UK and Gibraltar air quality modelling for annual reporting 2007 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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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.

2007 is the fourth 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 the levels of 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 2007 on a 1 km x 1 km grid have been prepared for the UK. The following metrics set out by the third Daughter Directive have been modelled:

- Number of days above 120 μgm^{-3} in 2007
- Number of days above 120 μgm^{-3} per year averaged over three years 2005-2007
- AOT40 wheat crops in 2007
- AOT40 wheat crops averaged over five years 2003-2007

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. An assessment of measured levels of ozone in Gibraltar is also presented in this report. Gibraltar is comprised of a single non-agglomeration zone for which no modelling assessment has been undertaken but data from an automatic monitoring campaign is presented in this report. The exceedence status of the zones in the UK has been determined from a combination of monitoring data and model results. The exceedence status of the Gibraltar zone has been determined from monitoring data only. The results of the UK assessment are summarised in Tables E1 and E2 in terms of exceedences of Target Values (TV) and Long-term Objectives (LTO). Corresponding results for Gibraltar based on monitoring data only are presented in Tables E3 and E4.

Table E1 UK 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 UK 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	41 zones (24 measured + 17 modelled)
AOT40 Long-term Objective	3 zones (1 measured + 2 modelled)

Table E3 Gibraltar 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 E4 Gibraltar 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	1 zone (measured)
AOT40 Long-term Objective	1 zone (measured)

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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 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[1,2,3,4]. 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. Obligations for assessments in Gibraltar are entirely fulfilled by measurements.

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. 2007 is the fourth 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 for the UK and Gibraltar can be found on the Central Data Repository of the European Environment Agency[5]. 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 and Gibraltar's obligation under the third Daughter Directive (AQDD3) 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[6] that can be found on the National Air Quality Archive.

[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] Bush T and Kent A J (2003) Preliminary assessment of air quality in Gibraltar. Report to the Gibraltar Environmental Agency. AEA Technology, Netcen report AEAT/ENV/R/1512/Issue1
[5] CDR, 2006, http://cdr.eionet.europa.eu/gb/eu/annualair

Section 2 describes the modelling procedures used for estimation of ozone in the UK. These include:

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

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

- Number of days above 120 $\mu g\ m^{-3}$ in 2007
- Number of days above 120 $\mu g\ m^{-3}$ per year averaged over three years 2005-2007
- AOT40 wheat crops in 2007
- AOT40 wheat crops averaged over five years 2003-2007

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 exposure to elevated levels of ozone. Annex I and II are presented below.

Section 3 presents the exceedence status of zones in the UK in relation to the TV and LTO in 2007. These results are distinct from the modelled results presented in Section 2, as they also incorporate monitoring data from the national networks to determine the zone status.

Section 4 presents the exceedence information for Gibraltar in 2007. Information for the Gibraltar zone is limited to measured data from the continuous automatic monitoring campaign, 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 TVs and LTOs 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.

[6] Grice et al. (2009). UK air quality modelling for annual reporting 2007 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 report. AEAT/ENV/R/2656 Issue 1.

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 µg/m^3
Alert threshold	1 hour average (a)	240 µg/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 2007
(UK agglomerations zones in red text, non-agglomeration zones in black text)

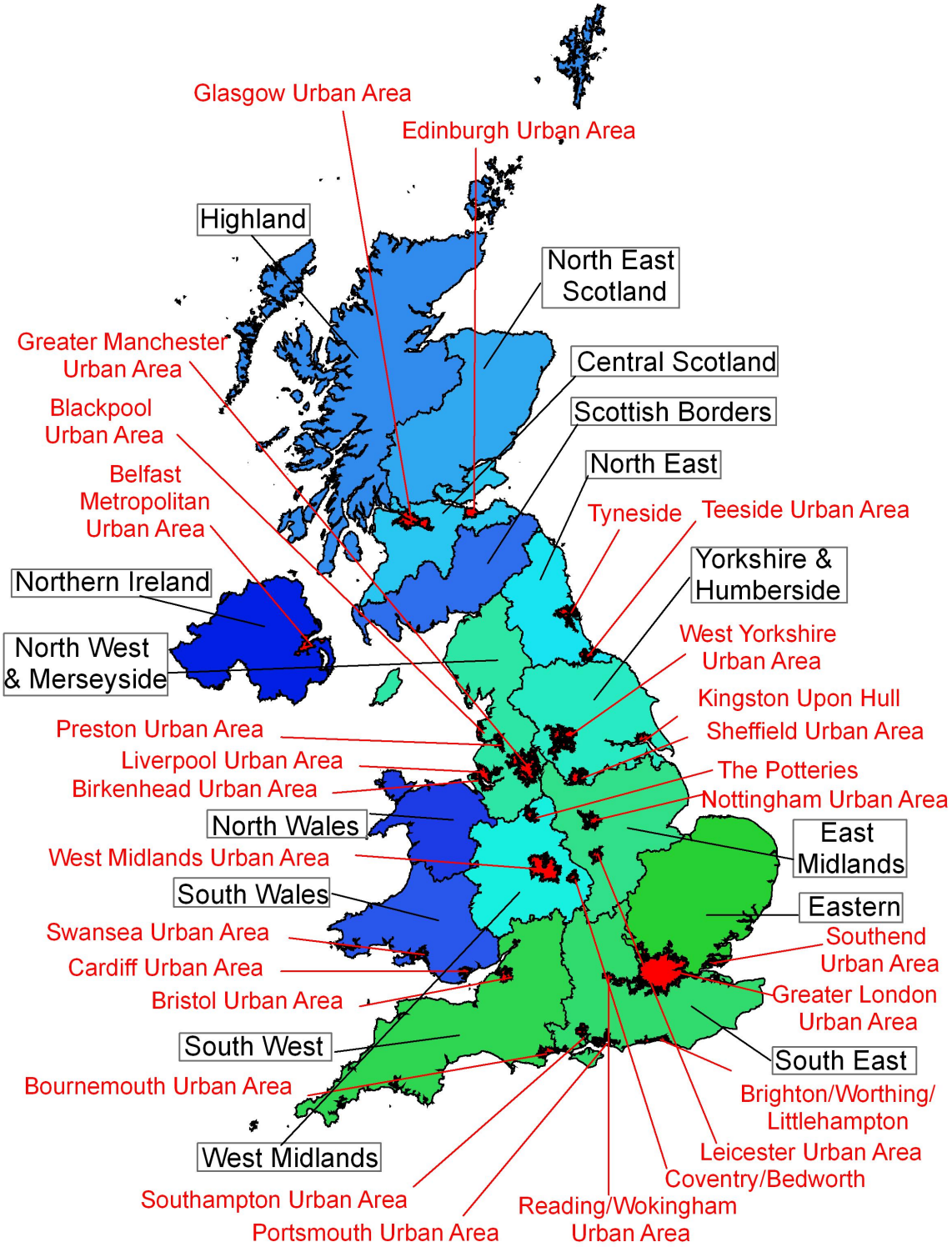


Table 1.1 Zones for AQDD3 reporting

Zone	Zone code	Ag or nonag*	Area (km^2)	Population
Greater London Urban Area	1	ag	1640	7791139
West Midlands Urban Area	2	ag	594	2083891
Greater Manchester Urban Area	3	ag	557	1846479
West Yorkshire Urban Area	4	ag	363	1150737
Tyneside	5	ag	223	721105
Liverpool Urban Area	6	ag	189	697951
Sheffield Urban Area	7	ag	165	521984
Nottingham Urban Area	8	ag	169	558935
Bristol Urban Area	9	ag	142	488798
Brighton/Worthing/Littlehampton	10	ag	103	388893
Leicester Urban Area	11	ag	102	374314
Portsmouth Urban Area	12	ag	102	358696
Teesside Urban Area	13	ag	114	302559
The Potteries	14	ag	91	266188
Bournemouth Urban Area	15	ag	123	340957
Reading/Wokingham Urban Area	16	ag	97	305786
Coventry/Bedworth	17	ag	76	277475
Kingston upon Hull	18	ag	82	260479
Southampton Urban Area	19	ag	80	265231
Birkenhead Urban Area	20	ag	92	266360
Southend Urban Area	21	ag	69	220761
Blackpool Urban Area	22	ag	70	218162
Preston Urban Area	23	ag	58	180687
Glasgow Urban Area	24	ag	366	1083323
Edinburgh Urban Area	25	ag	128	432414
Cardiff Urban Area	26	ag	76	264395
Swansea Urban Area	27	ag	88	191717
Belfast Metropolitan Urban Area	28	ag	208	517811
Eastern	29	nonag	19512	4965853
South West	30	nonag	24329	4105371
South East	31	nonag	19084	6231026
East Midlands	32	nonag	15564	3263622
North West & Merseyside	33	nonag	14137	3503815
Yorkshire & Humberside	34	nonag	14997	3022575
West Midlands	35	nonag	12192	2624016
North East	36	nonag	8439	1489985
Central Scotland	37	nonag	9615	1916281
North East Scotland	38	nonag	18837	1001550
Highland	39	nonag	43585	372539
Scottish Borders	40	nonag	11391	254141
South Wales	41	nonag	12624	1717133
North Wales	42	nonag	8710	716839
Northern Ireland	43	nonag	14546	1167417
Total			253729	58729386

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

1.4 MONITORING SITES

The monitoring stations operating during 2007 in the UK and Gibraltar for the purpose of AQDD3 are listed in Table A1.1 and A1.2 in Appendix 1. This information is included in Form 3 of the questionnaire. Not all sites had sufficient data capture during 2007 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 UK modelling analysis in order to ensure that we can make maximum use of data from the monitoring sites operational during 2007 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's Calibration Club customers and ad-hoc monitoring campaigns. These data are ratified to the same standard as data from the UK national networks 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 the available techniques for modelling ozone within the UK[7], an empirical mapping approach has been used for predicting ozone concentrations in 2007.

The empirical approaches draw upon measurements from the 92 monitoring stations in the AURN during 2007 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 used here are based upon those presented by Coyle *et al.*[8], NEGTAP[9] and PORG[10].

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 consistent over wide spatial scales. 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 NO_X titration effect arising from emissions of NO_X from combustion sources.

The resultant interpolated maps, however, will overestimate exceedences in urban areas, where nitric oxide emissions from combustion sources deplete ozone concentrations. This effect has been accounted for by subtracting an empirically derived urban ozone decrement expressed as a percentage. The percentage decrement is defined as follows:

> % decrement = 100 * ((measured concentrations - rural interpolated concentration) / rural interpolated concentration)

The derivation of a coefficient relating the percentage decrement to the modelled local NO_X concentration[11] is shown in Figure 2.1 and Figure 2.2.

[7] 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

[8] 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.

[9] 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.

[10] 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.

[11] Grice et al. (2009). UK air quality modelling for annual reporting 2007 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 report. AEAT/ENV/R/2656 Issue 1.

This local NO_X component is calculated as follows:

Local NO_X = modelled background NO_X concentration – modelled rural NO_X concentration

Thus the local NO_X concentration is the sum of contributions from local point and area NO_X emissions calculated using an air dispersion model. Figure 2.1 shows the decrement plot for days greater than 120 μg m^{-3} in 2007 μg m^{-3} (the LTO for human health metric) and Figure 2.2 shows the decrement plot for days greater than 120 μg m^{-3} between 2005 and 2007 (the TV for human health metric).

Figure 2.1 Days greater than 120 μg m^{-3} percentage decrement in ozone concentrations, 2007

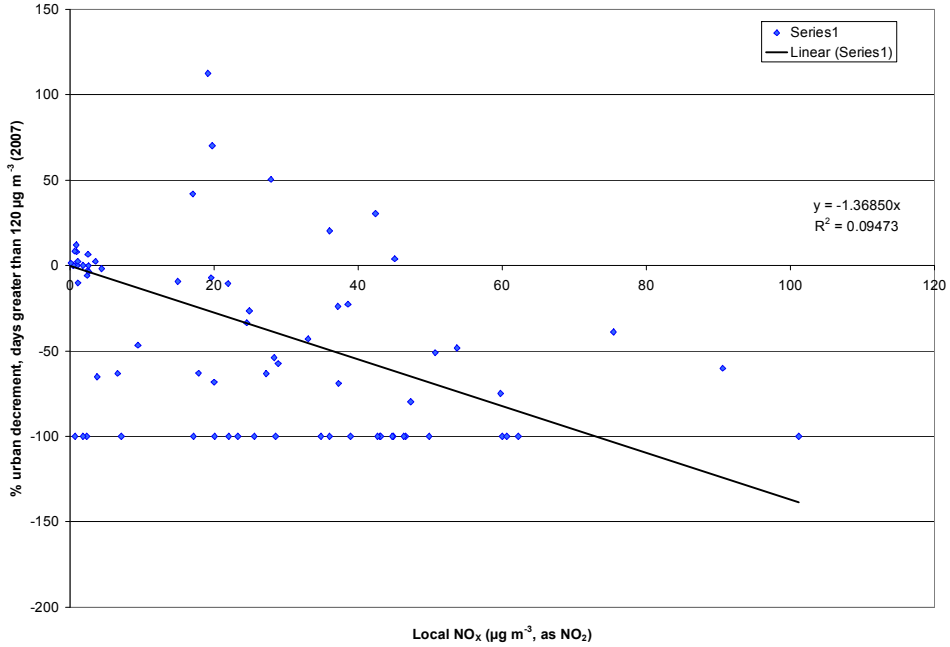
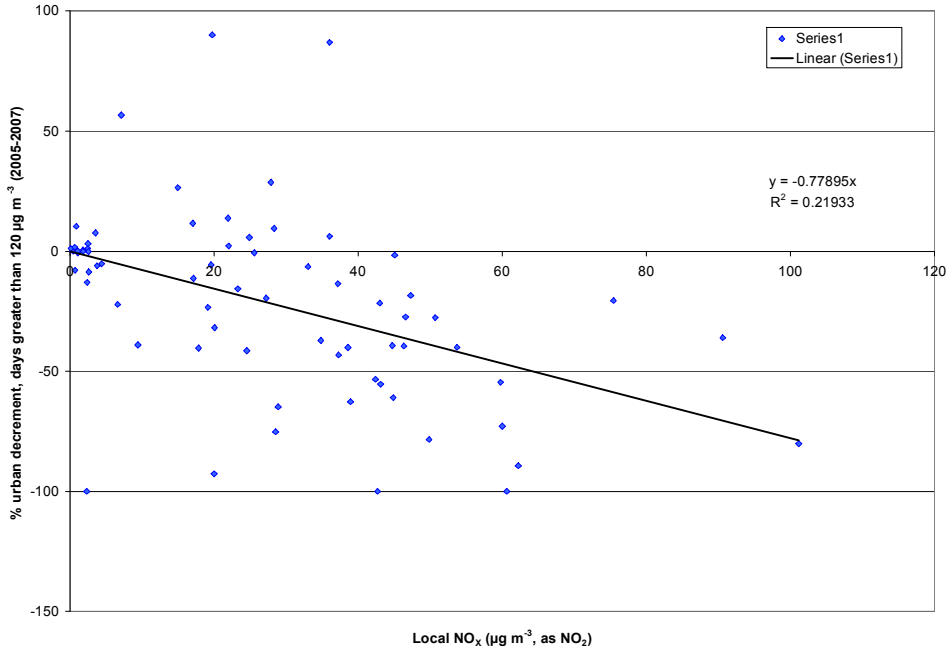


Figure 2.2 Days greater than 120 μg m^{-3} percentage decrement in ozone concentrations, 2005-2007



The calculated decrement is then used to correct the interpolated rural days above 120 $\mu g\ m^{-3}$ maps:

Corrected days above 120 $\mu g\ m^{-3}$ map = interpolated rural map + decrement

The decrement is a negative value and so reduces the concentration presented in the interpolated rural map to account for titration of ozone due to NO_X concentrations. Where the results of the expression above is 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 ozone concentrations greater than 120 $\mu g\ m^{-3}$ for comparison with the Long Term Objective (2007) and Target Value (averaged 2005 to 2007) are presented in Figures 2.3 and 2.4 respectively.

Figures 2.1 and 2.2 show that the relationship between the percentage urban decrement and local NO_X concentration. For some monitoring stations the decrement is positive, indicating that the measured number of days exceeding 120 $\mu g\ m^{-3}$ is higher than the corresponding estimated rural value i.e. that the urban influence for these sites is not being properly represented in the model. The cluster of low values close to the origin of these plots largely consists of the rural and remote sites at which there will be little difference between the rural estimated number of days exceeding 120 $\mu g\ m^{-3}$ and the measured value. This helps to anchor the relationship to the origin. Percentage urban increments of -100% indicate that there were no measured exceedences of 120 $\mu g\ m^{-3}$ that monitoring site.

Figure 2.3 Estimated number of days above 120 μgm^{-3}, 2007

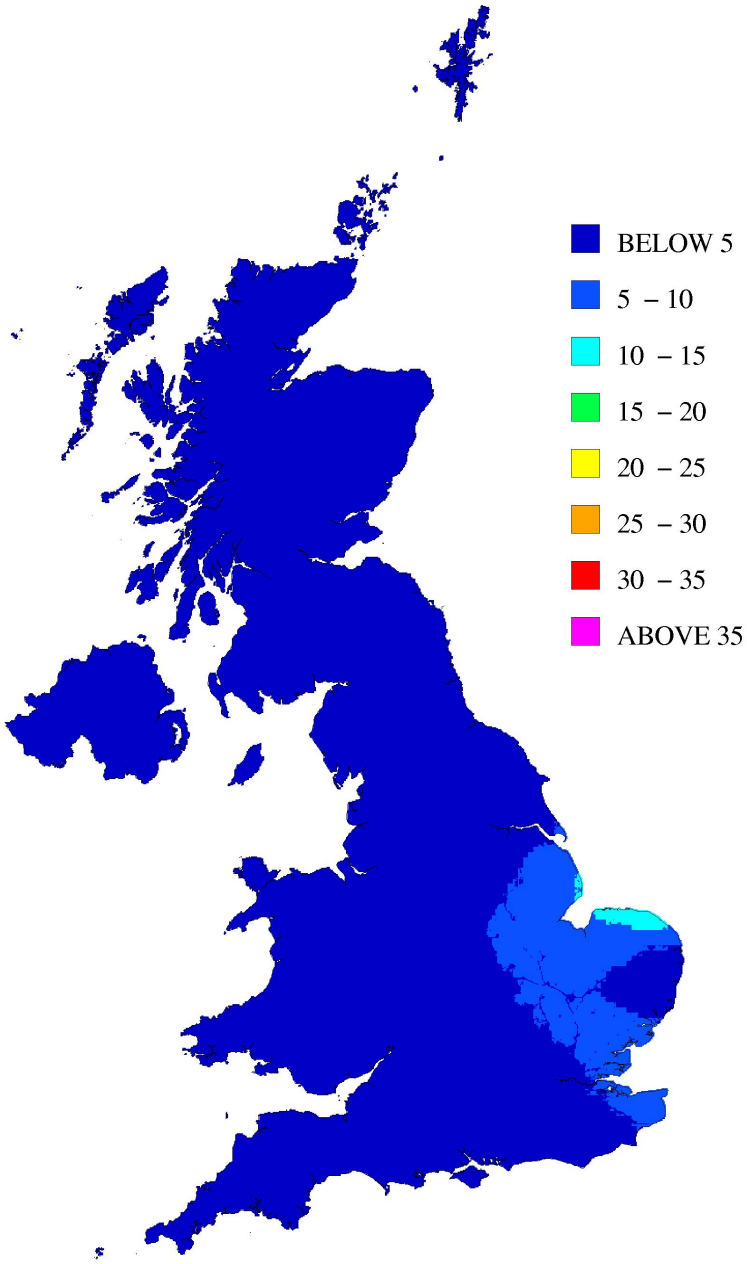
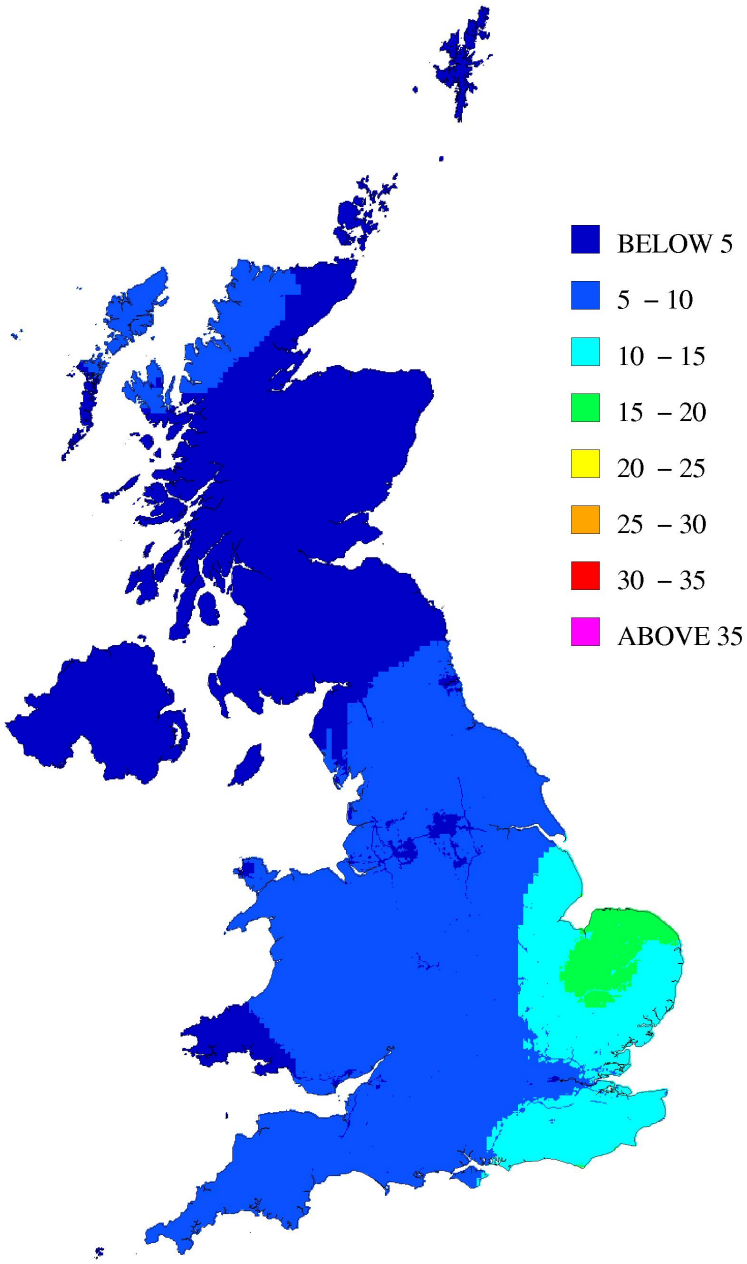


Figure 2.4 Estimated average number of days above 120 μgm^{-3}, 2005 to 2007



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 2007 and averaged 2005-2007 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 2007

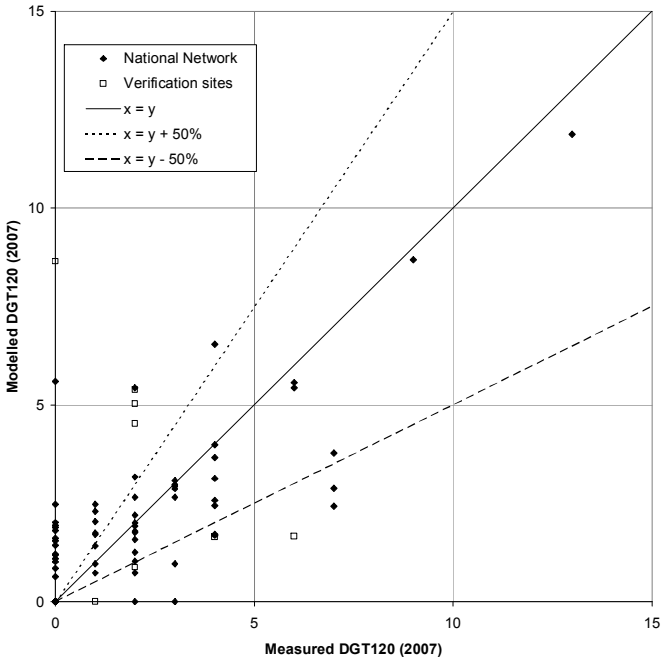


Figure 2.6 Verification of background number of days > 120 μg m^{-3} model 2005 – 2007

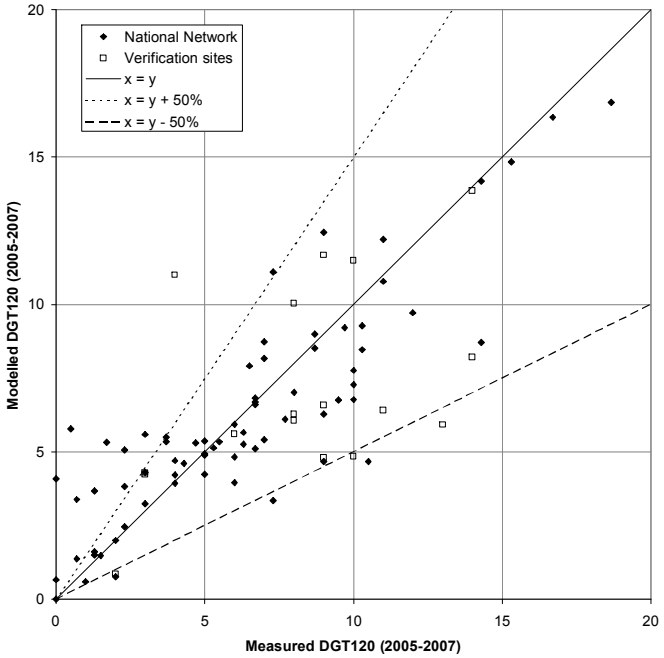


Figure 2.5 indicates that for 2007 half of the verification sites were under estimated, lying outside the +50% DQO and half were over estimated, lying outside the –50% DQO. Table 2.1 however, suggests that in general, the model over predicts concentrations across all sites with a difference of 1.1 between the number of measured and the number of modelled days above 120 µg m^{-3}. The r^2 value has not been presented in Table 2.1 because the relationship is negative as a result of the Thanet rural site which was predicted with 9 days above 120 µg m^{-3} but which recorded zero in 2007. All of the verification sites in 2007 were outside the +/50% DQO range. The National network sites display much better agreement between measured and modelled figures because these sites were used to generate the relationships used in the model.

Figure 2.6 shows the model performance for the years 2005-2007. This demonstrates significant improvement of the multi-year (TV) model over the 2007 (LTO) model. This is because the model performs best in years where ozone concentrations are higher. In 2007 ozone concentrations were particularly low whereas the multi-year model still contains data from the high ozone year of 2006. Again, the model results for the National network sites are shown to closely match the corresponding measured values which is because these sites were used to generate the relationships used in the model. The verification sites in Table 2.1 illustrate a slight under estimation.

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	2007	2.0	2.1	0.59	44	71
Verification Sites	2007	2.4	3.5	----- *	100	8
National Network	2005-7	6.1	6.0	0.76	20	71
Verification Sites	2005-7	8.3	7.2	0.24	24	17

* negative slope - r^2 not presented

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 Target Value and Long-term Objective, by zone, are summarised in Table 2.2. These data have also been presented in Form 19g of the questionnaire. Method B 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	B	0	B	1556	B	7034979	B
West Midlands Urban Area	UK0002	0	B	0	B	567	B	2019879	B
Greater Manchester Urban Area	UK0003	0	B	0	B	554	B	1837759	B
West Yorkshire Urban Area	UK0004	0	B	0	B	359	B	1146650	B
Tyneside	UK0005	0	B	0	B	223	B	721105	B
Liverpool Urban Area	UK0006	0	B	0	B	189	B	697951	B
Sheffield Urban Area	UK0007	0	B	0	B	164	B	521700	B
Nottingham Urban Area	UK0008	0	B	0	B	169	B	558935	B
Bristol Urban Area	UK0009	0	B	0	B	142	B	488798	B
Brighton/Worthing/Littlehampton	UK0010	0	B	0	B	103	B	388893	B
Leicester Urban Area	UK0011	0	B	0	B	102	B	374314	B
Portsmouth Urban Area	UK0012	0	B	0	B	102	B	358696	B
Teesside Urban Area	UK0013	0	B	0	B	114	B	302559	B
The Potteries	UK0014	0	B	0	B	91	B	266188	B
Bournemouth Urban Area	UK0015	0	B	0	B	123	B	340957	B
Reading/Wokingham Urban Area	UK0016	0	B	0	B	97	B	305786	B
Coventry/Bedworth	UK0017	0	B	0	B	76	B	277475	B
Kingston upon Hull	UK0018	0	B	0	B	81	B	259895	B
Southampton Urban Area	UK0019	0	B	0	B	79	B	264551	B
Birkenhead Urban Area	UK0020	0	B	0	B	92	B	266360	B
Southend Urban Area	UK0021	0	B	0	B	69	B	220761	B
Blackpool Urban Area	UK0022	0	B	0	B	70	B	218162	B
Preston Urban Area	UK0023	0	B	0	B	58	B	180687	B
Glasgow Urban Area	UK0024	0	B	0	B	0	B	0	B
Edinburgh Urban Area	UK0025	0	B	0	B	14	B	35501	B
Cardiff Urban Area	UK0026	0	B	0	B	76	B	264395	B
Swansea Urban Area	UK0027	0	B	0	B	85	B	185887	B
Belfast Urban Area	UK0028	0	B	0	B	0	B	0	B
Eastern	UK0029	0	B	0	B	19506	B	4963811	B
South West	UK0030	0	B	0	B	24329	B	4105371	B
South East	UK0031	0	B	0	B	19082	B	6230655	B
East Midlands	UK0032	0	B	0	B	15563	B	3260247	B
North West & Merseyside	UK0033	0	B	0	B	14132	B	3495567	B
Yorkshire & Humberside	UK0034	0	B	0	B	14996	B	3021264	B
West Midlands	UK0035	0	B	0	B	12191	B	2621810	B
North East	UK0036	0	B	0	B	8439	B	1489985	B
Central Scotland	UK0037	0	B	0	B	2302	B	332112	B
North East Scotland	UK0038	0	B	0	B	17340	B	883962	B
Highland	UK0039	0	B	0	B	36313	B	274106	B
Scottish Borders	UK0040	0	B	0	B	9161	B	216535	B
South Wales	UK0041	0	B	0	B	9637	B	1449103	B
North Wales	UK0042	0	B	0	B	8710	B	716839	B
Northern Ireland	UK0043	0	B	0	B	404	B	33739	B

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 2007 and the averaged metric 2003-2007 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). These data were interpolated to produce a rural well-mixed map at 5x5 km^2 resolution. Topographic effects are important for some ozone metrics, such as the AOT40 because of the disconnection of a shallow boundary layer from air aloft at times other than during the middle of the day at lowland locations. Surface ozone concentrations are lower at times other than during the middle of the day in these locations due to a combination of dry deposition and titration with NO emissions. This effect is much less marked at higher altitudes and at coastal locations, where wind is generally stronger and a shallow boundary layer does not form. As a result of the influence of altitude on this metric, it is necessary to calculate the metric between these well-mixed hours to allow an appropriate correction to the interpolated well-mixed rural map. This correction accounts for the diurnal variation in ozone, thereby converting the mapped well-mixed AOT40 to an 8.00 to 20.00 AOT40 for comparison against the Directive. The correction uses a variable ΔO_3, where ΔO_3 describes the difference between the AOT40 "well-mixed" and that between 0800 UTC and 2000 UTC during 2006[12]. For the purposes of this study the components of ΔO_3 are described as follows and were derived from measured values at rural sites in 2007 for the single year metric and years 2003-2007 for the multi-year metric:

$$\Delta O_{3\ 2007} = 0.0002.\text{altitude} + 1.3825$$

$$\Delta O_{3\ 2003\text{-}7} = 0.0002.\text{altitude} + 1.3493$$

An urban decrement term was subsequently defined for monitoring stations in the AURN and the 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, the decrement is closely related to annual mean NO_X concentration, and has been defined in a similar fashion, using a percentage decrement in ozone concentrations associated with NO_X concentrations. The relationships between the decrement and modelled NO_X concentrations for 2007 and 2003-2007 averaged metrics are presented in Figures 2.7 and 2.8 below.

Using the same methodology discussed in Section 2.1 for the days greater than 120 µg m^{-3} maps, the decrement was then used to correct the final AOT40 maps:

Corrected AOT40 map = interpolated rural map + decrement

Maps of modelled AOT40 for comparison with the Long-term Objective (2007) and Target Value (averaged 2003 to 2007) are presented in Figures 2.9 and 2.10.

[12] 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 AOT40 percentage decrement in ozone concentrations, 2007

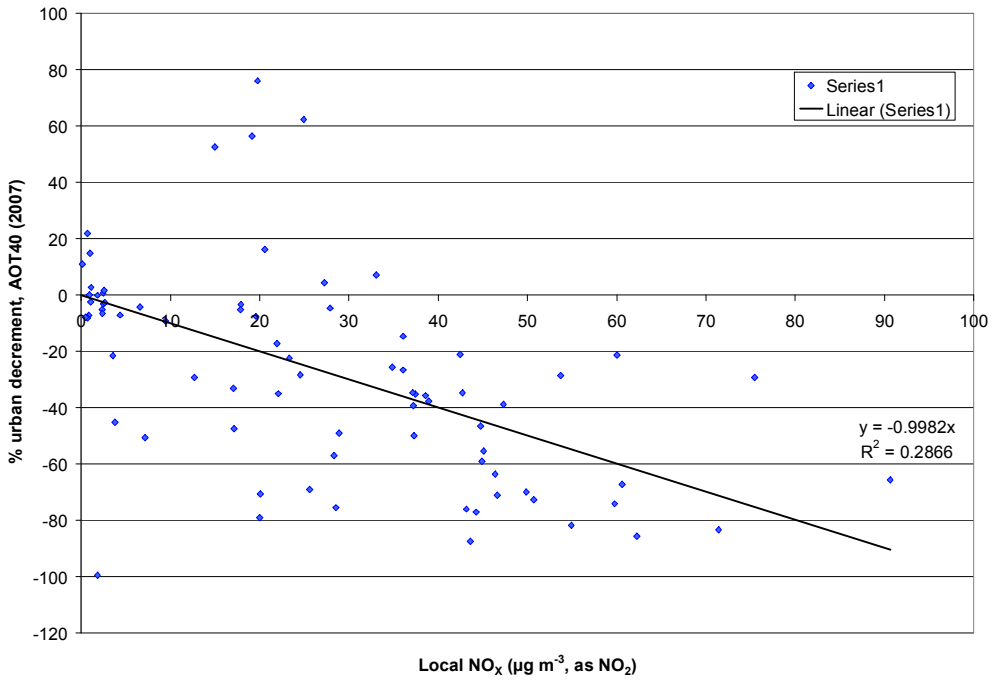


Figure 2.8 AOT40 percentage decrement in ozone concentrations, 2003-2007

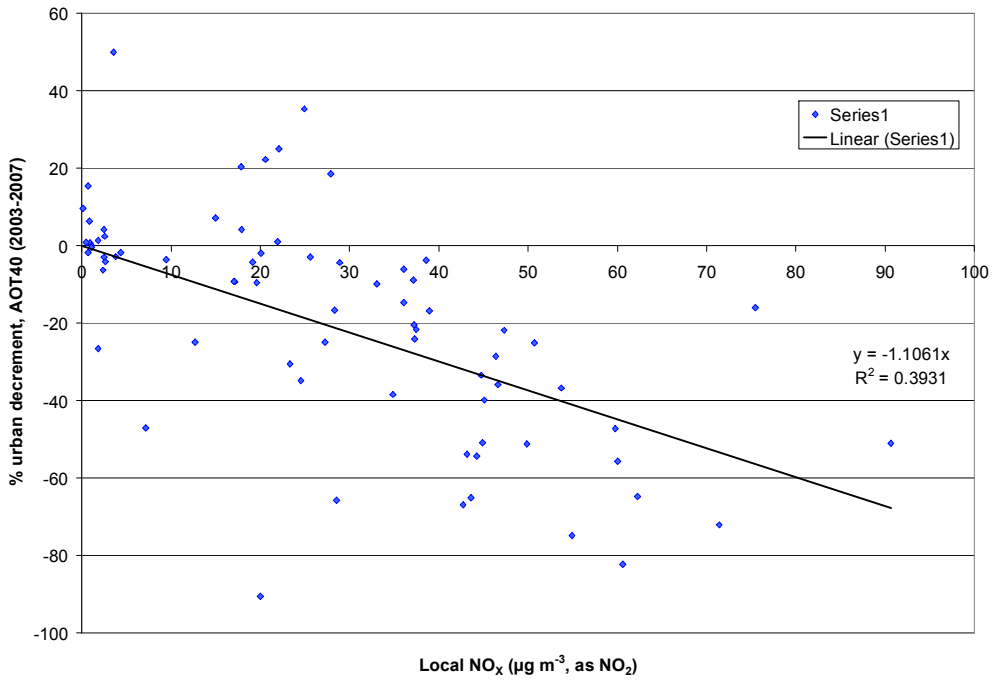


Figure 2.9 Estimated AOT40 vegetation metric, 2007 (μg m^{-3}.hours)

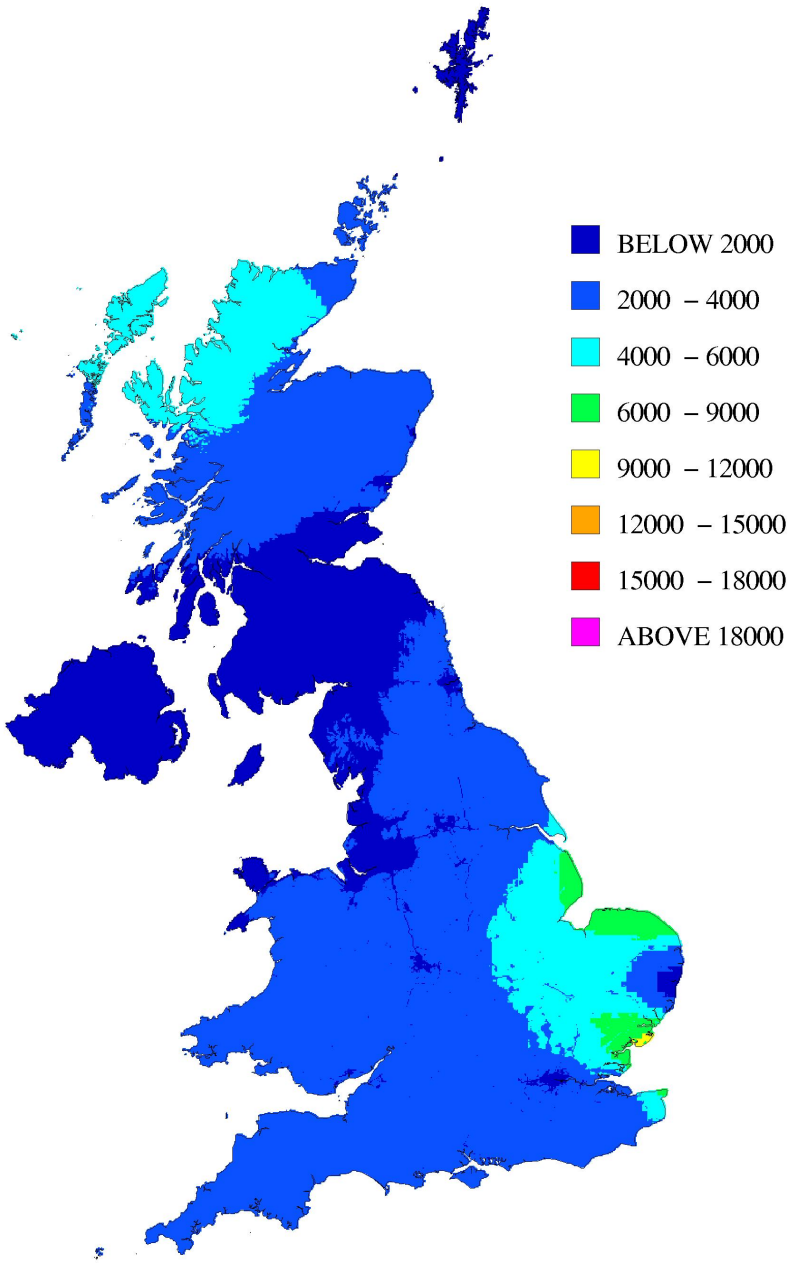
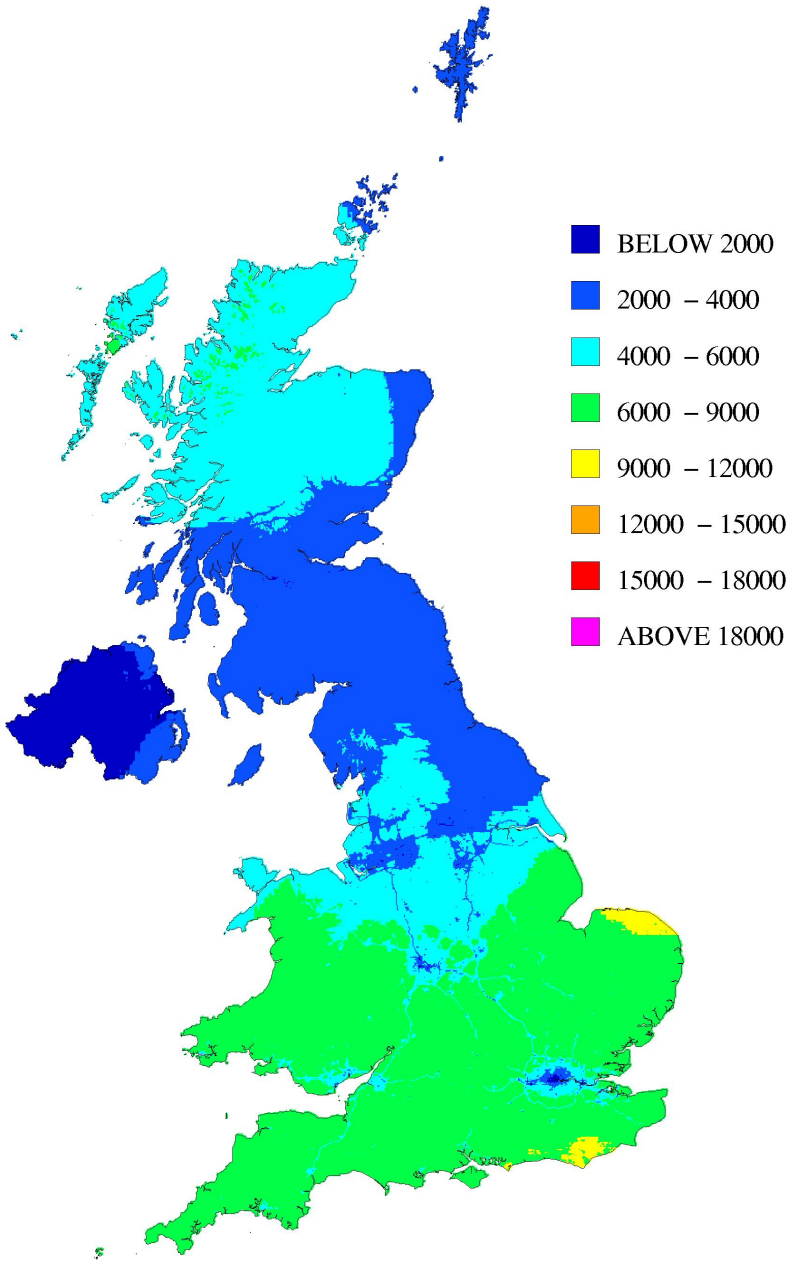


Figure 2.10 Estimated AOT40 vegetation metric, averaged 2003 – 2007 (μg m^{-3}.hours)



2.2.2 Verification of mapped AOT40 values

Figures 2.11 and 2.12 show comparisons of modelled and measured AOT40 metrics in 2007 and averaged 2003-7 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, 2007

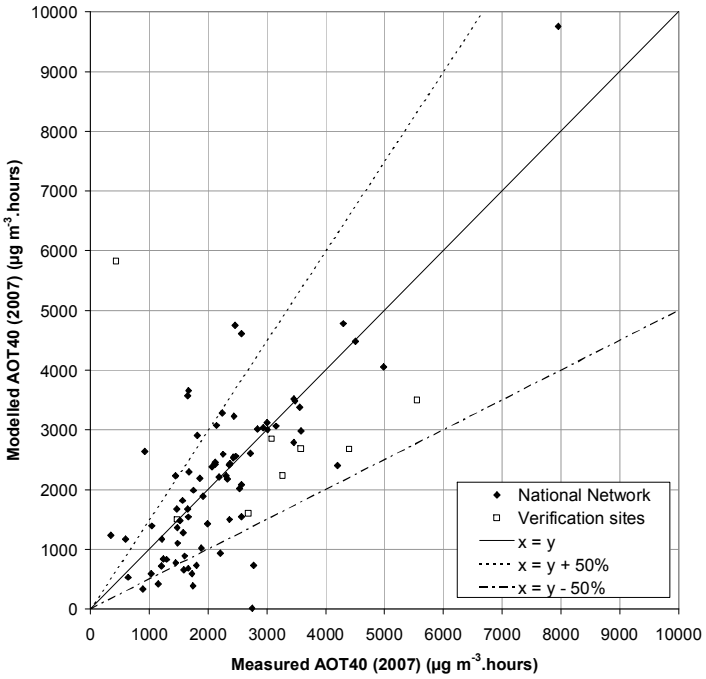
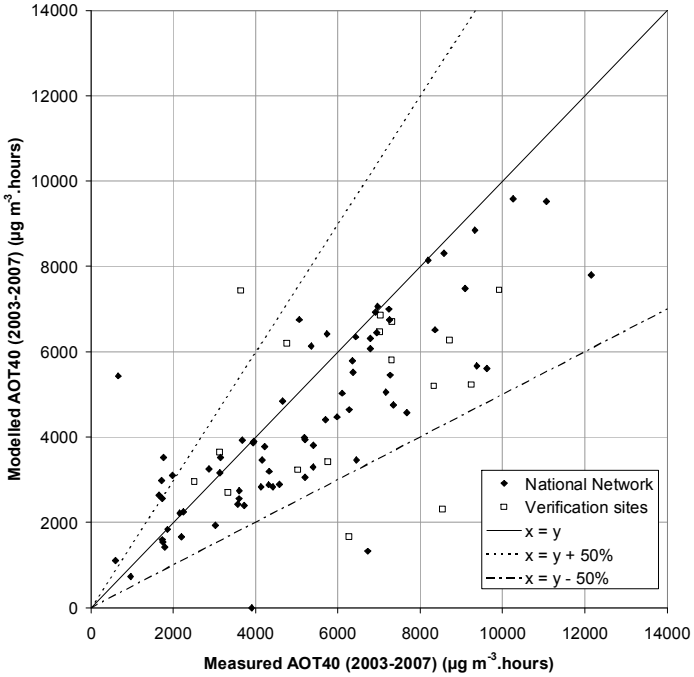


Figure 2.12 Verification of background AOT40 vegetation model, 2003-2007



With the exception of the Thanet rural site (also noted in section 2.1.2), the verification sites generally suggested a slight under estimation by the model for 2007. This is also reflected in the Table 2.3 which presents the summary statistics for the comparison between modelled and measured ozone concentrations. However, the results for the AOT40 metric are more encouraging that those for the number of days greater than 120 µg m^{-3} and all but one of the verification sites (Thanet rural, for which the modelled value was significantly in excess of that measured) was located within the +/- 50% DQO range.

There was more variation in the multi-year metric (TV) and the under estimation was more notable in this metric than in the single year model (LTO), as shown in Table 2.3 below. More verification sites were available for comparison of this metric given the several years across which the metric is calculated. This explains the difference between the 8 sites used for 2007 and the 17 used for 2003-2007.

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	2007	2281	2321	0.73	24.4	78
Verification Sites	2007	3061	2856	----- *	12.5	8
National Network	2003-7	5138	4344	0.72	8.3	72
Verification Sites	2003-7	6347	4910	0.23	17.6	17

* negative slope - r^2 not presented

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

The modelling results, in terms of a comparison of modelled concentrations with the Long-term Objective and the Target Value by zone, are summarised in Table 2.4. These data have also been presented in Form 19g of the questionnaire. Method B 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*	*km²*	*Method*	*km²*	*Method*	*km²*	*Method*	*km²*	*Method*
Greater London Urban Area	UK0001	0	B	n	B	0	B	n	B
West Midlands Urban Area	UK0002	0	B	n	B	0	B	n	B
Greater Manchester Urban Area	UK0003	0	B	n	B	0	B	n	B
West Yorkshire Urban Area	UK0004	0	B	n	B	0	B	n	B
Tyneside	UK0005	0	B	n	B	0	B	n	B
Liverpool Urban Area	UK0006	0	B	n	B	0	B	n	B
Sheffield Urban Area	UK0007	0	B	n	B	0	B	n	B
Nottingham Urban Area	UK0008	0	B	n	B	0	B	n	B
Bristol Urban Area	UK0009	0	B	n	B	0	B	n	B
Brighton/Worthing/Littlehampton	UK0010	0	B	n	B	0	B	n	B
Leicester Urban Area	UK0011	0	B	n	B	0	B	n	B
Portsmouth Urban Area	UK0012	0	B	n	B	0	B	n	B
Teesside Urban Area	UK0013	0	B	n	B	0	B	n	B
The Potteries	UK0014	0	B	n	B	0	B	n	B
Bournemouth Urban Area	UK0015	0	B	n	B	0	B	n	B
Reading/Wokingham Urban Area	UK0016	0	B	n	B	0	B	n	B
Coventry/Bedworth	UK0017	0	B	n	B	0	B	n	B
Kingston upon Hull	UK0018	0	B	n	B	0	B	n	B
Southampton Urban Area	UK0019	0	B	n	B	0	B	n	B
Birkenhead Urban Area	UK0020	0	B	n	B	0	B	n	B
Southend Urban Area	UK0021	0	B	n	B	0	B	n	B
Blackpool Urban Area	UK0022	0	B	n	B	0	B	n	B
Preston Urban Area	UK0023	0	B	n	B	0	B	n	B
Glasgow Urban Area	UK0024	0	B	n	B	0	B	n	B
Edinburgh Urban Area	UK0025	0	B	n	B	0	B	n	B
Cardiff Urban Area	UK0026	0	B	n	B	0	B	n	B
Swansea Urban Area	UK0027	0	B	n	B	0	B	n	B
Belfast Urban Area	UK0028	0	B	n	B	0	B	n	B
Eastern	UK0029	0	B	0	B	3839	B	1389	B
South West	UK0030	0	B	0	B	0	B	0	B
South East	UK0031	0	B	0	B	74	B	0	B
East Midlands	UK0032	0	B	0	B	976	B	513	B
North West & Merseyside	UK0033	0	B	0	B	0	B	0	B
Yorkshire & Humberside	UK0034	0	B	0	B	0	B	0	B
West Midlands	UK0035	0	B	0	B	0	B	0	B
North East	UK0036	0	B	0	B	0	B	0	B
Central Scotland	UK0037	0	B	0	B	0	B	0	B
North East Scotland	UK0038	0	B	0	B	0	B	0	B
Highland	UK0039	0	B	0	B	0	B	0	B
Scottish Borders	UK0040	0	B	0	B	0	B	0	B
South Wales	UK0041	0	B	0	B	0	B	0	B
North Wales	UK0042	0	B	0	B	0	B	0	B
Northern Ireland	UK0043	0	B	0	B	0	B	0	B

3 Exceedence of the Target Value and Long-term Objective

3.1 RESULTS FOR UK IN 2007

Table 3.1 presented in this section is derived from Form 9a of the questionnaire. Exceedence (or otherwise) of the Target Value (TV) and Long-term Objective (LTO) 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 concentrations 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 3.1 - Form 9a 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		y				y
Brighton/Worthing/Littlehampton	UK0010		y				y
Leicester Urban Area	UK0011		y				y
Portsmouth Urban Area	UK0012		y				y
Teesside Urban Area	UK0013		y				y
The Potteries	UK0014		y				y
Bournemouth Urban Area	UK0015		y				y
Reading/Wokingham Urban Area	UK0016		y				y
Coventry/Bedworth	UK0017		y				y
Kingston upon Hull	UK0018		m				y
Southampton Urban Area	UK0019		m				y
Birkenhead Urban Area	UK0020		m				y
Southend Urban Area	UK0021		m				y
Blackpool Urban Area	UK0022		y				y
Preston Urban Area	UK0023		m				y
Glasgow Urban Area	UK0024			y			y
Edinburgh Urban Area	UK0025		m				y
Cardiff Urban Area	UK0026		y				y
Swansea Urban Area	UK0027		m				m
Belfast Urban Area	UK0028			y			y
Eastern	UK0029		y			y	
South West	UK0030		y				y
South East	UK0031		y			m	
East Midlands	UK0032		y			m	
North West & Merseyside	UK0033		y				y
Yorkshire & Humberside	UK0034		y				y
West Midlands	UK0035		y				y
North East	UK0036		y				y
Central Scotland	UK0037		m				y
North East Scotland	UK0038		m				y
Highland	UK0039		y				y
Scottish Borders	UK0040		m				y
South Wales	UK0041		y				y
North Wales	UK0042		y				y
Northern Ireland	UK0043		m				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	41 zones (24 measured + 17 modelled)
AOT40 Long-term Objective	3 zones (1 measured + 2 modelled)

3.2 MEASURED EXCEEDENCES IN UK IN 2007

Forms 13a-c of the questionnaire require reasons associated with the measured exceedences of the LTO, Alert Threshold and Information Threshold to be documented. In 2007 there were no measured exceedences of the Alert or Information Threshold (Forms 13a and 13b). There were however, exceedences of the LTO and this information is summarised in Table 3.4 for monitoring stations in the UK. Measured annual statistics for ozone are presented in Form 15a of the questionnaire (see Table 3.5). Forms 14a-b relates to measured exceedence of the TVs of which there are none (see Table 3.2).

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

Table 3.4 - 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	4	14	123	S10
Aston Hill	UK0042	GB0031R	4	21	127	S10
Aston Hill	UK0042	GB0031R	4	22	131	S10
Birmingham Centre	UK0002	GB0569A	4	15	132	S10
Birmingham Tyburn	UK0002	GB0851A	4	15	126	S10
Birmingham Tyburn	UK0002	GB0851A	6	9	126	S10
Blackpool Marton	UK0022	GB0882A	4	2	123	S10
Blackpool Marton	UK0022	GB0882A	6	10	133	S10
Blackpool Marton	UK0022	GB0882A	6	11	143	S10
Blackpool Marton	UK0022	GB0882A	6	12	134	S10
Bottesford	UK0032	GB0032R	6	3	122	S10
Bottesford	UK0032	GB0032R	8	5	131	S10
Bournemouth	UK0015	GB0741A	5	1	123	S10
Bournemouth	UK0015	GB0741A	6	9	137	S10
Brighton Preston Park	UK0010	GB0860A	3	31	123	S10
Brighton Preston Park	UK0010	GB0860A	4	2	128	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)*
Brighton Preston Park	UK0010	GB0860A	4	3	123	S10
Brighton Preston Park	UK0010	GB0860A	4	24	145	S10
Brighton Preston Park	UK0010	GB0860A	4	28	123	S10
Brighton Preston Park	UK0010	GB0860A	5	24	135	S10
Brighton Preston Park	UK0010	GB0860A	6	3	126	S10
Bristol St Paul's	UK0009	GB0884A	4	14	124	S10
Bristol St Paul's	UK0009	GB0884A	6	9	130	S10
Bristol St Paul's	UK0009	GB0884A	6	10	130	S10
Cardiff Centre	UK0026	GB0580A	6	9	124	S10
Cardiff Centre	UK0026	GB0580A	6	10	130	S10
Coventry Memorial Park	UK0017	GB0739A	4	15	141	S10
Coventry Memorial Park	UK0017	GB0739A	4	22	121	S10
Coventry Memorial Park	UK0017	GB0739A	6	9	141	S10
Coventry Memorial Park	UK0017	GB0739A	8	5	125	S10
Cwmbran	UK0041	GB0744A	6	9	131	S10
Cwmbran	UK0041	GB0744A	6	10	130	S10
Exeter Roadside	UK0030	GB0640A	6	10	134	S10
Great Dun Fell	UK0033	GB0035R	3	28	123	S10
Great Dun Fell	UK0033	GB0035R	4	2	121	S10
Great Dun Fell	UK0033	GB0035R	6	11	131	S10
Great Dun Fell	UK0033	GB0035R	6	12	135	S10
Harwell	UK0031	GB0036R	6	9	132	S10
Harwell	UK0031	GB0036R	6	10	125	S10
Harwell	UK0031	GB0036R	8	5	126	S10
High Muffles	UK0034	GB0014R	6	3	131	S10
High Muffles	UK0034	GB0014R	8	5	121	S10
Ladybower	UK0032	GB0037R	4	15	134	S10
Ladybower	UK0032	GB0037R	6	3	124	S10
Ladybower	UK0032	GB0037R	6	9	121	S10
Leamington Spa	UK0035	GB0643A	4	15	127	S10
Leamington Spa	UK0035	GB0643A	6	9	130	S10
Leicester Centre	UK0011	GB0597A	6	3	129	S10
Leominster	UK0035	GB0861A	6	9	127	S10
London Eltham	UK0001	GB0586A	3	31	121	S10
London Eltham	UK0001	GB0586A	4	2	125	S10
London Eltham	UK0001	GB0586A	4	22	129	S10
London Eltham	UK0001	GB0586A	8	5	125	S10
London Haringey	UK0001	GB0638A	4	15	121	S10
London Haringey	UK0001	GB0638A	4	22	124	S10
London Haringey	UK0001	GB0638A	8	5	127	S10
London Haringey	UK0001	GB0638A	8	11	122	S10
London Hillingdon	UK0001	GB0642A	3	31	131	S10
London Hillingdon	UK0001	GB0642A	4	1	126	S10
London Hillingdon	UK0001	GB0642A	4	2	124	S10
London Hillingdon	UK0001	GB0642A	4	15	134	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 Hillingdon	UK0001	GB0642A	6	10	124	S10
London N. Kensington	UK0001	GB0620A	4	22	130	S10
London N. Kensington	UK0001	GB0620A	8	5	138	S10
London N. Kensington	UK0001	GB0620A	8	11	133	S10
London Teddington	UK0001	GB0644A	3	31	123	S10
London Teddington	UK0001	GB0644A	4	1	123	S10
London Teddington	UK0001	GB0644A	4	2	128	S10
London Teddington	UK0001	GB0644A	4	15	124	S10
London Teddington	UK0001	GB0644A	4	22	130	S10
London Teddington	UK0001	GB0644A	6	2	125	S10
London Teddington	UK0001	GB0644A	8	5	128	S10
London Westminster	UK0001	GB0743A	4	22	132	S10
London Westminster	UK0001	GB0743A	6	2	121	S10
Lullington Heath	UK0031	GB0038R	4	24	134	S10
Lullington Heath	UK0031	GB0038R	5	23	123	S10
Lullington Heath	UK0031	GB0038R	5	24	130	S10
Market Harborough	UK0032	GB0838A	4	1	126	S10
Market Harborough	UK0032	GB0838A	4	2	131	S10
Market Harborough	UK0032	GB0838A	4	15	139	S10
Market Harborough	UK0032	GB0838A	6	3	124	S10
Market Harborough	UK0032	GB0838A	6	9	121	S10
Market Harborough	UK0032	GB0838A	8	5	131	S10
Middlesbrough	UK0013	GB0583A	6	3	128	S10
Northampton	UK0032	GB0738A	4	2	122	S10
Northampton	UK0032	GB0738A	4	15	125	S10
Northampton	UK0032	GB0738A	6	3	126	S10
Northampton	UK0032	GB0738A	6	9	126	S10
Northampton	UK0032	GB0738A	8	5	150	S10
Northampton	UK0032	GB0738A	8	6	122	S10
Northampton	UK0032	GB0738A	8	11	127	S10
Norwich Centre	UK0029	GB0684A	4	1	122	S10
Norwich Centre	UK0029	GB0684A	6	2	131	S10
Norwich Centre	UK0029	GB0684A	8	5	145	S10
Norwich Centre	UK0029	GB0684A	8	6	121	S10
Plymouth Centre	UK0030	GB0687A	6	10	124	S10
Portsmouth	UK0012	GB0733A	6	9	134	S10
Reading New Town	UK0016	GB0840A	4	22	133	S10
Reading New Town	UK0016	GB0840A	6	3	125	S10
Reading New Town	UK0016	GB0840A	6	10	130	S10
Reading New Town	UK0016	GB0840A	8	11	124	S10
Rochester Stoke	UK0031	GB0617A	3	31	121	S10
Rochester Stoke	UK0031	GB0617A	4	22	124	S10
Rochester Stoke	UK0031	GB0617A	6	2	130	S10
Rochester Stoke	UK0031	GB0617A	8	5	121	S10
Sandwell West Bromwich	UK0002	GB0698A	4	15	144	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)*
Sandwell West Bromwich	UK0002	GB0698A	6	9	138	S10
Sibton	UK0029	GB0039R	8	5	138	S10
Somerton	UK0030	GB0044R	6	9	123	S10
Somerton	UK0030	GB0044R	6	10	127	S10
St Osyth	UK0029	GB0754A	3	31	132	S10
St Osyth	UK0029	GB0754A	4	2	137	S10
St Osyth	UK0029	GB0754A	4	3	122	S10
St Osyth	UK0029	GB0754A	5	24	135	S10
St Osyth	UK0029	GB0754A	6	2	121	S10
St Osyth	UK0029	GB0754A	6	10	122	S10
St Osyth	UK0029	GB0754A	6	11	124	S10
St Osyth	UK0029	GB0754A	6	12	131	S10
St Osyth	UK0029	GB0754A	8	5	144	S10
Stoke-on-Trent Centre	UK0014	GB0658A	6	9	134	S10
Stoke-on-Trent Centre	UK0014	GB0658A	6	10	125	S10
Strath Vaich	UK0039	GB0015R	4	21	121	S10
Strath Vaich	UK0039	GB0015R	5	5	124	S10
Strath Vaich	UK0039	GB0015R	6	9	123	S10
Sunderland Silksworth	UK0036	GB0863A	6	3	123	S10
Thurrock	UK0029	GB0645A	4	22	124	S10
Thurrock	UK0029	GB0645A	8	5	123	S10
Weybourne	UK0029	GB0745A	3	31	124	S10
Weybourne	UK0029	GB0745A	4	1	132	S10
Weybourne	UK0029	GB0745A	4	2	132	S10
Weybourne	UK0029	GB0745A	4	3	121	S10
Weybourne	UK0029	GB0745A	4	15	135	S10
Weybourne	UK0029	GB0745A	4	16	147	S10
Weybourne	UK0029	GB0745A	6	2	123	S10
Weybourne	UK0029	GB0745A	6	10	132	S10
Weybourne	UK0029	GB0745A	6	11	125	S10
Weybourne	UK0029	GB0745A	6	12	127	S10
Weybourne	UK0029	GB0745A	8	1	125	S10
Weybourne	UK0029	GB0745A	8	5	151	S10
Weybourne	UK0029	GB0745A	8	6	144	S10
Wigan Centre	UK0033	GB0864A	6	9	126	S10
Wigan Centre	UK0033	GB0864A	6	10	134	S10
Yarner Wood	UK0030	GB0013R	5	1	127	S10
Yarner Wood	UK0030	GB0013R	6	9	137	S10
Yarner Wood	UK0030	GB0013R	6	10	128	S10

Table 3.5- Form 15a Annual statistics of ozone (2002/3/EC, Article 10(2b) and Annex III)

Form 15 Annual statistics of ozone, arsenic, nickel, cadmium and benzo(a)pyrene (2002/3/EC, Article 10(2b) and Annex III, 2004/107/EC Article 5)

Form 15a Annual statistics for ozone

Station name	*Zone code*	*EoI station code*	*AOT40 for vegetation protection (µg/m³.h)*		*AOT40 for forest protection (µg/m³.h)*		*Annual average*
			Value	*Number of valid data*	*Value*	*Number of valid data*	
Aberdeen	UK0038	GB0729A	1677	1082	2326	2152	47
Aston Hill	UK0042	GB0031R	2175	1082	5827	2152	63
Auchencorth Moss	UK0037	GB0895A	1477	1104	3179	2196	58
Barnsley Gawber	UK0034	GB0681A	1499	1038	2722	2086	44
Belfast Centre	UK0028	GB0567A	1167	960	1808	1976	43
Birmingham Centre	UK0002	GB0569A	831	1082	2316	2108	38
Birmingham Tyburn	UK0002	GB0851A	887	1082	2449	2130	35
Blackpool Marton	UK0022	GB0882A	3657	1104	6082	2152	55
Bolton	UK0003	GB0654A	2671	386	4987	1362	42
Bottesford	UK0032	GB0032R	2398	1093	4922	2174	45
Bournemouth	UK0015	GB0741A	4608	1104	9027	2174	51
Brighton Preston Park	UK0010	GB0860A	4749	1049	9480	2108	50
Bristol St Paul's	UK0009	GB0884A	2293	1071	5675	2130	43
Bush Estate	UK0037	GB0033R	771	1082	1999	2152	56
Cardiff Centre	UK0026	GB0580A	1277	1071	2950	2152	40
Coventry Memorial Park	UK0017	GB0739A	3014	1093	7158	2152	45
Cwmbran	UK0041	GB0744A	2592	1093	5609	2196	50
Derry	UK0043	GB0673A	423	1093	821	2130	48
Edinburgh St Leonards	UK0025	GB0839A	1390	1060	2172	2130	48
Eskdalemuir	UK0040	GB0002R	1540	1093	3920	2152	54
Exeter Roadside	UK0030	GB0640A	1574	1093	2554	2174	46
Fort William	UK0039	GB0885A	746	972	1338	1581	54
Glasgow Centre	UK0024	GB0641A	532	1071	693	2130	36
Great Dun Fell	UK0033	GB0035R	2206	1082	5128	1691	62
Harwell	UK0031	GB0036R	3063	1060	5093	1845	48
High Muffles	UK0034	GB0014R	3119	1071	5432	2130	53
Hull Freetown	UK0018	GB0776A	2410	1093	4616	2130	43
Ladybower	UK0032	GB0037R	2607	1093	5957	2174	53
Leamington Spa	UK0035	GB0643A	1545	1093	3792	2042	39
Leeds Centre	UK0004	GB0584A	1102	1093	1881	2174	37
Leicester Centre	UK0011	GB0597A	2462	1093	4731	2152	38
Leominster	UK0035	GB0861A	2433	1093	5969	2152	48
Lerwick	UK0039	GB0881A	1817	1093	3094	2152	64
Liverpool Speke	UK0006	GB0777A	1171	1093	2039	2152	44
London Bloomsbury	UK0001	GB0566A	198	696	1396	1735	24
London Eltham	UK0001	GB0586A	2230	1093	5488	2130	39
London Haringey	UK0001	GB0638A	2542	1082	6267	2020	39
London Harlington	UK0001	GB0837A	1019	949	4037	2020	32
London Hillingdon	UK0001	GB0642A	2798	1060	5942	2152	30

Form 15 Annual statistics of ozone, arsenic, nickel, cadmium and benzo(a)pyrene (2002/3/EC, Article 10(2b) and Annex III, 2004/107/EC Article 5)

Form 15a Annual statistics for ozone

Station name	*Zone code*	*EoI station code*	*AOT40 for vegetation protection (µg/m³.h)*		*AOT40 for forest protection (µg/m³.h)*		*Annual average*
			Value	*Number of valid data*	*Value*	*Number of valid data*	
London Marylebone Road	UK0001	GB0682A	143	1082	645	2174	17
London N. Kensington	UK0001	GB0620A	2642	1049	6353	2108	36
London Teddington	UK0001	GB0644A	3227	1060	7303	2130	42
London Westminster	UK0001	GB0743A	1238	1093	3668	2086	34
Lough Navar	UK0043	GB0006R	1363	1093	1963	2152	46
Lullington Heath	UK0031	GB0038R	3039	1027	6973	2064	54
Manchester Piccadilly	UK0003	GB0613A	338	1093	400	2064	21
Manchester South	UK0003	GB0649A	591	1060	789	2130	31
Market Harborough	UK0032	GB0838A	4479	1082	9998	2086	55
Middlesbrough	UK0013	GB0583A	1426	1071	2427	2152	46
Narberth	UK0041	GB0043R	13	1016	24	2042	40
Newcastle Centre	UK0005	GB0568A	722	1082	1662	2130	43
Northampton	UK0032	GB0738A	2786	1093	6857	2152	46
Norwich Centre	UK0029	GB0684A	3379	1093	7116	2174	45
Nottingham Centre	UK0008	GB0646A	932	1082	2198	2152	34
Plymouth Centre	UK0030	GB0687A	726	1071	1093	2152	41
Portsmouth	UK0012	GB0733A	3074	1093	6407	2174	47
Preston	UK0023	GB0731A	659	1027	1715	2086	42
Reading New Town	UK0016	GB0840A	2427	1071	6096	2108	43
Rochester Stoke	UK0031	GB0617A	3486	1082	7147	2152	46
Salford Eccles	UK0003	GB0660A	836	1082	1630	2064	35
Sandwell West Bromwich	UK0002	GB0698A	2230	1027	4927	2108	42
Sheffield Centre	UK0007	GB0615A	1989	1060	2515	2130	38
Sibton	UK0029	GB0039R	1888	1038	4626	2020	50
Somerton	UK0030	GB0044R	3005	1082	7040	1998	54
Southampton Centre	UK0019	GB0598A	98	1060	273	2108	31
Southend-on-Sea	UK0021	GB0728A	2980	1093	6053	2152	45
St Osyth	UK0029	GB0754A	10128	1093	16468	2174	55
Stoke-on-Trent Centre	UK0014	GB0658A	2902	1071	5572	2152	47
Strath Vaich	UK0039	GB0015R	4779	1071	7604	1954	68
Sunderland Silksworth	UK0036	GB0863A	2379	1104	3317	2174	50
Thurrock	UK0029	GB0645A	2019	1104	4417	2130	37
Weybourne	UK0029	GB0745A	9758	1104	16040	2130	65
Wigan Centre	UK0033	GB0864A	3568	1027	7131	2108	46
Wirral Tranmere	UK0020	GB0730A	1673	1027	3169	2086	47
Yarner Wood	UK0030	GB0013R	3515	1071	8773	2042	59

3.3 RESULTS FOR GIBRALTAR IN 2007

A comparable air quality assessment for ozone is carried out for Gibraltar just as for the rest of the UK and is submitted to the European Commission in a separate questionnaire. The results of this assessment are presented in this section, summarising concentrations in 2007 and including Tables from the submitted questionnaire for Gibraltar. The results for Gibraltar have been based on measured data from the continuous automatic monitoring campaign, no model outputs being available for Gibraltar at this time.

Table 3.6 presented below is from Form 9a of the questionnaire. Exceedence (or otherwise) of the Target Value (TV) and Long-term Objective (LTO) where this exists are indicated by a 'y' for measured exceedences and with an 'm' for modelled exceedences.

The results for Gibraltar are summarised in Tables 3.7 and 3.8 in terms of exceedences of Target Values (TV) and Long-term Objectives (LTO).

Table 3.6 - Form 9a 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 3.7 - 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 3.8 - 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	1 zone (measured)
AOT40 Long-term Objective	1 zone (measured)

3.4 MEASURED EXCEEDENCES IN GIBRALTAR IN 2007

Forms 13a-c of the questionnaire require reasons associated with the measured exceedences of the LTO, Alert Threshold and Information Threshold to be documented. Available monitoring data shows that neither the Alert Threshold or the Information Threshold were exceeded in Gibraltar in 2007. There were measured exceedences of the LTO in Gibraltar in 2007, the details of which are presented in Table 3.9. Measured annual statistics for ozone are presented in Form 15a of the questionnaire (see Table 3.10). Forms 14a-b relates to measured exceedence of the TVs of which there are none (see Table 3.9).

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

Table 3.9 - 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	3	16	132	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	3	17	140	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	3	18	137	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	4	13	122	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	4	20	121	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	4	21	121	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	5	9	123	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	6	5	139	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	6	6	138	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	6	7	123	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	8	27	128	S10
Gibraltar Bleak House	UK(GIB)	GB0051A	8	28	127	S10

Table 3.10- Form 15a Annual statistics of ozone (2002/3/EC, Article 10(2b) and Annex III)

Form 15 Annual statistics of ozone, arsenic, nickel, cadmium and benzo(a)pyrene (2002/3/EC, Article 10(2b) and Annex III, 2004/107/EC Article 5)

Form 15a Annual statistics for ozone

Zone code	*EoI station code*	*AOT40 for vegetation protection ($\mu g/m^3.h$)*		*AOT40 for forest protection ($\mu g/m^3.h$)*		*Annual average*
		Value	*Number of valid data*	*Value*	*Number of valid data*	
UK(GIB)	GB0051A	7863	1082	18679	2152	62

3.5 ACKNOWLEDGEMENTS

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APPENDIX 1. NATIONAL NETWORK MONITORING SITES

Table A1.1. UK monitoring sites operating during 2007 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
GB0895A	Auchencorth Moss	UK0037	R	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
GB0884A	Bristol St Paul's	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
GB0885A	Fort William	UK0039	S	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	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
GB0837A	London Harlington	UK0001	U	y	y	y
GB0642A	London Hillingdon	UK0001	S	y	y	y
GB0672A	London Lewisham	UK0001	U	y	y	y
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
GB0906A	Port Talbot Margam	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 Stoke	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
GB0896A	Swansea Roadside	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

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
GB0013R	Yarner Wood	UK0030	R	y	y	y

Table A1.2. Gibraltar monitoring sites operating during 2007 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

* Station types defined in Annex IV of third Daughter Directive (2002/3/EC):
U = urban
S = suburban
R = rural
RB = rural background

Table A1.3 Data capture rates for sites used in model calibrations for AQDD3, 2007

Site	Data Capture (%)	
	O3	NO2 and NOX
Aberdeen	98.5	95.4
Aston Hill	91.9	91.8
Auchencorth Moss	99.5	nm
Barnsley Gawber	94.5	91.1
Belfast Centre	95	91
Birmingham Centre	96.5	85.4
Birmingham Tyburn	98.8	98.6
Blackpool Marton	98	97
Bolton	79.7	0
Bottesford	99.5	nm
Bournemouth	98.8	93.7
Bradford Centre	71.2	59.1
Brighton Preston Park	96.7	96.7
Bristol St Paul's	98.2	93.1
Bury Roadside	57.1	81.1
Bush Estate	98.7	90.5
Cardiff Centre	98.5	98.2
Coventry Memorial Park	99.3	98.9
Cwmbran	99.5	82.4
Derry	96.7	89.2
Edinburgh St Leonards	97.6	97.2
Eskdalemuir	98.6	78.2
Exeter Roadside	99.1	99
Fort William	78.5	84.8
Glasgow Centre	98	92
Glazebury	72.9	97.1
Great Dun Fell	86.5	nm
Harwell	82.4	90.7
High Muffles	98.5	97.8
Hull Freetown	98.2	94.7
Ladybower	98.5	73.3

Site	*Data Capture (%)*	
	O3	*NO2 and NOX*
Leamington Spa	96.1	71.2
Leeds Centre	99.1	99
Leicester Centre	99.1	99.1
Leominster	98.8	94
Lerwick	86.9	nm
Liverpool Speke	98.2	96.1
London Bexley	74	95.5
London Bloomsbury	85.4	78.4
London Brent	73.9	70.8
London Eltham	98.1	96.5
London Hackney	74.4	74.4
London Haringey	81.4	9
London Harlington	89.4	93.9
London Hillingdon	98.3	97.9
London Lewisham	74.4	69.1
London Marylebone Road	98.6	98
London N. Kensington	96.8	99
London Southwark	74	73.9
London Teddington	96.7	94.8
London Wandsworth	74.3	69.1
London Westminster	95.6	77.3
Lough Navar	97.9	nm
Lullington Heath	96.3	94.3
Manchester Piccadilly	88	96.2
Manchester South	94.8	85.5
Market Harborough	96.9	98.2
Middlesbrough	98.4	98.8
Narberth	86.8	89.4
Newcastle Centre	97.8	86.4
Northampton	97.2	97.4
Norwich Centre	99.1	99.1
Nottingham Centre	98.3	96.7
Plymouth Centre	87.3	84.6
Port Talbot	54.6	54.6
Port Talbot Margam	41.6	41.5
Portsmouth	99.1	99
Preston	95.7	95.8
Reading New Town	96.7	95.8
Redcar	62.1	65.1
Rochester Stoke	98.4	97.4
Rotherham Centre	70.2	67.1
Salford Eccles	94.2	91
Sandwell West Bromwich	97.1	98.8
Sheffield Centre	95.6	94.5
Sibton	95.4	nm
Somerton	94.5	93.1
Southampton Centre	97.3	77.6

Site	*Data Capture (%)*	
	O3	*NO2 and NOX*
Southend-on-Sea	98.8	98.9
St Osyth	98.4	92.3
Stoke-on-Trent Centre	94.6	96.5
Strath Vaich	87.9	nm
Sunderland Silksworth	96.3	87.5
Swansea Roadside	73	98.4
Thurrock	96.6	87.3
Weybourne	98.2	nm
Wicken Fen	74.3	86
Wigan Centre	98	96.1
Wirral Tranmere	97	96.9
Wolverhampton Centre	73.1	72.8
Yarner Wood	95.2	90.9

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
Chatham Luton Background	URBAN BACKGROUND	Kent & Medway Air Quality Monitoring Network
Folkestone Suburban	SUBURBAN	Kent & Medway Air Quality Monitoring Network
Glasgow Waulkmillglen Reservoir	RURAL	Glasgow City Council
Heathrow LHR2	AIRPORT	BAA
Heathrow Main Road	AIRPORT	BAA
Heathrow Oaks Road	AIRPORT	BAA
Maidstone Rural	RURAL	Kent & Medway Air Quality Monitoring Network
Marchlyn Mawr	REMOTE	Gwyneth Council
Newham Wren Close	URBAN BACKGROUND	London Borough of Newham
Newport Malpas Depot	URBAN BACKGROUND	Newport County BC
Oldham West End House	URBAN BACKGROUND	Oldham MBC
Oxford St Ebbes (Cal Club)	URBAN BACKGROUND	Oxford City Council
South Holland	RURAL	South Holland DC
Tameside Two Trees School	URBAN BACKGROUND	Tameside MBC
Thanet Rural	RURAL	Kent & Medway Air Quality Monitoring Network
V Glamorgan Fonmon	RURAL	Vale of Glamorgan Council