

# Changes to Output Areas and Super Output Areas in England and Wales, 2001 to 2011

**November 2012**

Edition No.: **2012 v1**

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**Office for National Statistics**

**2012 v1**

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## Summary

Output areas (OAs) are the lowest geographical level at which census estimates are released. Output areas for England and Wales were created from 2001 Census data. Super output areas (SOAs) were first created in 2004 as aggregations of OAs. Together they are known as 2001 OAs/SOAs and they are the core statistical geographies from which statistics are produced for all higher level geographies.

The 2001 OAs and SOAs were designed to contain approximately equal numbers of the census population and private residential households. They were intended to be stable geographies that would allow reporting of statistics across time on a consistent geographical base. They also had to contain a minimum number of population and households, so that statistics released at that level would not disclose information about any individual person or household. Small populations present in a range of communal establishments, such as armed forces bases, hotels and boarding schools, also contributed to the population count, but not to the household count.

The 2011 Census provided an opportunity to use up-to-date population estimates to consider if any 2001 OAs and SOAs needed to change to reflect these new populations.

After extensive public consultation about how the OAs and SOAs should be maintained using the 2011 Census data, ONS set a maximum limit of 5 per cent for the amount of OA and SOA change between 2001 and 2011, in England and Wales. Changes were only done where:

- There was a significant change in the OA/SOA's population size. If they were now too big in population size, they were split into smaller areas. If their population size had become too small, they were merged with one or more neighbouring areas.
- The local authority containing the OAs/SOAs had changed its boundary since the OAs/SOAs were created, and no longer aligned with the OA/SOA boundary.
- The OAs/SOAs were considered unsuitable for statistical outputs by their local authorities, following consultation and agreement with ONS.

Of the 175,434 output areas created for the 2001 Census, 2.6 per cent have been changed using the 2011 Census population data.

Here is a summary of the changes made.

- After the 2011 Census, there are now 181,408 output areas, 34,753 lower layer super output areas (LSOAs) and 7,201 middle layer super output areas (MSOAs) in England and Wales.
- Around 2.6 per cent of 2001 output areas were changed from the 2011 Census, along with 2.5 per cent of LSOAs, and 2.1 per cent of MSOAs.
- The average number of persons in an OA has increased from 297 in 2001 to 309 in 2011, and the average number of households in an OA from 124 in 2001 to 129 in 2011.
- Of 348 local authorities, 22 had changes to 5 per cent or more of their OAs, 54 had changes to 5 per cent or more of their LSOAs, and 61 had changes to 5 per cent or more of their MSOAs.
- Six local authorities had no changes to any of their OAs, LSOAs or MSOAs.
- A total of 161 OAs and SOAs were changed because they were considered unsuitable for statistical outputs.

## Output Areas and Super Output Areas

Output areas were created for the 2001 Census specifically for the output of census statistics. They were created from 2001 Census data using an automated process, and were designed to:

- be the lowest level geography for publishing census estimates.
- be a geography that would not change, allowing better comparison of statistics over time and between censuses.
- have roughly similar-sized populations.
- be used as a building block that can be used to build statistics for any higher level output geography.
- align with the local authority, ward and parish boundaries current at the time the 2001 OAs were created.
- be built from aggregations of postcodes.
- where possible align to road centrelines and railways.
- group together households that are socially similar, as far as possible.

Output areas were later grouped together to form higher level tiers for statistical reporting, known as super output areas (SOAs). These tiers were designed to allow statistics to be disseminated at the lowest reporting level in the hierarchy that would not risk disclosing information that could identify an individual person or household. A lower layer SOA (LSOA) and middle layer SOA (MSOA) were produced, and an upper layer (USOA) was produced for Wales only, although not by ONS.

The 2001 OAs were built using 2001 Census data to have a consistent population and number of households. To prevent statistical disclosure, each OA had to have a minimum population (100 persons) and number of households (40 households) within it. These are known as the lower threshold values for output areas. The 175,434 output areas that were created had an average 2001 Census population of 297 persons and 124 households.

## Policy for maintaining the 2001 OAs and SOAs

The policy for maintaining the 2001 output areas and super output areas was informed by extensive public consultation. The need to reflect the most current population distribution in the design of the OAs and SOAs was balanced against the strong demand to keep a stable set of OAs and SOAs for time series. The policy was also driven by the Geography Policy for National Statistics which sets out best practice for the production of national and official statistics by geography, to ensure outputs are accurate, consistent and comparable in their use of geography. The policy prescribes that statistical estimates should be produced for the core statistical geographies of OAs and SOAs, and that estimates for all geographies should be built from aggregations of OAs or SOAs. For this reason, OAs and SOAs are referred to as building block geographies.

The main principles of the policy for maintaining the 2001 output areas and super output areas were:

- to maintain the stability of OAs and SOAs between 2001 and 2011.

- to retain a high degree of stability, both at the OA and SOA level, to support analysis between 2001 and 2011.
- to take account of the most significant changes in population.
- to limit changes to 2001 OAs/SOAs to a maximum of 5 per cent across England and Wales.
- to make changes to OAs and SOAs through simple mergers and splits of the existing scheme.
- to change those exceptional 2001 OAs/SOAs considered unfit as a statistical unit, because they contain socially different households.
- to align OAs/SOAs to local authority boundaries that have changed since 2001 OAs were created.
- not to align to ward and parish boundaries that have changed since 2001 OAs were created.

## Using the 2011 Census data to change the 2001 OAs and SOAs

Between 2001 and 2011 the population of England and Wales increased from 52,041,916 to 56,075,900 persons and the number of households from 21,660,839 to 23,366,000. This represents an increase in population of 7.8 per cent and an increase in the number of households of 7.9 per cent.

The 2011 Census populations were allocated to the 2001 OA and SOA geographies to identify those OAs and SOAs whose population or number of households now breached the lower and upper thresholds. These thresholds and targets are in Table 1.

Table 1: Targets and thresholds applied to the OA-LSOA-MSOA hierarchy for 2011

Geography	Population thresholds			Household thresholds		
	Lower	Target	Upper	Lower	Target	Upper
OA	100	312	625	40	125	250
LSOA	1,000	1,500	3,000	400	600	1,200
MSOA	5,000	7,500	15,000	2,000	3,000	6,000

For any of the 2001 OAs or SOAs that were changed using 2011 Census data the objective was for each level of geography to remain within the bounds of a lower and upper threshold for population and households, as well as getting as close as possible to a target population.

The number of OAs, LSOAs and MSOAs has increased between 2001 and 2011 (Table 2). The average (mean) number of persons and households in each OA, LSOA and MSOA has also increased. The 2011 OAs contain an average of 309 (297 in 2001) persons and 129 households (123 in 2001). This increase is in line with the general population increase across the country.

Of the 348 local authorities in England and Wales, six had no changes to OAs, LSOAs or MSOAs after the 2011 Census (Isles of Scilly, Allerdale, Eden, Christchurch, Craven and Worthing).

Table 2: Change to mean population and households between 2001 and 2011 OAs, LSOAs and MSOAs

Level	Total number of geographical units		Difference 2001-2011 <sup>1</sup>		Population			Households		
					Mean <sup>2</sup>		Difference, 2001-2011	Mean <sup>2</sup>		Difference, 2001-2011
					2001	2011 <sup>3</sup>		2001	2011 <sup>3</sup>	
OA	175,434	181,408	5,974	3.4	297	309	12	124	129	5
LSOA	34,378	34,753	375	1.1	1,514	1,614	100	630	672	42
MSOA	7,194	7,201	8	0.1	7,235	7,787	552	3,011	3,245	234

<sup>1</sup> Implies absolute increase in total number of OAs/SOAs between 2001 and 2011

<sup>2</sup> Refer to Table 1 for target populations and household for an individual OA and SOA

<sup>3</sup> Based on census first release estimates (July 2012)

## Why and how the 2001 OAs/SOAs were changed

The 2001 OAs and SOAs were changed only for one of the following reasons:

1. Their population size had changed significantly
2. To improve an OA or SOA's social homogeneity
3. To align with changed local authority boundaries

### 1. Their population size had changed significantly

Most of the changes to the 2001 OAs/SOAs were made because their 2011 Census populations made their population too small or too big. Where the 2011 Census population fell below the set lower population threshold, the 2001 OA/SOA was merged with a neighbour. Merges were always applied where:

- the OA population fell below 100 persons or 40 households.
- the LSOA population fell below 1,000 persons or 400 households.
- the MSOA population fell below 5,000 persons or 2,000 households.

Where the population rose above a set upper threshold the 2001 OA/SOA was split into two or more new OAs/SOAs, depending on the population size needing to be split. Splits were made when:

- the OA population exceeded 625 persons or 250 households.
- the LSOA population exceeded 3,000 persons or 1,200 households.
- the MSOA population exceeded 15,000 persons or 6,000 households.

There were a few exceptional circumstances where splitting an OA or SOA was not possible, so the population remained above this upper population threshold. Splitting and merging whole 2001 OAs/SOAs, rather than building an entirely new set, means that direct comparisons can be easily made between 2001 and 2011 based statistics.

The algorithm to split and merge OAs/SOAs was developed by the University of Southampton as an extension of the work done in 2001 to develop the tool for the creation of OAs. Further details on the algorithm used to split and merge OAs can be found in the journal *Environment and Planning A*<sup>1</sup>.

### How OAs/SOAs were split and merged: an illustration

Figure 1 illustrates some simplified 2001 OAs with their (a) 2001 and (b) 2011 Census population counts given by the black numbers.

Figure 1: 2001 OAs showing their 2001 and 2011 Census populations

(a) 2001 population		(b) 2011 population	
OA1 300	OA2 300	OA1 90	OA2 250
OA3 300	OA4 300	OA3 700	OA4 400

The 2011 population for OA1 has fallen to 90, which is below the lower threshold for an OA (100 persons). Therefore no statistical tables could be released for OA1 as it stands because there is a risk this would disclose information about an individual or household. Where an area's population falls under the lower threshold, it is merged with one or more neighbouring areas so that the merged area's population is above this lower threshold. Tables can then be released for the merged area without risk of disclosure. So OA1 is merged with a suitable neighbouring OA – in this scenario this is OA2. This new feature created from merging OA1 and OA2 becomes a new 2011 OA, and is therefore given a new code – in this case OA5. OA5's boundary is therefore the aggregated boundaries of OA1 and OA2.

The 2011 population of OA3 is 700. This exceeds the upper threshold for an OA, set at 625. So OA3 needs to be split into two or more smaller OAs with roughly equal populations, so that estimates can be released at a lower level than if they had been released for OA3. So OA3 is split into two new 2011 OAs - OA6 and OA7 - each with roughly half the share of OA3's population.

<sup>1</sup> <http://www.envplan.com/epa/fulltext/a43/a43601.pdf>

OA4 has increased its population from 300 to 400, but it is still below the upper population threshold of 625, so there is no need for it to be changed. The result of these modifications to 2001 OA boundaries, resulting from population changes between 2001 and 2011 Censuses, are illustrated in Figure 2.

Figure 2: **2011 OAs resulting from splits and merges of the 2001 OAs using the 2011 Census population**

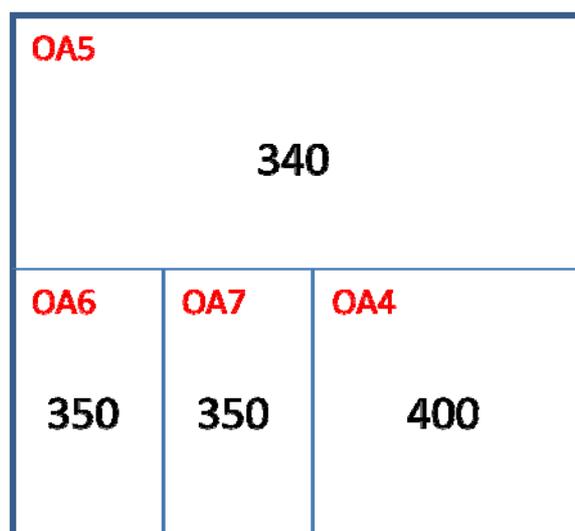


Table 3 summarises the outcome of the above examples in the associated look-up table between 2001 and 2011 OAs. Although this example illustrates OA boundary modifications resulting solely from population changes between censuses, maintenance policy was to also consider the number of private households in each OA. Household thresholds for OAs and SOAs were also predefined (Table 1), and used to assess change within individual OAs, LSOAs and MSOAs. An individual OA or SOA would be maintained if it breached either its upper or lower population or household threshold.

Table 3: **Example look-up between 2001 OAs and 2011 OAs** (based on scenario outlined in figures 1 and 2)

2001 OA	2011 OA	Changed or unchanged?
OA1	OA5	Changed – merged with OA2
OA2	OA5	Changed – merged with OA1
OA3	OA6	Changed – Split into OA6 and OA7
OA3	OA7	Changed – Split into OA6 and OA7
OA4	OA4	Unchanged - population increase but under the upper population threshold

## 2. To improve an OA or SOA's social homogeneity

The 2001 OAs were designed to group together households of roughly similar social types, based on the census variables tenure and accommodation type: an attempt to make OAs as socially homogeneous as possible. However this design constraint was given lower priority in the final design than other constraints, such as the need to align OAs to administrative boundaries, and the aim to create OAs of roughly similar population sizes. This meant that some 2001 OAs were not socially homogeneous, and in exceptional instances this made them unfit for use as a statistical area.

As part of a public consultation in 2009, ONS asked users of OAs/SOAs to submit any instances of OAs and LSOAs they felt were not socially homogeneous, and as a result were of little or no statistical use. An independent panel considered these and they were redesigned if their social homogeneity could be improved. One hundred and sixty one OAs and LSOAs were redesigned to improve their social homogeneity and these were redesigned in advance of the 2011 Census populations being applied. Twenty-one local authorities had OAs/SOAs changed to improve their social homogeneity.

## 3. To align with changed local authority boundaries

Local authorities are the primary geography for census estimates, and are used as a basis for funding and resource allocation. ONS policy was that the 2011 OAs and SOAs should not be split across the 2011 local authority boundaries, to avoid two different local authorities being responsible for populations in different parts of the same OA/SOA. OAs would not align to wards and parishes for 2011 (as they had in 2001) due to the high levels of change in these geographies. OAs were therefore realigned only to local authority boundaries where these have changed since the 2001 OAs were created. Only three Welsh local authorities were affected by boundary change during this period.

## OA and SOA changes: comparisons between 2001 and 2011.

The 175,434 OAs created after the 2001 Census were maintained using 2011 Census data, resulting in the following maintenance statistics to the original OAs:

- **Unchanged** - A total of 170,865 (97.4%) of the 2001 OAs remain unchanged. This means that direct comparisons can be made between these 2001 and 2011 OAs.
- **Split** - 3,239 (1.8%) 2001 OAs have been split into two or more 2011 OAs. This means direct comparisons can be made between estimates for the single 2001 OA and the estimates of the two or more 2011 OAs, aggregated together.
- **Merged** - 1,115 (0.6%) 2001 OAs have been merged with one or more other 2001 OAs. This means direct comparisons can be made between the estimates from the multiple 2001 OAs, aggregated together, and the single 2011 OAs estimates. Each original 2001 OA that was merged to other OAs into a new 2011 OA was counted towards the merge statistics (e.g. three 2001 OAs merged into one 2011 OA counted as three affected OAs).

- **Complex correction** - 215 (0.1%) of 2001 OAs have been redesigned because of local authority boundary changes, and/or to improve their social homogeneity. These can't be easily mapped to equivalent 2011 OAs, as they may also have been subsequently changed because of population changes, or may have been split and merged at different processing stages. Therefore like-for-like comparisons of these 2001 and 2011 OAs and SOAs are not possible.

## Summary of changes to Output Areas and Super Output Areas, 2001 to 2011, by local authority

Twenty local authorities had 5 per cent or more of their total OAs and SOAs changed, and are listed in Table 4.

The percentage of 2001 OAs and SOAs that have changed using 2011 Census data, across all 348 local authorities in England and Wales, is 2.6 per cent. The City of London is the local authority with most percentage change for its total OAs and SOAs, with 28.9 per cent of its OAs and SOAs (10 OAs and one LSOA) changed. Forest Heath is the only other local authority with over 10 per cent of its OAs and SOAs changed (12.4 per cent).

Table 4: Local authorities with 5 per cent or more of their 2001 OAs and SOAs changed

Area names	Number of OAs and SOAs changed	% of OAs and SOAs changed
City of London	11	28.9
Forest Heath	29	12.4
Tower Hamlets	79	8.5
Hackney	72	7.8
Liverpool	143	7.4
Redcar and Cleveland UA	41	7.2
Greenwich	67	6.7
Powys / Powys	36	6.7
Manchester	119	6.4
Southwark	68	6.2
Richmondshire	13	6.2
Westminster	56	6.0
East Cambridgeshire	19	5.8
Newham	59	5.8
Hartlepool UA	21	5.5
Nottingham UA	64	5.3
North Dorset	14	5.1
Colchester	36	5.1
Gosport	17	5.1
Cambridge	23	5.1

Output Areas were originally designed and promoted as the standard stable building block for creating statistics for all other higher geographies. Of the 348 local authorities in England and Wales, 22 had 5 per cent or more of their OAs changed. The City of London (27.8 per cent of OAs changed), Tower Hamlets (10.8 per cent) and Forest Heath (10.2 per cent) were the only local authorities that had more than 10 per cent of their OAs changed (Figure 3).

A complete list of all the changes to OAs and SOAs, by each local authority in England and Wales, is available in a separate table (2001-2011 OA/SOA change statistics may be found [here](#)).

## Percentage of 2001 OAs changed as a result of 2011 Census, by local authority district

