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UK and Gibraltar air quality modelling for annual reporting 2005 on ambient air quality assessment under Council Directives 96/62/EC and 2002/3/EC relating to ozone in ambient air

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Report to Department for Environment, Food and Rural Affairs, the Scottish Executive, Welsh Assembly Government, the Department of the Environment in Northern Ireland and the Government of Gibraltar

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Executive Summary

Directive 96/62/EC on Ambient Air Quality Assessment and Management (the Framework Directive) establishes a framework under which the EU sets limit values or target values for the concentrations of specified air pollutants. Directive 2002/3/EC (the third Daughter Directive) sets Target Values (TVs) and Long-term Objectives (LTOs) to be achieved for ozone.

2005 is the second year for which an annual air quality assessment for the third Daughter Directive pollutants is required. A questionnaire has been completed for submission to the EU containing the results of this air quality assessment along with those required for the first and second Daughter Directives. The assessment takes the form of comparisons of measured and modelled air pollutant concentrations with the Target Values and Long-term Objectives set out in the Directives. Air quality modelling has been carried out to supplement the information available from the UK national air quality monitoring networks.

This report provides a summary of key results from the questionnaire and additional technical information on the modelling methods that have been used to assess ozone throughout the UK. This includes:

- Details of modelling methods
- Information on the verification of the models used and comparisons with data quality objectives (DQOs)
- Detailed modelling results and comparison with Target Values and Long-term Objectives.

Maps of background ozone concentrations in 2005 on a 1 km x 1 km grid have been prepared. The following metrics set out by the third Daughter Directive have been modelled;

- Number of days above 120 μgm^{-3} in 2005
- Number of days above 120 μgm^{-3} per year averaged over three years 2003-2005
- AOT40 wheat crops in 2005
- AOT40 wheat crops averaged over five years 2001-2005

The models used in this assessment have been selected based on a critical appraisal of the techniques available within the UK.

The UK has been divided into 43 zones for air quality assessment. There are 28 agglomeration zones (large urban areas) and 15 non-agglomeration zones. The exceedence status of the zones has been determined from a combination of monitoring data and model results. The results of this assessment are summarised in Tables E1 and E2 in terms of exceedences of Target Values and Long-term Objectives.

Table E1 Summary results of air quality assessment relative to the Target Values for ozone for 2010

Target Value	*Number of zones exceeding*
Max Daily 8-hour mean Target Value	none
AOT40 Target Value	none

Table E2 Summary results of air quality assessment relative to the Long-term Objectives for ozone

Long-term Objective	*Number of zones exceeding*
Max Daily 8-hour mean Long-term Objective	32 zones (22 measured + 15 modelled)
AOT40 Long-term Objective	16 zones (9 measured + 7 modelled)

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Appendices

1 Introduction

1.1 THE FRAMEWORK AND DAUGHTER DIRECTIVES

Directive 96/62/EC on Ambient Air Quality Assessment and Management (the Framework Directive (Council Directive 96/62/EC)) establishes a framework under which the EU sets limit values or target values for the concentrations of specified air pollutants in ambient air. Directive 1999/30/EC (the first Daughter Directive, AQDD1) sets the limit values to be achieved for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particles and lead. Directive 2000/69/EC (the second Daughter Directive, AQDD2) sets out the limit values to be achieved for benzene and carbon monoxide. Directive 2002/3/EC (the third Daughter Directive, AQDD3) sets Target Values (TVs) and Long-term Objectives (LTOs) to be achieved for ozone.

The Framework Directive includes a requirement for Member States to undertake preliminary assessments of ambient air quality, prior to the implementation of the Daughter Directives under Article 5 this Directive. The objectives of these assessments are to establish estimates for the overall distribution and levels of pollutants, and to identify additional monitoring required to fulfil obligations within the Framework Directive. Reports describing the preliminary assessment for the UK for AQDD1, AQDD2 and AQDD3 have been prepared[1,2,3]. The Daughter Directives define the number of air quality monitoring sites required on the basis of the concentrations of pollutants and population statistics. The number of monitoring sites required is significantly reduced if other means of assessment, in addition to fixed monitoring sites, are also available. Air quality modelling has therefore been carried out to supplement the information available from the UK national air quality monitoring networks and contribute to the assessments required by the Framework and subsequent Daughter Directives.

1.2 THIS REPORT

The first and second Daughter Directives make provision for an annual air quality assessment for NO_2, PM_{10}, SO_2, CO and benzene. 2005 is the second year for which an annual air quality assessment is required for ozone as specified in the third Daughter Directive. A questionnaire has been completed for submission to the EU containing the results of this air quality assessment. A copy of the completed questionnaire can be found on the Central Data Repository of the European Environment Agency[4]. The assessment takes the form of comparisons of measured and modelled air pollutant concentrations with the limit values set out in the Directives. This report details the results of annual air quality assessments undertaken to satisfy the UK's obligation under the Daughter Directives and focuses on the modelling methodology for ozone. The air quality assessments for NO_2, PM_{10}, SO_2, CO and benzene are covered in a separate report[5] that can be found on the National Air Quality Archive. This report focuses on the modelling methodology for reporting under the AQDD3. Section 2 describes the modelling procedures used for estimation of ozone.

[1] Bush T (2000). Article 5 Assessment of Nitrogen Dioxide, PM10, sulphur dioxide and lead in the UK. Report to the Department for Environment, Food and Rural Affairs, the Scottish Executive, Welsh Assembly Government and the Department of the Environment in Northern Ireland. AEA Technology, Netcen report AEAT/R/ENV/0165. http://www.airquality.co.uk/archive/reports/cat09/0502100920_Art5_v9commission2(final_draft).pdf

[2] Bush T (2002) Preliminary Assessment of benzene and carbon monoxide levels in the UK. Report to the Department for Environment, Food and Rural Affairs, the Scottish Executive, Welsh Assembly Government and the Department of the Environment in Northern Ireland. AEA Technology, Netcen report AEAT/ENV/R/1333/Issue 1 http://www.airquality.co.uk/archive/reports/cat09/art5_dd2_v3aeat.pdf

[3] Bush T and Kent A (2003). Preliminary Assessment of ozone levels in the UK . Report to the Department for Environment, Food and Rural Affairs, the Scottish Executive, Welsh Assembly Government and the Department of the Environment in Northern Ireland. AEA Technology, Netcen report AEAT/ENV/R/1528/Issue 1. http://www.airquality.co.uk/archive/reports/cat09/0506130933_o3dd1_art5_rep2.pdf

[4] CDR, 2006, http://cdr.eionet.europa.eu/gb/eu/annualair

[5] Kent et al (2007). UK air quality modelling for annual reporting 2005 on ambient air quality assessment under Council Directives 96/62/EC, 1999/30/EC and 2000/69/EC. Report to the Department for Environment, Food and Rural Affairs, the Scottish Executive, Welsh Assembly Government and the Department of the Environment in Northern Ireland. AEA Energy & Environment report. AEAT/ENV/R/2278 Issue 1.http://www.airquality.co.uk/archive/reports/reports.php?report_id=453

These include:

- Information on the calibration and verification of the models
- Background ambient concentration maps
- Detailed model results and identification of exceedences of TV

The following metrics relevant to the annual reporting of data to the Commission have been investigated:

- Number of days above 120 μgm^{-3} in 2005
- Number of days above 120 μgm^{-3} per year averaged over three years 2003-2005
- AOT40 wheat crops in 2005
- AOT40 wheat crops averaged over five years 2001-2005

The definitions of the metrics presented above and the Target Values and Long-term Objectives are given in Annex I of the Directive. In addition, Annex II of the Directive presents Alert and Information Thresholds designed to inform the public and organisations representing sensitive population groups on occasions when there is increased a risk to human health from brief exposure to elevated levels of ozone. Annex I and II are presented below.

Information on the metrics outlined above are also presented for the Gibraltar zone in Section 3. Information for this zone is limited to measured data, no model output being available for Gibraltar at this time.

1.3 PRELIMINARY ASSESSMENTS AND DEFINITION OF ZONES

The preliminary assessment carried for AQDD1 defined a set of zones to be used for air quality assessments in the UK based on population and urban areas data from the 1991 UK Census. These data have now been updated using information on populations from the 2001 Census and land-use data from the Devolved Administrations. Updated zones are listed in Table 1.1 and illustrated in Figure 1.1. Information on the definition of zones is included in form 2 of the questionnaire. The zone codes listed in Table 1.1 are used throughout the questionnaire. The population and area of each zone is also shown. The zones are of two types: agglomeration zones (continuous urban areas with a population in excess of 250,000) and non-agglomeration zones. There are 28 agglomeration zones and 15 non-agglomeration zones, giving a total of 43 zones in the UK. The non-agglomeration zones in England correspond to the Government Office Regions, while those in Scotland, Wales and Northern Ireland were defined in conjunction with the Devolved Administrations.

The preliminary assessment for ozone also defined the monitoring and modelling requirements for each zone based on an assessment of concentrations in relation to Target Values ands Long-term Objectives specified by AQDD3. The minimum monitoring requirement for ozone and NOx in the majority of zones was found to be at least one monitoring site per zone, with the monitoring results to be supplemented with information from modelling studies.

ANNEX I

DEFINITIONS, TARGET VALUES AND LONG-TERM OBJECTIVES FOR OZONE

I. Definitions

All values are to be expressed in µg/m³. The volume must be standardised at the following conditions of temperature and pressure: 293 K and 101,3 kPa. The time is to be specified in Central European Time.

AOT40 (expressed in (µg/m³)·hours) means the sum of the difference between hourly concentrations greater than 80 µg/m³ (= 40 parts per billion) and 80 µg/m³ over a given period using only the 1 hour values measured between 8:00 and 20:00. Central European Time each day (1).

In order to be valid, the annual data on exceedances used to check compliance with the target values and long-term objectives below must meet the criteria laid down in Section II of Annex III.

II. Target values for ozone

	Parameter	Target value for 2010 (a) (1)
1. Target value for the protection of human health	Maximum daily 8-hour mean (b)	120 µg/m³ not to be exceeded on more than 25 days per calender year averaged over three years (c)
2. Target value for the protection of vegetation	AOT40, calculated from 1 h values from May to July	18 000 µg/m³·h averaged over five years (c)

(a) Compliance with target values will be assessed as of this value. That is, 2010 will be the first year the data for which is used in calculating compliance over the following three or five years, as appropriate.

(b) The maximum daily 8-hour mean concentration shall be selected by examining 8-hour running averages, calculated from hourly data and updated each hour. Each 8-hour average so calculated shall be assigned to the day on which it ends. i.e. the first calculation period for any one day will be the period from 17:00 on the previous day to 01:00 on that day; the last calculation period for any one day will be the period from 16:00 to 24:00 on the day.

(c) If the three or five year averages cannot be determined on the basis of a full and consecutive set of annual data, the minimum annual data required for checking compliance with the target values will be as follows:
— for the target value for the protection of human health: valid data for one year,
— for the target value for the protection of vegetation: valid data for three years.

(1) These target values and permitted exceedance are set without prejudice to the results of the studies and of the review, provided for in Article 11, which will take account of the different geographical and climatic situations in the European Community.

III. Long-term objectives for ozone

	Parameter	Long-term objective (a)
1. Long-term objective for the protection of human health	Maximum daily 8-hour mean within a calender year	120 µg/m³
2. Long-term objective for the protection of vegetation	AOT40, calculated from 1 h values from May to July	6 000 µg/m³·h

(a) Community progress towards attaining the long-term objective using the year 2020 as a benchmark shall be reviewed as part of the process set out in Article 11.

Source; Directive 2002/3/EC

ANNEX II

INFORMATION AND ALERT THRESHOLDS

I. Information and alert thresholds for ozone

	Parameter	Threshold
Information threshold	1 hour average	180 $\mu g/m^3$
Alert threshold	1 hour average (a)	240 $\mu g/m^3$

(a) For the implementation of Article 7, the exceedance of the threshold is to be measured or predicted for three consecutive hours.

II. Minimum details to be supplied to the public when the information or alert threshold is exceeded or exceedance is predicted

Details to be supplied to the public on a sufficiently large scale as soon as possible should include:

1. information on observed exceedance(s):
   - — location or area of the exceedance,
   - — type of threshold exceeded (information or alert),
   - — start time and duration of the exceedance,
   - — highest 1-hour and 8-hour mean concentration;
2. forecast for the following afternoon/day(s):
   - — geographical area of expected exceedances of information and/or alert threshold,
   - — expected change in pollution (improvement, stabilisation or deterioration);
3. information on type of population concerned, possible health effects and recommended conduct:
   - — information on population groups at risk,
   - — description of likely symptoms,
   - — recommended precautions to be taken by the population concerned,
   - — where to find further information;
4. information on preventive action to reduce pollution and/or exposure to it:

   indication of main source sectors; recommendations for action to reduce emissions.

———

Source; Directive 2002/3/EC

Figure 1.1 UK zones and agglomerations for 2005
(UK agglomerations zones in red text, non-agglomeration zones in black text)

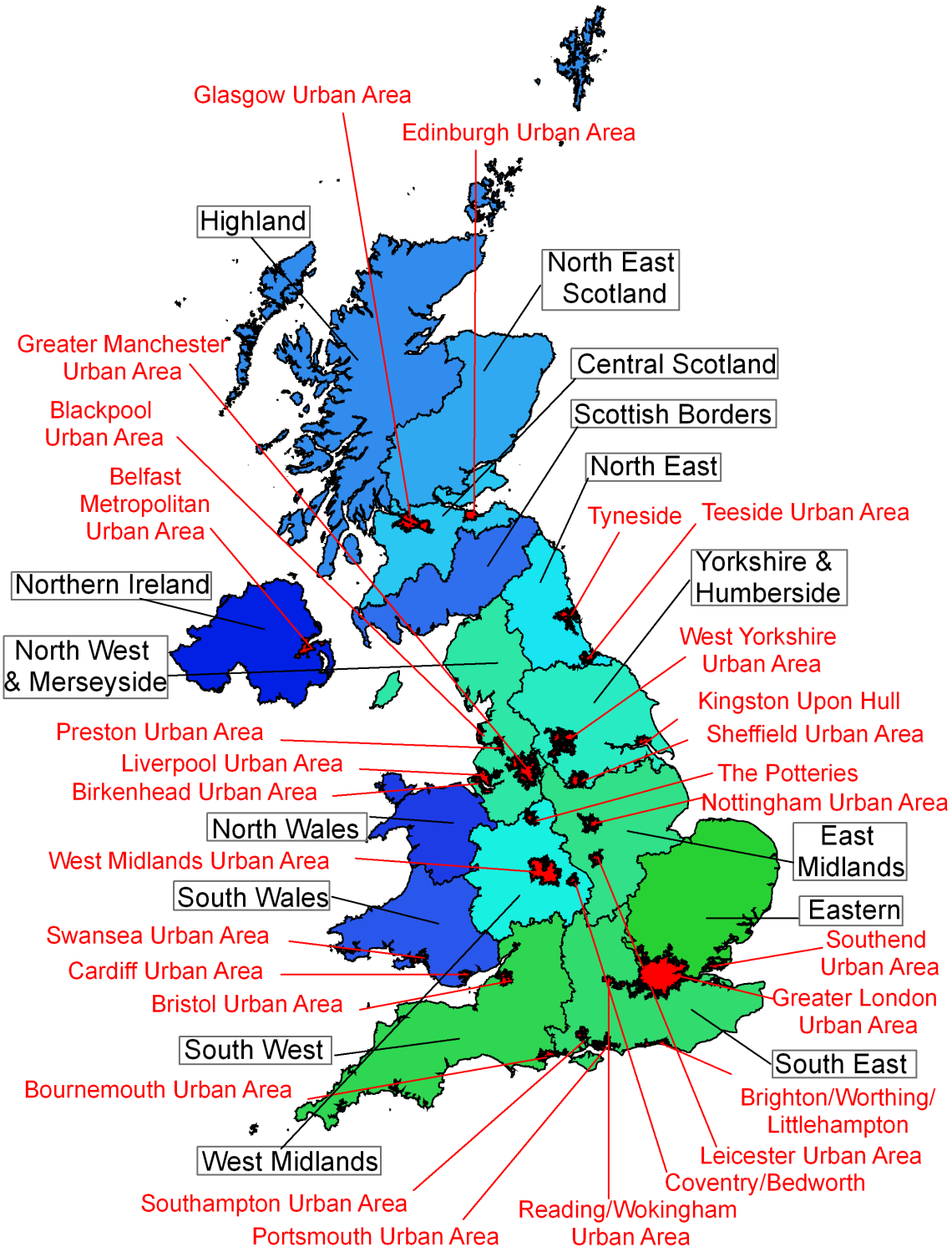


Table 1.1 Zones for AQDD3 reporting

Zone	Zone code	Ag or nonag*	Area (km^2)	Population
Greater London Urban Area	UK0001	ag	1628	8278251
West Midlands Urban Area	UK0002	ag	594	2284093
Greater Manchester Urban Area	UK0003	ag	557	2244931
West Yorkshire Urban Area	UK0004	ag	363	1499465
Tyneside	UK0005	ag	217	879996
Liverpool Urban Area	UK0006	ag	184	816216
Sheffield Urban Area	UK0007	ag	165	640720
Nottingham Urban Area	UK0008	ag	169	666358
Bristol Urban Area	UK0009	ag	142	551066
Brighton/Worthing/Littlehampton	UK0010	ag	97	461181
Leicester Urban Area	UK0011	ag	102	441213
Portsmouth Urban Area	UK0012	ag	91	442252
Teesside Urban Area	UK0013	ag	111	365323
The Potteries	UK0014	ag	91	362403
Bournemouth Urban Area	UK0015	ag	113	383713
Reading/Wokingham Urban Area	UK0016	ag	97	369804
Coventry/Bedworth	UK0017	ag	76	336452
Kingston upon Hull	UK0018	ag	80	301416
Southampton Urban Area	UK0019	ag	77	304400
Birkenhead Urban Area	UK0020	ag	88	319675
Southend Urban Area	UK0021	ag	64	269415
Blackpool Urban Area	UK0022	ag	63	261088
Preston Urban Area	UK0023	ag	58	264601
Glasgow Urban Area	UK0024	ag	366	1168270
Edinburgh Urban Area	UK0025	ag	117	452194
Cardiff Urban Area	UK0026	ag	72	327706
Swansea Urban Area	UK0027	ag	84	270506
Belfast Urban Area	UK0028	ag	193	580276
Eastern	UK0029	nonag	19113	4850132
South West	UK0030	nonag	23506	3980991
South East	UK0031	nonag	18645	6016677
East Midlands	UK0032	nonag	15491	3084598
North West & Merseyside	UK0033	nonag	13149	2826622
Yorkshire & Humberside	UK0034	nonag	14787	2514947
West Midlands	UK0035	nonag	12192	2271650
North East	UK0036	nonag	8282	1269803
Central Scotland	UK0037	nonag	9305	1813314
North East Scotland	UK0038	nonag	18587	1001499
Highland	UK0039	nonag	38269	380062
Scottish Borders	UK0040	nonag	11145	254690
South Wales	UK0041	nonag	12221	1578773
North Wales	UK0042	nonag	8368	720022
Northern Ireland	UK0043	nonag	13579	1104991
Total			242698	59211755

* ag = agglomeration zone, nonag = non-agglomeration zone

1.4 MONITORING SITES

The monitoring stations operating during 2005 in the UK for the purpose of AQDD3 are listed in Table A1.1 in Appendix 1. The monitoring stations operating during 2005 in Gibraltar are listed in Table A1.2 in Appendix 1. This information is included in form 3 of the questionnaire. Not all sites had sufficient data capture during 2005 for data to be reported in the questionnaire. The data quality objective (DQO) for AQDD measurements is 90 % data capture. We have included all measurements with at least 75% data capture in the analysis in order to ensure that we can make maximum use of data from the monitoring sites operational during 2005 for reporting purposes. Table A1.3 in Appendix 1 lists the data capture rates for all monitoring stations used in the calibration of models for reporting under AQDD1-3.

Measurement data from monitoring stations not in the UK's Automatic Urban and Rural Network have been used as an independent check on the performance of model outputs. These verification data have been sourced from AEA Energy & Environment's Calibration Club customers and are widely regarded as high quality and reliable. Monitoring stations used in this verification process are presented in Table A2.1 of Appendix 2.

2 Mapping Methods

This section of the report presents the methods used to map ozone throughout the UK. Following recommendations made by a study comparing the relative performance of available techniques for modelling ozone within the UK[6], an empirical mapping approach has been used for predicting ozone concentrations in 2005.

The empirical approaches draw upon measurements from the 85 monitoring stations in the AURN (2005) to produce functions describing ground-level ozone based upon wind velocity, topography and local emissions of NO_x. These functions are capable of predicting ozone levels at a resolution of 1 x 1 km^2 and the methods are briefly described in the following sections, full details can be sourced from the cited references. The methods are based upon those presented by Coyle et al[7], NEGTAP[8] and PORG 1998[9].

2.1 MODELLING THE NUMBER OF DAYS EXCEEDING 120 μg m^{-3} METRIC

2.1.1 Days greater than 120 μg m^{-3} methodology

At rural locations in the UK exceedences of 120 μg m^{-3} as a maximum daily 8-hour mean are broadly representative of wide spatial areas. As a result, measured exceedences from rural monitoring stations have been interpolated throughout the whole UK to represent the likely exceedences of this metric in the absence of NOx titration effect arising from emissions from combustion sources.

The resultant interpolated maps, however, will overestimate values in urban areas, where nitric oxide emissions from combustion sources deplete ozone concentrations. Hence, an 'urban influence' term (UI) has been defined for monitoring stations in the AURN and the interpolated rural map to correct for the depletion of ozone in areas close to sources of NO. UI is defined as follows;

UI = (mapped rural ozone concentrations – measured ozone concentrations) / mapped rural concentrations

UI is closely related to annual mean NOx concentration. In this study, we have used the map of NOx concentrations in the UK provided by Stedman et al (2005)[10]. The relationships between UI and empirically modelled NOx concentrations for 2005 and the 2003-2005 averaged metrics are presented in Figures 2.1 and 2.2 below.

[6] T Bush and J Targa, 2005. Ozone Mapping Techniques for the 3rd Daughter Directive; OSRM vs Empirical modelling Comparison Report. A report to The Department for Environment, Food and Rural Affairs, Welsh Assembly Government, The Scottish Executive and the Department of the Environment for Northern Ireland. AEA Technology plc, Netcen, Harwell. Report AEAT/ENV/R/2053

[7] Coyle M, Smith R, Stedman J, Weston K and Fowler D, 2002. Quantifying the spatial distribution of surface ozone concentration in the UK. Atmospheric Environment, 36 (2002) 1013-1024.

[8] NEGTAP 2001, Transboundary Air Pollution: Acidification, Eutrophication and Ground-level ozone in the UK. Prepared by the National Expert Group on Transboundary Air Pollution (NEGTAP) on behalf of the Department for Environment, Food and Rural Affairs, the Scottish Executive, Welsh Assembly Government and the Department of the Environment in Northern Ireland. ISBN 1 870393 61 9.

[9] PORG (UK Photochemical Oxidants Review Group), 1998. Ozone in the UK. 4th report of the UK Photochemical Oxidants Review Group, 1st Edition. The Department of the Environment Transport and the Regions.

[10] Kent et al (2007). UK air quality modelling for annual reporting 2005 on ambient air quality assessment under Council Directives 96/62/EC, 1999/30/EC and 2000/69/EC. Report to the Department for Environment, Food and Rural Affairs, the Scottish Executive, Welsh Assembly Government and the Department of the Environment in Northern Ireland. AEA Energy & Environment report. AEAT/ENV/R/2278 Issue 1. http://www.airquality.co.uk/archive/reports/reports.php?report_id=453

The x-axis intercepts on the graphs represent the NO_x concentration at which there is effectively no further UI. For 2005 and 2003-2005 UI/NOx relationships, the x-axis intercepts have been forced through 10.0 $\mu g\ m^{-3}$ since UI should be driven by local NOx emissions rather than regional concentrations.

A map of UI can subsequently be calculated for the UK at a 1 x 1 km^2 resolution;

$$UI = \text{gradient} * ([NOx\ map] - 10\ \mu g\ m^{-3})$$

UI is then used to correct the interpolated rural days above 120 $\mu g\ m^{-3}$ maps;

$$\text{Corrected days above 120 } \mu g\ m^{-3} \text{ map} = \text{interpolated rural map} * (1 - UI)$$

Where the product above expression results in a predicted number of days exceeding less than 1, the predicted value is rounded to the nearest integer.

Maps of modelled number of days with maximum daily 8-hour mean zone concentrations greater than 120 $\mu g\ m^{-3}$ for comparison with the Long-term Objective (2005) and Target Value (averaged 2003 to 2005) are presented in Figures 2.3 and 2.4 respectively.

Figures 2.1 and 2.2 show that the relationship between UI and NOx concentration for the multi-year metric is much better than that for the single year and arises from the concentrations in 2005 being relative low compared with previous years. In addition Figure 2.1 shows a number of monitoring sites with a UI of 1 because there were no measured exceedences in 2005. For some monitoring stations in both figures negative UI terms are observed. These values are being driven by the measured exceedences at urban sites being higher than the interpolated rural field in the corresponding region, suggesting that the rural sites have not fully characterised regional concentrations. However, in general the occurrence of negative UI terms relates to a small number of days exceeding at urban and rural locations and therefore their occurrence is not thought to be significant in relation to predicting the TV for the Directive.

Figure 2.1 Relationship between UI 2005 and NOx concentration

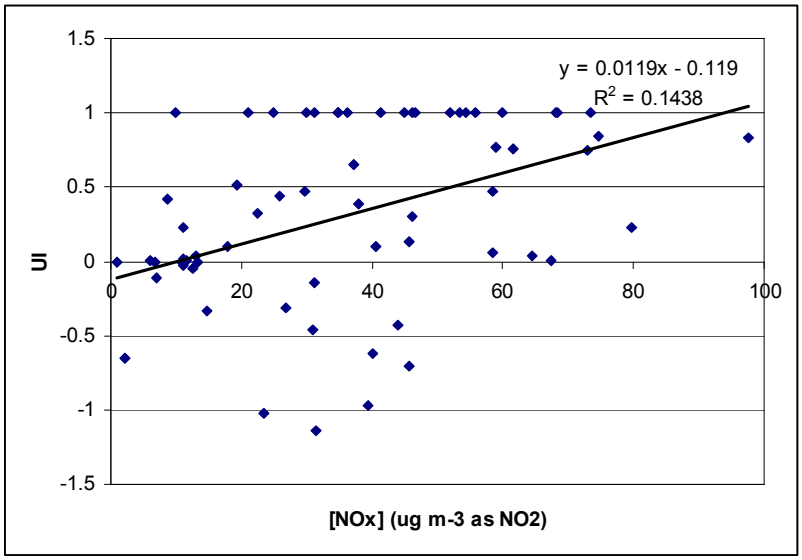


Figure 2.2 Relationship between UI 2003-5 and NOx concentration

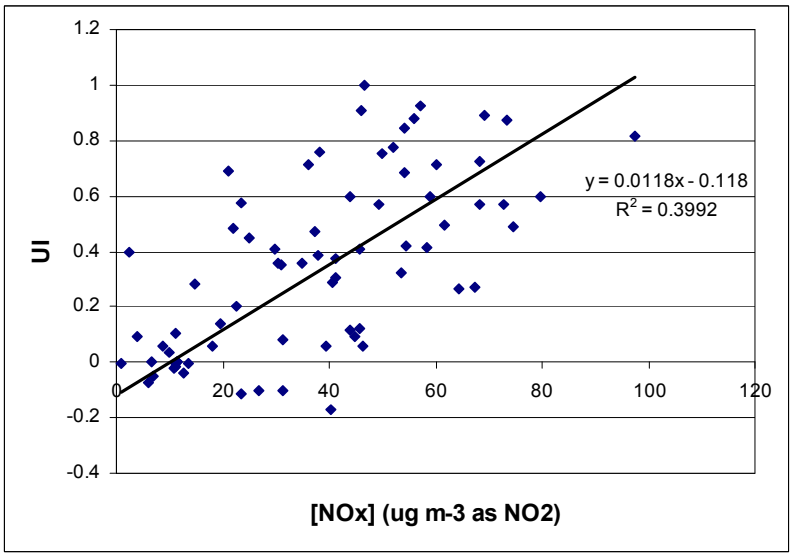


Figure 2.3 Estimated number of days above 120 μgm^{-3}, 2005

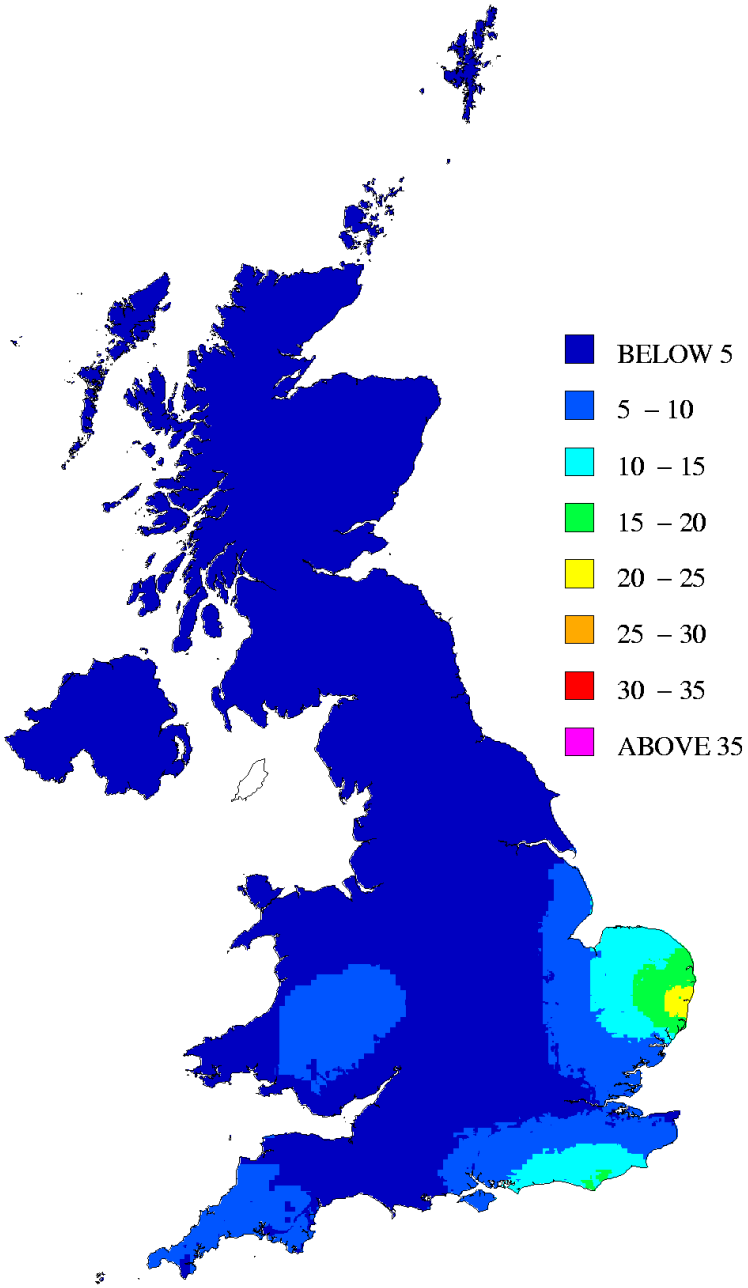
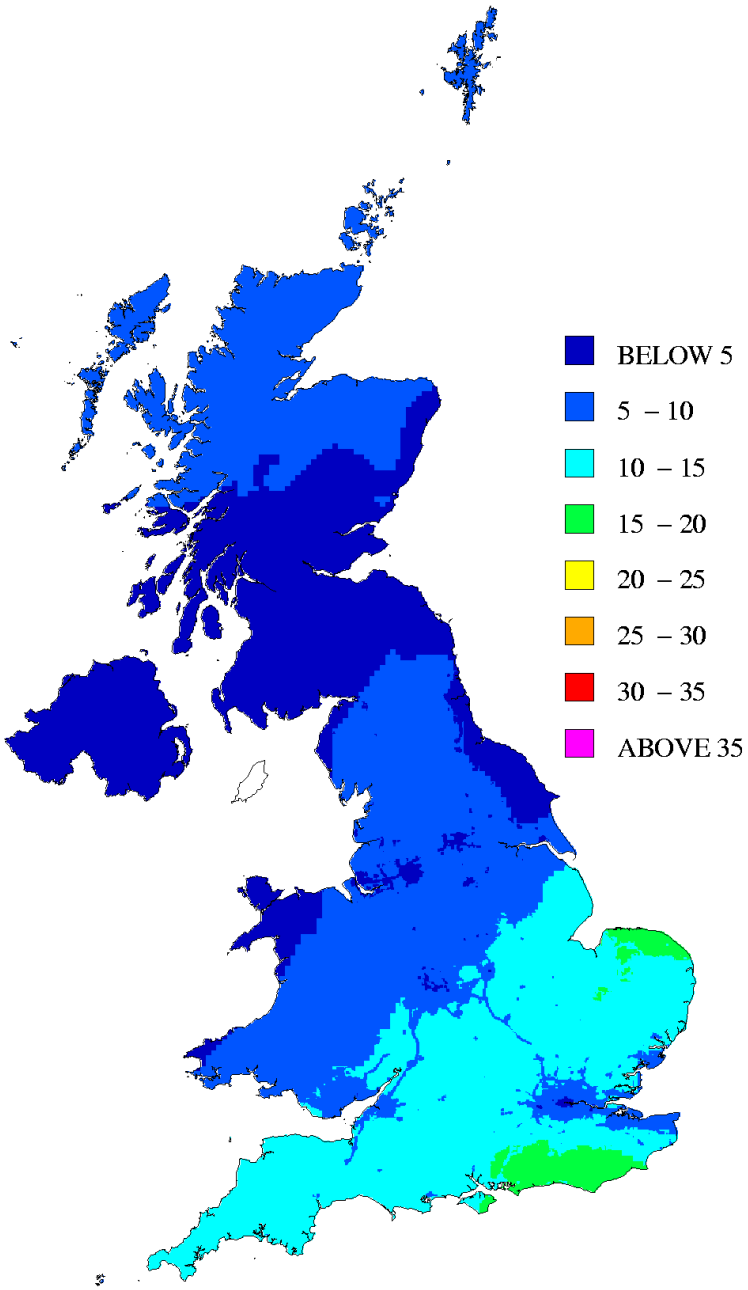


Figure 2.4 Estimated average number of days above 120 μgm^{-3}, 2003 to 2005



2.1.2 Verification of mapped number of days > 120 μg m^{-3} values

Figures 2.5 and 2.6 show comparisons of modelled and measured number of days with maximum daily 8-hour mean ozone concentrations greater than 120 μg m^{-3} in 2005 and averaged 2003-5 at background locations. Both the national network sites used to calibrate the models and the verification sites are shown. Lines representing y = x – 50 % and y = x + 50% are also shown (this is the AQDD3 data quality objective for modelled ozone concentrations).

Figure 2.5 Verification of background number of days > 120 μg m^{-3} model 2005

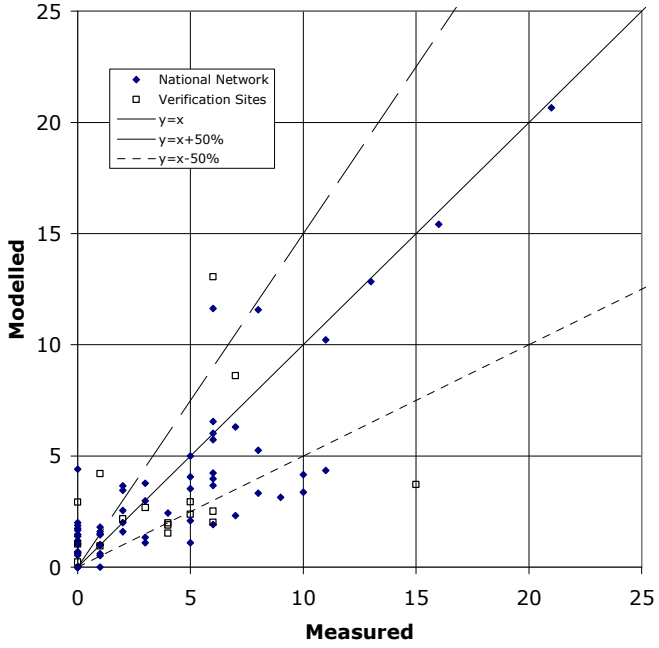


Figure 2.6 Verification of background number of days > 120 μg m^{-3} model 2003 – 2005

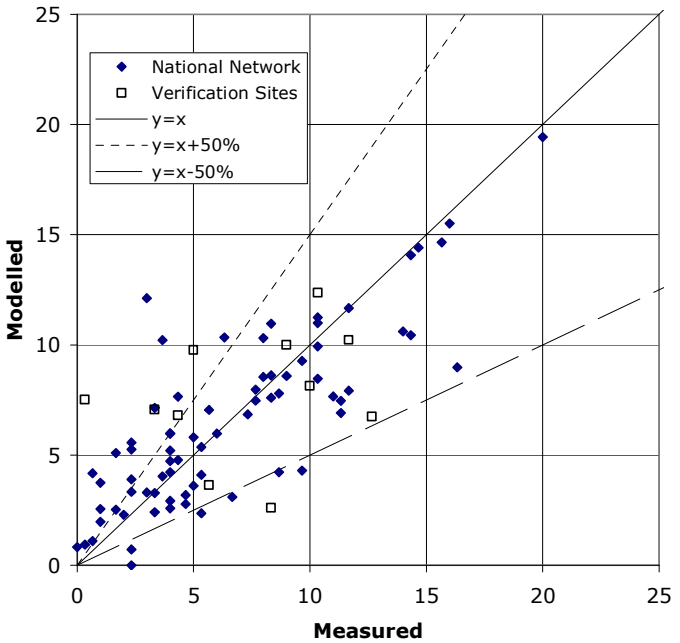


Figure 2.5 illustrates that in general, the model under predicts the number of days greater than 120 μg m^{-3} for 2005 although there are also several sites at which the model identifies days greater than 120 μg m^{-3} where none were recorded. Figure 2.6 shows the same metric averaged between 2003 and 2005. This shows a better model agreement with the corresponding measured results although there is a slight over prediction at the lower end of the scale.

Summary statistics for the comparison of modelled and measured ozone concentrations are listed in Table 2.1. These data show that on average there is good agreement between the modelled and measured data, although there is some degree of scatter in the model predictions.

Table 2.1 Summary statistics for comparison between modelled and measured number of days exceeding 120 μg m^{-3} as a maximum daily 8-hour mean

		Mean of measurements (days)	Mean of model estimates (days)	r^2	% outside data quality objectives	No. sites
National Network	2005	3.4	3.0	0.73	38	73
Verification Sites	2005	4.1	3.2	0.12	65	17
National Network	2003-5	6.5	6.5	0.67	34	73
Verification Sites	2003-5	7.3	7.1	0.06	45	11

2.1.3 Detailed comparison of model results with Target Values and Long-term Objectives

The modelling results, in terms of a comparison of modelled concentrations with the TV and LTO by zone, are summarised in Table 3.3. These data have also been presented in form 19g of the questionnaire. Method D in this table refers to the modelling method described in this report.

Estimates of area and population exposed have been derived from the background maps only.

Table 2.2 Tabular results of and methods used for supplementary assessment (1999/30/EC Article 7(3) and Annex VIII(II), 2000/69/EC Article 5(3) and Annex VI(II) and 2002/3/EC Article 9(1) and Annex VII(II))

		Above TV for health				*Above LTO for health*			
		Area		*Population exposed*		*Area*		*Population exposed*	
Zone	*Zone code*	*km²*	*Method*	*Number*	*Method*	*km²*	*Method*	*Number*	*Method*
Greater London Urban Area	UK0001	0	D	0	D	1617	D	7728198	D
West Midlands Urban Area	UK0002	0	D	0	D	594	D	2083891	D
Greater Manchester Urban Area	UK0003	0	D	0	D	557	D	1846479	D
West Yorkshire Urban Area	UK0004	0	D	0	D	363	D	1150737	D
Tyneside	UK0005	0	D	0	D	217	D	714326	D
Liverpool Urban Area	UK0006	0	D	0	D	184	D	696998	D
Sheffield Urban Area	UK0007	0	D	0	D	165	D	521984	D
Nottingham Urban Area	UK0008	0	D	0	D	169	D	558935	D
Bristol Urban Area	UK0009	0	D	0	D	142	D	488798	D
Brighton/Worthing/Littlehampton	UK0010	0	D	0	D	97	D	386373	D
Leicester Urban Area	UK0011	0	D	0	D	102	D	374314	D
Portsmouth Urban Area	UK0012	0	D	0	D	91	D	354964	D
Teesside Urban Area	UK0013	0	D	0	D	111	D	298093	D
The Potteries	UK0014	0	D	0	D	91	D	266188	D
Bournemouth Urban Area	UK0015	0	D	0	D	113	D	338103	D
Reading/Wokingham Urban Area	UK0016	0	D	0	D	97	D	305786	D
Coventry/Bedworth	UK0017	0	D	0	D	76	D	277475	D
Kingston upon Hull	UK0018	0	D	0	D	80	D	260201	D
Southampton Urban Area	UK0019	0	D	0	D	77	D	262379	D
Birkenhead Urban Area	UK0020	0	D	0	D	88	D	265019	D
Southend Urban Area	UK0021	0	D	0	D	64	D	217874	D
Blackpool Urban Area	UK0022	0	D	0	D	63	D	212909	D
Preston Urban Area	UK0023	0	D	0	D	58	D	180687	D
Glasgow Urban Area	UK0024	0	D	0	D	366	D	1083323	D
Edinburgh Urban Area	UK0025	0	D	0	D	117	D	428762	D
Cardiff Urban Area	UK0026	0	D	0	D	72	D	261383	D
Swansea Urban Area	UK0027	0	D	0	D	84	D	190040	D
Belfast Urban Area	UK0028	0	D	0	D	193	D	513811	D
Eastern	UK0029	0	D	0	D	19113	D	4903503	D
South West	UK0030	0	D	0	D	23506	D	4035009	D
South East	UK0031	0	D	0	D	18645	D	6157547	D
East Midlands	UK0032	0	D	0	D	15491	D	3261288	D
North West & Merseyside	UK0033	0	D	0	D	13149	D	3469390	D
Yorkshire & Humberside	UK0034	0	D	0	D	14787	D	3003552	D
West Midlands	UK0035	0	D	0	D	12192	D	2624016	D
North East	UK0036	0	D	0	D	8282	D	1443387	D
Central Scotland	UK0037	0	D	0	D	9314	D	1875411	D
North East Scotland	UK0038	0	D	0	D	18595	D	972129	D
Highland	UK0039	0	D	0	D	38404	D	334226	D
Scottish Borders	UK0040	0	D	0	D	11145	D	250175	D
South Wales	UK0041	0	D	0	D	12221	D	1696999	D
North Wales	UK0042	0	D	0	D	8368	D	702304	D
Northern Ireland	UK0043	0	D	0	D	8066	D	726508	D

2.2 MODELLING THE AOT40 VEGETATION METRIC

2.2.1 AOT40 methodology

Annex I of the Directive describes AOT40 (expressed in (µg m^{-3})·hours) as the sum of the difference between hourly concentrations greater than 80 µg m^{-3} (= 40 parts per billion) and 80 µg m^{-3} over a given period using only the 1 hour values measured between 8:00 and 20:00 Central European Time each day May to July.

The AOT40 vegetation metrics for 2005 and the averaged metric 2001-2005 were calculated from measured data at rural monitoring stations in the AURN during the "well-mixed" period of the day (hours 1200 UTC to 1800 UTC).

To derive an estimate of the AOT40 for the timeframe specified by the Directive, the "well-mixed" metrics from the rural AURN stations were interpolated at a 1 x 1 km^2 resolution throughout the UK. The resultant maps of AOT40 were then adjusted to take account of the diurnal cycle in ozone concentrations using a variable ΔO_3, where ΔO_3 describes the difference between the AOT40 "well-mixed" and that between 0800 UTC and 2000 UTC during 2005[11]. For the purposes of this study the components of ΔO_3 are described as follows and were derived from measured values in 2005 for the single year metric and 2001-2005 for the multi-year metric;

$$\Delta O_{3\ 2005} = 0.00021.\text{altitude} + 1.4504$$

$$\Delta O_{3\ 2001\text{-}5} = 0.00044.\text{altitude} + 1.4229$$

An urban influence term UI was subsequently defined for monitoring stations in the AURN and the interpolated rural map to correct for the depletion of ozone in areas close to sources of NO. As for the days above 120 µg m^{-3} metric, UI is closely related to annual mean NOx concentration, and has been defined in a similar fashion. The relationship between UI and empirically modelled NOx concentrations for 2005 and 2001-2005 averaged metrics is presented in Figures 2.6 and 2.7 below.

UI is then used to correct the interpolated rural "well-mixed" AOT40 maps;

$$\text{Corrected AOT40 map} = \text{interpolated rural map} * (1 - \text{UI})$$

Maps of modelled AOT40 for comparison with the Long-term Objective (2005) and Target Value (averaged 2001 to 2005) are presented in Figures 2.8 and 2.9.

[11] Coyle M, Smith R, Stedman J, Weston K and Fowler D, 2002. Quantifying the spatial distribution of surface ozone concentration in the UK. Atmospheric Environment, 36 (2002) 1013-1024.

Figure 2.7 Relationship between UI and NOx concentration in 2005 for the AOT40 metric

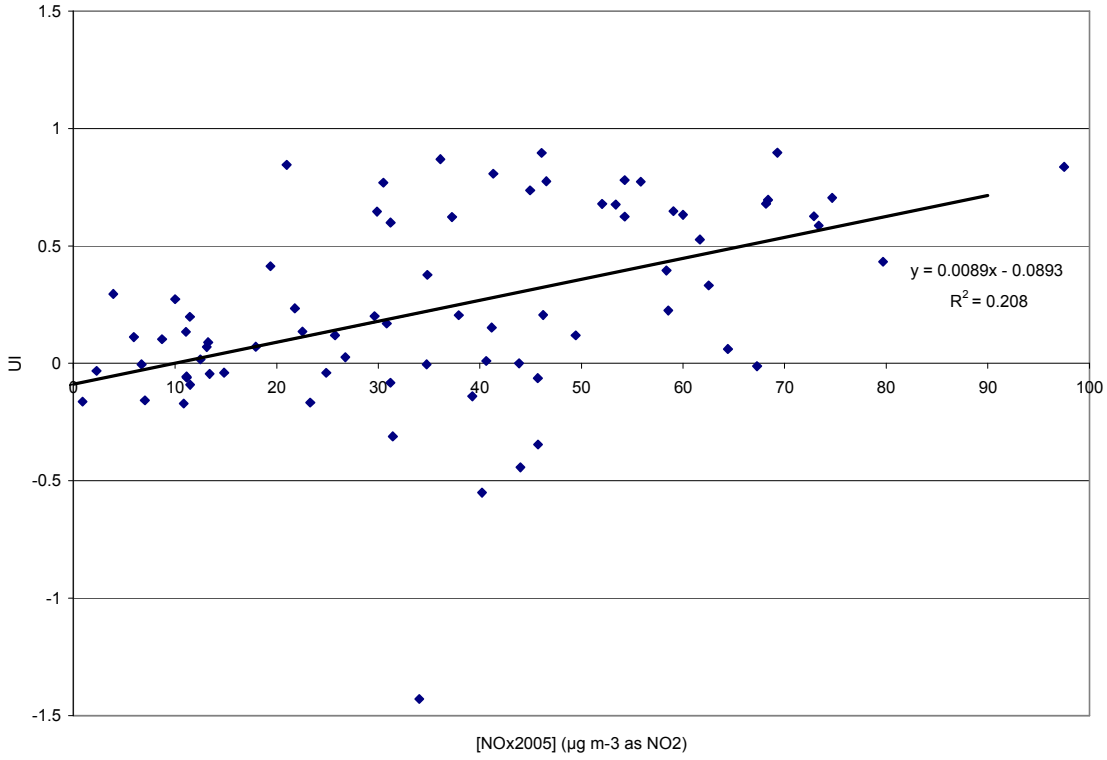


Figure 2.8 Relationship between UI and NOx concentration in 2001 - 2005 for the AOT40 metric

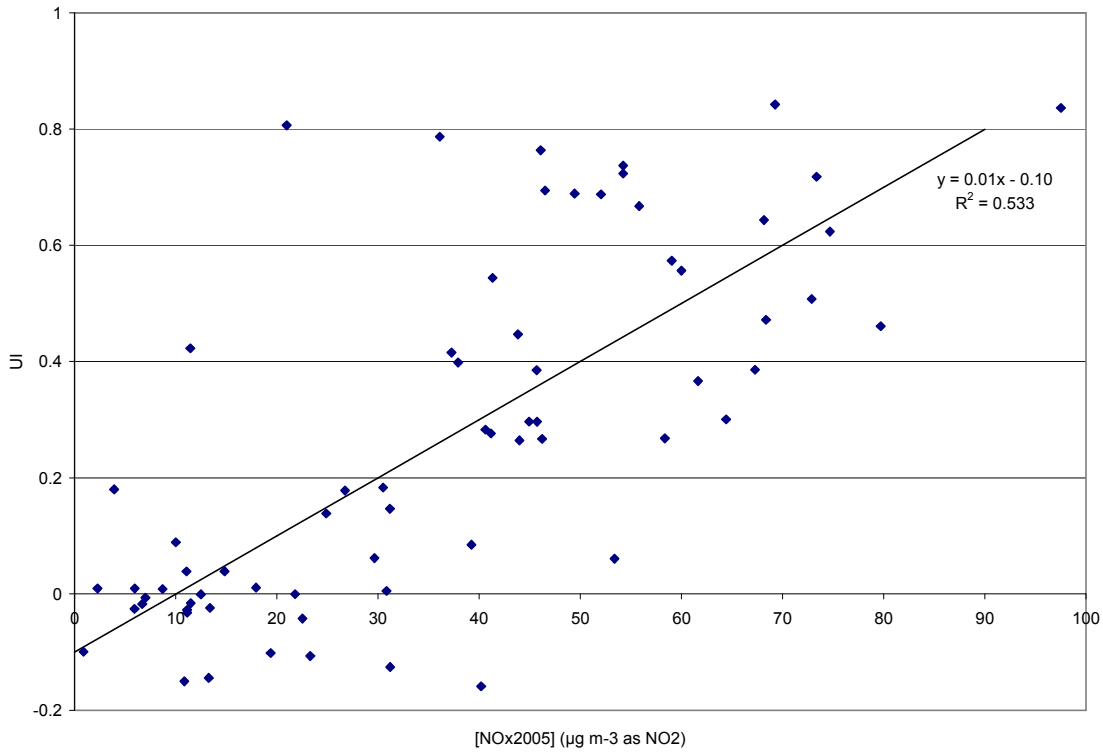


Figure 2.9 Estimated AOT40 vegetation metric, 2005 (μg m^{-3}.hours)

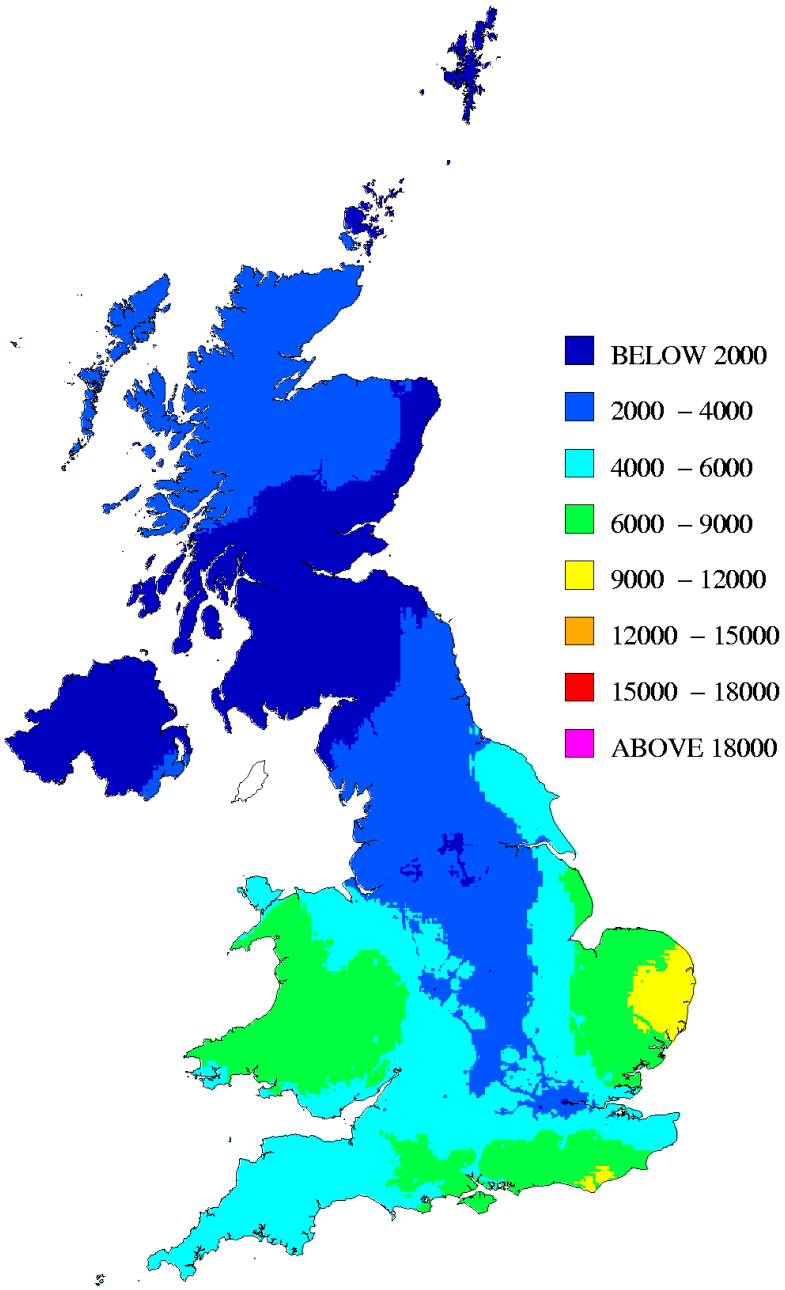
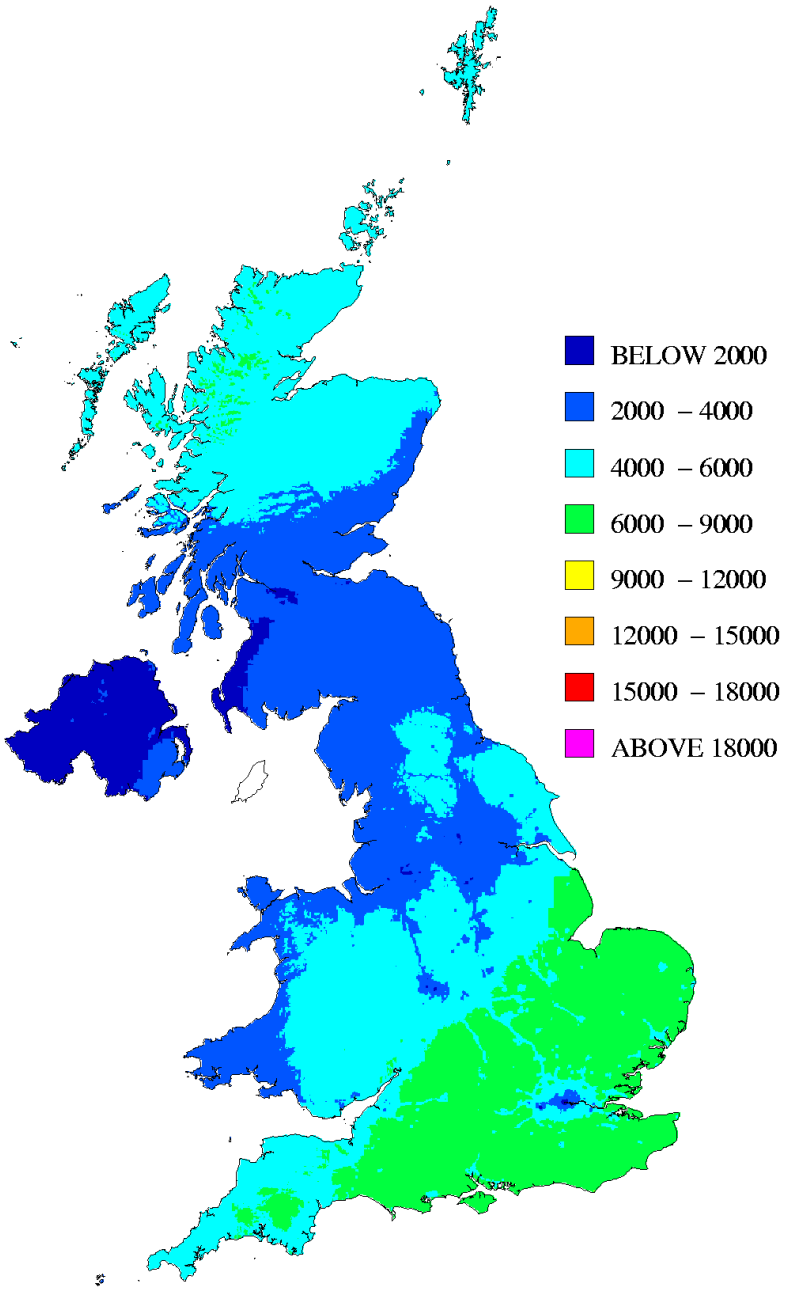


Figure 2.10 Estimated AOT40 vegetation metric, averaged 2001 – 2005 (μg m^{-3}.hours)



2.2.2 Verification of mapped AOT40 values

Figures 2.11 and 2.12 show comparisons of modelled and measured AOT40 metrics in 2005 and averaged 2001-5 at background locations. Both the national network sites used to calibrate the models and the verification sites are shown. Lines representing y = x – 50 % and y = x + 50% are also shown (this is the AQDD3 data quality objective for modelled ozone concentrations).

Figure 2.11 Verification of background AOT40 vegetation model, 2005

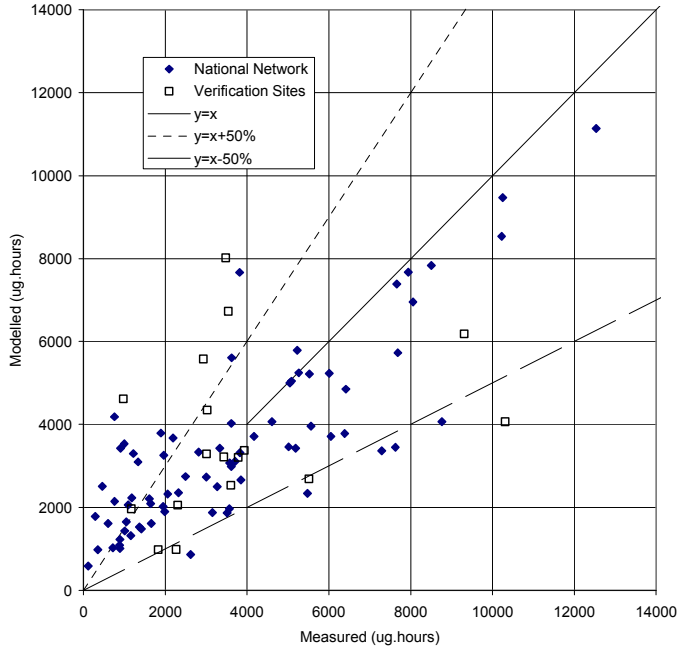
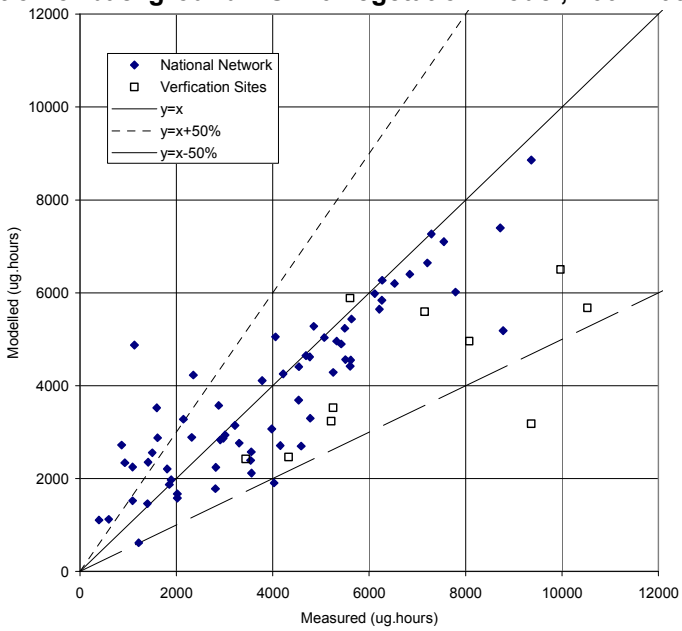


Figure 2.12 Verification of background AOT40 vegetation model, 2001-2005



Both Figures 2.11 and 2.12 show some over prediction by the models in the lower ranges. This is more prevalent in the AOT40 for 2005 than the 2001-2005 averaged AOT40 metric. These sites are all urban sites which are not best represented by the model.

Summary statistics for the comparison between modelled and measured ozone concentrations are listed in Table 2.3. As for the modelled days above 120 μg m^{-3} metric, Table 2.3 indicates that on average the modelled and measured data compare well although the scatter in the relationship is large.

Table 2.3 Summary statistics for comparison between modelled and measured AOT40 vegetation metric

		Mean of measurements (μg.hours)	Mean of model estimates (μg.hours)	r^2	% outside data quality objectives	No. sites
National Network	2005	3650	3501	0.68	32	75
Verification Sites	2005	3790	3754	0.10	47	17
National Network	2001-5	3980	3825	0.76	19	67
Verification Sites	2001-5	5743	4345	0.42	8	12

2.2.3 Detailed comparison of model results with Target Values and Long-term Objectives

The modelling results, in terms of a comparison of modelled concentrations with the Target Value by zone, are summarised in Table 2.4. These data have also been presented in form 19g of the questionnaire. Method D in this table refers to the modelling method described in this report.

Estimates of area and population exposed have been derived from the background maps only.

Table 2.4 Tabular results of and methods used for supplementary assessment (1999/30/EC Article 7(3) and Annex VIII(II), 2000/69/EC Article 5(3) and Annex VI(II) and 2002/3/EC Article 9(1) and Annex VII(II))

		Above TV for ecosystems				*Above LTO for ecosystems*			
		Area		*Ecosystem area exposed*		*Area*		*Ecosystem area exposed*	
Zone	*Zone code*	*km^2*	*Method*	*km^2*	*Method*	*km^2*	*Method*	*km^2*	*Method*
Greater London Urban Area	UK0001	1	D	0	D	0	D	0	D
West Midlands Urban Area	UK0002	0	D	0	D	0	D	0	D
Greater Manchester Urban Area	UK0003	0	D	0	D	0	D	0	D
West Yorkshire Urban Area	UK0004	0	D	0	D	0	D	0	D
Tyneside	UK0005	0	D	0	D	0	D	0	D
Liverpool Urban Area	UK0006	0	D	0	D	0	D	0	D
Sheffield Urban Area	UK0007	0	D	0	D	0	D	0	D
Nottingham Urban Area	UK0008	0	D	0	D	0	D	0	D
Bristol Urban Area	UK0009	0	D	0	D	0	D	0	D
Brighton/Worthing/Littlehampton	UK0010	97	D	0	D	0	D	0	D
Leicester Urban Area	UK0011	0	D	0	D	0	D	0	D
Portsmouth Urban Area	UK0012	42	D	0	D	0	D	0	D
Teesside Urban Area	UK0013	0	D	0	D	0	D	0	D
The Potteries	UK0014	0	D	0	D	0	D	0	D
Bournemouth Urban Area	UK0015	30	D	0	D	0	D	0	D
Reading/Wokingham Urban Area	UK0016	0	D	0	D	0	D	0	D
Coventry/Bedworth	UK0017	0	D	0	D	0	D	0	D
Kingston upon Hull	UK0018	0	D	0	D	0	D	0	D
Southampton Urban Area	UK0019	2	D	0	D	0	D	0	D
Birkenhead Urban Area	UK0020	0	D	0	D	0	D	0	D
Southend Urban Area	UK0021	0	D	0	D	0	D	0	D
Blackpool Urban Area	UK0022	0	D	0	D	0	D	0	D
Preston Urban Area	UK0023	0	D	0	D	0	D	0	D

Glasgow Urban Area	UK0024	0	D	0	D	0	D	0	D
Edinburgh Urban Area	UK0025	0	D	0	D	0	D	0	D
Cardiff Urban Area	UK0026	0	D	0	D	0	D	0	D
Swansea Urban Area	UK0027	19	D	0	D	0	D	0	D
Belfast Urban Area	UK0028	0	D	0	D	0	D	0	D
Eastern	UK0029	13318	D	4872	D	0	D	0	D
South West	UK0030	2212	D	880	D	0	D	0	D
South East	UK0031	7891	D	1131	D	0	D	0	D
East Midlands	UK0032	1105	D	519	D	0	D	0	D
North West & Merseyside	UK0033	0	D	0	D	0	D	0	D
Yorkshire & Humberside	UK0034	4	D	4	D	0	D	0	D
West Midlands	UK0035	4684	D	2941	D	0	D	0	D
North East	UK0036	0	D	0	D	0	D	0	D
Central Scotland	UK0037	0	D	0	D	0	D	0	D
North East Scotland	UK0038	0	D	0	D	0	D	0	D
Highland	UK0039	0	D	0	D	0	D	0	D
Scottish Borders	UK0040	0	D	0	D	0	D	0	D
South Wales	UK0041	10036	D	6851	D	0	D	0	D
North Wales	UK0042	4528	D	3512	D	0	D	0	D
Northern Ireland	UK0043	0	D	0	D	0	D	0	D

3 Lists of zones in relation to Target Values and Long-term Objectives

3.1 RESULTS FOR 2005

Table 3.1 presented in this section is from form 9 of the questionnaire – Table 3.1a presents the data for the UK and Table 3.1b presents the same information for Gibraltar. Exceedence (or otherwise) of the Target value and Long-term Objective where this exists are indicated by a 'y' for measured exceedences and with an 'm' for modelled exceedences. If both measurements and model estimates show that a threshold has been exceeded then the measurements are regarded as the primary basis for compliance status and 'y' is therefore used. An 'm' in the columns marked >TV, ≤TV; >LTO indicates that modelled concentrations were higher than measured concentrations or on rare occasions that measurements were not available for that zone and modelled values were therefore used. Modelled concentration may be higher than measured concentrations because the modelling studies provide estimates of concentrations over the entire zone. It is possible that the locations of the monitoring sites do not correspond to the location of the highest concentration in the zone. An 'm' in the columns marked ≤LTO indicates that measurements were not available for that zone and modelled values were therefore used.

The results are summarised in Tables 3.2 and 3.3 in terms of exceedences of Target Values (TV) and Long-term Objectives (LTO).

Table 3.1a Form 9 List of zones and agglomerations in the UK where levels exceed or do not exceed Target Values or Long-term Objective

		Thresholds for health			*Thresholds for vegetation*		
Zone	*Zone code*	*>TV*	*≤TV; >LTO*	*≤LTO*	*>TV*	*≤TV; >LTO*	*≤LTO*
Greater London Urban Area	UK0001		y			y	
West Midlands Urban Area	UK0002		y				y
Greater Manchester Urban Area	UK0003		m				y
West Yorkshire Urban Area	UK0004		m				y
Tyneside	UK0005		m				y
Liverpool Urban Area	UK0006		m				y
Sheffield Urban Area	UK0007		m				y
Nottingham Urban Area	UK0008		m				y
Bristol Urban Area	UK0009		m				m
Brighton/Worthing/Littlehampton	UK0010		y			y	
Leicester Urban Area	UK0011		y				y
Portsmouth Urban Area	UK0012		y			y	
Teesside Urban Area	UK0013		m				y
The Potteries	UK0014		m				y
Bournemouth Urban Area	UK0015		y			y	
Reading/Wokingham Urban Area	UK0016		y			y	
Coventry/Bedworth	UK0017		y				y
Kingston upon Hull	UK0018		y				y
Southampton Urban Area	UK0019		m			m	
Birkenhead Urban Area	UK0020		m				m
Southend Urban Area	UK0021		y			y	
Blackpool Urban Area	UK0022		m				m
Preston Urban Area	UK0023		y				y
Glasgow Urban Area	UK0024			y			y
Edinburgh Urban Area	UK0025			y			y
Cardiff Urban Area	UK0026		m				m
Swansea Urban Area	UK0027		y			m	
Belfast Urban Area	UK0028			y			y
Eastern	UK0029		y			y	
South West	UK0030		y			m	
South East	UK0031		y			y	
East Midlands	UK0032		y			m	
North West & Merseyside	UK0033		y				y
Yorkshire & Humberside	UK0034		y			m	
West Midlands	UK0035		m			m	
North East	UK0036		m				y
Central Scotland	UK0037			y			y
North East Scotland	UK0038			y			y
Highland	UK0039		y				y
Scottish Borders	UK0040			y			y
South Wales	UK0041		y			m	
North Wales	UK0042		y			y	
Northern Ireland	UK0043		y				y

Table 3.1b Form 9 List of zones and agglomerations in Gibraltar where levels exceed or do not exceed Target Values or Long-term Objective

		Thresholds for health			*Thresholds for vegetation*		
Zone	*Zone code*	*>TV*	*≤TV; >LTO*	*≤LTO*	*>TV*	*≤TV; >LTO*	*≤LTO*
Gibraltar	UK(GIB)		y			y	

Table 3.2 Summary results of air quality assessment relative to the Target Values for ozone for 2010

Target Value	*Number of zones exceeding*
Max Daily 8-hour mean Target Value	none
AOT40 Target Value	none

Table 3.3 Summary results of air quality assessment relative to the Long-term Objectives for ozone

Long-term Objective	*Number of zones exceeding*
Max Daily 8-hour mean Long-term Objective	32 zones (22 measured + 15 modelled)
AOT40 Long-term Objective	16 zones (9 measured + 7 modelled)

3.2 MEASURED EXCEEDENCES OF TARGET VALUES AND LONG-TERM OBJECTIVES

Forms 13a-c of the questionnaire requires reasons associated with the measured exceedences of the LTO, Alert Threshold and Information Threshold to be documented. This information is summarised in Tables 3.4 to 3.6 for monitoring stations in the UK at which exceedences of the LTO, Alert and Information Thresholds were measured. Measured annual statistics for ozone are presented in form 15 of the questionnaire (see Table 3.7). Forms 14a-b relate to measured exceedence of the TVs of which there are none. Where measured exceedences in Gibraltar have been recorded in 2005, these details appear in a separate table (e.g.Table 3.6b and Table 3.7b) from the UK data.

The Reason Code ‘S10’ refers to the ‘Transport of air pollution originating from sources outside the Member State’.

Table 3.4 Form 13a Individual exceedences of ozone thresholds (2002/3/EC, Article 10(2b) and Annex III)

- Form 13a Exceedence of ozone information threshold value									
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Max 1-hour mean ozone concentration (µg/m^3) during exceedence period*	*Reason code(s)*	*Starting time of the exceedence period*	*Total number of exceedence hours*	*1-hour mean NO_2 concentration (µg/m^3) during maximum ozone concentration*
London Bexley	UK0001	GB0608A	6	23	192	S10	17	2	11
London Bexley	UK0001	GB0608A	6	23	184	S10	18	1	11
London Brent	UK0001	GB0616A	5	27	188	S10	18	1	
London Eltham	UK0001	GB0586A	5	27	182	S10	18	1	11
London Haringey	UK0001	GB0638A	5	27	190	S10	18	1	
London Haringey	UK0001	GB0638A	6	23	192	S10	14	1	
London Teddington	UK0001	GB0644A	5	27	186	S10	17	2	6.9
London Teddington	UK0001	GB0644A	5	27	186	S10	18	1	6.9
Lullington Heath	UK0031	GB0038R	5	27	202	S10	13	5	6.7
Lullington Heath	UK0031	GB0038R	5	27	202	S10	14	4	6.7
Lullington Heath	UK0031	GB0038R	5	27	202	S10	15	3	6.7
Lullington Heath	UK0031	GB0038R	5	27	202	S10	16	2	6.7
Lullington Heath	UK0031	GB0038R	5	27	196	S10	17	1	6.7
Lullington Heath	UK0031	GB0038R	8	31	182	S10	16	1	11.1
Portsmouth	UK0012	GB0733A	5	27	204	S10	16	2	25
Portsmouth	UK0012	GB0733A	5	27	186	S10	17	1	23
Reading New Town	UK0016	GB0840A	5	27	188	S10	19	1	13
Sibton	UK0029	GB0039R	6	23	190	S10	14	5	
Sibton	UK0029	GB0039R	6	23	190	S10	15	4	
Sibton	UK0029	GB0039R	6	23	184	S10	16	3	
Sibton	UK0029	GB0039R	6	23	184	S10	17	2	
Sibton	UK0029	GB0039R	6	23	184	S10	18	1	
Sibton	UK0029	GB0039R	6	24	186	S10	10	2	

- Form 13a Exceedence of ozone information threshold value									
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Max 1-hour mean ozone concentration ($\mu g/m^3$) during exceedence period*	*Reason code(s)*	*Starting time of the exceedence period*	*Total number of exceedence hours*	*1-hour mean NO_2 concentration ($\mu g/m^3$) during maximum ozone concentration*
Sibton	UK0029	GB0039R	6	24	186	S10	11	1	
Sibton	UK0029	GB0039R	6	24	190	S10	13	1	
St Osyth	UK0029	GB0754A	6	19	182	S10	17	1	15.1
St Osyth	UK0029	GB0754A	6	19	186	S10	19	1	13
Weybourne	UK0029	GB0745A	6	19	182	S10	23	1	
Weybourne	UK0029	GB0745A	6	24	184	S10	15	1	
Weybourne	UK0029	GB0745A	6	24	202	S10	19	5	
Weybourne	UK0029	GB0745A	6	24	202	S10	20	4	
Weybourne	UK0029	GB0745A	6	24	196	S10	21	3	
Weybourne	UK0029	GB0745A	6	24	192	S10	22	2	
Weybourne	UK0029	GB0745A	6	24	188	S10	23	1	

Table 3.5 Form 13b Individual exceedences of ozone thresholds (2002/3/EC, Article 10(2b) and Annex III)

- Form 13b Exceedence of ozone alert threshold value								
Zone code	*EoI station code*	*Month*	*Day of month*	*Maximum 1-hour mean ozone concentration ($\mu g/m^3$) during exceedence period*	*Reason code(s)*	*Starting time of the exceedence period*	*Total number of exceedence hours*	*1-hour mean NO_2 concentration ($\mu g/m^3$) during maximum ozone concentration*
No exceedences								

Table 3.6a UK - Form 13c Individual exceedences of ozone thresholds (2002/3/EC, Article 10(2b) and Annex III)

- Form 13c Exceedence of ozone Long-term Objective for health protection						
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Daily maximum8-hour mean concentration ($\mu g/m^3$)*	*Reason code(s)*
Aston Hill	UK0042	GB0031R	May	27	139	S10
Aston Hill	UK0042	GB0031R	May	28	128	S10
Aston Hill	UK0042	GB0031R	July	9	124	S10
Aston Hill	UK0042	GB0031R	July	11	121	S10
Aston Hill	UK0042	GB0031R	August	17	123	S10
Aston Hill	UK0042	GB0031R	August	18	123	S10
Aston Hill	UK0042	GB0031R	September	4	133	S10
Barnsley Gawber	UK0034	GB0681A	July	10	129	S10
Birmingham Centre	UK0002	GB0569A	May	27	123	S10
Birmingham Tyburn	UK0002	GB0851A	May	27	124	S10
Birmingham Tyburn	UK0002	GB0851A	July	10	127	S10
Bottesford	UK0032	GB0032R	June	19	122	S10
Bottesford	UK0032	GB0032R	July	14	132	S10
Bottesford	UK0032	GB0032R	August	18	137	S10
Bottesford	UK0032	GB0032R	August	31	133	S10
Bottesford	UK0032	GB0032R	September	4	127	S10
Bournemouth	UK0015	GB0741A	May	18	121	S10
Bournemouth	UK0015	GB0741A	May	27	142	S10
Bournemouth	UK0015	GB0741A	June	19	144	S10
Bournemouth	UK0015	GB0741A	June	23	141	S10
Bournemouth	UK0015	GB0741A	June	27	136	S10
Bournemouth	UK0015	GB0741A	June	28	143	S10
Bournemouth	UK0015	GB0741A	July	10	135	S10
Bournemouth	UK0015	GB0741A	July	11	130	S10
Bournemouth	UK0015	GB0741A	September	22	126	S10
Bournemouth	UK0015	GB0741A	September	23	121	S10
Brighton Preston Park	UK0010	GB0860A	May	27	162	S10
Brighton Preston Park	UK0010	GB0860A	June	19	128	S10
Brighton Preston Park	UK0010	GB0860A	June	23	140	S10
Brighton Preston Park	UK0010	GB0860A	June	24	125	S10
Brighton Preston Park	UK0010	GB0860A	June	28	139	S10
Brighton Preston Park	UK0010	GB0860A	July	17	133	S10
Brighton Preston Park	UK0010	GB0860A	August	30	137	S10
Brighton Preston Park	UK0010	GB0860A	August	31	132	S10
Coventry Memorial Park	UK0017	GB0739A	May	27	155	S10
Coventry Memorial Park	UK0017	GB0739A	May	28	135	S10
Coventry Memorial Park	UK0017	GB0739A	June	23	132	S10
Coventry Memorial Park	UK0017	GB0739A	July	10	126	S10
Coventry Memorial Park	UK0017	GB0739A	July	14	129	S10
Coventry Memorial Park	UK0017	GB0739A	August	18	129	S10
Coventry Memorial Park	UK0017	GB0739A	September	4	123	S10
Cwmbran	UK0041	GB0744A	May	27	122	S10

- Form 13c Exceedence of ozone Long-term Objective for health protection						
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Daily maximum8-hour mean concentration ($\mu g/m^3$)*	*Reason code(s)*
Cwmbran	UK0041	GB0744A	July	9	123	S10
Cwmbran	UK0041	GB0744A	July	10	124	S10
Great Dun Fell	UK0033	GB0035R	April	25	127	S10
Harwell	UK0031	GB0036R	May	27	140	S10
Harwell	UK0031	GB0036R	August	18	122	S10
High Muffles	UK0034	GB0014R	April	25	126	S10
High Muffles	UK0034	GB0014R	August	31	124	S10
Hull Freetown	UK0018	GB0776A	June	19	122	S10
Hull Freetown	UK0018	GB0776A	June	24	132	S10
Hull Freetown	UK0018	GB0776A	June	25	125	S10
Leicester Centre	UK0011	GB0597A	July	10	125	S10
Leicester Centre	UK0011	GB0597A	July	14	133	S10
Leicester Centre	UK0011	GB0597A	September	4	122	S10
London Bexley	UK0001	GB0608A	May	27	153	S10
London Bexley	UK0001	GB0608A	May	28	128	S10
London Bexley	UK0001	GB0608A	June	22	130	S10
London Bexley	UK0001	GB0608A	June	23	159	S10
London Bexley	UK0001	GB0608A	July	17	144	S10
London Bexley	UK0001	GB0608A	August	31	128	S10
London Bloomsbury	UK0001	GB0566A	July	17	130	S10
London Brent	UK0001	GB0616A	May	27	167	S10
London Brent	UK0001	GB0616A	May	28	140	S10
London Brent	UK0001	GB0616A	June	19	136	S10
London Brent	UK0001	GB0616A	June	22	129	S10
London Brent	UK0001	GB0616A	June	23	159	S10
London Brent	UK0001	GB0616A	July	14	124	S10
London Brent	UK0001	GB0616A	July	17	149	S10
London Brent	UK0001	GB0616A	August	31	147	S10
London Eltham	UK0001	GB0586A	May	27	158	S10
London Eltham	UK0001	GB0586A	May	28	131	S10
London Eltham	UK0001	GB0586A	June	22	131	S10
London Eltham	UK0001	GB0586A	June	23	167	S10
London Eltham	UK0001	GB0586A	July	17	147	S10
London Eltham	UK0001	GB0586A	August	31	141	S10
London Hackney	UK0001	GB0650A	May	27	121	S10
London Hackney	UK0001	GB0650A	June	23	122	S10
London Hackney	UK0001	GB0650A	July	17	123	S10
London Hackney	UK0001	GB0650A	August	31	141	S10
London Hackney	UK0001	GB0650A	September	4	143	S10
London Hackney	UK0001	GB0650A	September	7	126	S10
London Haringey	UK0001	GB0638A	May	27	167	S10
London Haringey	UK0001	GB0638A	May	28	142	S10
London Haringey	UK0001	GB0638A	June	19	142	S10
London Haringey	UK0001	GB0638A	June	22	137	S10
London Haringey	UK0001	GB0638A	June	23	171	S10

- Form 13c Exceedence of ozone Long-term Objective for health protection						
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Daily maximum8-hour mean concentration ($\mu g/m^3$)*	*Reason code(s)*
London Haringey	UK0001	GB0638A	July	14	138	S10
London Haringey	UK0001	GB0638A	July	17	162	S10
London Haringey	UK0001	GB0638A	August	18	123	S10
London Haringey	UK0001	GB0638A	August	31	153	S10
London Haringey	UK0001	GB0638A	September	4	129	S10
London Harlington	UK0001	GB0837A	May	27	138	S10
London Harlington	UK0001	GB0837A	June	19	121	S10
London Harlington	UK0001	GB0837A	June	23	141	S10
London Harlington	UK0001	GB0837A	July	17	123	S10
London Harlington	UK0001	GB0837A	August	31	129	S10
London Lewisham	UK0001	GB0672A	May	27	140	S10
London Lewisham	UK0001	GB0672A	June	23	140	S10
London Lewisham	UK0001	GB0672A	June	24	121	S10
London Lewisham	UK0001	GB0672A	July	10	124	S10
London Lewisham	UK0001	GB0672A	July	17	134	S10
London Lewisham	UK0001	GB0672A	August	31	137	S10
London N. Kensington	UK0001	GB0620A	May	27	155	S10
London N. Kensington	UK0001	GB0620A	May	28	130	S10
London N. Kensington	UK0001	GB0620A	June	19	130	S10
London N. Kensington	UK0001	GB0620A	June	23	146	S10
London N. Kensington	UK0001	GB0620A	July	17	136	S10
London N. Kensington	UK0001	GB0620A	August	31	134	S10
London Southwark	UK0001	GB0656A	May	27	123	S10
London Teddington	UK0001	GB0644A	May	27	169	S10
London Teddington	UK0001	GB0644A	May	28	143	S10
London Teddington	UK0001	GB0644A	June	19	140	S10
London Teddington	UK0001	GB0644A	June	23	156	S10
London Teddington	UK0001	GB0644A	July	13	121	S10
London Teddington	UK0001	GB0644A	July	14	121	S10
London Teddington	UK0001	GB0644A	July	17	140	S10
London Teddington	UK0001	GB0644A	August	17	125	S10
London Teddington	UK0001	GB0644A	August	18	121	S10
London Teddington	UK0001	GB0644A	August	31	152	S10
London Teddington	UK0001	GB0644A	September	4	129	S10
London Westminster	UK0001	GB0743A	May	27	146	S10
London Westminster	UK0001	GB0743A	May	28	128	S10
London Westminster	UK0001	GB0743A	June	23	136	S10
London Westminster	UK0001	GB0743A	July	17	137	S10
London Westminster	UK0001	GB0743A	August	31	123	S10
Lough Navar	UK0043	GB0006R	April	25	127	S10
Lullington Heath	UK0031	GB0038R	May	27	179	S10
Lullington Heath	UK0031	GB0038R	May	28	146	S10
Lullington Heath	UK0031	GB0038R	June	19	137	S10
Lullington Heath	UK0031	GB0038R	June	20	127	S10
Lullington Heath	UK0031	GB0038R	June	22	138	S10

- Form 13c Exceedence of ozone Long-term Objective for health protection						
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Daily maximum8-hour mean concentration ($\mu g/m^3$)*	*Reason code(s)*
Lullington Heath	UK0031	GB0038R	June	23	168	S10
Lullington Heath	UK0031	GB0038R	June	24	157	S10
Lullington Heath	UK0031	GB0038R	June	28	129	S10
Lullington Heath	UK0031	GB0038R	July	14	145	S10
Lullington Heath	UK0031	GB0038R	July	15	121	S10
Lullington Heath	UK0031	GB0038R	July	17	147	S10
Lullington Heath	UK0031	GB0038R	July	18	134	S10
Lullington Heath	UK0031	GB0038R	August	18	136	S10
Lullington Heath	UK0031	GB0038R	August	30	140	S10
Lullington Heath	UK0031	GB0038R	August	31	145	S10
Lullington Heath	UK0031	GB0038R	September	3	125	S10
Market Harborough	UK0032	GB0838A	May	27	129	S10
Market Harborough	UK0032	GB0838A	July	14	128	S10
Market Harborough	UK0032	GB0838A	August	18	128	S10
Northampton	UK0032	GB0738A	May	27	144	S10
Northampton	UK0032	GB0738A	May	28	122	S10
Northampton	UK0032	GB0738A	August	18	135	S10
Northampton	UK0032	GB0738A	September	4	127	S10
Norwich Centre	UK0029	GB0684A	June	19	141	S10
Norwich Centre	UK0029	GB0684A	June	20	141	S10
Norwich Centre	UK0029	GB0684A	June	23	147	S10
Norwich Centre	UK0029	GB0684A	June	24	136	S10
Norwich Centre	UK0029	GB0684A	August	18	128	S10
Norwich Centre	UK0029	GB0684A	August	31	127	S10
Port Talbot	UK0027	GB0651A	July	10	122	S10
Port Talbot	UK0027	GB0651A	August	31	123	S10
Portsmouth	UK0012	GB0733A	May	27	162	S10
Portsmouth	UK0012	GB0733A	June	19	147	S10
Portsmouth	UK0012	GB0733A	June	23	128	S10
Portsmouth	UK0012	GB0733A	June	27	121	S10
Portsmouth	UK0012	GB0733A	July	10	126	S10
Portsmouth	UK0012	GB0733A	July	17	136	S10
Preston	UK0023	GB0731A	April	24	122	S10
Reading New Town	UK0016	GB0840A	May	27	168	S10
Reading New Town	UK0016	GB0840A	May	28	131	S10
Reading New Town	UK0016	GB0840A	June	19	126	S10
Reading New Town	UK0016	GB0840A	June	23	124	S10
Reading New Town	UK0016	GB0840A	July	17	135	S10
Reading New Town	UK0016	GB0840A	August	17	134	S10
Reading New Town	UK0016	GB0840A	August	18	134	S10
Reading New Town	UK0016	GB0840A	August	31	131	S10
Reading New Town	UK0016	GB0840A	September	4	124	S10
Rochester	UK0031	GB0617A	May	27	151	S10
Rochester	UK0031	GB0617A	June	19	123	S10
Rochester	UK0031	GB0617A	June	22	137	S10

- Form 13c Exceedence of ozone Long-term Objective for health protection						
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Daily maximum8-hour mean concentration ($\mu g/m^3$)*	*Reason code(s)*
Rochester	UK0031	GB0617A	June	23	123	S10
Rochester	UK0031	GB0617A	July	17	125	S10
Rochester	UK0031	GB0617A	August	31	140	S10
Sandwell West Bromwich	UK0002	GB0698A	July	10	124	S10
Sibton	UK0029	GB0039R	March	6	129	S10
Sibton	UK0029	GB0039R	April	3	133	S10
Sibton	UK0029	GB0039R	April	7	129	S10
Sibton	UK0029	GB0039R	April	8	145	S10
Sibton	UK0029	GB0039R	April	9	142	S10
Sibton	UK0029	GB0039R	April	22	139	S10
Sibton	UK0029	GB0039R	April	23	137	S10
Sibton	UK0029	GB0039R	April	29	131	S10
Sibton	UK0029	GB0039R	May	4	133	S10
Sibton	UK0029	GB0039R	May	5	127	S10
Sibton	UK0029	GB0039R	May	11	127	S10
Sibton	UK0029	GB0039R	June	19	167	S10
Sibton	UK0029	GB0039R	June	20	154	S10
Sibton	UK0029	GB0039R	June	22	147	S10
Sibton	UK0029	GB0039R	June	23	177	S10
Sibton	UK0029	GB0039R	June	24	168	S10
Sibton	UK0029	GB0039R	June	25	121	S10
Sibton	UK0029	GB0039R	July	17	122	S10
Sibton	UK0029	GB0039R	August	18	143	S10
Sibton	UK0029	GB0039R	August	31	148	S10
Sibton	UK0029	GB0039R	September	1	128	S10
Somerton	UK0030	GB0044R	May	27	126	S10
Somerton	UK0030	GB0044R	August	18	122	S10
Southend-on-Sea	UK0021	GB0728A	May	27	139	S10
Southend-on-Sea	UK0021	GB0728A	May	28	121	S10
Southend-on-Sea	UK0021	GB0728A	June	19	138	S10
Southend-on-Sea	UK0021	GB0728A	June	22	137	S10
Southend-on-Sea	UK0021	GB0728A	June	23	149	S10
Southend-on-Sea	UK0021	GB0728A	July	15	121	S10
Southend-on-Sea	UK0021	GB0728A	July	17	148	S10
Southend-on-Sea	UK0021	GB0728A	August	31	129	S10
St Osyth	UK0029	GB0754A	June	19	164	S10
St Osyth	UK0029	GB0754A	June	20	126	S10
St Osyth	UK0029	GB0754A	June	23	141	S10
St Osyth	UK0029	GB0754A	June	24	148	S10
St Osyth	UK0029	GB0754A	July	17	122	S10
St Osyth	UK0029	GB0754A	August	31	132	S10
Strath Vaich	UK0039	GB0015R	April	26	122	S10
Thurrock	UK0029	GB0645A	May	27	145	S10
Thurrock	UK0029	GB0645A	May	28	127	S10
Thurrock	UK0029	GB0645A	June	22	127	S10

- Form 13c Exceedence of ozone Long-term Objective for health protection						
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Daily maximum8-hour mean concentration ($\mu g/m^3$)*	*Reason code(s)*
Thurrock	UK0029	GB0645A	June	23	150	S10
Thurrock	UK0029	GB0645A	July	17	139	S10
Weybourne	UK0029	GB0745A	May	4	122	S10
Weybourne	UK0029	GB0745A	May	27	131	S10
Weybourne	UK0029	GB0745A	May	28	129	S10
Weybourne	UK0029	GB0745A	June	19	158	S10
Weybourne	UK0029	GB0745A	June	20	164	S10
Weybourne	UK0029	GB0745A	June	22	126	S10
Weybourne	UK0029	GB0745A	June	23	153	S10
Weybourne	UK0029	GB0745A	June	24	188	S10
Weybourne	UK0029	GB0745A	June	25	188	S10
Weybourne	UK0029	GB0745A	July	10	122	S10
Weybourne	UK0029	GB0745A	August	31	161	S10
Weybourne	UK0029	GB0745A	September	1	141	S10
Weybourne	UK0029	GB0745A	September	22	131	S10
Wicken Fen	UK0029	GB0045R	May	27	133	S10
Wicken Fen	UK0029	GB0045R	June	19	148	S10
Wicken Fen	UK0029	GB0045R	June	20	142	S10
Wicken Fen	UK0029	GB0045R	June	22	131	S10
Wicken Fen	UK0029	GB0045R	June	23	128	S10
Wicken Fen	UK0029	GB0045R	July	14	157	S10
Wicken Fen	UK0029	GB0045R	July	17	127	S10
Wicken Fen	UK0029	GB0045R	August	17	127	S10
Wicken Fen	UK0029	GB0045R	August	18	149	S10
Wicken Fen	UK0029	GB0045R	August	31	165	S10
Wicken Fen	UK0029	GB0045R	September	4	127	S10
Wolverhampton Centre	UK0002	GB0614A	May	27	121	S10
Yarner Wood	UK0030	GB0013R	June	28	132	S10
Yarner Wood	UK0030	GB0013R	July	9	123	S10
Yarner Wood	UK0030	GB0013R	July	10	124	S10
Yarner Wood	UK0030	GB0013R	July	11	133	S10
Yarner Wood	UK0030	GB0013R	September	3	124	S10

Table 3.6b Gibraltar - Form 13c Individual exceedences of ozone thresholds (2002/3/EC, Article 10(2b) and Annex III)

- Form 13c Exceedence of ozone Long-term Objective for health protection						
Station name	*Zone code*	*EoI station code*	*Month*	*Day of month*	*Daily maximum8-hour mean concentration ($\mu g/m^3$)*	*Reason code(s)*
Gibraltar Bleak House	UK(GIB)	GB0051A	April	5	122	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	April	12	123	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	April	13	122	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	May	20	132	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	May	25	122	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	May	26	126	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	May	28	128	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	May	29	129	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	June	2	124	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	June	3	121	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	June	4	131	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	June	11	131	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	June	15	140	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	June	19	139	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	June	20	133	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	July	2	122	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	July	14	121	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	July	15	124	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	July	19	129	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	June	19	139	S10

Table 3.7a UK - Form 15 Annual statistics of ozone (2002/3/EC, Article 10(2b) and Annex III)

Form 15 Annual statistics of ozone (2002/3/EC, Article 10(2b) and Annex III)							
			AOT40 for vegetation protection ($\mu g/m^3.h$)		*AOT40 for forest protection ($\mu g/m^3.h$)*		
Station name	*Zone code*	*EoI station code*	*Value*	*Number of valid data*	*Value*	*Number of valid data*	*Annual average*
Aberdeen	UK0038	GB0729A	1158	1104	2991	2152	50
Aston Hill	UK0042	GB0031R	8053	1093	13874	2152	70
Barnsley Gawber	UK0034	GB0681A	1987	1049	3516	2064	43
Belfast Centre	UK0028	GB0567A	355	960	892	2020	40
Birmingham Centre	UK0002	GB0569A	1946	1016	2767	2020	40
Birmingham Tyburn	UK0002	GB0851A	3848	1093	5842	2152	41
Bolton	UK0003	GB0654A	1095	1082	2170	2130	41
Bottesford	UK0032	GB0032R	4171	1082	7727	2174	47
Bournemouth	UK0015	GB0741A	7685	1093	11277	2152	51
Bradford Centre	UK0004	GB0689A	288	1060	463	1954	35
Brighton Preston Park	UK0010	GB0860A	7942	1093	12319	2152	51
Bury Roadside	UK0003	GB0652A	133	1082	136	2108	22
Bush Estate	UK0037	GB0033R	885	1082	1922	2130	55
Coventry Memorial Park	UK0017	GB0739A	5187	1093	8020	2152	45

Form 15 Annual statistics of ozone (2002/3/EC, Article 10(2b) and Annex III)							
			AOT40 for vegetation protection ($\mu g/m^3.h$)		*AOT40 for forest protection ($\mu g/m^3.h$)*		
Station name	*Zone code*	*EoI station code*	*Value*	*Number of valid data*	*Value*	*Number of valid data*	*Annual average*
Cwmbran	UK0041	GB0744A	5260	1104	8113	2196	52
Derry	UK0043	GB0673A	1412	1082	2359	2130	52
Edinburgh St Leonards	UK0025	GB0839A	2618	1038	5457	2086	53
Eskdalemuir	UK0040	GB0002R	722	1082	1716	2174	51
Exeter Roadside	UK0030	GB0640A	215	1082	492	2152	34
Glasgow Centre	UK0024	GB0641A	120	1049	279	2086	33
Glazebury	UK0033	GB0034R	3616	1093	7335	2130	46
Great Dun Fell	UK0033	GB0035R	2062	1104	4100	2174	60
Harwell	UK0031	GB0036R	3616	1082	6297	2152	50
High Muffles	UK0034	GB0014R	5524	1060	11011	2130	60
Hull Freetown	UK0018	GB0776A	3004	1082	4972	2108	43
Ladybower	UK0032	GB0037R	1613	1038	2615	2086	50
Leeds Centre	UK0004	GB0584A	893	1082	1562	2152	36
Leicester Centre	UK0011	GB0597A	3570	1060	5281	2152	37
Liverpool Speke	UK0006	GB0777A	2821	1093	4736	2130	47
London Bexley	UK0001	GB0608A	5565	1071	7078	2152	38
London Bloomsbury	UK0001	GB0566A	891	883	1186	1911	23
London Brent	UK0001	GB0616A	7624	1071	10838	2152	40
London Eltham	UK0001	GB0586A	6051	1071	7866	2130	39
London Hackney	UK0001	GB0650A	2024	1027	5498	1976	37
London Haringey	UK0001	GB0638A	7294	1093	10963	2174	39
London Harlington	UK0001	GB0837A	3510	1071	4966	2152	32
London Hillingdon	UK0001	GB0642A	2015	960	2276	2042	27
London Lewisham	UK0001	GB0672A	5018	1082	6436	2174	32
London Marylebone Road	UK0001	GB0682A	62	1093	64	2130	16
London N. Kensington	UK0001	GB0620A	5480	1027	6913	2108	35
London Southwark	UK0001	GB0656A	1642	1093	2285	2152	32
London Teddington	UK0001	GB0644A	8764	1093	13924	2174	48
London Wandsworth	UK0001	GB0622A	1166	1016	1793	2086	27
London Westminster	UK0001	GB0743A	3153	1016	4195	2064	33
Lough Navar	UK0043	GB0006R	1660	1104	2998	2130	50
Lullington Heath	UK0031	GB0038R	10251	1093	16437	2152	59
Manchester Piccadilly	UK0003	GB0613A	1372	1049	1525	2130	28
Manchester South	UK0003	GB0649A	462	1060	718	2152	30
Market Harborough	UK0032	GB0838A	3334	1082	5566	2152	47
Middlesbrough	UK0013	GB0583A	1219	1038	2074	2042	44
Newcastle Centre	UK0005	GB0568A	762	1093	1926	2174	44
Northampton	UK0032	GB0738A	3711	1071	6244	2130	44
Norwich Centre	UK0029	GB0684A	3818	1005	5762	2064	41
Nottingham Centre	UK0008	GB0646A	1178	1060	2164	2130	34
Plymouth Centre	UK0030	GB0687A	758	1071	953	2152	42
Port Talbot	UK0027	GB0651A	3624	1005	5123	2020	53
Portsmouth	UK0012	GB0733A	6005	1093	8758	2174	46
Preston	UK0023	GB0731A	2324	994	4630	1998	48

Form 15 Annual statistics of ozone (2002/3/EC, Article 10(2b) and Annex III)							
			AOT40 for vegetation protection (µg/m³.h)		*AOT40 for forest protection (µg/m³.h)*		
Station name	*Zone code*	*EoI station code*	*Value*	*Number of valid data*	*Value*	*Number of valid data*	*Annual average*
Reading New Town	UK0016	GB0840A	6389	1049	9647	2086	46
Redcar	UK0013	GB0679A	1893	1104	3452	1845	47
Rochester	UK0031	GB0617A	5043	1093	7270	2152	45
Rotherham Centre	UK0007	GB0677A	1006	1016	1491	2020	31
Salford Eccles	UK0003	GB0660A	1052	1060	1796	2130	35
Sandwell West Bromwich	UK0002	GB0698A	2495	1071	3625	2130	40
Sheffield Centre	UK0007	GB0615A	605	1093	889	2152	31
Sibton	UK0029	GB0039R	12539	916	22820	1998	59
Somerton	UK0030	GB0044R	5227	1060	9162	2108	55
Southampton Centre	UK0019	GB0598A	374	1071	484	1845	33
Southend-on-Sea	UK0021	GB0728A	6417	883	7647	1954	42
St Osyth	UK0029	GB0754A	8505	1093	12435	2042	53
Stoke-on-Trent Centre	UK0014	GB0658A	906	1093	1961	2152	42
Strath Vaich	UK0039	GB0015R	3571	883	9381	1976	67
Sunderland Silksworth	UK0036	GB0863A	1335	960	3026	1823	50
Swansea	UK0027	GB0609A	3087	1060	4380	2108	43
Thurrock	UK0029	GB0645A	4608	1093	6501	1976	39
Weybourne	UK0029	GB0745A	10223	1071	16422	2108	68
Wicken Fen	UK0029	GB0045R	7661	1082	13522	2152	53
Wigan Centre	UK0033	GB0864A	3273	1082	5360	2130	44
Wolverhampton Centre	UK0002	GB0614A	1965	1093	2956	2064	42
Yarner Wood	UK0030	GB0013R	5087	1060	8221	2152	60

Table 3.7b Gibraltar - Form 15 Annual statistics of ozone (2002/3/EC, Article 10(2b) and Annex III)

Form 15 Annual statistics of ozone (2002/3/EC, Article 10(2b) and Annex III)							
			AOT40 for vegetation protection (µg/m³.h)		*AOT40 for forest protection (µg/m³.h)*		
Station name	*Zone code*	*EoI station code*	*Value*	*Number of valid data*	*Value*	*Number of valid data*	*Annual average*
Gibraltar Bleak House	UK(GIB)	GB0051A	16132	1093	26831	2152	68

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APPENDIX 1. NATIONAL NETWORK MONITORING SITES

Table A1.1. UK monitoring sites operating during 2005 for AQDD3 reporting.

EoI station code	*Local station code*	*Zone code*	*Type of station*	*Use in relation to Directive 2002/3/EC*		
				O_3	NO_2	NO_x
GB0729A	Aberdeen	UK0038	U	y	y	y
GB0031R	Aston Hill	UK0042	R	y	y	y
GB0681A	Barnsley Gawber	UK0034	U	y	y	y
GB0567A	Belfast Centre	UK0028	U	y	y	y
GB0569A	Birmingham Centre	UK0002	U	y	y	y
GB0851A	Birmingham Tyburn	UK0002	U	y	y	y
GB0882A	Blackpool Marton	UK0022	U	y	y	y
GB0654A	Bolton	UK0003	U	y	y	y
GB0032R	Bottesford	UK0032	S	y		
GB0741A	Bournemouth	UK0015	U	y	y	y
GB0689A	Bradford Centre	UK0004	U	y	y	y
GB0860A	Brighton Preston Park	UK0010	U	y	y	y
GB0585A	Bristol Centre	UK0009	U	y	y	y
GB0652A	Bury Roadside	UK0003	U	y	y	y
GB0033R	Bush Estate	UK0037	R	y	y	y
GB0580A	Cardiff Centre	UK0026	U	y	y	y
GB0739A	Coventry Memorial Park	UK0017	U	y	y	y
GB0744A	Cwmbran	UK0041	U	y	y	y
GB0673A	Derry	UK0043	U	y	y	y
GB0839A	Edinburgh St Leonards	UK0025	U	y	y	y
GB0002R	Eskdalemuir	UK0040	R	y	y	y
GB0640A	Exeter Roadside	UK0030	U	y	y	y
GB0641A	Glasgow Centre	UK0024	U	y	y	y
GB0034R	Glazebury	UK0033	S	y	y	y
GB0035R	Great Dun Fell	UK0033	RB	y		
GB0036R	Harwell	UK0031	R	y	y	y
GB0014R	High Muffles	UK0034	R	y	y	y
GB0776A	Hull Freetown	UK0018	U	y	y	y
GB0037R	Ladybower	UK0032	R	y	y	y
GB0643A	Leamington Spa	UK0035	U	y	y	y
GB0584A	Leeds Centre	UK0004	U	y	y	y
GB0597A	Leicester Centre	UK0011	U	y	y	y
GB0861A	Leominster	UK0035	S	y	y	y
GB0881A	Lerwick	UK0039	R	y		
GB0777A	Liverpool Speke	UK0006	U	y	y	y
GB0608A	London Bexley	UK0001	S	y	y	y
GB0566A	London Bloomsbury	UK0001	U	y	y	y
GB0616A	London Brent	UK0001	U	y	y	y
GB0586A	London Eltham	UK0001	S	y	y	y
GB0650A	London Hackney	UK0001	U	y	y	y
GB0638A	London Haringey	UK0001	U	y		
GB0837A	London Harlington	UK0001	U	y	y	y
GB0642A	London Hillingdon	UK0001	S	y	y	y
GB0672A	London Lewisham	UK0001	U	y	y	y

EoI station code	*Local station code*	*Zone code*	*Type of station*	*Use in relation to Directive 2002/3/EC*		
				O_3	NO_2	NO_x
GB0682A	London Marylebone Road	UK0001	U	y	y	y
GB0620A	London N. Kensington	UK0001	U	y	y	y
GB0656A	London Southwark	UK0001	U	y	y	y
GB0644A	London Teddington	UK0001	U	y	y	y
GB0622A	London Wandsworth	UK0001	U	y	y	y
GB0743A	London Westminster	UK0001	U	y	y	y
GB0006R	Lough Navar	UK0043	RB	y		
GB0038R	Lullington Heath	UK0031	R	y	y	y
GB0613A	Manchester Piccadilly	UK0003	U	y	y	y
GB0649A	Manchester South	UK0003	S	y	y	y
GB0838A	Market Harborough	UK0032	R	y	y	y
GB0583A	Middlesbrough	UK0013	U	y	y	y
GB0043R	Narberth	UK0041	RB	y	y	y
GB0568A	Newcastle Centre	UK0005	U	y	y	y
GB0738A	Northampton	UK0032	U	y	y	y
GB0684A	Norwich Centre	UK0029	U	y	y	y
GB0646A	Nottingham Centre	UK0008	U	y	y	y
GB0687A	Plymouth Centre	UK0030	U	y	y	y
GB0651A	Port Talbot	UK0027	U	y	y	y
GB0733A	Portsmouth	UK0012	U	y	y	y
GB0731A	Preston	UK0023	U	y	y	y
GB0840A	Reading New Town	UK0016	U	y	y	y
GB0679A	Redcar	UK0013	S	y	y	y
GB0617A	Rochester	UK0031	R	y	y	y
GB0677A	Rotherham Centre	UK0007	U	y	y	y
GB0660A	Salford Eccles	UK0003	U	y	y	y
GB0698A	Sandwell West Bromwich	UK0002	U	y	y	y
GB0615A	Sheffield Centre	UK0007	U	y	y	y
GB0039R	Sibton	UK0029	RB	y		
GB0044R	Somerton	UK0030	R	y	y	y
GB0598A	Southampton Centre	UK0019	U	y	y	y
GB0728A	Southend-on-Sea	UK0021	U	y	y	y
GB0754A	St Osyth	UK0029	R	y	y	y
GB0658A	Stoke-on-Trent Centre	UK0014	U	y	y	y
GB0015R	Strath Vaich	UK0039	RB	y		
GB0863A	Sunderland Silksworth	UK0036	U	y	y	y
GB0609A	Swansea	UK0027	U	y	y	y
GB0645A	Thurrock	UK0029	U	y	y	y
GB0745A	Weybourne	UK0029	R	y		
GB0045R	Wicken Fen	UK0029	R	y	y	y
GB0864A	Wigan Centre	UK0033	U	y	y	y
GB0730A	Wirral Tranmere	UK0020	U	y	y	y
GB0614A	Wolverhampton Centre	UK0002	U	y	y	y
GB0013R	Yarner Wood	UK0030	R	y	y	y

Table A1.2. Gibraltar monitoring sites operating during 2005 for AQDD3 reporting.

EoI station code	*Local station code*	*Zone code*	*Type of station*	*Use in relation to Directive 2002/3/EC*		
				O_3	NO_2	NO_x
GB00051A	Gibraltar Bleak House	UK(GIB)	U	y	y	y

Table A1.3 Data capture rates for sites used in model calibrations for AQDD1-3, 2005

Site	*Data Capture (%)*							
	SO2	*NO2*	*PM10*	*CO*	*Benzene*	*Lead*	*O3*	*PM2,5*
Aberdeen	98.7	96.6	91.8	98.9	nm	nm	98.9	nm
Aston Hill	nm	97.8	nm	nm	nm	nm	98.8	nm
Auchencorth	nm	nm	nm	nm	nm	83	nm	nm
Avonmouth BZL	nm	nm	nm	nm	nm	100	nm	nm
Banchory	nm	nm	nm	nm	nm	81	nm	nm
Barnsley 12	97.2	nm	nm	nm	nm	nm	nm	nm
Barnsley Gawber	89.3	81	nm	56.8	nm	nm	96.2	nm
Barnsley Gawber HC	nm	nm	nm	nm	99.9	nm	nm	nm
Bath Roadside	nm	93.8	nm	93.8	nm	nm	nm	nm
Beacon Hill	nm	nm	nm	nm	nm	53	nm	nm
Belfast Centre	95.2	54.5	95.1	94.4	nm	nm	95.4	nm
Belfast Centre HC	nm	nm	nm	nm	100	nm	nm	nm
Belfast Clara St	nm	nm	94.7	nm	nm	nm	nm	nm
Belfast East	99.3	nm	nm	nm	nm	nm	nm	nm
Belfast Roadside HC	nm	nm	nm	nm	96.5	nm	nm	nm
Billingham	nm	97.5	nm	nm	nm	nm	nm	nm
Birmingham Centre	85.5	81.1	87.4	85	nm	nm	87	nm
Birmingham Roadside HC	nm	nm	nm	nm	99.9	nm	nm	nm
Birmingham Tyburn	98.9	99	98.6	99.2	nm	nm	99.2	nm
Blackpool Marton	50.6	52.1	53.1	49.2	nm	nm	52.8	nm
Bolton	94.2	58.9	96.5	97.8	nm	nm	97.6	nm
Bottesford	nm	nm	nm	nm	nm	nm	99.3	nm
Bournemouth	98.2	94.4	94.2	98.4	nm	nm	98.5	nm
Bournemouth HC	nm	nm	nm	nm	100	nm	nm	nm
Bradford Centre	90	88.4	92.8	90.2	nm	nm	93.1	nm
Brentford Roadside	nm	99.4	nm	83.6	nm	nm	nm	nm
Brighton Preston Park	nm	96.3	nm	nm	nm	nm	98.6	nm
Brighton Roadside	nm	99	nm	90.3	nm	nm	nm	nm
Brighton Roadside PM10	nm	nm	93.7	nm	nm	nm	nm	nm
Bristol Centre	67.5	68.7	68.4	67.8	nm	nm	68.8	nm
Bristol Old Market	nm	98.9	nm	99.2	nm	nm	nm	nm
Bristol Old Market HC	nm	nm	nm	nm	96.7	nm	nm	nm
Brookside 2	nm	nm	nm	nm	nm	100	nm	nm
Bury Roadside	80.8	90.4	96.2	78	nm	nm	95.7	nm
Bush Estate	nm	45.7	nm	nm	nm	nm	98.1	nm
Cambridge Roadside	nm	96.4	nm	nm	nm	nm	nm	nm
Camden Kerbside	nm	84.8	96.8	nm	nm	nm	nm	nm
Canterbury	nm	95.5	99.1	nm	nm	nm	nm	nm
Cardiff	nm	nm	nm	nm	nm	100	nm	nm
Cardiff Centre	55.4	56.3	53.8	58.3	nm	nm	58.3	nm
Cardiff Centre HC	nm	nm	nm	nm	51.1	nm	nm	nm
Central London Metals	nm	nm	nm	nm	nm	100	nm	nm
Cockley Beck	nm	nm	nm	nm	nm	86	nm	nm
Coventry Memorial Park	98.8	98.9	98.9	98.7	nm	nm	98.7	nm
Coventry Memorial Park HC	nm	nm	nm	nm	100	nm	nm	nm
Cwmbran	94	99.3	99.2	29.4	nm	nm	99.5	nm
Cwmbran HC	nm	nm	nm	nm	100	nm	nm	nm

Site	Data Capture (%)							
	SO2	*NO2*	*PM10*	*CO*	*Benzene*	*Lead*	*O3*	*PM2,5*
Cwmystwyth	nm	nm	nm	nm	nm	75	nm	nm
Derry	91.8	92	97.1	96.3	nm	nm	86.7	nm
Detling	nm	nm	nm	nm	nm	42	nm	nm
Dumfries	nm	96.8	97.5	97.2	nm	nm	nm	nm
Edinburgh Med. Sch. HC	nm	nm	nm	nm	76	nm	nm	nm
Edinburgh St Leonards	98.6	96	97.6	98.8	nm	nm	93.3	nm
Edinburgh St Leonards HC	nm	nm	nm	nm	18	nm	nm	nm
Elswick 6	nm	nm	nm	nm	nm	100	nm	nm
Eskdalemuir	nm	92.8	nm	nm	nm	nm	96	nm
Eskdalemuir Metals	nm	nm	nm	nm	nm	100	nm	nm
Exeter Roadside	81.1	83.4	nm	76.9	nm	nm	98.8	nm
Glasgow	nm	nm	nm	nm	nm	100	nm	nm
Glasgow Centre	97.5	95.6	97.9	94.6	nm	nm	97	nm
Glasgow City Chambers	nm	94.6	nm	79.4	nm	nm	nm	nm
Glasgow Kerbside	nm	98.3	90.8	91.3	nm	nm	nm	nm
Glasgow Kerbside HC	nm	nm	nm	nm	93.4	nm	nm	nm
Glazebury	nm	91.6	nm	nm	nm	nm	98.3	nm
Grangemouth	98.9	99.2	98.9	99.3	nm	nm	nm	nm
Grangemouth HC	nm	nm	nm	nm	100	nm	nm	nm
Great Dun Fell	nm	nm	nm	nm	nm	nm	99.4	nm
Hallen	nm	nm	nm	nm	nm	100	nm	nm
Haringey Roadside	nm	97	95.6	nm	nm	nm	nm	nm
Haringey Roadside HC	nm	nm	nm	nm	91.1	nm	nm	nm
Harwell	97.9	91.4	96.8	nm	nm	nm	97.9	98.3
Harwell HC	nm	nm	nm	nm	95.2	nm	nm	nm
Heigham Holmes	nm	nm	nm	nm	nm	65	nm	nm
High Muffles	nm	88.7	nm	nm	nm	nm	93.3	nm
Hove Roadside	96.3	95.7	nm	97.1	nm	nm	nm	nm
Hove Roadside HC	nm	nm	nm	nm	99.8	nm	nm	nm
Hull Freetown	82.3	66.2	97.7	62.9	nm	nm	97.7	nm
Hull Freetown HC	nm	nm	nm	nm	99.8	nm	nm	nm
Inverness	nm	95.1	94	97.3	nm	nm	nm	nm
Ladybower	94.6	91.8	nm	nm	nm	nm	96.5	nm
Leamington Spa	74.6	69.8	72.9	74.6	nm	nm	72.8	nm
Leamington Spa HC	nm	nm	nm	nm	100	nm	nm	nm
Leeds Centre	92.8	91.9	75.3	92.2	nm	nm	92.7	nm
Leeds Centre HC	nm	nm	nm	nm	99.6	nm	nm	nm
Leeds Roadside HC	nm	nm	nm	nm	93.2	nm	nm	nm
Leicester Centre	94.1	97	97.1	97.2	nm	nm	97.3	nm
Leicester Centre HC	nm	nm	nm	nm	98.6	nm	nm	nm
Leominster	nm	42.4	nm	nm	nm	nm	45.4	nm
Lerwick	nm	nm	nm	nm	nm	nm	57.8	nm
Liverpool Speke	98.3	98.2	96.9	96.1	nm	nm	98.3	nm
Liverpool Speke HC	nm	nm	nm	nm	87	nm	nm	nm
London A3 Roadside	nm	98	98.2	97	nm	nm	nm	nm
London Bexley	97.2	95.3	70.3	97.1	nm	nm	97.5	nm
London Bloomsbury	93.9	93.8	94.6	91.9	nm	nm	91.2	94.4
London Bloomsbury HC	nm	nm	nm	nm	97.8	nm	nm	nm

Site	*Data Capture (%)*							
	SO2	*NO2*	*PM10*	*CO*	*Benzene*	*Lead*	*O3*	*PM2,5*
London Brent	94.9	89	82.8	56.3	nm	nm	96.4	nm
London Bromley	nm	94.9	nm	46.3	nm	nm	nm	nm
London Cromwell Road 2	95	93.7	nm	94	nm	nm	nm	nm
London Eltham	94.6	84.5	78.7	nm	nm	nm	98	nm
London Eltham HC	nm	nm	nm	nm	94.8	nm	nm	nm
London Hackney	nm	97.2	nm	95.7	nm	nm	77.9	nm
London Haringey	nm	nm	nm	nm	nm	nm	99.6	nm
London Harlington	nm	99	84.9	99.3	nm	nm	99.1	nm
London Hillingdon	96.1	93.6	96.1	89.2	nm	nm	92.4	nm
London Lewisham	97	99.2	nm	nm	nm	nm	99.2	nm
London Marylebone Road	97.8	97.7	96.2	98	nm	nm	98	97.5
London Marylebone Road HC	nm	nm	nm	nm	86	nm	nm	nm
London N. Kensington	99.3	95.8	99	96.2	nm	nm	97.7	nm
London Southwark	98.3	98.7	nm	95.9	nm	nm	96.3	nm
London Teddington	98.9	94.6	nm	nm	nm	nm	99	nm
London Wandsworth	nm	96.4	nm	nm	nm	nm	97.5	nm
London Westminster	95.6	82.6	95.1	52	nm	nm	95.9	nm
Lough Navar	nm	nm	99.3	nm	nm	nm	98.3	nm
Lullington Heath	97.5	86.1	nm	nm	nm	nm	98.2	nm
Manchester Piccadilly	21.4	48.6	97.8	97.9	nm	nm	97.9	nm
Manchester Piccadilly HC	nm	nm	nm	nm	99.9	nm	nm	nm
Manchester South	20	6.5	nm	nm	nm	nm	95	nm
Manchester Town Hall	nm	94.9	nm	66.3	nm	nm	nm	nm
Market Harborough	nm	93.2	nm	98.8	nm	nm	98.9	nm
Middlesbrough	97	92.6	95.7	93.7	nm	nm	95.8	nm
Middlesbrough HC	nm	nm	nm	nm	96.3	nm	nm	nm
Narberth	94.5	92.2	82.9	nm	nm	nm	60.5	nm
Newcastle Centre	95.8	95.2	97.4	97.4	nm	nm	97.4	nm
Newcastle Centre HC	nm	nm	nm	nm	99.5	nm	nm	nm
Northampton	95	52	98.3	99.2	nm	nm	96.5	nm
Northampton HC	nm	nm	nm	nm	100	nm	nm	nm
Northampton PM10	nm	nm	94.2	nm	nm	nm	nm	nm
Norwich Centre	96.9	83.1	96.5	96.9	nm	nm	93.6	nm
Norwich Centre HC	nm	nm	nm	nm	94.1	nm	nm	nm
Norwich Forum Roadside	nm	70.1	nm	nm	nm	nm	nm	nm
Norwich Roadside	nm	11.8	nm	nm	nm	nm	nm	nm
Nottingham Centre	92.6	91.9	96.9	86.5	nm	nm	97.7	nm
Nottingham Centre HC	nm	nm	nm	nm	99.9	nm	nm	nm
Oxford Centre Roadside	98.1	97.7	nm	95.7	nm	nm	nm	nm
Oxford Centre Roadside HC	nm	nm	nm	nm	99.2	nm	nm	nm
Plymouth Centre	94.8	98	97.4	97.6	nm	nm	88.2	nm
Plymouth Centre HC	nm	nm	nm	nm	94.1	nm	nm	nm
Port Talbot	93.3	97.1	86.6	nm	nm	nm	94.8	nm
Portsmouth	98.9	98	98.7	94.4	nm	nm	99.2	nm
Portsmouth HC	nm	nm	nm	nm	88.2	nm	nm	nm
Preston	96.5	73.9	94.9	79.8	nm	nm	95.6	nm
Reading HC	nm	nm	nm	nm	95.6	nm	nm	nm
Reading New Town	69.8	95.3	97	80.9	nm	nm	96.6	nm

Site	Data Capture (%)							
	SO2	*NO2*	*PM10*	*CO*	*Benzene*	*Lead*	*O3*	*PM2,5*
Redcar	93.2	50.7	94.7	88.2	nm	nm	80.3	nm
Rochester	95.8	95.3	98.2	nm	nm	nm	98.7	98.3
Rotherham Centre	0	92.5	nm	nm	nm	nm	91.6	nm
Salford Eccles	95.7	83.2	88	95.4	nm	nm	95.9	nm
Sandwell West Bromwich	92.2	96.2	nm	89	nm	nm	95.8	nm
Scunthorpe Town	73.6	nm	98.1	nm	nm	nm	nm	nm
Sheffield Centre	98.1	66	96.6	96.9	nm	nm	98.3	nm
Sheffield Centre HC	nm	nm	nm	nm	99.9	nm	nm	nm
Sheffield Tinsley	nm	97.4	nm	99	nm	nm	nm	nm
Sibton	nm	nm	nm	nm	nm	nm	91.3	nm
Somerton	nm	87.1	nm	nm	nm	nm	95.4	nm
Southampton Centre	89.9	87.2	91	87.8	nm	nm	91.3	nm
Southampton Centre HC	nm	nm	nm	nm	99.9	nm	nm	nm
Southend-on-Sea	93.6	91.9	93.6	94.6	nm	nm	93.2	nm
Southend-on-Sea HC	nm	nm	nm	nm	99.1	nm	nm	nm
Southwark Roadside	98.7	98.8	nm	91.9	nm	nm	nm	nm
St Osyth	nm	93	nm	93	nm	nm	94.4	nm
Stockport Shaw Heath	99	91	43.2	75.5	nm	nm	nm	nm
Stockton-on-Tees Yarm	nm	99.1	99	97.9	nm	nm	nm	nm
Stockton-on-Tees Yarm HC	nm	nm	nm	nm	96.6	nm	nm	nm
Stoke-on-Trent Centre	50.7	95.6	97.8	93.3	nm	nm	96.1	nm
Stoke-on-Trent Centre HC	nm	nm	nm	nm	97.9	nm	nm	nm
Strath Vaich	nm	nm	nm	nm	nm	nm	92.7	nm
Sunderland	98.5	nm	nm	nm	nm	nm	nm	nm
Sunderland Silksworth	nm	92.7	nm	nm	nm	nm	88.6	nm
Swansea	91.8	94.7	97.6	97.3	nm	nm	97.5	nm
Thurrock	94	84.7	94.6	93.9	nm	nm	94.2	nm
Tower Hamlets Roadside	nm	99	nm	88.3	nm	nm	nm	nm
Walsall Alumwell	nm	99	nm	nm	nm	nm	nm	nm
Walsall Willenhall	nm	69.6	nm	nm	nm	nm	nm	nm
West London	nm	94.6	nm	93.7	nm	nm	nm	nm
Weybourne	nm	nm	nm	nm	nm	nm	86.1	nm
Wicken Fen	93.5	98.7	nm	nm	nm	nm	89.7	nm
Wigan Centre	96.7	97.6	95.7	98.3	nm	nm	98.2	nm
Wigan Centre HC	nm	nm	nm	nm	100	nm	nm	nm
Wirral Tranmere	51.9	63.9	60.2	61.3	nm	nm	66.3	nm
Wolverhampton Centre	90.9	91.6	95.1	96.2	nm	nm	96.6	nm
Wrexham	98.7	94.6	91.8	98.6	nm	nm	nm	nm
Yarner Wood	nm	81.5	nm	nm	nm	nm	96.4	nm

nm = not measured

APPENDIX 2. MONITORING SITES USED TO VERIFY THE MAPPED ESTIMATES

Table A2.1. Monitoring sites used to verify the mapped estimates

Site	Site Type	Authority
Abingdon	URBAN BACKGROUND	Vale of White Horse DC
Basingstoke Eastrop	URBAN BACKGROUND	Basingstoke & Deane DC
Birmingham Airport	AIRPORT	Birmingham International Airport
Bracknell Foxhill	URBAN BACKGROUND	Bracknell Forest BC
Cardiff Briardene	URBAN BACKGROUND	Cardiff City Council
Glasgow Waulkmillglen Reservoir	RURAL	Glasgow City Council
Heathrow LHR2	AIRPORT	BAA
Heathrow Main Road	AIRPORT	BAA
Heathrow Oaks Road	AIRPORT	BAA
Marchlyn Mawr	REMOTE	Gwyneth Council
Newham Cam Road	ROADSIDE	London Borough of Newham
Newham Wren Close	URBAN BACKGROUND	London Borough of Newham
Newport Malpas Depot	URBAN BACKGROUND	Newport County BC
Norwich Airport 2	AIRPORT	BAA
Oldham West End House	URBAN BACKGROUND	Oldham MBC
Oxford St Ebbes	URBAN BACKGROUND	Oxford City Council
South Holland	RURAL	South Holland DC
Tameside Two Trees School	URBAN BACKGROUND	Tameside MBC
V Glamorgan Fonmon	RURAL	Vale of Glamorgan Council