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URBIS: INSTRUMENT FOR LOCAL ENVIRONMENTAL SURVEY

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ABSTRACT
TNO has developed a GIS based instrument, named Urbis, which makes it possible to assess the noise situation in a municipality or region as a whole, with a high level of detail. On the basis of activity or emission data (road-traffic intensities, acoustical reports, etc.), noise loads are calculated for different source-types (road traffic, rail traffic, aviation, and industry). By using existing dose-response relations, the percentage highly annoyed can be calculated by area for each source-type. Cumulated noise loads from different source-types are calculated by combining the equal annoying noise levels of road-traffic, so that the total percentage of highly annoyed can be determined. Besides noise, air pollution, odor and safety hazards are integrated in the system. Urbis makes it also possible to assess and compare future situations on the basis of scenario's.

1 - INTRODUCTION

Increasing responsibility of local authorities
In recent years there are indications that in a number of countries municipalities are increasingly ambitious to claim a larger responsibility for their own environment. National governments often stimulate these initiatives and provide a policy framework for municipalities. With these developments the growing need for better technical instruments for the development of municipal environmental policy has become evident.
The European Commission's new noise policy is expected to strongly center attention on mapping noise and noise annoyance. Currently several international expert groups are preparing proposals to this end. These efforts are expected to result in a directive, describing the noise metric and the exposure/response relations to be used for the estimation of the effects of noise on the public. The directive for noise quality and annoyance by noise will also require a complete assessment of a municipality or agglomeration.
Information on the quality of the municipal environment is inadequate
In executing their task of informing the public on the environmental quality, municipalities are often poorly equipped. Some information is available, yet spread over several places and authorities, and in various forms. Insight into the environmental quality in a municipality is therefore often very limited.
Producing inventories of current environmental quality and exploring the future environmental quality is a complex task for municipal governments. These inventories however, are a prerequisite for the introduction of a policy cycle in which scenario analysis alternates with environmental policy planning and actions. In view of the increasing self-responsibility of municipalities, such information will be of paramount importance.
Anticipating to these developments, TNO has developed a methodology named URBIS. This method creates possibilities for such a policy cycle by incorporating available information on the municipal environment in a geographical information system and making scenario analysis a relatively easy task.
The development of Urbis
Urbis is a methodology for the calculation of the spatial distribution of noise, air pollution, odor and safety hazards, and the associated effects for (parts of) municipalities. The methodology describes the current situation and future scenarios by means of maps and indicators of the environmental quality and risks. Urbis aims at integrating existing information and methods, taking the need for particular

environmental information of all parties concerned into consideration. In doing so, the municipal environmental department has a key role. In the development of Urbis a parallel approach to both noise and air pollution is chosen, so that if possible, the same input information for the calculations and similar presentation methods can be used. At the start of the project a number of environmental target groups were interviewed to investigate their practical needs for specific information, and to attune presentation of results; tuning was further improved by means of workshops for users.

2 - OUTLINE OF THE METHODOLOGY

Three important basic premises of the development of Urbis are:

- The use of existing data. If necessary municipalities are advised to improve the registration of their data so that the quality of the results from Urbis can be improved. Various type of data are used, such as environmental data an data on numbers of inhabitants.
- Attuning methods for noise and air pollution as much as possible. Wherever required, existing methods were adjusted or completed with new ones.
- Using Urbis as a tool must enable municipalities to gain a relatively fast insight into the quality of the local environment at relatively low cost.

Data processing in URBIS

Human activities lead to emissions of air pollution and noise. These emissions affect the environmental quality. Consequently, people are exposed to the environmental (noise and air) pollution, which will subsequently lead to annoyance. The steps in the Urbis data processing procedure correspond with the steps in this cause-effect chain. These steps are further illustrated for noise.

Information on various activities is input for URBIS. For road traffic for example, data on traffic intensity, speed, and road surface height and type are input for the system. With emission models Urbis calculates emissions from these activity data. For some sources emission data are directly available. For example, noise emission data for factories may be directly available in acoustic reports.

Transmission models are used to calculate the environmental quality from emissions in terms of noise levels. For this purpose, data on ground surface type and building heights and configurations are used in addition to emissions. Some information on noise load is available directly, such as noise contours for air traffic.

In combining the calculated noise with information about the location of dwellings and numbers of inhabitants, exposures of dwellings and inhabitants are estimated. In the future, estimation of the actual noise exposure can be improved by using available information on sound proofing of the dwellings.

On the basis of the noise level on the facade with the highest noise load, the percentage highly annoyed can be assessed by area for each source type. For this purpose, existing dose-response relations are used. The reported level of annoyance differs when the same noise level originates from a different source type. Therefore cumulated noise loads from different source-types are calculated by combining the equal annoying noise levels of road traffic. On the basis of the exposure of this cumulated noise load, the total expected percentage of highly annoyed can be determined, using the dose-response relation for road traffic.

For some types sources of noise and noise annoyance, detailed calculations are not recommendable. The character of these source type is too divers and often unpredictable. For sources such as pubs and night-clubs, (un)loading activities, events, maps are produced that show their location only.

3 - SCENARIOS

Because the surveys in Urbis are produced on the basis of models instead of measurements, future scenarios can also be surveyed. Effects of expected developments in for instance road traffic intensities, car emissions, and air traffic noise can be investigated and mapped. Also, the effects of policy decisions on road traffic currents, spatial planning, etc. can be assessed. The difference in noise levels between scenarios and the present situation are mapped. Different scenarios can also be compared on the basis of indicators, e.g. the expected number highly annoyed. This way, Urbis can help municipalities to gain insight in the environmental consequences of their plans and decisions.

4 - SOME RESULTS FROM THE APPLICATION OF URBIS

On the following page, some results of the application of Urbis in the Dutch city of Leiden are shown. The method's level of detail is illustrated by the map of rail traffic noise in the city center of Leiden (Figure 1). Figure 2 shows the difference in noise level caused by road traffic between the present situation

(1998) and a scenario for 2010. This map shows that, in most parts of Leiden, these noise levels are expected to decrease. This is mainly due to the reduction of car emission. Only there where traffic intensities show a large increase, noise levels are expected to be higher. Figure 3 shows the percentage of surface area with noise loads above 50 and 65 dB(A) due to road traffic by district. Figure 4 shows the percentage highly annoyed by the cumulated noise caused by road, rail and air traffic and industry. A comparison between the percentage highly annoyed in different scenarios for road traffic are shown in Figure 5. Figure 6 shows the percentage of inhabitants with a cumulated noise load of more than 50 dB(A) at night time (23−7h).

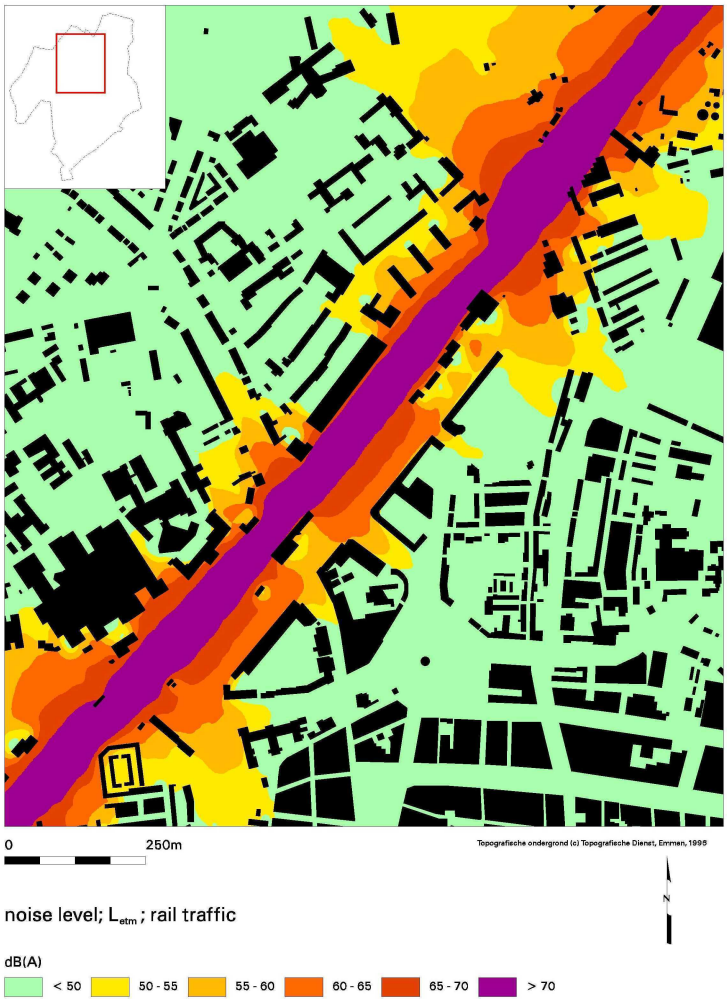

Figure 1: Noise level due to rail traffic.

5 - CONCLUSION

A practical methodology for mapping the local environmental quality has been developed. This method can be used to describe the environmental quality in municipalities in great detail. URBIS provides an integrated overview of noise, air pollution, odor and safety hazards. In addition, scenarios analysis is possible to get insight in potential future situations. This way, the environmental impact of plans and decisions can be evaluated.

Because existing data are used, and due to a high degree of automation, the method is a quick and can be applied at low cost. Cost and time largely depend on the effort required to collect the necessary input information.

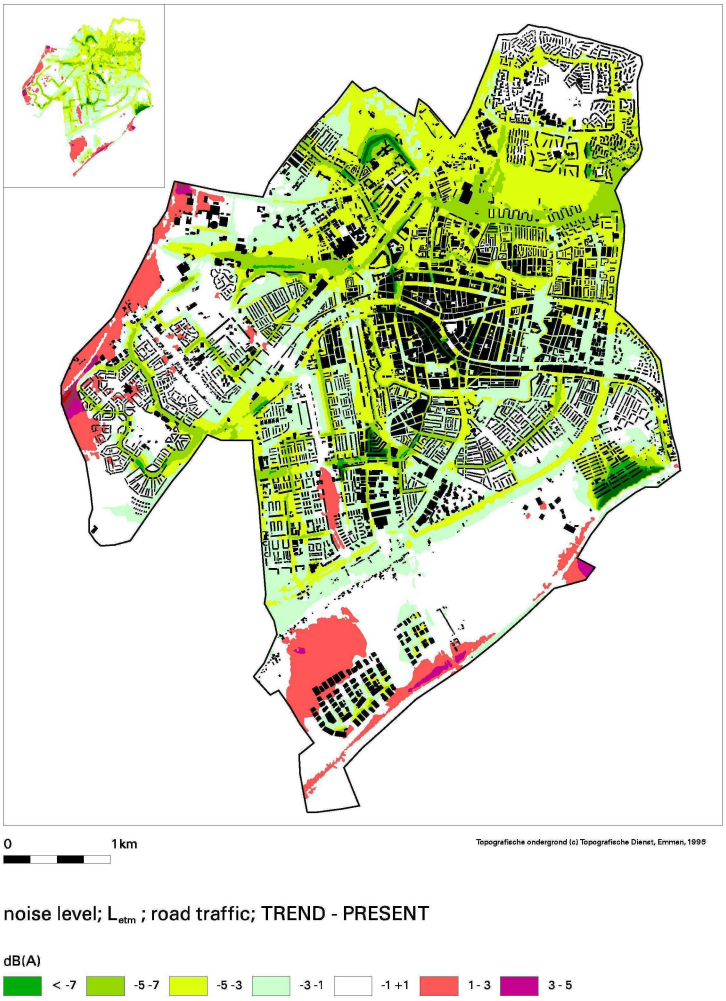

Figure 2: Difference in noise level due to road traffic scenario 2010-1998.

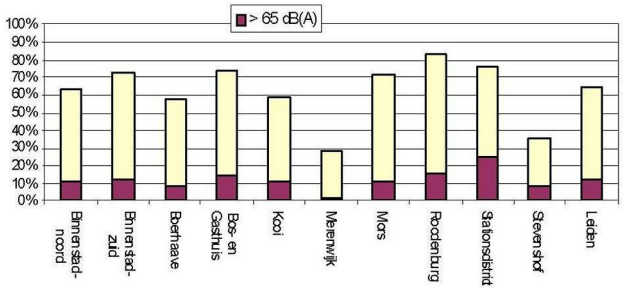

Figure 3: Surface with L_{etm}>50 and <65 dB(A) due to road traffic.

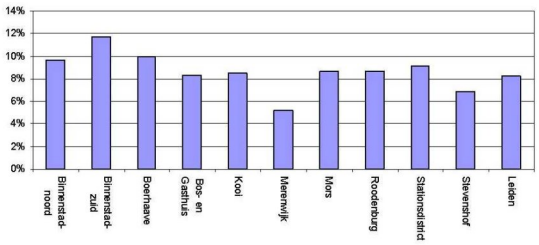

Figure 4: Highly annoyed by noise (over all).

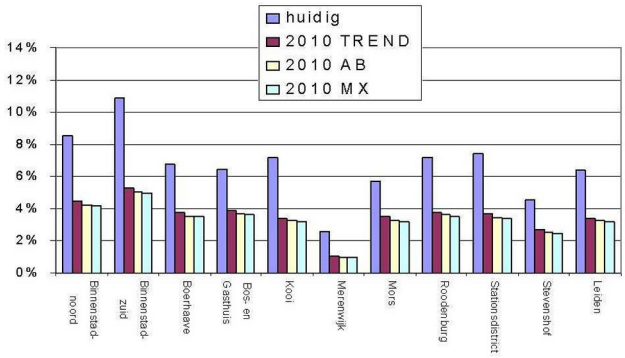

Figure 5: Percentage highly annoyed by road traffic (1998 and 2010).

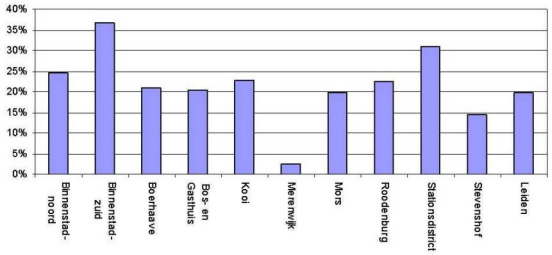

Figure 6: Inhabitants with $L_{aeq(23-7h)}$>50 dB(A).