EU to be used by Member States for strategic noise mapping according to the European Environmental Noise Directive 2002/49/EC.

JRC. Common Noise Assessment Methods in EU (CNOSSOS-EU). Analysis of the EU Member States (EU-MS) feedback on JRC Reference Report on CNOSSOS-EU (Draft version of 28 May 2010). November 2010.

During the meeting of the Regulatory Committee on Noise (11 June 2010, Bruxelles), EU-MS were invited by the Commission to nominate experts to be involved in the next steps of the process related to the development and implementation of CNOSSOS-EU. EU-MS were also invited to send their comments on the draft JRC Reference Report on CNOSSOS-EU (version 2d of 28 May 2010) by the end of August 2010. They were asked to focus on three aspects in their comments:

- general comments on the process, on the fit-for-purpose method and on the 2-level approach;
- more specific technical comments throughout the chapters of the report;
- views and comments on (a) the level of detail to be included in the implementing decision, (b) details to be left to the guidelines for the competent use of CNOSSOS-EU and (c) implementation time of CNOSSOS-EU including the testing/validation period.

The report gives recommendations for further strategic development and implementation.

JRC. Draft JRC Reference Report on Common Noise Assessment Methods in EU (CNOSSOS-EU) to be used by EU Member States for strategic noise mapping after adoption as specified in the Directive 2002/49/EC. Version 3, November 2010.

In the context of the END, the European Commission decided to prepare Common Noise aSSessment methOdS (CNOSSOS-EU) for road, railway, aircraft and industrial noise in order to improve the reliability and comparability of results across the EU Member States. The Joint Research Centre is responsible for preparing CNOSSOS-EU, which, after adoption by EU Member States, will be used in the future for producing noise maps and action plans. The roadmap for the preparation of CNOSSOS-EU started with the exercise on equivalence of existing noise assessment methods in EU and will end with the long-term planning for assisting EU MS in reliably implementing CNOSSOS-EU in the context of the next END rounds (from 2017 on).

JRC. JRC Reference Report on Common Noise Assessment Methods in Europe (CNOSSOS-EU) to be used by the EU Member States for strategic noise mapping following adoption as specified in the Environmental Noise Directive 2002/49/EC. September 2012.

This report describes this methodological framework, which was developed in the development phase (phase A) of the CNOSSOS-EU process to be applied for strategic noise mapping in Europe. It was based on state-of-the-art scientific, technical and practical knowledge about environmental noise assessment in Europe, while

considering the cost burden incurred by EU countries when undertaking the periodic strategic noise mapping.
The core of the CNOSSOS-EU methodological framework consists of:

- a quality framework that describes the objectives and requirements of CNOSSOS-EU;
- parts describing road traffic, railway traffic, industrial noise source emission and sound propagation;
- a part describing the methodology chosen for the aircraft noise prediction and its associated performance database;
- a methodology to assign receiver points to the façades of buildings and to assign population data to the receiver points at the façades of buildings;
- the scope and the concept of the “Guidance for the competent use of CNOSSOS-EU”, which should be fully developed in the implementation phase (phase B) of the CNOSSOS-EU process.

Moreover, a summary on the outcome of the revision of the Electronic Noise Data Reporting Mechanism, which was led by the European Environment Agency, is also included in the report as it represents the key interface between the noise assessment throughout Europe and the sharing of the results by means of one common noise methodological framework.

Based on this report, the European Commission will amend Annex II of Directive 2002/49/EC, in connection with the implementation phase of CNOSSOS-EU (phase B) in 2012-2015. The ultimate goal is to have the common noise assessment methodology operational for the next round of strategic noise mapping in the European Union, in 2017.

During phase B, the CNOSSOS-EU methodological framework will be extended to allow its application by EU Member States on a voluntary basis for other specific types of assessment at local scale (e.g. action planning). For the latter, the precision and accuracy requirements of the assessment are usually higher to those when producing strategic noise maps as required by Directive 2002/49/EC (mandatory requirement) in which case economically affordable solutions (i.e. related to input data gathering and computational time) are sought by eventually reducing the requirements of precision and accuracy.

Annex 2: Interesting websites

European information on environmental noise

http://ec.europa.eu/environment/noise/mapping.htm

http://projects.jrc.ec.europa.eu/jpb_public/act/publicsimplesearch.html

http://noise.eionet.europa.eu/

http://www.eea.europa.eu/themes/noise/publications

http://www.circa.europa.eu/Public/irc/env/noisedir/library

http://www.trl.co.uk/silvia/

http://www.cedex.es/egra/EGRA-ingles/I-Informacion.htm

http://www.euro.who.int/en/what-we-do/health-topics/environmental-health/noise

http://inspire.jrc.ec.europa.eu/

Noise maps of major roads

Austria:
http://www.laerminfo.at/

Belgium/Flanders: http://www.wegenenverkeer.be/natuur-en-infrastructuur/geluid-en-trillingen/geluidskaarten.html

Cyprus:
http://www.moa.gov.cy/moa/environment/environment.nsf/All/1FEFE293F3754B37C2257948003DF5A7?OpenDocument. reference Στρατηγικοί Χάρτες Θορύβου

Denmark: http://miljoegis.mim.dk/cbkort?profile=noise

England: http://services.defra.gov.uk/wps/portal/noise

Estonia: http://www.mnt.ee/index.php?id=12376

Finland:
1. Report, Road-traffic Noise Assessment of the Finnish Transport Agency, with English summary (roads outside agglomerations):
http://www2.liikennevirasto.fi/julkaisut/pdf3/lr_2012_liikenneviraston_maanteiden_web.pdf
2. Noise-zone maps: Liikennevirasto | Meluvyöhykekartat
Road noise maps L_{den}: http://www2.liikennevirasto.fi/meluselvitys2012/Lden.htm
Road noise maps L_{night}: http://www2.liikennevirasto.fi/meluselvitys2012/Lyo.htm
3. Agglomerations are mapped independently. See Helsinki.

Germany: http://www.umweltbundesamt.de/laermprobleme/ulr.html

Greece: http://www.ypeka.gr/Default.aspx?tabid=452&language=el-GR
and you open the documents with the references: «Στρατηγικοί χάρτες θορύβου, Παράρτημα Β» (Strategic noise maps, Appendix B), and «Παράρτημα Δ: ΧΑΡΤΕΣ 1-1000 Στρατηγικός…αρχείο zip, 32.4 MB)» (Appendix D: Strategic MAPS 1-1000)

Italy: http://www.autostrade.it/en/risanamento-acustico/mappa-del-rumore.html

Ireland: Done by the municipalities. See Dublin.

Norway:
http://www.vegvesen.no/Fag/Fokusomrader/Miljo+og+omgivelser/Stoy/Stoykart

Poland: www.pma.oos.pl

Scotland: http://www.scottishnoisemapping.org/default.aspx

Spain: http://www.cedex.es/egra/

Sweden: http://www.trafikverket.se/Privat/Miljo-och-halsa/Halsa/Buller-och-vibrationer/Trafikbullerstorningar-i-Sverige/Trafikbullerstorningar-i-Sverige---dokument/

the Netherlands: http://www.rws.nl/geotool/geluidsregister.aspx?cookieload=true

Noise maps of EU-cities: general information

EUROCITIES: http://workinggroupnoise.web-log.nl

http://www.cost.esf.org/domains_actions/tud/Actions/soundscape_of_european_cities_and_landscapes

http://www.silence-ip.org/site/

Noise maps of EU-cities: specific cities

Berlin: http://www.stadtentwicklung.berlin.de/umwelt/umweltatlas/ei705.htm

Paris: http://www.v1.paris.fr/fr/environnement/bruit/carto_jour_nuit/

London: http://www.londonnoisemap.com

Dublin:
http://www.dublincity.ie/WaterWasteEnvironment/NoiseMapsandActionPlans/Pages/default.aspx

Helsinki city report with summary in English:
http://www.hel2.fi/ymk/meluselvitys/tiedostot/julkaisu_FIN_2012.pdf

Vilnius: http://aplinka.vilnius.lt/noise_maps.html