

USING HSE's NATIONAL POPULATION DATABASE TOOL FOR RISK ASSESSMENT

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The National Population Database (NPD) tool has been developed by the Health and Safety Executive (HSE) for use in identifying and estimating population levels. The NPD tool is a Geographical Information System (GIS) application and uses a number of different source data sets for England, Scotland and Wales, from a national to a local level. These data sets include Ordnance Survey mapping at a number of scales, demographic data from the UK census as well as address data and transport infrastructure and flow rate network data.

The NPD tool is a sophisticated aid in establishing population patterns and provides population estimates on a 100 m grid, or for some population types, on an individual building basis. The tool also allows differentiation between population levels at different times of day and between those of different sensitivity. The populations that are available from the tool include residential, workplace, retail, transport system, leisure and sensitive populations, such as schools, hospitals, care homes or prisons.

The NPD was primarily developed for obtaining population estimates for major accident hazard modelling on a variety of scales. It has been employed in a range of applications including land use planning, identification of at risk populations and scenario planning. This paper will present a recent major hazard modelling case study that has used the NPD to aid the risk assessment process.

INTRODUCTION

The national governmental body responsible for health and safety in the workplace in Great Britain is the Health and Safety Executive (HSE). HSE is involved in setting policy, inspecting workplaces and investigating incidents within a range of industries, including nuclear, offshore oil and gas, and hazardous installations. The Health and Safety Laboratory (HSL) is an agency of HSE and provides scientific support and research relating to the industries of interest to HSE. HSL seeks to maintain an excellent standard of scientific expertise in order to provide invaluable support to HSE in their role of ensuring risks to employees and the public from the workplace are minimised.

One of HSE's statutory duties is to act as an adviser for land use planning issues. This involves being contacted by local authorities when a planning application is submitted in the vicinity of a hazardous installation and providing advice for whether planning

permission should be granted based on the site and the development in question. HSE will base their recommendation on whether the site is operational, the substance it holds, the quantity of the substance and the way it is stored. These factors are used to calculate zones of risk around a site which are then used to provide advice on planning applications that arise around the site. This method of dealing with land use planning takes into account the risk of death to an individual, known as individual risk (HSE, 1989).

NATIONAL POPULATION DATABASE TOOL

It is becoming increasingly important for HSE to look at the risk to society and the populations that might be at risk from specific events. Population information is increasingly being incorporated into decision making methods which has led HSE in conjunction with Staffordshire University to develop a powerful tool which can be used to assist in looking at populations that may be at risk in specific scenarios. The National Population Database (NPD) tool is a Geographical Information Systems (GIS) based tool containing data for a number of populations across the whole of England, Scotland and Wales. A GIS allows data with a spatial component to be stored, queried and manipulated and provides a beneficial visual representation of the data. This allows a quick understanding of the data of interest as the user can instantly see trends or areas of particular concern (HSE 2002, HSE 2005).

Data within the NPD is broken down into layers of population, including residential, transport, retail, workplaces, leisure facilities and sensitive and communal establishments which include schools, hospitals, care homes and prisons as places that may be difficult to evacuate in an emergency. Data within some of these layers is further broken down to give figures for different times of the day and the year, for example residential data is split into night time and daytime and then term time and non term time populations. Road data is broken down into average daily flow, peak flow and also a bumper-to-bumper population. Further details of the population layers and the methodology behind their development can be found in HSE research report 297 (HSE, 2005). The methodology behind the tool has been extended from that developed for HSE in 1998 (HSE, 1998).

CASE STUDY – POPULATION BUILD-UP AROUND A LARGE CHEMICAL SITE

HSE is particularly interested in the locations and types of populations around large chemical sites as these sites are considered potentially hazardous and could have a great impact if an incident were to occur. In order to assist HSE in their societal risk calculations and to give a picture of the situation the NPD can be used to obtain population data.

In this fictitious example, the chemical site is located and the hazards on site are modelled, then the resulting zones are plotted. Figure 1 shows the location of the chemical plant and the 3 planning zones around this site. The largest one here is 10 km from the centre of the site.

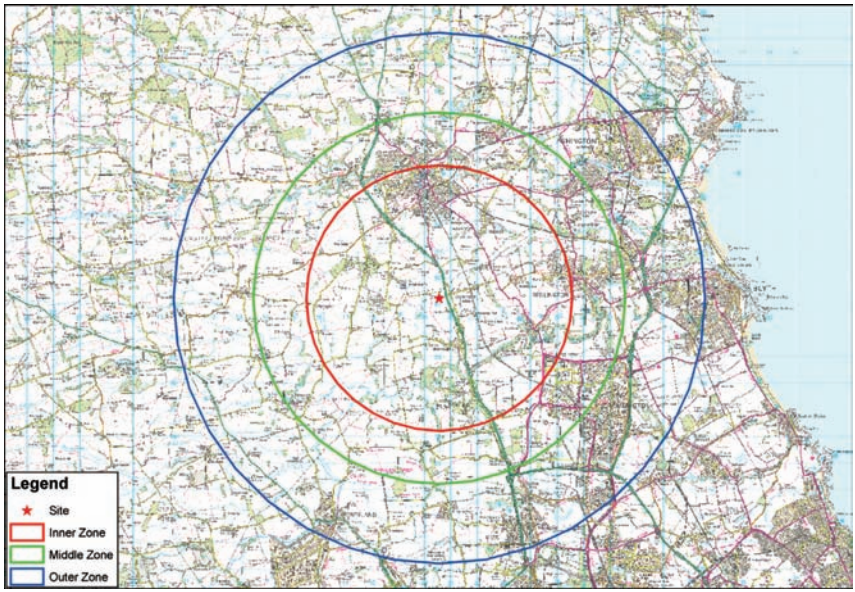

Figure 1. Location of chemical site with 3 fictional planning zones around it

RESIDENTIAL POPULATIONS

The NPD is then used to look in detail at the populations around the site. The largest population of concern is the residential population. This is shown as dark purple dots in Figure 2. The visual representation of the scenario discussed clearly shows where there are build-ups of residential properties and where there are areas of non residential populations, shown by the location and absence of dots.

The residential layer within the NPD allows data to be displayed at two resolutions depending on the amount of detail required. Firstly, it can be viewed on a 100-metre grid, where population data has been aggregated and attributed to a point every 100 metres. This is particularly useful when looking at populations over a large area. The second option for residential data is the Addresspoint layer. This contains a point for every residential property across England, Scotland and Wales and each is attributed with data for the property. This layer is more appropriate for use when looking at small areas as the detail can cause the map to look cluttered and difficult to interpret if looking at a large area.

When looking at the possible numbers of people at risk from a potentially hazardous site like this, we would consider the worst case scenario and for the residential layer this would be the night time population. Figure 2 shows the residential population around the site selected and the statistics for this data in the text box.

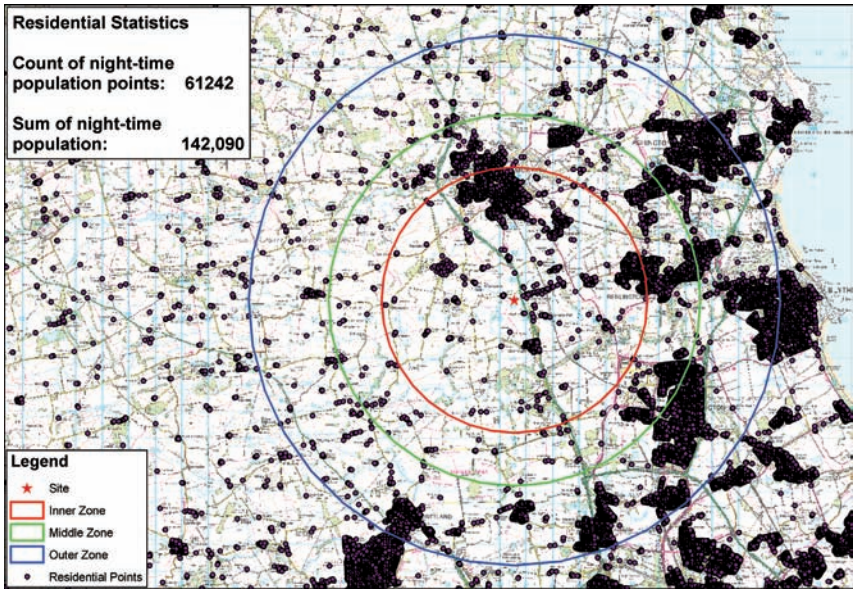

Figure 2. Residential points around the site shown in dark purple. The statistics relate to the residential points that are within the outer zone (blue)

The other residential populations available to use include daytime, term time and non term time. The numbers of people in their houses will obviously vary according to the time of day and the time of year and the availability of the options within the residential layer allow the user to select the scenario most appropriate to the situation they want to model.

SENSITIVE POPULATIONS

The next populations of interest are within the 'sensitive' layers and consist of school populations and hospital populations. HSE is particularly interested in populations that may be more vulnerable to harm or hard to evacuate. School populations have been obtained from the UK Government Department of Education and are available for every school across England, Scotland and Wales. The data for the populations of hospitals was obtained from the UK Government National Health Service and also data from the census. The hospital populations are based on the number of beds and do not include staff as these would be counted in the workplace layer.

Figure 3 shows the schools in yellow. The statistics from the NPD show that there are 52 schools in the area with a total population of 19,392 school children. The statistics

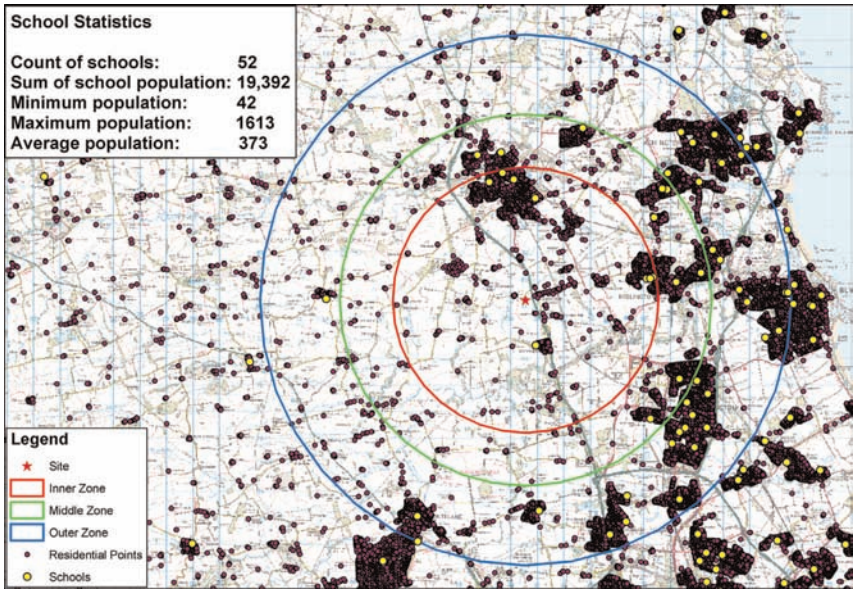

Figure 3. School populations shown as yellow spots. The statistics look at the schools within the outer zone (blue)

also show that the smallest school has a population of 42 while the largest school in this area has a population of 1613 children. The average size of the 52 schools inside the largest zone is given as 373 pupils.

Figure 4 shows the hospitals in turquoise. The NPD statistics show that there are 4 hospitals within the largest zone with a total maximum population of 1103 people. The smallest hospital has a population of 54 people and the largest has a population of 308. The average population of these 4 hospitals is 183 people.

TRANSPORT POPULATIONS

Data from the transport layer consists of the populations that would be found on the major road networks including motorways and A roads. It is assumed that these types of roads are carrying non-local populations, an issue of concern when considering double counting. Smaller roads are not included in the NPD as they are considered to be mostly carrying light, local traffic (HSE, 2005), and these people are likely to be counted in the workplace or residential layers. The road populations are shown in Figure 5 by the dark green dots.

The populations within this layer are broken down by time of day plus a potential maximum population. The most widely used figure is based on the average daily flow in the transport system. In this example the average number of people on the roads

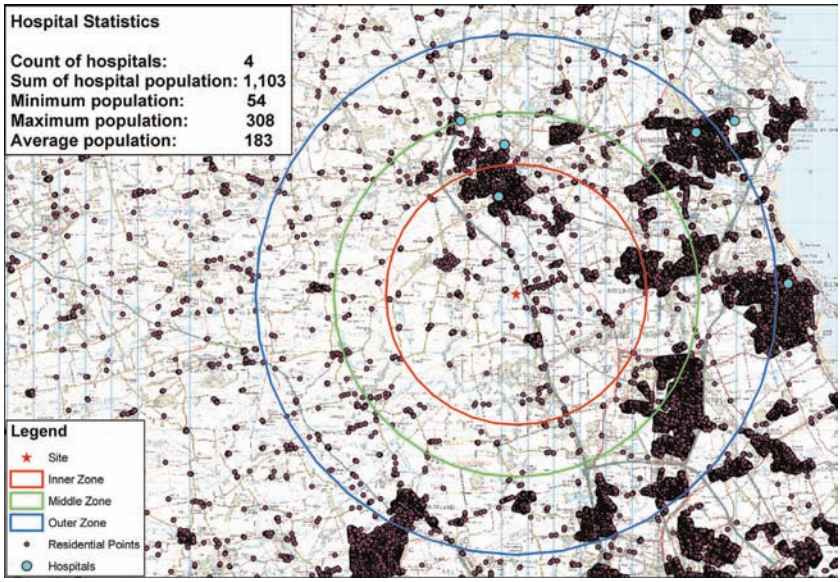

Figure 4. Hospital populations shown as turquoise circles. The statistics relate to the hospitals located within the outer zone (blue)

within the largest zone is 1878. The figure for the peak flow, which could be used if looking at rush hour times of the day, is 3568 in this area. The final figure available is called a bumper-to-bumper population and considers the maximum number of people that could be on the roads if there were a traffic jam situation or if the road was blocked, in this case this figure is 141,653.

SUMMARY

In summary, using the NPD gives detailed estimates and potential patterns of population distribution at any given time. It can be used to estimate population distribution around any site in Great Britain and to look at a wide range of population types. The data can also be extracted and used with further modelling techniques to give potential patterns of populations. Further case studies are discussed in Balmforth *et al* (2005).

This detailed method of looking at populations around major hazard sites could also be applied to emergency response planning where inspectors would be interested in the population build-up at different times of the day and year. For example, if an incident were to occur at 9am on a weekday, during term time then the populations of interest would most likely be the peak flow on the roads showing numbers of drivers on the roads in the rush hour, the day time, term time populations for the residential layer and

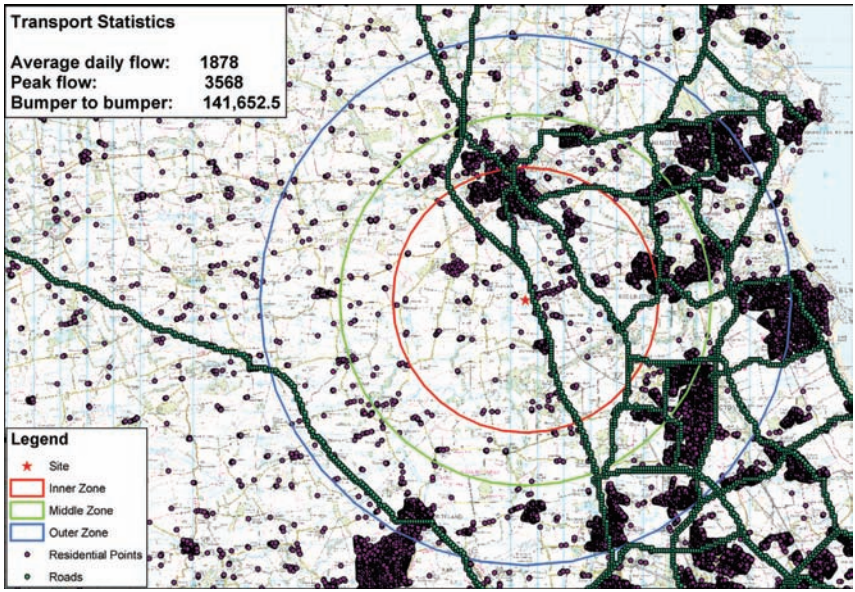

Figure 5. Populations in the road network are shown here in dark green. They represent major roads and motorways and the statistics relate to the points within the outer zone (blue)

school populations for the children who would be at school. The workplace layer would give an indication of the numbers of people at work. At this particular time of day it would probably be appropriate not to take into account maximum figures for stadia and some other leisure facilities, as it would be unlikely that these would be in use at this time.

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