

# Transport Statistics Bulletin

National Road Maintenance Condition  
Survey: 2006

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1 billion = 1,000 million	1 litre = 0.220 gallons

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{	= subsequent data is disaggregated	}	= subsequent data is aggregated
	= break in the series	P	= provisional data
F	= forecast expenditure	e	= estimated outturn
n.e.s	= not elsewhere specified	TSO	= The Stationary Office

# **Transport Statistics Bulletin**

## **National Road Maintenance Condition Survey: 2006**

SB(07)18



# NATIONAL ROAD MAINTENANCE CONDITION SURVEY: 2006

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# 1. INTRODUCTION

- 1.1 This publication reports on the condition of public roads, footways, kerbs and verges in England and Wales. This report also includes Scottish local authority performance indicators. Results are derived from a range of surveys of road condition which are collectively referred to as the National Road Maintenance Condition Survey (NRMCS).
- 1.2 This is the final year that the NRMCS will report in its present form. From 2007, DfT will no longer be collecting visual condition data on classified local roads and will instead be using the SCANNER machine-collected data to report on the condition of these roads in England. This reporting will be based around the SCANNER Road Condition Indicator, developed for reporting Best Value Performance Indicators on local roads. The visual condition survey will still be used to report on the unclassified network in England.
- 1.3 In future, DfT will report on English roads and the National Assembly for Wales will be producing its own road condition report, based on SCANNER data for all roads. The SCOTS (Society of Chief Officers of Transportation in Scotland) group will continue to report on road condition data for Scottish local roads using SCANNER.
- 1.4 The UK Roads Board will be continuing to work towards the production of a UK-wide road condition report. The UK Roads Board has a standing objective to develop consistent surveying methods across England, Scotland, Wales and Northern Ireland, with the eventual aim of producing both UK estimates of road condition and comparisons between the countries.
- 1.5 Information presented in this publication includes:
  - **Chapter 2** - key statistics from the 2006 NRMCS;
  - **Chapter 3** - results from visual condition surveys in 1984 to 2006. These record the visible physical condition of the road network (excluding motorways and all-purpose trunk roads) and include information on footways, verges and kerbs. They do not measure the requirement for road maintenance;
  - **Chapter 4** - results derived from surveys of the structural condition of motorways and all purpose trunk roads in Wales;
  - **Chapter 5** - results from 2005-06 local performance indicators, in England and Scotland, relating to the percentage of the local road network for which further investigation should be considered;
  - **Chapter 6** - results from a survey of wet road skidding resistance;
  - **Chapter 7** - results from the Highways Agency's machine based survey of the surface condition of the trunk road network;
  - **Chapter 8** - reports on factors which affect road conditions. It includes results from a survey to measure the amount of maintenance undertaken, by type of treatment, on principal and non-principal roads in England and Wales in 2005-06. This chapter also includes information on road maintenance expenditure and motor traffic volumes; and
  - **Annexes 1 to 7** - details of methodologies and technical terms.
- 1.6 The NRMCS report is supported by the Department for Transport, the Local Government Association, the Highways Agency, the National Assembly for Wales and the Scottish Executive. The surveys are managed by the Department for Transport, with the UK Roads Board providing technical advice and an input to the Quality

Assurance process. Advice on the publication of the report is provided by the Roads Performance Management Group, which reports to the UK Roads Board.

- 1.7 Suggestions for improvements to the content and presentation of the report are welcome and should be sent to the Department for Transport, ST 5 (Highways Maintenance Data Unit), Zone 3/09 Great Minster House, 76 Marsham Street, London, SW1P 4DR (E-Mail: [roadmaintenance.stats@dft.gsi.gov.uk](mailto:roadmaintenance.stats@dft.gsi.gov.uk); Tel: 020 7944 3092; Fax: 020 7944 2166). A copy of this publication is available at <http://www.dft.gov.uk/transtat/roadtraff>

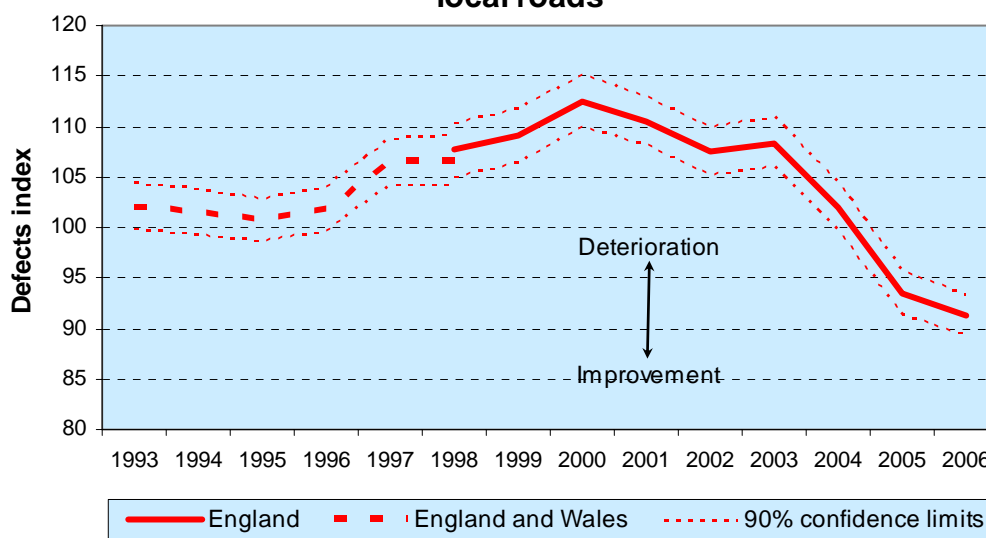
## KEY RESULTS

- 2.3 This report presents information on the condition of local and trunk roads.
- 2.4 Surface condition of local roads in England and Wales is measured using a visual survey of defects. Wet road skidding resistance on principal and trunk roads in England and Wales is monitored using machines, as is the surface condition of the English trunk road network.
- 2.5 The structural survey of trunk roads in Wales uses Deflectograph machines to provide an estimate of the remaining life of the road.

### Visual condition

- 2.6 In July 2000, the Government set out its transport strategy in ‘Transport 2010 – The 10 Year Plan’. This included the target to halt the deterioration in the condition of local roads, i.e. non-trunk roads, in England by 2004. This target has been monitored by a surface condition ‘defects index’ which is derived from results of the NRMCS visual survey. The defects index is set at 100 for the base year 1977. **A significant decrease in the index indicates an improvement in the road condition.**
- 2.7 Figure 2.1 shows that the average defects index for English local roads has fallen from 112.5 in 2000 to 91.2 in 2006. In order to reflect the uncertainty due to sampling error, ranges are calculated within which the true average defects index lies with a 90 per cent probability. Although a decrease in the index represents improving road conditions, for it to be possible to say with confidence that condition in one year is different from that in another, the confidence limits (as represented by the dotted lines) should not overlap.
- 2.8 Taking into account the confidence limits, statistical analysis shows that the significant improvement in local road conditions in England since 2000 has been sustained in 2006. That is, the net fall in the index since 2000 is unlikely to be a result of sampling error alone and reflects a real improvement in road conditions. The 90% confidence interval for the change since 2000 is between 18 and 25 points.

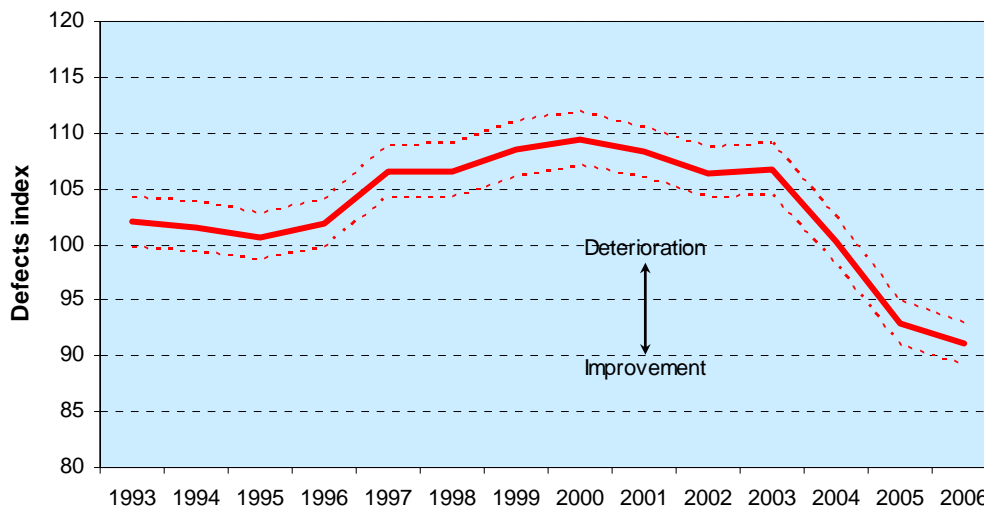
**Figure 2.1 Defects index, England <sup>1</sup>, 1993 to 2006 - local roads**



1. A defects index for England is not available prior to 1998 so the index for England and Wales is included as an indication of the earlier trend.

- 2.9 Although the England index has also fallen by between around 2 points during the last year, this fall is not statistically significant.

**Figure 2.2 Defects index, England and Wales, 1993 to 2006 - local roads**

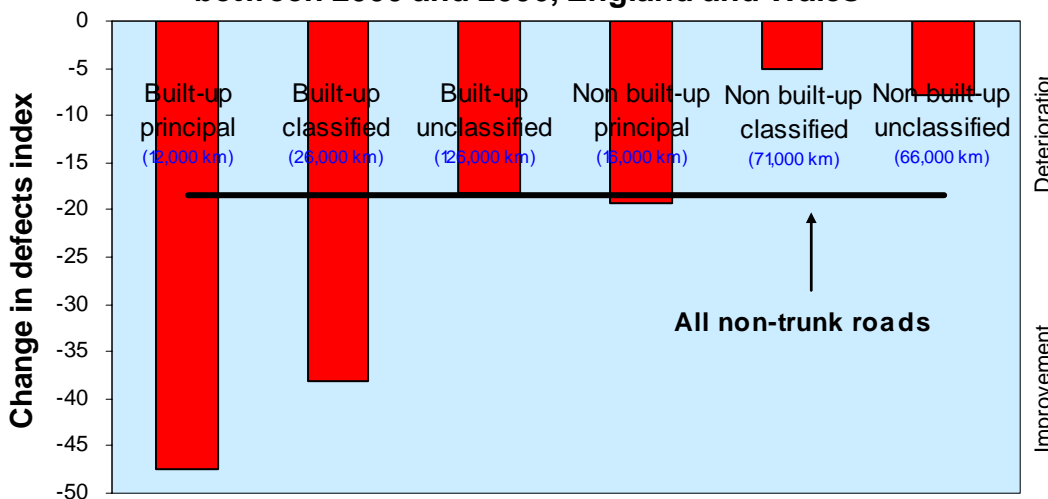


- 2.10 The length of local roads in England accounts for 90 per cent of all local roads in England and Wales and so it is not surprising to find that the trend in visual condition in England is similar to that in England and Wales (see Figure 2.2). However, the trend in Wales is fairly different to that for England; road conditions in Wales have not changed significantly since 2000 (see Table 3.1).

- 2.11 The local roads defects index for England and Wales fell from 109.5 in 2000 to 91.1 in 2006. This fall in the index is statistically significant and has a confidence interval of between 16 and 21 index points.

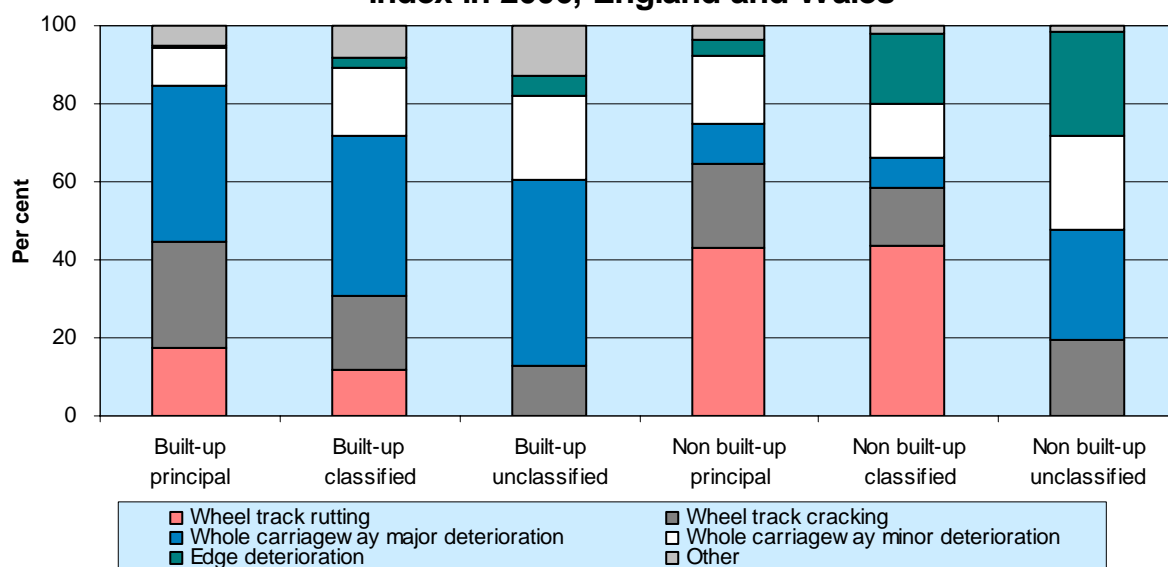
- 2.12 Changes in conditions vary across the different road types as shown in Figure 2.3. Since 2000, real improvements - as indicated by significant falls in the index - have been seen on all road types in England and Wales, except for non built-up unclassified roads, which tend to be country lanes. Built-up unclassified roads are generally through residential areas and account for 40 per cent of all local roads. The reduction, of between 13 and 23 points, in the defects index for these roads will have contributed most to the reduction in the overall defects index since 2000.

**Figure 2.3 Change in defects index by road class between 2000 and 2006, England and Wales**



- 2.13 In 2006, the defects index for non built-up unclassified roads was 118.4, by far the highest of any road class. Having the highest index signifies that conditions on this group of roads have deteriorated more than other groups, relative to their conditions when the survey began in 1977.
- 2.14 The defects index of 70.8 in 2006 on non built-up principal roads is the lowest of any road class and signifies the greatest improvement relative to the condition of this type of road in 1977. However, conditions on these roads have improved significantly since 2004, with the index falling by between 9 and 30 points.
- 2.15 Figure 2.4 shows that almost half of the defects index for built-up roads of all types was a result of major deterioration to the whole carriageway, i.e. not just in the wheel tracks. Rutting contributed to over 40 per cent of the index on non built-up principal and classified roads, i.e. non built-up local authority owned A, B and C roads. Major deterioration also has a large effect on non built-up unclassified roads, as does edge deterioration since these tend to be roads without kerbs. See Annexes 2 and 3 for descriptions of the defects.

**Figure 2.4 Percentage contribution of defects<sup>1</sup> to defects index in 2006, England and Wales**

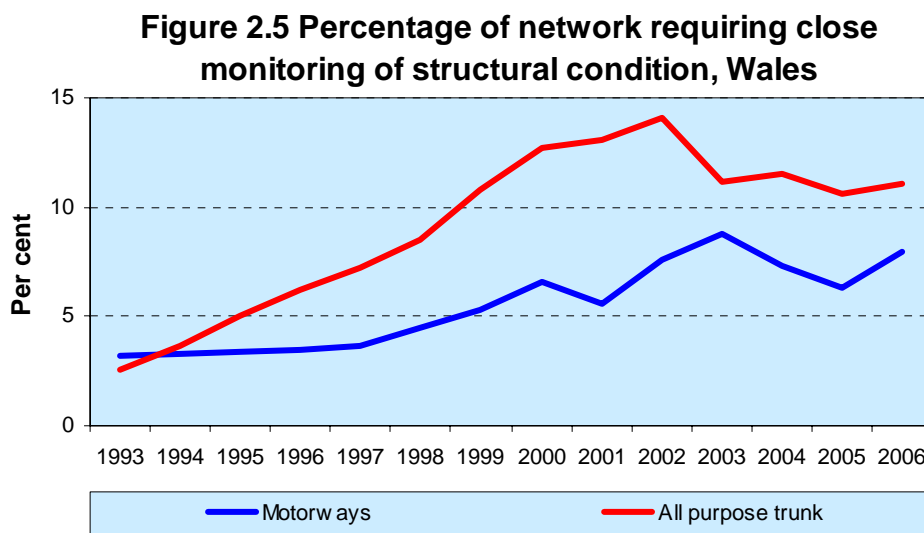


1. In practice, rutting alone would not generally be treated on unclassified roads and so the contribution is assumed to be zero.

## Structural condition

- 2.16 To supplement results on visual road condition, DfT has been producing structural survey indicators, based on data from local engineering surveys. These indicators have been used to report on the proportion of the major road network where structural condition has deteriorated to the point at which close monitoring is needed to see whether maintenance is required.
- 2.17 Results for English motorways and all purpose trunk roads have not been available since 2002, following changes in the way the Highways Agency monitors its network. In 2006, due to variations in the supply of data, there have been some difficulties producing results for principal roads in England and Wales. Further analyses and additional data processing are needed, and as a result indicators for principal roads are not available at this time. A separate paper will be produced during June to provide analysis of the issues and explanation of the effects. Consequently, results are only reported here for Welsh motorways and all purpose trunk roads.

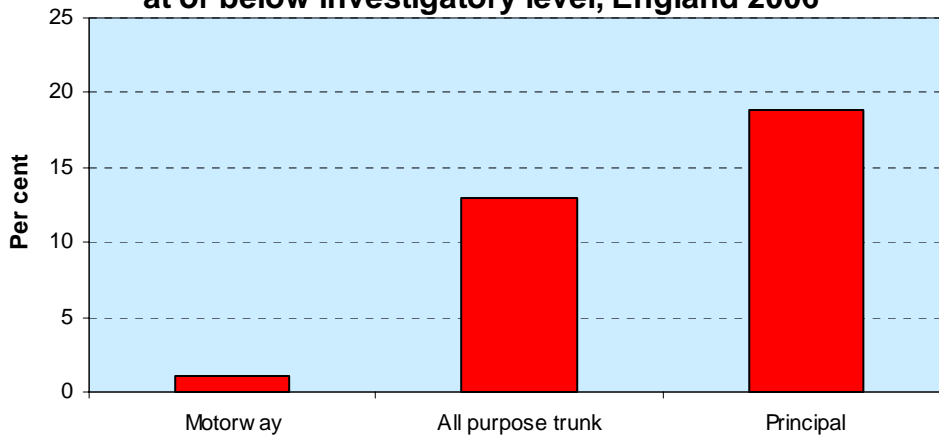
- 2.18 Figure 2.5 shows the motorway and all purpose trunk road figures for Wales. In 2006, 7.9 per cent of motorways needed close monitoring, a slightly higher level than in 2000.
- 2.19 The National Assembly for Wales has been working to a target that by 2004-05 no more than 13 per cent of the all purpose trunk roads network should need close monitoring of its structural condition. The 2006 value was 11.1 per cent, which is very similar to the 2000 level.



### Skidding resistance

- 2.20 Road safety is improved when roads have a satisfactory level of skidding resistance. The skidding resistance of major roads is assessed when the road surface is wet and compared with an investigatory level that is set for the characteristics of the particular length of road. Where the skidding resistance is below the investigatory level, the road is not necessarily unsafe but it does show that further investigation is required. This further investigation would include an assessment of the safety record for the length of road and assessment of the road features, to see if maintenance is needed. Latest results for England are shown in Figure 2.6.

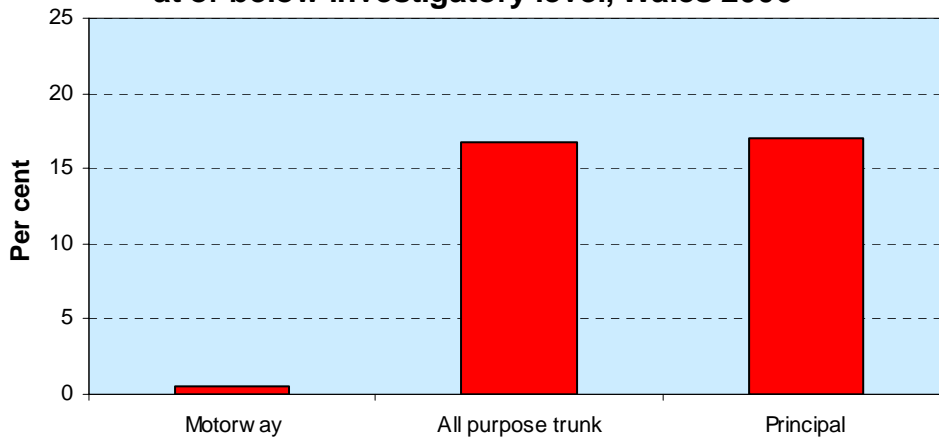
**Figure 2.6 Skidding resistance, percentage length at or below investigatory level, England 2006<sup>1</sup>**



1. Figures for principal roads relate to the average in 2003 to 2005
2. Figures for motorways and all purpose trunk roads are for lane 1 and are based on different investigatory standards to those for principal roads

2.21 The percentage needing further investigation was lowest for motorways and highest for principal roads. In particular, 51 per cent of principal roads in London and 28 per cent in metropolitan authorities needed further investigation to determine if remedial treatment in relation to skidding resistance is required. Figure 2.7 shows the latest skidding resistance results for Wales.

**Figure 2.7 Skidding resistance, percentage length at or below investigatory level, Wales 2006<sup>1</sup>**



1. Figures for principal roads relate to the average in 2003 to 2005
2. Figures for motorways and all purpose trunk roads are based on different investigatory standards to those for principal roads

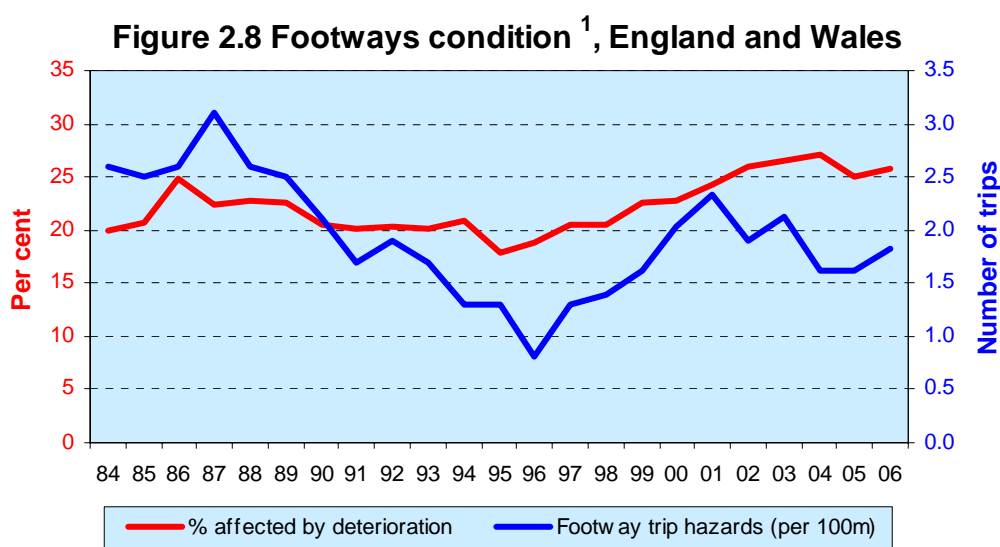
## Trunk roads in England

2.22 Highways Agency results from machine based surveys of the surface condition of lane 1 the English trunk road network are derived from comparisons of the severity of each type of defect with thresholds representing levels of condition where treatment may be required. Results represent the percentage of the network where the threshold for at least one aspect of condition has been exceeded. In 2006, 5 per cent of motorways in England needed further investigation to see if maintenance is required, compared with 7 per cent on all purpose trunk roads.

## Footways, verges and kerbs

2.23 Along with the condition of roads, the NRMCS also collects visual survey information on the condition of footways, verges and kerbs on all local roads and, prior to 2003, on all purpose trunk roads as well. Results are therefore no longer available for all road classes (excluding motorways). However the relatively short length of all purpose trunk roads means their exclusion from the survey makes little difference to the overall total and comparisons between recent figures for non-trunk roads and historic figures for non-trunk roads and all purpose trunk roads should provide a relatively consistent picture of changes over time.

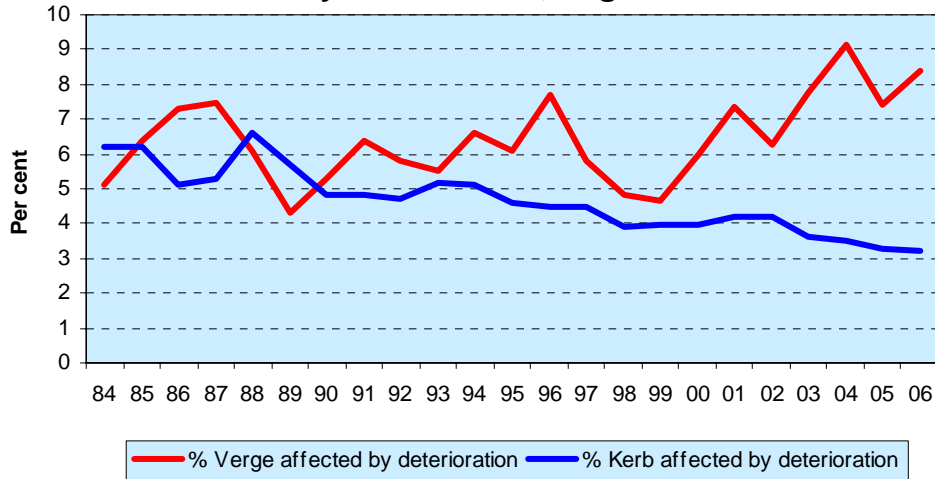
2.24 Figure 2.8 shows that the percentage length of footways, in England and Wales, affected by deterioration (a combination of various defects on the footway) rose steadily between 1995 and 2001 and has been at around 25 to 26 per cent for the last four years. The steady rise in the number of ‘trip hazards’ (spot conditions per 100 metres posing potential danger to pedestrians) over the latter part of the 1990s has also halted, staying at around 2 trip hazards per 100m or less since 2000.



1. Figures are for local roads from 1999. Prior to that they include all purpose trunk roads although this will have little effect on the overall total.

2.25 The percentages of verges and kerbs affected by deterioration are shown in Figure 2.9. The percentage of **verge area** which is disintegrating or deformed has varied considerably over the years and it is difficult to draw conclusions about current trends. In 2006, the percentage of **kerb lengths** which need replacing or resetting is at its lowest level since the survey began.

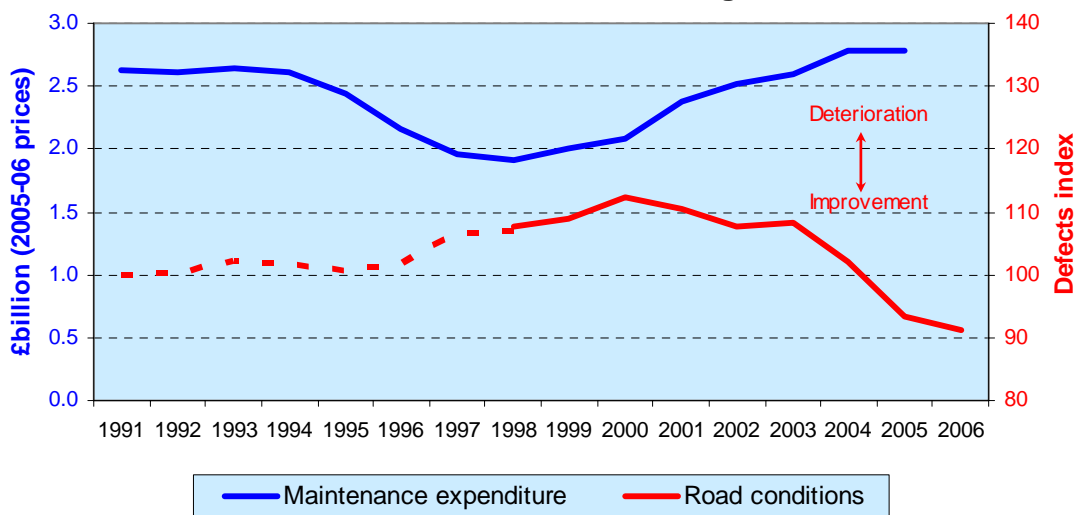
**Figure 2.9 Percentage of verges and kerbs<sup>1</sup> affected by deterioration, England and Wales**



## Maintenance expenditure

2.26 Levels of maintenance expenditure on local roads in England were fairly stable in the early 1990s but were around some 25 per cent lower towards the end of the decade (see Figure 2.10). During this period, visible conditions on local roads worsened. Since then, funding has increased and this has been followed by the recent overall improvement in conditions. Expenditure did not increase in real terms between 2004-05 and 2005-06, but it should be noted that the adjustment to bring earlier years figures on to 2005-06 prices is based on GDP deflators, rather than engineering specific cost indices, at a time when maintenance costs are rising at rates above more general inflation.

**Figure 2.10 Maintenance expenditure<sup>1</sup> and surface road conditions<sup>2</sup> on local roads, England<sup>3</sup>**



1. Expenditure relates to the financial year. Figures for 2006-7 are not yet available.
2. An increase in the index indicates deterioration; a decrease indicates improvement.
3. A defects index for England is not available prior to 1998 so the index for England and Wales is included as an indication of the earlier trend.



### 3. VISUAL SURVEY

#### Description

- 3.1 This sample survey is used to measure trends in the visual road condition in England and Wales by comparing changes in a 'defects index' for the following types of road (see Annex 2 for definitions):
- All purpose trunk roads - until 2002.
  - Principal roads – built-up and non built-up
  - Classified roads – built-up and non built-up
  - Unclassified roads – built-up and non built-up
- 3.2 Information collected on the condition of footways, verges and kerbs is not included in the calculation of the defects index, but is presented separately in Tables 3.2 to 3.4.
- 3.3 The defects index is set at 100 for the base year 1977. **A significant increase in the value of the defects index relates to deterioration in road conditions and a significant decrease relates to an improvement.** Definitions of individual defects, details on survey coverage and methodology and a description of the defects index are included in Annex 3.
- 3.4 The network wide visual survey on all purpose trunk roads ceased in 2002 following changes in the methods used to monitor their condition. Results for all purpose trunk roads and therefore all road classes are no longer available from 2003 onwards. The tables in this section include estimates for all non-trunk roads from 1999. The relatively short length of all purpose trunk roads means their exclusion from the survey makes little difference to the overall totals and so comparisons between recent figures for non-trunk roads and historic figures for all road classes should provide a relatively consistent picture of changes over time.
- 3.5 From 2007 onwards, DfT will no longer be collecting visual survey data on classified roads. Visual survey data will only be collected on unclassified roads in England, with no data at all collected on Welsh roads. In future years, DfT will report on the condition of classified roads in England using SCANNER machine survey data. The National Assembly for Wales will use the SCANNER surveys to report on all Welsh local roads.

#### Visual survey results for roads

- 3.6 Trends in the defects index for each road class are presented in Table 3.1. This shows estimated national average values and, in order to reflect sampling error, gives ranges for 2006 within which the true national average defects indices lie with a 90 per cent probability. Figure 3.1 shows that the non-trunk roads defects index for England and Wales has fallen substantially since its 2000 peak. A decrease in the index represents improving road conditions but, for it to be possible to say with confidence that condition in one year is different from that in another, the confidence limits (as represented by the dotted lines) should not overlap.
- 3.7 Taking into account the confidence limits, statistical analysis shows that the significant improvement in local road conditions in England and Wales since 2000 has been sustained. The net fall in the index over this period is unlikely to be a result of sampling error alone and probably reflects a real improvement in road conditions. The 90% confidence interval for the change since 2000 was between 16 and 21 points, with the point estimates being 109.5 in 2000 and 91.1 in 2005.
- 3.8 The change between 2005 and 2006 is not statistically significant.

**Table 3.1 Defects index by road class <sup>1</sup>**  
England and Wales 1984 to 2006

Year	Average values (1977=100)								All roads <sup>3</sup>
	All purpose trunk	Non-trunk						All non-trunk	
		Built-up <sup>2</sup>			Non built-up <sup>2</sup>				
	Principal	Classified	Unclassified	Principal	Classified	Unclassified			
<b>England and Wales</b>									
1984	102.5	104.0	95.7	83.0	105.4	89.8	99.4	91.7	<b>92.2</b>
1985	121.6	112.7	97.1	84.3	98.6	100.6	112.2	96.7	<b>97.8</b>
1986	121.5	118.4	112.5	88.3	98.9	103.8	123.3	102.1	<b>103.0</b>
1987	111.4	114.6	104.8	91.2	101.7	102.0	120.7	101.7	<b>102.1</b>
1988	108.0	101.1	107.3	91.9	100.5	108.1	116.9	101.9	<b>102.2</b>
1989	111.2	92.8	106.1	85.4	101.6	105.9	114.7	98.0	<b>98.6</b>
1990	101.7	96.1	109.7	84.4	98.0	101.0	105.8	95.6	<b>95.9</b>
1991	101.8	101.4	106.2	90.5	100.1	104.5	114.1	100.0	<b>100.1</b>
1992	102.3	119.2	102.5	91.7	99.7	104.3	103.0	100.2	<b>100.3</b>
1993	95.9	114.6	112.5	97.9	97.7	102.7	99.9	102.0	<b>101.8</b>
1994	92.0	109.5	115.2	99.6	92.7	99.8	101.9	101.5	<b>101.1</b>
1995	89.0	107.5	121.2	92.3	92.6	100.1	113.0	100.7	<b>100.2</b>
1996	91.1	120.5	110.8	97.6	90.0	94.5	120.1	101.9	<b>101.4</b>
1997	83.9	123.1	122.8	105.6	89.7	96.5	118.1	106.5	<b>105.6</b>
1998	93.8	122.2	124.8	105.3	91.4	98.2	113.3	106.6	<b>106.1</b>
1999	90.4	129.7	140.2	105.9	88.2	93.3	119.0	108.5	<b>107.8</b>
2000	82.7	118.3	130.4	111.9	89.0	92.2	126.3	109.5	<b>108.4</b>
2001	74.4	115.5	122.9	111.0	86.8	94.0	125.7	108.3	<b>107.0</b>
2002	..	104.4	122.3	104.5	82.1	96.0	138.6	106.4	<b>105.7</b>
2003	..	99.3	115.7	107.7	84.3	94.6	141.3	106.7	..
2004	..	93.7	124.8	98.0	73.3	85.4	139.7	100.3	..
2005	..	79.4	104.2	95.6	69.1	81.6	122.1	92.9	..
2006	..	70.8	92.2	93.8	69.7	87.0	118.4	91.1	..
<b>90 per cent confidence limits</b>									
2006 upper	..	75.7	97.3	97.5	72.6	89.9	124.7	92.9	..
2006 lower	..	65.8	87.1	90.2	66.8	84.2	112.1	89.2	..
<b>England only</b>									
1998	95.5	120.6	127.7	103.7	93.7	101.0	117.6	107.7	<b>107.3</b>
1999	88.9	129.4	140.9	104.4	89.8	96.1	119.5	109.0	<b>108.3</b>
2000	83.5	121.2	133.5	112.6	91.5	96.5	133.0	112.5	<b>111.4</b>
2001	78.5	114.3	125.3	110.3	89.9	99.8	131.7	110.5	<b>109.4</b>
2002	..	101.5	122.7	104.0	85.0	100.9	141.3	107.6	<b>107.1</b>
2003	..	101.0	117.1	108.1	86.5	97.9	144.3	108.4	..
2004	..	96.7	127.2	97.6	75.0	87.9	144.7	101.9	..
2005	..	79.6	105.6	95.2	71.0	81.8	124.7	93.5	..
2006	..	71.3	91.8	93.5	70.9	87.5	119.8	91.2	..
<b>90 per cent confidence limits</b>									
2006 upper	..	76.4	97.1	97.3	74.0	90.6	126.8	93.3	..
2006 lower	..	66.2	86.6	89.6	67.8	84.5	112.8	89.2	..
<b>Wales only</b>									
1998	..	..	..	..	..	..	..	98.7	<b>97.8</b>
1999	..	..	..	..	..	..	..	103.8	<b>103.4</b>
2000	..	..	..	..	..	..	..	82.5	<b>82.3</b>
2001	..	..	..	..	..	..	..	87.9	<b>85.7</b>
2002	..	..	..	..	..	..	..	94.8	<b>92.6</b>
2003	..	..	..	..	..	..	..	91.0	..
2004	..	..	..	..	..	..	..	85.3	..
2005	..	..	..	..	..	..	..	87.9	..
2006	..	..	..	..	..	..	..	89.4	..
<b>90 per cent confidence limits</b>									
2006 upper	..	..	..	..	..	..	..	94.1	..
2006 lower	..	..	..	..	..	..	..	84.6	..

1 An increase in the index indicates deterioration.

2 Built-up and non built-up were previously referred to as urban and rural.

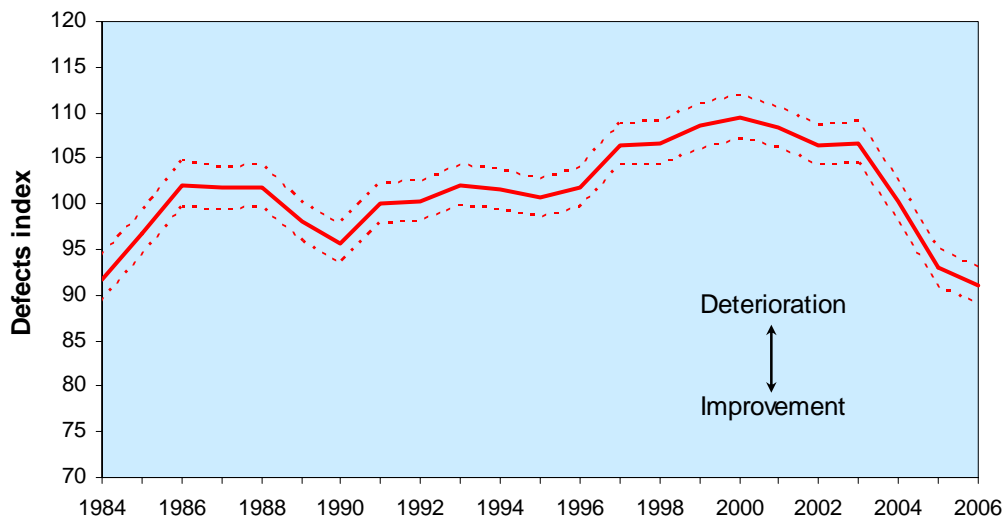
3 Excludes motorways.

.. The small sample size means that reliable figures by individual road class are not available. However, results for these road classes have been used in calculating aggregated totals. Results for all purpose trunk roads, and hence all roads, are not available from 2003.

3.9 Figures in Table 3.1 from 1998 onwards are based on an improved methodology which includes estimates for non-responding authorities. It has not been possible to recalculate

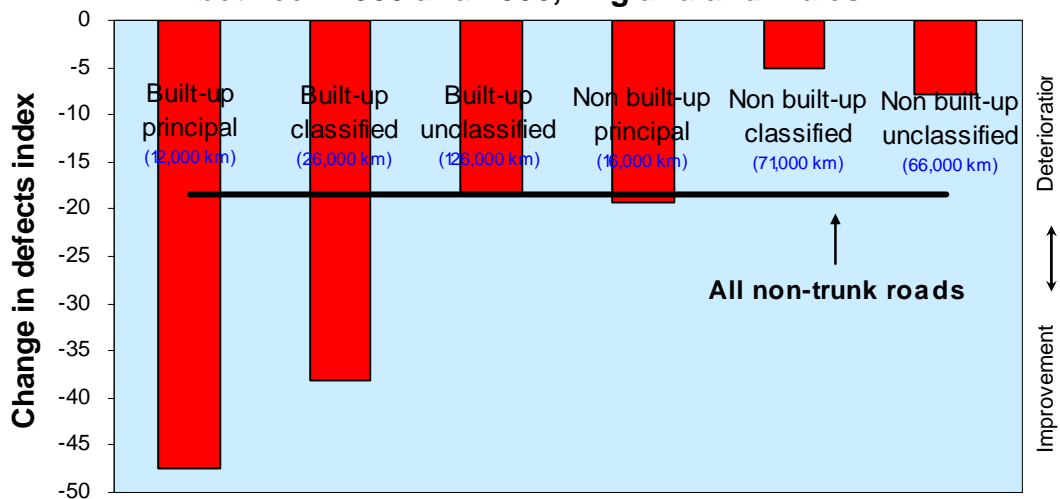
results for earlier years because detailed records are not readily available. However, the resulting annual revisions to national estimates are small and not statistically significant.

**Figure 3.1 Defects index, England and Wales - non-trunk roads**



3.10 Changes in road condition vary across different road types. The changes since 2000 for the different local road types in England and Wales are presented in Figure 3.2.

**Figure 3.2 Change in defects index by road class between 2000 and 2006, England and Wales**



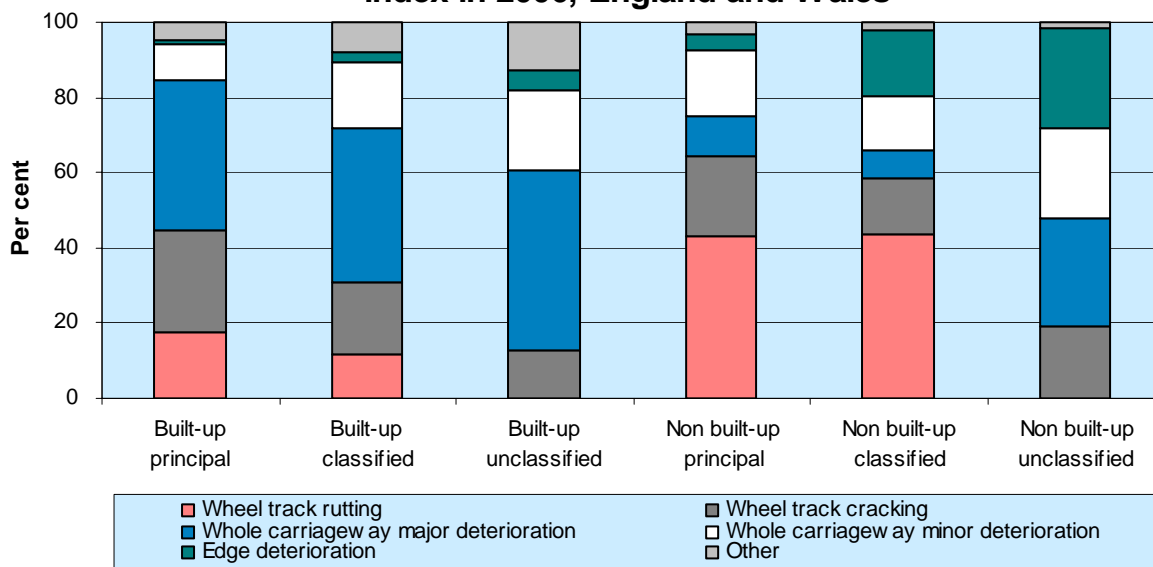
3.11 Between 2000 and 2006, the defects index fell significantly for all local road classes apart from non built-up unclassified roads. The results for non built-up unclassified roads showed a real worsening in condition before 2005, but the index for these roads has now returned to a condition similar to that in the late 1990s. Real improvements have been seen on all other types of roads.

3.12 The defects index is derived from a combination of extent, severity and cost of treatment for various defects (see Annex 3). The estimated contributions of the defect types to the local road defects index in 2006 are shown in Figure 3.3.

3.13 Whole carriageway major deterioration has the biggest impact on the defects index for built-up roads whereas rutting contributes most to the index on non built-up principal and classified roads. Whole carriageway major deterioration has a large effect on non-built-up unclassified roads too, as does edge deterioration since these tend to be country lanes without kerbs.

3.14 The contributions of the different defects in 2006 was very similar to that in 2005.

**Figure 3.3 Percentage contribution of defects <sup>1</sup> to defects index in 2006, England and Wales**

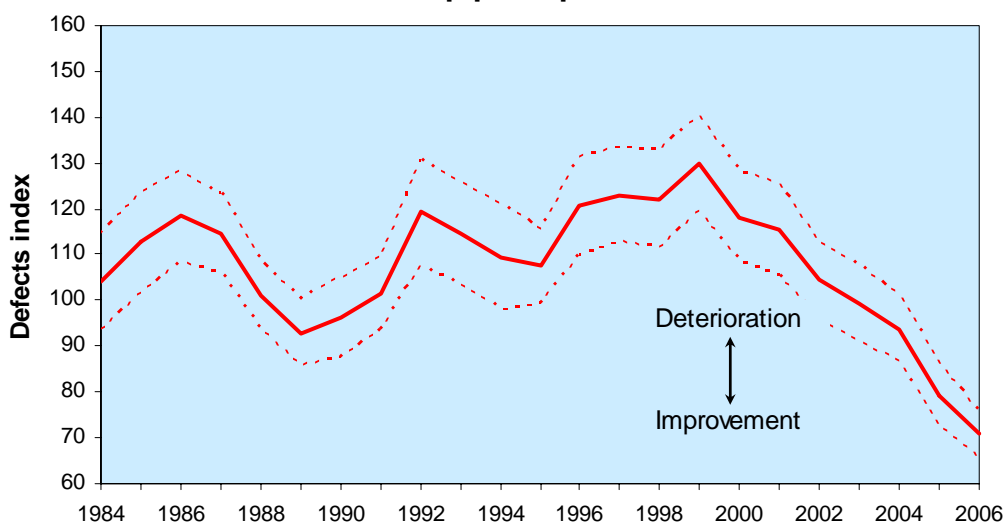


1. In practice, wheel track rutting alone would not generally be treated on unclassified roads and so the contribution is assumed to be zero.

### Non-trunk roads results by individual road class

3.15 In the case of road conditions the magnitude of year on year changes can be expected to be quite small. This means that normally a trend is composed of a series of annual changes each of which is not statistically significant but which over a number of years produce a significant difference. Where annual changes are statistically significant, there are still relatively large error bands around the point estimates. It is therefore sensible to make comparisons over a number of years and not focus exclusively on year on year changes. 90 per cent confidence intervals around the condition index values are represented on the chart by the dotted lines. A more detailed examination of the changes for each road class is shown in Figures 3.4 to 3.9.

**Figure 3.4 Defects index, England and Wales - Built-up principal roads**



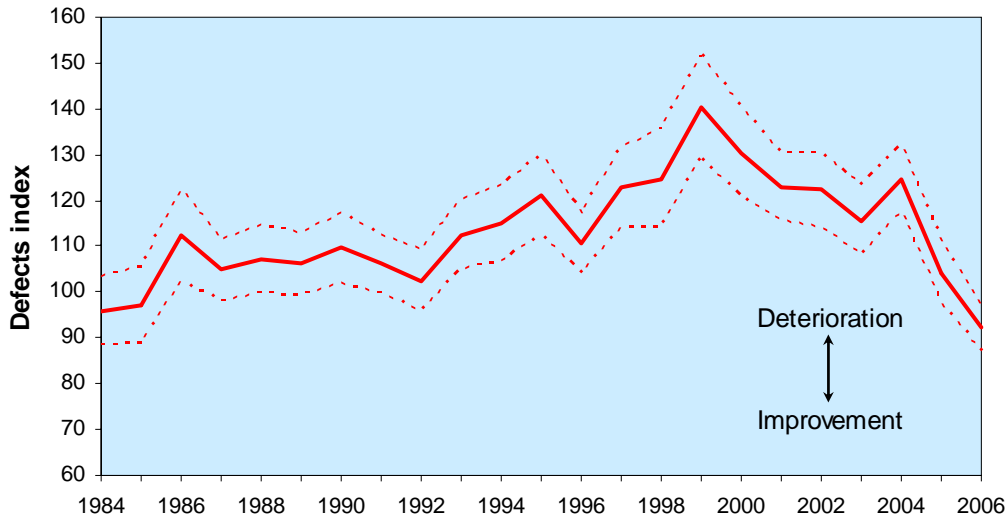
### Built-up principal roads (12,000 kilometres)

3.16 Conditions on built-up principal roads have consistently improved over the last seven years (see Figure 3.4). The defects index increased by 34 points during the 1990s but has since

fallen by almost 60 points. In 2006, about 40 per cent of the defects index value for this road type arose from whole carriageway major deterioration and around a quarter was from wheel track cracking (see Figure 3.3).

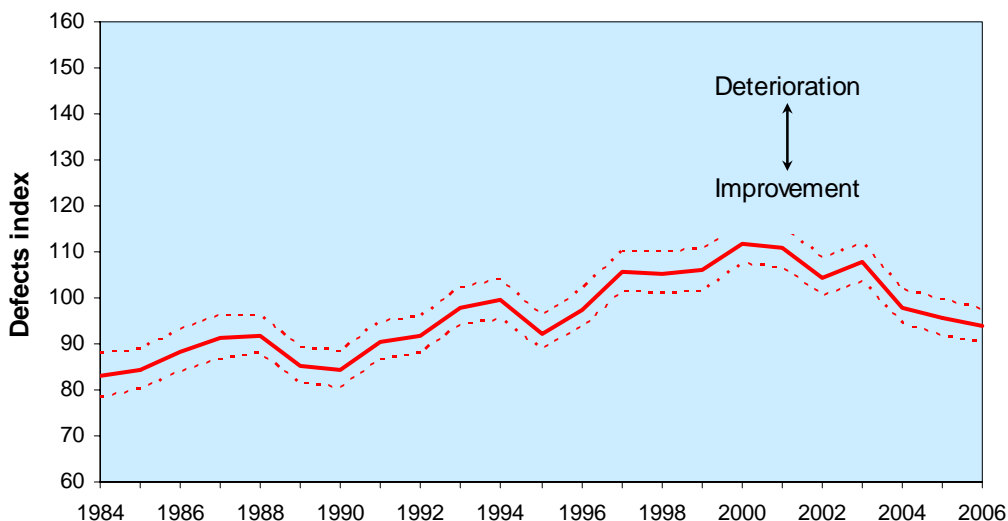
**Built-up classified roads (26,000 kilometres)**

**Figure 3.5 Defects index, England and Wales - Built-up classified roads**



3.17 Conditions have also improved on built-up classified roads in recent years. Although the defects index rose in 2004 on this road type, the increase was not statistically significant and there has been a clear general decreasing trend overall since 1999. The index is now 48 points below its 1999 peak. The fall since 1999 has followed a 10 year period of declining conditions, during which the index increased by 34 points. In 2006, about 40 per cent of the defects index on built-up classified roads was caused by whole carriageway major deterioration (see Figure 3.3).

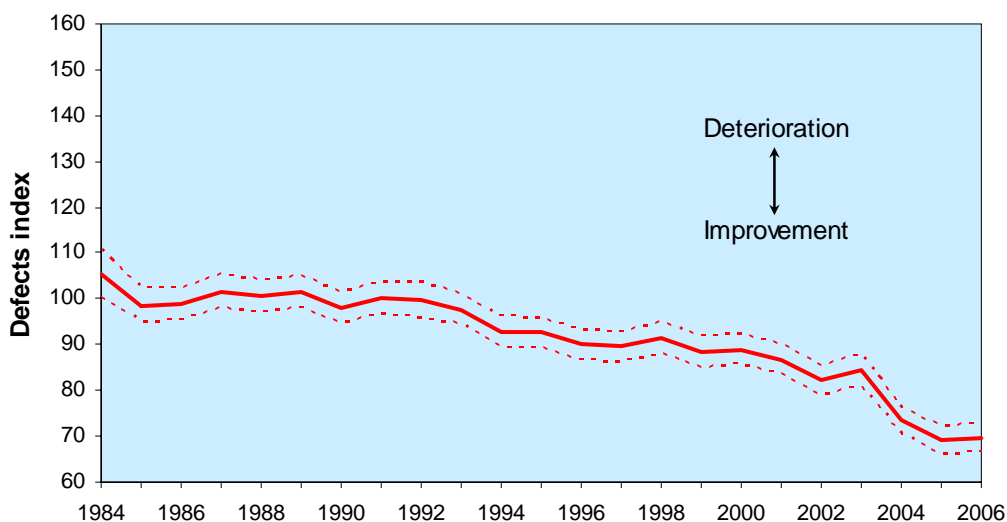
**Figure 3.6 Defects index, England and Wales - Built-up unclassified roads**



### Built-up unclassified roads (126,000 kilometres)

3.18 Built-up unclassified roads account for 40 per cent of all local roads and, as can be seen by a comparison with the trend in Figure 3.1, their condition has a powerful influence on the non-trunk roads defects index (see Figure 3.6). Overall, these roads have now improved since 2000, with the index falling by 17 points. As with all classes of built-up roads, whole carriageway major deterioration accounted for a large part (47 per cent) of the defects index (see Figure 3.3) on this type of road.

**Figure 3.7 Defects index, England and Wales - Non built-up principal roads**



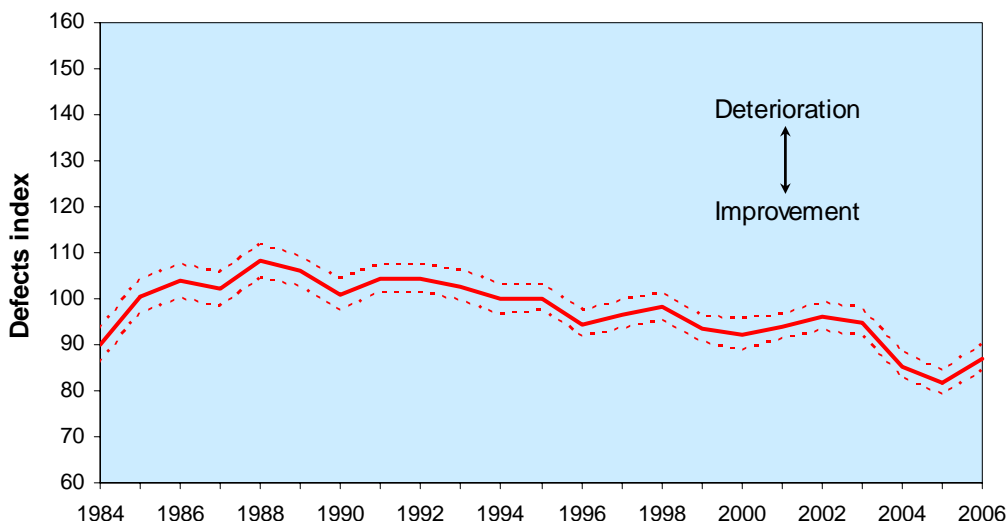
### Non built-up principal roads (16,000 kilometres)

3.19 The defects index for non built-up principal roads continues to have the lowest value of any road class, signifying the greatest improvement in conditions since the survey began in 1977. Conditions are about the same as in 2005. The largest contributors to the defects index for these roads in 2006 were wheel track rutting and wheel track cracking – 43 per cent and 22 per cent respectively (see Figure 3.3).

### Non built-up classified roads (71,000 kilometres)

3.20 The defects index for non built-up classified roads has increased by 5 points in the last year and this is a significant worsening of condition (see Figure 3.8). However, conditions are still

**Figure 3.8 Defects index, England and Wales - Non built-up classified roads**

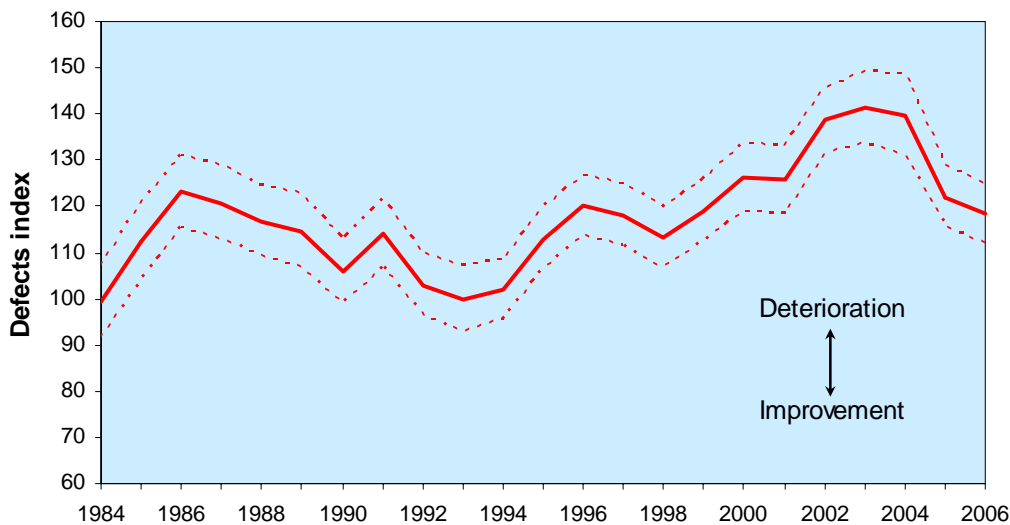


significantly better compared with the 2000 position. About 44 per cent of the defects index for non built-up classified roads in 2006 was accounted for by wheel track rutting, 18 per cent by edge deterioration and 15 per cent by wheel-track cracking (see Figure 3.3).

### Non built-up unclassified roads (66,000 kilometres)

3.21 Conditions on non built-up unclassified roads have not significantly changed in 2006 (see Figure 3.9), although the index fell to 118.4. This is still the highest of any road class and not a significant improvement over the 2000 position. Having the highest index signifies that conditions on this group of roads have deteriorated more than other classes, relative to their conditions when the survey began in 1977, but does not necessarily mean these roads are in worse absolute condition than other road types. Edge deterioration accounted for around 27 per cent and whole carriageway major deterioration for about 29 per cent of the defects index for these roads in 2006 (see Figure 3.3).

**Figure 3.9 Defects index, England and Wales -  
Non built-up unclassified roads**



## Visual survey results for footways, verges and kerbs

### Footways

3.22 There are estimated to be almost 300,000 km of footways on non-trunk roads in England and Wales, of which 213,000 km are on built-up unclassified roads (see Table A3.6 in Annex 3). There are insufficient footways on non built-up unclassified roads for reliable footway estimates to be produced for this road type.

3.23 There are two measures of footway defects covered by the survey:

- **Footway Deterioration** - the percentage of footways subject to deterioration (see Annex 3 for defects included in 'footway deterioration'); and
- **Footway Trip Hazards** - the average number of spot conditions in every 100 metres of road which constitute a specific danger to pedestrians. Where a surveyed site has a footway on both sides of the carriageway, the average condition of the two footways is used in the calculation of the national average.

3.24 Trends in the two measures of footway condition are summarised in Table 3.2 and in Figures 3.10 and 3.11. Note that the fine dotted lines represent 90 per cent confidence limits of the condition measurements.

**Table 3.2 Condition of footways by road class**  
England and Wales 1984 to 2006

Year	All purpose trunk <sup>1</sup>	Non-trunk						All non-trunk	All classes <sup>1</sup>
		Built-up <sup>2</sup>			Non built-up <sup>2</sup>				
		Principal	Classified	Unclassified	Principal	Classified	Unclassified <sup>3</sup>		
<b>Footway deterioration (per cent) <sup>4</sup></b>									
1984	18.1	19.3	19.2	21.2	27.7	24.7	..	..	<b>20.0</b>
1985	15.8	19.7	19.2	20.6	28.7	33.1	..	..	<b>20.7</b>
1986	19.3	23.9	21.2	25.5	32.6	29.5	..	..	<b>24.9</b>
1987	18.8	19.9	21.2	22.3	32.5	23.8	..	..	<b>22.3</b>
1988	19.7	21.3	20.5	22.9	31.7	24.2	..	..	<b>22.7</b>
1989	20.0	18.7	21.5	22.7	25.6	31.3	..	..	<b>22.5</b>
1990	18.5	19.0	19.8	20.6	27.7	25.2	..	..	<b>20.6</b>
1991	14.4	19.0	19.0	20.3	26.0	19.2	..	..	<b>20.1</b>
1992	17.2	17.7	18.9	20.7	26.2	21.1	..	..	<b>20.3</b>
1993	16.8	18.0	19.2	20.3	26.1	21.6	..	..	<b>20.2</b>
1994	14.4	18.5	18.4	21.3	25.4	24.3	..	..	<b>20.8</b>
1995	13.1	15.8	16.2	18.0	25.3	24.1	..	..	<b>17.9</b>
1996	14.3	17.6	16.2	19.3	26.2	21.3	..	..	<b>18.9</b>
1997	..	16.7	18.7	21.1	26.6	23.1	..	..	<b>20.6</b>
1998	..	17.4	17.2	21.2	26.7	27.5	..	..	<b>20.5</b>
1999	..	18.1	19.6	23.2	28.7	24.2	..	22.5	<b>22.3</b>
2000	..	20.0	20.2	23.1	30.7	30.8	..	22.8	<b>22.6</b>
2001	..	21.7	20.8	24.6	30.1	32.5	..	24.2	<b>24.0</b>
2002	..	22.1	21.5	27.1	30.3	21.7	..	25.9	<b>25.8</b>
2003	..	20.8	24.4	26.8	30.3	25.8	..	26.5	..
2004	..	21.9	23.8	27.8	28.1	26.5	..	27.2	..
2005	..	20.0	22.6	25.1	29.6	27.8	..	24.9	..
2006	..	20.5	24.3	25.7	30.4	32.5	..	25.7	..
<b>90 per cent confidence limits</b>									
2006 upper	..	21.4	25.3	26.6	32.8	36.7	..	26.4	..
2006 lower	..	19.5	23.3	24.8	27.9	28.3	..	25.1	..
<b>Footway trip hazards (number of trip hazards) per 100 metres <sup>4</sup></b>									
1984	0.9	2.1	2.6	2.8	0.6	1.7	..	..	<b>2.6</b>
1985	0.6	2.3	2.0	2.8	0.5	1.8	..	..	<b>2.5</b>
1986	1.3	2.6	2.3	2.8	0.5	1.1	..	..	<b>2.6</b>
1987	1.2	2.4	2.5	3.5	0.7	1.2	..	..	<b>3.1</b>
1988	0.9	2.1	2.0	3.0	0.3	0.4	..	..	<b>2.6</b>
1989	0.5	2.2	2.1	2.8	0.5	1.0	..	..	<b>2.5</b>
1990	0.6	1.6	1.8	2.3	0.6	1.2	..	..	<b>2.1</b>
1991	0.5	1.6	1.4	1.9	0.4	0.3	..	..	<b>1.7</b>
1992	0.8	1.6	1.2	2.2	0.4	0.2	..	..	<b>1.9</b>
1993	0.6	1.4	1.5	1.9	0.2	0.3	..	..	<b>1.7</b>
1994	0.4	1.4	1.1	1.4	0.2	0.1	..	..	<b>1.3</b>
1995	0.4	1.1	0.8	1.5	0.2	0.1	..	..	<b>1.3</b>
1996	0.3	0.9	0.7	0.9	0.4	0.2	..	..	<b>0.8</b>
1997	..	1.0	1.0	1.5	0.3	0.5	..	..	<b>1.3</b>
1998	..	1.4	0.9	1.6	0.3	0.4	..	..	<b>1.4</b>
1999	..	1.4	1.7	1.8	0.6	0.4	..	1.6	<b>1.6</b>
2000	..	1.7	1.6	2.2	0.5	1.3	..	2.0	<b>2.0</b>
2001	..	1.8	1.9	2.5	1.4	1.9	..	2.3	<b>2.3</b>
2002	..	2.0	1.5	2.1	0.6	0.8	..	1.9	<b>1.9</b>
2003	..	1.5	1.6	2.4	0.8	1.0	..	2.1	..
2004	..	1.5	1.4	1.7	0.7	0.2	..	1.6	..
2005	..	1.1	1.3	1.8	0.5	0.2	..	1.6	..
2006	..	1.4	1.5	1.9	1.1	1.6	..	1.8	..
<b>90 per cent confidence limits</b>									
2006 upper	..	1.6	1.6	2.1	1.6	3.2	..	2.0	..
2006 lower	..	1.1	1.3	1.7	0.6	-	..	1.7	..

1 Excludes motorways. Trunk road agents took over responsibility for providing data in 1997. This led to a reduction in the response rates. Results for all purpose trunk roads since 1997 are therefore subject to considerable error and are not shown separately. Results for all purpose trunk roads, and hence all road classes, are not available from 2003 and so results for all non-trunk roads have been included from 1999 to allow comparisons over time to be made.

2 Built-up and non built-up were previously referred to as urban and rural.

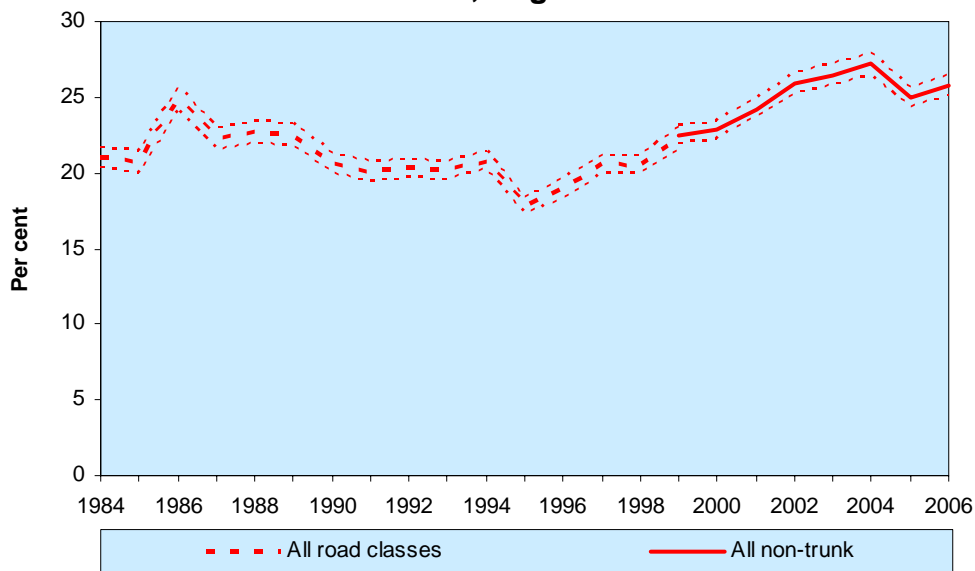
3 The small sample size means results are subject to considerable sample error and are therefore not shown separately.

4 See paragraph 3.22 for definitions.

3.25 In 2006, 25.7 per cent of footways on non-trunk roads were subject to deterioration, which is a similar level to 2002. There had been a steady decline in condition between 1995 and 2004, represented by a 9 per cent overall increase in percentage of footways affected by deterioration (see Figure 3.10).

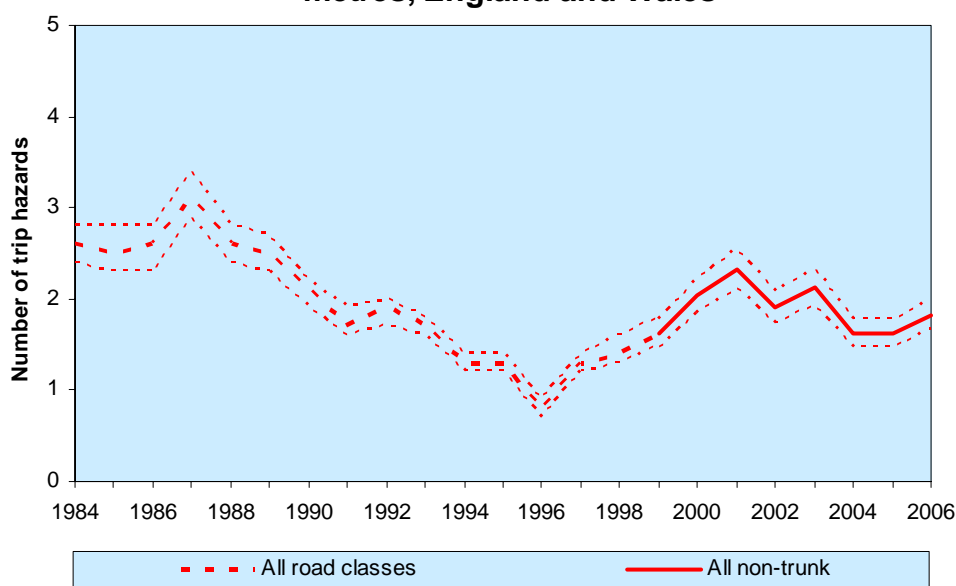
3.26 The worsening footway conditions on non-trunk roads between 2001 and 2004, as indicated by a **significant** increase in the percentage affected by deterioration, were mainly a result of significant increases in deterioration on built-up classified and unclassified roads. These classes of road account for 86 per cent of the total footway length. In 2006, around 26 per cent of footways on built-up unclassified roads were affected by deterioration.

**Figure 3.10 Percentage of footways affected by deterioration, England and Wales**



3.27 The steady rise in the number of footway trip hazards from 1996 to 2000 appears to have been halted (see Figure 3.11), with no significant change since 2000. As with footway deterioration, the overall result and trend is largely determined by the condition on built-up unclassified roads. These tend to be footways on residential streets and Table 3.2 shows that they have the highest number of trip hazards for any road class.

**Figure 3.11 Number of footway trip hazards per 100 metres, England and Wales**



## Verges

3.28 There are estimated to be 305,000 km of verge of all types (including bituminous and soft verges) on non-trunk roads in England and Wales. Verges are mostly on non built-up classified and unclassified roads (see Table A3.6 in Annex 3). Trends in the condition of verges are summarised in Table 3.3 and in Figure 3.12. Note that the fine dotted lines represent 90 per cent confidence limits of the condition measurements.

**Table 3.3** Condition of verges by road class, percentage affected by deterioration  
England and Wales 1984 to 2006

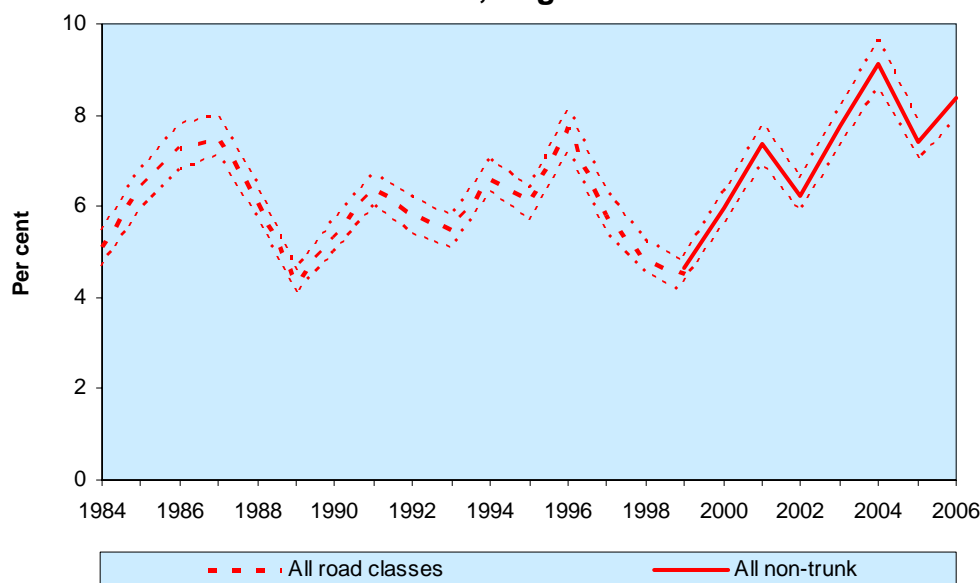
Year	Percentage								
	All purpose trunk <sup>1</sup>	Non-trunk						All non-trunk	All classes <sup>1</sup>
		Built-up <sup>2</sup>			Non built-up <sup>2</sup>				
	Principal	Classified	Unclassified	Principal	Classified	Unclassified			
1984	4.6	8.9	7.9	8.4	3.3	4.3	4.5	..	<b>5.1</b>
1985	6.4	8.8	8.4	9.9	3.9	5.4	5.8	..	<b>6.4</b>
1986	4.0	11.3	10.7	11.5	4.1	6.2	6.7	..	<b>7.3</b>
1987	4.3	6.8	9.5	10.2	4.5	7.2	7.5	..	<b>7.5</b>
1988	3.8	7.9	7.8	10.1	3.6	5.0	5.8	..	<b>6.1</b>
1989	3.3	6.4	8.2	7.4	3.3	3.8	3.4	..	<b>4.3</b>
1990	3.7	8.1	9.9	7.7	5.2	5.0	4.4	..	<b>5.3</b>
1991	5.2	8.1	9.0	7.6	5.1	6.3	5.8	..	<b>6.4</b>
1992	4.4	5.6	7.4	8.3	4.0	6.0	4.7	..	<b>5.8</b>
1993	5.2	6.0	7.3	7.2	3.6	5.8	4.4	..	<b>5.5</b>
1994	4.0	6.1	9.3	8.3	3.3	6.3	7.0	..	<b>6.6</b>
1995	2.9	5.7	8.5	6.7	3.0	6.4	6.2	..	<b>6.1</b>
1996	4.2	7.6	7.6	9.4	4.2	7.6	8.0	..	<b>7.7</b>
1997	..	7.6	6.9	9.0	2.8	6.0	4.8	..	<b>5.8</b>
1998	..	5.7	7.3	7.1	3.0	4.7	4.3	..	<b>4.8</b>
1999	..	7.6	6.9	8.6	2.9	4.1	3.1	4.6	<b>4.5</b>
2000	..	5.5	7.0	9.6	2.0	5.8	4.9	6.0	<b>5.8</b>
2001	..	5.1	7.0	10.9	3.1	6.4	7.7	7.4	<b>7.2</b>
2002	..	6.0	7.9	11.2	2.1	4.8	5.7	6.2	<b>6.1</b>
2003	..	5.8	8.5	12.5	2.6	5.6	7.9	7.8	..
2004	..	5.0	8.6	10.8	4.1	8.8	9.0	9.1	..
2005	..	6.9	7.6	10.7	4.1	6.8	6.3	7.4	..
2006	..	5.2	8.5	8.5	4.4	7.8	9.2	8.4	..
<b>90 per cent confidence limits</b>									
2006 upper	..	6.0	9.7	9.6	5.1	8.7	10.0	8.9	..
2006 lower	..	4.3	7.2	7.4	3.7	7.0	8.4	7.9	..

1 Excludes motorways. Trunk road agents took over responsibility for providing data in 1997. This led to a reduction in the response rates. Results for all purpose trunk roads since 1997 are therefore subject to considerable error and are not shown separately. Results for all purpose trunk roads, and hence all road classes, are not available from 2003 and so results for all non-trunk roads have been included from 1999 to allow comparisons over time to be made.

2 Built-up and non built-up were previously referred to as urban and rural.

3.29 Verge deterioration (see Annex 3 for definition) has varied considerably over the years and it is difficult to draw firm conclusions about current trends. In 2005, 8.4 per cent of non-trunk verge area was affected by deterioration. Verges on non built-up unclassified roads, which are generally country roads, are in the worst condition.

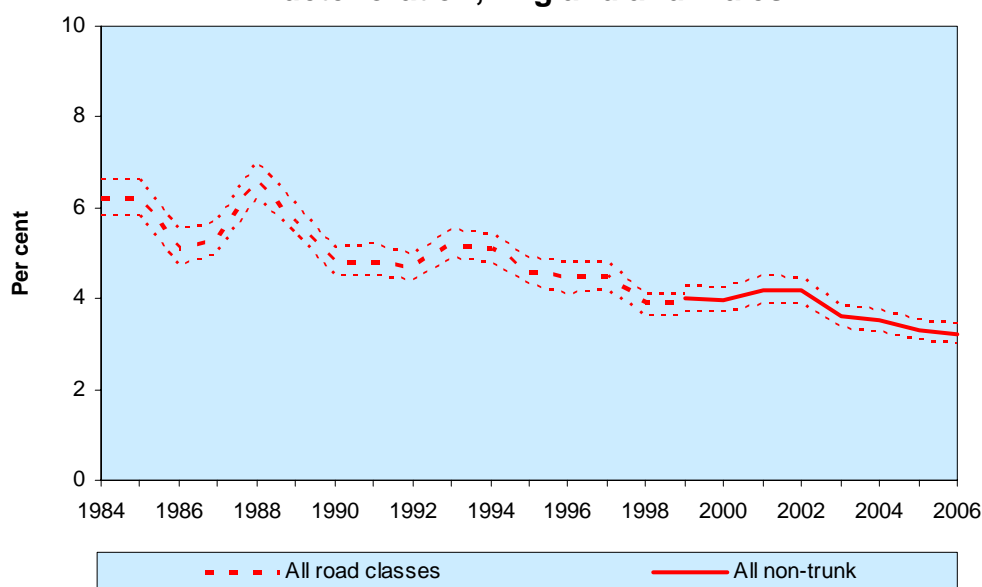
**Figure 3.12 Percentage of verge affected by deterioration, England and Wales**



### Kerbs

3.30 There are estimated to be around 330,000 km of kerbs on non-trunk roads in England and Wales. Kerbs are most prevalent on built-up unclassified roads (see Table A3.6 in Annex 3) and least prevalent on non built-up unclassified roads. The survey includes measures of kerb deterioration and kerb upstand, i.e. kerb height (see Annex 3 for definitions). Trends are summarised in Table 3.4 and in Figures 3.13 and 3.14. Note that fine dotted lines represent 90 per cent confidence limits of the condition measurements.

**Figure 3.13 Percentage of kerb affected by deterioration, England and Wales**



3.31 The condition of kerbs, as measured by the percentage of kerb length affected by deterioration, has mainly been improving since the late 1980s. Conditions have also improved since 2000; in 2006 3.2 per cent of non-trunk road kerbs were affected by deterioration compared with 4.0 per cent in 2000. In 2006, kerb condition varied between 1.2 per cent affected by deterioration on non built-up principal roads and 3.5 per cent on built-up unclassified roads.

**Table 3.4 Condition of kerbs by road class**  
England and Wales 1984 to 2006

Year	All purpose trunk <sup>1</sup>	Non-trunk						All non-trunk	All classes <sup>1</sup>
		Built-up <sup>2</sup>			Non built-up <sup>2</sup>				
		Principal	Classified	Unclassified	Principal	Classified	Unclassified <sup>3</sup>		
<b>Per cent affected by deterioration</b>									
1984	2.5	3.8	5.4	7.1	3.2	6.2	..	..	<b>6.2</b>
1985	1.7	3.3	4.6	7.5	2.4	5.1	..	..	<b>6.2</b>
1986	1.9	4.3	3.3	6.0	3.5	3.8	..	..	<b>5.1</b>
1987	1.8	3.1	4.2	6.3	3.1	4.0	..	..	<b>5.3</b>
1988	1.7	3.3	4.4	8.1	2.7	4.7	..	..	<b>6.6</b>
1989	2.3	3.5	4.5	6.7	2.7	5.0	..	..	<b>5.7</b>
1990	1.1	3.1	4.0	5.7	2.4	3.7	..	..	<b>4.8</b>
1991	1.4	3.0	4.5	5.6	2.0	4.3	..	..	<b>4.8</b>
1992	1.6	3.1	4.2	5.5	2.5	3.0	..	..	<b>4.7</b>
1993	1.2	3.5	4.3	6.2	3.0	3.9	..	..	<b>5.2</b>
1994	1.3	3.6	3.8	6.1	2.7	3.5	..	..	<b>5.1</b>
1995	1.3	3.2	4.3	5.3	1.6	3.1	..	..	<b>4.6</b>
1996	1.0	3.2	3.4	5.4	2.1	2.6	..	..	<b>4.5</b>
1997	..	3.0	3.7	5.4	2.0	2.0	..	..	<b>4.5</b>
1998	..	2.7	2.8	4.7	1.3	2.0	..	..	<b>3.9</b>
1999	..	3.0	3.8	4.4	1.5	2.6	..	4.0	<b>3.9</b>
2000	..	3.0	2.8	4.5	1.9	2.6	..	4.0	<b>3.9</b>
2001	..	2.0	3.0	4.8	2.1	3.2	..	4.2	<b>4.1</b>
2002	..	2.2	3.2	4.8	1.9	3.6	..	4.2	<b>4.2</b>
2003	..	1.8	2.6	3.9	1.8	4.1	..	3.6	..
2004	..	1.9	2.8	3.8	1.6	2.3	..	3.5	..
2005	..	1.4	2.8	3.6	1.2	2.6	..	3.3	..
2006	..	1.7	2.6	3.4	1.2	3.5	..	3.2	..
<b>90 per cent confidence limits</b>									
2006 upper	..	2.0	2.9	3.7	1.5	4.5	..	3.4	..
2006 lower	..	1.5	2.3	3.1	0.9	2.5	..	3.0	..
<b>Kerb upstand (millimetres)</b>									
1984	93.6	100.3	97.3	97.1	92.7	94.4	..	..	<b>96.9</b>
1985	95.0	100.1	98.2	96.9	93.7	94.6	..	..	<b>97.0</b>
1986	95.0	100.3	99.1	97.0	93.2	96.5	..	..	<b>97.2</b>
1987	95.0	102.1	98.9	96.6	96.0	96.9	..	..	<b>97.3</b>
1988	95.5	101.8	99.1	96.7	94.9	95.2	..	..	<b>97.1</b>
1989	94.7	103.4	98.3	97.7	95.6	97.2	..	..	<b>98.0</b>
1990	95.6	103.5	99.5	97.5	95.5	97.9	..	..	<b>98.0</b>
1991	95.0	102.2	99.6	98.0	96.8	97.0	..	..	<b>98.2</b>
1992	95.5	102.9	101.1	99.3	98.1	96.2	..	..	<b>99.4</b>
1993	96.9	103.1	101.1	98.9	97.0	94.4	..	..	<b>99.0</b>
1994	98.7	104.4	101.2	99.2	97.5	94.3	..	..	<b>99.4</b>
1995	98.7	104.0	100.6	98.6	98.4	97.0	..	..	<b>99.1</b>
1996	99.7	104.6	101.4	99.5	99.2	97.7	..	..	<b>99.9</b>
1997	..	105.1	101.5	100.5	99.4	95.4	..	..	<b>100.5</b>
1998	..	103.2	100.2	98.5	100.3	95.9	..	..	<b>98.9</b>
1999	..	105.6	99.8	97.7	97.7	94.9	..	98.3	<b>98.3</b>
2000	..	105.2	101.5	100.1	97.5	94.6	..	100.1	<b>100.0</b>
2001	..	104.8	101.5	99.7	101.3	98.9	..	100.2	<b>100.4</b>
2002	..	104.4	100.6	99.5	100.4	102.4	..	100.1	<b>100.1</b>
2003	..	103.7	100.0	99.5	99.6	97.7	..	99.9	..
2004	..	101.7	97.6	97.1	99.1	98.2	..	97.7	..
2005	..	101.5	98.8	97.0	100.6	98.1	..	97.8	..
2006	..	102.3	99.7	99.0	102.1	100.7	..	99.7	..
<b>90 per cent confidence limits</b>									
2006 upper	..	102.9	100.5	99.7	103.2	102.7	..	100.3	..
2006 lower	..	101.6	99	98.3	101.1	98.6	..	99.2	..

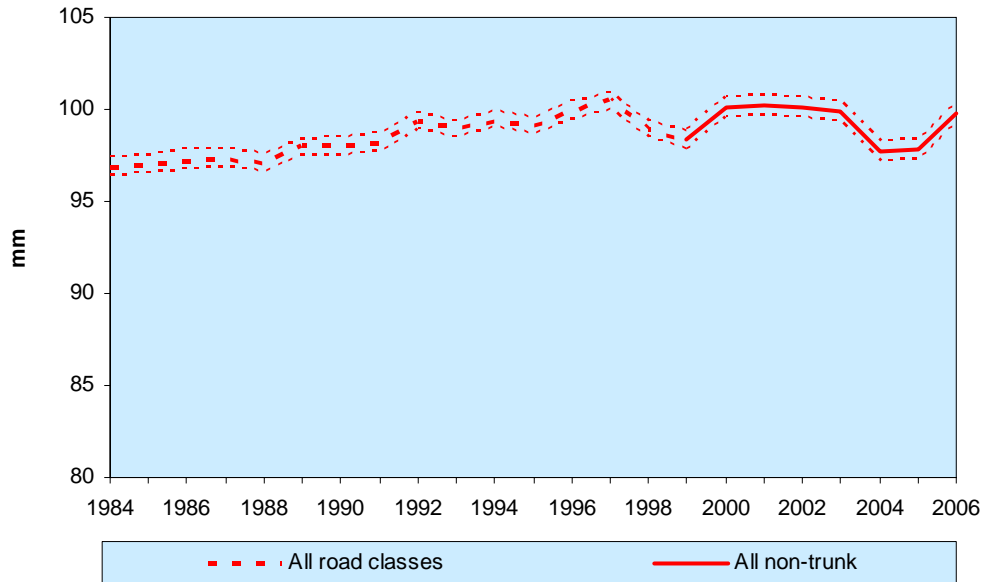
1 Excludes motorways. Trunk road agents took over responsibility for providing data in 1997. This led to a reduction in the response rates. Results for all purpose trunk roads since 1997 are therefore subject to considerable error and are not shown separately. Results for all purpose trunk roads, and hence all road classes, are not available from 2003 and so results for all non-trunk roads have been included from 1999 to allow comparisons over time to be made.

2 Built-up and non built-up were previously referred to as urban and rural.

3 The small sample size means results are subject to considerable sample error and are therefore not shown separately.

3.32 In 2005, the average kerb height (upstand) for non-trunk roads was 99.7mm. This is a similar level to 2000 and a significantly worse level than 2005. There is little variation in average kerb heights for different road classes. Excluding results for non built-up unclassified roads which have very few kerbs, the highest average upstand is on built-up principal roads and the lowest is on built-up unclassified roads.

**Figure 3.14 Kerb upstand (mm),  
England and Wales**





## 4. STRUCTURAL SURVEY

### Description

- 4.1 It is considered useful to complement information about the **visual condition** of major roads with information about their **structural condition**. Many highway authorities obtain information about the structural condition of parts of their major road networks by carrying out Deflectograph surveys. As explained in Annex 4, a Deflectograph is a machine for measuring the deflection of a road surface under a standard load. Software has been developed to allow the structural condition of the road to be derived from the measured deflections, given certain data about traffic loading and the construction of the road.
- 4.2 The structural condition is represented by the residual life of the road which is calculated from Deflectograph measurements. The residual life of a road is the expected period before its structure reaches an 'investigatory condition'. At this point further deterioration is no longer predictable, so that even though the road may still be serviceable it is not possible to predict how long it will remain so. Residual life is therefore a similar concept to the supermarket 'shelf life'. The point at which close monitoring of structural condition should start is defined to be when residual life falls below zero, i.e. there is a negative residual life. Annex 4 gives a more detailed description of how residual life is calculated.
- 4.3 Since the early 1990s, data from Deflectograph surveys on principal roads carried out by highways authorities in England and Wales have been reprocessed centrally in order to derive national results. These have been published as part of the NRMCS, as are results for motorways and all purpose trunk roads in Wales, which have been produced by the National Assembly for Wales.
- 4.4 There were considerable changes after 2001 in the collection and analysis of structural condition data for the trunk road network in England. This saw the Highways Agency stop using deflection data for network monitoring purposes and only for very specific scheme design use. Further details are given in Annex 4. As a result, from 2002 onwards, it was no longer possible to produce representative national estimates for English trunk roads. The National Assembly for Wales has continued to conduct full-scale surveys, so representative results are available for the strategic road network in Wales.
- 4.5 Advice to local authorities also changed at this time, with authorities advised to carry out structural surveying primarily for scheme design purposes. This led to a slow decline in the use and coverage of Deflectograph surveys and it has been apparent for some time that the supply of data would at some point drop to a level where calculation of national network values was no longer viable.
- 4.6 In recent years, despite the changes in local practice, there has still been sufficient data for DfT to have structural condition indicators calculated at national level. Given the level of data available in 2006, these calculations will not be viable after next year. However, other problems have arisen in the course of collecting and processing the local data this year.
- 4.7 As a result of a significant reduction in the supply of new deflectograph data in 2006, other influences such as local historical data on structural maintenance start to have an increasing effect on the analysis, and therefore the national results. This year's analysis has suggested that the supply of additional historic data by some authorities has had a disproportionate effect on the series. Further analyses and additional data processing are needed, and as a result indicators for principal roads are not available at this time. A separate paper will be produced during June to provide analysis of the issues and explanation of the effects.

4.8 For Welsh motorways and all purpose trunk roads, Table 4.1 shows the percentage of the network needing close monitoring of its structural condition. For each network type, the estimated numbers of years before close monitoring is required, in terms of the percentage of the network, are also provided.

**Table 4.1** Percentage of strategic road network requiring close monitoring of structural condition Wales, 1993 to 2006<sup>1</sup>

*Per cent / kilometres*

Road class	Percentage of network requiring close monitoring <sup>2</sup> :				Whole eligible network		Percentage of network surveyed
	Now	in 0 to 4 years	in 5 to 19 years	in 20 or more years	%	kms	
	%	%	%	%	%		%
<b>Motorway <sup>4</sup></b>							
1993	3.2	1.0	8.7	87.1	100	304	84
1994	3.3	1.1	9.7	85.9	100	306	85
1995	3.4	1.1	11.4	84.1	100	306	88
1996	3.5	1.6	12.8	82.1	100	306	80
1997	3.7	1.7	14.5	80.1	100	303	89
1998	4.5	1.7	16.5	77.3	100	303	89
1999	5.3	1.8	17.9	75.0	100	303	89
2000	6.6	2.8	17.4	73.2	100	303	89
2001	5.6	4.6	19.5	70.3	100	303	100
2002	7.6	5.9	18.8	67.7	100	303	100
2003	8.8	5.9	21.5	64.0	100	303	100
2004	7.3	7.3	23.1	62.4	100	303	100
2005	6.3	5.0	20.1	68.6	100	303	100
2006	7.9	4.3	15.8	71.9	100	303	100
<b>All purpose trunk <sup>4</sup></b>							
1993	2.6	3.4	16.6	77.4	100	2,313	61
1994	3.7	3.9	16.8	75.6	100	2,292	71
1995	5.0	4.7	16.8	73.5	100	2,304	79
1996	6.2	4.7	17.6	71.5	100	2,293	74
1997	7.2	5.0	18.1	69.7	100	2,313	80
1998	8.5	4.9	18.6	68.0	100	2,301	81
1999	10.8	4.4	19.1	65.7	100	2,301	81
2000	12.7	4.8	19.0	63.5	100	2,295	81
2001	13.1	5.0	18.6	63.3	100	2,295	81
2002	14.1	5.9	18.0	62.0	100	2,295	81
2003	11.2	4.7	20.2	63.9	100	2,295	86
2004	11.5	4.4	19.2	64.9	100	2,295	83
2005	10.6	3.9	20.7	64.7	100	2,295	86
2006	11.1	4.0	20.9	64.0	100	2,295	88

1 The structural condition of a section of road is in need of close monitoring when it has a negative residual life (see Annex 4). Figures are for the whole flexible network.

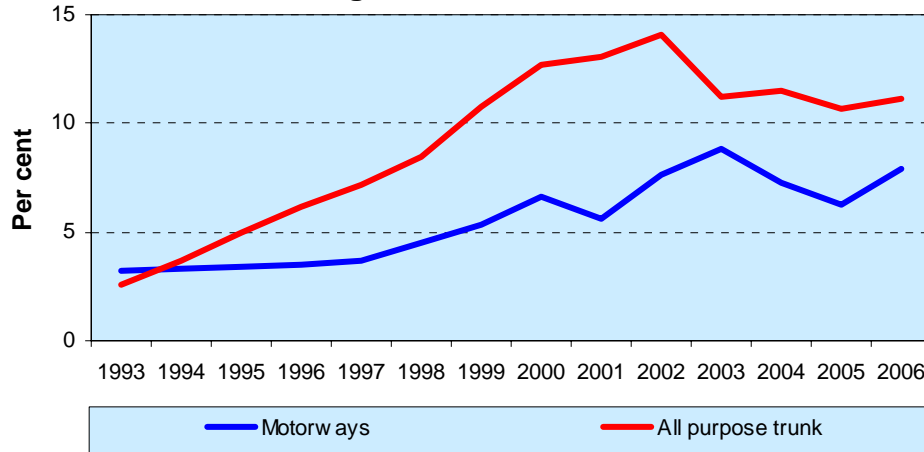
2 Percentages may not add up to 100 per cent due to rounding.

3 Excludes concrete pavements and elevated carriageways.

4 Calculated using Deflec.

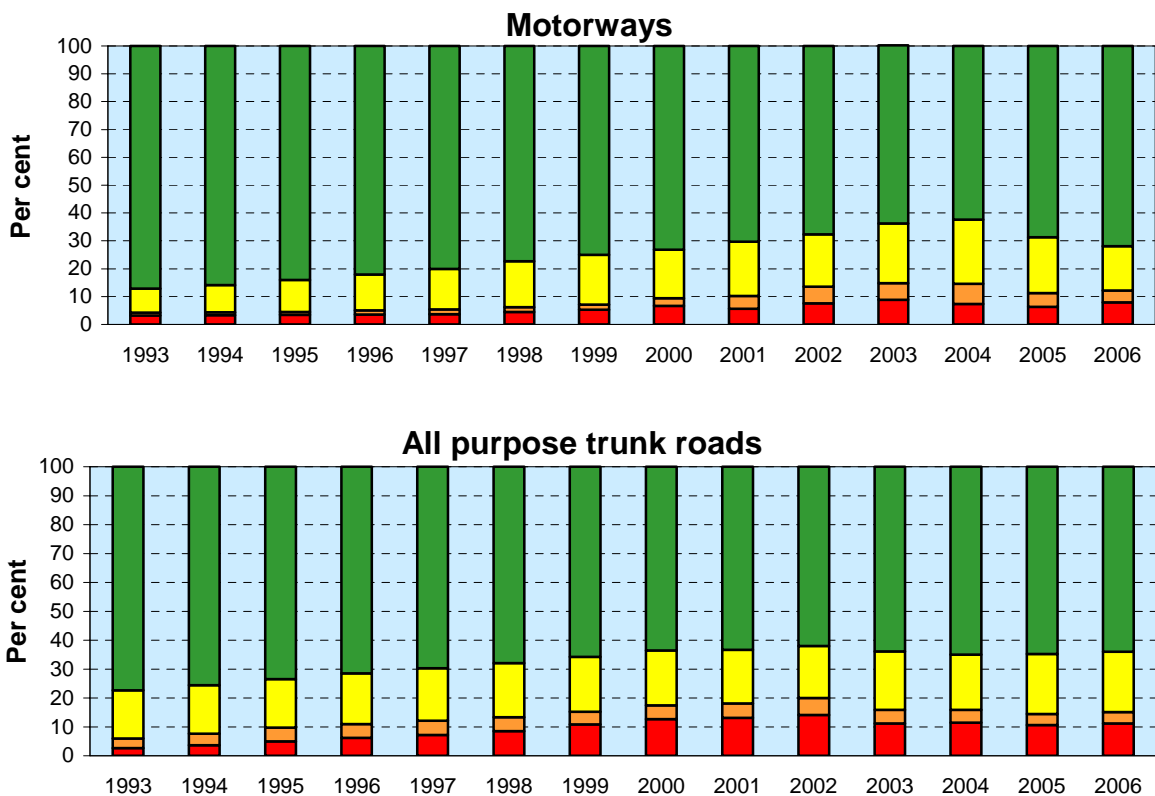
4.9 11.1 per cent of all purpose trunk roads in Wales needed close monitoring in 2006. This is about the same level as in 2005 and slightly lower than 2000. The percentage of motorways needing close monitoring was 7.9 per cent, a slightly higher level than 2000 (see Figure 4.1).

**Figure 4.1 Percentage of network requiring close monitoring of structural condition, Wales**



4.10 Comparisons of residual life results over time are shown in Figures 4.2.

**Figure 4.2 Structural condition - percentage of strategic road network by residual life, Wales**





## 5. LOCAL PERFORMANCE INDICATORS

### Description

- 5.1 England and Scotland both currently have separate reporting regimes for local authority highway maintenance performance indicators. No such arrangements exist at the present time in Wales. The data for English and Scottish authorities are reproduced in this chapter to provide a detailed view of local highway maintenance performance.
- 5.2 The Best Value regime, introduced in England in April 2000, has a key role to play in raising local authorities' performance on the public services they provide. Under Best Value, authorities are required to undertake fundamental reviews of performance on all their service areas and produce demanding action plans for improvement. This is underpinned by the national Best Value Performance Indicators (BVPI) and targets.
- 5.3 In 2002, Audit Scotland, after consultation with Local Authorities through the Society of Chief Officers of Transportation in Scotland (SCOTS), introduced a performance indicator (PI) for road condition, based predominately on TRACS Type Surveys, referred to as the Scottish Road Maintenance Condition Survey (SRMCS). This machine based survey currently measures rutting, surface texture, longitudinal profile and cracking, although the latter is not yet included in the PI.
- 5.4 The local Road Condition Performance Indicators in Scotland are different from those in England (see 5.15 below for details).

### Best Value Performance Indicators

- 5.5 In 2005-06, authorities in England were required to collect data for BV223 and BV224a using SCANNER Survey. Data for BV97b were collected using coarse (CVI) or detailed (DVI) visual surveys (see Annex 2 for definitions). The required coverage for each of these surveys is shown in Annex 5.
- 5.6 For the 2005-06 BVPI process, the indicator threshold values have been reconsidered in the light of the results obtained on English principal roads in 2004-05 using TTS. As a result, a new indicator has been designed, to more closely align with the type of engineering decisions taken in choosing when to treat the various classes of local roads that were surveyed in 2005-06.
- 5.7 In recognition of the fact that this is a new survey method, and also that the fully developed indicator will be in use, from 2005-06 a new BVPI number, BV223, was introduced to replace BV96. Similarly, BV224a has also replaced BV97a. Indicators for the last year of BV96, although calculated using machine surveys, were constructed differently from BV223 and gave very different results. It will be necessary to recalculate these figures, on a consistent basis with BV223, to provide a consistent time series.
- 5.8 For reasons outside authorities' control, there were some difficulties carrying out SCANNER surveys in some authorities during 2005-06. Although surveys were carried out in all authorities, due to a problem with one contractor's processing routines, 49 authorities received output data which were not fully compliant with the SCANNER specification. The problem affected only the cracking data output, but this resulted in artificially high BVPI values for the authorities receiving these data. It is anticipated that revised data will be available for these authorities in time for the next NRMCS report.

- 5.9 Table 5.1 shows all BVPI results for English authorities, including BV223 and BV224a using SCANNER surveys, BV224b using the visual surveys, and BV187 using visual surveys on category 1, 1a and 2 footways.
- 5.10 The estimated SCANNER RCI value for principal roads in England in 2005-06 is 9 per cent requiring further investigation. On other classified roads in England, it is estimated that 15 per cent of the network requires further investigation. These figures are provisional and are likely to be amended when a full England level SCANNER report is produced in 2008.
- 5.11 NRMCS Deflectograph structural survey results have in previous years been included in Table 5.1, for authorities where sufficient surveys were undertaken, as a basis for comparing the structural and visual conditions of principal road networks. However, as there have been difficulties with the collection and processing of these data in 2006, these results are not included in this report. See Chapter 4 for further details.

**Table 5.1** Percentage of network in need of further investigation, England 2005-06  
Best Value Performance Indicators<sup>1</sup> and structural condition indicators

Per cent

	Principal roads BV223 2005-06	Non-principal classified roads BV224a 2005-06	Unclassified roads BV224b 2005-06	BV187 2005-06		Principal roads BV223 2005-06	Non-principal classified roads BV224a 2005-06	Unclassified roads BV224B 2005-06	BV187 2005-06
<b>Unitary authorities</b>					<b>County councils</b>				
Bath and North East Somerset	<b>10</b>	<b>22</b>	<b>5</b>	<b>27</b>	Bedfordshire	<b>4</b>	<b>6</b>	<b>18</b>	<b>9</b>
Blackburn	<b>26</b> <sup>2</sup>	<b>39</b> <sup>2</sup>	<b>9</b>	<b>8</b>	Buckinghamshire	<b>8</b>	<b>12</b>	<b>3</b>	<b>24</b>
Blackpool	<b>22</b> <sup>2</sup>	<b>18</b> <sup>2</sup>	<b>6</b>	<b>23</b>	Cambridgeshire	<b>4</b>	<b>13</b>	<b>14</b>	<b>11</b>
Bournemouth	<b>8</b>	<b>12</b>	<b>14</b>	<b>7</b>	Cheshire	<b>12</b> <sup>2</sup>	<b>33</b> <sup>2</sup>	<b>12</b>	<b>40</b>
Bracknell Forest	<b>9</b>	<b>21</b>	<b>25</b>	<b>24</b>	Cornwall	<b>3</b>	<b>6</b>	<b>14</b>	<b>27</b>
Brighton	<b>34</b> <sup>2</sup>	<b>35</b> <sup>2</sup>	<b>4</b>	<b>19</b>	Cumbria	<b>8</b>	<b>16</b>	<b>14</b>	<b>8</b>
Bristol	<b>11</b>	<b>9</b>	<b>18</b>	<b>19</b>	Derbyshire	<b>15</b> <sup>2</sup>	<b>39</b> <sup>2</sup>	<b>16</b>	<b>38</b>
Darlington	<b>10</b> <sup>2</sup>	<b>40</b> <sup>2</sup>	<b>9</b>	<b>16</b>	Devon	<b>6</b>	<b>8</b>	<b>17</b>	<b>8</b>
Derby	<b>19</b> <sup>2</sup>	<b>28</b> <sup>2</sup>	<b>8</b>	<b>36</b>	Dorset	<b>4</b>	<b>7</b>	<b>20</b>	<b>18</b>
East Riding	<b>2</b>	<b>9</b>	<b>22</b>	<b>47</b>	Durham County	<b>5</b>	<b>10</b>	<b>18</b>	<b>28</b>
Halton	<b>1</b>	<b>2</b>	<b>13</b>	<b>22</b>	East Sussex	<b>14</b> <sup>2</sup>	<b>54</b> <sup>2</sup>	<b>11</b>	<b>12</b>
Hartlepool	<b>11</b> <sup>2</sup>	<b>23</b> <sup>2</sup>	<b>17</b>	<b>15</b>	Essex	<b>8</b>	<b>18</b>	<b>24</b>	<b>38</b>
Herefordshire	<b>21</b> <sup>2</sup>	<b>50</b> <sup>2</sup>	<b>22</b>	<b>31</b>	Gloucestershire	<b>11</b> <sup>2</sup>	<b>6</b> <sup>2</sup>	<b>26</b>	<b>13</b>
Isle of Wight	<b>18</b>	<b>29</b>	<b>59</b>	<b>49</b>	Hampshire	<b>17</b> <sup>2</sup>	<b>43</b> <sup>2</sup>	<b>14</b>	<b>29</b>
Kingston Upon Hull	<b>10</b>	<b>9</b>	<b>13</b>	<b>49</b>	Hertfordshire	<b>8</b>	<b>14</b>	<b>19</b>	<b>36</b>
Leicester	<b>13</b>	<b>12</b>	<b>6</b>	<b>29</b>	Kent	<b>7</b>	<b>11</b>	<b>21</b>	<b>22</b>
Luton	<b>6</b>	<b>5</b>	<b>47</b>	<b>19</b>	Lancashire	<b>5</b>	<b>8</b>	<b>8</b>	<b>58</b>
Medway	<b>6</b>	<b>6</b>	<b>24</b>	<b>27</b>	Leicestershire	<b>3</b>	<b>10</b>	<b>8</b>	<b>7</b>
Middlesbrough	<b>14</b> <sup>2</sup>	<b>20</b> <sup>2</sup>	<b>10</b>	<b>8</b>	Lincolnshire	<b>3</b>	<b>6</b>	<b>19</b>	<b>12</b>
Milton Keynes	<b>10</b> <sup>2</sup>	<b>24</b> <sup>2</sup>	<b>2</b>	<b>5</b>	Norfolk	<b>3</b>	<b>15</b>	<b>40</b>	<b>36</b>
North East Lincolnshire	<b>5</b>	<b>10</b>	<b>15</b>	<b>46</b>	Northamptonshire	<b>4</b>	<b>12</b>	<b>17</b>	<b>27</b>
North Lincolnshire	<b>4</b>	<b>11</b>	<b>24</b>	<b>45</b>	Northumberland	<b>5</b>	<b>9</b>	<b>23</b>	<b>19</b>
North Somerset	<b>7</b>	<b>12</b>	<b>9</b>	<b>35</b>	North Yorkshire	<b>9</b>	<b>11</b>	<b>15</b>	<b>31</b>
Nottingham	<b>18</b>	<b>19</b>	<b>6</b>	<b>7</b>	Nottinghamshire	<b>2</b>	<b>8</b>	<b>14</b>	<b>33</b>
Peterborough	<b>8</b>	<b>16</b>	<b>18</b>	<b>15</b>	Oxfordshire	<b>6</b>	<b>23</b>	<b>9</b>	<b>26</b>
Plymouth	<b>6</b>	<b>14</b>	<b>9</b>	<b>19</b>	Shropshire	<b>6</b>	<b>18</b>	<b>25</b>	<b>10</b>
Poole	<b>5</b>	<b>8</b>	<b>6</b>	<b>7</b>	Somerset	<b>6</b>	<b>7</b>	<b>15</b>	<b>36</b>
Portsmouth	<b>16</b>	<b>16</b>	<b>25</b>	<b>7</b>	Staffordshire	<b>6</b>	<b>10</b>	<b>25</b>	<b>30</b>
Reading	<b>13</b>	<b>17</b>	<b>10</b>	<b>5</b>	Suffolk	<b>4</b>	<b>11</b>	<b>19</b>	<b>28</b>
Redcar and Cleveland	<b>25</b> <sup>2</sup>	<b>23</b> <sup>2</sup>	<b>11</b>	<b>14</b>	Surrey	<b>13</b>	<b>20</b>	<b>16</b>	<b>29</b>
Rutland	<b>5</b>	<b>2</b>	<b>9</b>	<b>49</b>	Warwickshire	<b>5</b>	<b>9</b>	<b>15</b>	<b>34</b>
Slough	<b>12</b>	<b>13</b>	<b>32</b>	<b>1</b>	West Sussex	<b>8</b> <sup>2</sup>	<b>18</b> <sup>2</sup>	<b>12</b>	<b>22</b>
South Gloucestershire	<b>5</b>	<b>8</b>	<b>5</b>	<b>10</b>	Wiltshire	<b>9</b>	<b>13</b>	<b>7</b>	<b>44</b>
Southampton	<b>34</b> <sup>2</sup>	<b>33</b> <sup>2</sup>	<b>12</b>	<b>16</b>	Worcestershire	<b>7</b>	<b>18</b>	<b>21</b>	<b>46</b>
Southend	<b>11</b>	<b>16</b>	<b>11</b>	<b>13</b>	<b>Metropolitan authorities</b>				
Stockton-on-Tees	<b>14</b> <sup>2</sup>	<b>16</b> <sup>2</sup>	<b>8</b>	<b>31</b>	Barnsley	<b>7</b>	<b>18</b>	<b>21</b>	<b>42</b>
Stoke-on-Trent	<b>10</b>	<b>12</b>	<b>10</b>	<b>3</b>	Birmingham	<b>24</b> <sup>2</sup>	<b>34</b> <sup>2</sup>	<b>9</b>	<b>26</b>
Swindon	<b>2</b>	<b>5</b>	<b>5</b>	<b>12</b>	Bolton	<b>15</b> <sup>2</sup>	<b>30</b> <sup>2</sup>	<b>25</b>	<b>44</b>
Telford and Wrekin	<b>2</b>	<b>7</b>	<b>18</b>	<b>35</b>	Bradford	<b>18</b> <sup>2</sup>	<b>27</b> <sup>2</sup>	<b>9</b>	<b>16</b>
Thurrock	<b>7</b>	<b>9</b>	<b>7</b>	<b>26</b>	Bury	<b>19</b> <sup>2</sup>	<b>33</b> <sup>2</sup>	<b>9</b>	<b>42</b>
Torbay	<b>8</b>	<b>22</b>	<b>11</b>	<b>12</b>	Calderdale	<b>9</b>	<b>15</b>	<b>16</b>	<b>6</b>
Warrington	<b>24</b> <sup>2</sup>	<b>16</b> <sup>2</sup>	<b>9</b>	<b>16</b>	Coventry	<b>27</b> <sup>2</sup>	<b>35</b> <sup>2</sup>	<b>14</b>	<b>35</b>
West Berkshire	<b>5</b>	<b>11</b>	<b>26</b>	<b>26</b>	Doncaster	<b>3</b>	<b>8</b>	<b>21</b>	<b>30</b>
Windsor and Maidenhead	<b>13</b>	<b>25</b>	<b>25</b>	<b>28</b>	Dudley	<b>14</b> <sup>2</sup>	<b>17</b> <sup>2</sup>	<b>10</b>	<b>18</b>
Wokingham	<b>8</b>	<b>10</b>	<b>4</b>	<b>6</b>	Gateshead	<b>9</b> <sup>2</sup>	<b>15</b> <sup>2</sup>	<b>6</b>	<b>19</b>
York	<b>6</b>	<b>10</b>	<b>12</b>	<b>11</b>	Kirklees	<b>23</b> <sup>2</sup>	<b>44</b> <sup>2</sup>	<b>15</b>	<b>7</b>
<b>London boroughs</b>					Knowsley	<b>11</b> <sup>2</sup>	<b>13</b> <sup>2</sup>	<b>8</b>	<b>23</b>
City of London	..	..	<b>0</b>	<b>1</b>	Leeds	<b>6</b>	<b>13</b>	<b>24</b>	<b>30</b>
Barking and Dagenham	<b>8</b>	<b>15</b>	<b>20</b>	<b>38</b>	Liverpool	<b>6</b> <sup>2</sup>	<b>4</b> <sup>2</sup>	<b>6</b>	<b>39</b>
Barnet	<b>8</b>	<b>12</b>	<b>8</b>	<b>16</b>	Manchester	<b>19</b> <sup>2</sup>	<b>28</b> <sup>2</sup>	<b>15</b>	<b>14</b>
Bexley	<b>9</b>	<b>19</b>	<b>12</b>	<b>34</b>	Newcastle upon Tyne	<b>17</b> <sup>2</sup>	<b>15</b> <sup>2</sup>	<b>8</b>	<b>23</b>
Brent	<b>16</b>	<b>34</b>	<b>28</b>	<b>23</b>	North Tyneside	<b>10</b> <sup>2</sup>	<b>24</b> <sup>2</sup>	<b>8</b>	<b>27</b>
Bromley	<b>6</b>	<b>18</b>	<b>34</b>	<b>36</b>	Oldham	<b>37</b> <sup>2</sup>	<b>27</b> <sup>2</sup>	<b>60</b>	<b>46</b>
Camden	<b>26</b>	<b>5</b>	<b>6</b>	<b>34</b>	Rochdale	<b>23</b> <sup>2</sup>	<b>37</b> <sup>2</sup>	<b>10</b>	<b>14</b>
Croydon	<b>12</b>	<b>11</b>	<b>14</b>	<b>9</b>	Rotherham	<b>7</b>	<b>16</b>	<b>8</b>	<b>45</b>
Ealing	<b>11</b>	<b>8</b>	<b>6</b>	<b>32</b>	Salford	<b>28</b> <sup>2</sup>	<b>36</b> <sup>2</sup>	<b>23</b>	<b>30</b>
Enfield	<b>10</b>	<b>29</b>	<b>28</b>	<b>15</b>	Sandwell	<b>19</b> <sup>2</sup>	<b>36</b> <sup>2</sup>	<b>14</b>	<b>11</b>
Greenwich	<b>11</b>	<b>20</b>	<b>12</b>	<b>32</b>	Sefton	<b>23</b> <sup>2</sup>	<b>31</b> <sup>2</sup>	<b>8</b>	<b>22</b>
Hackney	<b>14</b>	<b>14</b>	<b>19</b>	<b>11</b>	Sheffield	<b>15</b>	<b>32</b>	<b>47</b>	<b>59</b>
Hammersmith and Fulham	<b>20</b>	<b>17</b>	<b>27</b>	<b>41</b>	Solihull	<b>13</b> <sup>2</sup>	<b>19</b> <sup>2</sup>	<b>13</b>	<b>25</b>
Haringey	<b>15</b>	<b>22</b>	<b>11</b>	<b>34</b>	South Tyneside	<b>14</b> <sup>2</sup>	<b>25</b> <sup>2</sup>	<b>4</b>	<b>11</b>
Harrow	<b>13</b>	<b>17</b>	<b>13</b>	<b>15</b>	St Helens	<b>20</b> <sup>2</sup>	<b>30</b> <sup>2</sup>	<b>10</b>	<b>20</b>
Havering	<b>8</b>	<b>27</b>	<b>14</b>	<b>51</b>	Stockport	<b>25</b> <sup>2</sup>	<b>35</b> <sup>2</sup>	<b>10</b>	<b>26</b>
Hillingdon	<b>10</b>	<b>17</b>	<b>18</b>	<b>17</b>	Sunderland	<b>12</b> <sup>2</sup>	<b>16</b> <sup>2</sup>	<b>7</b>	<b>5</b>
Hounslow	<b>16</b>	<b>20</b>	<b>25</b>	<b>26</b>	Tameside	<b>32</b> <sup>2</sup>	<b>37</b> <sup>2</sup>	<b>18</b>	<b>18</b>
Islington	<b>22</b>	<b>28</b>	<b>14</b>	<b>26</b>	Trafford	<b>36</b> <sup>2</sup>	<b>44</b> <sup>2</sup>	<b>12</b>	<b>25</b>
Kensington and Chelsea	<b>20</b>	<b>9</b>	<b>5</b>	<b>10</b>	Wakefield City	<b>5</b>	<b>13</b>	<b>22</b>	<b>32</b>
Kingston Upon Thames	<b>9</b>	<b>14</b>	<b>8</b>	<b>38</b>	Walsall	<b>17</b> <sup>2</sup>	<b>23</b> <sup>2</sup>	<b>15</b>	<b>11</b>
Lambeth	<b>17</b>	<b>11</b>	<b>6</b>	<b>45</b>	Wigan	<b>25</b> <sup>2</sup>	<b>27</b> <sup>2</sup>	<b>8</b>	<b>11</b>
Lewisham	<b>11</b>	<b>21</b>	<b>24</b>	<b>7</b>	Wirral	<b>19</b> <sup>2</sup>	<b>22</b> <sup>2</sup>	<b>8</b>	<b>25</b>
Merton	<b>13</b>	<b>22</b>	<b>24</b>	<b>8</b>	Wolverhampton	<b>16</b> <sup>2</sup>	<b>24</b> <sup>2</sup>	<b>14</b>	<b>15</b>
Newham	<b>18</b>	<b>32</b>	<b>25</b>	<b>18</b>					
Redbridge	<b>11</b>	<b>16</b>	<b>18</b>	<b>22</b>					
Richmond	<b>13</b>	<b>17</b>	<b>22</b>	<b>48</b>					
Southwark	<b>16</b>	<b>29</b>	<b>11</b>	<b>15</b>					
Sutton	<b>9</b>	<b>26</b>	<b>16</b>	<b>9</b>					
Tower Hamlets	<b>21</b>	<b>0</b>	<b>15</b>	<b>10</b>					
Waltham Forest	<b>14</b>	<b>20</b>	<b>25</b>	<b>11</b>					
Wandsworth	<b>13</b>	<b>9</b>	<b>5</b>	<b>23</b>					
Westminster	<b>26</b>	<b>13</b>	<b>15</b>	<b>20</b>					

<sup>1</sup> Local authority Best Value Performance Indicators BV223, BV224a, BV224b and BV187 are shown in bold.

<sup>2</sup> This value is not fully comparable with those from other authorities, due to problems with data collection

.. not submitted

## Local authority performance indicators for Scotland

- 5.12 Table 5.2 presents local road performance indicator data for Scotland. These indicators are produced using the same survey specification and standards as for the BV223 and BV224a values in Table 5.1. However, the indicator construction is different and therefore the Scotland indicators are not comparable with any of the England values.
- 5.13 The Scottish performance indicator represents the percentage of the network for which the investigatory thresholds for any one of the measured parameters (excluding cracking at present) has been exceeded. The results presented here provide the red band, from the following system.
- The portion within the “Red band” is indicative of the length which is likely to require early maintenance treatment
  - The portion in the “Amber band” reflects the length likely to require maintenance in the medium term”
  - The portion in the “Green band indicates the road is in a serviceable condition, although isolated defects may still exist
  - It should be noted however that it may be appropriate and cost effective in some instances to treat sections in the “Amber band” before they deteriorate further and require more extensive and more costly treatment.
- 5.14 The results are reported on a 2-year rolling average basis, which is the case for BV223 in England in 2005-06 (and will be the case for BV224a in England in 2006-07). As the Scottish PI does not include cracking data and is compiled in a different manner, the results are currently not directly comparable to those in England. It is however the intention to move to a standard method of assessment in 2007-08, using the same SCANNER Road Condition Indicator as is used for BV223 and BV224a in England. In making this change, SCOTS will also re-calculate results for earlier years to provide a time series consistent with the new indicator.
- 5.15 Under the present reporting system, about 11 per cent of the local road network in Scotland was considered to be likely to require early maintenance treatment.

**Table 5.2** Scottish Local Roads – Road Condition Performance Indicator, red band only

Authority name	Principal roads			B Roads		C Roads		Unclassified		All Local Roads	
	2002-2004	2003-2005	2004-2006	2003-2005	2004-2006	2003-2005	2004-2006	2003-2005	2004-2006	2003-2005	2004-2006
Western Isles	9.9	9.4	8.2	8.7	8.6	5.0	4.2	9.3	10.6	8.6	8.8
Shetland	8.7	5.2	1.7	8.6	7.0	5.4	3.1	12.2	7.3	8.8	5.1
Orkney	2.5	1.7	2.8	6.0	5.5	1.3	0.4	7.3	7.7	5.2	5.2
<b>Island LAs</b>	7.9	6.4	5.0	7.7	7.0	4.0	2.7	9.6	8.6	7.6	6.5
Borders	4.1	3.4	3.7	13.6	10.8	6.0	5.5	15.8	17.4	10.8	10.8
Aberdeenshire	3.7	3.4	4.0	6.4	5.6	2.7	2.0	9.4	9.8	6.3	6.2
D&G	8.0	7.4	7.0	9.6	8.3	6.9	4.4	22.8	21.6	14.1	12.6
Highland	4.9	4.3	3.8	9.9	7.2	6.0	4.0	14.1	11.6	9.7	7.7
Argyll & Bute	13.2	10.4	9.7	18.3	15.8	9.4	7.2	22.5	19.8	16.0	14.0
Perth & Kinross	8.3	7.2	7.0	10.4	9.0	5.8	3.6	12.0	15.9	9.3	10.0
Moray	4.3	4.7	4.1	7.3	6.6	3.8	3.0	11.0	11.6	7.9	7.7
Angus	5.7	4.7	4.1	10.9	10.5	3.8	2.9	8.9	8.1	7.3	6.6
<b>Rural LAs</b>	6.4	5.5	5.3	10.8	9.0	5.4	3.8	14.4	14.0	10.1	9.1
E Lothian	8.1	7.0	6.0	11.6	10.1	5.9	3.8	17.9	17.3	12.7	11.5
Stirling	7.6	6.6	6.1	11.5	10.9	18.2	7.0	31.9	24.3	20.7	15.2
S Ayrshire	7.8	6.1	5.6	13.5	11.4	16.7	9.4	17.8	17.2	15.7	13.4
E Ayrshire	5.7	5.6	5.5	13.5	9.1	8.9	5.5	15.5	13.8	12.8	10.5
Midlothian	5.5	7.3	7.2	19.2	17.2	6.0	3.8	15.5	15.0	13.4	12.5
S Lanarkshire	9.6	7.8	7.4	11.7	10.1	9.0	7.5	18.9	17.8	14.7	13.6
N Ayrshire	29.2	24.7	21.1	11.2	10.1	7.5	7.2	16.8	16.5	15.7	14.7
Fife	7.5	6.4	7.2	10.0	10.3	6.5	5.6	15.1	16.0	12.1	12.6
W Lothian	3.7	2.9	3.0	10.5	10.2	5.4	5.1	10.2	10.9	8.5	8.8
<b>Semi Urban LAs</b>	9.4	8.1	7.7	12.1	10.7	9.5	6.4	17.3	16.5	13.9	12.7
Clackmannan	6.8	5.4	4.6	7.3	7.3	10.5	8.6	16.9	15.9	12.8	11.9
Falkirk	7.5	5.9	6.2	10.9	11.5	9.6	6.6	12.3	14.7	11.1	12.3
Renfrewshire	9.8	8.4	7.7	13.0	11.5	11.6	9.6	17.3	16.8	15.4	14.6
E Renfrewshire	8.4	8.3	7.6	16.4	12.7	10.1	7.8	29.5	25.0	23.0	19.3
Inverclyde	10.7	6.6	5.9	18.2	11.2	13.6	8.2	20.9	19.1	18.7	16.1
E Dunbartonshire	11.6	10.2	9.7	13.1	11.6	5.8	6.5	15.9	14.8	14.3	13.4
N Lanarkshire	7.6	5.9	5.4	11.9	10.5	8.1	5.1	17.4	18.7	14.5	14.8
W Dunbartonshire	7.2	5.7	5.5	7.2	6.5	4.7	3.8	25.7	20.6	20.2	16.5
<b>Urban LAs</b>	8.3	6.8	6.4	12.3	10.9	9.4	6.8	18.2	17.9	15.4	14.6
Aberdeen	9.8	7.7	6.0	7.4	6.6	6.5	4.2	12.6	14.3	11.3	12.2
Dundee	6.6	5.2	4.2	6.8	5.1	4.8	5.1	18.6	14.2	14.0	11.1
Edinburgh	12.7	10.4	12.1	12.5	16.1	11.6	8.4	23.0	19.1	20.1	17.2
Glasgow	15.2	15.2	9.9	14.5	10.4			13.8	7.5	14.0	7.9
<b>City LAs</b>	12.6	11.3	9.5	11.5	10.6	7.7	6.0	16.7	12.8	15.3	11.9
<b>All Scottish LAs</b>	7.8	6.3	6.1	10.9	9.4	6.4	4.5	15.7	14.6	11.8	10.6



## 6. SKIDDING RESISTANCE SURVEY

### Description

- 6.1 A key objective of highway maintenance is to maintain road safety. One of the means of achieving this, although not relevant in all cases, is to ensure that roads have a satisfactory level of skidding resistance, both to reduce the risk of uncontrolled skids and to improve braking efficiency. Skidding resistance can be represented in terms of the percentage of the network which is equal to or below an investigatory level. This does not necessarily mean that these roads are unsafe; it indicates a need for further investigation to determine the need for maintenance.
- 6.2 Results from wet road skidding resistance surveys were first included in the 2000 NRMCS report. Results on motorways and all purpose trunk roads have been provided by the Highways Agency and the National Assembly for Wales. Principal roads results are supplied by local highway authorities on a statistical return to the Department for Transport. See Annex 6 for further details of survey coverage, data collection methods and the definition of skidding resistance.
- 6.3 In 2004, following a study of required levels of skidding resistance, the Highways Agency updated the Investigatory Levels set out in the Highways Agency Standard HD28 document. This has resulted in a break in the series, with values for 2003 provided on both the old and new basis. Further details about HD28 are provided in Annex 6.
- 6.4 Local authorities have been encouraged to develop their own local skid resistance policies, based around the Highways Agency standards. This has led to some variations in the thresholds used for investigatory levels, on different classes of roads, between different local authorities.

### Results

- 6.5 Table 6.1 shows average skidding resistance results for principal roads. These are averaged over a three year period because it is common practice for authorities to survey their principal road network on a two or three year cycle.
- 6.6 Latest results show that an estimated 19 per cent of principal roads in England needed further investigation to see whether the existing level of skidding resistance is in need of maintenance. This rises to 51 per cent in London boroughs and to 28 per cent in metropolitan authorities. In Wales, 17 per cent of surveyed principal roads need further investigation.

**Table 6.1 Skidding resistance of principal roads** <sup>1,2</sup>  
England and Wales, average in 2002 to 2004 and 2003 to 2005

Type of authority	Network length km	2002 to 2004			2003 to 2005		
		Length surveyed		Surveyed length below investigatory level <sup>3</sup> Per cent	Length surveyed		Surveyed length below investigatory level <sup>3</sup> Per cent
		km	Per cent		km	Per cent	
<b>England</b>							
Counties	33,300	15,300	48	16	18,500	46	17
Unitary authorities	6,700	2,700	35	17	3,500	40	15
Metropolitan authorities	6,900	2,800	38	26	2,400	40	28
London boroughs	2,300	2,000	87	48	2,000	86	51
<b>All authorities</b> <sup>4</sup>	<b>49,100</b>	<b>22,700</b>	<b>47</b>	<b>19</b>	<b>26,300</b>	<b>46</b>	<b>19</b>
<b>Wales</b>							
All authorities	5,300	2,800	48	14	2,600	53	17

1 Figures are provided by local highway authorities.

2 Results relate to lane 1 length of the principal road network, i.e. the near side lane.

3 Results are available for different authorities in 2002 to 2004 and 2003 to 2005. The percentages below investigatory level in 2003 to 2005 are based on data for all responding authorities, while those for 2002 to 2004 have been chained to those for 2003 to 2005 to allow comparisons to be made. Details of the methodology are given in Annex 6. In deriving results for each type of authority, percentages for individual responding authorities have been weighted by their road length.

4 In deriving the percentage at or below investigatory level, results for each type of authority have been weighted by the total lane 1 network length for each authority type.

6.7 Table 6.2 shows results for English and Welsh motorways and all purpose trunk roads.

6.8 In 2005, the Highways Agency moved from a survey of lane 1 of one third of the trunk road network every 3 years to a complete survey of lane 1 every year. Rather than the calculation of the Mean Summer SCRIM Coefficient (MSSC), the results of the survey provide the calculation of the Characteristic SCRIM Coefficient (CSC). The CSC values are not available for earlier years but the development of the Single Annual SCRIM Survey for trunk roads showed that the methods of reporting in 2004 and 2005 were equivalent and the results can be compared.

6.9 2006 results show the skidding resistance to be best for motorways in both England and Wales. Comparing results with those in Table 6.1, it is noticeable that, in England, the percentage of the network needing further investigation continues to be lowest for motorways and highest for principal roads.

**Table 6.2 Skidding resistance of motorways and all purpose trunk roads** <sup>1,3</sup>  
England and Wales 1999 to 2006

	Lane 1 length of network	Lane 1 length surveyed <sup>2</sup>		Percentage of Lane 1 length surveyed at or below investigatory level <sup>2</sup>
	km	km	Per cent	Per cent
<b>England</b>				
<b>Motorways</b>				
1999	5,601	3,221	58	1
2000	5,714	4,111	72	1
2001	5,679	4,311	76	2
2002	5,667	4,522	80	2
2003	5,753	4,593	80	2
2003	5,756	4,424	77	1
2004	5,752	5,078	88	1
2005	5,756	5,078	88	1
2006	5,782	5,738	99	1
<b>All purpose trunk</b>				
1999	14,597	6,977	48	9
2000	13,948	9,898	71	9
2001	13,948	10,021	72	8
2002	10,959	8,321	76	5
2003	9,882	7,982	81	6
2003	9,829	7,352	75	13
2004	9,149	7,824	86	12
2005	8,900	8,255	93	12
2006	8,643	7,673	89	13
<b>Wales</b>				
<b>Motorways</b>				
1999	305	299	98	0.2
2000	305	299	98	0.3
2001	305	296	97	0.4
2002	305	298	98	0.5
2003	305	296	97	0.5
2003 <sup>4</sup>	305	296	97	0.6
2004	325	325	100	0.3
2005	325	325	100	0.5
2006	325	325	100	0.5
<b>All purpose trunk</b>				
1999	3,071	3,060	100	14
2000	3,071	3,060	100	18
2001	3,071	3,019	98	14
2002	3,071	2,987	97	9
2003	3,071	2,979	97	15
2003 <sup>4</sup>	3,071	2,979	97	20
2004	3,071	2,979	97	21
2005	3,071	2,979	97	24
2006	3,071	2,865	93	17

1 Figures are provided by the Highways Agency and the National Assembly for Wales.

2 Figures for England relate to road lengths surveyed in the year and in the previous two years. Figures for Wales relate to road lengths surveyed in the year and in the previous year.

3 Figures were calculated on a new basis from 2004. Details of the change, which affects all-purpose trunk roads more severely than motorways, are provided in Annex 6

4 New figures for 2003 were back-calculated to provide a figure equivalent to the new standard used from 2004.



## 7. TRUNK ROAD SURFACE CONDITION SURVEY IN ENGLAND

### Description

- 7.1 Until 1999 the Highways Agency carried out an annual programme of High-speed Road Monitor (HRM) based surveys of wheel-track rutting, texture and longitudinal profile. These were superseded in 2000 by surveys undertaken as part of the TRAFFIC-speed Condition Survey, or TRACS contract. The surveys undertaken as part of the TRACS contract provide data on the extent of cracking in the pavement surface as well as enhanced measurements of the aspects of condition gathered by the HRM. For motorways and all purpose trunk roads, measurements are currently made for lanes 1 and 2 on dual carriageways and lane 1 on single carriageway roads. Roundabouts are excluded.
- 7.2 At the same time as TRACS was introduced, routine Deflectograph surveys of all trunk roads were replaced by Deflectograph surveys of only those parts of the network proposed for maintenance. The historic surveys were used to provide reports on the structural condition of the trunk road network until 2001 but since then the sample of valid surveys has been too small and the residual life of the trunk road network has therefore not been included in the NRMCS report (see Chapter 4).
- 7.3 The Highways Agency has introduced a new performance indicator to represent the condition of the trunk road network for 2004-05. This is based on a combination of the measurements made from TRACS and routine SCRIM surveys and represents the condition of lane 1 of the network.
- 7.4 Best Value Performance Indicators for the condition of principal roads in 2004-05 were based on measurements made by TRACS type Surveys (TTS). The machine survey regime was extended to other classified roads in 2005-06, using the revised SCANNER specification. It will therefore be possible for the condition of trunk roads and principal roads to be reported on a similar basis in the future and the intention is for the 2007 report to be based around SCANNER data, with no new CHART data collected on classified roads (see Chapter 3 for further details of future plans). To this end, the condition of the trunk road network from 2002 is reported here, using measurements obtained under the TRACS contract, and provisional estimates for classified local roads based on local PIs reported using SCANNER data in Chapter 5.
- 7.5 The TRACS results are derived by comparing each aspect of condition with thresholds representing a level of condition that should be considered for maintenance, i.e. it is not expected that all the lengths beyond the threshold levels will require immediate maintenance. The results are based on the condition of 100m lengths of the main carriageway of the road network and represent the percentage of the network where none of the thresholds for all the aspects of condition has been exceeded.
- 7.6 The SCANNER results are derived through a similar process of threshold comparison to that for TRACS, although the indicator is constructed quite differently. The SCANNER Road Condition Indicator uses a scoring system which generally requires at least two parameter measurements to be above the relevant thresholds (see Annex 7 for details). The results are based on the condition of 10m lengths of the main carriageway of the road network and represent the percentage of the network where none of the thresholds for all the aspects of condition has been exceeded.
- 7.7 Full details of the TRACS and SCANNER surveys can be found in Annex 7.

## Results

- 7.8 Table 7.1 shows results for 2002 through 2006 for lane 1 of motorways and all purpose trunk roads.
- 7.9 The percentage of the English trunk road network that is considered to be in good condition is highest for motorways.
- 7.10 Results for motorways show that the percentage of the network that may need maintenance has been broadly constant over this period, at around 5 or 6 per cent.
- 7.11 The condition of all purpose trunk roads has been improving slightly over the last two years; the percentage of all purpose trunk roads that may need maintenance decreased from 8 per cent in 2005 to 7 per cent in 2006.

**Table 7.1** Surface condition of trunk roads <sup>1, 2</sup>  
England 2002 to 2006

	Lane 1 length of network km	Lane 1 length surveyed		Percentage of Lane 1 exceeding investigatory level <sup>3</sup> Per cent
		km	Per cent	
<b>Motorways</b>				
2002	5,667	5,293	93	5
2003	5,752	5,349	93	5
2003 <sup>4</sup>	5,756	5,522	96	6
2004	5,752	5,516	96	6
2005 <sup>5</sup>	5,756	5,713	99	5
2006	5,782	5,486	95	5
<b>All purpose trunk</b>				
2002	10,959	7,824	71	8
2003	9,882	7,286	74	7
2003 <sup>4</sup>	9,830	9,482	96	11
2004	9,150	8,802	96	10
2005 <sup>5</sup>	8,900	8,791	99	8
2006	8,644	8,337	96	7

1 Figures are provided by the Highways Agency and are based on surveys of surface condition.

2 Figures were calculated on a new basis from 2004, when new condition thresholds determining which roads should be investigated were introduced. Details of the changes are provided in Annex 7.

3 The percentage of the network where the threshold for at least one aspect of condition has been exceeded. In deriving the percentage exceeding the threshold for all purpose trunk roads, results for built-up/non built-up and single/dual carriageway have been weighted by their lane 1 network length.

4 New figures for 2003 were back-calculated to provide a figure equivalent to the new standard used from 2004.

5 From 2005, TRACS surveys in lane 1 take place twice a year, meaning that figures from 2005 onwards are based on more recent data than in earlier years

## **8. FACTORS AFFECTING ROAD CONDITION**

- 8.1 Many factors influence road condition, including how well the roads were built in the first place, the wear they have experienced from traffic, how frequently they have been dug up to install and repair public utility services, weather conditions and, of course, how they have been maintained.

### **Road traffic**

- 8.2 As stated in Annex 4, vehicles with high axle loadings (mostly heavy goods vehicles, but also some public service vehicles) are responsible for virtually all pavement wear on the road carriageway. Table 8.1 shows traffic volumes in Great Britain for each road class and also the volume of heavy lorry traffic. (A heavy lorry is defined as a rigid vehicle with 4 or more axles or an articulated vehicle with 5 or more axles.) For all purpose trunk roads the percentage of heavy lorries is greater than that for principal roads, which in turn is higher than that for non-principal roads. The number of heavy lorries per kilometre on all purpose trunk roads is more than 5 times the number on principal roads and around 200 times the number on non-principal roads.
- 8.3 Table 8.1 shows that the use of heavy lorries grew rapidly during the 1980s. Levels of heavy lorry traffic continued to grow on all purpose trunk roads and principal roads in the 1990s but remained fairly constant on non-principal roads. As a result, heavy lorry traffic has become increasingly concentrated on all purpose trunk roads and principal roads - in 2005, 90 per cent of heavy lorry vehicle kilometres were on all purpose trunk or principal roads compared with 76 per cent in 1984.
- 8.4 The proportion of heavy lorry traffic compared with all lorry traffic has also risen sharply on all purpose trunk roads. In 1984, journeys by heavy lorries accounted for just 15 per cent of the distance travelled by all lorries. This had risen to 54 per cent in 2005. A switch to heavy lorries has also taken place on principal roads. In 2005, 33 per cent of distance travelled was by heavy lorries compared with 9 per cent in 1984.

**Table 8.1 Motor traffic volumes<sup>1</sup> by road class and type of vehicle**  
Great Britain 1984 to 2005

	All vehicles (Billion vehicle km)	All lorries <sup>2</sup> (Billion vehicle km)	Heavy lorries <sup>2,3</sup> (Billion vehicle km)	Heavy lorries as a <sup>2,3</sup> percentage of all lorries	Number of heavy lorries per kilometre (000)
<b>All purpose trunk</b>					
1984	51	5.4	0.8	14.8	
1985	51	5.3	1.1	20.8	
1986	56	5.5	1.3	23.6	
1987	59	5.7	1.5	26.3	
1988	62	6.1	1.7	27.9	
1989	69	6.6	2.1	31.8	
1990	69	6.4	2.1	32.8	
1991	69	6.3	2.3	36.5	
1992	69	6.2	2.3	37.1	
1993	69	6.4	2.6	40.8	
1994	70	6.6	2.8	41.8	
1995	72	6.8	3.0	44.4	
1996	74	6.9	3.1	44.9	
1997	76	7.0	3.3	46.3	
1998	77	7.3	3.5	47.8	
1999	79	7.3	3.5	47.5	
2000	78.2	7.2	3.5	48.2	
2001	74	6.9	3.4	50.2	
2002	72	6.7	3.4	51.1	321.0
2003	68	6.3	3.3	51.7	341.6
2004	66	6.3	3.3	52.7	360.0
2005	64	6.0	3.2	54.0	374.3
<b>All non-trunk</b>					
1984	216	8.9	0.9	10.1	
1985	220	8.9	1.0	11.2	
1986	229	9.2	1.3	14.1	
1987	241	9.7	1.6	16.5	
1988	259	10.2	1.7	16.7	
1989	274	10.9	2.1	19.3	
1990	280	10.5	2.1	20.0	
1991	281	10.5	2.0	19.0	
1992	282	10.1	1.9	18.8	
1993	276	9.0	1.9	21.4	
1994	281	9.0	1.9	21.0	
1995	284	9.1	2.1	23.2	
1996	288	9.1	2.1	23.1	
1997	292	9.2	2.2	23.6	
1998	296	9.3	2.3	24.3	
1999	301	9.4	2.2	23.6	
2000	300	9.4	2.2	23.7	
2001	310	9.7	2.3	24.0	
2002	322	10.0	2.5	24.9	6.6
2003	329	10.6	2.7	25.5	7.1
2004	336	10.9	3.0	27.5	8.0
2005	339	11.0	3.0	27.7	8.0

**Table 8.1** Motor traffic volumes<sup>1</sup> by road class and type of vehicle  
Great Britain 1984 to 2005

	All vehicles (Billion vehicle km)	All lorries <sup>2</sup> (Billion vehicle km)	Heavy lorries <sup>2,3</sup> (Billion vehicle km)	Heavy lorries as a percentage of all lorries <sup>2,3</sup>	Number of heavy lorries per kilometre (000)
<b>Principal</b>					
1984	101	5.3	0.5	9.4	
1985	102	5.2	0.7	13.5	
1986	103	5.1	0.8	15.7	
1987	108	5.3	0.9	17.0	
1988	116	5.6	1.1	19.6	
1989	117	5.9	1.3	22.0	
1990	124	5.9	1.3	22.0	
1991	127	5.9	1.3	22.0	
1992	128	5.8	1.4	24.1	
1993	122	5.5	1.4	25.9	
1994	125	5.7	1.5	25.6	
1995	128	5.8	1.6	28.1	
1996	130	5.7	1.6	28.6	
1997	131	5.8	1.7	29.2	
1998	133	6.0	1.8	30.0	
1999	134	5.9	1.7	28.7	
2000	133	5.8	1.7	29.1	
2001	142	6.0	1.8	29.4	
2002	147	6.3	2.0	31.5	54.8
2003	153	6.7	2.2	32.0	58.3
2004	158	7.2	2.4	34.1	65.1
2005	160	7.2	2.4	33.3	63.2
<b>Non-principal</b>					
1984	115	3.6	0.4	11.1	
1985	119	3.7	0.3	8.1	
1986	126	4.1	0.5	12.2	
1987	133	4.4	0.7	15.9	
1988	143	4.6	0.6	13.0	
1989	157	5.0	0.8	16.0	
1990	156	4.6	0.8	17.4	
1991	154	4.6	0.7	15.2	
1992	154	4.3	0.5	11.6	
1993	154	3.5	0.5	13.4	
1994	156	3.3	0.4	13.4	
1995	156	3.3	0.5	14.1	
1996	158	3.4	0.5	13.8	
1997	161	3.4	0.5	14.7	
1998	163	3.3	0.5	15.3	
1999	167	3.5	0.5	14.4	
2000	167	3.6	0.5	14.3	
2001	168	3.7	0.5	14.3	
2002	175	3.7	0.5	14.1	1.5
2003	176	3.9	0.5	14.0	1.6
2004	178	3.7	0.6	14.9	1.7
2005	179	3.8	0.6	15.6	1.8

1 Traffic volume figures are published annually in Chapter 1 of DfT's Road Traffic Statistics. There is a break in the series following revisions to figures from 1993 onwards.

2 Goods vehicles over 3.5 Tonnes gross weight.

3 Rigid vehicles with 4 axles or more and articulated vehicles with 5 axles or more.

## Maintenance expenditure

- 8.5 The maintenance expenditure data in Tables 8.2 and 8.3 include expenditure on bridges.
- 8.6 Maintenance expenditure on English trunk roads in 2005-06 rose by 13 per cent, compared with 2004-05, to around £981 million. Structural maintenance accounts for just over a half of all maintenance expenditure on trunk roads in England (see Table 8.2) and expenditure on this increased on these roads in 2005-06. Other maintenance expenditure includes covers environmental, safety and routine maintenance.
- 8.7 Total maintenance expenditure on all English local authority owned roads, i.e. non-trunk roads, in 2005-06 remained the same in real terms as in 2004-05. This expenditure had increased in real terms in each of the previous five years. In 2005-06 expenditure was over £2.7 billion, almost one and a half times that in 1998-99. Structural maintenance (including patching) accounted for just under two thirds of the money spent in 2005-06.
- 8.8 Maintenance expenditure on English principal roads reached a peak in 1993-94 at £889 million. This was followed by a relatively sharp decline and then a sustained period of increases over the five years to 2004-05. In 2005/06, expenditure was £876 million compared with £902 million in 2004-05, but this was still over 55 per cent higher in real terms than in 1998-99.
- 8.9 Maintenance expenditure on English non-principal roads declined steadily to a low point in 1998-99. Since then, expenditure has increased in real terms by 41 per cent to over £1.9 billion in 2005-06.
- 8.10 In 2005-06, maintenance expenditure on Welsh trunk roads decreased by 2 per cent to £57 million (see Table 8.3). Maintenance expenditure on Welsh local roads was about 5 per cent higher than in 2004-05, at about £174 million. As in England, about two thirds of the money spent on maintaining local roads was allocated to structural maintenance.
- 8.11 Note that in 1999-00 there was a reclassification of expenditure on patching on non-trunk roads in England and Wales from 'routine and other maintenance' to 'structural maintenance'. Because of this, it is not always possible to compare year on year changes for either treatment type, although comparisons between total expenditure can of course still be made.

**Table 8.2 Maintenance expenditure <sup>1</sup> by road class**  
England 1995-96 to 2005-06

£ million at 2004-05 prices

Road class	Treatment		Total
	Structural	Routine and other	
<b>All purpose trunk roads and motorways</b>			
1995-96	534.9	193.3	728.2
1996-97	468.5	183.1	651.6
1997-98	500.0	209.9	709.9
1998-99	540.1	177.0	717.1
1999-00	598.2	186.4	784.6
2000-01	614.1	215.1	829.2
2001-02	521.4	210.0	731.4
2001-02 <sup>2</sup>	489.6	285.9	775.5
2002-03 <sup>2</sup>	509.5	318.0	827.5
2003-04 <sup>2</sup>	426.2	471.8	898.0
2004-05 <sup>2</sup>	448.6	422.5	871.1
2005-06 <sup>2</sup>	523.4	457.5	980.9
<b>Non-trunk roads</b>			
1995-96	1,297.3	1,139.9	2,437.2
1996-97	1,089.3	1,068.6	2,157.9
1997-98	980.2	983.5	1,963.8
1998-99	898.6	1,009.1	1,907.7
1999-00 <sup>3</sup>	1,171.8	836.4	2,008.3
2000-01	1,335.0	753.9	2,088.9
2001-02	1,547.9	825.8	2,373.7
2002-03	1,650.7	865.1	2,515.8
2003-04	1,670.5	933.1	2,603.6
2004-05	1,805.0	974.0	2,779.0
2005-06	1,753.5	1,025.9	2,779.4
<b>Principal roads</b>			
1995-96	542.6	238.6	781.1
1996-97	418.6	210.2	628.7
1997-98	383.2	205.8	589.0
1998-99	342.4	214.1	556.5
1999-00 <sup>3</sup>	411.9	161.4	573.3
2000-01	528.8	181.3	710.1
2001-02	518.1	243.5	761.6
2002-03	586.2	268.9	855.2
2003-04	605.9	270.1	876.0
2004-05	590.4	311.6	902.0
2005-06	535.6	340.3	875.9
<b>Non-principal roads</b>			
1995-96	754.7	901.4	1,656.1
1996-97	670.7	858.5	1,529.2
1997-98	597.0	777.8	1,374.8
1998-99	556.2	795.0	1,351.2
1999-00 <sup>3</sup>	759.9	675.0	1,434.9
2000-01	806.1	572.6	1,378.7
2001-02	1,029.8	582.3	1,612.1
2002-03	1,064.5	596.2	1,660.7
2003-04	1,064.7	663.0	1,727.6
2004-05	1,214.6	662.4	1,876.9
2005-06	1,217.9	685.6	1,903.5

1 Includes expenditure on bridges.

2 Figures are on a resource accounting basis. Other trunk figures are on an accruals basis, hence the break in the series represented by the dotted line.

3 Expenditure on 'patching' was reclassified from 'routine and other' to 'structural' in 1999-00, hence the break in the series represented by the dotted line for each treatment type. Note this does not affect total expenditure.

**Table 8.3** Maintenance expenditure <sup>1</sup> by road class  
Wales 1995-96 to 2005-06

£ million at 2003-04 prices

Road class	Treatment		Total
	Structural	Routine and other	
<b>All purpose trunk roads and motorways</b>			
1995-96	52.9	36.5	89.4
1996-97	30.0	28.5	58.5
1997-98	29.9	30.5	60.4
1998-99	33.2	32.5	65.6
1999-00	21.2	32.7	53.8
2000-01	30.3	35.6	65.9
2001-02	27.0	31.5	58.6
2002-03	29.1	31.9	61.0
2003-04	24.3	30.9	55.2
2004-05	25.7	33.5	59.2
2005-06	27.8	28.9	56.7
<b>Non-trunk roads</b>			
1995-96	n/a	n/a	n/a
1996-97	123.0	83.6	206.6
1997-98	90.5	84.7	175.2
1998-99	80.4	82.1	162.5
1999-00 <sup>2</sup>	89.3	63.7	153.0
2000-01	100.7	57.8	158.5
2001-02	108.8	59.1	167.9
2002-03	119.7	60.0	179.7
2003-04	115.9	62.2	178.1
2004-05	105.4	60.1	165.5
2005-06	117.0	56.5	173.5
<b>Principal roads</b>			
1995-96	n/a	n/a	n/a
1996-97	47.5	15.4	62.9
1997-98	40.3	15.6	55.9
1998-99	27.4	16.2	43.6
1999-00 <sup>2</sup>	31.7	17.9	49.6
2000-01	32.7	13.2	45.9
2001-02	36.8	13.5	50.3
2002-03	44.0	12.5	56.6
2003-04	33.3	14.3	47.7
2004-05	29.5	15.2	44.7
2005-06	33.5	13.5	47.0
<b>Non-principal roads</b>			
1995-96	n/a	n/a	n/a
1996-97	75.5	68.2	143.6
1997-98	50.1	69.1	119.2
1998-99	53.0	65.9	118.9
1999-00 <sup>2</sup>	57.7	45.8	103.4
2000-01	68.0	44.6	112.6
2001-02	72.0	45.6	117.6
2002-03	75.6	47.5	123.1
2003-04	82.6	47.8	130.4
2004-05	76.0	44.8	120.8
2005-06	83.5	43.0	126.5

1 Includes expenditure on bridges.

2 Expenditure on 'patching' was reclassified from 'routine and other' to 'structural' in 1999-00, hence the break in the series represented by the dotted line for each treatment type. Note this does not affect total expenditure.

## Carriageway Work Done

8.12 The English and Welsh figures for carriageway work done on local roads in Table 8.4 show that in 2005-06 there has been little change in the **overall** proportion of the principal road network that has been maintained this year. There has been an increase in the **overall** proportion of principal and non-principal roads being treated since 2000.

**Table 8.4** Road lengths receiving maintenance treatment by road class and type of treatment <sup>1</sup>, England and Wales 1984-85 to 2005-06

Road class	Treatment type			Surface dressing <sup>3</sup>
	Strengthening <sup>2</sup>	Resurfacing	Total	
Percentage of road network				
<b>Principal</b>				
1984-85	1.2	2.6	<b>3.8</b>	7.3
1985-86	0.9	2.0	<b>2.8</b>	6.2
1986-87	1.2	2.9	<b>4.0</b>	7.1
1987-88	1.1	2.8	<b>3.9</b>	6.2
1988-89	1.4	2.5	<b>3.9</b>	6.6
1989-90	1.2	3.2	<b>4.5</b>	7.5
1990-91	1.2	2.8	<b>4.0</b>	5.7
1991-92	1.5	2.7	<b>4.2</b>	6.8
1992-93	1.7	2.6	<b>4.3</b>	6.2
1993-94	1.8	2.7	<b>4.5</b>	8.6
1994-95	1.6	2.5	<b>4.1</b>	4.4
1995-96	1.3	2.1	<b>3.3</b>	3.9
1996-97	0.7	2.4	<b>3.2</b>	4.3
1997-98	0.6	1.4	<b>2.0</b>	3.6
1998-99	1.4	1.1	<b>2.5</b>	4.1
1999-00	0.9	1.8	<b>2.7</b>	3.9
2000-01	1.8	1.7	<b>3.5</b>	4.4
2001-02	2.2	2.1	<b>4.4</b>	5.1
2002-03	2.3	3.1	<b>5.4</b>	3.8
2003-04	1.9	3.0	<b>5.0</b>	3.5
2004-05	2.3	2.5	<b>4.8</b>	3.6
2005-06	2.2	2.7	<b>4.8</b>	3.7
<b>Non-principal</b>				
1984-85	0.4	0.5	<b>0.9</b>	7.4
1985-86	0.4	0.5	<b>0.9</b>	7.5
1986-87	0.5	0.6	<b>1.1</b>	7.5
1987-88	0.4	0.5	<b>0.9</b>	6.9
1988-89	0.4	0.5	<b>0.9</b>	6.9
1989-90	0.6	0.9	<b>1.5</b>	8.9
1990-91	0.4	0.5	<b>0.9</b>	7.1
1991-92	0.4	0.6	<b>1.0</b>	6.2
1992-93	0.4	0.6	<b>1.0</b>	6.5
1993-94	0.3	0.5	<b>0.9</b>	5.1
1994-95	0.3	0.5	<b>0.8</b>	4.9
1995-96	0.3	0.3	<b>0.6</b>	4.3
1996-97	0.2	0.3	<b>0.5</b>	4.7
1997-98	0.2	0.3	<b>0.5</b>	4.0
1998-99	0.1	0.1	<b>0.2</b>	4.5
1999-00	0.2	0.3	<b>0.5</b>	3.7
2000-01	0.2	0.4	<b>0.6</b>	3.7
2001-02	0.4	0.5	<b>0.9</b>	3.3
2002-03	0.3	0.6	<b>0.9</b>	3.2
2003-04	0.3	0.6	<b>0.9</b>	3.2
2004-05	0.4	0.7	<b>1.0</b>	3.3
2005-06	0.3	0.8	<b>1.1</b>	3.2

**Table 8.4****Road lengths receiving maintenance treatment by road class and type of treatment <sup>1</sup>, England and Wales 1984-85 to 2005-06**

Percentage of road network

Road class	Treatment type			Surface dressing <sup>3</sup>
	Strengthening <sup>2</sup>	Resurfacing	Total	
<b>Built-up principal <sup>4</sup></b>				
1984-85	1.3	4.5	<b>5.9</b>	4.4
1985-86	1.1	2.6	<b>3.7</b>	4.5
1986-87	0.9	3.4	<b>4.2</b>	3.6
1987-88	1.4	3.8	<b>5.2</b>	3.7
1988-89	1.1	3.7	<b>4.7</b>	4.4
1989-90	1.3	4.1	<b>5.4</b>	5.0
1990-91	1.0	4.4	<b>5.4</b>	3.9
1991-92	1.4	4.0	<b>5.4</b>	3.8
1992-93	1.6	3.5	<b>5.1</b>	3.3
1993-94	1.9	4.0	<b>5.9</b>	4.0
1994-95	1.7	3.9	<b>5.6</b>	2.9
1995-96	1.3	3.0	<b>4.3</b>	3.5
1996-97	0.8	2.2	<b>3.1</b>	2.4
1997-98	0.8	2.3	<b>3.0</b>	2.2
1998-99	0.9	1.9	<b>2.8</b>	2.8
1999-00	1.3	2.2	<b>3.6</b>	2.3
2000-01	1.9	2.6	<b>4.6</b>	2.0
2001-02	2.6	2.7	<b>5.3</b>	2.0
2002-03	3.1	3.8	<b>6.9</b>	1.6
2003-04	2.5	3.9	<b>6.4</b>	1.5
2004-05	2.3	3.3	<b>5.5</b>	1.9
2005-06	1.9	3.6	<b>5.5</b>	2.4
<b>Non built-up principal <sup>4</sup></b>				
1984-85	1.2	1.6	<b>2.8</b>	9.7
1985-86	0.7	1.5	<b>2.2</b>	7.7
1986-87	1.4	1.7	<b>3.1</b>	9.3
1987-88	1.0	2.0	<b>2.9</b>	7.9
1988-89	1.8	2.1	<b>3.9</b>	8.3
1989-90	1.2	3.0	<b>4.2</b>	9.4
1990-91	1.3	1.8	<b>3.0</b>	7.6
1991-92	1.4	1.8	<b>3.2</b>	8.3
1992-93	1.8	2.2	<b>4.0</b>	8.3
1993-94	1.8	2.1	<b>3.9</b>	12.3
1994-95	1.6	1.7	<b>3.3</b>	5.5
1995-96	1.2	1.5	<b>2.8</b>	4.2
1996-97	0.7	2.6	<b>3.3</b>	5.3
1997-98	0.5	1.0	<b>1.5</b>	4.3
1998-99	0.8	0.6	<b>1.4</b>	5.5
1999-00	0.7	1.5	<b>2.2</b>	4.9
2000-01	1.7	1.0	<b>2.7</b>	6.1
2001-02	1.9	1.8	<b>3.7</b>	7.3
2002-03	1.7	2.6	<b>4.3</b>	5.4
2003-04	1.5	2.4	<b>3.9</b>	5.0
2004-05	2.4	1.8	<b>4.2</b>	5.0
2005-06	2.4	1.9	<b>4.3</b>	4.8

1. Figures from 2000-01 include estimates for non-responding authorities. In 2004-05, 100 out of 171 authorities provided data for these tables compared with 108 in 2003-04.

2. Includes reconstruction and overlay (see Annex 2 for definitions).

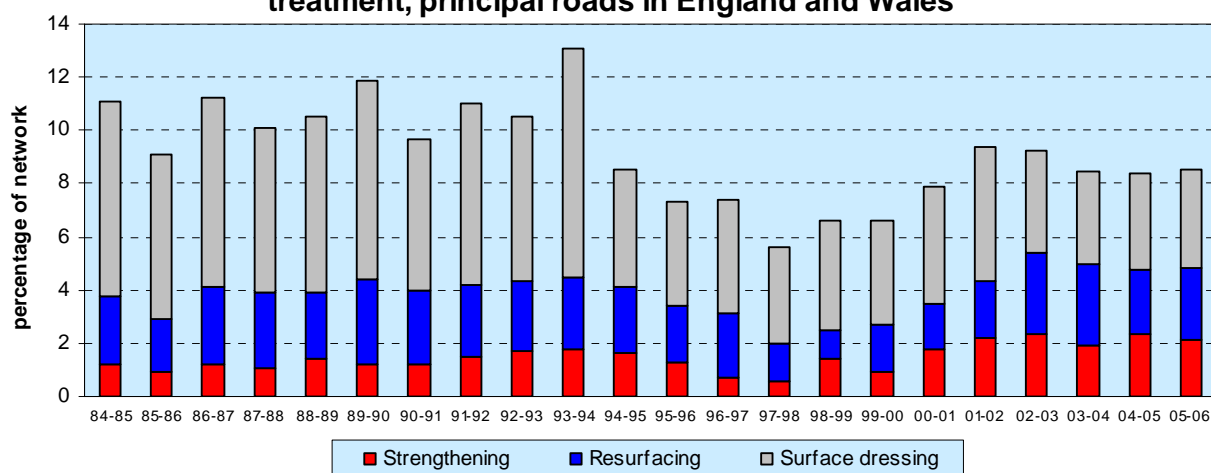
3. Includes surface dressing and thin surfacing (see Annex 2 for definitions).

4. Built-up and non built-up were previously referred to as urban and rural.

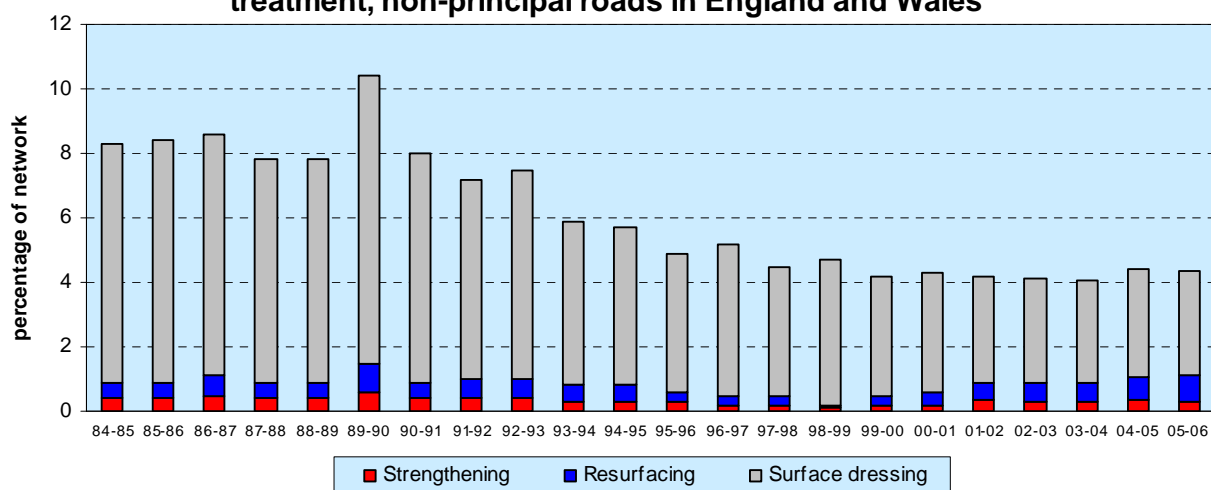
Note: The figures in this table are outside the scope of National Statistics

- 8.13 Figures for 2000-01 onwards are based on an improved methodology which includes estimates for non-responding authorities. Revisions to national estimates are small and are not statistically significant.
- 8.14 Results in Table 8.4 are shown graphically in Figures 8.1 and 8.2. The percentage of the road network treated each year is currently less than the levels experienced in the late 1980s and early 1990s, although there has been increased maintenance on principal roads in recent years, compared with the late 1990s. Figures 8.3 and 8.4 show, for those roads which have had maintenance, what types of treatment were used. For instance, treatment on principal and non-principal roads has for some years been moving away from the cheaper surface dressing treatments towards strengthening (reconstruction and overlay) or resurfacing. Despite this, surface dressing is still the most common treatment - around 45 per cent on principal roads and 75 per cent on non-principal roads.

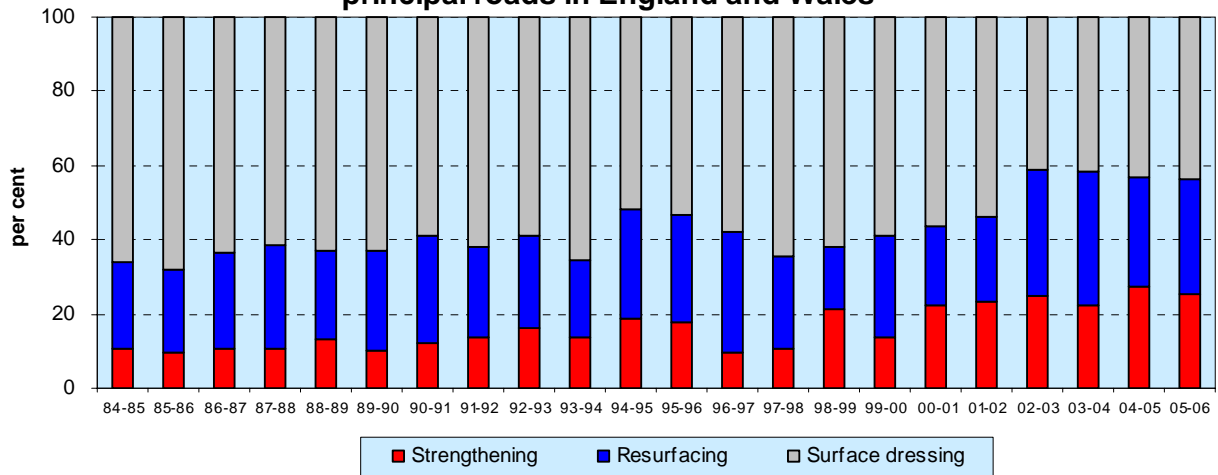
**Figure 8.1 - Road lengths receiving maintenance by type of treatment, principal roads in England and Wales**



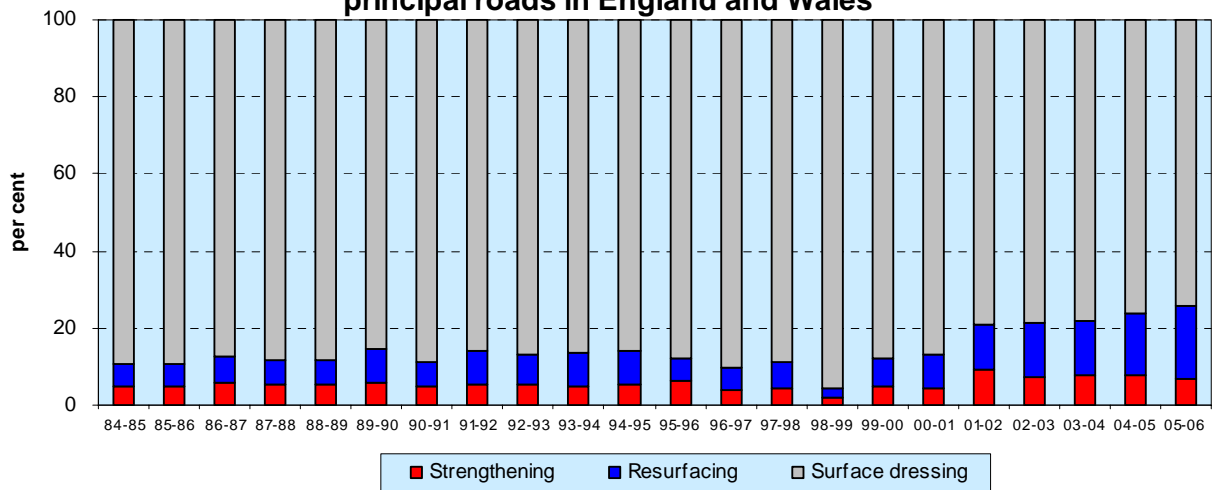
**Figure 8.2 - Road lengths receiving maintenance by type of treatment, non-principal roads in England and Wales**



**Figure 8.3 - Proportion of maintenance by type of treatment, principal roads in England and Wales**



**Figure 8.4 - Proportion of maintenance by type of treatment, non-principal roads in England and Wales**

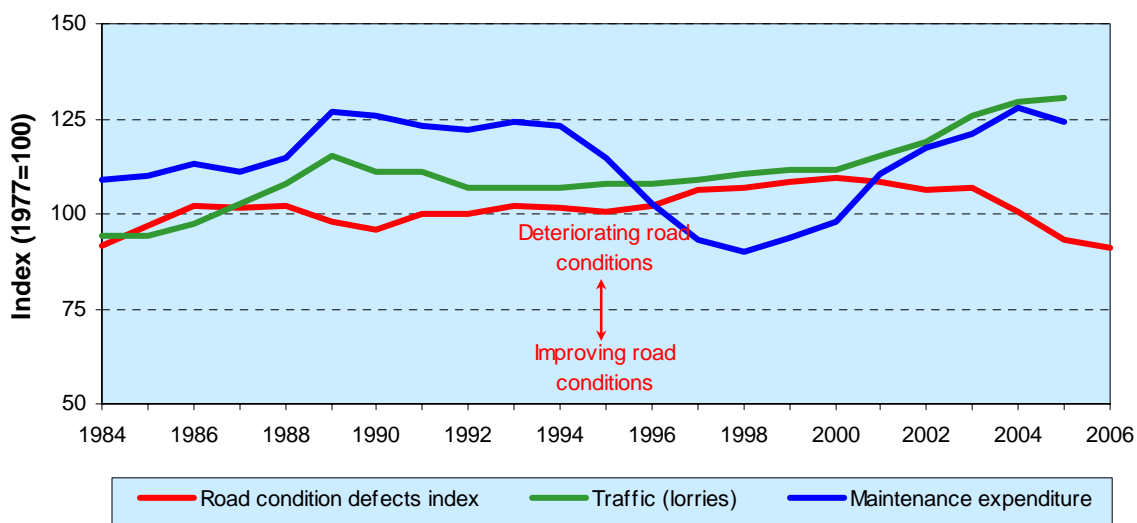


## Comparison of condition, road traffic and maintenance expenditure

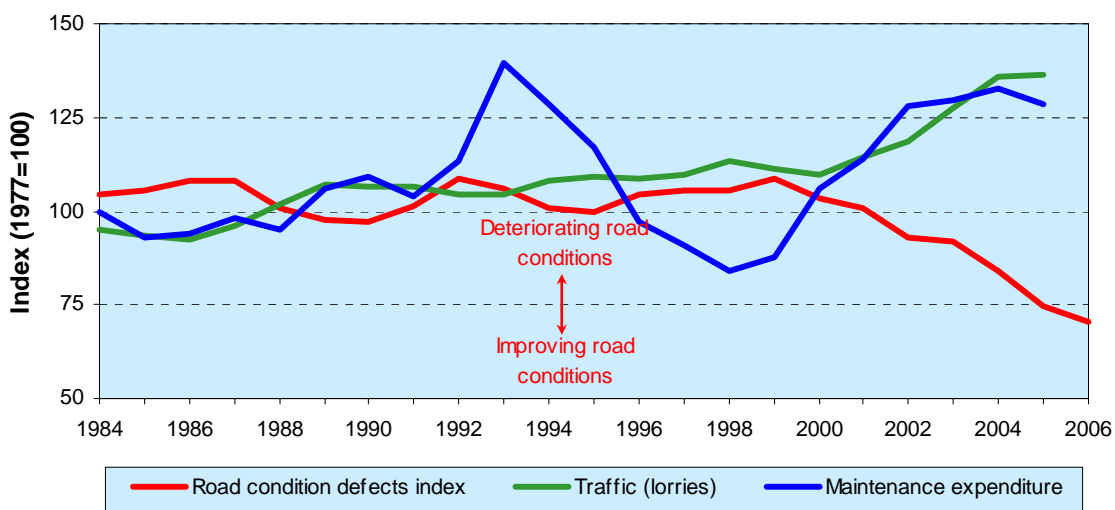
8.15 A detailed analysis of the inter-relationship between the condition of the road network, the traffic carried and the levels of maintenance expenditure is beyond the scope of this report. However, to put the results of the condition survey into perspective, Figures 8.5 to 8.7 compare trends in maintenance expenditure and road traffic with changes in the road condition defects index (see Chapter 3). To do this, expenditure and traffic have been converted into an index with a base of 100 in 1977. It is to be expected that an increase in expenditure generally leads to improving condition, while an increase in traffic will lead to worsening condition. There may be time lags in the effects of these factors on condition and the relationship is generally complex, depending as it does on the deterioration profiles of roads constructed and maintained in a variety of ways.

8.16 Traffic figures are for Great Britain and relate to lorries, i.e. goods vehicles over 3.5 tonnes gross weight. The index for maintenance expenditure relates to financial years and has been converted to constant prices using Gross Domestic Product indices. It includes expenditure on bridges but excludes expenditure on lighting and winter maintenance.

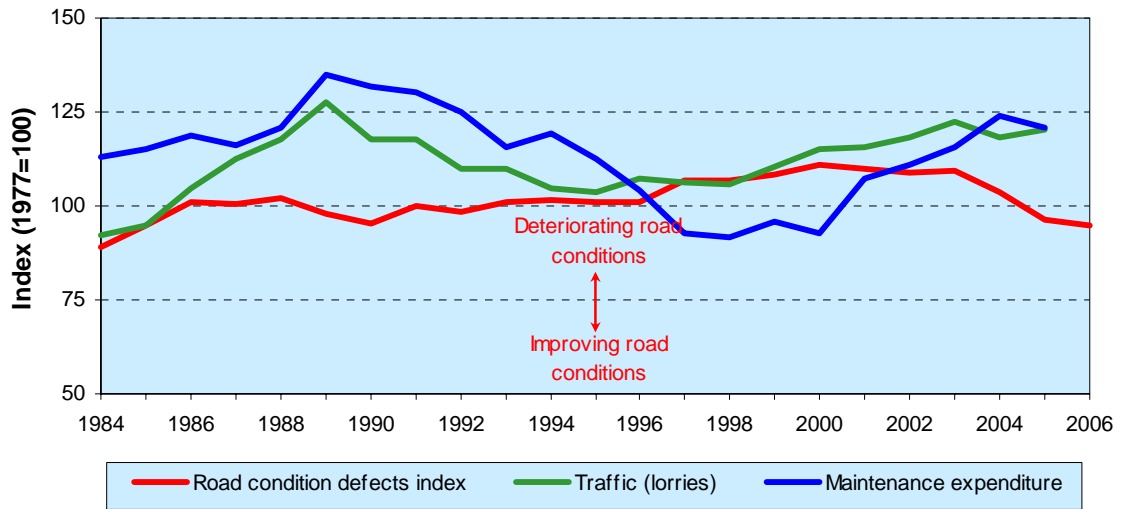
**Figure 8.5 Comparison of condition, road traffic and maintenance expenditure, England and Wales - Non-trunk roads**



**Figure 8.6 Comparison of condition, road traffic and maintenance expenditure, England and Wales - Principal roads**



**Figure 8.7 Comparison of condition, road traffic and maintenance expenditure, England and Wales - Non-principal roads**



## ANNEX 1

### MEMBERS OF THE ROADS PERFORMANCE MANAGEMENT GROUP

The Roads Performance Management Group (RPMG, formerly the NRMCS Technical Sub-Group) is a sub-group of the UK Roads Board. The UK Roads Board (itself a daughter body of the Roads Liaison Group) brings together national and local governments from across the UK to advise on issues relating to the management of the highway asset.

**Chair** Gordon Prangnell, London Borough of Hammersmith and Fulham

#### Members

##### **Representing the local highway authorities**

Stephen Child, Surrey County Council

Gordon Prangnell, London Borough of Hammersmith & Fulham

##### **Representing the Highways Agency**

Ramesh Sinhal

Richard Abell

##### **Representing the National Assembly for Wales**

Richard Morgan

##### **Representing CSS Wales**

Neil Fenby

##### **Representing the Scottish Road Maintenance Condition Survey (SRMCS)**

Alistair Gow (Project Manager)

##### **Representing the Society of Chief Officers for Transportation in Scotland**

John McRobert

##### **Representing the Department for Regional Development (Northern Ireland)**

Roddy Crilly

##### **Representing the CSS (County Surveyors' Society)**

Ed Lawrence (Jacobs Babbie Group Ltd)

##### **Representing Transport for London**

Jim DeSouza

##### **Representing the Footway and Cycletrack Management Group**

Kevin Fuller

##### **Representing the UKPMS steering group**

Andy Pickett (Chris Britton Consultancy)

##### **Representing the Department for Transport**

Anthony Boucher

Paul Foskett  
Drew Hird  
Edward Bunting  
Roger Thompson (Secretariat)

## ANNEX 2

### GLOSSARY OF TECHNICAL TERMS

Note that definitions regarding specific visual defects can be found in Annex 3. Detailed explanations of terms relating to the structural survey, Best Value Performance Indicators, the skidding resistance survey and the trunk road surface condition survey can also be found in Annexes 4 to 7 respectively.

All purpose trunk roads	Centrally owned and maintained 'A' roads.
Built-up roads	Roads that have a speed limit of 40 mph or less. These were referred to as urban roads in previous editions.
BVPI	Best Value Performance Indicator – BVPIs show the relative performance of English local authorities for different aspects of performance. The BVPIs for the condition of local roads are included in Chapter 5.
Carriageway	The paved area of the highway carrying vehicular traffic and including any hard shoulders and marginal strips.
CHART	Computerised Highway Assessment of Ratings and Treatments – a system of assessing structural maintenance need of highways, developed in the 1970s at TRL and used by the Highways Agency on the trunk road network. The CHART system of recording defects was adopted for the NRMCS visual survey when it was established in 1977 and remains in use.
Classified roads	Local authority owned and maintained roads with A, B or C classification. Note that in the report's tables and figures, the term principal roads refers to local authority A roads and the term classified roads refers to local authority B and C roads. Local authority A, B and C roads account for some 40 per cent of the local authority road network.
CSC	Characteristic SCRIM Coefficient. An estimate of the underlying skid resistance once the seasonal variation has been taken into account.
CVI	Coarse Visual Inspection – a method of inspecting road condition at network level developed as part of the UK Pavement Management System (see below). Fewer defect details are recorded than from a DVI (see below) while a CVI may be carried out either from a moving vehicle or by walking along a road. A CVI provides information on road condition at the local authority network level and identifies sections of road where a more detailed DVI survey is required to more accurately determine the appropriate maintenance treatment.
DBFO	Design, build, finance and operate.
Defects	See Annex 3 for definitions and photographs of visual defects, as well as a description of how the defects index is calculated.
Defects index	Representation of the carriageway defects that will show the trends in

condition (1977 value = 100) (see Annex 3).

DEFLEC	Software developed in the 1980s to process Deflectograph data and to provide the residual life (see below) of the road structure. DEFLEC was superseded by various versions of PANDEF (see below). It is still used by the National Assembly for Wales.
Deflectograph	A lorry-based machine that measures the deflection of a flexible pavement as the vehicle passes over the pavement. These deflections are used to assess the current load-bearing structural capacity of the pavement and enable the residual life of the pavement to be calculated (see Annex 4). Deflectograph surveys are not appropriate for non-flexible roads such as those of a concrete or block construction, or for elevated carriageways.
DVI	Detailed Visual Inspection – a method of inspecting road condition developed as part of the UK Pavement Management System (see below). A DVI is carried out by one or more inspectors walking along the road. The method is often used after initial problems have been noted during a CVI but some built-up authorities conduct a DVI where a driven CVI survey is impractical.
Flexible pavement	A pavement with the base (Roadbase) and all layers above the base of bituminous material.
Flexible composite	A pavement with a cement bound base and bituminous upper pavement layers.
Footway	Any area alongside a road intended for use by pedestrians. (Colloquially a footway will be described either as a ‘pavement’ or as a footpath alongside a road.)
HAPMS	A generic term to cover the computer systems and related engineering and business processes that comprise the Highways Agency Pavement Management System.
Investigatory level	The level of condition at which consideration is given of the need for maintenance. At this juncture, all available evidence (e.g. accident rates) would be taken into account.
Local roads	Local authority maintained A, B, C and unclassified roads. These are also known as non-trunk roads.
Long life pavements	A flexible pavement that is thicker than traditional pavement and has a low deflection. Residual life (see below) is not used for long life pavements.
Mean Summer SCRIM coefficient	Mean of 3 or more SCRIM Coefficients measured for a length of road at well spaced intervals between May and September in a year.
Motorway	A particular type of road with restricted use carrying predominantly long distance traffic. Most motorways are the responsibility of the Highways Agency but there are some short lengths of local authority motorways.
Non built-up roads	Roads that have a speed limit in excess of 40 mph. These were referred to as rural roads in previous editions.

Non-trunk roads	Local authority maintained A, B, C and unclassified roads. These are also known as local roads.
Non-principal roads	Local authority maintained B, C and unclassified roads
Overlay	Material placed on top of the existing pavement in a layer (or layers) of regular thickness. This is a more substantial treatment than surface dressing.
PANDEF	Software developed for the Highways Agency to analyse Deflectograph data and determine the residual life of flexible and flexible composite pavements. PANDEF was developed to replace an earlier program called DEFLEC (see above). The current version of PANDEF is Version 3. This version identifies long life pavements (see above).
Pavement	Technical term for the carriageway of a road. Note this is not a footway (see definition above).
Principal roads	Local authority maintained 'A' roads. In general they carry less traffic than all purpose trunk roads which are 'A' roads owned and maintained by central government.
Reconstruction	The removal of some or all of the structural layers of a road pavement and their replacement with new material, including a new surfacing. This is a more substantial treatment. This is a more substantial treatment than overlay.
Residual life	The expected period before the structure of a flexible or flexible composite pavement reaches an 'investigatory condition'. At this point further deterioration is no longer predictable, so that even though the road may still be serviceable it is not possible to predict how long it will remain so. Residual life is therefore a similar concept to the supermarket 'shelf life'.
Resurfacing	The removal and replacement of the existing surface, in order to restore the running surface and improve surface characteristics.
Rigid composite pavement	A pavement in which the structural layer is cement based concrete and the surface layers are bituminous material
Rigid pavement	A pavement in which the structural layers and the surface are cement-based concrete.
SCRIM	Sideway-force Coefficient Routine Investigation Machine – a lorry-based machine that when driven over a pavement surface, measures the resistance to skidding of the wet pavement surface (see Annex 6).
Single annual SCRIM survey	All of lane 1 of the network is surveyed once during the SCRIM testing season in each year. In successive years each road length is tested in the early, middle and late parts of the season.
Site (NRMCS)	100 metres of carriageway and associated footways and verges identified by DfT (for inspection by local authorities and - up to 2002 - by trunk road agents) to provide the visual condition for analysis by DfT. The sites are selected from a random sample of all roads (except motorways) in England and Wales.

Standard axle	A single axle with 2 wheels and carrying a load of 80kN. The life of a pavement that will carry different axle types and loads is expressed in terms of the number of standard axles the pavement will carry.
Surface dressing	A single/double/triple layer of aggregate combined with one or more layers of binder (e.g. bitumen) to form a running surface. This may be laid over the existing surface.
Thin surfacing	Thin surfacing systems are machine-laid proprietary mixes of asphalt that have the capability to regulate and smooth the surface profile of a road pavement, restoring surface texture and skid resistance.
TRACS	Traffic Speed Condition Survey – a label to describe a methodology for machine-based surveys of surface condition, including cracking and rutting, of the trunk road network in England. The TRACS specification covers the requirements for both the machinery used and the survey process.
Trunk roads	Motorways and all purpose trunk roads owned by central government and for which the Highways Agency (in England) and the National Assembly for Wales (in Wales) have responsibility for maintenance and operation. These are strategic roads with a high proportion of long distance traffic although some trunk roads may also have lengths, with the same number, designated as an ‘A’ principal road, where traffic is predominantly local in nature.
TTS	TRACS type surveys. New pavement surface condition surveys based on the TRACS surveys used for the trunk road network.
UKPMS	United Kingdom Pavement Management System – this is a standard logical design for software used by local highway authorities for the management of the maintenance of their road networks. The development of UKPMS is currently funded by DfT. A number of companies market software that meets the UKPMS requirements. Associated with UKPMS are standard survey types (CVI and DVI, see above) and standard ‘rules and parameters’ to be used when processing survey data for ‘national’ purposes e.g. for Best Value Performance Indicators.
Unclassified roads	Minor roads which are not designated as classified roads and which are owned and maintained by a local highway authority. Some 60 per cent of the local authority network is unclassified.

## ANNEX 3

### VISUAL SURVEY

#### Description

Since being established in 1977, the main objective of the visual survey has been to estimate the trend in road conditions, in England and Wales, by type of road. The road types surveyed are:

- all purpose trunk (except those roads covered by DBFO contracts)
- built-up principal
- built-up classified
- built-up unclassified
- non built-up principal
- non built-up classified
- non built-up unclassified

The last year of the visual survey on all purpose trunk roads was 2002. This is owing to changes in the methods used to monitor road conditions on the trunk road network and details can be found in the new Chapter 7 and Annex 7. Results for all purpose trunk roads and all road classes (excluding motorways) are therefore not available from 2003 onwards. Similarly, 2006 will be the last year that the visual survey is carried out on classified roads, as DfT will be using machine collected SCANNER data to report on English classified roads in future years. The National Assembly for Wales will be reporting on all Welsh roads using SCANNER.

Motorways are excluded from the visual survey because of the expensive traffic control measures that would be required to carry out visual surveys. Roads with a concrete running surface, which exhibit different faults from blacktop roads are also excluded, but not blacktop roads with a concrete base. (Roads with a concrete running surface, which would need a separate survey, form only a small proportion of roads nationally.) In addition to carriageway defects the survey also records footway, verge and kerb defects.

In 2006, 124 local authorities (out of a possible total of 171) in England and Wales participated in the visual survey. Responding authorities are representative of almost 80 per cent of the total length of local roads. Results in Chapter 3 and this annex include estimates for the following local authorities which did not supply visual data in 2006:

Barking & Dagenham, Bath and North East Somerset, Bexley, Bournemouth, Bradford, Bristol, Ceredigion, City of London, Conwy, Croydon, Denbighshire, Derby, Ealing, Gloucestershire, Hackney, Haringey, Havering, Hillingdon, Isle of Wight, Islington, Kensington & Chelsea, Kingston-upon-Thames, Lewisham, Merthyr Tydfil, Monmouthshire, Newham, North Lincolnshire, North Yorkshire, Poole, Portsmouth, Reading, Redcar & Cleveland, Rhondda Cynon & Taff, Rutland, Staffordshire, Stockport, Stockton on Tees, Stoke-on-Trent, Sutton, Swindon, Tameside, Telford & Wrekin, Vale of Glamorgan, Westminster, West Berkshire, Wirral, Wokingham, York.

In 2006, 11,745 non-trunk sites were surveyed compared with 11,800 in 2005; Details of the types of sites surveyed in each authority are shown in Table A3.1.

**Table A3.1** Number of sites in visual survey  
England and Wales 2006

Local authority	Built-up <sup>1</sup>			Non built-up <sup>1</sup>			All non-trunk
	Principal	Classified	Unclassified	Principal	Classified	Unclassified	
<b>Total</b>	<b>2,027</b>	<b>2,079</b>	<b>2,623</b>	<b>1,647</b>	<b>1,754</b>	<b>1,598</b>	<b>11,745</b>
Anglesey	10	7	3	15	23	28	86
Barnet	6	3	13	0	0	0	22
Barnsley	25	5	6	2	9	3	50
Bedfordshire	8	8	8	10	10	10	54
Birmingham	50	29	20	0	0	0	99
Blackburn	7	6	8	8	6	6	41
Blackpool	8	5	5	0	0	0	18
Blaenau Gwent	3	3	15	3	3	0	27
Bolton	20	11	15	0	1	0	47
Bracknell Forest	6	10	10	7	1	6	40
Brent	5	7	8	0	0	0	20
Bridgend	3	5	14	3	7	8	40
Brighton & Hove	6	9	11	0	0	0	26
Bromley	7	13	12	0	0	0	32
Buckinghamshire	26	20	21	29	25	24	145
Bury	18	11	18	0	0	0	47
Caerphilly	5	5	15	5	5	7	42
Calderdale	2	10	5	2	1	4	24
Cambridgeshire	15	23	43	42	28	31	182
Camden	10	6	10	0	0	0	26
Cardiff	15	16	31	9	6	0	77
Carmarthenshire	3	20	13	11	29	17	93
Cheshire	34	36	50	44	49	52	265
City of York	11	7	10	10	7	8	53
Cornwall	47	37	44	57	28	68	281
Coventry	9	10	16	0	0	0	35
Cumbria	22	24	48	35	54	63	246
Darlington	5	9	11	8	8	7	48
Derbyshire	17	44	60	21	52	47	241
Devon	30	30	25	55	60	55	255
Doncaster	15	25	15	15	35	10	115
Dorset	23	40	36	71	40	56	266
Dudley	31	8	11	0	0	0	50
Durham	20	31	50	34	48	33	216
East Riding	4	22	19	11	26	37	119
East Sussex	32	27	25	32	32	32	180
Enfield	10	4	8	0	0	0	22
Essex	22	62	21	41	36	36	218
Flintshire	8	14	19	10	7	11	69
Gateshead	7	10	55	5	5	20	102
Greenwich	9	15	18	0	0	0	42

**Table A3.1** Number of sites in visual survey  
England and Wales 2006

Local authority	Built-up <sup>1</sup>			Non built-up <sup>1</sup>			All non-trunk
	Principal	Classified	Unclassified	Principal	Classified	Unclassified	
Gwynedd	10	20	23	50	34	24	161
Halton	3	9	9	11	4	2	38
Hammersmith	8	5	11	0	0	0	24
Hampshire	32	41	40	40	43	40	236
Harrow	4	4	4	0	0	0	12
Hartlepool	14	6	10	15	5	8	58
Herefordshire	15	16	11	41	41	30	154
Hertfordshire	38	33	30	28	27	27	183
Hounslow	11	4	8	0	0	0	23
Kent	29	34	38	46	29	36	212
Kingston-upon-Hull	15	5	15	0	0	0	35
Kirklees	31	33	50	28	20	12	174
Knowsley	10	10	23	3	9	3	58
Lambeth	6	6	11	0	0	0	23
Lancashire	57	47	53	45	32	33	267
Leeds	31	23	40	32	22	18	166
Leicester	11	6	30	0	0	0	47
Leicestershire	5	61	31	10	64	43	214
Lincolnshire	40	25	17	50	28	24	184
Liverpool	50	21	60	0	0	0	131
Luton	7	3	6	1	0	0	17
Manchester	35	30	28	0	0	0	93
Medway	8	11	10	9	0	1	39
Merton	7	2	5	0	0	0	14
Middlesbrough	5	15	10	4	6	0	40
Milton Keynes	8	20	12	11	13	5	69
Neath Port Talbot	11	13	15	7	7	10	63
Newcastle	13	12	60	5	5	5	100
Newport	5	8	16	2	4	3	38
Norfolk	28	40	34	31	44	37	214
North East Lincolnshire	4	7	8	6	4	5	34
North Tyneside	8	7	10	7	0	0	32
North West Somerset	6	19	18	6	12	18	79
Northamptonshire	16	20	20	30	20	10	116
Northumberland	30	40	42	48	71	59	290
Nottingham	14	10	9	0	0	0	33
Nottinghamshire	36	38	26	53	28	20	201
Oldham	14	9	2	0	0	0	25
Oxfordshire	12	25	26	28	32	25	148
Pembrokeshire	6	7	14	7	18	13	65
Peterborough	18	8	16	25	8	12	87
Plymouth	24	29	3	0	0	0	56
Powys	10	13	18	20	34	38	133
Redbridge	8	4	26	1	0	0	39
Richmond-upon-Thames	10	5	12	0	0	0	27

**Table A3.1** Number of sites in visual survey  
England and Wales 2006

Local authority	Built-up <sup>1</sup>			Non built-up <sup>1</sup>			All non-trunk
	Principal	Classified	Unclassified	Principal	Classified	Unclassified	
Rochdale	8	9	4	0	0	0	21
Rotherham	10	34	36	4	18	12	114
Salford	11	8	16	2	0	0	39
Sandwell	31	17	32	0	0	0	80
Sefton	21	22	63	0	0	0	106
Sheffield	27	17	25	1	14	20	104
Shropshire	20	18	27	29	75	35	204
Slough	9	3	6	0	0	0	18
Solihull	10	7	12	11	8	19	67
Somerset	22	15	18	24	24	27	130
South Gloucestershire	9	14	13	12	12	14	74
South Tyneside	18	15	28	0	0	0	61
Southampton	18	7	16	0	0	0	41
Southend-on-Sea	5	5	5	0	0	0	15
Southwark	11	6	5	0	0	0	22
St Helens	29	6	21	5	5	3	69
Suffolk	25	27	20	23	29	26	150
Sunderland	6	20	31	12	10	8	87
Surrey	47	57	56	31	21	25	237
Swansea	10	10	15	5	5	5	50
Thurrock	6	0	5	4	1	4	20
Torbay	18	7	10	4	0	0	39
Torfaen	3	3	15	3	3	3	30
Tower Hamlets	7	8	12	0	0	0	50
Trafford	22	37	49	0	0	0	108
Wakefield	29	21	30	12	11	15	118
Walsall	28	18	42	2	2	4	96
Waltham Forest	6	3	6	0	0	0	15
Wandsworth	6	6	9	0	0	0	21
Warrington	14	8	13	3	7	9	54
Warwickshire	42	23	45	38	50	33	231
West Sussex	25	35	16	32	49	15	172
Wigan	13	13	26	0	0	0	52
Wiltshire	25	39	33	27	42	41	207
Windsor and Maidenhead	11	5	13	9	4	6	48
Wolverhampton	15	6	18	0	0	0	39
Worcestershire	25	32	19	46	43	30	195
Wrexham	8	7	8	13	16	4	48

1 Built-up and non built-up were previously referred to as urban and rural.

As stated above, the purpose of the survey is to provide estimates of road condition at the national level, and the number of sites that local authorities are requested to survey reflects this objective. A greater number of sites in each area would be required to provide reliable estimates of the trend in road condition at a regional level, and a very much greater number to provide reliable estimates at a local level. This should be borne in mind when interpreting the results for regions published towards the end of this annex. While individual highway authorities are advised of the number of sites it is necessary to survey in their area for the overall survey results to be reliable at the national level, they can if they wish survey more sites to enable a more accurate picture of their authority's road condition to be obtained. In calculating national results however the survey analysis programmes ensure that such authorities are correctly represented in the calculation of overall road condition.

## Definitions of visual defects

Brief descriptions of the various defects recorded by the visual survey are given below. Where these refer to 'whole carriageway', the defects do not necessarily relate to the whole of the carriageway, but indicate that the deterioration is not confined solely to the wheel tracks. Descriptions are sometimes accompanied by illustrative photographs which have been provided by the UKPMS Owners' Forum and TRL (see pages 64 and 65).

### Wheel track cracking

Most vehicles follow a similar path on a road, resulting in the formation of identifiable wheel tracks. The significance of the wheel tracks is that damage to the road structure, as well as the surface, is most serious there. In particular, cracking in the area of the wheel tracks may indicate structural damage, especially if associated with the presence of a rut along the wheel track. The survey records the average length of cracking present, per 100 metres of road. Wheel track cracking, if present, is assessed as severity 1 (less than half the wheel track cracked) or 2 (at least half the wheel track cracked) for each metre of the site for both sides of the carriageway. The measure recorded for the survey is the length of cracking weighted by severity code. Thus the maximum length is 400 if there is severity 2 cracking along the full length of both sides of a 100-metre site.

#### *Wheel Track Cracking*



### Wheel track rutting

Wheel track rutting does not necessarily indicate structural damage if there is no cracking, but it is undesirable because the ruts can hold water which can cause skidding, especially in Winter when the roads can become icy. On built-up roads, in particular, pedestrians may get splashed and there is a hazard to cyclists and motorcyclists, while on roads with higher speeds there is the risk of vehicles aquaplaning. The survey records the average depth of deformation in the near side wheel track in millimetres.

## Wheel track Rutting



### **Whole carriageway major deterioration**

The percentage of the carriageway area affected by cracking, coarse crazing or loss of aggregate, deformation or defective patches.

### **Whole carriageway Minor Deterioration**

The number of 20 metre lengths per 100 metres of road where fine crazing, loss of chippings from surface dressing or excess bitumen on the pavement surface show the need for a maintenance treatment.

### *Whole carriageway Major Deterioration*



### *Edge Deterioration*



## Edge deterioration

The length of edge with disintegration along the edge, erosion of verges or failed patching, per 100 metres of edge.

## Patching

The percentage of carriageway area consisting of patches or reinstatements. Patching is not strictly a defect since it includes patching that is satisfactory. Failed patching is included also as whole carriageway major deterioration.

## Potholes

The number of isolated defects that may be dangerous. The term potholes also includes broken, sunken or upstanding manhole covers, isolated depressions more than 25mm deep and patches or failed reinstatements.

## Footway Deterioration

The percentage of footway area with a badly disintegrated or deformed surface, likelihood of standing water, cracked or uneven paving flags or a badly weed-ridden surface.

*Footway deterioration*



*Footway trips*



## Footway Trips

The number of spot conditions constituting a specific danger to pedestrians.

## Verge Deterioration

For grassed verges, the percentage deformed (generally through rutting due to parked or over-riding vehicles). For bituminous verges, the percentage with a badly disintegrated or deformed surface (as for Footway Deterioration).

## Kerb Deterioration

The percentage of kerb length where the kerb needs to be replaced or reset because of spalling, disintegration, broken kerb, tilting or poor alignment.

## **Kerb Upstand**

The kerb upstand measurement is the total height of kerb upstand in millimetres. An increase in the average value represents an improvement and a decrease represents deterioration.

## **Survey method**

Each year DfT selects a sample of 100 metre long sites which are sent to local authorities and, prior to 2003, trunk road agents that have agreed to take part in the survey. Inspectors carry out a visual survey of the selected sites in their areas and the data collected are sent to DfT for processing. The inspectors record the presence of specified carriageway, footway and verge defects. These defects relate to visible physical condition only and are either purely surface defects which can be addressed in normal periodic maintenance or the surface effects of defects developing in the roadbase. (The roadbase is the middle layer of a flexible pavement, below the bituminous surfacing.) The system of inspection and recording is based on the CHART/TRANSFER method, see TRL Report SR153UC.

Survey results are used to calculate a 'defects index'.

## **The visual defects index**

The purpose of the defects index is to summarise the various carriageway defects with a single index that will show trends in condition more clearly than is possible by looking at the defects individually.

The first step is to calculate the total of the defects on each site in the survey. The next step is to calculate the national average of the resulting ratings for each road class. Then finally the national average ratings are converted to indices by dividing by the corresponding ratings in 1977, the base year for the index, and multiplying by 100. The final defects index therefore shows condition relative to a base year rather than as an absolute level.

The defects on a site cannot simply be added together because they vary in importance and because the units vary - some are percentages, some lengths and so on. They have to be converted first to a common measure, and the measure chosen is the notional cost of treating each defect. The costs are based on standard treatments and corresponding standard costs. To account for the value of deterioration in the form of Defects that are not yet serious enough to need treatment, these Defects are costed at an appropriate proportion of the full cost (based on their relative seriousness). The absolute level of the costs is not important, as their purpose is to convert defects to a common unit of measurement in the same way each year and in each local authority. The costs remain the same from year to year.

For 1998 survey data onwards, ratings by road class have been estimated for non-responding authorities. These are based on the average rating within the authority's region or, where the authority has provided data in another year, estimates are calculated by applying the regional year on year changes in average ratings to the authority's ratings in that year.

A full description of how site ratings are calculated is given in a paper 'Defects Index: calculating Site Ratings' which is available from the address given at the end of Chapter 1.

## **Calculation of results of the visual survey**

### **Local authority averages**

The local authority average for an item on a road class is the straight average of values on all sites in the class. Exceptions are for footway, verge and kerb defects because the features on which these defects can occur may be absent from a site, or be present on only part of its length. For these

defects the average is a weighted average, the weight for a site being the length of the relevant feature.

### **National averages**

The national average for an item on a road class is a weighted average of the local authority averages (including, for 1998 data onwards, estimated averages for non-responding authorities), the weight for each authority being its road length in the class. For footway, verge and kerb defects the weight is the total feature length.

### **Averages for all classes and non-trunk roads**

For an individual defect an average for several road classes would have little meaning, as the relevance of different defects varies between road classes. This difficulty does not arise with the defects index, but there is still the question of how to do the averaging. Following the rebasing, mentioned in paragraph 7 of the 1989 report, average site ratings have been devised which vary between road classes in a more reasonable way than did those derived previously. Therefore, the procedure to derive average indices for combinations of road classes has been simplified.

An average defect rating is calculated by taking the weighted average of the ratings for the individual road classes, the weights being proportional to the lengths of road of the respective classes. A similar weighted average is calculated from the ratings which were found in the base year. The ratio of these two weighted-average ratings is the proportional change in the all-roads index since the base year.

### **Local authority confidence intervals**

The 90 per cent confidence limits in tables and charts are the upper and lower ends of the range within which there is an estimated 9 out of 10 chance that the true average lies. They are calculated from the standard error:

$$SE = \sqrt{[(\sum x_i^2 - (\sum x_i)^2/n)/(n(n-1))]}$$

where  $x_i$  is the value of  $x$  on site  $i$ , and  $n$  is the number of sites.

The 90 per cent confidence limits for the average  $\sum x_i/n$  are then

$$\sum x_i/n \pm 1.64 * SE * \sqrt{(n/(n-2))}$$

The calculation is modified appropriately for footway, verge and kerb defects.

### **National confidence limits**

The national standard error for an item is calculated from the local authority standard errors, using local authority road lengths as weights. The formula can be supplied on request, or refer to a standard text book. The confidence limits are then calculated from the average and the standard error.

### **Comparing averages**

We wish to know if the change in average between 2 years (not necessarily successive) is statistically significant - in other words unlikely to be the result of chance alone - and a local authority may wish to know if its results are significantly different from the national average. In both cases we need to calculate confidence limits for a difference in averages. Labelling the averages of items to be compared A and B the difference in averages is:

$$d = A - B$$

and the usual formula for standard error of the difference in averages is:

$$SE(d) = \sqrt{[SE^2(A) + SE^2(B)]}$$

The 95 per cent confidence limits for d are:

$$d \pm 1.96 \text{ SE}(d)$$

In Chapter 3, statements on whether visual condition has improved or worsened are based on statistical tests at the 95 per cent confidence level. Thus if d is greater than the positive limit, then A is greater than B at the 95 per cent confidence level. Similarly, if d is less than the negative limit, then A is less than B at the 95 per cent confidence level. But if d is between the confidence limits then we cannot say that the difference between A and B is significant.

If the two averages to be compared are not based on independent samples, then this formula can overestimate the standard error of the difference. One half of the sites surveyed for NRMCS are re-surveyed the following year, so when averages for two successive years are compared, the samples cannot be regarded as independent. The exact formula for the standard error depends upon the extent to which condition of individual sites in one year is correlated with its condition in the comparison year, i.e. whether sites in relatively poor condition in one year tend to be the sites in poor condition in the other and vice versa. If there is no correlation, then the simple formula applies. Analysis confirms that the condition of a site in one year does tend to be correlated with its condition in the following year. The correlation is such that the standard error of the difference is less than that obtained by the simple formula by a factor of about 0.85. This only provides a rough rule of thumb. Exact estimates would require a different factor to be calculated for every comparison.

## **Quality assurance processes**

A number of Quality Assurance procedures were undertaken to check the visual survey data.

Analysis of the responding sample suggested no major differences from previous years. This analysis looked at the sites allocated sites and compared with both sites where data were received and also with what was received in previous years.

Some of the data were also followed up with the contributing local authorities. The discussions held suggested that improved surface conditions were real and probably resulted from differing practices in using surface dressing treatments.

## **Average results recorded in visual survey**

Average results for defects and features recorded in the visual survey for each road class are shown in Table A3.2.

**Table A3.2** Average results from visual survey (per 100 metre site)  
England and Wales 2006

Road class	Whole c'way major Per cent	Wheel track rutting mm	Wheel track cracking Metres	Whole c'way minor Number	Edge deterioration Metres	Patching Per cent	Pot-holes Number	C'way width Metres	Footway length Metres	Verge length Metres	Kerb length Metres
<b>Built-up principal <sup>1</sup></b>											
National average	3.1	1.0	2.1	1.2	1.5	2.9	0.1	8.9	151.1	49.9	170.2
upper bound	3.4	1.1	2.3	1.5	2.3	4.3	0.1	9.2	157.1	58.6	175.3
lower bound	2.7	0.9	1.9	0.9	0.6	1.6	0.1	8.6	145.0	41.2	165.1
<b>Built-up classified <sup>1</sup></b>											
National average	4.0	1.3	2.6	2.2	3.4	4.6	0.2	7.3	153.4	48.8	162.6
upper bound	4.4	1.4	2.9	2.5	4.0	5.6	0.3	7.5	156.9	56.2	165.8
lower bound	3.7	1.2	2.3	2.0	2.7	3.5	0.1	7.2	149.8	41.3	159.3
<b>Built-up unclassified <sup>1</sup></b>											
National average	6.0	1.1	2.6	2.0	5.6	3.4	0.4	6.5	166.4	46.9	172.2
upper bound	6.4	1.2	2.9	2.1	6.4	3.8	0.5	6.6	169.0	51.2	174.5
lower bound	5.6	1.0	2.3	1.9	4.9	3.1	0.4	6.4	163.7	42.7	169.8
<b>Non built-up principal <sup>1</sup></b>											
National average	2.1	0.4	0.2	2.1	3.7	1.6	0.1	8.6	79.5	127.5	145.7
upper bound	2.7	0.5	0.3	2.6	6.0	2.4	0.2	9.0	92.4	140.6	158.8
lower bound	1.5	0.2	0.2	1.5	1.5	0.9	0.0	8.2	66.6	114.3	132.6
<b>Non built-up classified <sup>1</sup></b>											
National average	3.5	2.1	1.9	2.8	11.7	1.6	0.2	5.3	9.8	146.1	22.1
upper bound	3.8	2.2	2.2	3.0	12.9	2.1	0.3	5.4	11.5	148.4	25.3
lower bound	3.1	2.0	1.6	2.7	10.4	1.2	0.2	5.2	8.1	143.8	18.9
<b>Non built-up unclassified <sup>1</sup></b>											
National average	4.7	1.2	1.4	2.8	11.1	2.1	0.2	3.8	2.2	164.9	6.6
upper bound	5.5	1.3	1.6	3.1	13.0	3.0	0.3	3.9	4.0	167.6	10.7
lower bound	3.8	1.1	1.1	2.4	9.3	1.2	0.2	3.7	0.3	162.2	2.4

<sup>1</sup> Built-up and non built-up were previously referred to as urban and rural.

## Visual survey results for the 'tail' of the site ratings

In the report on the 1997 survey, the possibility was investigated of presenting the visual survey results in terms of the poor condition 'tail' of the distribution of site ratings. The aim was to present an alternative view of the NRMCS results - that might provide a better indication of the need to undertake highway maintenance - than is provided by the traditional defects index.

Table A3.3 shows for each road class and each year from 1994 to 2005 the values that define the highest (i.e. poorest condition) 5 per cent, 10 per cent and 20 per cent of site ratings. As the readily available software produces road class distributions grouped in terms of categories, defined in terms of index values (class mean in 1977=100) precise 'tail' (i.e. percentile) values could not be read directly from the distributions but have had to be derived by interpolation. This process will have introduced a small amount of error into individual estimates but there is no reason to think that there is any consistent bias in the values derived.

The percentile points and the class means are shown in the table in the form of index values, however the figures could be converted to cost ratings in terms of 1986-87 prices by multiplying by the base year (1977) ratings for each class. This would, of course, have no effect on the trends.

**Table A3.3** Values defining poorest condition tail  
England and Wales

Road class/ percentile point	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
<b>Built-up principal</b> <sup>1</sup>											
5%	390.0	443.3	490.0	501.7	501.7	400.0	294.0	350.0	350.0	247.1	204.8
10%	197.5	204.8	223.3	247.8	225.0	203.0	188.5	181.8	177.5	165.0	157.5
20%	135.7	144.0	151.0	153.3	142.0	144.6	132.8	127.8	124.1	113.3	110.2
Average	120.5	123.1	122.2	129.7	118.3	115.5	104.4	99.3	93.7	79.4	70.8
<b>Built-up classified</b> <sup>1</sup>											
5%	370.0	450.0	494.4	558.3	504.0	498.8	460.0	403.3	476.7	360.0	247.1
10%	206.0	234.6	243.3	283.3	217.5	227.3	207.2	206.4	221.1	200.6	185.4
20%	149.7	151.4	157.8	158.9	156.5	158.3	151.4	150.4	152.2	142.5	139.4
Average	110.8	122.8	124.8	140.2	130.4	122.9	122.3	115.7	124.8	104.2	92.2
<b>Built-up unclassified</b> <sup>1</sup>											
5%	330.0	356.7	341.1	342.0	347.5	345.7	330.0	337.5	308.0	301.1	305.7
10%	238.4	264.7	262.9	258.0	268.9	265.3	252.0	262.7	240.0	233.6	230.0
20%	176.7	194.3	195.0	190.4	197.5	202.4	199.4	197.5	186.3	180.0	172.5
Average	97.6	105.6	105.3	105.9	111.9	111.0	104.5	107.7	98.0	95.6	93.8
<b>Non built-up principal</b> <sup>1</sup>											
5%	212.9	210.0	210.0	205.1	218.6	197.5	202.9	209.3	195.0	192.5	193.3
10%	176.1	174.7	176.3	175.9	180.0	172.2	170.9	177.9	166.7	164.3	161.3
20%	148.1	149.0	152.3	151.5	151.9	143.9	142.9	149.9	130.8	119.1	117.1
Average	90.0	89.7	91.4	88.2	89.0	86.8	82.1	84.3	122.1	69.1	69.7
<b>Non built-up classified</b> <sup>1</sup>											
5%	214.7	226.8	213.0	207.3	207.3	209.1	222.2	218.5	208.9	208.8	205.0
10%	188.1	191.7	192.5	186.1	183.7	187.8	194.3	194.6	183.0	179.4	177.2
20%	148.8	159.7	159.3	158.2	155.5	156.7	159.4	157.5	144.2	138.2	139.2
Average	94.5	96.5	98.2	93.3	92.2	94.0	96.0	94.6	85.4	81.6	87.0
<b>Non built-up unclassified</b> <sup>1</sup>											
5%	434.4	423.3	382.0	416.7	428.2	442.5	485.0	472.5	495.4	425.0	396.7
10%	312.7	316.0	283.7	293.3	331.5	328.8	339.3	355.7	349.0	321.1	291.5
20%	205.5	203.1	192.5	200.4	232.5	213.3	235.2	247.5	235.4	205.0	196.7
Average	120.1	118.1	113.3	119.0	126.3	125.7	138.6	141.3	139.7	122.1	118.4

<sup>1</sup> Built-up and non built-up were previously referred to as urban and rural.

In 2006, consistent with the average index values falling by small amounts, the tails shortened or stayed about the same for all of the road groups. However, it is interesting to note that the relative shapes of the distributions have been changing over time.

For principal roads, both built-up and non built-up, the distributions have become narrower in general, with all of the percentile values reducing. For the other built-up roads (classified and unclassified), the extreme values (in the poorest 5 per cent) have been most reduced. The distribution for non built-up unclassified roads was very similar to 2004, while the distribution for non built-up unclassified roads is now quite similar to the distribution in 1996 and 1997.

## Regional visual survey results

Table A3.4 shows defects indices for all non-trunk roads, by region, in England and Wales. London has been excluded because of its small sample size. The visual survey was not designed to be accurate at the regional level and so estimates, even for all non-trunk roads, will be subject to some error. Furthermore, the defects index for non-trunk roads is a weighted average which reflects the distribution of road lengths in each region. This will vary and so the regional figures will differ even if the indices for each road class are equal. Because of this, figures in Table A3.4 should be used to interpret the trend in regional road condition and not to compare road condition between regions. Table A3.5 provides a comparison of regions on a snapshot basis. Results for Table A3.4 are plotted in Figures A3.1 to A3.4, and results from Table A3.5 are plotted in Figure A3.5.

**Table A3.4** Defects indices for all non-trunk roads <sup>1</sup> by region <sup>2</sup>  
1995 to 2006

1977=100<sup>3</sup>

Region		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
England & Wales	Average	101.9	106.5	106.6	108.5	109.5	108.3	106.4	106.7	100.3	92.9	91.1
	Upper bound	104.0	108.8	109.1	111.0	112.0	110.5	108.6	109.0	102.5	95.0	92.3
	Lower bound	99.7	104.2	104.1	106.0	107.1	106.1	104.2	104.5	98.2	90.9	89.8
North East	Average	144.4	148.8	138.1	123.9	173.9	175.6	165.7	161.3	145.4	140.4	113.2
	Upper bound	153.4	158.3	147.0	132.4	184.2	187.2	175.6	170.6	154.0	148.2	121.0
	Lower bound	135.3	139.2	129.3	115.3	163.7	164.1	155.8	152.0	136.8	132.6	105.5
North West	Average	101.2	109.3	107.7	117.7	104.0	110.9	89.8	99.6	89.2	89.8	91.9
	Upper bound	107.0	115.3	113.4	123.7	110.0	118.2	95.3	105.4	94.4	94.9	97.1
	Lower bound	95.4	103.3	101.9	111.6	98.1	103.7	84.3	93.8	84.0	84.6	86.8
Yorkshire and the Humber	Average	98.0	110.6	105.5	101.9	113.7	92.9	107.5	101.0	104.8	103.8	91.9
	Upper bound	104.5	117.3	111.5	108.2	120.9	98.6	114.6	108.2	112.8	110.5	98.6
	Lower bound	91.4	103.9	99.6	95.6	106.6	87.1	100.5	93.9	96.9	97.1	85.1
East Midlands	Average	103.2	93.5	87.1	119.4	97.4	108.2	106.8	104.9	96.6	91.3	100.1
	Upper bound	110.5	101.6	94.4	127.3	103.9	114.9	113.8	112.6	103.4	97.4	106.3
	Lower bound	95.8	85.3	79.7	111.5	91.0	101.5	99.7	97.1	89.7	85.1	94.0
West Midlands	Average	95.9	125.4	115.0	137.6	106.2	109.4	107.8	98.9	85.7	88.2	83.0
	Upper bound	101.5	132.1	122.6	145.9	113.4	116.8	115.3	106.3	91.5	94.5	89.3
	Lower bound	90.3	118.6	107.4	129.4	99.0	102.1	100.2	91.6	79.9	81.9	76.7
East	Average	100.0	104.1	111.8	117.0	111.3	115.0	96.8	110.5	121.5	93.6	91.5
	Upper bound	106.0	110.2	122.4	127.2	119.8	123.7	103.6	118.8	131.0	99.7	97.6
	Lower bound	94.0	97.9	101.2	106.9	102.8	106.3	90.0	102.2	112.1	87.4	85.3
South East (excl London)	Average	91.4	104.9	111.8	87.8	113.9	112.1	123.2	121.6	106.5	85.7	97.6
	Upper bound	96.6	110.9	118.4	92.7	119.9	117.9	129.6	128.0	112.3	90.3	102.1
	Lower bound	86.2	98.9	105.3	82.8	108.0	106.3	116.7	115.2	100.7	81.1	93.0
South West	Average	92.6	82.7	88.0	85.5	88.3	89.5	91.8	96.9	87.2	79.4	79.9
	Upper bound	97.6	87.1	92.4	90.7	93.3	93.6	96.4	102.3	91.8	84.4	84.9
	Lower bound	87.6	78.3	83.7	80.4	83.3	85.5	87.1	91.4	82.6	74.3	74.8
Wales	Average	95.7	97.5	98.7	103.8	82.5	87.9	94.8	91.0	85.3	87.9	89.4
	Upper bound	101.3	103.9	104.2	110.8	89.4	93.0	100.3	95.9	90.1	92.7	94.1
	Lower bound	90.0	91.1	93.1	96.9	75.6	82.8	89.3	86.0	80.6	83.2	84.6

<sup>1</sup> This is a weighted average which reflects the distribution of road lengths in each region. As this will differ from the national distribution, the regional figure for all non-trunk roads will differ from the national figure even if for each road class the regional index is equal to the corresponding national index.

<sup>2</sup> London has been excluded because of its small sample size but it is included in figures for England and Wales.

<sup>3</sup> The national average is 1977=100. Hence the values shown represent increases or decreases relative to that national average. For example the average of 161.3 for all non-trunk roads in 2003 in the North East means that the defects index on these roads was 61.3 points higher than on non-trunk roads nationally in 1977.

Table A3.5 compares regional road condition for local authority roads. To reduce the effect of sampling error the results for the three-year period, 2004 to 2006, have been averaged. The value for England and Wales (excluding London) over this period is 100. As variations in the regional mix of road types will tend to distort comparisons, **the index values for every region have been calculated using the same mix of road types as in England and Wales.**

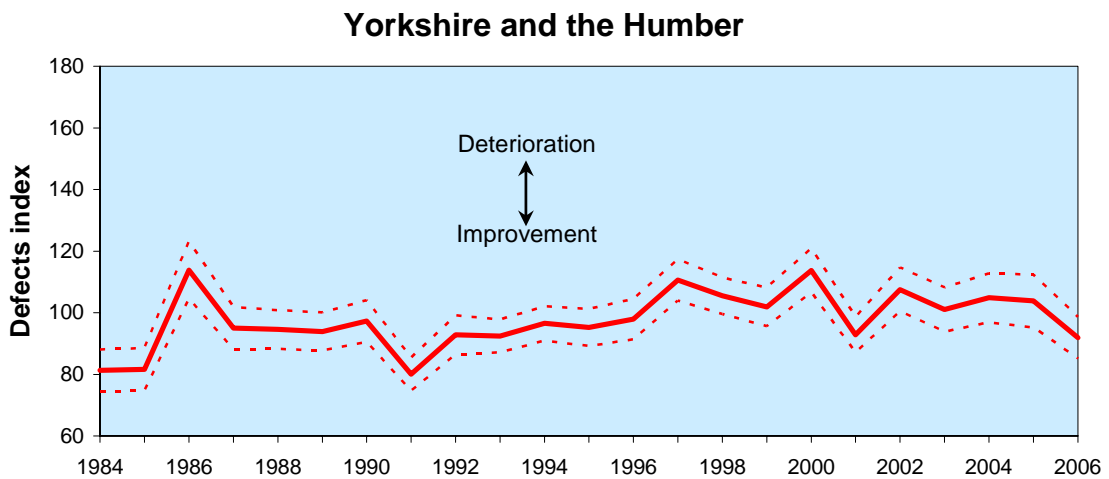
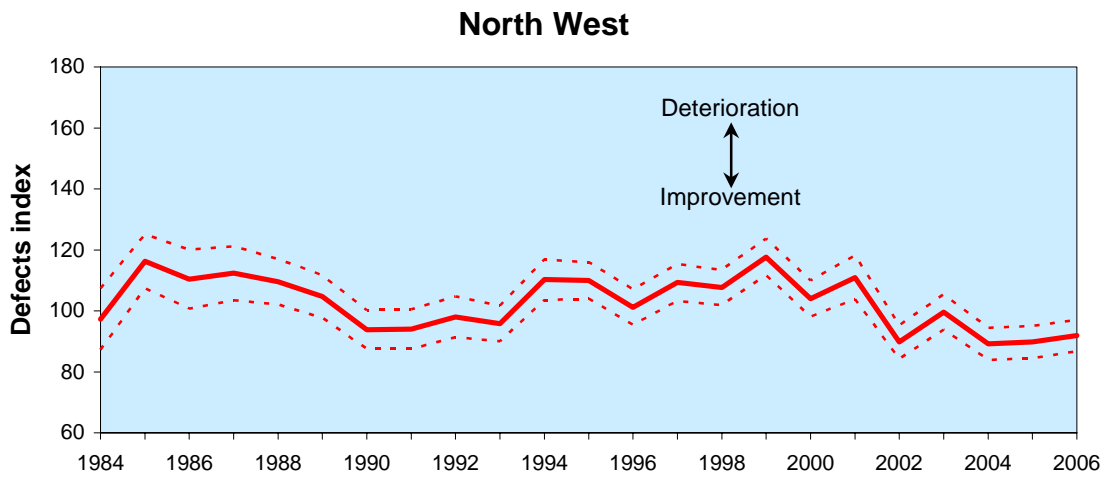
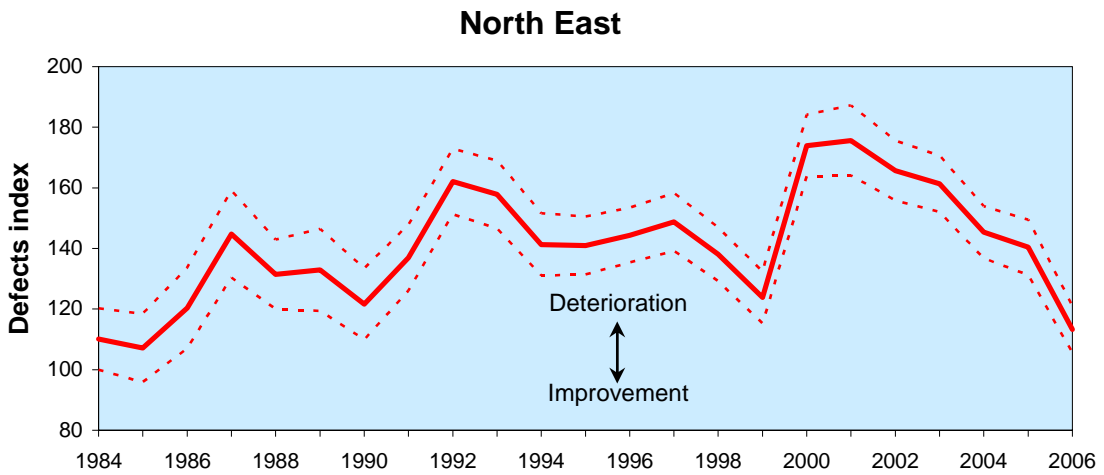
Results for all non-trunk roads are plotted in Figure A3.5 and show that the level of defects in the North East is considerably higher than in the other regions. The level of defects in the South West is the smallest.

**Table A3.5 Comparison of road condition by region and road class**  
England and Wales, average in 2004 to 2006

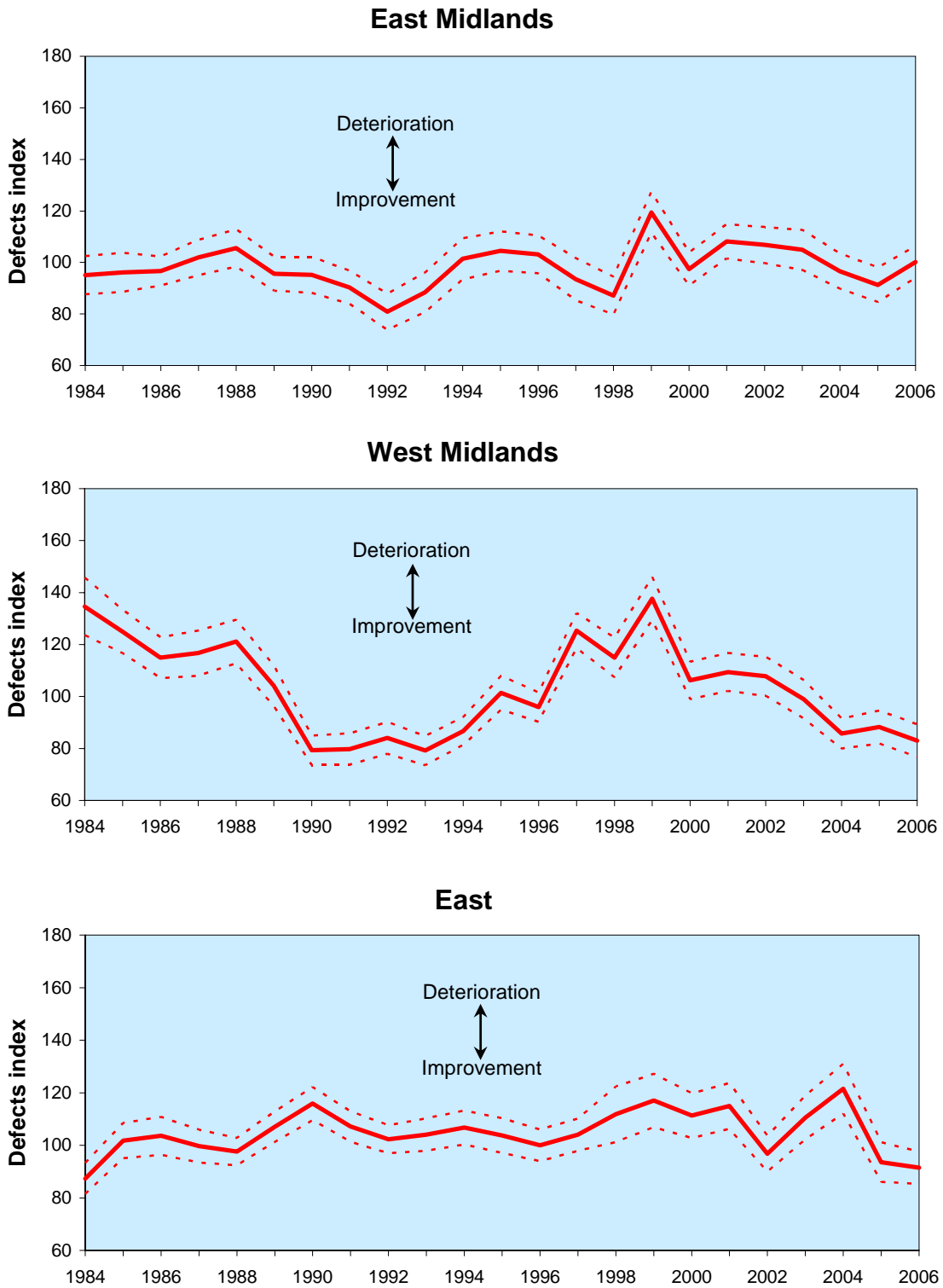
Region <sup>1</sup>		England and Wales (exc London) = 100		
		Principal	Non-principal	All non-trunk
<b>North East</b>	Average	133.9	146.6	145.0
	Upper bound	148.0	152.4	150.5
	Lower bound	119.7	140.9	139.6
<b>North West</b>	Average	110.0	97.8	99.4
	Upper bound	117.4	101.7	102.7
	Lower bound	102.5	94.0	96.1
<b>Yorkshire and the Humber</b>	Average	141.4	118.8	121.7
	Upper bound	155.9	123.3	126.6
	Lower bound	126.9	114.3	116.7
<b>East Midlands</b>	Average	97.9	105.7	104.7
	Upper bound	105.9	111.3	108.9
	Lower bound	90.0	100.1	100.5
<b>West Midlands</b>	Average	85.4	95.9	94.6
	Upper bound	90.7	100.5	98.5
	Lower bound	80.0	91.4	90.7
<b>East</b>	Average	122.7	110.7	112.2
	Upper bound	130.1	117.3	117.2
	Lower bound	115.3	104.0	107.2
<b>South East</b>	Average	95.4	99.0	98.6
	Upper bound	101.7	102.8	101.7
	Lower bound	89.1	95.2	95.4
<b>South West</b>	Average	86.2	93.8	92.8
	Upper bound	92.3	97.7	95.8
	Lower bound	80.0	89.9	89.8
<b>Wales</b>	Average	86.4	100.9	99.1
	Upper bound	94.7	104.9	102.2
	Lower bound	78.1	96.9	95.9

<sup>1</sup> London has been excluded because of its small sample size.

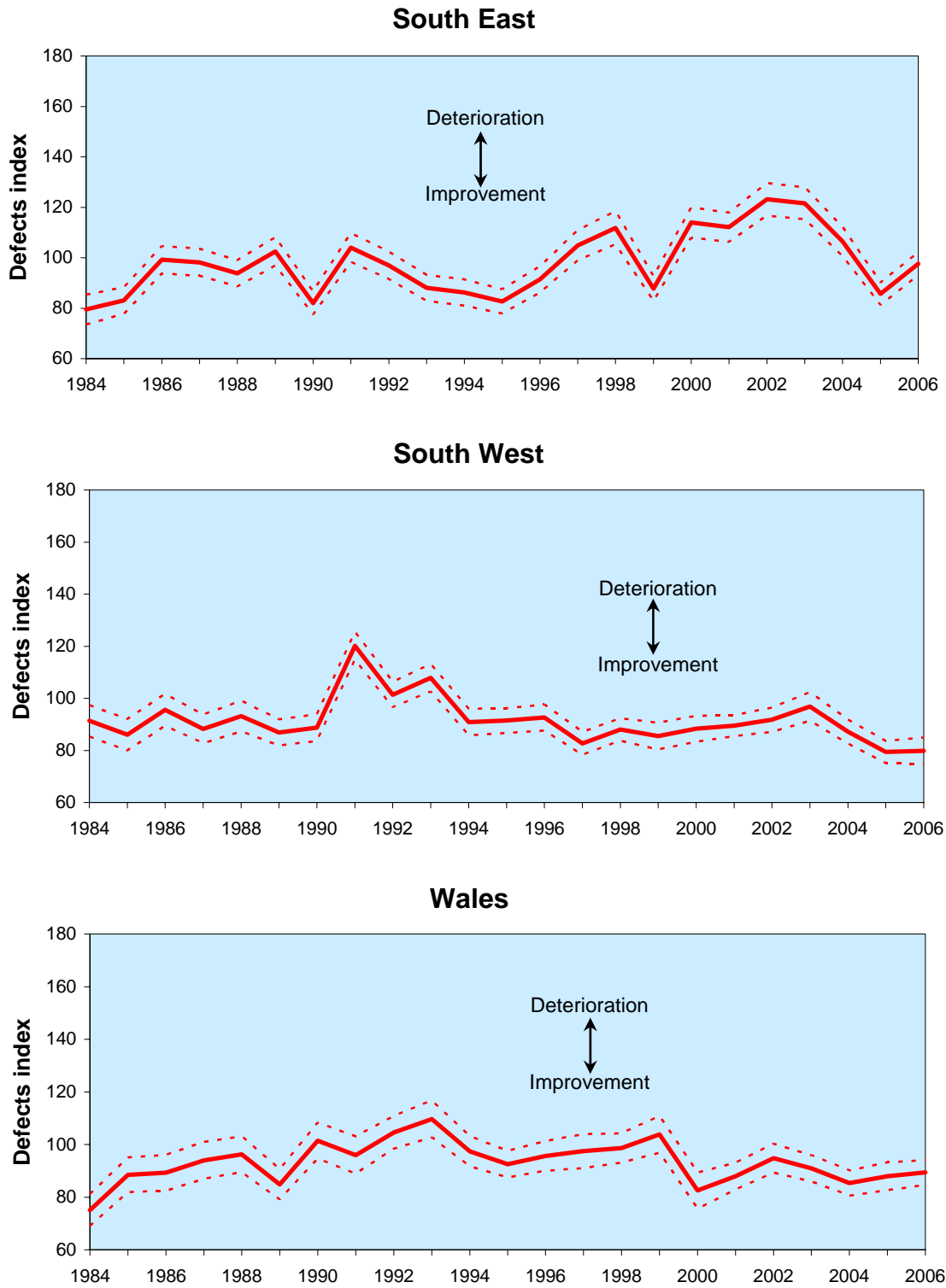
**Figure A3.1** Defects indices for non-trunk roads  
North East, North West, Yorkshire and the Humber



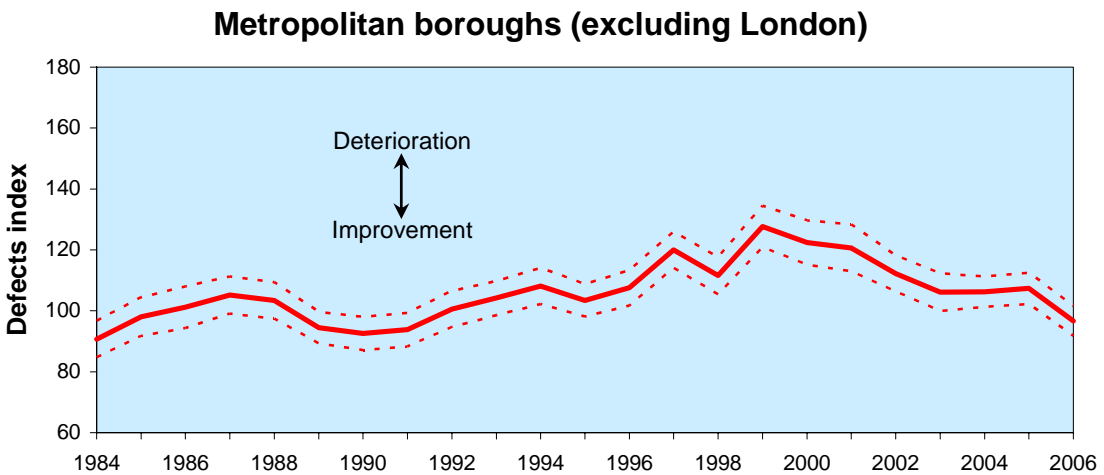
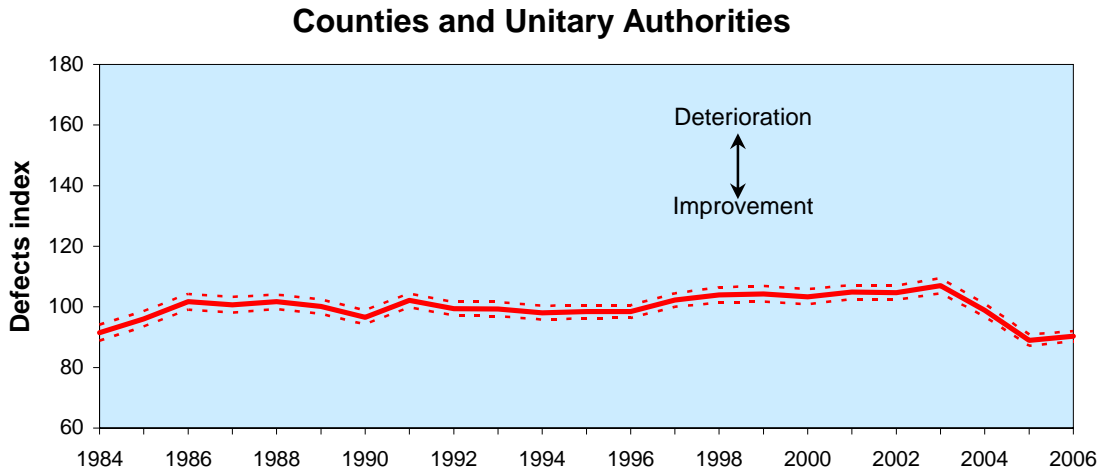
**Figure A3.2** Defects indices for non-trunk roads  
East Midlands, West Midlands, East



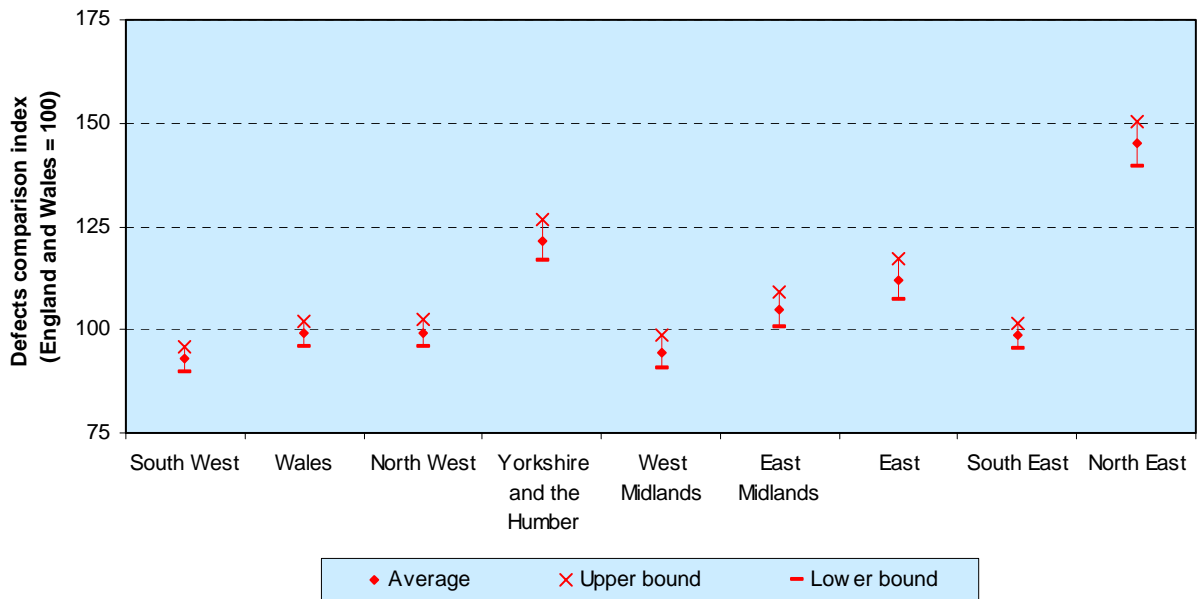
**Figure A3.3** Defects indices for non-trunk roads  
South East, South West, Wales



**Figure A3.4 Defects indices for non-trunk roads**  
 Counties, Unitary Authorities, Metropolitan boroughs



**Figure A3.5 Comparison of road condition by region, average in 2004 to 2006 - non-trunk roads**



## Footways, kerbs and verges

**Table A3.6** Length of footways, kerbs and verges by road class  
England and Wales, average in 2004 to 2006

	Built-up principal <sup>1</sup>	Built-up classified <sup>1</sup>	Built-up unclassified <sup>1</sup>	Non built-up principal <sup>1</sup>	Non built-up classified <sup>1</sup>	Non built-up unclassified <sup>1</sup>	All classes
<b>Total Length (thousand kilometres)</b>							
Footway	21	40	212	12	7	1	295
Kerb	24	43	219	23	16	4	329
Verge	6	13	58	21	104	105	308
<b>Distribution of length by road class (percentage)</b>							
Footway	7	14	72	4	2	0	100
Kerb	7	13	67	7	5	1	100
Verge	2	4	19	7	34	34	100
<b>Length (metres per 100m road length <sup>2</sup>)</b>							
Footway	156	155	167	73	10	2	92
Kerb	176	166	172	136	22	6	102
Verge	46	49	46	127	147	159	96

<sup>1</sup> Built-up and non built-up were previously referred to as urban and rural.

<sup>2</sup> Both sides of road so that maximum for any site is 200 metres, except for dual carriageways where only one side is surveyed so maximum is 100 metres.

## ANNEX 4

### STRUCTURAL SURVEY

#### Background

Studies, over 20 years by TRL (formerly the Transport Research Laboratory), of the behaviour of flexible and flexible composite pavements, resulted in the development of models capable of predicting the future performance of individual sections of road within the UK road network. These models, which are not applicable to rigid and rigid composite pavements (e.g. roads of concrete/block construction, elevated carriageways) require the following information;

- the deflection of the road surface under a standard load;
- traffic loading, i.e. commercial vehicles only. Note that the use of commercial vehicles reflects the fact that pavement wear follows the ‘fourth power law’. This states that road wear per axle is proportional to the fourth power of the axle load, i.e.

$$\text{Wear / axle} \propto L^4 \quad (\text{where } L = \text{axle load})$$

The much heavier axle loading of HGVs means that although they account for less than 10 per cent of vehicle kilometres they cause most of the pavement wear; and

- construction thickness of the road and traffic borne over its lifetime.

Data on road surface deflection are usually collected by means of Deflectograph surveys. The Deflectograph, which was originally developed in France by the Laboratoire Central des Ponts et Chaussées, is an automated technique for measuring deflections under a rolling wheel and is suitable for carrying out deflection surveys over long lengths of road (e.g. a road network).

#### Deflection and residual life

Research by TRL established that there are two main phases of structural behaviour during the life of a road (pavement). In the first phase there is a slow increase in deflection until the onset of ‘investigatory’ conditions; this increase in deflection is related to traffic (in cumulative standard axles<sup>1</sup>) measured from the date on which the road was built or last strengthened. In the second phase, which is rarely more than one third as long as the first in terms of standard axles or time, there are increasingly unpredictable changes in pavement condition. This phase ends when the pavement reaches a failed condition, from which it can be restored only by total reconstruction and when its surface condition may be unsafe for the movement of high-speed traffic.

During the first phase the rate of deterioration can be predicted, but in the second phase, the rate of deterioration to structural failure is difficult to forecast with any confidence. **Residual life is therefore defined as the life of a pavement (measured in standard axles or converted into years) until the onset of ‘investigatory’ conditions, i.e. until the end of the first phase.** (This definition has been adopted because it allows a reasonably accurate estimate of residual life to be made.)

<sup>1</sup> A standard axle is a computational device for assessing the road wear of different vehicles taking account of the ‘fourth power law’. For each vehicle a standard axle value is calculated based on how much road wear the vehicle causes compared to one standard (8 tonne) 2-wheel axle.

For each flexible or flexible composite pavement type TRL has established relationships between deflection and cumulative traffic, and also the onset of ‘investigatory’ condition (see Figure A4.1). These relationships take into account the type and thickness of the road structure. Essentially for any pavement type the higher the initial level of deflection for a given level of traffic and thickness of pavement, the shorter the residual life (until the onset of ‘investigatory’ conditions). The models use past as well as projected wear factors to convert past as well as projected commercial vehicle lane 1 cumulative traffic flows into road wear. The lane 1 traffic projections for any point are derived from a whole road count at a survey date, not necessarily the same date as the Deflectograph survey. The onset of investigatory conditions can only be predicted in probabilistic terms. That is, it can be stated that, for a given initial level of deflection, after the road has carried a certain number of standard axles there is a 10 per cent probability that investigatory conditions will have set in and a 90 per cent probability that they will not. After the road has carried a higher number of standard axles there is a 50 per cent probability that the investigatory condition will have been reached; after a still higher number of standard axles the probability of the investigatory condition occurring is 90 per cent. The choice of probability level determines the level of deflection that corresponds to zero residual life. Given the relationship between deflection and cumulative traffic, the level of deflection at zero residual life determines the corresponding cumulative traffic level, and by subtraction gives the outstanding residual life measured in standard axles. (To convert standard axles into years it is of course necessary to have projected traffic levels and the computer programs used for residual life analysis produce such projections.) The computer programs (PANDEF, DEFLEC etc - see below) calculate residual life on the basis of 50 per cent probability.

A separate residual life can be calculated for each point for which there is a Deflectograph reading (and the necessary ancillary data). Typically there are approximately 25 Deflectograph readings in a 100 metre section of road. Deflection values are measured in each wheel-track of a lane and the highest of the 2 deflection values is usually taken to represent the condition of the pavement at a location. To represent the condition of a 100 metres length of road the 85th percentile value of the deflections is taken. (This is a conservative measure since 85 per cent of the readings in each section are lower than the selected value. If a separate residual life is calculated for each point, and construction and traffic do not change along the length, 85 per cent of the calculated residual lives in the 100 metres will be longer than the residual life that is taken to represent that length of road.) The combination of the use of the 85th percentile value together with the 0.5 probability level represents a conservative assessment of residual life for each 100 metre section. If more than 15 metres in 100 metres requires maintenance, it generally becomes more cost effective to treat a longer length of road rather than carrying out a large number of small repairs. This work is therefore likely to be classed as major maintenance rather than minor works.

## **Software used to analyse deflection survey results**

In the UK since 1997, deflection values have normally been analysed using PANDEF software. This suite of computer programs incorporates the TRL models for the analysis of deflection measurements. For the analysis from 1999 to 2001, PANDEF Version 3 was used both by the Highways Agency, and by local authorities in England and Wales while DEFLEC continued to be used for the motorways and all purpose trunk roads in Wales. From 2002, the Deflectograph measurements made on those lengths of the trunk road network in England that are likely to need maintenance have been analysed using the deflection analysis facilities in the Highways Agency Pavement Management System (HAPMS). The deflection relationships contain small modifications to the relationships in PANDEF and are used with the construction and traffic data held in HAPMS. Local authorities continue to use PANDEF Version 3 for the analysis of Deflectograph measurements.

## **Changes to collection and analysis of English trunk road data in 2002**

There have been considerable changes since 2001 in the collection and analysis of structural condition data for the trunk road network in England. This means the results from 2002 are not comparable with earlier years and it is therefore not useful to continue the time series. The main changes affecting the results are:

- until 2001, the Highways Agency carried out routine surveys of the structural condition of the trunk road network aiming to cover all the network every five years. In 2002, routine surveys were stopped and surveys are now targeted and undertaken only on those lengths of road where there is a possibility of undertaking maintenance in the next few years. The sample of results does not therefore represent the overall condition of the network.
- since 2001, de-trunking has significantly reduced the size of the all purpose trunk road network. The lengths de-trunked are mainly single carriageway roads.
- improvements have been made in the analysis process with the previous analysis software (PANDEF) superseded by the computer software incorporated in the Highways Agency Pavement Management System (HAPMS).
- as part of the introduction of HAPMS, the existing data for the trunk road network used to represent the structural condition of trunk roads were re-analysed. Only for that part of the data where the supporting information (i.e. traffic and road construction) used in the analysis of the Deflectograph measurements was available and reliable were the deflection measurements transferred to HAPMS. This resulted in a significant reduction in the data available on the structural condition of the trunk road network compared with 2001.

## **Published distribution of residual life (Tables 4.1 and 4.2)**

It is important to note that the results for a year, say 2006, in this Report are not all based on Deflectograph surveys carried out in 2005 but are derived from measurements from 1995 to the end of 2005. Thus for 2006, and for every reporting year, the distribution shown represents the projected, not actual, distribution of residual life as at 1 July. For any point on the road network only the most recent survey data are used and so for 2006 results the proportion of data from the mid-1990s will in fact be quite small. For any point on the network for which Deflectograph survey data exist, road condition was projected forward from the date of the survey to the middle of the year of the report (see example at Figure A4.1).

## **Construction and maintenance**

As stated above, construction data are required in order to allow the software to convert deflection data collected at some past date into an estimate of the residual life for a given length of road as at the common base date (say mid-2006). This construction information has been obtained from local highway authorities and by the Highways Agency/National Assembly for Wales Agents for every section of road for which there are deflection data. In addition data are obtained, often through interviews, on maintenance work carried out up to the middle of the analysis year (mid-2006 in this example).

The information on maintenance allows the calculation of residual lives for the relevant road sections to take account of maintenance that has been completed or is under way. A 20 year life is assumed for a stretch of road where there has been reconstruction or an overlay of 50 mm or more unless local knowledge has indicated that a shorter design life was adopted (in which case the

shorter life is taken). This assumed life is reduced at the rate of 1 year per calendar year until there is a new deflection survey, which allows a genuine estimate of residual life to be produced. The maintenance adjustment increases the reliability of the overall residual life distribution by moving stretches of road that have been maintained from the 'poor condition' end of the distribution, where they were correctly located before the maintenance work was carried out, to the 'good condition' end of the distribution. (The calculated residual lives before maintenance will normally have been zero or near zero.)

## **Chaining**

While the steady increase in the number of local authorities taking part in the survey has been very welcome, the inclusion of additional authorities may have a distorting effect on year to year comparisons if these additional authorities have principal roads that are in particularly good or bad condition. In order to ensure that trends in structural condition are estimated more accurately, the national figures for principal roads in Tables 4.1 and 4.2 have been calculated using 'chaining'. This means that for each pair of years the change has been calculated for the same set of authorities, excluding data for authorities for which data are available for only one year in the pair. Thus if data for an authority are available for 1995 onwards but not for 1994, that authority will be excluded from the 1994 and 1995 comparison, but it will be included in the 1995 and 1996 comparison. The base year for chaining is currently 2002. This means that results for 2002 are based on data for all responding authorities for that year, while those in other years are based on year on year comparisons which are chained to 2002.

## **Targeting**

When an authority commissions its first Deflectograph surveys it is quite common to focus these Deflectograph surveys on the worst roads. This means that the results will not be representative of the authority's network since the proportion of the network with a short residual life will tend to be overstated. As the authority covers an increasing proportion of the network, thereby bringing in better roads, this will produce an apparent improvement in road condition. To avoid the potential distortion caused by 'targeting', data for authorities whose coverage of their network is less than 30 per cent have been excluded from the calculation of national results for principal roads in Tables 4.1 and 4.2.

## **Eligible network**

The deflection models for predicting the future performance of lengths of road are not applicable to rigid pavements. (Some 10 per cent of the national road network, and 2-3 per cent of the principal road network is not eligible on these grounds.) Research has also shown that Deflectograph surveys are not appropriate for 'long life' flexible pavements (Annex 2) and these pavements are also considered to be non-eligible for the analysis of residual life. The results of the analysis are therefore shown for non-long life flexible and flexible composite pavements.

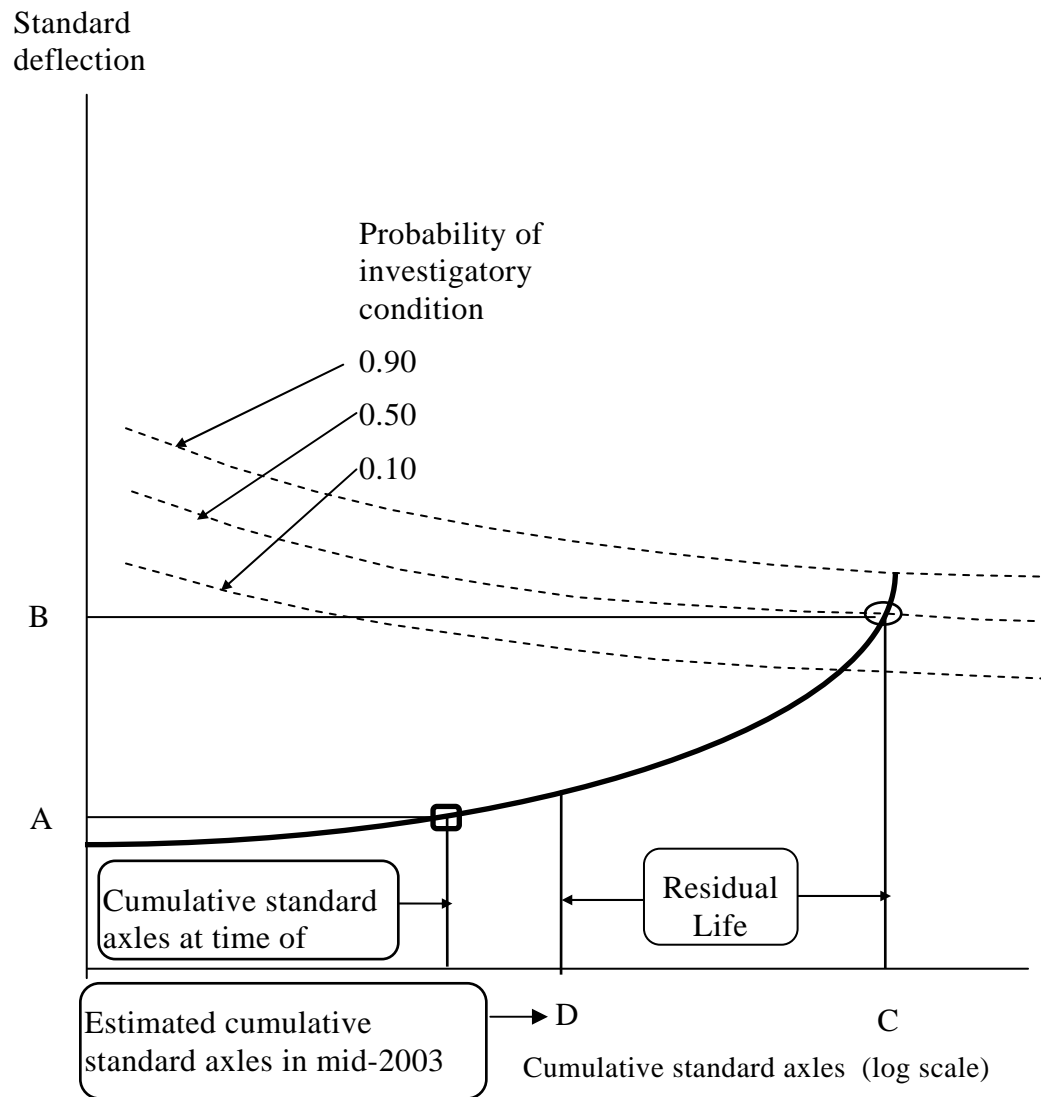
## **Coverage**

For trunk roads until 2002, the Highways Agency had a programme of carrying out routine Deflectograph surveys on the whole of its eligible network over a five year cycle. From 2002, the Highways Agency surveys are only carried out for specific sites on the network that have been identified for possible maintenance. The coverage of residual life values will therefore reduce with time and the values from the routine surveys will progressively become older and more unreliable. As part of the analysis of residual lives of the network, PANDEF Version 3 (see Annex 2) and the analysis in HAPMS identifies long life pavements and these have been included in the results for English motorways and all purpose trunk roads between 1999 and 2001.

The National Assembly for Wales surveyed the network on a three year cycle prior to 2000 but has since moved to a five year cycle. DEFLEC software (see Annex 2) is used to produce the results of its deflection surveys of motorways and all purpose trunk roads; long life pavements are not identified.

For principal roads, until 1999 the central processing of Deflectograph data collected from local highway authorities used PANDEF Version 1. In 1999 the results for principal roads were calculated using Version 2 of PANDEF, and since 2000 using PANDEF Version 3. (The change of software reflected local authority practice.) To provide comparison with 1999, the 1999 results have been adjusted from PANDEF Version 2 to Version 3. Adjustment factors were derived by processing the 1999 data sets for a sample of local authorities using both Version 2 and Version 3. The calculation of coverage is more complicated than for trunk roads since not all of the data provided by highway authorities are used. Firstly, to avoid targeting bias (see above) only data for authorities where the coverage of the eligible network is at least 30 per cent are included. In addition the use of chaining (see above) causes data for certain authorities to be excluded. Coverage is calculated from the route kilometres surveyed as a percentage of total eligible route kilometres. In calculating overall coverage at the national level, the formula used is the total eligible lane kilometres for which data were used, as a percentage of total eligible lane kilometres for the whole of the principal road network (i.e. including authorities that have supplied data which were not used, and the few authorities that have not supplied any Deflectograph data). In calculating total lane kilometres for which data were used, the figure taken for any authority known to survey in one direction only, is twice the route kilometres surveyed. The principal road coverage figures in Tables 4.1 and 4.2 prior to 1997 relate to all local authorities supplying data, not only to those where the coverage was at least 30 per cent. No adjustment has been made for authorities surveying in one direction only. For these years coverage has probably been slightly overstated.

**Figure A4.1 Relationship between standard deflection and life for a given pavement type**



**Example:** Deflections shown here are the measured values corrected for the load and temperature measured at the time of the survey. Deflection at the time of the last survey equals A. The model predicts a 50 per cent probability that investigatory condition will be reached when the deflection increases to B. This implies that the total life of the road will be C in terms of standard axles. As the estimate of cumulative standard axles at the reference date (here mid-2003) equals D, the residual life in 2003 equals (C-D) in terms of standard axles.

## **ANNEX 5**

### **LOCAL AUTHORITY PERFORMANCE INDICATORS**

#### **Background**

Chapter 5 reports on the following Best Value Performance Indicators for 2005-06:

- BV223 - percentage of the principal road network in need of planned maintenance soon.
- BV224a - percentage of the non-principal classified road network in need of planned maintenance soon.
- BV224b - percentage of the unclassified road network in need of further investigation.

Chapter 5 also reports on the following Scottish Road Maintenance Condition Survey indicators for Scotland, covering the years 2002-03 to 2004-05:

- Percentage of the principal road network likely to require early maintenance.
- Percentage of the B road network likely to require early maintenance.
- Percentage of the C road network likely to require early maintenance.
- Percentage of the unclassified road network likely to require early maintenance.
- Percentage of the local road network (as a whole) likely to require early maintenance.

#### **Coverage in England**

The Department for Transport's requirements in terms of survey type and coverage in 2005-06 were:

BV223 to be reported using SCANNER on 100 per cent of the principal road network in one direction or 50 per cent in both directions.

BV224a to be reported using SCANNER covering 100 per cent of B roads in one direction and 50 per cent of C roads in one direction.

BV224b to be reported using CVI or DVI surveys covering a minimum of 25 per cent each year, so that 100 per cent coverage is achieved in four years or less.

2005-065 was the first year in which the requirement was to report BV223 and BV224a using the SCANNER Road Condition Indicator.

#### **Coverage in Scotland**

Each year, 100% of the Principal A road network, 50% of B and C roads, and 15% of unclassified roads in Scotland are surveyed in one direction. In 2005-2006 the direction of survey was reversed and it is the intention to move to a 4 year rolling programme, which will cover classified roads in both directions.

## ANNEX 6

### SKIDDING RESISTANCE

#### Background

For the purposes of monitoring skidding resistance, sections of road are allocated to 12 categories, each of these categories has an investigatory level which is related to the risk of skidding. (The investigatory level is the level that is used to determine the need for further investigation on site.) In the case of skidding resistance further investigation is justified if the level of skidding resistance is equal to or less than the specified investigatory level. If a road is below this investigatory level, it does not necessarily mean that the road is unsafe; it indicates a need for further investigation to determine the need for maintenance. The investigatory level used for a site category can either be that specified in the Design Manual for Roads and Bridges, Volume 7, HD28, or a locally determined value.

#### Coverage

The NRMCS 2000 report was extended to include results of a new return on skidding resistance which had been sent to highway authorities. So far, the number of authorities providing data on principal roads has been 56 for 1999, 76 for 2000, 99 for 2001, 103 for 2002, 101 in 2003 and 100 in 2004. Published results are calculated by averaging data over a period of three years. This is because response rates in the earlier years were not as high as expected and also because some authorities survey roads on a two or three year cycle. An average percentage (at or below investigatory level) was calculated for each responding authority. Results were then weighted by road length to provide aggregate figures for each type of authority, i.e. counties, unitary authorities, etc. In deriving the percentage at or below investigatory level in England, results for each road type have been weighted by the total network length for each authority type. For 2000 to 2002, results have been used from 130 different highway authorities (76 per cent) which represent 87 per cent of the principal road network. Results for individual site categories and for non-principal roads have not been shown because the small samples could lead to misleading results.

The Highways Agency provides results for trunk roads in England. In 2005, the Highways Agency revised the operational procedure for skidding resistance measurements. This involved surveying all the trunk road network each year and providing the Characteristic SCRIM Coefficient (CSC) rather than the MSSC. The SCRIM measurements are still input to the Highways Agency Pavement Management System (HAPMS). The percentage shown needing further investigation is based on results in HAPMS from the analysis of the Single Annual Survey. The National Assembly for Wales surveys about half of its network each year and the percentage needing investigation is calculated on a similar basis..

#### Methodology

A vehicle will skid when, in braking, accelerating or manoeuvring, the frictional 'demand' exceeds the limiting friction force that can be generated at the tyre/road interface, and skid resistance is therefore defined as the limiting frictional coefficient i.e. the frictional coefficient developed when the wheel is actually skidding. The degree of skidding resistance required at a given site on the road network depends on the site category (e.g. junction approach, bend, non-event section) and Highways Agency Standard HD 28/04 sets out investigatory levels for the Characteristic SCRIM Coefficient and the Mean Summer SCRIM Coefficient (MSSC), the skidding resistance, for each site category. If wet skidding resistance at a site is found to be at or below the investigatory level, the highway authority policy is normally to carry out a site investigation to determine whether the existing level of skidding resistance is likely to cause an accident problem. In 2004, following a

study of required levels of skidding resistance, the Highways Agency updated the investigatory levels in HD28.

Skidding resistance data can be collected in various ways. The most widely used is the Sideway-force Coefficient Routine Investigation Machine (SCRIM). This is a 10 tonne water tanker with a test wheel mounted at 20 degrees to the direction of travel. The test wheel is free to rotate and is subject to a 200 kilogramme vertical load. Water is sprayed onto the road surface immediately in front of the test wheel, which is permanently in a controlled-skid condition, and the frictional force developed perpendicular to the plane of the test wheel is measured.

On Motorways and Dual Carriageway All Purpose Trunk Roads where the posted speed limit is greater than 50mph, the target test SCRIM vehicle speed is 80kmh. On all other roads, the target test speed is 50km/h. The permitted speed range at this target test speed is 25 to 85km/h. Skidding resistance data recorded at speeds within this range are speed corrected to give equivalent values at 50km/h. Skidding resistance data are recorded continuously by SCRIM and stored as an average for each 5, 10 or 20 metre section of road.

In 2005, the Highways Agency plans to revise the operational procedure for skidding resistance measurements. This will involve surveying all the trunk road network each year and providing the Characteristic SCRIM Coefficient (CSC) rather than the MSSC.

Skidding resistance surveys can also be carried out using a Griptester. The Griptester is a three-wheeled trailer, the third wheel being braked to produce a drag (skid) and both drag and load are continuously monitored. The friction coefficient (i.e. load/drag) is calculated and transmitted to a data collection computer held in the cab of the towing vehicle.

The majority of the Principal Road network in England and Wales is surveyed over a three-year period. Some authorities survey one third of their network each year, while other, usually smaller, authorities survey the whole of their network every two or three years.

## **Chaining**

As with results for the structural survey (see Annex 4), in order to ensure that trends in condition are estimated more accurately, the figures for principal roads in Table 6.1 have been calculated using 'chaining'. The base period is taken to be 2001 to 2003. That is, results for 2001 to 2003 are based on all available data for those years. The change in condition between 2000 to 2002 and 2001 to 2003 is also calculated for authorities responding to the survey in both periods. Published percentages for the length of network equal to or below the investigatory level for 2000 to 2002 are then derived by applying the change in condition in both periods to the 2001 to 2003 results.

## **Seasonal variation**

In England and Wales there is a significant seasonal variation in skidding resistance, with minimum values occurring during summer and early autumn. During the summer dry polishing of the road's microtexture occurs due to the action of traffic, and SCRIM values fall. Later in the year when the road is wet for prolonged periods wet polishing with gritty materials tends to restore the microtexture and SCRIM values rise. To offset the effect of seasonal variation the testing season is restricted to 1 May to 30 September. . When surveying to produce MSSC values, the 3 surveys are measured at fairly equal intervals over the summer. For surveys that produce the Characteristic SCRIM Coefficient, the surveys are carried out early, middle and late in the summer survey period in successive years.

## **Software used to analyse skidding resistance results**

In the UK, skidding resistance measurements have generally been analysed using SKID software. With this suite of computer programs the measurements are corrected for speed and temperature at the time of measurement. The measurements are then compared with the investigatory level for each measurement length to identify the percentage of the network below investigatory level. For the trunk roads in England, since 2002, the SCRIM skidding resistance measurements have been analysed using the analysis facilities in the Highways Agency Pavement Management System (HAPMS). In 2005 the software was adapted to process CSC values. From 2002, analysis of SCRIM skidding resistance measurements by local authorities in England and for the trunk and principal roads in Wales continued to use the SKID software.

## ANNEX 7

### TRUNK ROAD SURFACE CONDITION SURVEY IN ENGLAND

#### Background

Information on the surface condition of the trunk road network is provided to the Highways Agency under the TRAffic-speed Condition Survey (TRACS) contract. As part of this contract, surveys of lane 1 of the network have been carried out annually since 2000. In 2005 the surveys were carried twice in lane 1 of the main carriageways. The measurements made in 2002 to 2005 are described in Chapter 7 of this report. For 2005, the most recent survey measurements have been used for each length of the network. The equipment used for the surveys included lasers, video image collection and inertial measurement apparatus to enable surveys of the road surface condition to be carried out while travelling at variable speeds of up to 100 km/h and hence minimise the disruption to road users.

The condition data from the surveys can be aggregated over a specified length to represent the surface condition of the network. Rut depth and texture depth can be used to evaluate safety aspects (together with any available SCRIM measurements), the crack data can be used as guidance on the condition of the surface and the longitudinal profile can be used to assess riding quality. In addition, the texture measurements can be analysed further to identify levels of fretting on Hot Rolled Asphalt surfaces. The interpretation of the texture and cracking measurements is still under development so the levels of defectiveness act only as guidance rather than as a definite identifier of the need for maintenance.

#### Methodology

The survey provides measurements of rutting, texture, cracking intensity, fretting and longitudinal profile.

##### *Rut Depth*

To provide rut depth, the survey records the transverse profile of the road surface over a width of 3.2m at approximately 0.1m longitudinal intervals using 20 laser sensors. The transverse profile measurements were processed using an algorithm to simulate placing a notional 2m straight edge on the recorded transverse profile, and the largest deviation from the straight edge to the transverse profile calculated for each wheel-track. This transverse profile measurement method for rut determination has been shown to be highly comparable with the measurements made using a conventional straight edge and wedge.

##### *Texture Depth*

Texture depth contributes to skidding resistance, primarily at medium and high speeds, in two ways. Firstly, it provides drainage paths to allow water to be removed rapidly from the tyre/road interface. Secondly, the projections, which contribute to hysteresis losses in the tyre, are an important factor in the braking process. The texture depth measured in the survey was the coarser element of macrottexture and the finer element of megattexture formed by aggregate particles in the surfacing material (e.g. the chippings rolled into asphalt or brushing/grooving of a concrete surface). Texture was measured in the nearside wheel-track at approximately 1mm longitudinal intervals.

##### *Cracking*

The measurement of cracking was made using downward facing video cameras that continuously collect images of the road surface over a transverse width of 3.2m. The video images from each

camera were passed to a data processing system that automatically interpreted the images to detect cracking. The image collection system had a transverse and longitudinal resolution of approximately 2.5mm (the 'pixel size'). The system was therefore unlikely to detect cracks in the road surface less than 2.5mm wide.

Crack identification software identified the cracks present within each image collected. Before commencing network surveys the survey equipment was calibrated against the results of manual crack surveys. The calibration involved adjusting the sensitivity of the system to minimise the false detection of cracks but this also affected the detection of 'real' cracks. Therefore, the total intensity of cracking was, generally, lower than that recorded by an inspector in a manual crack survey.

Manual inspections estimate the extent of cracking by placing a theoretical frame around the cracking and recording the area within the frame. The survey equipment only records the cracking that it identifies and does not, therefore, 'fill-in' between cracks, as is the case when an inspector estimates an area of cracking. This contributed to a reduction in the area of cracking recorded by the survey equipment, in comparison with the results of a manual survey.

The intensity of cracking was obtained by simulating a grid, made up of 0.2m squares, over the cracks. The percentage of grid squares containing 1 or more cracks was then evaluated over 10m lengths to give a percentage value of crack intensity. It has been shown that this method and the manual method report the presence of deterioration on a subsection where cracking is present.

Monitoring of the behaviour of the cracking intensities recorded on the network has shown that they can be affected by variations in the survey conditions, which thereby influence the relative intensities of cracking reported. As a result, the intensities recorded in surveys carried out in consecutive survey years can vary and, when applying analyses based on threshold levels, the categories within which the cracking measurements fall may change from survey year to survey year. Therefore as the variability in the cracking intensities can introduce a degree of uncertainty in the cracking measurements the thresholds are provided for guidance only, to aid in identifying lengths in need of further investigation and have not been used to report the condition of the trunk road network.

### *Longitudinal Profile*

The parameter used for the assessment of profile unevenness was the Longitudinal Profile Variance (LPV) of individual deviations of the profile relative to a datum derived from a moving average of the profile measurements. Measurements were made in the nearside wheel-track at approximately 0.1m longitudinal intervals.

Profile unevenness can be used to assess the ride quality of the pavement. The short, medium and long wavelength features found to have the most effect on vehicle ride are represented by variance from 3m, 10m and 30m moving averages respectively.

High values of 3m variance may arise from short wavelength features such as faulting, potholes and poor reinstatements that cross the nearside wheel-track. Extremes of 10m variance may arise from poor reinstatements along the wheel-track, the presence of high and/or variable levels of rutting, and bay length irregularities (in concrete roads). High levels of 30m variance may be associated with subsidence.

Profile unevenness does not only affect ride quality. In particular, high levels of profile unevenness in the 3m and 10m wavelength ranges, have been shown to contribute to increased dynamic loading of the pavement, hence accelerating the structural deterioration. Extremes of profile unevenness can also lead to increased stopping distances, and have an adverse effect on vehicle manoeuvrability.

## Assessment criteria

In association with the introduction of TRACS, the Highways Agency introduced new condition thresholds for texture, rutting, longitudinal profile variance (LPV) and cracking. In 2004, these thresholds were updated to coincide with the modification to the Longitudinal Profile Variance defects to become Enhanced longitudinal Profile Variance (ELPV). The thresholds used to report the surface condition of trunk roads in England are shown in Table A7.1.

**Figure A7.1: TRACS surface condition thresholds**

Aspect of condition	Threshold
Rutting	15.5mm
Texture	0.6mm
Enhanced Longitudinal Profile Variance (LPV) – 3m	
Motorways and Rural Dual Carriageways	3.3mm <sup>2</sup>
Urban Dual Carriageways	3.85mm <sup>2</sup>
Rural Single Carriageway Roads	3.85mm <sup>2</sup>
Urban Single Carriageway Roads	6.55mm <sup>2</sup>
Enhanced Longitudinal Profile Variance (LPV) – 10m	
Motorways and Rural Dual Carriageways	10.6mm <sup>2</sup>
Urban Dual Carriageways	15.7mm <sup>2</sup>
Rural Single Carriageway Roads	15.7mm <sup>2</sup>
Urban Single Carriageway Roads	27.45mm <sup>2</sup>
Enhanced Longitudinal Profile Variance (LPV) – 30m	
Motorways and Rural Dual Carriageways	88.0mm <sup>2</sup>
Urban Dual Carriageways	98.0mm <sup>2</sup>
Rural Single Carriageway Roads	98.0mm <sup>2</sup>
Urban Single Carriageway Roads	145.0mm <sup>2</sup>

Analysis of the rutting measurements provided the average rut depth for each wheel-track over a 10m length. These base data were used to calculate representative values of rutting for required reporting lengths. The threshold value used for NRMCS is for a reporting length of 100m for the average rut depth (using both wheel-track values).

The threshold value for a reporting length of 100m for texture was assessed against the measured texture depths expressed as averages over 10m lengths. Different thresholds would be applied to High Friction Surfacing and all other surface types because of the different ways in which texture is provided by these materials. For the NRMCS analysis, the threshold for non-High Friction Surfacing has been used for all surface types.

Texture measurements can be analysed to provide estimates of fretting of the pavement surface. As the current thresholds for fretting are for guidance only, this defect has not been used to report the condition of the trunk road network.

The guidance level for cracking applies to the intensity of whole carriageway cracking derived from the crack measurements and expressed as average intensities over 100m lengths. As the current

thresholds for cracking are for guidance only, this defect has not been used to report the condition of the trunk road network.

The threshold values for enhanced longitudinal profile variance were compared with the values of 3m, 10m and 30m depending on the date of the survey. The variances were derived from the profile measurements and expressed as averages over 10m lengths taking into account the different threshold values for different road classifications, e.g. a motorway requires a better standard of ride quality than a built-up single carriageway, where traffic is generally travelling at a lower speed.

For each year, the analysis considered the most recent survey on each 10m length for comparison with the thresholds. Where no survey was carried out in the calendar year, results from the most recent of the earlier years were used in the analysis. Where more than one survey was carried out on a length in a year, only the most recent survey was used.

## **Software used to analyse TRACS measurements**

The Highways Agency's Machine Survey Pre-processor (MSP) software, developed as part of the Highways Agency Pavement Management System (HAPMS) Project, was used to process the Raw Condition Data (RCD) output from the survey equipment. The MSP calculated rut depths in the nearside and offside wheel-tracks from the measured transverse profile, Sensor Measured Texture Depth (SMTD) derived from the measured texture profile, the intensity of cracking from the measured cracks, the level of fretting of the pavement surface and the enhanced longitudinal profile variances from the measured longitudinal profile.

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### Transport Statistics Users Group

The Transport Statistics Users Group (TSUG) was set up in 1985 as a result of an initiative by the Statistics Users Council and the Chartered Institute of Transport (now known as The Institute of Logistics and Transport). From its inception it has had strong links with the Department for Transport. The aims of the Group are:

- to identify problems in the collection, provision, use and understanding of transport statistics, and to discuss solutions with the responsible authorities;
- to provide a forum for the exchange of views and information between users and providers of transport statistics;
- to encourage the proper use of statistics through publicity and education.

The Group holds regular seminars on topical subjects connected with the provision and/or use of transport statistics. Recent seminars have included:

- The International Passenger Survey (IPS) and its use by Government and travel sector
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A newsletter is sent to all members about four times a year. Corporate membership of the Group is £50, personal membership £22.50, and student membership £10. For further details please contact:

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The TSUG has contributed to the production of the *Transport Yearbook 2006*. This contains information on sources from governmental and non-governmental organisations, including some European sources. One copy is supplied free to TSUG members. Non-members can purchase a copy from The Stationery Office.

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