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AIRPORT NOISE REDUCTION STRATEGY DEVELOPMENT BASED ON LOCAL POPULATION DENSITY INFORMATION

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INTRODUCTION

The growth of civil air traffic and cities near major airports often causes serious environmental problems. If these problems have not been foreseen in the town planning, traffic restrictions may be the only way of improving the environment.

Measures to reduce airport noise may be divided into two groups. In the first group a general reduction of the noise exposure is achieved by e.g. reduction of operations, night-ban, special noise abatement procedures, and restrictions for noisy aircraft. Most often these measures cause considerable inconvenience to airport operators. In the second group the noise exposure is moved from densely populated areas to less populated areas by measures as e.g. preferential runways and minimum noise routing. Most frequently these measures cause limited or no inconvenience as it does not reduce the traffic volume.

For many airports both groups of noise reduction measures must be considered to achieve an acceptable environment, and very often the planner even has to balance the economical impact against the environmental impact. In such cases the technical adviser has to face the fact that his recommendations both involve costs and inconvenience. It becomes very important that decisions are based on the results of an accurate and reliable prediction tool to ensure that costly measures produce the expected environmental improvement after all.

EVALUATION OF AIRPORT NOISE REDUCTION STRATEGIES

Until now the effect of noise reduction strategies has in general been analysed by calculation of noise exposure contours by means of a conventional airport noise exposure prediction program. By comparing the siting of dwelling areas and the course of the contours the noise environment is evaluated in each particular area. This method is adequate when the dwelling area pattern is not too complex and the task is to decide whether the noise exposure is below or above an environmental limit.

If many residential areas are situated in zones with an unacceptable noise exposure, and if the areas are unevenly distributed with highly varying dwelling density, it is impossible to estimate the overall effect of a noise reduction strategy on the basis of noise exposure contours. In this case the distribution and density of the dwellings must be taken into account.

THE COPENHAGEN AIRPORT RUNWAY USE STRATEGY STUDY

In 1987 the Danish Acoustical Institute was asked by the Copenhagen Airport Authority to investigate the possibilities of reducing noise problems around the Copenhagen Airport by changing the runway use principle. Approx. 30,000 dwellings around the airport are situated inside the 55 dB contour (L_{DEN}) which is considered the limit of an acceptable environment in Denmark. As these dwellings are unevenly distributed, and as a change in the runway use principle only moves the noise exposure from one area to another, we had to include local dwelling density information.

The residential areas were divided into areas with a uniform distribution of dwellings. The boundary of each area was approximated by a polygon, and a dwelling density (number of dwellings per 1000 m^2) was assigned to the area. Figure 1 shows the dwelling density map stored in the computer memory together with the three runways at Copenhagen Airport, Kastrup. The dwelling density map covers approx. 70,000 dwellings on the island of Amager where the airport is placed.

The noise exposure was calculated by means of a conventional airport noise exposure prediction program which produced the noise exposure in a grid. A high grid resolution was used (grid spacing of 50 m).

Another program counted the number of dwellings in each noise exposure class. For each point in the grid the program examined if the point was within one of the polygons. If this was the case, the number of dwellings in the subarea represented by the grid point was added to the total of the class which contained the grid point noise exposure. In the runway use strategy study at Copenhagen Airport the width of the classes was 1 dB, and after completion of the histogram the inverse cumulative distribution was calculated as shown in Figure 2. The figure shows the number of dwellings with a noise exposure L_{DEN} above the value shown on the axis for one specific runway use strategy. To compare different strategies the distribution was calculated for each strategy.

In this way it was possible to select the runway use strategies which could reduce the number of dwellings with a noise exposure above a specific value. It was, however, not possible to deduce from the calculation whether an improvement was due to a general reduction of the noise exposure in all residential areas or the change covered substantial but opposite changes in different areas. For this reason the program was developed also to count the number of dwellings as a function of the change in noise exposure relative to a reference situation. An example is given in Figure 3.

OTHER APPLICATIONS

The method outlined in the previous section is a straightforward method to evaluate the overall environmental impact from air traffic. The method is well suited to investigate the effect of different noise reduction measures in densely populated areas around major airports. The method has no limitations in the use beyond the limitations given by the airport noise exposure prediction program.

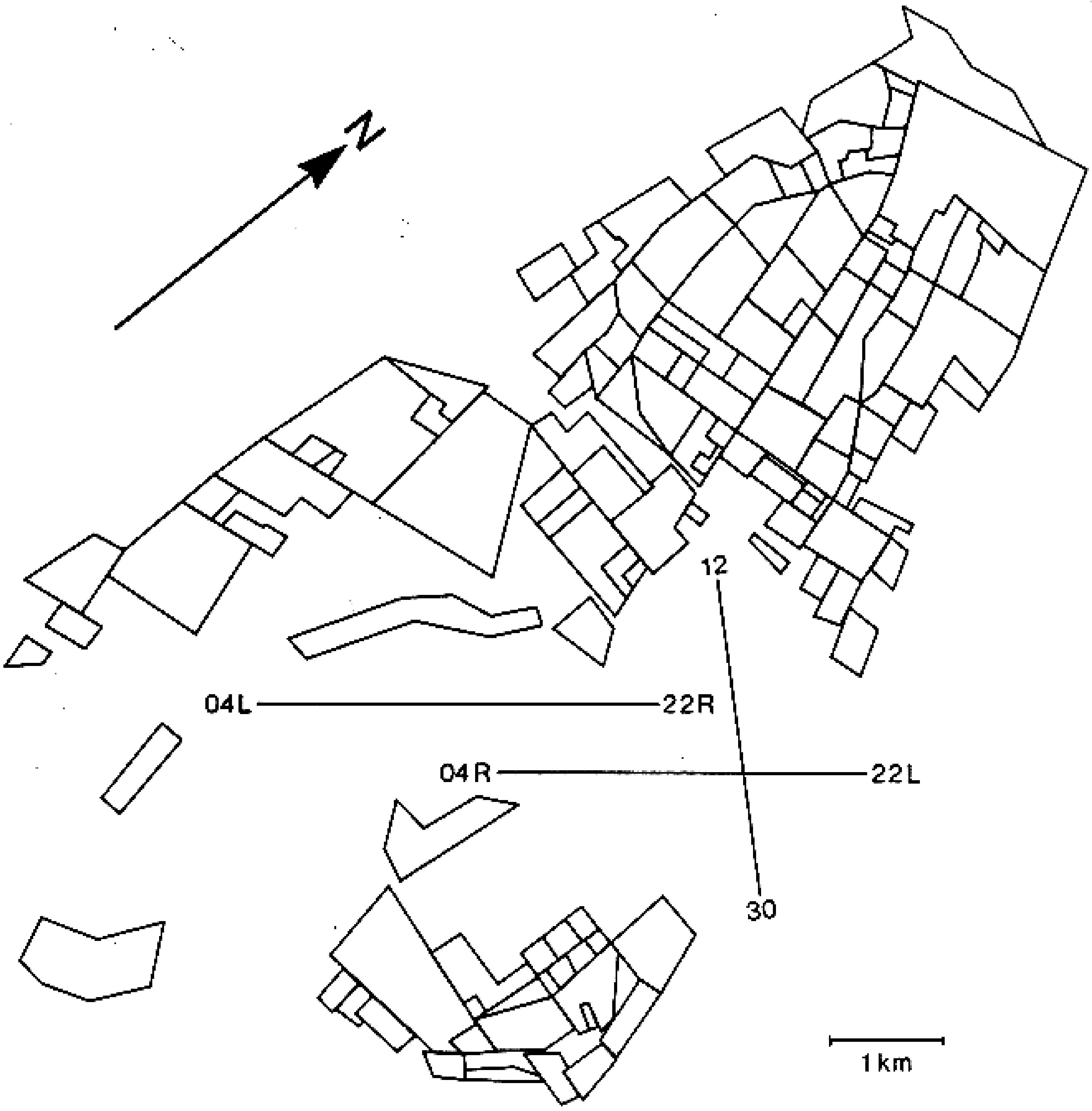

Figure 1

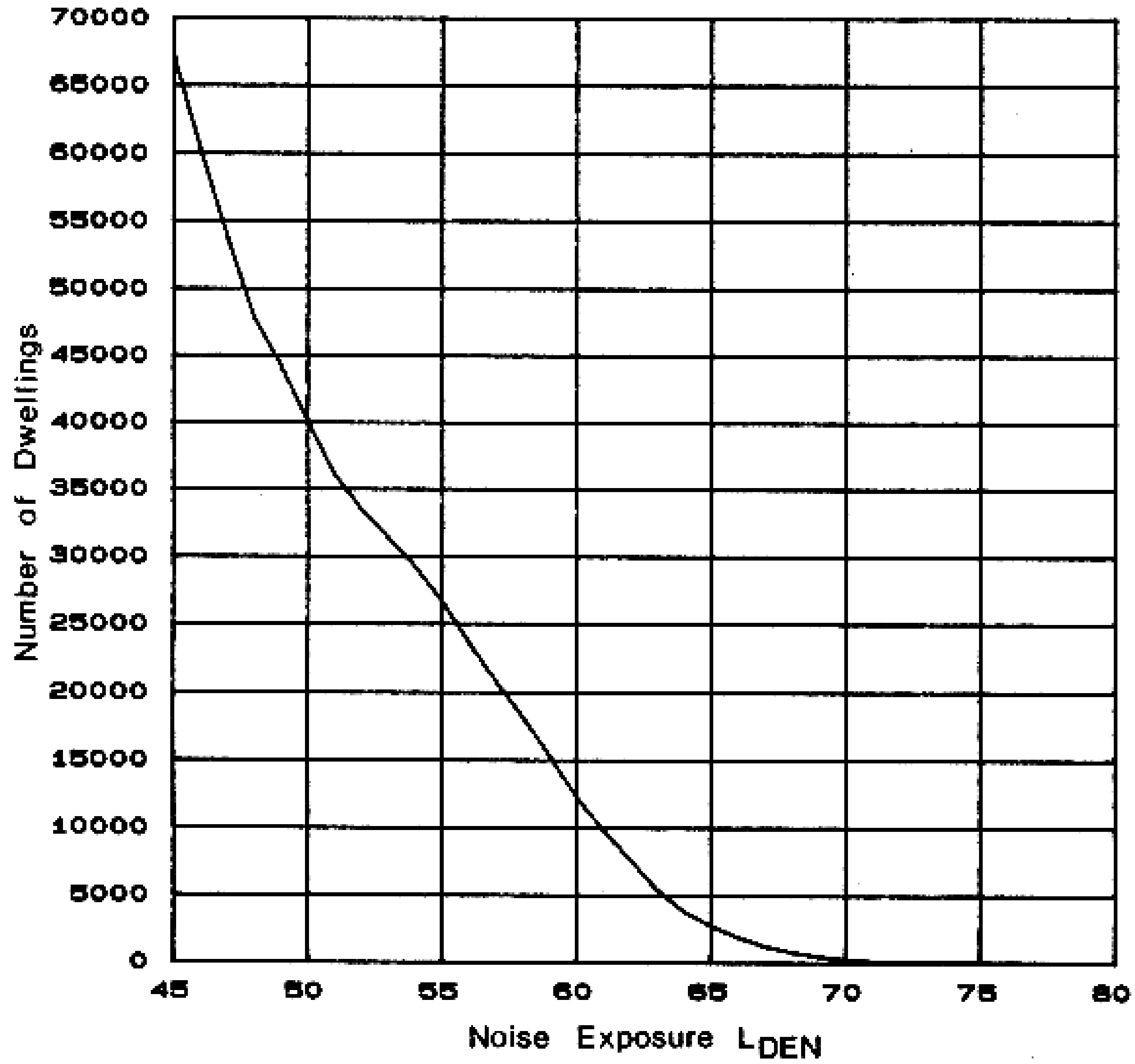

Figure 2

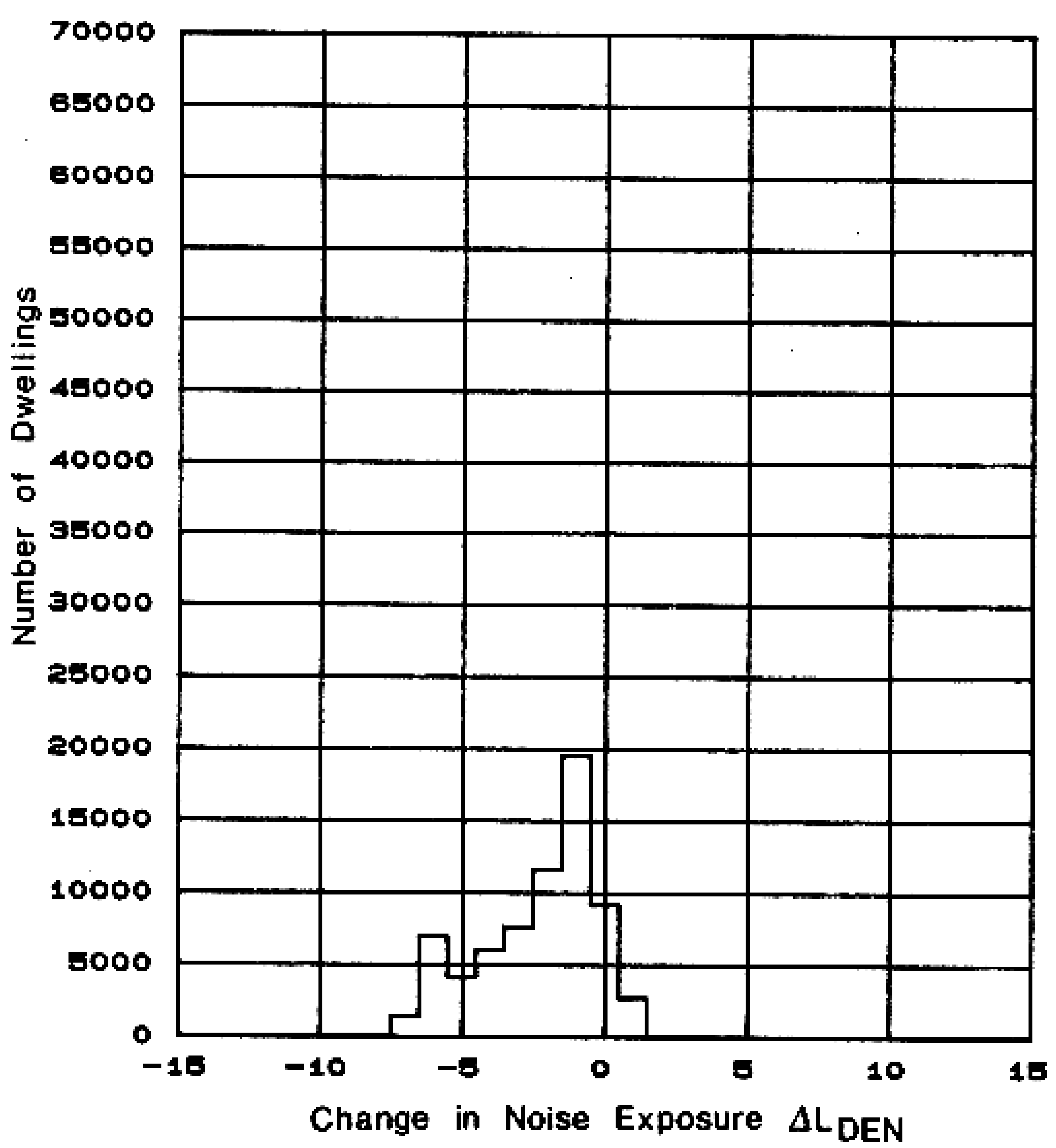

Figure 3