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## **SPATIAL ANALYSIS OF LAND USE STATISTICS**

Submitted by the Department for the Environment, Transport and the Regions, United Kingdom <sup>1</sup>

CONTRIBUTED PAPER

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## **ABSTRACT**

Land Use Change Statistics (LUCS) are the main means of monitoring the Government's aim that 60% of all new housing in England should be built on previously developed land. In order to assess the sustainability of new housing development, it is necessary to measure how much of this land 'recycling' is occurring within urban areas. Until recently, it has not been possible to determine how much of this new housing has been built within existing urban boundaries. The Department for the Environment, Transport and the Regions has developed a set of tools, using Geographical Information Systems, to enable analysis of LUCS within urban areas, and other areas of interest such as Green Belts. This paper also discusses a new project to construct a national database of land use, which will eventually contain the digitised boundaries of every land parcel in England, along with an associated land use identifier.

## **I. BACKGROUND**

1. Land is a finite resource. While some land can only be used for a limited range of purposes, other land can accommodate many potentially competing uses. The amounts of land used for each purpose are constantly changing and the nature and extent of these changes are of vital importance to those developing, implementing or monitoring planning policies. Areas of current policy interest are the proportion of new housing that is on previously developed land; the transfer of agricultural land to housing or other development; and the development of vacant land in urban areas.
2. The Department for the Environment, Transport and the Regions (DETR) has carried out a number of surveys of land use over the last 20 years. These include surveys of derelict land, vacant land, and the countryside. However, these surveys were designed with specific purposes in mind, and are not carried out with sufficient regularity to provide a consistent assessment of the nature of changes in land use. Therefore, in response to demand for information about changes in land use to inform policy makers and others, the Department started to obtain land use change data from The Ordnance Survey (the UK's national mapping agency) in 1985.
3. Comprehensive and consistent information about the total amount of land devoted to different uses is not currently available. The lack of information on the amount of previously developed land, particularly the amount available for residential development, is currently a high profile policy issue. In his statement to the House of Commons on 23rd February 1998, the Deputy Prime Minister, John Prescott said "I have asked my Department to work with English Partnerships and local government to create a national database of land use which will give local authorities reliable information on the amount of recycled land available for housing". Planning minister Richard Caborn announced the start of this project on 19th May. This initiative is discussed at greater length later in this paper.

## II. LAND USE CHANGE STATISTICS

### II.1 Method of data collection

4. Details of changes in land use are recorded for the Department by OS as part of its map revision work in England (Scotland, Wales and Northern Ireland do not fall under the scope of the land use planning responsibilities of DETR). A land use change is recorded when the current land use category of a parcel of land differs from that depicted on the existing OS map. A change is also recorded where there is no change in the appropriate land use category, but a new feature is added, such as a house being demolished and one or more built in its place.

5. The previous and new uses of a parcel of land are each recorded as one of twenty-four land use categories. For the purpose of analysis the land use categories can be grouped into ten land use groups. The groups can in turn be aggregated into two divisions, which are referred to as “urban uses” and “rural uses” as shown in the diagram below. The allocation of a specific category to “urban” or “rural” use is to some extent arbitrary - for example agricultural buildings may be considered an urban use, as might some types of defence land.

#### Land use categories, groups and divisions

##### Urban uses

Group	Category (codes)
<b>Residential</b>	• Residential (R)
	• Institutional and communal accommodation (Q)
<b>Transport and Utilities</b>	• Highways and road transport (H)
	• Transport (other) (T)
	• Utilities (U)
<b>Industry and Commerce</b>	• Industry (I)
	• Offices (J)
	• Retailing (K)
	• Storage and warehousing (S)
<b>Community Services</b>	• Community buildings (C)
	• Leisure and recreational buildings (L)
<b>Vacant</b>	• Vacant land previously developed (V)
	• Derelict land (Z)
	• Urban land not previously developed (X)

##### Rural uses

Group	Category (codes)
<b>Agriculture</b>	• Agricultural land (A)
	• Agricultural buildings (B)
<b>Forestry, open land and water</b>	• Forestry and woodland (F)
	• Rough grassland and bracken (G)
	• Natural and semi-natural land (N)
	• Water (W)
<b>Minerals and landfill</b>	• Minerals (M)
	• Landfill waste disposal (Y)
<b>Outdoor recreation</b>	• Outdoor recreation (O)
<b>Defence</b>	• Defence (D)

6. Ordnance Survey records details of land use change for the Department throughout the year. When OS surveys a site of land use change, the information recorded includes:

- date of the survey;
- the grid reference of the centroid of the site to a resolution of 10 metres;
- the approximate area of the site in hectares;
- the new and previous use of the site, according to the Land Use Classification system;
- the year in which the change in use is judged to have occurred;
- the estimates number of dwellings demolished and built as part of the change

7. Ordnance Survey's main task is to maintain the archive of national survey (mapped) information. The map revision programme is determined by the amount of change taking place on the ground and its relative importance to its customers and the national archive. Consequently change in some areas will be surveyed more quickly than others, but over time all maps covering the country are revised.

8. Detailed analyses of the data, carried out by researchers for the Department in 1994, concluded that for changes to urban uses occurring in a particular year, five years of data collection were necessary to provide reliable estimates. Changes to residential use are recorded more quickly, most within three years of the change occurring. Hence the resulting land use change statistics are best suited to analyses of changes to urban uses and of the recycling of land already in urban uses. However, a new OS programme of rural revision will improve information on change between rural uses.

## II.2 Key Results

9. The main results are expressed in terms of percentages of total change occurring in each year, rather than directly in terms of hectares. Percentages have proven to provide robust statistics after just a few years of land use change recording, whilst the underlying figures for numbers of hectares of land changing use are more affected by the OS map revision programme. In particular, changes that occurred several years ago continue to be recorded, so the hectares figures for earlier years are likely to be higher than for the most recent years, as a longer time has elapsed in which to record the earlier changes. The hectares figures are of course also subject to underlying fluctuations in the level of development activity.

10. Land Use Change Statistics are of increasing interest, and have been used in formulating and monitoring a national target for the percentage of housing that should be built on reused sites. The current target, set earlier this year, is to raise the national proportion of new homes to be built on previously developed land to 60% over the next 10 years. Previous targets have been monitored in terms of the proportion of land changing to residential use that was previously developed. It could also be measured in terms of the proportion of new dwellings on re-used sites. The results for both measures are shown in Table 1. The difference is largely due to the higher density of development (on average, 28 dwellings per hectare) on previously developed land which is mostly in urban areas and, conversely, the lower density of development (22 dwellings per hectare) on greenfield sites.

**Table 1 Re-use of previously developed land for housing**

<b>Year</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>	<b>1991</b>
Percentage of land for new housing that was previously developed	38	37	36	40	42	43	44
Percentage of new dwellings on previously developed land (2)	-	-	-	-	51	50	49
<b>Year</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995(1)</b>	<b>Average 1989-1994</b>		
Percentage of land for new housing that was previously developed	47	48	45	50	45		
Percentage of new dwellings on previously developed land (2)	53	53	50	-	51		

(1) 1995 figure for % by land is provisional and for % by dwellings not yet available

(2) Statistics for dwellings are not available prior to 1989

### **II.3 Refining the Target for Recycling Land**

11. The issue of recycling of land is a prominent one - people refer to the development of 'brownfield' land. This is a much-used term, but not a well-defined one. There are various characteristics of a site that may lead to it being classified as 'brownfield': use; location (within or outside an urban area); dereliction; nature of its previous uses and any contamination. In LUCS terms, we use 'previously developed for urban uses' to define recycling of land, but as mentioned before, the allocation of a land use classification to either an 'urban' or 'rural' category is arbitrary. For example, how should we classify airfields - are they an urban or rural use? It is clear that there is a need to consider these issues further, and the Department will be publishing a discussion document that will consider these issues of definition.

### **II.4 Spatial Analysis**

12. There is a desire to sharpen up some of these targets. "Previously developed land" includes land formerly in "urban uses", according to the LUCS classification, but located in rural areas. Previously developed land is sometimes in remote places where major development may be unsustainable. Therefore, it is becoming increasingly important to measure recycling of land within urban areas.

13. The information recorded by OS does not allow us to evaluate whether the land use change has occurred in an urban area. Therefore it is necessary to link LUCS to another dataset that contains information on the size and location of urban areas. With the increased availability of Geographic Information Systems, it is now easier to link a variety of datasets that are spatially referenced.

14. The Department, along with the Welsh Office and the Office for National Statistics have developed a set of digital boundaries for all urban areas in England and Wales. An urban area is defined as a set of contiguous parcels of 'urban land' (i.e. built-up sites) that extend for 20 hectares or more (separate areas of urban land are linked if less than 50 metres apart), and that contain a minimum population of approximately 1000 persons. A more detailed specification is given in Annex A.

15. The spatial analysis of both datasets was performed in ArcView using a 'point-in-polygon' technique. This process overlays both datasets and then selects those LUCS records whose grid references fall within the boundary of an urban area. These records were then exported back into the main database, and results of land use change within urban areas were produced by running existing retrievals on this subset of data.

16. Table 2 shows the previous uses of land changing to residential use in 1994, by urban/non-urban split. Around 50 per cent of new dwellings were built on previously developed land, 38 per cent in urban areas, and the remaining 12 per cent in rural areas. Similarly, of the 45 per cent of land developed for residential use that was previously developed, 30 per cent was in urban areas and 15 per cent in rural areas. This means that 30 per cent of all previously developed land changing to residential use was in rural areas. In terms of dwellings, 25 per cent of all new houses built on previously developed land were in rural areas. What is of interest is where these changes in rural areas are occurring. The Department has plans to investigate how much of this change is on the urban fringe, within 1km of the urban boundaries.

Table 2 Previous uses of land changing to residential use: 1994

per cent of all uses on all land

	Area in Hectares			Dwellings		
	Non-urban	Urban	All land	Non-urban	Urban	All land
<b>Rural Uses</b>						
Agriculture	32	5	37	26	5	31
Other rural uses	3	3	6	2	3	6
<b>All Rural Uses</b>	35	8	43	28	9	37
<b>Urban Uses</b>						
Residential	4	9	13	2	8	11
Transport & Utilities	0	0	1	0	1	1
Industry & Commerce	1	3	4	1	4	5
Community Services	1	3	3	1	3	4
Vacant: Previously developed	8	16	24	8	22	29
<b>All land previously developed for Urban Uses</b>	15	30	45	12	38	50
Vacant: Not previously developed	6	7	12	6	8	13
<b>All Urban Uses</b>	20	37	57	17	46	63
<b>All Uses</b>	55	45	100	45	55	100

## II.5 Analysis within other areas of interest

17. As well as monitoring how much land use change is occurring in urban areas, the Department is soon to begin analysing land use change within other areas of interest, such as Green Belts, Areas of Outstanding Natural Beauty and National Parks. These designated areas were established to protect the countryside and also rural areas on the edge of urban areas, to reduce urban sprawl. By monitoring how much land is changing to developed uses within these designated areas it is possible to assess their effectiveness. Results from this analysis will be available later in the year.

## III. NATIONAL LAND USE DATABASE

### III.1 Policy 'Drivers'

18. As mentioned previously, the Department is currently working with Ordnance Survey and local government to develop a national database of land use. LUCS are a valuable means of monitoring the amounts of land changing use, but there is a lack of consistent information about the stock of land across all land uses. A particular policy area requiring information is the re-use of land for development, particularly in respect of accommodating household growth. It is also important when setting targets for recycling of land that we take account of what is realistic and achievable, so information is required on the amounts of previously developed land which may be available for development.

19. As well as a national target of 60 per cent of new homes on previously developed land, Regional Planning Conferences have been asked to set regional targets which take account of how much of this land is available. To assist this, the Department is working with others to develop a consistent assessment of previously developed land, and an indication of how much of this may be available for housing and other development. This is seen as the first step towards a

comprehensive National Land Use Database (NLUD) which will cover all land uses and will be based on a digital version of the official Ordnance Survey map which divides England into polygons of different land uses. This database would be updated regularly so as to provide not only a picture of the amounts of land in different uses at particular times but how this changes. This will provide a consistent and defensible information source for assessing the land use effects of planning policies and the land use implications of other DETR concerns including the countryside, the environment and sustainability. The use of the OS digital map base means that other geographical datasets can be related to the land use information.

### **III.2 Methodology**

20. The development of NLUD will be based on a partnership approach. Wherever possible, DETR intends to use existing sources of information and expertise. The majority of information on the stock of land is held by local government; by joining together in a partnership, it will be possible to draw all this information together on a consistent basis. Similarly, we will be drawing on the expertise of organisations such as Ordnance Survey, with many years expertise in the handling of geographic information, and English Partnerships, the DETR's regeneration agency who have experience in assessing the redevelopment potential of land. This approach through partnership is both innovative and mutually beneficial.

21. A number of research projects in recent years have developed and tested options for filling the gap in land use stock information by undertaking a national land use census, but the costs were preventatively high. But recent developments in technology, digital mapping and data handling in local government authorities now provide the opportunity to assemble such a database at much lower cost as a joint development by DETR and the Local Authorities, using Ordnance Survey digital maps as a base. Other data sources such as remote sensing (particularly for rural areas) and private sector sources will be considered for the development of the complete NLUD.

22. Phase 1 of NLUD will involve all 350 local authorities providing information to DETR on the size and location of all previously developed land within their authority, to a specification currently being developed by the partners. In most cases this will build on existing information; some authorities may need to carry out a primary survey to collect this information. Where they are able to do so, digital boundaries of each parcel will also be collected. In order to assess whether any such land is available for development, information will also be sought on issues such as whether the land has any planning permission, proposed use, if derelict, type of dereliction and any contamination. Once validated, this information will allow a consistent national assessment of previously developed land that may be available for housing. Initial results on a subset of sites will be available by the end of the year. Summary results for all sites should be available by March 1999.

23. Phase 2 will progress to populating NLUD with all other land use classes, in accordance with a hierarchical classification system. We shall be developing proposals for how this will be done, incorporating the principle that we will use existing data sources as far as possible, as long as certain quality criteria are met. These proposals may also include scope for the private sector to contribute data.

#### **IV. CONCLUSIONS**

24. Land Use Change Statistics have been a valuable means of assisting policy making within the Department for over 12 years. The new National Land Use Database will consist of a digital map of every parcel of land in England, and by using a GIS will provide a powerful means of analysing patterns in land use, and their relationship with other geographical datasets.

#### **REFERENCES**

1. OPCS, *Key Statistics for Urban Areas: Great Britain*, HMSO, 1984
2. Ordnance Survey, *Urban\_Areas.91, User Manual*, 1994 (mimeo)

## **ANNEX A - DOE/OS Definition of Urban Areas**

A1. As described in the DOE/OPCS urban areas document "...the starting point in the definition of urban areas is the identification of areas with land use which is irreversibly urban in character." (OPCS 1984). The basis of this definition essentially remains the same in the Urban\_Areas.91 data (OS 1994).

A2. Land included as urban (built-up sites) in the 1991 definition comprises:

- i. permanent structures and the land on which they are situated. For this purpose, land is defined as the ground covered by the permanent structure and any ground enclosed by or closely associated with such a structure;
- ii. transportation corridors (roads, railways and canals) which have built-up sites on one or both sides or which link up built-up sites which are less than 50 metres apart;
- iii. transportation features such as railways, motorway service areas and car parks (operational airfields and airports are also included);
- iv. mine buildings (but workings and quarries are to be excluded); and
- v. any areas completely surrounded by built-up areas.

A3. This differs from the 1981 urban definition where mineral workings were included. Areas such as playing fields and golf courses are excluded unless they are completely surrounded by built-up sites as at (v) above.

A4. The prerequisite for the recognition of an urban area is a continuous area of urban land extended for 20 hectares or more. Separate areas of urban land are linked if less than 50 metres apart. Urban areas are a subset of the areas of urban land defined above and included only those areas which contain at least four Enumeration Districts (which equate to a minimum population of approximately 1,000 persons).