An innovative G.I.S. tool for environmental noise management

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Introduction

The Technical Studies Centre of Equipment of Lyon (CETE de Lyon) has been requested by the Departmental Direction of Equipment of Isère (DDE 38) to help the authorities to improve the acoustic environment along the 36 km long network of Grenoble's highways.

The goal is to establish a reference state and to draw up, test and follow up a set of noise action plans aiming at reducing nuisances.

In order to meet this purpose, CETE de Lyon has built up an original tool based on Geographical Information System (GIS) allowing for environmental noise management along the highways network.

The G.I.S. tool

The achieved database is made up of three topics :

1. basic data

Data are given concerning urbanization and land use around the road network (housing, hospitals, schools, offices, open spaces, leisure areas…), as well as noise sensitivity in these areas as shown in figure 1.

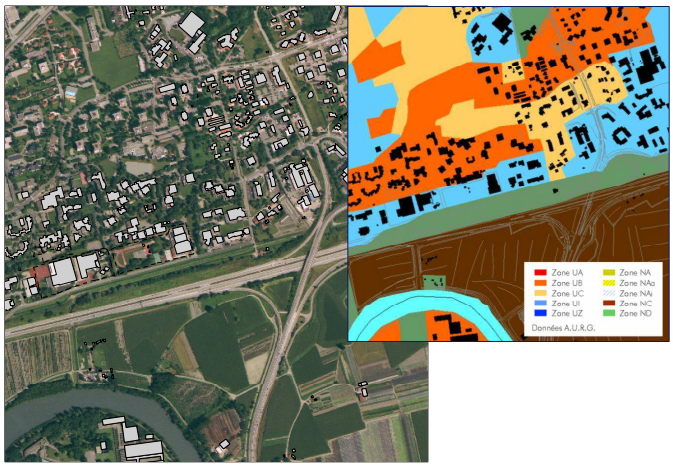

Figure 1: Land use data are the basis of the G.I.S.

Information about traffic distribution and evolution during the past ten years have also been collected. These data are issued from permanent traffic counters owned by DDE 38.

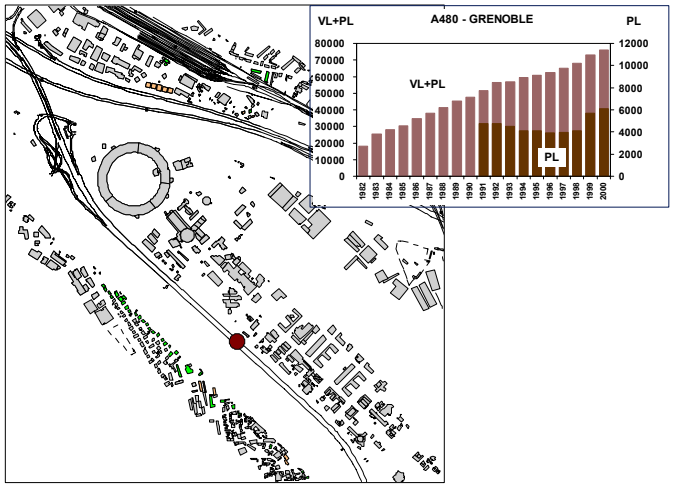

Figure 2: Example of traffic data with exact location of the traffic counter

All the existing noise shielding devices have been listed and included in the G.I.S. Noise barriers, berms, building insulation, road pavements have been assigned Lambert geographical coordinates. Tables give the main characteristics of each shielding device (height, length, type of material, type of covering, sound insulation, date of achievement). Every object is illustrated by a picture such as figure 3.

Figure 3: Every noise shielding devices are included in the G.I.S. with a picture and detailed characteristics.

2. acoustic reference data

These data rely on results of noise measurements achieved at around 15 receivers (24h) with histograms and pictures of the exact locations in order to allow for as many new measurement campaigns as wished at the same places

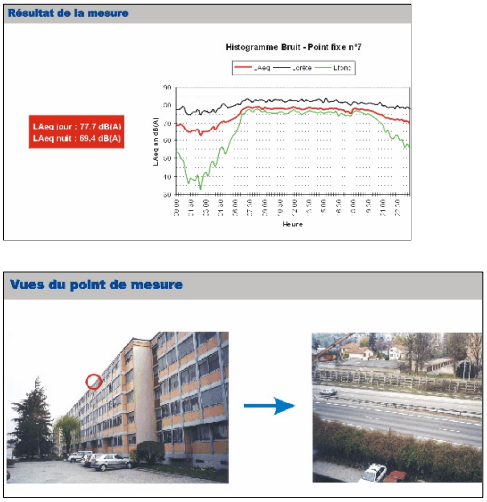

Figure 4: Example of acoustic reference data for 24H-experimental results at one receiver

These experimental data have been used for calibrating a 3D propagation model for noise environment along the 36 km long highways network using MITHRA© software (CSTB) based on the New French Method for Noise Prediction (NMPB).

The modelling allows noise maps with isophones to be drawn (3 categories have been defined 60-65, 65-70 et >70dB(A)) and sound levels on the façades of the sensitive building to be assessed.

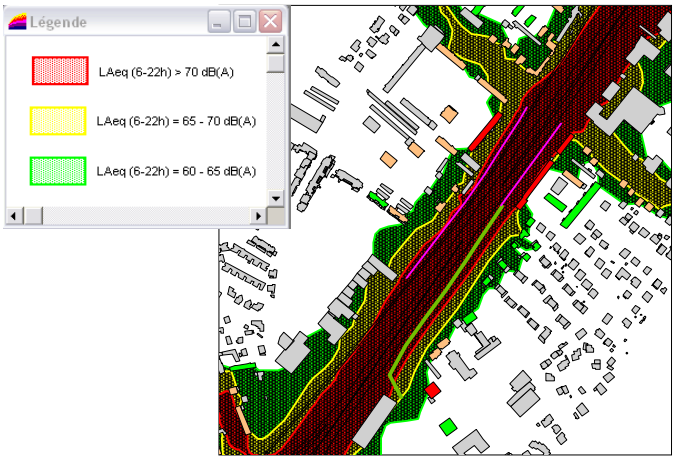

Figure 5: Noise map and exposure of sensitive buildings on the studied area

These buildings have been classified into 3 categories according to their sensitivity and exposure to noise. Around 100 buildings have actually been registered as exposed initially to more than 70 dB(A), about 300 as exposed to levels between 65 and 70 dB(A) and 400 to levels ranging from 60 to 65 dB(A) in terms of Laeq[6-22h].

This gives rise to a classification of the road network into around 30 homogeneous areas in terms of noise exposure and potential noise abatement measures.

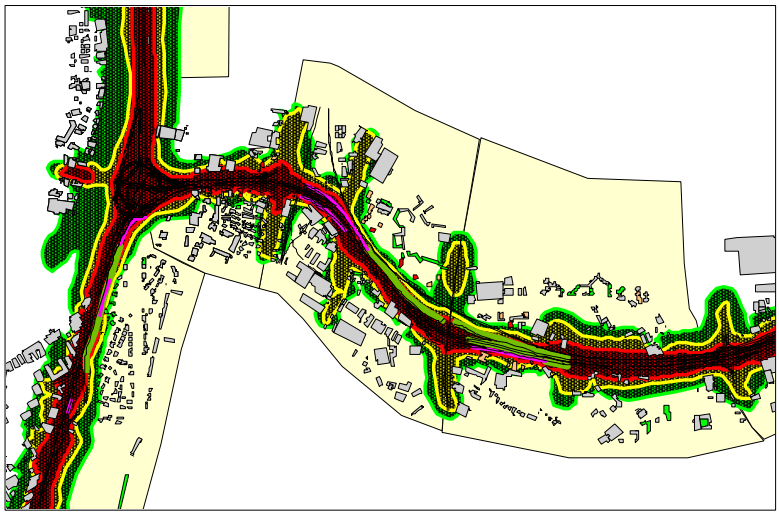

Figure 6: Example of the splitting up into homogeneous areas (Grenoble south bypass)

3. action plans

The last topic contains different action plans. A first step has aimed at defining a goal of acoustical comfort in the highways' vicinity. Regarding the sensitivity related to varying land use, a range of levels between 60 and 65 dB(A) in terms of Laeq[6-22h] has been fixed for this goal.

The different action plans have been tested using the noise propagation model. They consist in lowering traffic speeds, settling efficient acoustical road pavements on the whole network, building noise barriers, enhancing façade insulation.

Since the achievement of this G.I.S. tool, DDE 38 has set up an important program of actions for the coming years based on the results of this work.

Today the road pavements of most of the highways' network have been modified (an average gain of 5 dB(A) at the buildings' façades has been reached). Traffic speed has been lowered uniformly down to 90 km/h (a 2 dB(A) gain on some road sections). Some complementary sound insulation actions are in progress.

Each time a noise action plan is undertaken, the G.I.S. tool is updated by CETE de Lyon in order to insure to authorities an up to date database.

This approach comes within the framework of the 2002/49/EC European Directive relating to the assessment and management of environmental noise. It brings to authorities noise maps, action plans and allows to follow up the effect of the achieved measures.