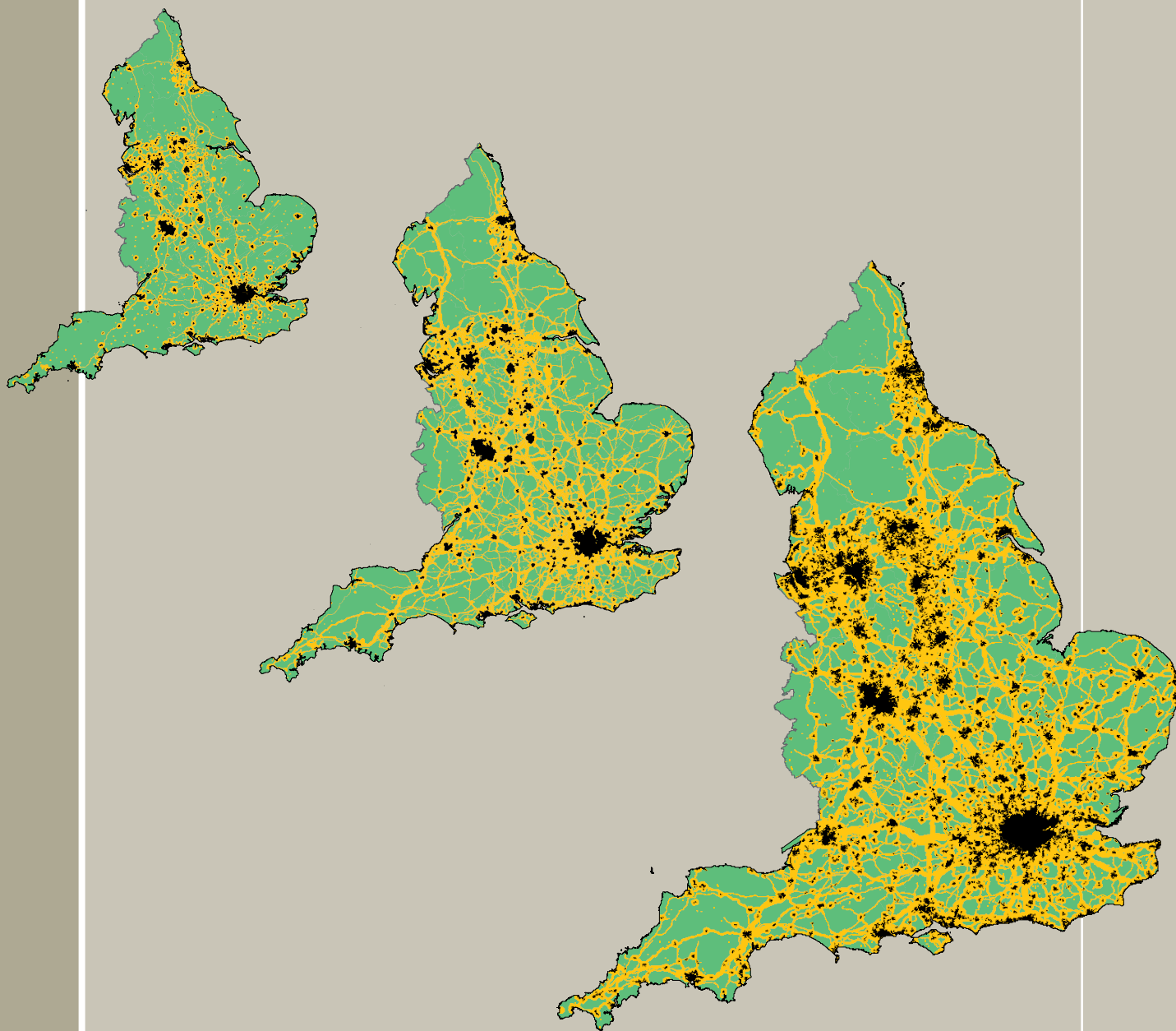


August 2007

Developing an Intrusion Map of England



**Prepared for CPRE
by
Land Use Consultants**

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I. INTRODUCTION

CONTEXT

- I.1. In 1995 the Council for the Protection of Rural England, now the Campaign to Protect Rural England (CPRE) and the then Countryside Commission first published a national set of 'Tranquil Area' maps. These had enormous impact at the time and brought the loss of tranquillity to national attention. These maps, showing intrusions into the countryside by features that had an impact both visually and audibly, such as roads, railways, and urban areas, were based on a methodology first developed by Simon Rendel of ASH Consulting in 1991. The impetus for the development of the methodology was a major Department of Transport highways project, and the output was a tranquil areas map for parts of Hertfordshire, Bedfordshire and Essex which would potentially be affected by the development of a new transport corridor. Following this work, which was groundbreaking at the time, the methodology was developed further and a national map of tranquil areas in England was produced in 1995 by ASH Consulting, published as the regional tranquil areas maps in October 1995 by CPRE and the Countryside Agency. These maps provided a snap shot of Tranquil Areas in the early 1990s and, for comparison, in the early 1960s following the same methodology.
- I.2. These regional maps of tranquil areas played a vital role in raising political awareness of tranquillity. Nevertheless, over time the approach that lay behind the maps was subject to criticism. The main thrust of this criticism was that the approach:
 - did not take local perceptions into account
 - only considered detractors from tranquillity, ignoring factors that contribute to tranquillity
- I.3. Subsequent work has been carried out by CPRE and Natural England, in conjunction with Northumbria and Newcastle Universities and others, to refine the approach to tranquillity mapping, leading to the publication of a new national map of tranquillity in 2006¹. This newer methodology builds strongly on consultation methods to determine what people consider to be 'tranquil' and 'non-tranquil' rather than the objective 'expert judgement' used in the original 1995 Tranquil Areas maps.
- I.4. To avoid confusion with the new national tranquillity maps, the Tranquil Area maps published in 1995 will now be termed 'Intrusion Maps' to reflect the fact that they map distances to various visual and audible intrusions in the landscape.

¹ The pilot work was co-funded by North East Regional Assembly, Northumberland Strategic Partnership, Northumberland National Park Authority and Durham County Council. The project was carried out by The Centre for Environmental and Spatial Analysis and Participatory Evaluation and Appraisal in Newcastle upon Tyne (PEANuT), both at Northumbria University and The Landscape Research Group, University of Newcastle. The national study was funded by the Esmée Fairbairn foundation and supported by the Countryside Agency, subsequently Natural England.

THIS STUDY

- I.5. Land Use Consultants (LUC) was asked to develop new national Intrusion Maps (based on the 1995 Tranquil Areas maps) for the present day, in order to compare the amount of land affected by such intrusions in the early 1960s, the early 1990s, and the present day. Although the earlier Intrusion Maps were subject to some criticism, as mentioned above, they remain a valid and robust way of identifying the area of land likely to be affected by intrusions into the otherwise undisturbed countryside. Critically, they also allow a comparison to be made over the last 40 plus years, using a consistent method of analysis.
- I.6. As part of this exercise the 1960s and 1990s maps themselves have not been re-created from raw data, but scanned and georeferenced, in order to calculate the area affected by intrusions on these original maps. Some re-working of these earlier maps was carried out in order to reclassify the semi-tranquil category, although the maps themselves were not materially altered. This process is described in **paragraph 2.23**, and the scanning and georeferencing process is described at the end of **Section 2**. The main challenge of this work has therefore been to ensure that the approach adopted for the 2007 Intrusion Map follows as closely as possible the methodology used to generate the original maps, given that precise details of the methodology used are no longer available.
- I.7. In preparing the 2007 map we have developed a comprehensive methodology which is described in **Section 2**, detailing the thresholds, data sets and processes used, to allow the map to be re-produced again in the future, to continue the process of comparison over time.

2. METHODOLOGY

- 2.1. The work undertaken by LUC in preparing the 2007 Intrusion Map has been based on two main data sources:
1. the national and regional maps of tranquil areas developed by ASH Consulting and published by CPRE and the Countryside Commission in October 1995 (hereafter referred to as the 1995 Tranquil Area maps).
 2. a methodological report drawn up in 1994 by ASH Consulting: Tranquil Areas - The Concept, Methodology and Potential: A report to Countryside Commission and CPRE by the ASH Consulting Group, December 1994 (hereafter referred to as the 1994 report).
- 2.2. Neither of these sources contain information on the data sets used to map the intrusions. We therefore used these sources to identify the features to be mapped and the distance thresholds at which to map them, and then used the most up to date national data sets available for each feature, from established authoritative sources.

THE 1995 REGIONAL TRANQUIL AREA MAPS

- 2.3. As already identified, the Regional Tranquil Area maps of 1995 plotted tranquil areas for two time frames: the early 1990s and the early 1960s to provide a comparator. Both were plotted using the same methodology.
- 2.4. The text on the back of the 1995 Tranquil Area maps states that, tranquil areas are:
- “places which are sufficiently far away from the **visual or noise** intrusion of development or traffic to be considered unspoilt by urban influences”.*
- 2.5. These areas were determined by distances from various disturbing factors, with tranquil areas defined as those that lay:
- 4km from the largest power stations
 - 3km from the most highly trafficked roads such as the M1/M6; from large towns (e.g. towns the size of Leicester and larger); and from major industrial areas
 - 2km from most other motorways and major trunk roads such as the M4 and A1 and from the edge of smaller towns
 - 1km from medium disturbance roads i.e. roads that are difficult to cross at peak times (taken to be roughly equivalent to greater than 10,000 vehicles per day) and some main line railways
 - beyond military and civil airfield/airport noise lozenges as defined by published noise data (where available) and beyond very extensive open cast mining.

- 3.3. These regional tranquil areas were drawn with a minimum radius of 1km to eliminate local effects. These therefore were very clearly regional Tranquil Areas.
- 3.4. Within the Tranquil Areas a further set of factors were identified as creating lower levels of disturbance affecting areas 1km wide. These were:
- low disturbance roads
 - 400KV and 275KV power lines
 - some well-trafficked railways.
- 2.6. Additionally, this lower disturbance category included:
- large mining or processing operations
 - groups of pylons or masts
 - settlements greater than 2,500 in population
 - some half-abandoned airfields
 - most windpower developments
- 2.7. This lower disturbance or 'semi-tranquil' category divided into two sub-categories:
- vulnerable areas (which were the road corridors themselves falling within the low disturbance category, as traffic levels were projected to increase and growth in traffic levels would cause further loss of tranquillity)
 - less vulnerable areas (all other factors within the lower disturbance category)
- 2.8. On this basis, the regional maps that were prepared for the early 1990s and the early 1960s identified *Tranquil Areas* (that met the first set of criteria) and *Semi-tranquil Areas* (ie those areas that fell within the influence of factors creating a lower level of disturbance).
- 2.9. An important issue in reproducing this approach for the present day (2007) is that for a number of criteria there is insufficient information to identify exactly how some thresholds were defined. For example,
- what defines the 'largest power stations'?
 - what differentiates 'some main line railways' from 'some well-trafficked railways'?
 - how were 'large mining or processing operations' defined?
- 2.10. If any accompanying information was produced with the 1995 maps to answer these and other similar questions, it is no longer available. In trying to identify criteria and thresholds consistent with the 1995 maps, we have therefore also considered the 1994 report written by ASH Consulting, which is described below.

TRANQUIL AREAS: 1994 REPORT

- 2.11. 'Tranquil Areas: The Concept, Methodology and Potential' a report to the Countryside Commission & CPRE by the ASH Consulting Group (1994), pre-dates the publication of the 1995 Tranquil Area maps. The report was written following the creation of tranquillity maps in 1993 for the South East region and the North East region.
- 2.12. The brief for the report was to provide "*a thorough documenting of the concept and its origins, scope and limitations*", before the completion of a national tranquillity map for England.
- 2.13. Table 2.1 of the 1994 report sets out the distance buffers that had been used for the creation of the two initial regional maps. This table has been recreated in **Table I**, below.

Table I: Summary of thresholds used in 1993 pilot maps (recreated from Table 2.1 of 1994 report)

Source		Disturbance distance (km)
Noise Disturbance		
<u>Roads</u>	e.g. north of London	
very high	M1, M25	3.0
high	A1, M11	2.0
medium	A5, A10	1.0
low	Other 'A' and 'B' roads	0.5*
<u>Railways</u>		
Mainline		0.5*
<u>Airports</u>		
International	distance from 35NNI contour	1.0
Military	standard lozenge:	
	along flightpath	24.0
	lateral	5.0
Visual/Psychological Disturbance		
<u>Built up areas</u>	greater than 4000 population	2.0
<u>Mineral Extraction</u>	(large scale/intrusive with high structures)	2.0
<u>Electrical equipment</u>		
power stations		3.0 4.5*
400kV and 275kV overhead lines		0.5*
grid stations		1.0*

* = partial disturbance creating semi-tranquil zones

- 2.14. Section 4 of the 1994 report sets out a number of possible refinements to the criteria and thresholds used for the development of a national map of tranquillity. These are listed below:
- the weighting of urbanisation, including lighting, against road disturbances should be altered;

- the report asserts that a consensus existed that some urbanisation effects were underweighted when compared with roads. Following field validation it proposed a revised banding of settlement types and disturbance distances, as set out in **Table 2** below.

Table 2: Revised settlement banding (taken from section 4 of 1994 report)

Type of settlement	Population band	Absolute disturbance distance	Partial disturbance distance
metropolitan	above 500,000	0-2km	2-5km
large towns	75,000 – 500,000	0-2km	2-4km
medium towns	15,000 – 75,000	0-2km	2-3km
small towns	4,000 – 15,000	0-2km	1-2km
large villages	2,500 – 4,000	NA	0-1km

- the disturbance distances for roads should be reduced slightly (with part of the previous disturbance distance becoming a partial disturbance);
- the thresholds adopted for airports and airfields need to be increased especially in the direction of the flight path,
 - the report asserts that a consensus existed to increase the thresholds for airports and airfields, especially in the direction of the flight path, and that it was also sensible to use extrapolated Leq data wherever possible. Accordingly, it suggests thresholds should be set to allow for at least a 5:1 factor in the direction of the flightpath. The contour to be used would be 57 Leq where available and 70 Leq elsewhere using a suitable conversion factor.
- potentially to class some railways as disturbing tranquillity absolutely, depending on the availability of timetable information.

2.15. Finally, the report states that:

“other matters referred to in this section, low-flying aircraft zones, motor circuits and power boating will need to be judged on a case by case basis. As an aid to describing noise effects the following adjectives will be used:

- if the noise source has substantial effects, ie causes regular or persistent annoyance to users of the countryside for recreation it will be said to remove all Tranquillity*
- if the noise source has significant effects it will be said to remove Tranquillity partially.”*

2.16. Section 5 of the 1994 report considers a number of visual elements which may also need to be taken into consideration, the list (in addition to elements previously dealt with) is set out below:

- (a) mineral extraction
- (b) airfields as visual intrusion
- (c) racecourses
- (d) wind farms
- (e) dish aerials
- (f) transmission towers and other masts
- (g) derelict land
- (h) glasshouses
- (i) rural car parks and lorry parks
- (j) golf courses and golf driving ranges
- (k) coastline visual intrusion not picked up under other criteria, especially caravan parks and skyline development
- (l) areas where no one feature would infringe Tranquillity but the combination of various intrusive elements or, say, a mosaic of small semi-industrial settlements would have an equivalent effect
- (m) waste incinerators
- (n) agricultural complexes, especially grain silos
- (o) smaller roads and isolated roundabouts which are lit.

2.17. Finally, Section 8 of the 1994 report sets out some conclusions and recommendations, and puts forward some more elaborate thresholds which represent the maximum degree of elaboration recommended. The suggestions extend the concept of the semi-tranquil zones to all categories of feature. Table 8.1 of the 1994 report sets out these thresholds, this table is reproduced as **Table 3** below, although it is evident that a large number of recommendations in terms of the more refined thresholds were not taken forward.

Table 3: More elaborate thresholds recommended (taken from Table 8.1 of 1994 report)

Source		Disturbance distance (km)	
		<i>Loss of tranquillity</i>	
		Absolute	Partial
Noise Disturbance			
<u>Roads</u>	e.g. north of London	from centreline	
very high	M1, M25	2.0	3.0

high	AI, M11	1.0	2.0
medium	A5, A10	0.5	1.0
			(2.0)*
low	Other 'A' and 'B' roads		0.5
			(2.0)*
(2.0) = distance for lit road or junction			
Railways			
High frequency		0.5	1.0
Medium frequency			
Airports			
distance from 57 Leq contour			
Or () = distance from 70 Leq contour if 57 LEQ			
unavailable			
	along flightpath	5.0	7.5
		(7.5)	(10.0)
	lateral	1.0	1.5
		(1.5)	(2.0)
Other			
low-flying aircraft, motor circuits, power boating max:		from edge	
		2.0	3.0
Visual/Psychological Disturbance			
Built up areas	e.g.	from edge	
metropolitan	Liverpool	2.0km	3.5km
large towns	Leicester, Oxford	2.0km	3.0km
medium towns	Salisbury	2.0km	2.5km
small towns	Baldock	1.0km	1.5km
large villages	Woodstock	-	1 km
industrial areas:	Fawley	max:	2.0 3.0
Electrical equipment			
major power stations		from centre(line)	
	with cooling towers	3.0	4.5
	marine cooled	2.0	30
	nuclear	1.0	2.0
grid stations			1.0
400kV and 275kV overhead lines			0.5
Other			
mineral extraction		max:	from edge
airfields, racecourses,		2.0	3.0
windfarms, caravan parks		max:	1.0 2.0
masts		max:	2.0
dish aerials, derelict land, glasshouses		max:	1.0
rural carparks, golfcourses, etc.	exceptionally:		0.5

- 2.18. With all of the recommendations in Sections 4, 5 and 8 of the 1994 report, there is no clear trail to identify which were taken forward to the national mapping and which

were rejected. On comparison with the 1995 maps it is clear that some recommendations were partially adopted, but that many were not.

- 2.19. The final paragraph of the 1994 report sets out that:

“All things considered it is perhaps best not to be too prescriptive about what to include or not include in visual disturbance – some abandoned mining areas are picturesque, others are depressing and detract significantly or even substantially from Tranquillity. However there will be value in constantly comparing with other criteria, especially that for pylon lines and to consider the appropriate epithet – significant, psychologically insistent, substantial, dominating etc before making a judgement.”

- 2.20. This suggests that **some of the data on the final maps may have been the result of professional judgement on an individual feature by feature basis.** Although this may have strengthened the 1960s and 1990s maps, it adds considerable complexity to re-producing the maps for the present day.
- 2.21. To create the 2007 map we have therefore relied on the criteria from the 1995 maps, but supplemented where necessary with data from the 1994 report to clarify the criteria used. The 1995 map criteria were considered the primary resource, and the 1994 report was used to establish detailed thresholds and criteria. For each type of feature considered, we also checked the original maps, to see if the conclusions reached could be ground-truthed on these maps. Where discrepancies occurred, the most cautious approach was taken; the result of this being that the level of intrusion presented on the 2007 map is likely to be an underestimate when compared to the earlier maps. We have recorded all criteria, thresholds and data sets used in the following section, with the aim of enabling the map to be re-created readily at some point in the future.

CREATING THE 2007 INTRUSION MAP

- 2.22. Each data set contributing to the 2007 map is detailed below, together with a detailed methodology of how the data was processed.
- 2.23. One major methodological change in the production of these maps, and the classification of the earlier maps has been the decision to re-classify all areas which were termed semi-tranquil (i.e. vulnerable and less vulnerable areas) as areas disturbed by noise and visual intrusion. Given that the distance buffers for these features are much lower (i.e. 0.5km in the case of most features) it has been determined that it is more realistic to classify these as disturbed areas, on the grounds that their lesser impact is already provided for in terms of the lower distance buffers. The one exception to this is the military airfields. Extremely large lozenges of semi-tranquil areas were produced for these on the 1995 maps (of roughly 40km x 5km in total length/width), surrounding a completely non-tranquil lozenge of a smaller size (roughly 14km x 2km in total length/width). A review of the earlier methodology has revealed no detailed rationale for the 40km lozenges and it has therefore been decided to re-classify these as undisturbed areas. Whilst it is impossible to give precision to distance thresholds from military airfields it is recognised that military aircraft can frequently have a far wider impact than illustrated by lozenges, especially in the case of low flying areas. There is potentially further

work required to give precision to the boundaries used for military airfields, and it is envisaged that each may be unique to the airfield, and the area covered by flights from each base.

- 2.24. **It is important to note that these changes have been applied consistently to all three maps (the 1960s, the 1990s and the 2007 maps), and therefore the comparisons of maps in terms of disturbed area remain valid.**
- 2.25. The following section sets out, for each class of feature, the information from the 1995 maps and from the 1994 report. A conclusion is reached regarding the thresholds to be used for each feature in order to re-create the 1995 maps as accurately as possible. The data sets used and methodological approach is then set out for each feature. **Table 9** on page 20 summarises this work, and shows the final features, thresholds and data sets.

Roads

Defining the thresholds

- 2.26. The 1995 maps state that tranquil areas are:
- 3km from the most highly trafficked roads such as the M1/M6
 - 2km from most other motorways and major trunk roads such as the M4 and A1
 - 1km from medium disturbance roads i.e. roads which are difficult to cross in peak hours (taken to be roughly equivalent to greater than 10,000 vehicles per day)
- 2.27. Additionally, a low disturbance area (classified as vulnerable), is identified as a 1km wide corridor around low disturbance roads.
- 2.28. The 1994 report states that the original pilot regional maps for the South East and the North East were developed from the following criteria and buffers:

Table 4: Road thresholds from pilot maps (taken from 1994 report, table 2.2)

Average daily traffic flow in both directions	Examples	Assumed disturbance distance from centreline	
		to edge of Tranquil zone (absolute loss of Tranquillity)	within Tranquil zone (partial loss of Tranquillity: i.e. semi-Tranquil)
Above 75,000	M1, most of M25	3km	
25,000 – 75,000	most motorways/trunk roads	2km	
10,000 – 25,000	many A class roads	1km	
5,000 – 10,000	many B class roads	no absolute loss	½ km

		of Tranquillity	
Below 5,000			no partial loss of tranquillity

- 2.29. The data between the map and the report correspond, so we have taken these values directly to produce the 2007 map.

Developing the data

- 2.30. GIS data: Ordnance Survey Strategi 2006.
- 2.31. Road traffic: Annual Average Daily Traffic Flows, GB National Road Traffic Survey, DfT (2005).
- 2.32. Process: The Annual Average Daily Traffic Flows (AADF) data set provides estimated traffic flows on every link of the 'A' road and motorway network in Great Britain. The data is derived from a combination of automatic traffic counters and manual traffic counts. The data set provides:
- Road Name
 - Grid reference of site at count point (in British National Grid coordinates)
 - The total length of the network road link
 - Year of the last traffic count
 - The AADF of all motor vehicles combined.
- 2.33. It is important to note that this data set contains traffic flows only for A roads and motorways, and not for any B roads or minor roads. Data on traffic levels for these lower class roads is collated at County Council or Unitary Authority level, and collection of data from all these authorities was not possible within the scope of this study. However, a brief investigation into the road traffic levels within two Counties (Surrey and Hertfordshire) showed that a number of B roads or minor roads reach the 5,000 AADF threshold used within the maps, as shown in **Table 5**. **It is therefore clear that the level of intrusion on the 2007 map due to roads is under-represented.**

Table 5: Numbers of B roads and minor roads reaching intrusion thresholds from sample counties

County	Number of B roads or minor roads within each class		
	Under 5,000	5,000 – 10,000	Over 10,000
Surrey	5	15	10
Hertfordshire	22	42	46

- 2.34. As the AADF data set is point based it was necessary to attribute information from the points to the line data available from OS Strategi. This was done through:
- buffering each point by half of the distance of the total length field
 - buffering the roads by a nominal 4m
 - combining both data sets, so that the each area of the road polygon had information about the point buffer that overlaid it
 - comparing the road names information between the road buffer data and the point buffer data, and removing any polygons where these were not equal (i.e. where the point buffer overlapped a road buffer, but for the incorrect road)
 - attributing sections of the original Strategi Roads data set with the information from the combined buffer data set.
- 2.35. The output at this stage was: 72,701 sections of road attributed with AADF data, 1772 sections of road without any attribute data (including Scotland and Wales).
- 2.36. To attribute the remaining stretches of road that had not been covered by the point buffers, the roads adjoining to the start and finish of each section were compared. If both sections fell into the same road class, the road in between was also attributed with the same class. Where the two road sections differed in class, the road in between was attributed with the lower of the two classes in order to provide the most cautious outcome in terms of the area intruded upon. Finally, a process of visual inspection was used to check the final road data set, and some manual adjustments were made to roads which were below the minimum threshold but which joined two roads with higher traffic levels.

Road classes and buffer distances

- 2.37. The roads were grouped into the final classes as set out in **Table 6**.

Table 6: Road classes and disturbance distances (2007 mapping)

Annual Average Daily Traffic Flow	Example of roads	Disturbance Distance (km)
Over 75,000	Most major motorways (M25, M1, M6) and some A roads (e.g. A406, A580)	3km
25,000 – 75,000	Some sections of motorways (e.g. M6 north of Preston, M5 through Somerset and Devon) and many urban A roads (e.g. A184 in Durham, A24 in West Sussex)	2km
10,000 – 25,000	Many urban A roads (e.g. within London and Birmingham) and some rural A roads (e.g. A30 between	1km

	Exeter and Bodmin, much of the A259 along the South Coast)*	
5,000 – 10,000	Many rural A roads (e.g. the A591 between Ambleside and Keswick in the Lake District, and the A354 from Salisbury to Dorchester).*	0.5km
Below 5,000	Small stretches of minor A roads such as the A5012 at Matlock and the A631 in the Lincolnshire Roads.*	no loss of tranquillity

* note that as no B roads were included in the analysis it is not possible to include a description of the types of B roads that would fall into these categories.

Railways

Defining the thresholds

- 2.38. The 1995 maps state that tranquil areas are:
- 1km from some main line railways,
- and that semi-tranquil areas are created
- 0.5km from some well-trafficked railways
- 2.39. The 1994 report assumes that no railways have more than a partial effect on tranquillity, and that mainline railways partially disturb tranquillity over a 1km band (i.e. a 0.5km radius) within tranquil areas. However, Section 4 of the report suggests that it may be appropriate to class some railways as disturbing tranquillity absolutely, on the basis of traffic measurements, which it suggests may be obtained via passenger timetables. Section 8 of the 1994 report concludes that high frequency railway lines should have a 0.5km buffer zone of absolute loss of tranquillity, and a 1km buffer with a partial loss of tranquillity.
- 2.40. Given the contrasting information in the two sources, and the lack of definition in both as to what threshold could be used to distinguish the most heavily trafficked railways from others, it was decided to use a buffer zone of just 0.5km for all mainline railways. This is to ensure that any judgements are erring on the side of caution, so that the relative degree of intrusions in the present day is not overstated in comparison with the previous two maps. **The result of this is that the impact of railways may be comparatively understated in the 2007 map.**

Developing the data

- 2.41. GIS Data: Ordnance Survey Strategi 2006, combined with a map produced by National Rail showing 'Principal Routes' and 'Other selected routes'.
- 2.42. The OS Strategi Railways data was compared with the National Rail information to identify all Principal Routes. Due to the nature of the Strategi data set, rail lines were

merged into continuous polylines to enable the entire length of line to be attributed as Principal Routes and Other selected routes.

- 2.43. All Principal Routes (i.e. main line routes) were then buffered by 0.5km, branch lines or 'other selected routes' were not buffered.

Airports

Defining the thresholds

- 2.44. The 1995 maps state that tranquil areas are:
- beyond military and civil airfield/airport noise lozenges as defined by published noise data (where available)
- 2.45. The 1994 report states that an absolute loss of tranquillity occurs:
- up to 1km outside the 35NNI contour for civil airports
 - within a standard 'lozenge' 24km x 5km for military airfields which have jet squadrons
- 2.46. Measurements from the 1995 maps conclude that the military noise lozenge areas are actually slightly variable, and that values are also given within the two categories of non tranquil and semi-tranquil. These are approximately:

	Disturbed area (non-tranquil)	Semi-disturbed area (semi-tranquil / less vulnerable areas)
1960s	7km x 1.25km	19km x 2.5km
1990s	7 – 7.5km x 1km	21km x 3km

- 2.47. The distances given are the lengths of the semi-major axis and the semi-minor axis, i.e. half the total length and width of the full ellipse.
- 2.48. On this basis, it was decided that:
- civil airports would be defined as disturbed for 1km beyond the 57LEQ contour (which corresponds broadly with the 35NNI contour value).
 - military airfields would be defined as disturbed in a 7 x 1km lozenge, in the direction of the runway. As with other decisions, we have erred on the side of under-representing the impact of intrusions on the 2007 map.

Developing the data

- 2.49. Data on civil airport noise contours is available through the Civil Aviation Authority. For this project, this data was collected by Helen Dunsford at the University of Northumbria. This paper based information showed the LEQ and/or NNI contours

for major airports, and the data was digitised into GIS by the University of Northumbria.

- 2.50. Five airports had available data on the 57 LEQ contour, these were: London Gatwick, London Heathrow, London Luton, London Stansted and Nottingham East Midlands airports.
- 2.51. The 57 LEQ was estimated for the remaining thirty-four airports². For all the civil airports, a 1km buffer was produced around the 57 LEQ contour (both real and estimated).
- 2.52. Data on military airfields with jet squadrons was provided from the MOD to Northumbria University, and was based on a paper map, supplemented by verbal communication.
- 2.53. For these military airfields a 24km x 5km lozenge was produced (measuring approximately 48km x 10 km in total length and width) by the University of Northumbria. To correspond with the agreed thresholds for this project, this data was then converted back to centre points, and new lozenges created, in the same direction as the original lozenges, but at the revised size of 7km x 1km (or 14km x 2km for the whole length / width).

Built up areas

Defining the thresholds

- 2.54. The 1995 maps state that tranquil areas are:
 - 3km from large towns (e.g. towns the size of Leicester and larger);
 - 2km from the edge of smaller towns;and that semi-tranquil areas are defined within:
 - 0.5km from settlements greater than 2,500 in population.
- 2.55. The 1994 report states that tranquil areas are:
 - 2km from built up areas greater than 4,000 population,but also sets out some revised bandings of settlement sizes and threshold distances in section 4, as shown in **Table 2** of this report.

² These thirty-four airports are: Isles of Scilly (St Marys), Treco Heliport, Lands End (St Just) Aerodrome, Penzance Heliport, Plymouth City, Newquay St Mawgan, Sandown (Isle of Wight), Exeter, Bournemouth International, Shoreham, Southampton International, Lydd (London-Ashford), Biggin Hill, Bristol International, London Manston, London City, London Southend, Gloucestershire, London Stansted, Cambridge, Coventry, Birmingham International, Norwich, Hawarden, Liverpool John Lennon, Manchester, Robin Hood (Doncaster), Humberside, Blackpool, Leeds, Walney Island (Barrow in Furness), Middleton St George, Carlisle and Newcastle International.

- 2.56. More elaborate thresholds are suggested in Section 8 of the 1994 report, as set out in **Table 3** of this report but it would appear from the maps that these more elaborate thresholds were not used.
- 2.57. Due to differences in the 1995 maps and 1994 report, we needed to establish the size categories of the towns specified in the 1995 maps to use as the basis for the revised map. This was carried out as follows:

- 3km from large towns (e.g. towns the size of Leicester and larger)

In 1991, Leicester Urban Area had a population of 416,601, and Leicester City itself had a population of 318,518³, in 1961, Leicester had a population of 273,470⁴. These numbers would suggest that it was placed in the 'large towns category', of urban areas above 270,000. Although this doesn't correspond directly with the categories in the 1994 report, this figure is the closest estimate we are able to provide, erring on the side of caution. We have therefore taken large towns to be those with populations greater than 270,000.

- 2km from the edge of smaller towns

Smaller towns would therefore have a population less than 270,000, and from the 1994 report it seems likely that the lower cut-off for these towns was 4,000 people. Salisbury had a population of 35,492 in 1961, and Baldock a population of 6,764. We have therefore taken smaller towns to be those between 4,000 and 270,000 population.

- 0.5km from settlements greater than 2,500 in population.

These smallest settlements would therefore be between 2,500 and 4,000.

Developing the data

- 2.58. As detailed above, the following size categories and corresponding disturbance distances have been used:

Table 7: Settlement sizes and disturbance distances

Settlement size	Example (present day)	Disturbance distance (km)
Over 270,000	Southampton, Liverpool	3km
4,000 to 270,000	Lutterworth, Carlisle	2km
2,500 to 4,000	Pulborough, Corbridge	0.5km

- 2.59. The data sets used were the Office of National Statistics: Urban Areas, and Urban Area Key Statistics (drawn from Census 2001).

³ http://www.statistics.gov.uk/census2001/leicester_urban_area.asp

⁴ direct communication with Office of National Statistics, 23/07/2007

- 2.60. The population sizes of urban areas are provided in this data set for 2001, and these population figures were attributed to the GIS data defining the extent of urban areas. These settlements were then classified into the appropriate categories, shown in **Table 7**, and the disturbance buffers were calculated.

Areas of mineral extraction

Defining the thresholds

- 2.61. The 1995 maps state that tranquil areas are:
- beyond very extensive open cast mining, and also
 - that a 1km wide (i.e. 0.5km radius) lower level of disturbance was created from large mining or processing operations.
- 2.62. The 1994 report notes that mineral extraction areas were not included in the first two regional pilot maps, but notes in Section 5.1 that they should also be considered. Section 8 of the report proposes that mineral extraction sites should be buffered by a distance of 2km for an absolute loss of tranquillity, and 3km for a partial loss of tranquillity.
- 2.63. As the 1995 maps did not provide a buffer distance for very extensive open cast mining, and as it was not possible to differentiate between 'extensive open cast mining' and 'large mining or processing operations' consistently with the 1995 maps, for the 2007 maps a 0.5km buffer was used against all mining and processing operations (these areas did not include the full footprints of the sites, and were generated from point data, as detailed below). Although this is likely to be more comprehensive than the 1960s and 1990s map, the total area covered by these buffer zones for the entire country is 1,393km², so is relatively small in the context of the figures shown in **Section 3** of this report. It also establishes a reasonable future basis for including active areas of mineral extraction in potential mapping in the future.

Developing the data

- 2.64. Data on both open cast and non open cast mines and processing operations was obtained from the 'BritPits' (2007) data set, an Excel spreadsheet provided by the Economic Minerals Programme of the British Geological Survey showing the location of all active mines and quarries, in British National Grid coordinates. This data set was converted to point locations in GIS, and was buffered by 0.5km.

Electrical installations (Power Stations / Overhead Lines / Grid Stations)

Defining the thresholds

- 2.65. The 1995 maps state that tranquil areas are:
- 4km from the largest power stations,

- 3km from major industrial areas, and that
 - a lower level of disturbance 1km wide is created from 400KV and 275KV power lines, and from groups of pylons or masts.
- 2.66. The 1994 report states that “*the presence of a major power station is assumed to remove absolute Tranquillity within a circle of radius 3km.*” The report also states that “*overhead lines and their pylons are assumed to disturb Tranquillity partially over a 1km band when they form part of the 275kV or 400kV national grid.*” Grid stations are assumed to disturb tranquillity partially within a radius of 1km. Section 8 of the report recommends the following refined thresholds as shown in **Table 8 (also Table 3)**:

Table 8: Suggested revised thresholds for electrical installations (from Section 8 of 1994 report)

Electrical equipment		Absolute disturbance distance (from edge)	Partial disturbance distance (from edge)
Major power stations	with cooling towers	3.0km	4.5km
	marine cooled	2.0km	3.0km
	nuclear	1.0km	2.0km
grid stations		-	1.0km
400kV and 275kV overhead lines		-	0.5km

- 2.67. As it was not possible to determine what defined the ‘largest power stations’, it was agreed that the lesser 3km buffer (from major industrial areas) would be used around all power stations. As with other decisions made, this errs on the side of caution, and may in particular under-represent the impact of the most intrusive power stations on the 2007 map compared to the earlier maps.
- 2.68. A 0.5km buffer from 400kV and 275kV power lines and grid stations was also agreed, corresponding with the 1995 maps.

Developing the data

- 2.69. GIS data showing a 3km buffer from power stations was provided by Helen Dunsford, of the University of Northumbria. The data was collected in 2006 and supplied to LUC in July 2007.
- 2.70. The location of high voltage cables (400kV and 275kV power lines) and grid stations was provided as GIS data by the National Grid Transco. The data was supplied and current as at July 2007.

This data was buffered by 0.5km.

Major industrial areas

Defining the thresholds

- 2.71. The 1995 maps state that tranquil areas are:
- 3km from major industrial areas.
- 2.72. The 1994 report contains no information on major industrial areas, other than the inclusion in Table 8.1 of industrial areas such as Fawley, with a maximum intrusion zone of 2km and a semi-disturbed zone of 3km.
- 2.73. Given that major industrial areas are not defined in either the 1995 maps or the 1994 report, and that there are no comprehensive data sets available which may outline their extent, it has been decided to omit these from the 2007 intrusion maps. **This is likely to under-represent the area of disturbance, although it is not clear how significantly.**

Developing the data

- 2.74. No data was obtained on major industrial areas.

Windpower developments

Defining the thresholds

- 2.75. The 1995 maps state that a 1km wide (i.e. 0.5km radius) lower level of disturbance is created from most windpower developments.
- 2.76. The 1994 report shows that windpower developments were not included on the first two regional pilot maps, but Section 5 of the report recommends that they are considered. The more elaborate thresholds set out in Section 8 of the report suggest that loss of tranquillity is absolute within 1km of a windfarm, and partial within 2km of a windfarm.
- 2.77. To correspond with the 1995 maps it was agreed that a 0.5km radius be used around all active windpower developments.

Developing the data

- 2.78. An Excel spreadsheet providing the location (in British National Grid coordinates) of operational windpower developments was provided by AEA Technology (which was up to date as at July 2007). These locations were then converted into point data in GIS, and buffered by 0.5km.
- 2.79. As with other data sets, this 0.5km radius was selected in order to provide consistency with the 1995 maps. It is possible that the zones of visual influence for windpower developments are actually significantly larger than this, and it is likely that the effect of large turbines particularly is underestimated within the maps.

Half-abandoned airfields

Defining the thresholds

- 2.80. The 1995 maps state that a 1km wide lower level of disturbance is created from some half-abandoned airfields.
- 2.81. The 1994 report does not refer to half-abandoned airfields.

Developing the data

- 2.82. Given that very little information was available on how these airfields were defined, and that no information was found on half-abandoned airfields in the present day, this data set was not included in the 2007 map.

SUMMARY OF THRESHOLDS AND DATA SETS USED

- 2.83. **Table 9** sets out the final features, data sets and thresholds used to create the 2007 map.

Table 9: Summary of thresholds and data sets used

Feature	Data set(s) used	Definition	Distance threshold
Roads	OS Strategi (2006) Annual Average Daily Traffic Flows, GB National Road Traffic Survey, DfT (2005).	Annual Average Daily Traffic Flow	
		Over 75,000	3km
		25,000 – 75,000	2km
		10,000 – 25,000	1km
		5,000 – 10,000	0.5km
		Below 5,000	no disturbance
Railways	OS Strategi (2006) National Rail 'Principal Routes' map in PDF format (ATOC, 2007)	Mainline routes	0.5km

Airports	<p>Civil Aviation Authority information on airports and the 57Leq contour*</p> <p>MOD information on the location of military airports with jet air squadrons*</p> <p>(Data generated by CESA in 2006 and transferred to LUC in July 2007)</p>	Civil Airports, distance from 57Leq contour	1 km
		Military airports, ellipse along axis of runway	7 km x 1 km

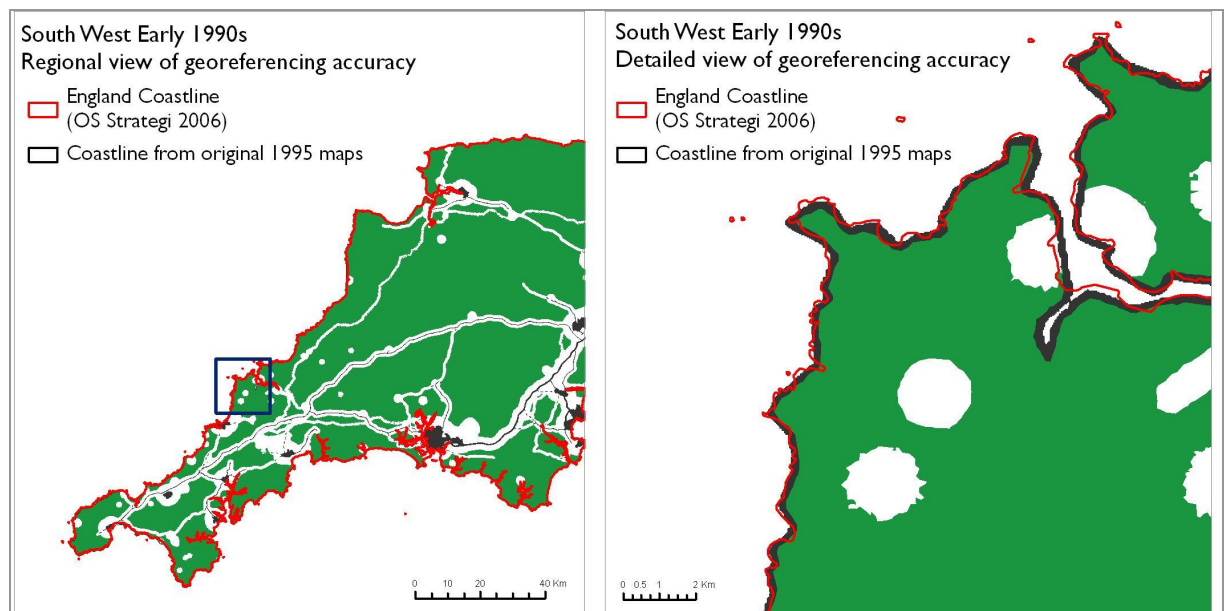
Feature	Data set(s) used	Definition	Distance threshold
Built up areas	ONS Urban Areas and ONS Census 2001 (Urban Area Key Statistics)	Settlement size	
		Over 270,000	3km
		4,000 to 270,000	2km
		2,500 to 4,000	0.5km
Areas of mineral extraction	BGS Britpits data set for all other mineral extraction sites (BGS, 2007)		0.5km from point data
Electrical installations	Power Stations* (Data generated by CESA in 2006 and transferred to LUC in July 2007) National Grid Transco GIS data on location of 400kV and 275kV power lines and grid stations (National Grid, 2007)	Power stations	3km
		400kV and 275kV power lines	0.5km
		Grid stations	0.5km
Major industrial areas	no data	n/a	n/a
Wind power developments	Spreadsheet provided by AEA Technology on the location of operational wind power developments (AEA, 2007)	Operational wind power developments	0.5km
Half-abandoned airfields	no data	n/a	n/a

*data supplied by Helen Dunsford of CESA, University of Northumbria. This data was based on research conducted in 2006 and was supplied to LUC in July 2007.

CONVERTING THE 1960s AND 1990s MAPS

- 2.84. In order to be able to compare accurately the 2007 map with the Intrusion Maps from the early 1960s and early 1990s, it was necessary to convert the earlier maps into a GIS format for analysis.
- 2.85. The earlier maps were not available in digital format, so a 1:750,000 scale England wide map (roughly A0 size) of each time period was scanned at 600dpi and georeferenced to the current England administrative boundary.
- 2.86. The process of georeferencing places the scanned images in the correct geographical location, 'fitting' the boundary from the scanned image to the England administrative boundary. Although issues such as paper stretch may have occurred over time, the process of georeferencing should minimise errors arising from this. The scans were georeferenced to the Ordnance Survey Strategi dataset, using the coastline layer. Although the boundaries match reasonably well, some minor differences are apparent. An example of the degree of accuracy can be seen in **Figure I**.

Figure I: Georeferencing example



- 2.87. Once georeferenced, the scans were converted to vector⁵ format, to allow for analysis of the area affected by noise and visual disturbance. This process was carried out using the ESRI ArcGIS Spatial Analyst extension. This enabled the two images to be mapped by colour code in a raster⁶ format, and then converted into vector format. The images were manually processed to check for colour values that had been incorrectly attributed as the colour quality of the original prints meant that some pixels were wrongly interpreted. Quality assurance was provided through manual comparison of the processed maps against the original scans.

⁵ Vector data consists of points, lines and polygons that can be considered as 'entities' in their own right.

⁶ Raster data consists of 'pixels' or blocks of colour of a fixed and equal size, rather like a photograph. When zoomed in, the data can become blocky or 'pixelated'. For further information on both data types see: http://www.gis.com/implementing_gis/data/data_types.html

CALCULATING AREAS AFFECTED BY INTRUSION

- 2.88. Once converted into a vector format, the maps were divided into regions (based on the regional boundary lines provided in the OS BoundaryLine 2006 data set), so that calculations could be made of the total area subject to intrusion within each region.
- 2.89. It is important to note that the regional (and other administrative) boundaries do not match exactly the England boundary on the 1995 maps. This is because the original 1995 maps were drawn to the Mean High Water Mark, whereas the current administrative boundary was derived from Ordnance Survey's BoundaryLine product (a 1:10,000 scale vector boundaries dataset, showing the administrative areas up to the Extent of the Realm, which is equivalent of the Mean Low Water Mark).
- 2.90. Given that these 'additional areas' on the 2007 map are largely estuarine areas (e.g. Morecambe Bay sands in the North West and Maplin Sands near Southend in the East of England) it is very likely that the majority of the areas would have been classed as 'tranquil' in the 1995 maps, and it is considered that this will have very little impact on intrusion figures.
- 2.91. The following section of this report contains the analysis of regions for each of the three time periods.

3. RESULTS OF ANALYSIS

- 3.1. For each of the three time periods and each English region, a map has been produced showing the area disturbed by noise and visual intrusions. These maps have been provided separately in TIFF format files as a digital annex to this report. These maps should be viewed at a regional scale, and do not aim to show very local effects of intrusion. Three overview maps have been provided in

Figure 2, showing areas disturbed by noise and visual intrusions for the whole of England for the three time periods.

- 3.2. **Table 10**, overleaf, sets out the area within each government region that was/is disturbed by noise and visual intrusion within the three time periods, and the percentage change within each. **Table 11** sets out the inverse of this, i.e. the area within each government region that was/is undisturbed by noise and visual intrusion within the three time periods. **Table 12** and **Table 13** set out the same calculations for Counties, Unitary Authorities and Metropolitan Districts. Despite consistently adopting a conservative approach when applying the methodology (see for example, paragraphs **2.33**, **2.40** and **2.73**), it can be seen from the tables that there is still a considerable amount of change between the early 1990s and the 2007 map. It is worth noting that, as commented on in paragraph **2.33**, B roads were omitted from the 2007 analysis, and were they to be included could have a further significant effect. Moreover, although we have included data from Scotland and Wales where readily available, we have not specifically sought out data in these countries, and therefore intrusions which have their source beyond the England border are not comprehensively mapped. **In many ways the 2007 figures therefore present an ‘optimistic scenario’.**
- 3.3. It is important to take into account when comparing the percentage change between the early 1960s and early 1990s with the change from the early 1990s to 2007, that the former is a thirty year time period, and the latter is broadly a fifteen year period.
- 3.4. The worst affected region is the South West, with a percentage increase of disturbed area of over 34% between the 1990s and 2007, due to an additional 2,629.99km² of land subject to intrusion according to the 2007 map. This difference is broadly equivalent to an area the size of the county of Oxfordshire. The region with the least relative change between the two most recent time periods is the North East, with a percentage increase of disturbed area of 10.04% between the early 1990s and 2007. The amount of land affected by this change in the North East is 271.71km² and therefore still not inconsiderable (an area over twice the size of the Teesside Urban Area itself).
- 3.5. As the maps show just two classes of land: undisturbed areas, and those areas affected by noise and visual disturbance, it is not possible to show where there have been increases in the scale of the disturbance for example from more road traffic in areas

already shown as disturbed . This is particularly relevant in areas such as the South East, which already suffer from high levels of intrusion (in the South East almost 70% of the region is classified as disturbed) and the relatively small percentage change from the 1990s to 2007 does not take into account the worsening situation within areas already classed as disturbed.

Table 10: National and regional calculations of areas disturbed by noise and visual intrusion

Region	Region Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
East Midlands	15810.76	4080.32	25.81%	6460.60	40.86%	7934.19	50.18%	58.34%	22.81%
East of England	19574.10	4275.67	21.84%	7549.64	38.57%	9714.99	49.63%	76.57%	28.68%
North East	8676.41	2127.07	24.52%	2644.24	30.48%	3010.00	34.69%	24.31%	13.83%
North West	14922.52	4548.54	30.48%	6185.73	41.45%	7245.02	48.55%	35.99%	17.12%
South East and London	21002.05	7947.37	37.84%	12380.00	58.95%	14541.15	69.24%	55.77%	17.46%
South West	24388.83	3565.48	14.62%	7351.67	30.14%	10355.96	42.46%	106.19%	40.87%
West Midlands	13003.80	3650.40	28.07%	5578.94	42.90%	6396.88	49.19%	52.83%	14.66%
Yorkshire & Humber	15564.03	3739.15	24.02%	5774.35	37.10%	7141.36	45.88%	54.43%	23.67%
ENGLAND TOTAL	132942.50	33934.00	25.53%	53925.17	40.56%	66339.54	49.90%	58.91%	23.02%

Table 11: National and Regional calculations of undisturbed areas

Region	Region Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un-disturbed area (km ²)	% of region	un-disturbed area (km ²)	% of region	un-disturbed area (km ²)	% of region		
East Midlands	15810.76	11556.11	73.09%	9138.71	57.80%	7876.57	49.82%	-20.92%	-13.81%
East of England	19574.10	14791.58	75.57%	11472.83	58.61%	9859.11	50.37%	-22.44%	-14.07%
North East	8676.41	6444.21	74.27%	5891.41	67.90%	5666.41	65.31%	-8.58%	-3.82%
North West	14922.52	9529.32	63.86%	7862.39	52.69%	7677.50	51.45%	-17.49%	-2.35%
South East and London	21002.05	12675.89	60.36%	8245.87	39.26%	6460.90	30.76%	-34.95%	-21.65%
South West	24388.83	20125.26	82.52%	16339.85	67.00%	14032.87	57.54%	-18.81%	-14.12%
West Midlands	13003.80	9328.03	71.73%	7387.45	56.81%	6606.93	50.81%	-20.80%	-10.57%
Yorkshire & Humber	15564.03	11660.48	74.92%	9570.13	61.49%	8422.67	54.12%	-17.93%	-11.99%
ENGLAND TOTAL	132942.50	96110.87	72.30%	75908.65	57.10%	66602.96	50.10%	-21.02%	-12.26%

Table 12: County and Unitary Authority calculations of areas disturbed by noise and visual intrusion

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
East Midlands									
City of Derby	78.03	78.03	100.00%	78.03	100.00%	78.03	100.00%	0.00%	0.00%
City of Leicester	73.31	73.28	99.95%	73.31	100.00%	73.31	100.00%	0.05%	0.00%
City of Nottingham	74.61	74.53	99.88%	74.52	99.87%	74.61	100.00%	-0.01%	0.13%
Derbyshire County	2550.71	963.96	37.79%	1278.10	50.11%	1462.12	57.32%	32.59%	14.40%
Leicestershire County	2083.81	673.59	32.33%	998.64	47.92%	1238.76	59.45%	48.26%	24.05%
Lincolnshire County	6102.59	547.74	8.98%	1245.54	20.41%	1907.93	31.26%	127.40%	53.18%
Northamptonshire County	2366.99	687.37	29.04%	1198.88	50.65%	1402.59	59.26%	74.42%	16.99%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Nottinghamshire County	2086.95	925.59	44.35%	1398.40	67.01%	1504.29	72.08%	51.08%	7.57%
Rutland	393.75	56.24	14.28%	115.19	29.25%	192.54	48.90%	104.82%	67.15%
East Midlands TOTAL	15810.76	4080.32	25.81%	6460.60	40.86%	7934.19	50.18%	58.34%	22.81%
East of England									
Bedfordshire County	1192.08	416.32	34.92%	683.29	57.32%	787.21	66.04%	64.13%	15.21%
Cambridgeshire County	3054.01	526.95	17.25%	1197.76	39.22%	1602.60	52.48%	127.30%	33.80%
City of Peterborough	343.44	120.67	35.14%	201.52	58.68%	239.03	69.60%	67.00%	18.61%
Essex County	3694.78	1031.78	27.93%	1721.82	46.60%	2185.45	59.15%	66.88%	26.93%
Hertfordshire County	1643.06	891.44	54.25%	1136.98	69.20%	1246.14	75.84%	27.54%	9.60%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Luton	43.35	43.35	100.00%	43.35	100.00%	43.35	100.00%	0.00%	0.00%
Norfolk County	5497.51	456.97	8.31%	1255.95	22.85%	1914.17	34.82%	174.84%	52.41%
Southend-on- Sea	67.85	42.87	63.18%	43.80	64.56%	64.09	94.46%	2.18%	46.32%
Suffolk County	3853.71	629.87	16.34%	1114.78	28.93%	1457.29	37.82%	76.99%	30.72%
Thurrock	184.32	115.44	62.63%	150.38	81.58%	175.65	95.30%	30.26%	16.81%
East of England TOTAL	19574.10	4275.67	21.84%	7549.64	38.57%	9714.99	49.63%	76.57%	28.68%
North East									
Darlington	197.47	114.63	58.05%	135.12	68.42%	139.58	70.68%	17.88%	3.30%
Durham County	2232.74	704.22	31.54%	835.74	37.43%	904.93	40.53%	18.68%	8.28%
Gateshead District	144.08	128.65	89.29%	136.36	94.64%	142.32	98.78%	5.99%	4.37%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Hartlepool	98.44	74.94	76.13%	92.03	93.49%	96.57	98.11%	22.80%	4.94%
Middlesbrough	54.56	44.43	81.43%	53.82	98.63%	54.56	100.00%	21.12%	1.39%
Newcastle upon Tyne District	115.12	102.93	89.41%	109.58	95.19%	112.96	98.12%	6.46%	3.09%
North Tyneside District	85.18	83.81	98.40%	83.78	98.36%	85.18	100.00%	-0.04%	1.67%
Northumberland County	5078.41	394.58	7.77%	651.57	12.83%	858.46	16.90%	65.13%	31.75%
Redcar and Cleveland	253.89	141.19	55.61%	168.33	66.30%	210.69	82.99%	19.22%	25.17%
South Tyneside District	67.15	66.67	99.29%	63.84	95.08%	67.15	100.00%	-4.24%	5.18%
Stockton-on- Tees	209.74	138.22	65.90%	180.70	86.15%	197.96	94.38%	30.73%	9.55%
Sunderland District	139.64	132.81	95.11%	133.39	95.52%	139.64	100.00%	0.43%	4.69%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
North East TOTAL	8676.41	2127.07	24.52%	2644.24	30.48%	3010.00	34.69%	24.31%	13.83%
North West									
Blackburn with Darwen	137.01	96.07	70.12%	97.48	71.15%	118.19	86.26%	1.47%	21.24%
Blackpool	43.18	35.20	81.53%	34.35	79.56%	43.18	100.00%	-2.42%	25.70%
Bolton District	139.80	117.81	84.27%	129.03	92.29%	139.80	100.00%	9.52%	8.35%
Bury District	99.48	84.25	84.69%	87.55	88.00%	99.37	99.89%	3.91%	13.51%
Cheshire County	2107.55	867.60	41.17%	1231.80	58.45%	1450.53	68.83%	41.98%	17.76%
Cumbria County	7185.07	556.86	7.75%	1312.00	18.26%	1578.40	21.97%	135.61%	20.30%
Halton	90.33	75.82	83.94%	76.07	84.21%	89.82	99.44%	0.33%	18.08%
Knowsley District	86.47	86.47	100.00%	86.47	100.00%	86.47	100.00%	0.00%	0.00%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Lancashire County	3083.41	1010.58	32.77%	1492.07	48.39%	1780.07	57.73%	47.65%	19.30%
Liverpool District	133.54	113.52	85.01%	110.17	82.50%	133.54	100.00%	-2.95%	21.21%
Manchester District	115.65	115.61	99.97%	115.65	100.00%	115.65	100.00%	0.03%	0.00%
Oldham District	142.35	98.10	68.91%	92.28	64.82%	110.50	77.63%	-5.93%	19.75%
Rochdale District	158.08	125.78	79.56%	139.36	88.16%	156.21	98.82%	10.80%	12.09%
Salford District	97.19	92.17	94.84%	97.19	100.00%	97.19	100.00%	5.44%	0.00%
Sefton District	204.77	122.29	59.72%	114.84	56.08%	183.73	89.72%	-6.09%	59.99%
St. Helens District	136.39	131.68	96.55%	129.42	94.89%	136.39	100.00%	-1.72%	5.39%
Stockport District	126.05	114.65	90.95%	112.04	88.88%	125.39	99.48%	-2.28%	11.92%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Tameside District	103.19	99.70	96.62%	98.42	95.38%	101.08	97.95%	-1.29%	2.70%
Trafford District	106.03	99.85	94.17%	104.43	98.48%	106.03	100.00%	4.58%	1.54%
Warrington	182.37	172.14	94.39%	178.89	98.09%	182.37	100.00%	3.92%	1.94%
Wigan District	188.19	174.50	92.73%	187.32	99.54%	188.19	100.00%	7.35%	0.46%
Wirral District	256.40	157.89	61.58%	158.91	61.98%	222.90	86.93%	0.65%	40.27%
North West TOTAL	14922.52	4548.54	30.48%	6185.73	41.45%	7245.02	48.55%	35.99%	17.12%
South East									
Bracknell Forest	109.38	96.19	87.94%	106.06	96.96%	106.49	97.36%	10.26%	0.41%
Buckinghamshire County	1564.94	520.81	33.28%	835.42	53.38%	1037.61	66.30%	60.41%	24.20%
City of Portsmouth	60.19	40.05	66.53%	42.55	70.69%	60.19	100.00%	6.25%	41.46%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
City of Southampton	56.39	53.23	94.40%	52.50	93.11%	56.39	100.00%	-1.36%	7.40%
East Sussex County	1725.17	381.47	22.11%	798.05	46.26%	973.25	56.41%	109.21%	21.95%
Greater London Authority	1594.72	1489.99	93.43%	1568.70	98.37%	1593.88	99.95%	5.28%	1.61%
Hampshire County	3738.14	1046.56	28.00%	1896.75	50.74%	2420.71	64.76%	81.24%	27.62%
Isle of Wight	394.93	103.72	26.26%	179.31	45.40%	237.77	60.20%	72.88%	32.60%
Kent County	3639.42	1131.71	31.10%	1963.39	53.95%	2326.92	63.94%	73.49%	18.52%
Medway	268.86	103.25	38.40%	144.28	53.67%	203.06	75.53%	39.75%	40.74%
Milton Keynes	308.63	170.90	55.38%	234.67	76.04%	267.07	86.53%	37.31%	13.81%
Oxfordshire County	2605.95	639.77	24.55%	1182.42	45.37%	1525.80	58.55%	84.82%	29.04%
Reading	40.40	40.40	100.00%	40.40	100.00%	40.40	100.00%	0.00%	0.00%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Slough	32.54	32.54	100.00%	32.54	100.00%	32.54	100.00%	0.00%	0.00%
Surrey County	1670.06	966.72	57.89%	1359.13	81.38%	1411.68	84.53%	40.59%	3.87%
The City of Brighton and Hove	85.38	76.55	89.67%	79.01	92.54%	85.38	100.00%	3.21%	8.06%
West Berkshire	704.17	179.11	25.44%	391.89	55.65%	474.06	67.32%	118.81%	20.97%
West Sussex County	2025.40	608.87	30.06%	1113.71	54.99%	1316.43	65.00%	82.91%	18.20%
Windsor and Maidenhead	198.43	164.04	82.67%	196.21	98.88%	195.86	98.70%	19.61%	-0.18%
Wokingham	178.97	101.49	56.71%	162.99	91.07%	175.67	98.16%	60.60%	7.78%
South East TOTAL	21002.05	7947.37	37.84%	12380.00	58.95%	14541.15	69.24%	55.77%	17.46%
South West									

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Bath and North East Somerset	351.12	172.88	49.24%	215.47	61.37%	241.47	68.77%	24.63%	12.07%
Bournemouth	47.17	45.55	96.58%	45.91	97.33%	47.17	100.00%	0.77%	2.75%
City of Bristol	235.34	111.46	47.36%	110.79	47.07%	146.88	62.41%	-0.61%	32.58%
City of Plymouth	84.37	80.06	94.89%	81.39	96.47%	84.29	99.90%	1.66%	3.55%
Cornwall County	3613.38	431.87	11.95%	946.39	26.19%	1404.95	38.88%	119.14%	48.45%
Devon County	6755.63	590.50	8.74%	1501.70	22.23%	2104.37	31.15%	154.31%	40.13%
Dorset County	2572.93	250.09	9.72%	652.89	25.38%	999.85	38.86%	161.06%	53.14%
Gloucestershire County	2704.54	498.02	18.41%	944.80	34.93%	1322.78	48.91%	89.71%	40.01%
Isles of Scilly	22.85	0.00	0.00%	0.00	0.00%	5.98	26.17%	0.00%	N/A ⁷
North Somerset	390.80	183.81	47.03%	312.06	79.85%	351.28	89.89%	69.77%	12.57%

⁷ Isles of Scilly are not comparable over the time period as no data was available for early 1960s and early 1990s.

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Poole	74.72	68.16	91.23%	67.72	90.63%	74.72	100.00%	-0.65%	10.33%
Somerset County	3513.92	376.87	10.73%	997.08	28.38%	1465.43	41.70%	164.57%	46.97%
South Gloucestershire	536.64	178.26	33.22%	350.23	65.26%	416.19	77.56%	96.47%	18.83%
Swindon	230.09	123.69	53.76%	161.00	69.97%	193.78	84.22%	30.16%	20.36%
Wiltshire County	3255.34	454.24	13.95%	964.26	29.62%	1496.83	45.98%	112.28%	55.23%
South West TOTAL	24388.83	3565.48	14.62%	7351.67	30.14%	10355.96	42.46%	106.19%	40.87%
West Midlands									
Birmingham District	267.79	267.72	99.97%	267.79	100.00%	267.79	100.00%	0.03%	0.00%
City of Stoke- on-Trent	93.45	93.45	100.00%	93.45	100.00%	93.45	100.00%	0.00%	0.00%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
City of Wolverhampton District	69.43	69.43	100.00%	69.43	100.00%	69.43	100.00%	0.00%	0.00%
County of Herefordshire	2179.73	86.17	3.95%	279.80	12.84%	465.19	21.34%	224.71%	66.26%
Coventry District	98.65	98.41	99.76%	98.65	100.00%	98.65	100.00%	0.24%	0.00%
Dudley District	97.97	97.97	100.00%	97.97	100.00%	97.97	100.00%	0.00%	0.00%
Sandwell District	85.56	85.56	100.00%	85.56	100.00%	85.56	100.00%	0.00%	0.00%
Shropshire County	3197.30	271.45	8.49%	613.57	19.19%	841.53	26.32%	126.04%	37.15%
Solihull District	178.29	153.98	86.37%	174.66	97.96%	176.02	98.73%	13.43%	0.78%
Staffordshire County	2623.33	1066.31	40.65%	1528.94	58.28%	1564.98	59.66%	43.39%	2.36%
Telford and Wrekin	290.31	121.46	41.84%	164.34	56.61%	177.69	61.21%	35.30%	8.13%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Walsall District	103.95	103.95	100.00%	103.95	100.00%	103.95	100.00%	0.00%	0.00%
Warwickshire County	1977.53	657.68	33.26%	1112.77	56.27%	1306.42	66.06%	69.20%	17.40%
Worcestershire County	1740.51	476.86	27.40%	888.06	51.02%	1048.25	60.23%	86.23%	18.04%
West Midlands TOTAL	13003.80	3650.40	28.07%	5578.94	42.90%	6396.88	49.19%	52.83%	14.66%
Yorkshire and Humber									
Barnsley District	329.05	169.37	51.47%	232.25	70.58%	294.46	89.49%	37.12%	26.79%
Bradford District	366.42	259.85	70.92%	273.10	74.53%	323.70	88.34%	5.10%	18.53%
Calderdale District	363.92	168.43	46.28%	204.98	56.33%	257.57	70.78%	21.70%	25.65%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
City of Kingston upon Hull	81.50	75.55	92.70%	76.46	93.82%	81.50	100.00%	1.21%	6.58%
Doncaster District	568.52	336.76	59.23%	454.96	80.02%	498.54	87.69%	35.10%	9.58%
East Riding of Yorkshire	2496.73	322.14	12.90%	648.80	25.99%	896.84	35.92%	101.41%	38.23%
Kirklees District	408.60	282.44	69.13%	318.89	78.04%	374.26	91.60%	12.90%	17.36%
Leeds District	551.72	420.53	76.22%	505.71	91.66%	533.75	96.74%	20.26%	5.54%
North East Lincolnshire	203.57	113.32	55.67%	129.43	63.58%	154.46	75.88%	14.21%	19.34%
North Lincolnshire	875.70	180.52	20.61%	366.46	41.85%	499.03	56.99%	103.01%	36.18%
North Yorkshire County	8053.19	629.94	7.82%	1623.68	20.16%	2157.96	26.80%	157.75%	32.90%
Rotherham District	286.53	193.18	67.42%	248.27	86.65%	270.30	94.33%	28.52%	8.87%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		disturbed area (km ²)	% of region	disturbed area (km ²)	% of region	disturbed area (km ²)	% of region		
Sheffield District	367.95	202.18	54.95%	211.49	57.48%	260.01	70.66%	4.61%	22.94%
Wakefield District	338.61	257.76	76.12%	312.60	92.32%	338.49	99.96%	21.27%	8.28%
York	272.01	127.17	46.75%	167.25	61.49%	200.50	73.71%	31.51%	19.88%
Yorkshire and Humber TOTAL	15564.03	3739.15	24.02%	5774.35	37.10%	7141.36	45.88%	54.43%	23.67%

Table 13: County and Unitary Authority calculations of undisturbed areas

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
East Midlands									
City of Derby	78.03	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
City of Leicester	73.31	0.04	0.05%	0.00	0.00%	0.00	0.00%	-100.00%	0.00%
City of Nottingham	74.61	0.09	0.12%	0.10	0.13%	0.00	0.00%	11.66%	-100.00%
Derbyshire County	2550.71	1586.75	62.21%	1272.61	49.89%	1088.59	42.68%	-19.80%	-14.46%
Leicestershire County	2083.81	1410.21	67.67%	1085.17	52.08%	845.05	40.55%	-23.05%	-22.13%
Lincolnshire County	6102.59	5380.52	88.17%	4645.61	76.13%	4194.66	68.74%	-13.66%	-9.71%
Northamptonshire County	2366.99	1679.63	70.96%	1168.11	49.35%	964.41	40.74%	-30.45%	-17.44%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Nottinghamshire County	2086.95	1161.36	55.65%	688.55	32.99%	582.67	27.92%	-40.71%	-15.38%
Rutland	393.75	337.51	85.72%	278.56	70.75%	201.21	51.10%	-17.47%	-27.77%
East Midlands TOTAL	15810.76	11556.11	73.09%	9138.71	57.80%	7876.57	49.82%	-20.92%	-13.81%
East of England									
Bedfordshire County	1192.08	775.76	65.08%	508.78	42.68%	404.87	33.96%	-34.41%	-20.42%
Cambridgeshire County	3054.01	2527.06	82.75%	1856.25	60.78%	1451.41	47.52%	-26.54%	-21.81%
City of Peterborough	343.44	222.77	64.86%	141.92	41.32%	104.41	30.40%	-36.29%	-26.43%
Essex County	3694.78	2400.56	64.97%	1703.50	46.11%	1509.33	40.85%	-29.04%	-11.40%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Hertfordshire County	1643.06	751.62	45.75%	506.08	30.80%	396.92	24.16%	-32.67%	-21.57%
Luton	43.35	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
Norfolk County	5497.51	4909.15	89.30%	4075.83	74.14%	3583.34	65.18%	-16.97%	-12.08%
Southend-on- Sea	67.85	0.00	0.00%	0.00	0.00%	3.76	5.54%	-100.00%	0.00%
Suffolk County	3853.71	3162.73	82.07%	2672.12	69.34%	2396.42	62.18%	-15.51%	-10.32%
Thurrock	184.32	41.94	22.75%	8.35	4.53%	8.67	4.70%	-80.10%	3.90%
East of England TOTAL	19574.10	14791.58	75.57%	11472.83	58.61%	9859.11	50.37%	-22.44%	-14.07%
North East									
Darlington	197.47	82.85	41.95%	62.35	31.58%	57.89	29.32%	-24.74%	-7.16%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Durham County	2232.74	1523.81	68.25%	1386.78	62.11%	1327.81	59.47%	-8.99%	-4.25%
Gateshead District	144.08	15.42	10.71%	7.72	5.36%	1.75	1.22%	-49.96%	-77.27%
Hartlepool	98.44	22.84	23.20%	1.48	1.50%	1.86	1.89%	-93.53%	26.17%
Middlesbrough	54.56	10.13	18.57%	0.75	1.37%	0.00	0.00%	-92.64%	-100.00%
Newcastle upon Tyne District	115.12	12.19	10.59%	5.54	4.81%	2.16	1.88%	-54.53%	-61.05%
North Tyneside District	85.18	1.22	1.43%	0.13	0.15%	0.00	0.00%	-89.29%	-100.00%
Northumberland County	5078.41	4588.78	90.36%	4317.74	85.02%	4219.95	83.10%	-5.91%	-2.26%
Redcar and Cleveland	253.89	109.00	42.93%	76.02	29.94%	43.20	17.01%	-30.26%	-43.17%
South Tyneside District	67.15	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Stockton-on-Tees	209.74	71.53	34.10%	29.05	13.85%	11.78	5.62%	-59.39%	-59.43%
Sunderland District	139.64	6.45	4.62%	3.86	2.76%	0.00	0.00%	-40.20%	-100.00%
North East TOTAL	8676.41	6444.21	74.27%	5891.41	67.90%	5666.41	65.31%	-8.58%	-3.82%
North West									
Blackburn with Darwen	137.01	40.94	29.88%	39.53	28.85%	18.83	13.74%	-3.44%	-52.38%
Blackpool	43.18	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
Bolton District	139.80	21.99	15.73%	10.77	7.71%	0.00	0.00%	-51.01%	-99.99%
Bury District	99.48	15.23	15.31%	11.94	12.00%	0.11	0.11%	-21.65%	-99.07%
Cheshire County	2107.55	1206.82	57.26%	839.12	39.81%	657.02	31.17%	-30.47%	-21.70%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Cumbria County	7185.07	6219.91	86.57%	5451.01	75.87%	5606.67	78.03%	-12.36%	2.86%
Halton	90.33	1.51	1.68%	0.25	0.28%	0.51	0.56%	-83.25%	100.25%
Knowsley District	86.47	0.00	0.00%	0.00	0.00%	0.00	0.00%	-100.00%	0.00%
Lancashire County	3083.41	1863.62	60.44%	1378.84	44.72%	1303.34	42.27%	-26.01%	-5.48%
Liverpool District	133.54	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
Manchester District	115.65	0.04	0.03%	0.00	0.00%	0.00	0.00%	-100.00%	0.00%
Oldham District	142.35	44.25	31.09%	50.07	35.18%	31.84	22.37%	13.15%	-36.40%
Rochdale District	158.08	32.31	20.44%	18.72	11.84%	1.87	1.18%	-42.05%	-90.01%
Salford District	97.19	5.02	5.16%	0.00	0.00%	0.00	0.00%	-100.00%	0.00%
Sefton District	204.77	30.13	14.71%	32.98	16.11%	21.05	10.28%	9.46%	-36.18%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
St. Helens District	136.39	4.71	3.45%	6.97	5.11%	0.00	0.00%	48.06%	-100.00%
Stockport District	126.05	11.40	9.05%	14.01	11.12%	0.66	0.52%	22.91%	-95.29%
Tameside District	103.19	3.49	3.38%	4.77	4.62%	2.11	2.05%	36.85%	-55.72%
Trafford District	106.03	6.18	5.83%	1.61	1.52%	0.00	0.00%	-73.98%	-100.00%
Warrington	182.37	8.07	4.42%	0.92	0.51%	0.00	0.00%	-88.54%	-100.00%
Wigan District	188.19	13.69	7.27%	0.87	0.46%	0.00	0.00%	-93.67%	-100.00%
Wirral District	256.40	0.00	0.00%	0.00	0.00%	33.50	13.07%	-100.00%	0.00%
North West TOTAL	14922.52	9529.32	63.86%	7862.39	52.69%	7677.50	51.45%	-17.49%	-2.35%
South East									

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Bracknell Forest	109.38	13.19	12.06%	3.33	3.04%	2.89	2.64%	-74.79%	-13.04%
Buckinghamshire County	1564.94	1044.13	66.72%	729.52	46.62%	527.33	33.70%	-30.13%	-27.72%
City of Portsmouth	60.19	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
City of Southampton	56.39	0.05	0.08%	0.00	0.00%	0.00	0.00%	-100.00%	0.00%
East Sussex County	1725.17	1330.85	77.14%	908.61	52.67%	751.92	43.59%	-31.73%	-17.25%
Greater London Authority	1594.72	93.40	5.86%	18.17	1.14%	0.84	0.05%	-80.55%	-95.39%
Hampshire County	3738.14	2615.86	69.98%	1768.79	47.32%	1317.43	35.24%	-32.38%	-25.52%
Isle of Wight	394.93	266.83	67.56%	206.81	52.37%	157.16	39.80%	-22.49%	-24.01%
Kent County	3639.42	2396.06	65.84%	1559.01	42.84%	1312.50	36.06%	-34.93%	-15.81%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Medway	268.86	91.18	33.91%	49.49	18.41%	65.80	24.47%	-45.72%	32.96%
Milton Keynes	308.63	137.72	44.62%	73.96	23.96%	41.56	13.47%	-46.30%	-43.81%
Oxfordshire County	2605.95	1966.18	75.45%	1423.53	54.63%	1080.15	41.45%	-27.60%	-24.12%
Reading	40.40	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
Slough	32.54	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
Surrey County	1670.06	703.34	42.11%	310.92	18.62%	258.37	15.47%	-55.79%	-16.90%
The City of Brighton and Hove	85.38	6.89	8.07%	1.81	2.12%	0.00	0.00%	-73.79%	-100.00%
West Berkshire	704.17	525.06	74.56%	312.28	44.35%	230.11	32.68%	-40.53%	-26.31%
West Sussex County	2025.40	1373.28	67.80%	861.46	42.53%	708.97	35.00%	-37.27%	-17.70%
Windsor and Maidenhead	198.43	34.40	17.33%	2.22	1.12%	2.58	1.30%	-93.54%	15.86%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Wokingham	178.97	77.48	43.29%	15.98	8.93%	3.30	1.84%	-79.38%	-79.35%
South East TOTAL	21002.05	12675.89	60.36%	8245.87	39.26%	6460.90	30.76%	-34.95%	-21.65%
South West									
Bath and North East Somerset	351.12	178.24	50.76%	135.66	38.63%	109.65	31.23%	-23.89%	-19.17%
Bournemouth	47.17	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
City of Bristol	235.34	0.03	0.01%	0.00	0.00%	88.46	37.59%	-100.00%	0.00%
City of Plymouth	84.37	2.65	3.14%	0.29	0.34%	0.09	0.10%	-89.22%	-69.72%
Cornwall County	3613.38	3044.57	84.26%	2536.62	70.20%	2208.43	61.12%	-16.68%	-12.94%
Devon County	6755.63	5999.43	88.81%	5096.63	75.44%	4651.26	68.85%	-15.05%	-8.74%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Dorset County	2572.93	2265.36	88.05%	1856.94	72.17%	1573.08	61.14%	-18.03%	-15.29%
Gloucestershire County	2704.54	2151.55	79.55%	1696.97	62.75%	1381.76	51.09%	-21.13%	-18.57%
Isles of Scilly	22.85	0.00	0.00%	0.00	0.00%	16.87	73.83%	N/A	N/A ⁸
North Somerset	390.80	186.67	47.77%	56.96	14.58%	39.52	10.11%	-69.48%	-30.61%
Poole	74.72	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
Somerset County	3513.92	3069.44	87.35%	2456.36	69.90%	2048.49	58.30%	-19.97%	-16.60%
South Gloucestershire	536.64	319.82	59.60%	143.26	26.70%	120.44	22.44%	-55.21%	-15.92%
Swindon	230.09	106.40	46.24%	69.10	30.03%	36.31	15.78%	-35.06%	-47.45%
Wiltshire County	3255.34	2801.09	86.05%	2291.08	70.38%	1758.51	54.02%	-18.21%	-23.25%

⁸ Isles of Scilly are not comparable over the time period as no data was available for early 1960s and early 1990s.

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
South West TOTAL	24388.83	20125.26	82.52%	16339.85	67.00%	14032.87	57.54%	-18.81%	-14.12%
West Midlands									
Birmingham District	267.79	0.07	0.03%	0.00	0.00%	0.00	0.00%	-100.00%	0.00%
City of Stoke- on-Trent	93.45	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
City of Wolverhampton District	69.43	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
County of Herefordshire	2179.73	2091.36	95.95%	1891.70	86.79%	1714.54	78.66%	-9.55%	-9.37%
Coventry District	98.65	0.24	0.24%	0.00	0.00%	0.00	0.00%	-100.00%	0.00%
Dudley District	97.97	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%

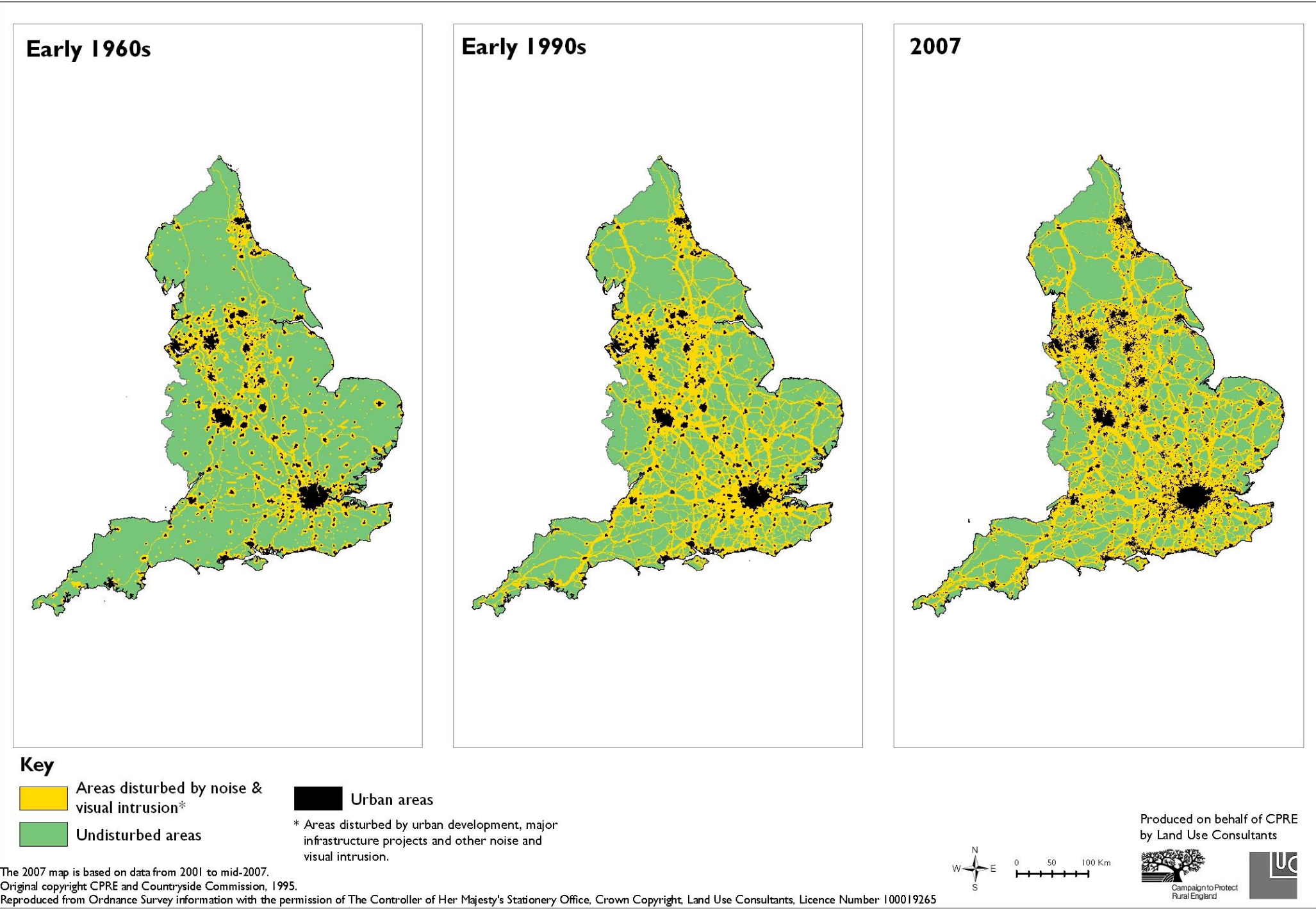
County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Sandwell District	85.56	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
Shropshire County	3197.30	2902.68	90.79%	2554.55	79.90%	2355.78	73.68%	-11.99%	-7.78%
Solihull District	178.29	24.31	13.63%	3.63	2.04%	2.27	1.27%	-85.07%	-37.47%
Staffordshire County	2623.33	1557.02	59.35%	1094.39	41.72%	1058.35	40.34%	-29.71%	-3.29%
Telford and Wrekin	290.31	168.85	58.16%	125.98	43.39%	112.62	38.79%	-25.39%	-10.60%
Walsall District	103.95	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00%	0.00%
Warwickshire County	1977.53	1319.85	66.74%	864.76	43.73%	671.11	33.94%	-34.48%	-22.39%
Worcestershire County	1740.51	1263.65	72.60%	852.45	48.98%	692.26	39.77%	-32.54%	-18.79%
West Midlands TOTAL	13003.80	9328.03	71.73%	7387.45	56.81%	6606.93	50.81%	-20.80%	-10.57%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
Yorkshire and Humber									
Barnsley District	329.05	159.68	48.53%	96.80	29.42%	34.59	10.51%	-39.38%	-64.26%
Bradford District	366.42	106.56	29.08%	93.31	25.47%	42.72	11.66%	-12.44%	-54.22%
Calderdale District	363.92	195.49	53.72%	158.94	43.67%	106.36	29.22%	-18.70%	-33.08%
City of Kingston upon Hull	81.50	0.04	0.05%	0.00	0.00%	0.00	0.00%	-100.00%	0.00%
Doncaster District	568.52	231.76	40.77%	113.57	19.98%	69.98	12.31%	-51.00%	-38.38%
East Riding of Yorkshire	2496.73	2087.94	83.63%	1749.66	70.08%	1599.89	64.08%	-16.20%	-8.56%
Kirklees District	408.60	126.15	30.87%	89.71	21.96%	34.34	8.40%	-28.89%	-61.73%
Leeds District	551.72	131.19	23.78%	46.01	8.34%	17.97	3.26%	-64.93%	-60.94%

County, Unitary Authority or Metropolitan District	Total Area (km ²)	Early 1960s		Early 1990s		2007		Percentage change 1960s – 1990s	Percentage change 1990s - 2007
		un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region	un- disturbed area (km ²)	% of region		
North East Lincolnshire	203.57	77.52	38.08%	53.24	26.15%	49.11	24.12%	-31.32%	-7.76%
North Lincolnshire	875.70	657.72	75.11%	465.70	53.18%	376.67	43.01%	-29.20%	-19.12%
North Yorkshire County	8053.19	7401.60	91.91%	6377.70	79.19%	5895.24	73.20%	-13.83%	-7.56%
Rotherham District	286.53	93.35	32.58%	38.26	13.35%	16.23	5.67%	-59.02%	-57.57%
Sheffield District	367.95	165.78	45.05%	156.46	42.52%	107.95	29.34%	-5.62%	-31.01%
Wakefield District	338.61	80.84	23.88%	26.01	7.68%	0.12	0.04%	-67.83%	-99.54%
York	272.01	144.84	53.25%	104.77	38.51%	71.51	26.29%	-27.67%	-31.74%
Yorkshire and Humber TOTAL	15564.03	11660.48	74.92%	9570.13	61.49%	8422.67	54.12%	-17.93%	-11.99%

Note: Due to the difference in coastal boundaries on the early 1960s and 1990s maps with the 2007 map, the sum of the area disturbed by noise and visual intrusion and the undisturbed area will not always equal the region and/or county/UA total area for the 1960s and 1990s time periods.

Figure 2: National Intrusion Maps



4. ACKNOWLEDGEMENTS

- 4.1. This work was carried out by Land Use Consultants on behalf of the Campaign to Protect Rural England. Graeme Willis and Tom Oliver at CPRE provided support and information throughout the project. We would also like to acknowledge the support that Dr Helen Dunsford of the Centre of Environmental and Spatial Analysis at Northumbria University provided, in making available a number of data sets to contribute to the analysis.

Land Use Consultants

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