Final

Identifying the Options Available for Determining Population Data and Identifying Agglomerations in Connection with EU Proposals Regarding Environmental Noise

A report produced for Department of the Environment Transport and the Regions, The Scottish Executive, The National Assembly for Wales and Department of Environment for Northern Ireland

Katie King
Tony Bush

January 2001

Final

Identifying the Options Available for Determining Population Data and Identifying Agglomerations in Connection with EU Proposals Regarding Environmental Noise

---

A report produced for Department of the Environment Transport and the Regions, The Scottish Executive, The National Assembly for Wales and Department of Environment for Northern Ireland

Katie King
Tony Bush

January 2001

Title	Identifying the Options Available for Determining Population Data and Identifying Agglomerations in Connection with EU Proposals Regarding Environmental Noise
Customer	Department of the Environment Transport and the Regions, The Scottish Executive, The National Assembly for Wales and Department of Environment for Northern Ireland
Customer reference	
Confidentiality, copyright and reproduction	
File reference	\\151.182.168.37\kk\noise\ed50035\final report\final report 15-2.doc
Report number	AEAT/ENV/R/0461 (Final)
Report status	Final

AEA Technology
E5 Culham
Abingdon
Oxfordshire, OX14 3ED

Telephone 01235 463715
Facsimile 01235 463574
AEA Technology is the trading name of AEA Technology plc
AEA Technology is certificated to BS EN ISO9001:(1994)

	Name	**Signature**	**Date**
Author	Katie King Tony Bush		
Reviewed by	Tony Bush		
Approved by	John Stedman		

Executive Summary

AEA Technology were contracted by DETR and the Devolved Administrations to carry out this study to identify the options available for determining population exposure to noise and identifying agglomerations in connection with EU proposals regarding environmental noise. The first part of this report is concerned with the identification of agglomerations in the UK and the second part (Section 5 onwards) considers the draft Directive requirements on assessing exposure of the population to noise.

The current draft of the Directive of the European Parliament and of the Council relating to the Assessment and Management of Environmental Noise (COM(2000) 468 final) requires that Member States identify agglomerations of >250,000 and >100,000 population within which to map noise levels.

Three alternative methods were investigated for defining agglomerations. These were based upon:

1. The population density of Local Authorities;
2. The population density of ward or similar level administrative boundaries;
3. The total population of discrete areas of continuous urban land (the Air Quality Daughter Directive approach).

It was assumed that for the practical purpose of noise mapping for the Noise Directive, the geographical extent of agglomerations to be mapped should be restricted to urbanised areas (or non-urban areas entirely surrounded by built-up areas) and where residential houses, schools and hospitals are most likely to be located. As a result, the urban areas approach (3 above) was identified as the approach most likely to deliver a practicable definition of urban agglomerations for the Noise Directive. Alternative approaches have the drawback of the inclusion of non-urban land parcels within agglomerations. The selection of the urban areas approach also has the advantage of maintaining consistency with previous Government work.

Application of the urban areas approach to the UK identified 28 agglomerations with population >250,000 persons and a further 40 agglomerations with population >100,000 and < 250,000 persons.

A method has been developed for assessing the number of people exposed to modelled noise levels in 5dB bands. This method combines data on the location of households from the OS Address Point database with population statistics by Census Enumeration District. A possible improvement using household specific data on occupancy from the electoral and school rolls has also been considered.

The results from a trial of the proposed method in a hypothetical case study area in Birmingham show that the spatial resolution of the noise maps has an important influence over the results.

Availability of new data sources in future, such as the 2001 Census data and new base mapping from Ordnance Survey, will enable improved accuracy of the proposed methodology.

Contents

Appendices

1 Introduction

The current draft of the Directive of the European Parliament and of the Council relating to the Assessment and Management of Environmental Noise (COM(2000) 468 final) requires that Member States identify agglomerations of >250,000 and >100,000 population within which to map noise levels:

"'Agglomeration' *means part of a territory, delimited by the Member State, having a population in excess of 100 000[*] persons and a population density such that the Member State considers it to be an urbanised area;*

'Noise map' *means the presentation of data on an existing or predicted noise situation in terms of a noise indicator, breaches of a limit value, the number of people affected in a certain area, the number of dwellings exposed to certain values of a noise indicator in a certain area, or on cost-benefit ratios or other economic data on mitigation methods or scenarios."* [Article 3]

The first part of this report describes the evaluation of a preferred methodology for identifying the UK agglomerations and the results of this method. The choice of preferred method was influenced by availability of population data, digital map data and a practicable definition for urban areas in the UK. Both administrative boundaries and a bottom-up urban areas approach have been considered. These methods are outlined in Section 2. The preferred method has been chosen to limit, as far as possible, the agglomeration boundaries to continuous urban areas. It is described in Section 3, and lists of the agglomerations identified are given in Section 4.

The second part of the report is concerned with the calculation of population exposure to noise levels in 5dB bands, as defined by the Directive:

"The total number of people that is living in dwellings that are exposed to each of the following ranges of values of LDEN in dB at 4 m height at the most exposed façade: < 55, 55- 59, 60-64, 65-69, 70-74, 75-79, >79, separately for noise from road, rail and air traffic, and from industrial sources. The figures shall be given to the nearest hundreds of people (example: 5200 = between 5150 and 5249; 100 = between 50 and 149; 0 = less than 50)." …

"Additionally it shall be stated how many schools and hospitals are exposed to each of the above ranges of LDEN and how many pupils and patients are related to these figures. Additionally the total area of parks (in km²) within each of the above ranges of LDEN." [Annex VI]

Section 5 of this report describes the data available for making this assessment and a preferred methodology is described in Section 6. A small test area in Birmingham has been used to illustrate the data available in the UK and to assess the sensitivity of the results to variations in noise map resolution.

[*] In the first round of mapping the agglomerations to be considered are those in excess of 250000 persons

2 Defining agglomerations

Article 7 of the proposed Noise Directive places a requirement upon Member States to initially collect noise maps for agglomerations with a population >250,000 and for all major roads, railways and airports. In addition there is a subsequent requirement for noise mapping within agglomerations with a population >100,000.

Agglomerations are defined by Article 3 of the Directive as:

'part of a territory, delimited by the Member State, having a population in excess of 100,000 persons and a population density such that the Member State considers it to be urbanised.'

Clear similarities may be drawn between the definition of agglomerations outlined above and that applied within the first air quality Daughter Directive (Council Directive 1999/30/EC). The Daughter Directive defines agglomerations as:

'a zone with a population concentration in excess of 250,000 inhabitants or, where the population concentration is 250,000 or less, a population density per km^2 for which the Member States justifies the need for ambient air quality to be assessed and managed.'

An important distinction between these definitions lies in the treatment of population density. Within the Noise Directive, population density is applied as formal qualification for an agglomeration. However, within the air quality Directive it is applied as an optional qualifier for the identification of additional agglomerations where the Member State may feel that ambient air quality should be assessed.

In addition, within the air quality Directive, the mechanism for defining agglomeration is designed to enable the identification of the total population of the agglomeration. This is used to define the number of monitoring stations required for compliance monitoring within the agglomeration based on guidance provided by the Directive. As long as the number of monitoring stations within an agglomeration meets the specification of the guidance in the Directive and they are located in representative locations, compliance with the Directive is achieved. However, within the Noise Directive the mechanism for defining agglomerations has the aim of identifying the extent of an 'urban area' throughout which noise must be assessed by mapping.

2.1 OPTIONS AVAILABLE FOR DEFINITION OF AGGLOMERATIONS

Three alternative methods were considered for identifying agglomerations in the UK. These are outlined below.

2.1.1 Definition of agglomerations using population density statistics for local authority boundaries

Population counts for Local Authorities and digital Geographic Information System (GIS) maps representing authority boundaries were used to calculate population density statistics for all Local Authorities in the UK. Local Authority in this context means a district, Unitary

Authority or Metropolitan Borough. A criteria for the definition of urban land was identified from the 1991 Census of Key Statistics for Urban and Rural Areas (ONS, 1997). This definition specifies that land may be considered to be urban if the population density per km^2 is in excess of 500 persons.

Using these data the following method for defining Local Authorities with urban area characteristics was developed.

1. Calculate the population density of each local authority in the UK
2. Identify all Local Authorities with a population density of >500 persons per km^2 as 'urban area' authorities
3. Aggregate all Local Authorities identified in step 2 that are separated by less than 200 metres* to form a continuous 'urban area'
4. Calculate total population of aggregated 'urban area' Local Authorities identified in step 3
5. Identify all aggregated 'urban area' Local Authorities with total population >250,000 persons as agglomerations
6. Identify all aggregated 'urban area' Local Authorities with total population >100,000 persons as agglomerations

Figure 1 and Figure 2 present the geographical extent of two agglomerations in the UK based on this approach.

It should be noted that this method suffers from a lack of resolution because it does not take account of variations in population density within Local Authorities. Local Authority boundaries are arbitrary in relation to geographical variations in population density. Hence, it is possible for areas with a low population density (non-urban land) to be included in urban Local Authority because of the relatively high population density of the Local Authority as a whole. Conversely it is also feasible that areas with a high population density (urban land) may be overlooked as a result of the population density of a Local Authority as a whole being low.

The inclusion of rural land parcels is evident in the two examples presented in Figure 1 and Figure 2. These figures clearly show that although the local authorities identified satisfy the population density criteria for urban land, (as defined in the 1991 Census of Key Statistics for Urban and Rural Areas), it is unlikely that all land within the boundaries identified will be composed solely of urban land. As a result, it is likely that the extent of agglomerations will be overestimated. In Figure 1 this artefact of the methodology is clearly identified by the north-south extent of the London agglomeration which is shown to encompass Local Authorities from Milton Keynes in the north to Crawley in the south.

* 200m, as defined by ONS (1997), has been used for consistency with the other methods described later, but in this case is equivalent to identifying adjacent Local Authorities.

Figure 1 Extent of an agglomeration with total population >250,000 persons based on contiguous Local Authorities with population density >500 persons/km^2 (London).

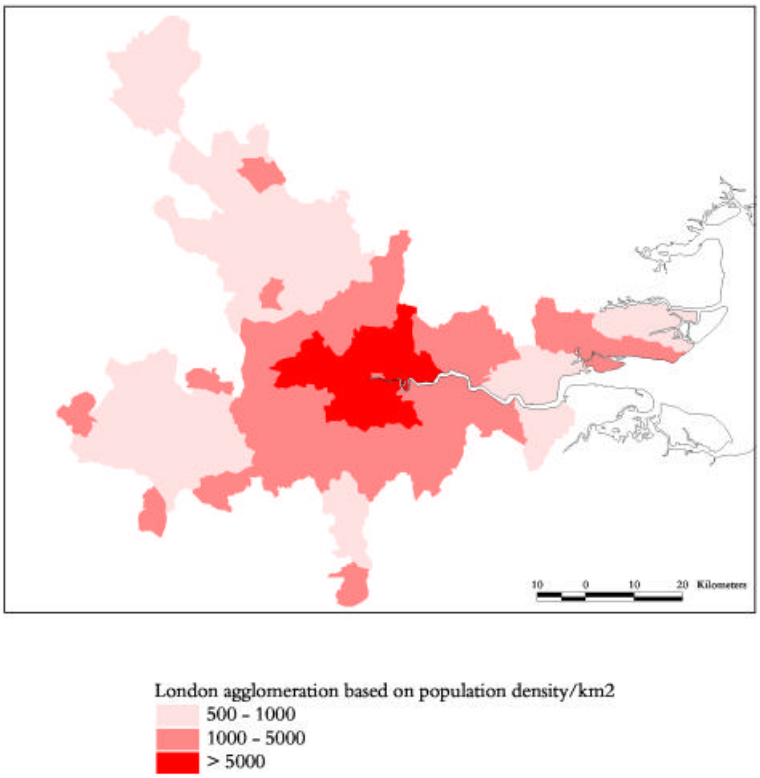


Figure 2 Extent of an agglomeration with total population >100,000 persons based on contiguous Local Authorities with population density >500 persons/km^2 (Aberdeen).

2.1.2 Definition of agglomerations using population density statistics for high resolution administrative boundaries (ward level)

Using an identical approach to that established for Local Authorities above, the analysis was repeated at a higher resolution using electoral wards. The method developed for defining wards with urban area characteristics is outlined below.

1. Calculate the population density of each electoral ward
2. Identify wards with a population density of >500 persons per km^2 as 'urban area' wards
3. Aggregate all wards identified in step 2 that are separated by less than 200 metres to form a continuous area
4. Calculate total population of aggregated urban area wards identified in step 3
5. Identify all aggregated wards with total population >250,000 persons as agglomerations
6. Identify all aggregated wards with total population >100,000 persons as agglomerations

Using this approach, Figure 3 and Figure 4 present alternative geographical extents for the two agglomerations presented in Figure 1 and Figure 2.

This method offers some improvements on the local authority analysis method by avoiding including so much non-urban land and also avoiding disregarding small areas of higher density land within generally rural Local Authorities. However, in general it is still likely to lead to an over-estimate of the extent of urban agglomerations in the UK owing to the inclusion of non-urban land parcels within the ward boundaries.

Figure 3 Extent of an agglomeration with total population >250,000 persons based on contiguous wards with population density >500 persons/km^2 (London).

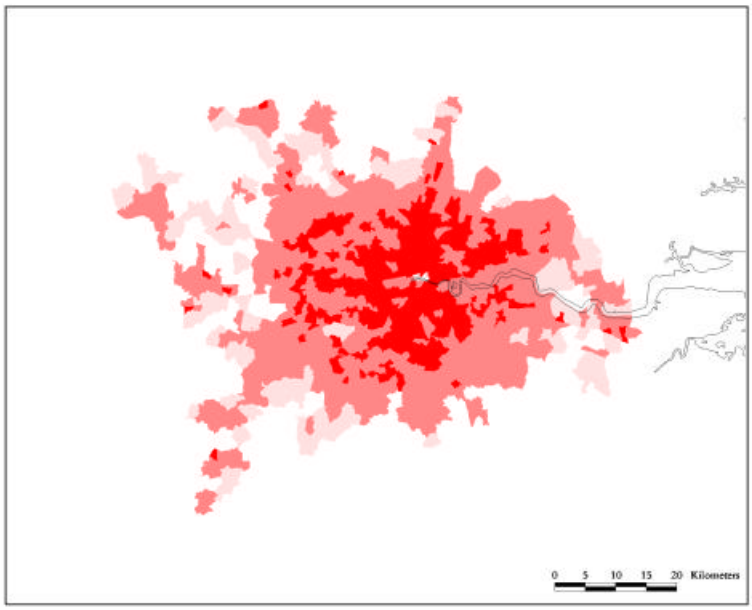
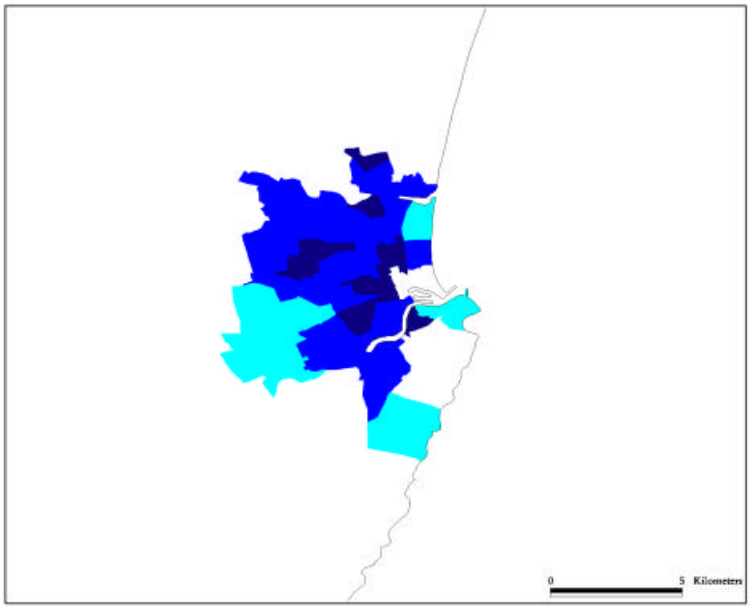


Figure 4 Extent of an agglomeration with total population >100,000 persons based on contiguous wards with population density >500 persons/km^2 (Aberdeen).



2.1.3 Definition of agglomeration using an urban areas approach

The approach to defining agglomerations adopted by the UK with regard to the first Air Quality Daughter Directive is based upon the identification of continuous urban areas throughout the UK (Bush, 2000). The total population of each area was calculated from official census statistics. Subsequently, urban areas meeting the population criteria for agglomerations set by this Directive were identified.

This method utilises a number of different techniques to define urban areas owing to the absence of a consistent data for the whole of the UK. However, an assessment of comparability of the techniques throughout the UK recognises that the essential concepts of urban land are very similar (ONS, 1997).

The following definitions of urban land were derived from the 1991 Census of Key Statistics for Urban and Rural Areas.

Within England and Wales land defined as urban land comprises:

- Permanent built-up structures,
- Transportation corridors,
- Transportation features,
- Mine buildings,
- Any area completely surrounded by built up sites.

The prerequisite for recognition of urban land as part of an urban area is that the urban land should have a minimum area of 20 hectares (separate areas are linked if they are less than 50m apart). The critical factor in the definition of an urban area is a minimum population of 1,000 inhabitants. It should be noted that no specific population density criteria are used in this approach.

Within Scotland, a Localities approach is used, where a Locality is defined as follows:

- Unit Postcodes areas were identified as urban if the population density > 5 residents per hectare or the postcode was included in a locality as part of the 1981 census
- Adjoining postcodes were grouped as a Locality if the total number of residents was >500
- Localities with total population <500 were discarded

Using digital representations of the urban areas as defined above, the following methodology was applied to define urban agglomerations using a GIS.

1. Identify all urban areas
2. Aggregate all urban areas identified in step 1 that are separated by less than 200 metres to form a continuous urban area
3. Calculate total population of aggregated urban area identified in step 2
4. Identify all urban areas with total population >250,000 persons as agglomerations
5. Identify all urban areas with total population >100,000 persons as agglomerations

Within Northern Ireland, urban land and population statistics were not available in digital format. As a result the extent of continuous urban land was determined using CORINE land cover information at a 250m resolution (CORINE, 1997). Northern Ireland 1991 Census data were used to calculate total populations of urban areas (Census Office for Northern Ireland)

Using this approach, Figure 5 and Figure 6 present alternative geographical extents for the two agglomerations presented in previous sections. It should be noted that the use of the urban areas

approach largely limits the extent of the agglomerations to the built-up areas as demonstrated in Figure 7 and Figure 8. These show the geographical extent of the London and Aberdeen agglomerations superimposed on Ordnance Survey's Meridian small scale mapping. The residential roads shown on these maps aid the identification of urban areas.

Figure 5 Extent of an agglomeration with total population >250,000 persons based on contiguous urban areas/localities (London).

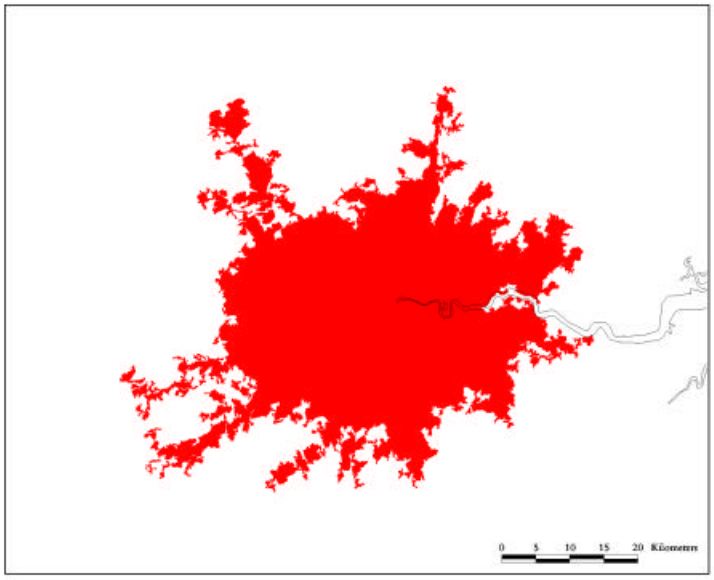


Figure 6 Extent of an agglomeration with total population >100,000 persons based on contiguous urban areas/localities (Aberdeen).

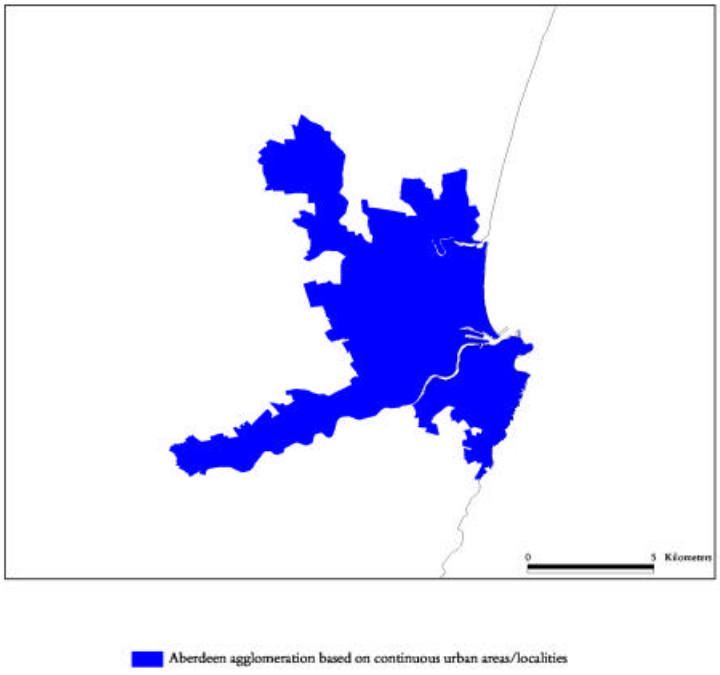


Figure 7 Overlay of London agglomeration on OS Meridian map

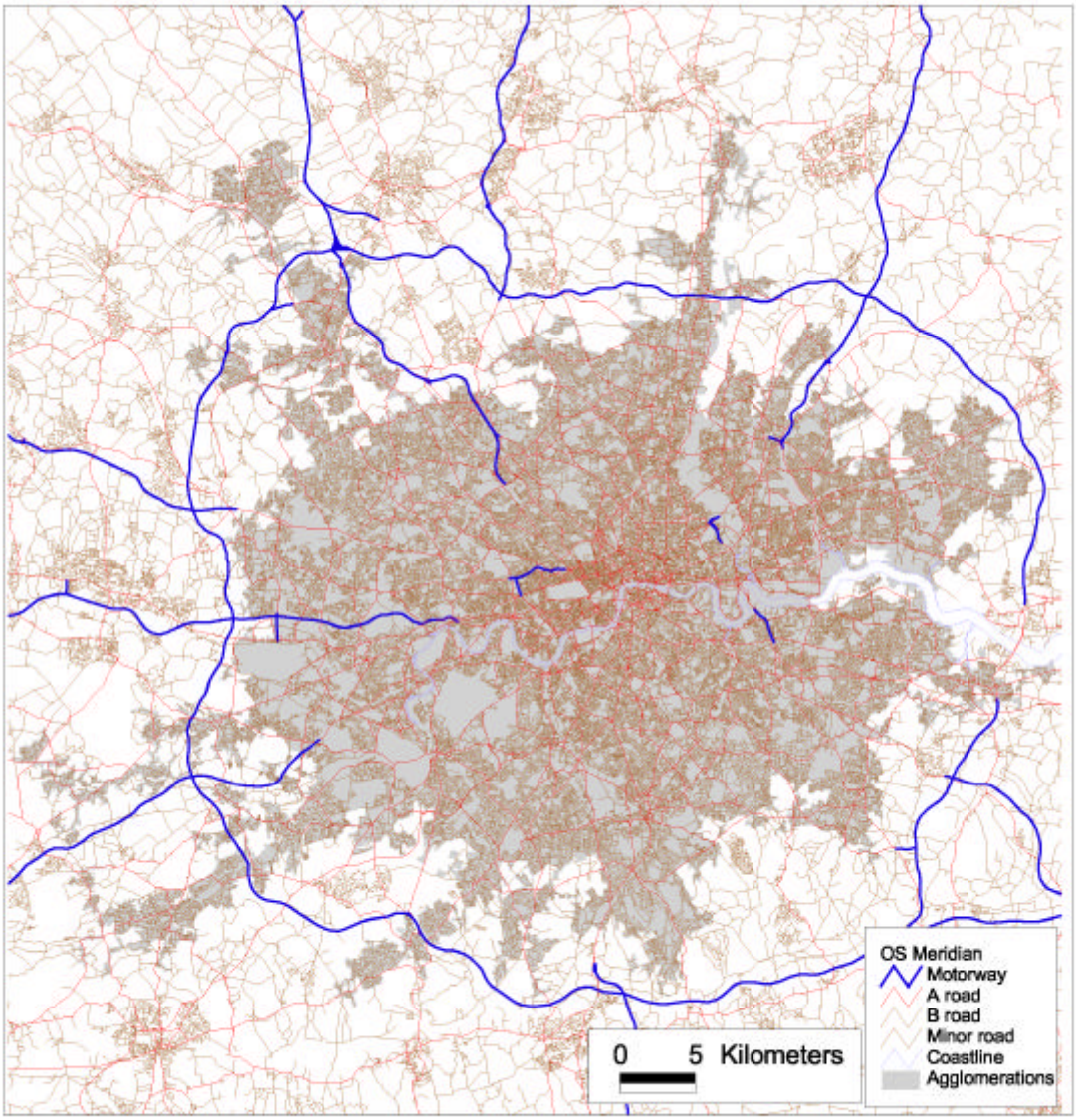
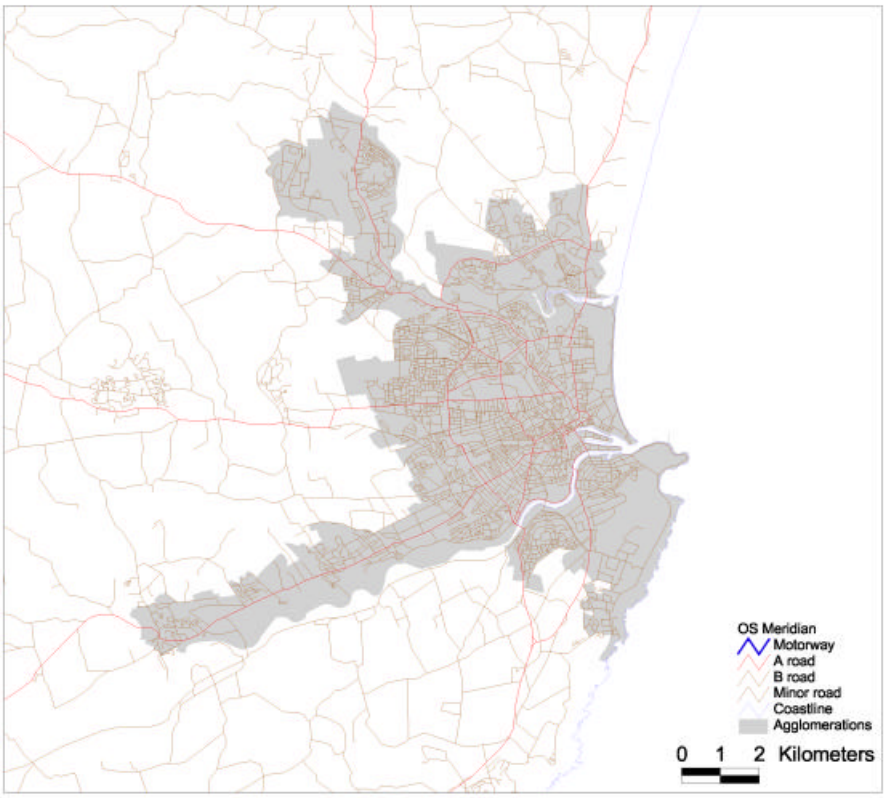


Figure 8 Overlay of Aberdeen agglomeration on OS Meridian map



As a comparison between the three methods described above, Figure 9 and Figure 10 show the extent of all three resulting agglomerations for London and Aberdeen respectively. Table 1 shows a comparison of the areas covered by the agglomerations defined by the three methods.

Table 1 Comparsion of area covered by agglomerations as defined by the three different methods

		Area of agglomerations identified by approach (km^2)		
	Agglomeration type by population	**Local Authority boundary**	**Wards**	**Urban Areas**
England	>250,000	17347	11263	5098
	>100,000 and < 250,000	18231	12991	1394
Scotland	>250,000	1714	801	197
	>100,000 and < 250,000	2398	1082	575
Wales	>250,000	1325	n/a	157
	>100,000 and < 250,000	1568	n/a	31
Northern Ireland	>250,000	n/a	n/a	155
	>100,000 and < 250,000	n/a	n/a	0

n/a – indicates that the statistics were not calculated due to unavailability of spatially disaggregated population data or digital boundary datasets

Figure 9 Comparison of agglomeration boundaries for London using three different methods

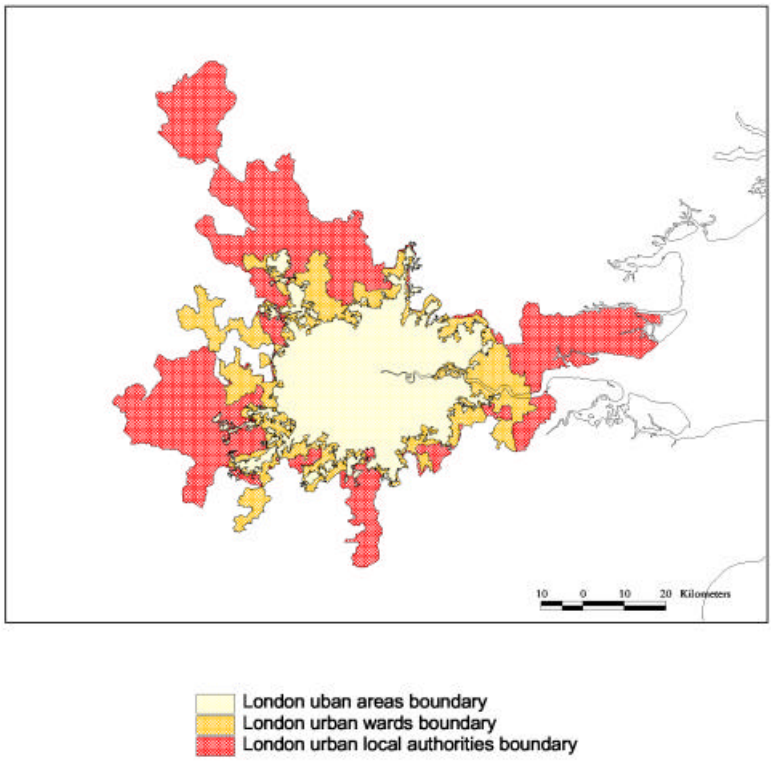
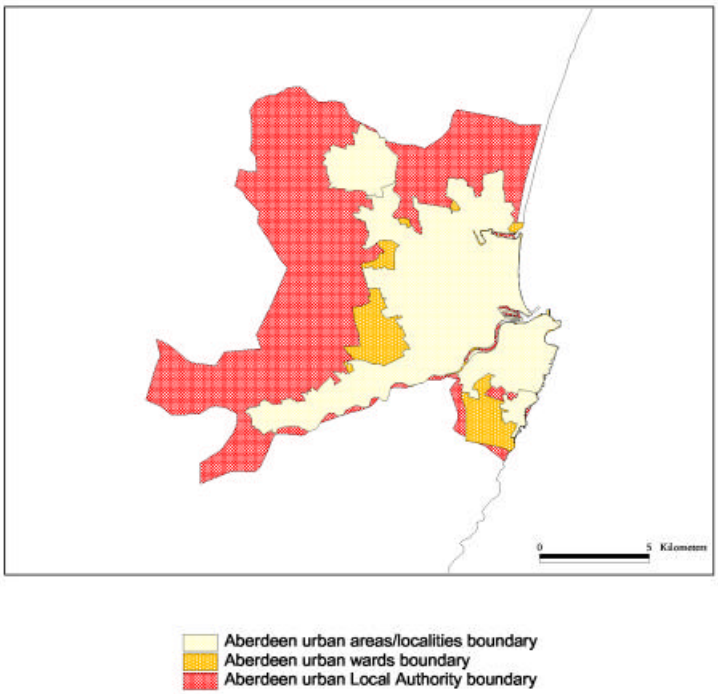


Figure 10 Comparison of agglomeration boundaries for Aberdeen using three different methods



3 Defining preferred approach to identification of agglomerations

In defining the preferred approach to the identification of agglomerations in the UK, it is useful to consider the scope of the proposed Directive, which is set out by Article 2 of the Directive:

'This Directive applies to environmental noise perceived by humans in and near their home, in public parks or other relatively quiet areas in an agglomeration…'

It is therefore assumed that, for the practical purpose of mapping, the geographical extent of agglomerations should be restricted to urbanised areas (or non-urban areas entirely surrounded by built-up areas) and where residential houses, schools and hospitals are most likely to be located.

It is anticipated, therefore, that the urban areas method as utilised by the first Air Quality Daughter Directive is most likely to provide a practicable definition of urban agglomerations. Although this method is not specifically based on population density, its concepts are very similar.

The approaches based on population density, utilising local authority and ward level administrative boundaries suffer from poor resolution and from the inclusion of rural land parcels within the agglomeration boundaries. Although this is not such a problem in the centre of towns and cities, on the periphery the ward and local authority approaches are likely to misrepresent the extent of an agglomeration and therefore result in a larger than appropriate area being included in the noise mapping exercise.

Table 2 summarises the alternative methods that have been investigated for the definition of agglomerations in the UK. The advantages and disadvantages of each method are also presented.

Table 2 Methods available for identification of agglomerations

Method	Advantage	Disadvantage
Administrative boundaries	• Boundaries and population statistics readily available throughout UK • Enables identification of areas with 'urban area characteristics' to be identified based on population density	• Potential for inclusion of non-urban land in agglomerations • Potential for over-estimating the extent of agglomerations • Low spatial resolution
Ward based Population Density	• Boundaries and population statistics readily available throughout UK • Enables identification of areas with 'urban area characteristics' to be identified based on population density • Better spatial resolution than Administrative boundaries	• Potential for inclusion of non-urban land in agglomerations • Potential for over-estimating the extent of agglomerations • Low spatial resolution
Urban Areas approach	• Consistency with other UK Government work • Digital data and statistics for England, Wales and Scotland readily available from DETR and the Devolved Administrations • Avoids inclusion of rural land parcels in agglomerations and over-estimation of the extent of agglomerations • Utilises Government recognised definitions and population statistics • The 2001 census may enable uniform approach to collection of population and urban area statistics throughout the UK	• Urban area information for Northern Ireland not readily available • There is not an explicit population density used to define an urban area.

The urban areas approach is considered to be the preferred method for reasons of consistency with other work, use of recognised methods which have their base in population density criteria for urban land, and limitation of areas to be mapped to larger urban areas of the UK which are consistent with the population criteria for agglomerations.

4 Agglomerations identified

The two tables in this section list the agglomerations that have been identified using the preferred methodology outlined in the previous section. There are 28 agglomerations with a population of over 250,000 and a further 40 with a population of over 100,000 but less than 250,000. These are listed by UK administrative area (England, Scotland, Wales and Northern Ireland). Maps showing the extent of these agglomerations are provided in Figures 11 – 14. Appendix 2 details the Local Authority districts/boroughs that these agglomerations intersect.

The agglomerations of over 250,000 persons identified here are the same in extent and population as those identified in earlier work for DETR relating to the Air Quality Daughter Directive.

Table 3 Agglomerations of > 250,000 population in the UK

Agglomeration	Population	Proportion of total population by administrative area (%)
England		
Greater London Urban Area	7,650,944	16
West Midlands Urban Area	2,296,180	5
Greater Manchester Urban Area	2,277,330	5
West Yorkshire Urban Area	1,445,981	3
Tyneside	885,981	2
Liverpool Urban Area	837,998	2
Sheffield Urban Area	633,362	1.3
Nottingham Urban Area	613,726	1.3
Bristol Urban Area	522,784	1.1
Brighton/Worthing/Littlehampton	437,592	0.9
Leicester Urban Area	416,601	0.9
Portsmouth Urban Area	409,341	0.8
Teeside Urban Area	369,609	0.8
The Potteries	367,976	0.8
Bournemouth Urban Area	358,321	0.7
Reading/Wokingham Urban Area	335,757	0.7
Coventry/Bedworth	331,248	0.7
Kingston upon Hull	310,636	0.6
Southampton Urban Area	276,752	0.6
Birkenhead Urban Area	270,207	0.6
Southend-on-Sea Urban Area	266,749	0.6
Blackpool Urban Area	261,355	0.5
Preston Urban Area	256,411	0.5
	21,832,841	**45**
Scotland		
Glasgow Urban Area	1,315,544	26
Edinburgh Urban Area	416,232	8
	1,731,776	**34**
Wales		
Cardiff	306,904	11
Swansea	272,456	9
	579,360	**20**
Northern Ireland		
Belfast	475,987	30
Grand total and % UK	**24,619,964**	**43**

Table 4 Agglomerations of > 100,000 and < 250,000 population in the UK

Agglomeration	Population	Proportion of total population by administrative area (%)
England		
Plymouth	245,295	1
Farnborough	231,194	0.5
Derby	223,836	0.5
Gillingham	222,388	0.5
Luton	221,337	0.5
Barnsley	211,448	0.4
Sunderland	189,281	0.4
Norwich	185,420	0.4
Northampton	183,082	0.4
Wigan	174,406	0.4
Milton Keynes	156,148	0.3
Mansfield	154,966	0.3
Warrington	152,458	0.3
Burnley	149,906	0.3
Swindon	145,236	0.3
Grimsby	136,456	0.3
Blackburn	135,858	0.3
Peterborough	134,788	0.3
Ipswich	133,270	0.3
Doncaster	128,847	0.3
Slough	126,662	0.3
Gloucester	126,149	0.3
York	124,609	0.3
Hastings	120,044	0.2
Telford	119,340	0.2
Oxford	118,795	0.2
Margate	116,745	0.2
High Wycombe	116,361	0.2
Southport	116,315	0.2
Crawley	115,554	0.2
Cambridge	113,127	0.2
St Albans	111,480	0.2
Chesterfield	105,660	0.2
Basildon	102,913	0.2
Cheltenham	102,633	0.2
Torquay	102,576	0.2
	5,354,583	**11**
Scotland		
Aberdeen	199,747	4
Dundee	154,697	3
Falkirk & Grangemouth	117,459	2
	471,903	**9**
Wales		
Newport	115,522	4
Grand total and % UK	**5,942,008**	**10**

Figure 11 Agglomerations in Scotland

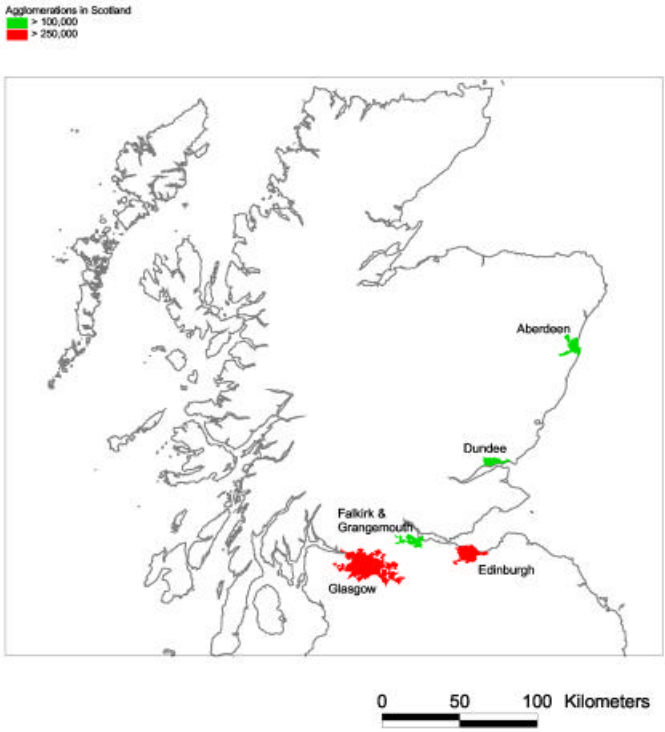


Figure 12 Agglomerations in Northern England

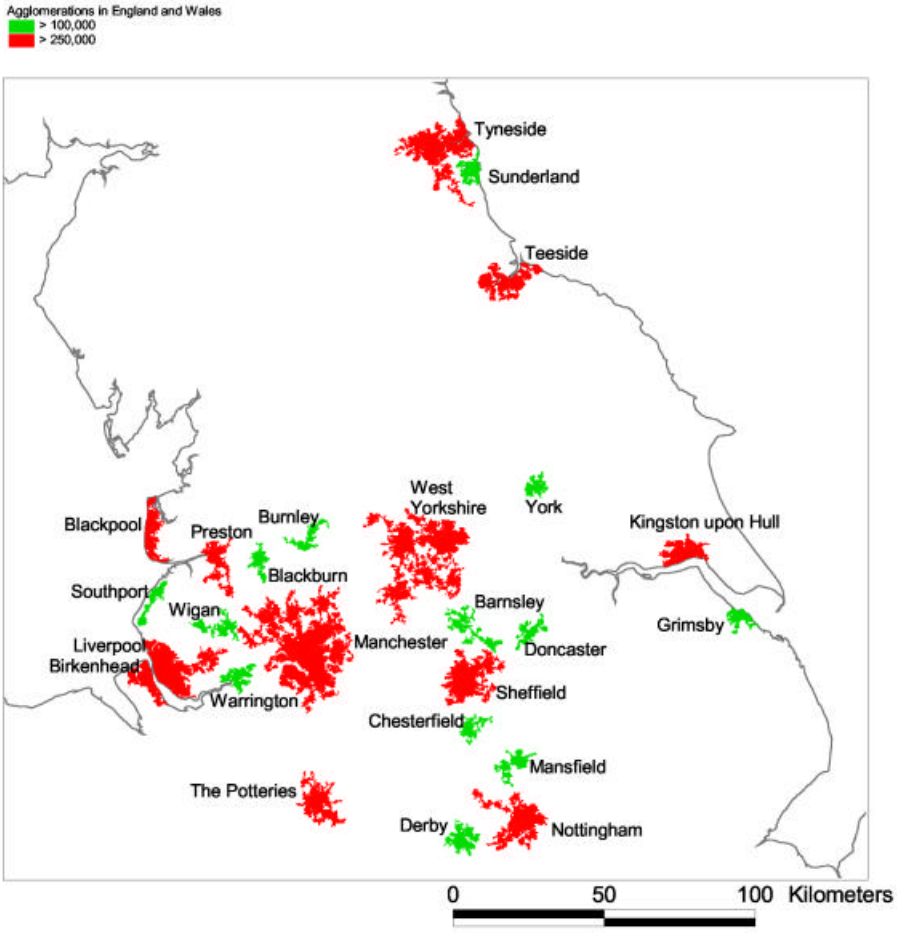


Figure 13 Agglomerations in Southern England and Wales

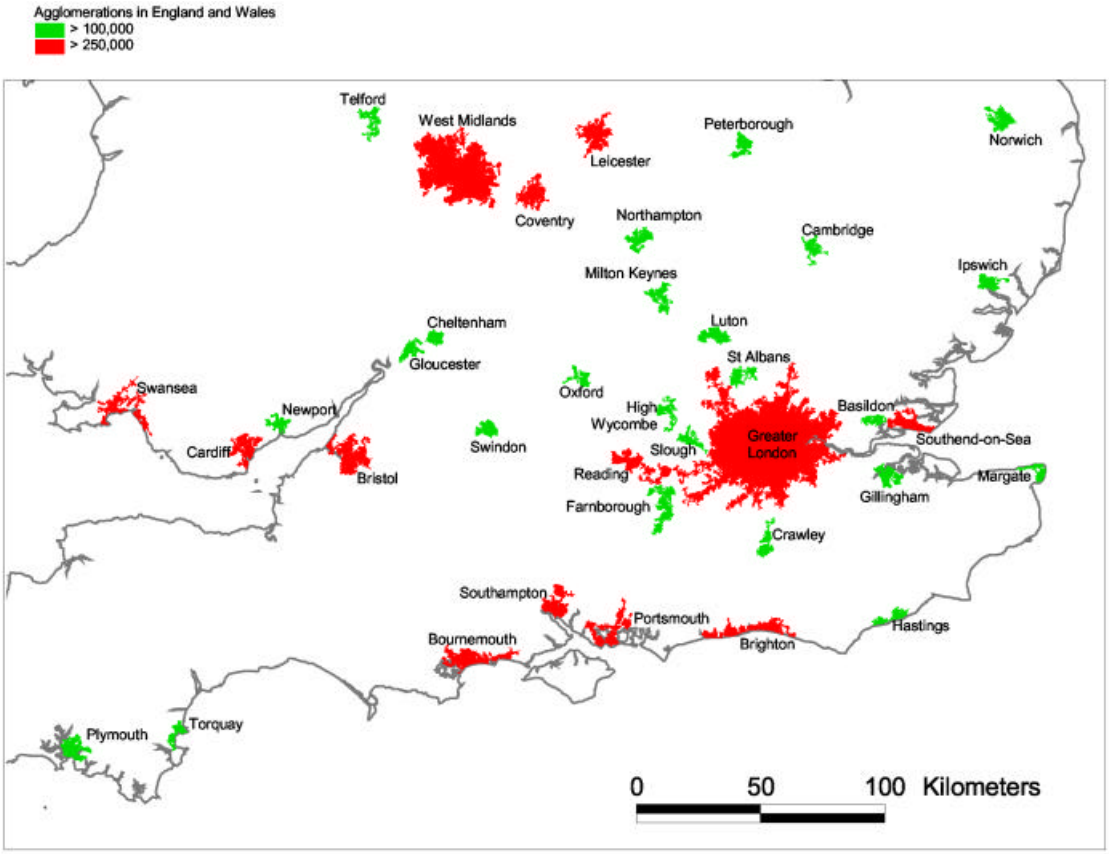


Figure 14 Agglomerations in Northern Ireland

5 Population data for exposure assessment

Population data are available for all parts of the UK as a result of the GB and Northern Ireland Censuses taken in 1991. The boundary definitions of the census in Northern Ireland are comparable to that of the rest of the UK. The smallest geographical unit for which population counts are available is the Enumeration District (ED). This is an area one census enumerator can cover for collecting census returns. It is typically about 150 households and its size is therefore dependent on housing density. Published census data are aggregated to at least ED level in order to prevent any breach of confidentiality.

The Census provides the official and most reliable data on population in the UK. For this study 1991 ED level data have been used, because these are currently the most suitable as the basis of the population estimates by noise contour. Future analysis should make use of the most up to date Census data available.

The noise maps to be used in the assessment of noise exposure are likely to be high resolution, possibly with a noise estimate for every 10m square or by building façade. However, the ED level census data are not of a comparable resolution. Therefore a proxy measure of population on a finer resolution is required. Ordnance Survey Address Point data can be used for this purpose when combined with the ED data.

Address Point is Ordnance Survey's national address database. It is based on the Royal Mail's postal delivery database called the Postcode Address File (PAF), with a national grid co-ordinate for each individual address. This includes all residential and commercial addresses. The data set is updated every six months using updates of the PAF. The accuracy of the data set is quoted as 96% of all urban addresses within 1 metre of their actual location. The grid co-ordinate locates the centre of the building with that address. For Northern Ireland the equivalent data set is called Compass, available from Ordnance Survey Northern Ireland.

5.1 POTENTIAL IMPROVEMENTS IN FUTURE

The 2001 Census will provide a more up to date picture of current population counts. A change in the geography of data collection will mean that it is more directly linked to the UK postcode system. Output Areas (OAs) will be built up from boundaries of unit postcodes (e.g OX11 9JS). These will replace Enumeration Districts. This will allow a simpler link to be made between address point information and census output areas. However, this data will not be available until 2003.

6 Preferred approach for population and noise mapping

6.1 DATA SOURCES

Address Point data has been used in this study to assess the noise level at each residential address. However, there is no explicit distinction made in the Address Point database between residential and commercial addresses. Therefore an assumption has been made that a residential address has no Organisation Name (ON). An extract of the Address Point file is illustrated in Appendix 2.

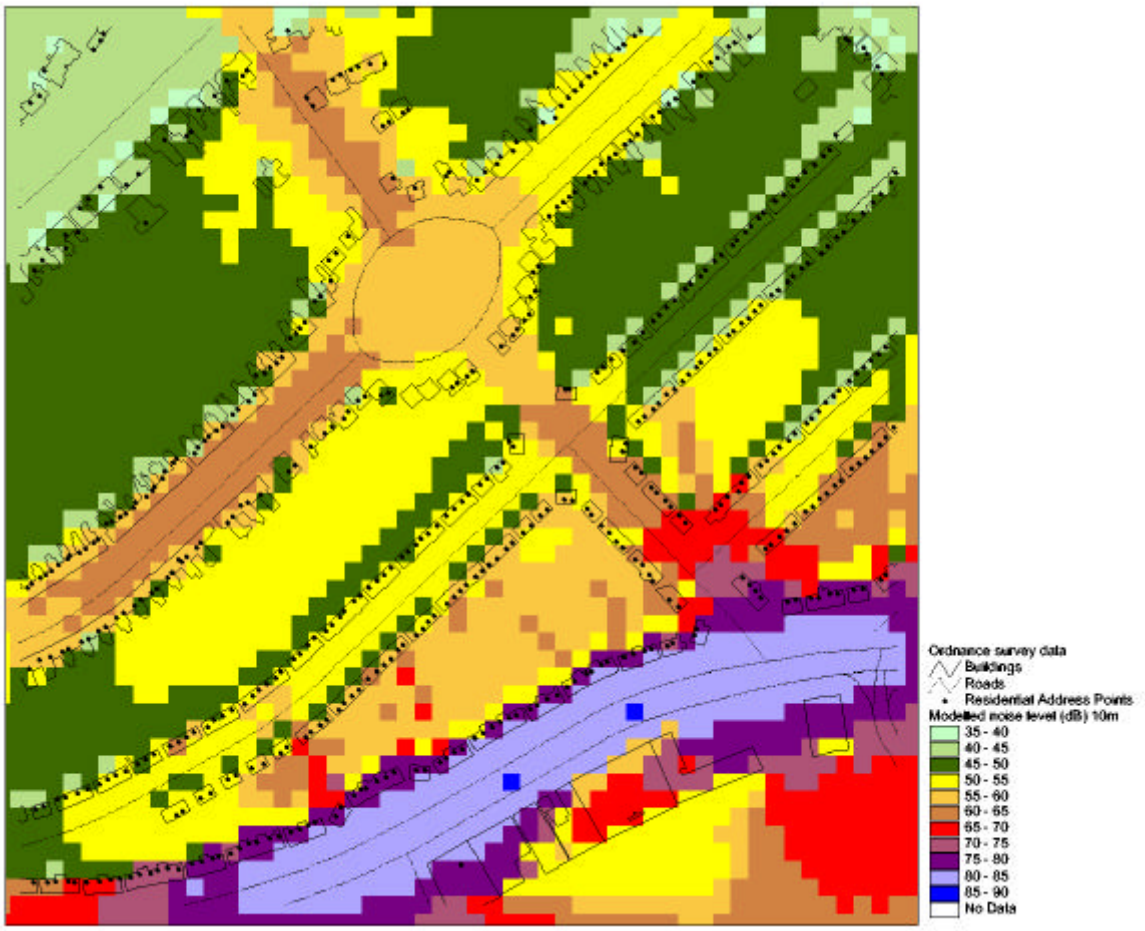
The Usually Resident Population within each ED, as given by the Census, has been used to determine an average occupancy rate per address. This calculation required a count of residential addresses per ED, which is obtained using a Geographical Information System to link these two data sets. The occupancy rate by ED could then be used when calculating numbers of people living within different noise contour bands.

Figure 15 shows the location of a 500m square which has been chosen as a case study area for estimating numbers of people exposed to different noise levels. The area is in north east Birmingham close to the junction of the M6 and A38. The figure also shows the boundaries of the enumeration districts that are included within the case study area. Each is shaded according to the number of people usually resident there. The average occupancy rate across all of this set of EDs is 2.4 people per residential address.

The draft Noise Directive also contains a requirement for noise levels at schools and hospitals to be assessed. These can be identified from the Organisation Name in the Address Point database and are highlighted in Figure 15. However, there are none in the 500m test area chosen for the analysis in this study.

Figure 15 Population by Enumeration District and location of residential Address Points

Figure 16 Notional noise levels by grid square (10m resolution)



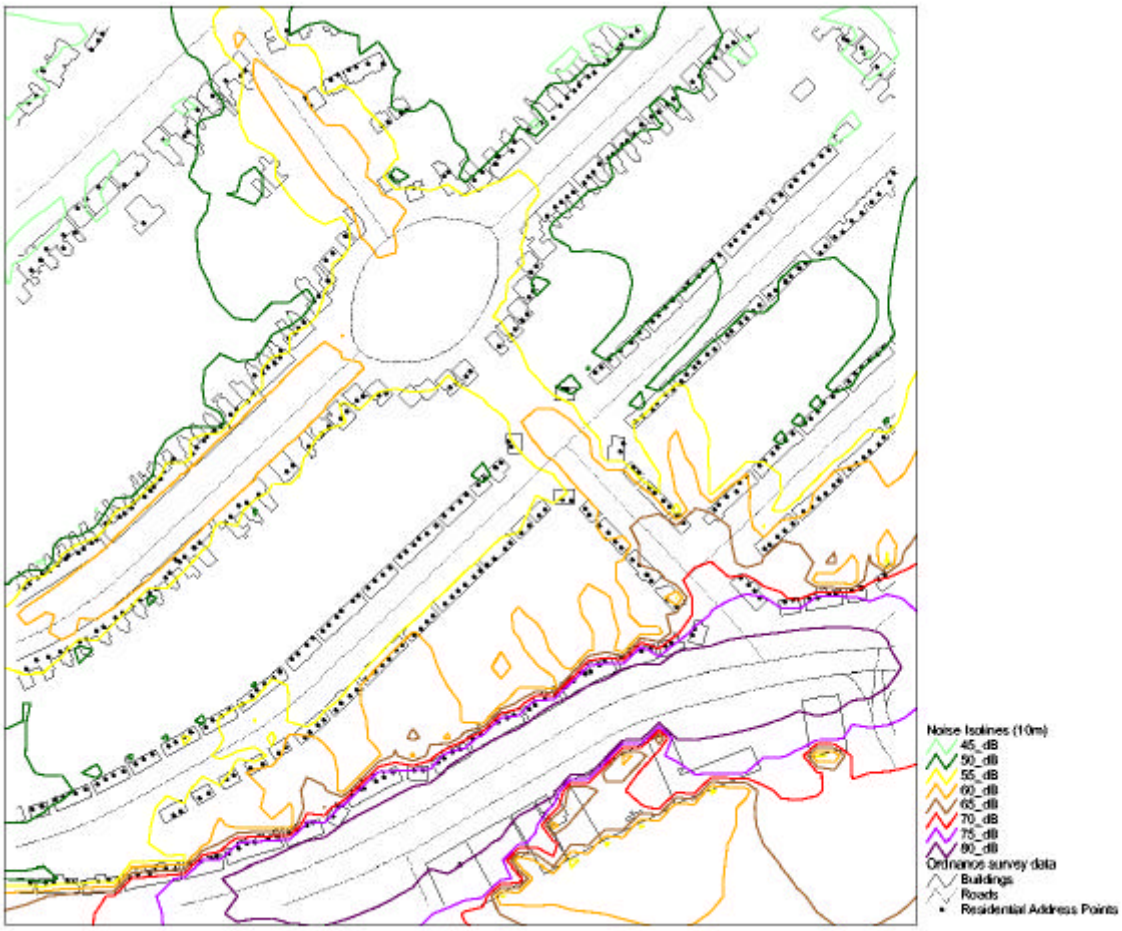
Stephen Turner, of Stanger Science and Environment, has generated a set of notional noise maps for the case study area. A range of resolutions (10m, 5m and 1m) have been used in order to assess the sensitivity of the results to this variation in the modelling.

The noise level in each grid square has been calculated in the integrated noise modelling software, with geographic data on road and building locations from Ordnance Survey Landline mapping and notional road traffic flows. The result of the modelling at a resolution of 10m is shown in Figure 16, and those for 5m and 1m resolutions in Figure 19 and Figure 20 respectively. Figure 17 shows the same data but with the noise levels represented as noise contours or isolines. Both maps show high noise levels close to the major road in the south of the study area with a decrease away from the road. Noise levels are lower behind buildings as these act as a barrier. Noise levels are lower in the residential area to the north of the main road.

For the analysis of exposure of the population to noise levels the gridded data are most suitable as this provides a noise level at each location. The gridded data assumes a constant noise level across a grid square, rather than requiring some sort of interpolation between noise contours which have themselves been interpolated from the grid square estimates.

It should be noted that the noise maps presented here are purely hypothetical and are not equivalent to those that have been produced by Birmingham City Council.

Figure 17 Notional noise contours (derived from the 10m grid)



6.2 PROPOSED METHOD

The proposed method for calculating numbers of people within noise contours is as follows. Results for the test area using three different grid resolutions are given in Table 5. The results are shown graphically in Figure 18.

1. Overlay residential address point data on noise grid (see Figure 16, Figure 19 and Figure 20).
2. At each address look up the noise level of the grid square in which is it located.
3. Count up the number of addresses in each noise band 40-45dB, 45-50dB etc.
4. Each Address point has an occupancy rate according to which ED it is in, so the number of people in each property and hence in each noise contour can be calculated.
5. Schools and hospitals can be identified from the Address Point data. The noise level at these points can be obtained using the above method.

Table 5 Results for the test area using three different grid resolutions

Noise band	10 m resolution		5m resolution		1m resolution	
(dB)	Estimated Total Population	Count of Address Points	Estimated Total Population	Count of Address Points	Estimated Total Population	Count of Address Points
35 - 40	57	24	23	9	12	5
40 - 45	177	71	216	88	154	65
45 – 50	311	122	311	122	288	114
50 - 55	372	141	356	135	393	148
55 - 60	254	94	347	128	397	147
60 - 65	119	44	59	22	67	25
65 - 70	52	19	35	13	22	8
70 - 75	27	10	30	11	35	13
75 - 80	152	56	158	58	165	60
80 - 85	14	5	0	0	2	1
Sum < 50dB	545		550		454	
Sum 50 - 70 dB	797		797		857	
Sum > 70 dB	245		223		224	

The results show that there are considerable differences in the estimates of population exposure with variation in noise map resolution. Making the assumption that the 1m resolution map gives the best representation of reality, it can be seen that in this case the 5m and 10m maps over estimate the populations in the quieter areas and underestimate populations in the mid range of noise bands. There is no consistent pattern in the higher dB bands, although the 5m noise map shows no Addresses in the >80dB band.

Figure 18 Effect of variation in noise map resolution on population exposure estimates

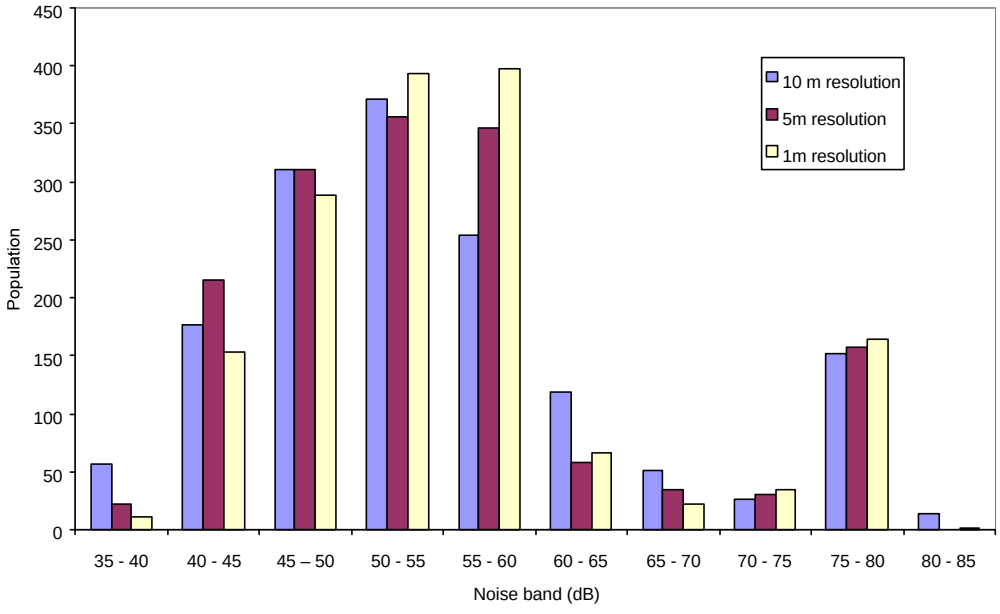


Figure 19 Notional noise levels by grid square (5m resolution)

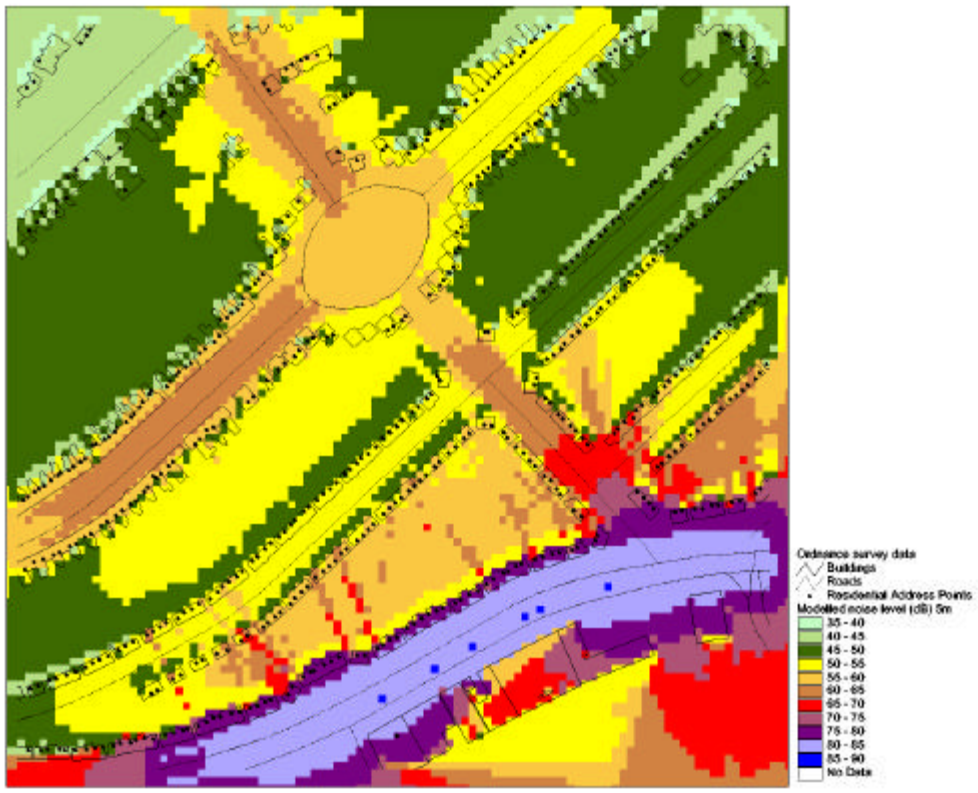
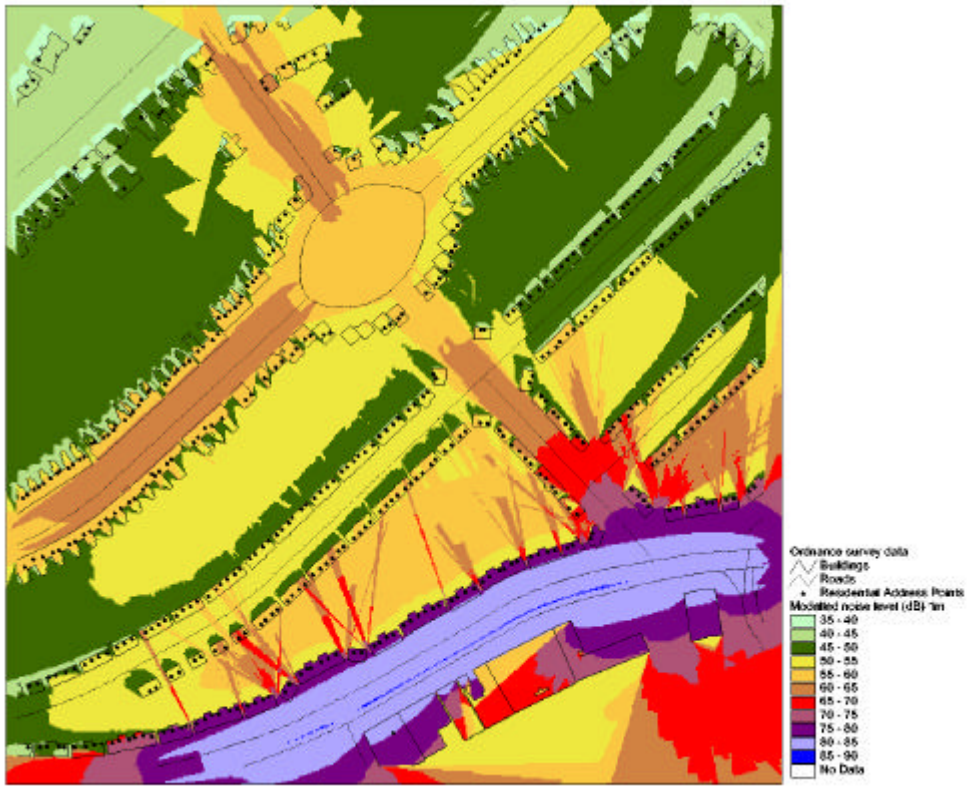


Figure 20 Notional noise levels by grid square (1m resolution)



6.3 SOURCES OF UNCERTAINTY

There are issues of uncertainty in noise mapping and in population mapping. In relation to the population data it is possible that not all addresses are included in the Address Point database, or more likely that a misallocation of addresses between the residential and non-residential categories could occur. This could result in an underestimate of population exposed.

It is proposed that ED level (or future equivalent) population data are used. In compiling total population estimates for whole agglomerations a check should be undertaken to ensure that the totals are accurate for the relevant time period, using Local Authority population totals. Census data for 2001 will be available in 2003.

The method outlined above assumes a constant occupancy rate per address and is therefore a simplification of reality. If there are in fact higher rates of occupancy in an area with high noise levels there will be an under estimate of exposure at these levels. Only data on actual occupants in each address could reduce this uncertainty. A possible solution to this could be the use of electoral and school roll data. Birmingham City Council is currently undertaking a project to consider this (see below).

6.4 POSSIBLE IMPROVEMENTS

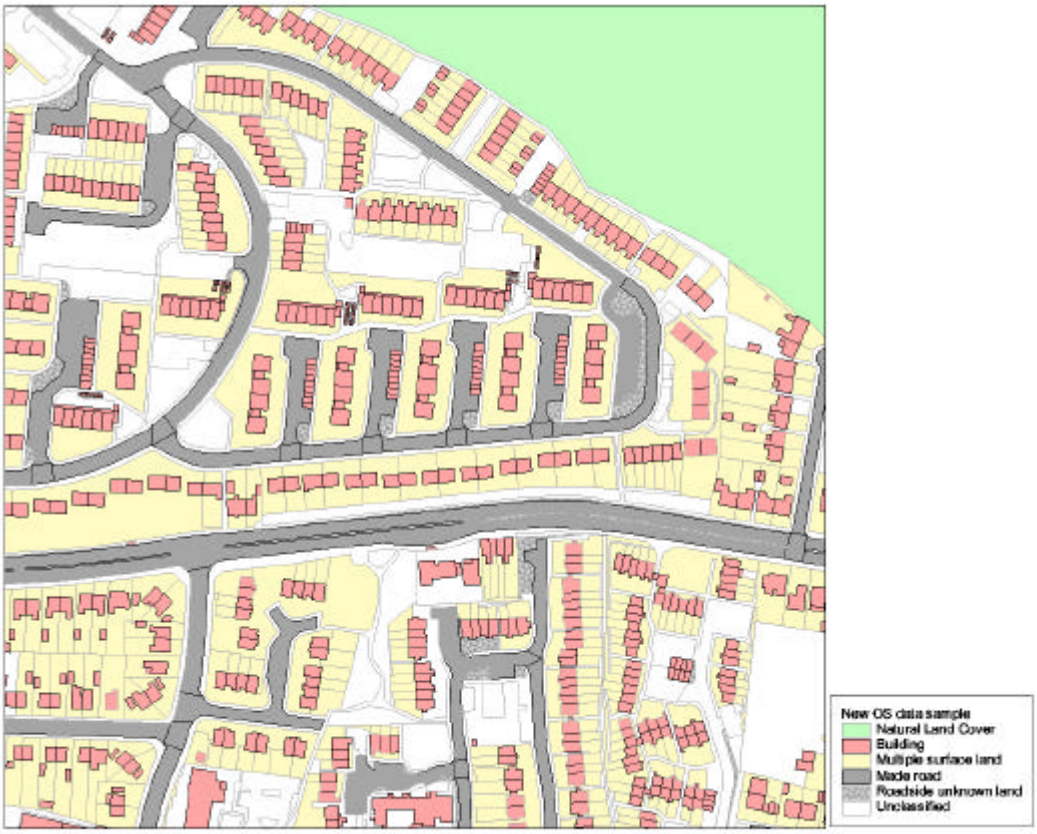
6.4.1 New data from Ordnance Survey

Using the method outlined above does not allow for a detailed assessment of noise levels at individual façades of each building, as specified in the Directive. This is as a result of the Address Point data being used as a simplification of the building - i.e defining the building as a point and not a polygon. The current Ordnance Survey maps of buildings (Landline) do not include an explicit polygon definition of each building, and therefore individual buildings cannot be identified by the Geographical Information System. However, OS are currently updating their Landline data set to a fully polygonised coverage. This development is part of the OS Digital National Framework. Sample data are available, an example of which is shown in Figure 21. The key improvements that are being made with respect to the noise mapping work are as follows (Ordnance Survey 2000):

- explicit polygons;
- a uniform digital identifier applied to all features; and
- geometric quality improvements – for example, the removal of double digitising, undershoots, overshoots, etc.

These changes will make the analysis of noise at building façades easier because they will allow automatic identification of individual buildings. The digital identifier will also be linked to the Address Point information. Some Local Authorities already have access to similar data sets which have been derived from the current Landline data.

Figure 21 Sample new data from Ordnance Survey



6.4.2 Use of electoral and school roll data

Birmingham City Council has produced detailed daytime and nighttime maps of road traffic noise, rail traffic noise, air traffic noise and some industrial noise. These maps cover the entire 330 square kilometres of the City and show noise contours in 5dB bands. The contours have been derived from basic noise predictions that have been calculated at all points on a 10 metre grid, which cover the City (3.3 million individual receptor points), through the use of sophisticated noise mapping software.

Earlier this year this software was further developed so that the basic noise data could be used to calculate the noise levels outside, or at the facades of, all buildings in the City. Recently the noise levels outside each individual building have been linked to a unique property reference number (UPRN) for each address in the City.

The next step in this on-going project will be to acquire demographic data on the number of people who live at each residential address in the City. This data is being acquired from the Electoral Roll Database and the Education Department Database for the City. As the information in these databases can be readily linked to the same UPRNs as the noise data, it will be possible to merge the different data sets in a GIS environment and produce the number of people living in dwellings exposed to different bands of noise in the City (Hinton, *pers comm*).

If the electoral and school roll data are not available for the correct year these data sets could be used to generate a normalised distribution of population across census districts then combined with accurate population totals from the Census.

6.5 IMPLICATIONS OF BS7666

Information has been obtained from a DETR report containing details of British Standard BS7666 (DETR 1999). This standard provides a nationally accepted method of referencing land and property in order to make possible the easy identification, retrieval and integration of land and property related data sets. The standard has four parts for the specification of:

- Street gazetteers (BS 7666-1:2000)
- Land and Property Gazetteers (BS 7666-2:2000);
- Addresses (BS 7666-3:2000);
- Data sets for recording Public Rights of Way (BS 7666-4:2000).

In general the standard provides a common specification for the key elements of maintained data sets of Land and Property in Great Britain in order to maintain quality and consistency of these data sets.

The geographical extent of each property will be defined as a Basic Land and Property Unit (BLPU) and each will have a Unique Property Reference Number (UPRN) which will be grid referenced to a point within the BLPU. The UPRN will be a nationally unique reference number.

This standardisation of referencing will be of benefit in the current work because it will enable easier linking of different data sets, such as OS Address Points and Local Authority data such as the Electoral Roll. If the assessment of noise exposure involves the identification of individual properties in a database, the UPRN should be stored in this database.

7 Conclusions

7.1 IDENTIFICATION OF AGGLOMERATIONS

Three alternative methods were investigated for defining agglomerations in the UK. These were based upon:

1. The population density of Local Authorities;
2. The population density of ward or similar level administrative boundaries;
3. The total population of discrete areas of continuous urban land (the Air Quality Daughter Directive approach).

It was assumed that for the practical purpose of noise mapping for the Noise Directive, the geographical extent of agglomerations to be mapped should be restricted to urbanised areas (or non-urban areas entirely surrounded by built-up areas) and where residential houses, schools and hospitals are most likely to be located. As a result, the urban areas approach (3 above) was identified as the approach most likely to deliver a practicable definition of urban agglomerations for the Noise Directive. Alternative approaches have the drawback of the inclusion of non-urban land parcels within agglomerations. The selection of the urban areas approach also has the advantage of maintaining consistency with previous Government work.

Application of the urban areas approach to the UK identified 28 agglomerations with population >250,000 persons and a further 40 agglomerations with population >100,000 and < 250,000 persons.

7.2 CALCULATION OF POPULATIONS WITHIN NOISE CONTOURS

A method has been developed for assessing the number of people exposed to modelled noise levels in 5dB bands. This method combines data on the location of households from the OS Address Point database with population statistics by Census Enumeration District. A possible improvement using household specific data on occupancy from the electoral and school rolls has also been considered.

The results from a trial of the proposed method in a hypothetical case study area in Birmingham show that the spatial resolution of the noise maps has an important influence over the results.

Availability of new data sources in future, such as the 2001 Census data and new base mapping from Ordnance Survey, will enable improved accuracy of the proposed methodology.

8 References

Bush, T (2000). *Article 5 Assessment of nitrogen dioxide, PM10, sulphur dioxide and lead in the UK.* AEA Technology Report to the DETR, Scottish Executive, National Assembly for Wales and DoE in Northern Ireland. Culham, Oxon, November 2000.

CORINE (1997) Corine Land Cover of Europe, produced by the European Topic Centre on Land Cover, July 8th, 1997. European Environment Agency, Environment Satellite Data Centre, Sweden.

Council Directive 1999/30/EC, relating to limit values for sulphur dioxide, nitrogen dioxide, PM10 and lead in ambient air.

DETR (1999) *Report and recommendations from Task Force on Housing Flow Statistics,* Central and Local Government Information Partnership, Planning Information Group (PILG) Task Force on Housing Flow Statistics, August 1999. Obtained from the Web: (http://www.housing.detr.gov.uk/research/pilg99/index.htm)

Hinton (*pers comm*.) John Hinton, Birmingham City Council Environmental Services Acoustics Department, 2000.

Census Office for Northern Ireland (not dated) *The Northern Ireland Census 1991: Summary Report*, Department of Finance and Personnel, Census Office for Northern Ireland, Belfast.

ONS (1997) 1991 *Census, key statistics for urban and rural areas, Great Britain*. Office for National Statistics (ONS). Published by Stationery Office.

Ordnance Survey (2000) *Illustrative Sample Data: Explanatory Notes*, from OS Web site http://www.ordnancesurvey.co.uk/dnf/data.htm

Appendix 1
Local Authority Districts Within Agglomeration Boundaries

Table A1 Districts within the Agglomerations of > 250,000 persons

Agglomeration	District Name	Percent of agglomeration area
England		
Birkenhead	Wirral District	100.00
Birmingham	Birmingham District	39.80
	Sandwell District	13.87
	Dudley District	13.69
	Wolverhampton District	10.67
	Walsall District	10.39
	Solihull District	8.71
	Bromsgrove District	0.95
	North Warwickshire District	0.90
	South Staffordshire District	0.66
	Lichfield District	0.35
Blackpool	Blackpool	46.49
	Wyre District	33.30
	Fylde District	20.21
Bournemouth	Poole	38.00
	Bournemouth	35.57
	Christchurch District	13.36
	New Forest District	9.12
	East Dorset District	2.46
	Purbeck District	1.49
Brighton	Brighton And Hove	41.83
	Worthing District	23.39
	Arun District	17.95
	Adur District	16.15
	Lewes District	0.68
Bristol	City Of Bristol	67.61
	South Gloucestershire	31.01
	North Somerset	0.97
	Bath And North East Somerset	0.41
Coventry	Coventry District	84.34
	Nuneaton And Bedworth District	10.11
	Warwick District	4.59
	Rugby District	0.95
Greater London	Hillingdon London Borough	5.08
	Bromley London Borough	4.82
	Croydon London Borough	4.45
	Barnet London Borough	4.09
	Richmond Upon Thames London Borough	3.63
	Hounslow London Borough	3.50
	Ealing London Borough	3.43
	Enfield London Borough	3.26
	Havering London Borough	3.16
	Bexley London Borough	2.90
	Greenwich London Borough	2.84
	Elmbridge District	2.73
	Redbridge London Borough	2.69
	Brent London Borough	2.67
	Harrow London Borough	2.52
	Sutton London Borough	2.39
	Merton London Borough	2.32
	Newham London Borough	2.32
	Waltham Forest London Borough	2.21
	Lewisham London Borough	2.18
	Wandsworth London Borough	2.18
	Barking And Dagenham London Borough	2.01

Agglomeration	District Name	Percent of agglomeration area
Greater London continued	Kingston Upon Thames London Borough	1.93
	Southwark London Borough	1.85
	Haringey London Borough	1.83
	Lambeth London Borough	1.68
	Woking District	1.54
	Three Rivers District	1.54
	Spelthorne District	1.48
	Dacorum District	1.42
	City Of Westminster London Borough	1.36
	Camden London Borough	1.35
	Tower Hamlets London Borough	1.33
	Runnymede District	1.33
	Epping Forest District	1.25
	Epsom And Ewell District	1.23
	Broxbourne District	1.21
	Hackney London Borough	1.18
	Watford District	1.07
	Hammersmith And Fulham London Borough	1.06
	Reigate And Banstead District	1.05
	Mole Valley District	0.97
	Islington London Borough	0.92
	Dartford District	0.84
	Kensington And Chelsea London Borough	0.77
	Tandridge District	0.76
	Windsor And Maidenhead	0.49
	Hertsmere District	0.39
	Surrey Heath District	0.23
	City Of London	0.19
	St Albans District	0.10
	Guildford District	0.07
	Bracknell Forest	0.07
	East Hertfordshire District	0.06
	South Bucks District	0.05
Kingston upon Hull	City Of Kingston Upon Hull	77.81
	East Riding Of Yorkshire	22.19
Leeds	Leeds District	39.22
	Kirklees District	24.86
	Bradford District	24.11
	Wakefield District	9.30
	Calderdale District	2.51
Leicester	City Of Leicester	60.52
	Blaby District	13.57
	Oadby And Wigston District	13.30
	Charnwood District	8.57
	Hinckley And Bosworth District	2.25
	HarBoroughugh District	1.77
Liverpool	Liverpool District	55.15
	St Helens District	17.21
	Sefton District	15.91
	Knowsley District	11.38
	Halton	0.34
Manchester	Manchester District	18.84
	Stockport District	12.41
	Trafford District	10.61
	Salford District	10.09
	Bolton District	9.30
	Rochdale District	8.23

Agglomeration	District Name	Percent of agglomeration area
Manchester continued	Tameside District	8.21
	Bury District	7.58
	Oldham District	7.49
	Wigan District	3.98
	Macclesfield District	3.01
	Rossendale District	0.24
Middlesbrough	Stockton-On-Tees	38.36
	Redcar And Cleveland	32.57
	Middlesbrough	29.07
Nottingham	City Of Nottingham	42.23
	Broxtowe District	16.78
	Gedling District	13.60
	Erewash District	7.85
	Amber Valley District	7.45
	Rushcliffe District	7.17
	Ashfield District	4.92
Portsmouth	City Of Portsmouth	33.75
	Havant District	25.31
	Gosport District	17.67
	Fareham District	16.74
	East Hampshire District	6.33
	Winchester District	0.21
Preston	Preston District	40.40
	South Ribble District	37.72
	Chorley District	21.88
Reading	Wokingham	38.56
	Reading	34.22
	Bracknell Forest	20.45
	West Berkshire	6.76
	South Oxfordshire District	0.01
Sheffield	Sheffield District	74.76
	Rotherham District	25.21
	North East Derbyshire District	0.01
Southampton	City Of Southampton	64.43
	Eastleigh District	30.62
	Test Valley District	4.79
	Winchester District	0.16
Southend-on-Sea	Southend-On-Sea	52.99
	Rochford District	23.69
	Castle Point District	23.32
The Potteries	City Of Stoke-On-Trent	66.42
	Newcastle-Under-Lyme District	25.37
	Staffordshire Moorlands District	4.75
	Stafford District	2.58
	Congleton District	0.87
Tyneside	Newcastle Upon Tyne District	29.05
	Gateshead District	21.94
	North Tyneside District	19.10
	South Tyneside District	15.77
	Sunderland District	10.55
	Chester-Le-Street District	2.94
	Easington District	0.63
	Castle Morpeth District	0.01
Scotland		
Edinburgh	City Of Edinburgh	93.86
	East Lothian	5.84
	Midlothian	0.30

Agglomeration	District Name	Percent of agglomeration area
Glasgow	City Of Glasgow	39.39
	North Lanarkshire	17.07
	Renfrewshire	13.16
	South Lanarkshire	11.58
	East Dunbartonshire	8.37
	East Renfrewshire	6.65
	West Dunbartonshire	3.77
Wales		
Cardiff	Caerdydd - Cardiff	89.14
	Bro Morgannwg - The Vale Of Glamorgan	10.86
Swansea/Neath/Port Talbot	Abertawe - Swansea	56.88
	Castell-Nedd Port Talbot - Neath Port Talbot	43.12
Northern Ireland		
Belfast	Belfast	52.84
	Lisburn	16.05
	Newtownabbey	13.33
	Castlereagh	11.17
	North Down	6.61

Table A2 Districts within the Agglomerations of > 100,000 and < 250,000 persons

Agglomeration	District Name	Percent of agglomeration area
England		
Barnsley	Barnsley District	72.17
	Rotherham District	21.93
	Doncaster District	5.43
	Wakefield District	0.47
Basildon	Basildon District	99.95
	Thurrock	0.05
Blackburn	Blackburn	94.81
	Ribble Valley District	4.05
	Hyndburn District	1.14
Burnley	Burnley District	58.08
	Pendle District	39.28
	Ribble Valley District	2.63
Cambridge	Cambridge District	75.71
	South Cambridgeshire District	24.29
Cheltenham	Cheltenham District	99.08
	Tewkesbury District	0.92
Chesterfield	Chesterfield District	91.60
	North East Derbyshire District	8.01
	Bolsover District	0.39
Crawley	Crawley District	73.46
	Reigate And Banstead District	20.96
	Tandridge District	4.13
	Mole Valley District	0.90
	Horsham District	0.39
	Mid Sussex District	0.16
Derby	City Of Derby	97.01
	South Derbyshire District	1.42
	Amber Valley District	0.94
	Erewash District	0.62
Doncaster	Doncaster District	100.00
Farnborough	Rushmoor District	35.41
	Surrey Heath District	22.08
	Waverley District	18.01
	Hart District	10.97
	Guildford District	7.20
	Bracknell Forest	6.08
	East Hampshire District	0.24
Gillingham	Medway Towns	95.59
	Tonbridge And Malling District	3.00
	Maidstone District	1.16
	Gravesham District	0.25
Gloucester	Gloucester District	78.75
	Tewkesbury District	16.98
	Stroud District	4.28
Grimsby	North East Lincolnshire	100.00
Hastings	Hastings District	60.33
	Rother District	39.67
High Wycombe	Wycombe District	87.76
	Windsor And Maidenhead	6.93
	Chiltern District	5.31
Ipswich	Ipswich District	81.02
	Suffolk Coastal District	15.68
	Babergh District	3.28
	Mid Suffolk District	0.01

Agglomeration	District Name	Percent of agglomeration area
Luton	Luton	74.77
	South Bedfordshire District	25.21
	North Hertfordshire District	0.02
Mansfield	Mansfield District	54.62
	Ashfield District	41.35
	Newark And Sherwood District	2.31
	Gedling District	1.01
	Bolsover District	0.71
Margate	Thanet District	100.00
Milton Keynes	Milton Keynes	99.61
	Aylesbury Vale District	0.39
Northampton	Northampton District	95.97
	Daventry District	4.02
	South Northamptonshire District	0.01
Norwich	Norwich District	59.98
	Broadland District	32.36
	South Norfolk District	7.66
Oxford	Oxford District	89.90
	Vale Of White Horse District	9.36
	South Oxfordshire District	0.69
	Cherwell District	0.05
Peterborough	City Of Peterborough	99.30
	Huntingdonshire District	0.70
Plymouth	City Of Plymouth	98.78
	South Hams District	1.22
Slough	Slough	73.12
	South Bucks District	26.74
	Windsor And Maidenhead	0.13
Southport	Sefton District	97.91
	West Lancashire District	2.09
St Albans	St Albans District	73.61
	Welwyn Hatfield District	25.73
	Hertsmere District	0.66
Sunderland	Sunderland District	97.17
	South Tyneside District	2.83
Swindon	Swindon	99.91
	North Wiltshire District	0.09
Telford	The Wrekin	94.69
	Bridgnorth District	3.30
	Shrewsbury And Atcham District	2.01
Torquay	Torbay	100.00
Warrington	Warrington	100.00
Wigan	Wigan District	70.97
	West Lancashire District	29.02
	St Helens District	0.01
York	York	100.00
Scotland		
Aberdeen	City Of Aberdeen	99.93
	Aberdeenshire	0.07
Dundee	City Of Dundee	88.34
	Angus	10.15
	Perth And Kinross	1.50
Falkirk & Grangemouth	Falkirk	100.00
Wales		
Newport	Casnewydd - Newport	99.99

Appendix 2
Sample Address Point File

Example Address Point Data

OA	ON	BN	SB	BD	TN	PT	PC	XCOORD	YCOORD	SF	CT	CD	RV
APP0AC8V1VD5BFJ020	EASTWOOD COMMERCIAL MOTORS LTD			229-241	TYBURN ROAD	BIRMINGHAM	B24 8NB	4103899	2900704	354	C	19961101	19990219
APKBF58G5UM5CMC0HQ	KWEEN B LTD	2			COMPTON ROAD	BIRMINGHAM	B24 8QA	4101908	2903863	354	I	19961014	19990219
APP0AC8V5VD5BFJ020	LAB TAB			205-211	TYBURN ROAD	BIRMINGHAM	B24 8NB	4102637	2900318	354	I	19961014	19990219
APKBLT8C7UM5CM00VG	MATRE ENGINEERING				COMPTON ROAD	BIRMINGHAM	B24 8QA	4101449	2904160	354	I	19961014	19990219
APP0AC8V6VD5BFJ020	POWDER COATINGS LTD	215			TYBURN ROAD	BIRMINGHAM	B24 8NB	4103177	2900333	354	I	19961014	19990219
APP0AC8V0VD5BFJ020	SCAFFOLD ERECTION	225			TYBURN ROAD	BIRMINGHAM	B24 8NB	4103401	2900456	354	I	19961014	19990219
APD8628C5VB4CLG010	ST. JUDES REST HOME	54			OVAL ROAD	BIRMINGHAM	B24 8PL	4102942	2903836	354	C	19970506	19990219
APKRGD8V5UP4CJG02G	WELFARE CENTRE	86			OVAL ROAD	BIRMINGHAM	B24 8PP	4102332	2902896	354	I	19961014	19990219
APMA7C8G5UX6CHGGBQ			FLAT 2	145-147	MINSTEAD ROAD	BIRMINGHAM	B24 8PR	4100901	2901966	400	I	19980911	19990219
APMA7C8G6UX6CHGGBQ			FLAT 3	145-147	MINSTEAD ROAD	BIRMINGHAM	B24 8PR	4100901	2901966	400	I	19980911	19990219
APMA7C8G7UX6CHGGBQ			FLAT 4	145-147	MINSTEAD ROAD	BIRMINGHAM	B24 8PR	4100901	2901966	400	I	19980911	19990219
APMA7C8G0UX6CHGGBQ			FLAT 5	145-147	MINSTEAD ROAD	BIRMINGHAM	B24 8PR	4100901	2901966	400	I	19980911	19990219
APMA7C8G1UX6CHGGBQ			FLAT 6	145-147	MINSTEAD ROAD	BIRMINGHAM	B24 8PR	4100901	2901966	400	I	19980911	19990219
APMA7C8G2UX6CHGGBQ			FLAT 7	145-147	MINSTEAD ROAD	BIRMINGHAM	B24 8PR	4100901	2901966	400	I	19980911	19990219
APK3628C5UR4BFG010		30			HAWKESYARD ROAD	BIRMINGHAM	B24 8LE	4100087	2900540	354	I	19961014	19990219
APW3628C5UR4BFGG10		32			HAWKESYARD ROAD	BIRMINGHAM	B24 8LE	4100136	2900555	354	I	19961014	19990219

OA - OSAPR (OS Address Point reference)

ON - Organisation Name

BN - Building number

SB - Sub-building number

BD - Building name

TN - Thoroughfare name

PT – Post town name

PC - Postcode

XCOORD - Easting

YCOORD - Northing

SF - Address point status flag

CT - Change type

CD - Change date

RV - RM version