The Addition of Background Concentrations to Modelled Contributions from Discharge Stacks

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This report is an assessment of methods of adding measured background concentrations of SO_2, NO_2 and NO_x to modelled contributions from discharge stacks. The information in this document is meant for use by EA staff and others involved in regulation of the release of pollutants to the atmosphere.

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EXECUTIVE SUMMARY

In order to assess the impact of emissions from industrial sources on local air quality using dispersion models, it is necessary to predict the contribution of the industrial source to ground level concentrations and then add the predicted contribution to background concentrations. If the impact on air quality is assessed in terms of pollutant concentrations averaged over a year, then the total concentration is simply the sum of the source and background averaged concentrations. However, serious effects of many air pollutants on human health arise from short term peak concentrations rather than longer term averages. This is reflected in the National Air Quality Strategy objectives which are set in terms of the highest percentiles of hourly, or in the case of SO_2 15 minute, concentrations experienced in a year. For example the objective for NO_2 is that the 99.8th percentile of hourly concentrations in a year should not exceed 105 ppb. For impacts assessed in this way it is not appropriate to add the maximum modelled source concentrations to the maximum background concentrations because they may not occur simultaneously. This problem is particularly marked for emissions from large industrial sources because the meteorological conditions which produce high concentrations from tall stacks are not the same as those which produce the highest concentrations from low level background sources.

Nevertheless, in the absence of a reliable method of combining source and background concentrations it has been common practice to sum the high percentiles. From a regulatory point of view this is a conservative practice because it represents the worst case. It is recognised that this overestimates the impact of industrial sources and various formulations have been suggested to provide a more accurate assessment. These include combinations of maximum modelled stack contributions with multiples of annual average or percentiles of the background concentration. In some situations these formulations have been found to be more accurate than simple addition but the confidence with which they can be applied has remained uncertain.

The objective of this project was to investigate the degree to which simple addition of maximum concentrations overestimates the actual maximum concentrations and to assess the accuracy of other formulations. This has been done by taking a year of consecutive hourly measurements of SO_2, NO_x and NO_2 from monitoring stations in Liverpool and Manchester. Using hourly local meteorological data for the same period, consecutive hourly ground level concentrations have been modelled for emissions from representative hypothetical new industrial sources. Modelled source and measured background concentrations have been added hour by hour to provide a data set of consecutive hourly combined concentrations for the year. This has been used as a baseline for the determination of the highest combined concentrations occurring in the year against which the addition of maximum percentiles and estimates from other formulations can be compared.

In a similar manner the limitations on the contribution of industrial sources to ground level concentrations of NO_2 have been assessed. The limitation arises because the conversion of emissions of NO to NO_2 is restricted by the availability of ambient ozone. A year of consecutive hourly measured ozone concentrations has been combined with modelled source concentrations of NO and measured background concentrations of NO_2 to provide a data set of consecutive hourly NO_2 concentrations which take into account the restriction on the conversion of NO. These results are compared with the conservative assumption that all NO is converted to NO_2 and with other formulations used to approximate the effects of restricted conversion.

The results show that:

1. For the highest percentiles simple addition can overestimate the source contribution by a factor of up to two and that in general the overestimate is less severe for lower percentiles.
2. Of the formulations used to add source contributions to background the best were:
    - sum of squares;
    - correlation;
    - maximum twice annual mean.
3. The "correlation" method was no improvement on the "sum of squares" method, which indicates that the extent of the correlation between modelled stack concentrations and background concentrations was not great and that there is little benefit in taking the correlation into account.
4. All methods produced estimates outside confidence limits based on the Poisson distribution suggesting that the errors in the methods of addition are not all attributable to chance. However, the above methods produced estimates within the confidence limits in most comparisons.
5. The use of the Poisson distribution to derive confidence limits for percentile concentrations was tested using modelling data from earlier studies of the impact of power stations on sulphur dioxide concentrations in Yorkshire. The analysis indicates that to a large extent the differences between modelled results when using meteorological data for different years may be attributed to chance. In consequence, it is recommended that confidence limits are derived for modelled percentile concentrations from the Poisson distribution when carrying out impact assessments using dispersion models. The confidence limits may be determined by calculating higher percentile concentrations: suitable percentiles are suggested.
6. Limited availability of ambient ozone restricted significantly the source contributions to concentrations of NO_2.
7. Of the formulations used to take account of the restricted production of NO_2 the best were:
    - maximum annual mean;
    - sum of squares;
    - 90th percentile ozone.
8. All methods produced estimates outside confidence limits based on the Poisson distribution suggesting that the errors in the methods of addition are not all attributable to chance. The 90th percentile ozone method produced most estimates within the confidence limits.
9. The spatial variation in total (stack plus background) concentrations was investigated. Modelling results showed that the maximum total concentration may not occur at the same location as the maximum stack contribution. However, the concentration at the location of the total concentration maximum was similar to that at the location of the stack only maximum.

These results have been obtained using only a restricted set of data: one model, one year of data from three monitoring sites and one year of meteorological data from one site. Further investigation will be required to consolidate the conclusions of the work. Nevertheless, the results suggest that the use of hourly sequential modelling combined with hourly measured

data from monitoring sites may provide improved methods for assessing the impact of industrial sources on local air quality.

Keywords

Industrial sources, background concentrations, dispersion modelling, sulphur dioxide, nitrogen oxides, nitric oxide, nitrogen dioxide, ozone.

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1 INTRODUCTION

The emissions from many industrial plants to air have the potential to have a significant effect on local air quality. A legislative and policy framework exists to control these impacts: the key elements of the framework are described, for example, in the National Air Quality Strategy (DETR, 1997). As the result of this legislative framework, plant operators, regulators and local authorities may be required to assess the impact of emissions on local air quality against air quality standards and objectives. Guidance documents have been prepared to advise on methods of assessment in order to prevent the task becoming too onerous. These include "Guidance for estimating the air quality impact of stationary sources" (Environment Agency, 1998) and "Review and Assessment: Pollutant Specific Guidance" (DETR, 1998).

The assessment of local air quality involves the estimation of the contributions to pollutant concentrations from the plant (the process contribution, PC) and from background sources (the ambient concentration, AC). The estimation of these contributions separately greatly simplifies the assessment process. It is then necessary to combine these separate contributions in an appropriate way to give an estimate of the maximum total concentration at ground level (the predicted environmental concentration, PEC).

Many air pollutants have acute short-term impacts on human health. Consequently air quality standards for many pollutants are specified in terms of percentile concentrations with averaging periods of typically between 15 minutes and 24 hours. Thus, for example, the UK National Air Quality Strategy adopted the objective for sulphur dioxide that the concentration should be less than 100 ppb for more than 99.9 percent of 15 minute averaging periods over a year. The combination of process contribution and ambient concentration to give estimates of the predicted environmental concentration for air quality standards specified in terms of percentile concentrations is not straightforward, because it is necessary to take account of the fact that the relevant percentile events may not occur simultaneously. In particular, the fact that the maximum ambient concentration may not occur at the same time as the maximum process contribution means that it would be unduly conservative to obtain the maximum PEC by simply adding the maximum PC to the maximum AC. A more realistic approach to estimating the PEC for short-term statistics is to assume that there is only limited coincidence of relevant high-percentile events within the concentration time series of AC and PC. For example, for short-term sulphur dioxide the government's Pollutant Specific Guidance (DETR, 1998) suggests taking twice the annual average as a more frequently occurring value of the AC and adding this value to the high-percentile PC to give a realistic PEC. A range of alternative methods is investigated in this report in order to assess the potential errors resulting from the use of simple techniques for combining the PC with the AC.

Dispersion models are used to estimate the impact of existing or planned stationary sources on local air quality. These models typically derive percentile concentrations by:

- calculating the contributions from modelled sources to concentrations at receptor sites for each hour sequentially using meteorological data for each hour throughout a year,
- ordering the data in order of decreasing concentration,
- and selecting the value corresponding to the appropriate percentile.

Alternatively, models make use of statistically-analysed meteorological data which assigns a relative frequency to each class of meteorological condition. Such models may derive percentile concentrations by:

- calculating the contributions from modelled sources to concentrations at receptors for each meteorological class,

- ordering the data in order of decreasing concentration,
- calculating the cumulative frequency,
- and selecting the value for which the cumulative frequency corresponds to the appropriate percentile.

However, pollutant sources do not exist in isolation so that there is an existing ambient background concentration which varies throughout the year. If concentration measurements are available, it may be possible to take account of this background on an hour by hour basis. For each hour of the year, the total concentration may be calculated as the sum of the modelled concentration and the ambient concentration derived from other sources. The percentile concentration may then be determined by ordering the total concentration values.

Usually, ambient background concentration measurements close to the modelled source are not available. Detailed monitoring data is available for many city centre sites: less detailed monitoring data (usually daily, monthly or annual average concentrations) may be available at other sites. Estimates of annual average concentrations at 1 km resolution throughout the UK are available for key pollutants at the AEA Technology site on the World Wide Web. The use of concentration statistics from other sites in impact assessments results in errors because:

- the monitoring site may not be representative of the source site;
- computational errors resulting from the use of concentration statistics (e.g. annual average concentrations).

In this study, we have investigated the computational errors resulting from the use of alternative procedures in the calculation of percentile concentrations. We have considered the impact of hypothetical new emissions sources located close to monitoring stations in Manchester and Liverpool during 1996. We have used a dispersion model to calculate the contribution from the emission sources to ground level concentrations for each hour based on meteorological data from Ringway. We have then added the background concentration measured at the monitoring station to the modelled contribution and calculated the appropriate percentile concentrations by ordering the total concentrations. We have compared the results with those obtained using a selection of alternative procedures based on concentration statistics from the monitoring stations.

Percentile concentrations are subject to considerable year-to-year variation. These variations may be associated with changes in meteorological conditions or may occur entirely by chance. We have investigated the extent to which year-to-year variations in percentiles might be expected to occur by chance. We have then compared the computational errors associated with alternative method of calculating percentiles with chance year-to-year variations. We have also compared modelled year-to-year variations at an example site with variations that might be expected to occur by chance, drawing on earlier studies of Yorkshire power stations.

2 DISPERSION MODELLING

2.1 The dispersion model

The dispersion model, ADMS Version 2.2, was used for this study. It is an up-to-date model in which the boundary layer structure is characterised by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and heat flux at the surface. Concentration distributions are assumed to be Gaussian in stable and neutral conditions, but the vertical distribution is non-Gaussian in convective conditions to take account of the skewed structure of the vertical component of turbulence. It contains a number

of complex modules that can allow for the effects of plume rise, complex terrain and buildings. The model and its components are described in a User Manual (CERC, 1995).

The study made use of two main modes of operation of the model:

- short term, in which the concentrations at receptors are calculated and reported sequentially for each hour of a meteorological data set, for data sets of up to 99 hours;
- long term, in which the concentrations are calculated sequentially for each hour of a meteorological data set using a data set that covered a complete year but concentrations are reported only as averages and percentile values at each receptor.

A computer script was prepared to facilitate the multiple runs of the model in short term mode required to cover a complete years meteorological data. Model runs in long term mode were used solely to identify the locations where average and percentile concentrations would be highest.

2.2 Sources modelled

Hypothetical new sources close to monitoring stations in Manchester and Liverpool were modelled in order to assess their incremental impact on air quality. The modelled sources had the following characteristics:

Stack height	25, 50, 100 m
Stack diameter	1 m
Discharge velocity	15 m/s
Discharge temperature	150 ^{o}C

2.3 Meteorological data

Sequential hourly meteorological data supplied by the Meteorological Office for Manchester (Ringway) Airport for 1996 was used throughout the study. The data represented meteorological conditions in terms of wind speed, wind direction, time of day, time of year and cloud cover. The data was preprocessed using the ADMS-2 meteorological preprocessor to provide estimates of boundary layer height for each hour throughout the year.

A surface roughness value of 0.5 m was used to represent the terrain, characteristic of open suburbia.

2.4 Receptors

The model was initially run in long term mode using a 21 x 21node grid with grid spacing 100 m centred on the source in order to identify the locations of the highest modelled concentrations. These were as shown in Table 2.1. The model was then used in short term mode to calculate hourly concentrations at each of these receptor locations.

For the 50 m high stack, calculations were also carried out in short term mode for a polar grid of receptors at 30 degree intervals and 100 m radius intervals out to 800 m from the stack. These were used to determine concentration isopleths.

Table 2.1 Locations of largest concentrations.

Stack height (m)	Statistics	Coordinates of maximum (m)
50	Annual average	(100,500)
	Annual maximum	(100,-100)
	98th percentile	(400, -100)
25	Annual average	(0, 300)
	Annual maximum	(0, -100)
	98th percentile	(100, 200)
100	Annual average	(100,1000)
	Annual maximum	(100, -200)
	98th percentile	(700, -200)

3 THE ADDITION OF BACKGROUND CONCENTRATIONS

3.1 Background concentrations

Air quality monitoring data for the United Kingdom are archived by AEA Technology on behalf of the Department for the Environment, Transport and the Regions. The following data for 1996 were used in the analysis:

Manchester Piccadilly - sulphur dioxide
Liverpool Centre - sulphur dioxide
Manchester Town Hall - oxides of nitrogen
Liverpool Centre - oxides of nitrogen
Liverpool Centre - nitrogen dioxide

The dispersion model ADMS was unable to calculate concentrations for a small number (~200) hours as a result of inadequate meteorological data or calm conditions. These hours were excluded from the analysis.

There are a small number of hours missing from the air quality monitoring data set. The ambient concentrations were set to zero for hours with missing data.

3.2 Addition methods

3.2.1 The baseline method

The background concentrations were added to the modelled concentrations on an hour by hour basis using an Excel 5.0 spreadsheet. For nitrogen dioxide, it was initially assumed that all oxides of nitrogen were converted to nitrogen dioxide (see Section 4). The nth largest total concentrations were determined, where values of n corresponding to various percentiles are shown in Table 3.1.

The other methods tested attempt to represent the total concentration distribution in terms of a small number of parameters. A statistical measure is required to determine whether the differences between methods arise because of chance deviations in the concentration distribution. Confidence limits for n have been estimated on the following basis. Assume that the concentration values throughout the year may be binned into k categories according to, say, time of day and time of year, with n_k values in each category and that the probability of exceeding a specified concentration in each category is θ_k. Then the probability that there will be exactly x_k exceedences in each category will be given by the binomial distribution. For

high percentiles, the probabilities, θ_k, are small. For $\theta_k<0.1$, the binomial distribution may be approximated (Hald, 1960) to the Poisson distribution with parameter ξ_k. The addition theorem for the Poisson distribution (Hald, 1960) holds that:

If x_1, x_2, ..., x_k are stochastically independent and Poisson-distributed with parameters ξ_1, ξ_2, ... ξ_k, then the sum $x= x_1+x_2+....+x_k$ will be Poisson-distributed with parameter $\xi_1+ \xi_1+ .... +\xi_k$.

We have therefore used the Poisson distribution to estimate one sided 95 %ile confidence limits for n shown in Table 3.1. For n>140, we have approximated the Poisson distribution by the normal distribution (see Hald, 1960). The confidence limits for n have then been used to estimate confidence limits for the percentile concentrations. Thus we have calculated upper confidence limits for the 98th percentile concentration by determining the 149th highest concentration.

The use of the Poisson distribution for the setting of confidence limits for modelled percentile concentrations is discussed further in Section 5.

Table 3.1 Numbers of hours in a year corresponding to percentiles.

Percentile	n	95 % Confidence limits on n	
		Lower	Upper
Maximum	1		
99.9 %	8	4	13
99.8 %	16	10	24
98 %	170	149	191
90 %	851	805	898

3.2.2 Method A: Addition of percentile values

The percentile concentrations were determined separately for the stack contribution and the background concentration. The two values were then added.

$$T_{A,q} = S_q + A_q$$

where: $T_{A,q}$ is the qth percentile total concentration calculated using method A;
S_q is the qth percentile stack contribution;
A_q is the qth percentile ambient concentration.

3.2.3 Method B: Sum of squares

This method has the following basis.
The deviation of the percentile from the annual mean value may be expressed in terms of the standard deviation of the concentrations. Thus:

$$S_q - S_m = k_S \sigma_S$$
$$A_q - A_m = k_A \sigma_A$$
$$T_q - T_m = k_T \sigma_T$$

where: S_m, A_m, T_m are annual average stack, ambient and total concentrations;
k_S, k_A, k_T are multipliers;
σ_S, σ_A, σ_T are the standard deviations of concentrations.

The method then makes use of the additive property of variances:

$$\sigma_T^2 = \sigma_S^2 + \sigma_A^2 + 2\rho_{SA}\sigma_S\sigma_A$$

where ρ_{SA} is the correlation coefficient between the stack concentrations and the ambient concentrations.

By substitution,

$$\left(T_q - T_m\right)^2 = \left(\frac{S_q - S_m}{k_S / k_T}\right)^2 + \left(\frac{A_q - A_m}{k_A / k_T}\right)^2 + 2\rho_{SA}\left(S_q - S_m\right)\left(A_q - A_m\right)\left(\frac{k_T^2}{k_S k_A}\right)$$

The method then makes the assumptions that:

- the stack contribution and the background concentrations are not correlated;
- the concentration distributions are similar so that $k_T=k_S=k_A$.

Then:

$$\left(T_q - T_m\right)^2 = \left(\frac{S_q - S_m}{1}\right)^2 + \left(\frac{A_q - A_m}{1}\right)^2$$

The annual average total concentration is given by the sum of the annual average stack and background concentrations. The percentile total concentration is calculated using:

$$T_q = S_m + A_m + \sqrt{\left[\left(S_q - S_m\right)^2 + \left(A_q - A_m\right)^2\right]}$$

3.2.4 Method C: Correlation

This method is the same as Method B but takes account of the possible correlation between the background concentration and the stack concentration.

$$T_q = S_m + A_m + \sqrt{\left[\left(S_q - S_m\right)^2 + \left(A_q - A_m\right)^2 + 2\rho_{SA}\left(S_q - S_m\right)\left(A_q - A_m\right)\right]}$$

3.2.5 Method D: 90th percentile

This method assumes that the contribution from the stack to the percentile concentrations is considerably greater than that from the background sources and that the background concentrations and stack contribution are not correlated. A conservative estimate of the likely background concentrations during periods of elevated stack concentrations is that the background concentration is approximately equal to the annual 90th percentile background concentration. Thus the percentile total concentration is calculated from:

$$T_q = S_q + A_{90}$$

where A_{90} is the 90th percentile background concentration.

3.2.6 Method E: Twice annual mean

This method is similar to Method D except that a value of twice the annual mean is used as a conservative estimate of background concentrations during periods of elevated stack concentration.

$$T_q = S_q + 2A_m$$

3.2.7 Method F: Annual mean

This method is similar to Method D and E but uses a less conservative estimate of background concentrations.

$$T_q = S_q + A_m$$

3.2.8 Method G: Statistical estimates of percentile background concentrations

Methods B and C might be considered to be theoretically superior to other methods. However, in practice local measurements of background concentrations will not be available. If methods B and C are to be useful in these circumstances it will be necessary to estimate the percentile background concentrations. Analysis of monitoring data at Urban Monitoring sites suggests the following relationships (Broughton et al, 1998):

Maximum = 20 x Annual mean
99.9th percentile = 12.3 x Annual mean
98th percentile = 4.75 x Annual mean
90th percentile = 2 x Annual mean

Method G applies Method B using these relationships.

3.2.9 Method H: Annual mean stack contributions

The percentile concentrations are calculated using:

$$T_q = S_m + A_q$$

3.2.10 Method I: Twice annual mean stack contributions

Methods D and E may be applicable when the stack contribution is large compared to the background concentration. Method I is equivalent to Method E but is applied where the background concentrations are large compared to the stack contribution.

$$T_q = 2S_m + A_q$$

3.2.11 Method J: Maximum twice annual mean

Method J is used where it is unclear whether the stack or the ambient concentrations are largest. The value used is the larger of the values derived by Method E and Method I.

3.2.12 Method K: Maximum annual mean

Method K is similar to Method J. The percentile concentration is the larger of the values derived by methods F and H.

3.3 Normalisation of results

The relative magnitude of the background concentrations and the stack contributions depends on the rate of emission of pollutants. The methods are required to be useful across the range of emissions. The calculation methods have therefore been applied for a range of emission rates such that the percentile stack contribution is various multiples of the percentile background concentration. Thus the percentile concentrations have been calculated where the percentile stack contribution is 0.1, 0.5, 1, 2, or 10 times the percentile background concentration. The results have then been normalised by dividing by the total percentile concentration, calculated by hour by hour addition.

3.4 Results

Percentile concentrations calculated using the above methods are tabulated in Appendices A-C. Each table shows the calculated concentration and the normalised concentrations. Appendix A shows percentile concentrations calculated at the location of the largest annual average concentrations. Appendix B shows percentile concentrations at the locations of the largest annual maximum concentrations. Appendix C shows percentile concentrations at the locations of the largest 98th percentile concentrations.

Figure 1 shows the spatial distribution of 99.8th percentile nitrogen dioxide concentrations predicted assuming all oxides of nitrogen from the stack are as nitrogen dioxide at the receptor for:

- the baseline method;
- 50 m stack;
- Liverpool centre background concentrations;
- emission such that the 99.8th percentile stack contribution at the location of maximum concentration is equal to the 99.8th percentile background concentration.

Figure 2 shows modelled stack contribution. Figure 3 shows the total concentrations predicted using the sum of squares method (Method B).

4 NITROGEN DIOXIDE

4.1 Introduction

Oxides of nitrogen are emitted from industrial stacks primarily as a mixture of the two gases, nitric oxide and nitrogen dioxide. Approximately 95% by volume of the oxides of nitrogen emitted is nitric oxide with the remaining 5% nitrogen dioxide. Nitric oxide reacts with ozone in the atmosphere to form nitrogen dioxide:

$$NO + O_3 \Rightarrow NO_2 + O_2$$

The reverse reaction takes place in the presence of light:

$$NO_2 + O_2 + \text{light} \Rightarrow NO + O_3$$

Nitric oxide, nitrogen dioxide and ozone also react with other substances in the atmosphere and in the stack emission. At high concentrations, nitric oxide can also react with oxygen. The complete reaction scheme is rather complicated: however, the above reaction scheme provides an adequate description for the purposes of this analysis.

In Section 3, concentrations of nitrogen dioxide at receptors were calculated on the basis that all the nitric oxide emitted from the stack is converted to nitrogen dioxide. This approach results in a very conservative assessment of the nitrogen dioxide concentration at the receptors. In practice, the reaction is limited by:

- the amount of ozone available in the atmosphere;
- the rate of mixing of the ozone in the atmosphere with the plume of gases discharging from the stack;
- the rate of chemical reaction;
- the reverse reaction.

In this section, the limitation resulting from the availability of ozone in the atmosphere is considered.

4.2 Addition methods

4.2.1 The baseline method

The concentration of nitrogen dioxide was calculated for each hour of 1996 from:

$$T^{NO2} = A^{NO2} + 0.05S^{NOx} + \min(0.95S^{NOx}, A^{O3})$$

where T is the total concentration, S is the stack contribution to ground level concentrations at the receptor and A is the ambient concentration and the superscript indicates the relevant substance.

The nth largest total concentrations were determined, where values of n corresponding to various percentiles are shown in Table3.1.

4.2.2 Method M: Addition of percentiles

The percentile concentrations were determined separately for the stack contribution and the background concentrations of nitrogen dioxide and ozone. The values were then added.

$$T_{A,q}^{NO2} = 0.05S_q^{NOx} + A_q^{NO2} + \min(0.95S_q^{NOx}, A_q^{O3})$$

where: $T_{A,q}$ is the qth percentile total concentration calculated using method A;
S_q is the qth percentile stack contribution;
A_q is the qth percentile ambient concentration.

4.2.3 Method N: 90th percentile

This method assumes that the contribution from the stack to the percentile concentrations is considerably greater than that from the background sources and that the background concentrations and stack contribution are not correlated. A conservative estimate of the likely background concentrations during periods of elevated stack concentrations is that the background concentration is approximately equal to the annual 90th percentile background concentration. Thus the percentile total concentration is calculated from:

$$T_{A,q}^{NO2} = 0.05S_q^{NOx} + A_{90}^{NO2} + \min(0.95S_q^{NOx}, A_q^{O3})$$

where A_{90} is the 90th percentile background concentration.

4.2.4 Method O: Twice annual mean

This method is similar to Method N except that a value of twice the annual mean is used as a conservative estimate of background concentrations during periods of elevated stack concentration.

$$T_{A,q}^{NO2} = 0.05S_q^{NOx} + 2A_m^{NO2} + \min(0.95S_q^{NOx}, A_q^{O3})$$

4.2.5 Method P: Annual mean

This method is similar to Method N and O except that the annual mean is used as an estimate of background concentrations during periods of elevated stack concentration.

$$T_{A,q}^{NO2} = 0.05S_q^{NOx} + A_m^{NO2} + \min(0.95S_q^{NOx}, A_q^{O3})$$

4.2.6 Method Q: Twice annual mean stack contributions

Method O may be applicable when the stack contribution is large compared to the background concentration. Method Q is equivalent to Method O but is applied where the background concentrations are large compared to the stack contribution.

$$T_{A,q}^{NO2} = 2 \times 0.05 S_m^{NOx} + A_q^{NO2} + 2\min(0.95 S_m^{NOx}, A_m^{O3})$$

4.2.7 Method R: Maximum twice annual mean

Method R is used where it is unclear whether the stack or the ambient concentrations are largest. The value used is the larger of the values derived by Method O and Method Q.

4.2.8 Method S: Annual mean stack contributions

Method P may be applicable when the stack contribution is large compared to the background concentration. Method S is equivalent to Method P but is applied where the background concentrations are large compared to the stack contribution.

$$T_{A,q}^{NO2} = 0.05 S_m^{NOx} + A_q^{NO2} + \min(0.95 S_m^{NOx}, A_m^{O3})$$

4.2.9 Method T: Maximum annual mean

Method T is used when it is unclear whether the stack or the ambient concentrations are largest. The value used is the larger of the values derived by Method P and Method S.

4.2.10 Method U: Sum of squares

Method U has a similar basis to method B.

$$T_{A,q}^{NO2} = A_m^{NO2} + S_m^{NOx} + \sqrt{\left[\left(A_q^{NO2} - A_m^{NO2}\right)^2 + \left(0.05 S_q^{NOx} + \min\left\{0.95 S_q^{NOx}, A_q^{O3}\right\} - S_m^{NOx}\right)^2\right]}$$

4.2.11 Method V: 90th percentile ozone

Method V is similar to method U except that it is assumed that the expected ozone concentration during hours of peak concentration has been conservatively estimated as the 90th percentile ozone concentration:

$$T_{A,q}^{NO2} = A_m^{NO2} + S_m^{NOx} + \sqrt{\left[\left(A_q^{NO2} - A_m^{NO2}\right)^2 + \left(0.05 S_q^{NOx} + \min\left\{0.95 S_q^{NOx}, A_{90}^{O3}\right\} - S_m^{NOx}\right)^2\right]}$$

4.3 Normalisation of results

The relative magnitude of the background concentrations and the stack contributions depends on the rate of emission of pollutants. The methods are required to be useful across the range of emissions. The calculation methods have therefore been applied for a range of emission rates such that the percentile stack oxides of nitrogen concentration contribution is various multiples of the percentile background nitrogen dioxide concentration. Thus the percentile concentrations have been calculated where the percentile stack oxides of nitrogen contribution is 0.1, 0.5, 1, 2, or 10 times the percentile background nitrogen dioxide concentration. The results have then been normalised by dividing by the total percentile nitrogen dioxide concentration, calculated by hour by hour addition taking account of the stoichiometric ozone limit.

4.4 Results

Appendix D shows percentile nitrogen dioxide concentrations calculated by the above methods at the locations of the largest annual maximum oxide of nitrogen concentrations.

5 DISCUSSION

5.1 Methods of comparison

In order to compare the performance of the methods we have used the following measures:

- general observations;
- the number or fraction of calculated values above the baseline value;
- the greatest normalised errors;
- the number or fraction of calculated values outside of the confidence limits.

The discussion is limited to consideration of the following air quality statistics.

- 99.9th percentile hourly average sulphur dioxide;
- 99.8th percentile hourly average nitrogen dioxide;
- 100th percentile hourly average nitrogen dioxide.

These statistics are of particular relevance to the calculation of concentrations for comparison with National Air Quality Strategy objectives.

5.2 99.9th percentile sulphur dioxide concentrations

Table 5.1 shows the number of calculated values in Appendix B of the 99.9th percentile for sulphur dioxide above the baseline value, the upper and lower normalised estimates and the number of calculated values outside of confidence limits.

Table 5.1 Summary of results for 99.9th percentile sulphur dioxide concentrations, at location of greatest maximum concentration.

Method	A	B	C	J	K
Number of values above baseline value, (/30)	30	23	23	14	8
Largest normalised value	1.68	1.21	1.24	1.03	1.00
Smallest normalised value	1.01	0.81	0.81	0.67	0.62
Number of values within confidence limits (/30)	16	30	28	30	28

Table 5.1 shows that the addition of percentile values (Method A) always overestimated the total concentration with almost half the estimated results outside the confidence limits. The sum of squares method (Method B) tended to overestimate the total concentration although all results were within the confidence limits. Concentrations calculated by Method B were generally in the range 80-120% of the baseline values. The performance of the correlation method (Method C) was similar but slightly inferior to the sum of squares method with a small number of values outside the confidence limits. All the values predicted by Method J were within the confidence limits, with approximately half the results above the baseline

values. Concentrations calculated by Method J were generally in the range 67-103% of the baseline values. Method K usually underestimated the total concentrations although only a small number of values were outside the confidence limits. Concentrations calculated by Method J were generally in the range 62-100% of the baseline values.

5.3 Maximum nitrogen dioxide concentrations

The concentrations in Appendices A-C were calculated on the assumption that all the oxides of nitrogen emitted from the stack are converted to nitrogen dioxide. Table 5.2 shows the number of calculated values in Appendix B of the 100th percentile concentrations for nitrogen dioxide above the baseline value and the upper and lower normalised estimates.

Table 5.2 shows that the addition of percentiles (Method A) always overestimated the total concentration. Concentrations calculated by Methods B, C, J and K were generally in the range 70-150% of the baseline values.

Table 5.2 Summary of results for 100th percentile nitrogen dioxide concentrations, at location of greatest maximum concentration assuming all oxides of nitrogen are converted to nitrogen dioxide.

Method	A	B	C	J	K
Number of values above baseline value, (/15)	15	11	11	11	11
Largest normalised value	1.88	1.43	1.45	1.51	1.22
Smallest normalised value	1.07	0.82	0.84	0.79	0.70

The nitrogen dioxide concentrations shown in Appendix D attempt to take account of the limit on the conversion of nitric oxide to nitrogen dioxide resulting from the availability of ozone in the atmosphere. Table 5.3 shows the number of calculated values in Appendix D of the 100th percentile concentrations for nitrogen dioxide above the baseline value and the upper and lower normalised estimates.

Table 5.3 Summary of results for 100th percentile nitrogen dioxide concentrations, at location of greatest maximum concentration taking account of the availability of ozone in the atmosphere.

Method	M	R	T	U	V
Number of values above baseline value, (/15)	15	13	10	13	10
Largest normalised value	2.24	1.89	1.61	1.75	1.30
Smallest normalised value	1.07	0.88	0.80	0.93	0.78

Table 5.3 shows that the addition of percentiles (Method M) always overestimated the total concentration. Methods R,T, U and V usually overestimated the total concentration with predicted values generally in the range 80-190% of the baseline value.

5.4 99.8th percentile nitrogen dioxide concentrations

The concentrations in Appendices A-C were calculated on the assumption that all the oxides of nitrogen emitted from the stack are converted to nitrogen dioxide. Table 5.4 shows the number of calculated values in Appendix B of the 99.8th percentile concentrations for nitrogen dioxide above the baseline value, the upper and lower normalised estimates and the number of values within the confidence limits.

Table 5.4 Summary of results for 99.8th percentile nitrogen dioxide concentrations, at location of greatest maximum concentration assuming all oxides of nitrogen are converted to nitrogen dioxide.

Method	A	B	C	J	K
Number of values above baseline value, (/15)	15	10	14	13	3
Largest normalised value	1.46	1.13	1.14	1.25	1.04
Smallest normalised value	1.05	0.98	0.99	0.99	0.86
Number of values within confidence limits (/15)	7	13	13	12	14

Table 5.4 shows that the addition of percentiles (Method A) always overestimated the total concentration. Concentrations calculated by Methods B, C and J usually overestimated the total concentration while Method K usually provided an underestimate. Predicted concentrations for Methods B, C, J and K were generally in the range 86-125% of the baseline values.

The nitrogen dioxide concentrations shown in Appendix D attempt to take account of the limit on the conversion of nitric oxide to nitrogen dioxide resulting from the availability of ozone in the atmosphere. Table 5.5 shows the number of calculated values in Appendix D of the 99.8th percentile concentrations for nitrogen dioxide above the baseline value, the upper and lower normalised estimates and the number of values within the confidence limits.

Table 5.5 Summary of results for 99.8th percentile nitrogen dioxide concentrations, at location of greatest maximum concentration taking account of the availability of ozone in the atmosphere.

Method	M	R	T	U	V
Number of values above baseline value, (/15)	15	14	12	15	14
Largest normalised value	1.98	1.70	1.36	1.54	1.18
Smallest normalised value	1.09	0.99	0.95	1.00	0.97
Number of values within confidence limits (/15)	0	3	6	3	8

Table 5.5 shows that the addition of percentiles (Method M) always overestimated the total concentration. Methods R, T and U usually overestimated the total concentration with predicted values generally in the range 95-170% of the baseline value. Method V usually overestimated the total concentrations slightly, with predicted concentrations in the range 97%-118% of the baseline values. Method V had the greatest proportion of the predicted values within confidence limits.

5.5 Spatial distribution of concentrations

Figure 1 shows that the maximum total 99.8th percentile concentration calculated using the baseline method is predicted approximately 200 m to the north-east of the stack. Figure 2 shows that the maximum value for the stack alone lies a little to the east of the baseline method maximum. The maximum for method B shown in Figure 3 also lies a little to the east of the baseline method maximum. However, the predicted values at the locations of the total concentration and stack only maxima are similar (129 ppb compared with 119 ppb in Figure 1; 131 ppb compared with 136 ppb in Figure 3).

5.6 The use of the Poisson distribution to estimate confidence limits for modelled percentiles

The extent to which year to year variations in modelled percentile concentrations may be attributed to chance was investigated with reference to earlier modelling studies of Drax, Eggborough and Ferrybridge power stations (Abbott et al, 1998). The earlier modelling studies determined the number of hours during each of the years 1990-1994 for which the expected 15 minute average sulphur dioxide concentrations would exceed 100 ppb assuming constant emissions and discharge conditions throughout the whole period for a range of scenarios (Scenarios 1-9). The modelling studies made use of hourly meteorological data for the period from the Meteorological Office station at Finningly.

The possibility that the year-to-year variations in the number of exceedence hours occurred by chance was investigated using the following test (Hald, 1960). The modelling results provide 5 Poisson-distributed observations of the number of hours of exceedence, x_1, x_2,...., x_5 for which we wish to test the hypothesis that the means of each of the Poisson distributions ξ_1, ξ_2, ξ_3, ξ_4, ξ_5 are the same. Introducing the mean $\bar{x}$, as an estimate of ξ, the statistic:

$$\frac{\sum_{i=1}^{5}\left(x_i - \bar{x}\right)^2}{\bar{x}}$$

is approximately distributed as χ^2 with 4 degrees of freedom. Hald reports that the approximation is good for 5 samples if the mean of the distribution is greater than 5 (i.e. if more than 5 hours of exceedence are expected).

Figure 4 shows a χ^2 plot of the modelled frequency of exceedence for the power station study (Scenario 6 based on 1997 annual emissions from Eggborough and Ferrybridge, but for operation without FGD at Drax). The isopleth shown is for χ^2=9.49. For areas outside this isopleth, the probability that the differences in modelled concentrations between years arose through chance is greater than 5%. The area of applicability of the test is also shown in Figure 4. Examination of Figure 4 shows that there is a significant probability that the modelled year-on-year differences resulting from the use of different meteorological data may have arisen by chance for most of the area of impact from the power stations.

It follows that assessments of the impacts from industrial sources that compare modelled percentile concentrations with air quality standards should take account of chance variations. In most modelling studies percentile concentrations are calculated using hourly meteorological data for periods of between one and ten years. The modelling studies thus provide sample estimates of the probability of hourly meteorological conditions being such that the concentration exceeds the standard. The probability that the concentration exceeds the standard for x hours or more in other years may then be estimated using the binomial distribution following an analysis of the relationship between two Poisson parameters reported by Ross (Ross, 1987):

$$P\{x \le i\} = \sum_{k=0}^{i} \frac{n!}{(n-k)!\,k!}\left[\frac{1}{1+l}\right]^k \left[1 - \frac{1}{1+l}\right]^{n-k}$$

where: l is the number of years meteorological data used in the modelling;
n is the sum of the number of hours of exceedence in the modelling and in the future year.

95th percent confidence limits are then estimated by determining the value of n for which :

$$P\{x \leq i\} \geq 0.95$$

On this basis, it is recommended that 95% confidence levels for percentile concentrations are calculated as shown in Table 5.6, where more detailed investigations of the effect of meteorological conditions are not carried out.

Table 5.6 Upper 95% confidence limits for use when calculating percentiles.

	Upper 95 percentile confidence limits			
	Number of years of met data			
Percentile	1	2	5	10
98	98.4	98.3	98.25	98.2
99.9	99.95	99.95	99.94	99.94

6 CONCLUSIONS

A number of methods of adding background concentrations to stack concentrations modelled by dispersion models to calculate percentile concentrations have been compared with formal hour-by-hour addition by means of numerical experiments involving the incremental impact of hypothetical discharge stacks in Manchester and Liverpool. A number of alternative measures of performance have been used in the assessment.

The best methods were:

- Method B: sum of squares;
- Method C: correlation;
- Method J: maximum twice annual mean.

The methods are described in the text.

The “correlation” method was no improvement on the “sum of squares” method, which indicates that the extent of the correlation between modelled stack concentrations and background concentrations was not great and that there is little benefit in taking the correlation into account.

All methods produced estimates outside confidence limits based on the Poisson distribution suggesting that the errors in the methods of addition are not all attributable to chance. However, Methods B, C and J produced estimates within the confidence limits in most comparisons.

The use of the Poisson distribution to derive confidence limits for percentile concentrations was tested using modelling data from earlier studies of the impact of power stations on sulphur dioxide concentrations in Yorkshire. The analysis indicates that to a large extent the differences between modelled results when using meteorological data for different years may be attributed to chance. In consequence, it is recommended that confidence limits are derived for modelled percentile concentrations from the Poisson distribution when carrying out impact assessments using dispersion models. The confidence limits may be determined by calculating higher percentile concentrations: suitable percentiles are suggested.

The limitation on the conversion of nitric oxide emitted from a stack to nitrogen dioxide as the result on the limit on the availability of ozone in the atmosphere has been considered. The

best methods for calculating total nitrogen dioxide concentrations taking account of the availability of ozone were:

- method T: maximum annual mean;
- method U: sum of squares;
- method V: 90th percentile ozone.

The methods are described in the text. All methods produced estimates outside confidence limits based on the Poisson distribution suggesting that the errors in the methods of addition are not all attributable to chance. Method V produced most estimates within the confidence limits.

The spatial variation in total (stack plus background) concentrations was investigated. Modelling results showed that the maximum total concentration may not occur at the same location as the maximum stack contribution. However, the concentration at the location of the total concentration maximum was similar to that at the location of the stack only maximum.

7 REFERENCES

Abbott J A, Campbell G, Hall D, Spanton A and Vincent K, 1998. *The impact of the loss of FGD at Drax on local air quality and acid deposition.* AEA Technology AEAT-3830/20500001/002 Issue 2.

Broughton G J F, Bower J S, Clark H and Willis P G, 1998. *Air pollution in the UK: 1996.* AEA Technology AEA/RAMP/20441002/001.

Cambridge Environmental Research Consultants, 1995. *ADMS 2: The multiple source air dispersion model: User Guide*.

Department of the Environment, Transport and the Regions, 1997. *The United Kingdom National Air Quality Strategy*.

Department of the Environment, Transport and the Regions, 1998. *Review and Assessment: Pollutant Specific Guidance*. LAQM TG4(98).

Environment Agency, 1998. *Guidance for estimating the air quality impact of stationary sources*.

Hald A, 1960. *Statistical theory with engineering applications*. John Wiley and Sons.

Ross S M, 1987. *Introduction to probability and statistics for engineers and scientists*. John Wiley and Sons.

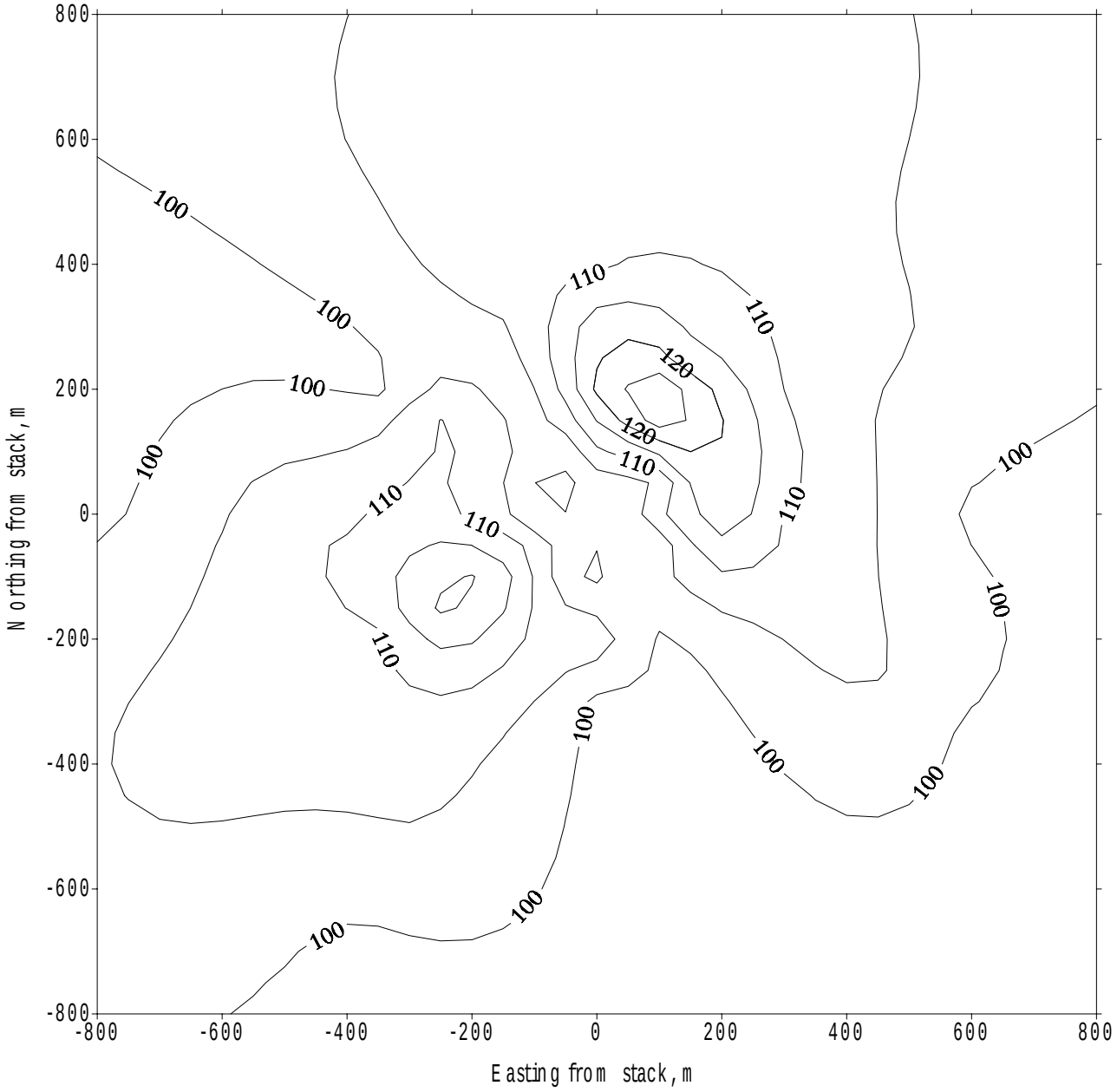


Figure 1 Modelled total 99.8th percentile nitrogen dioxide concentration, ppb, using the baseline method assuming all oxides of nitrogen released are converted to nitrogen dioxide. 50 m stack. Liverpool Centre background concentrations. Stack 99.8th percentile = Background 99.8th percentile.

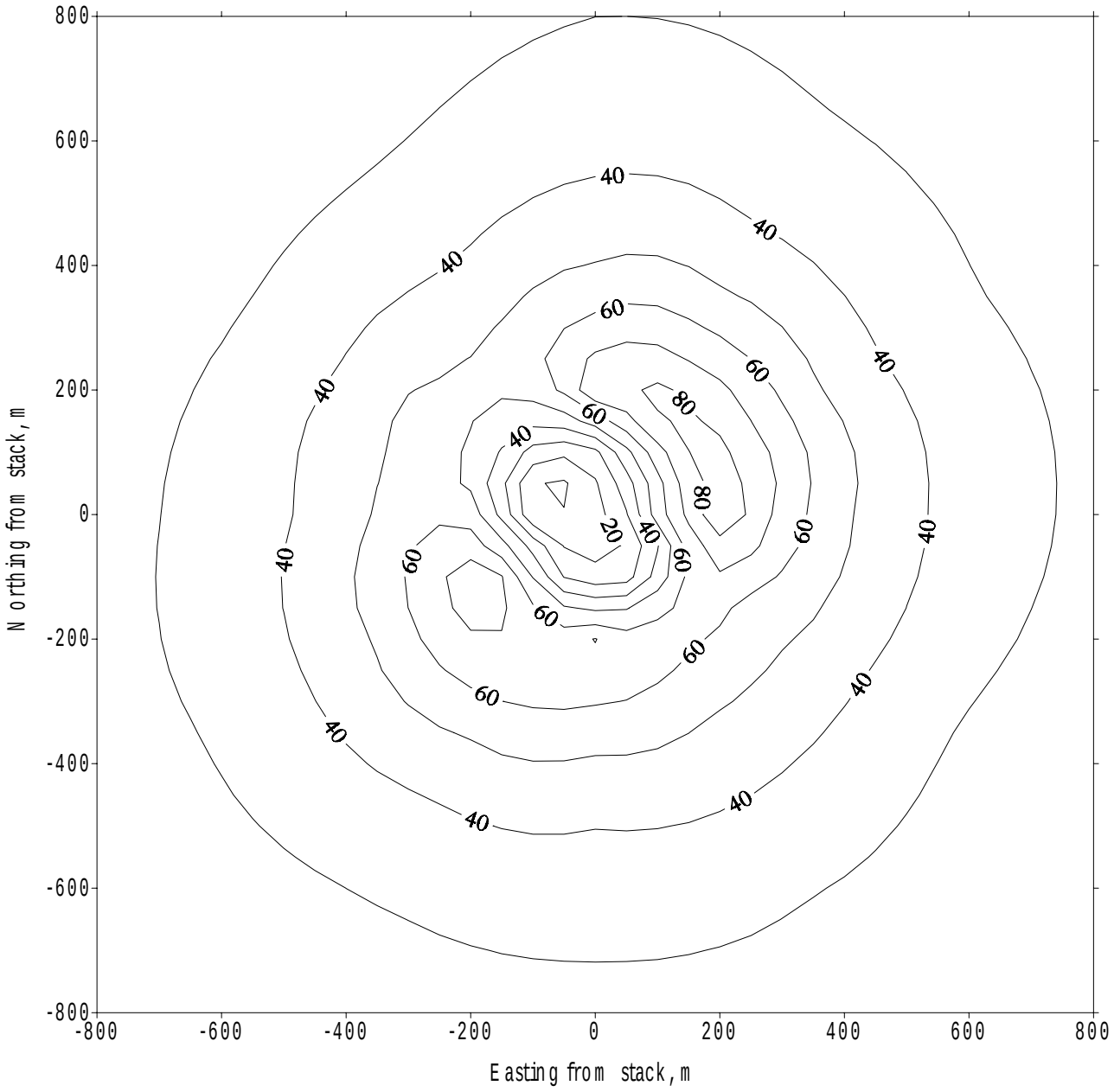


Figure 2 Modelled 99.8th percentile nitrogen dioxide stack concentrations, ppb, assuming all oxides of nitrogen released are converted to nitrogen dioxide. 50 m stack. Stack 99.8th percentile = 99.8th percentile Liverpool Centre background concentrations.

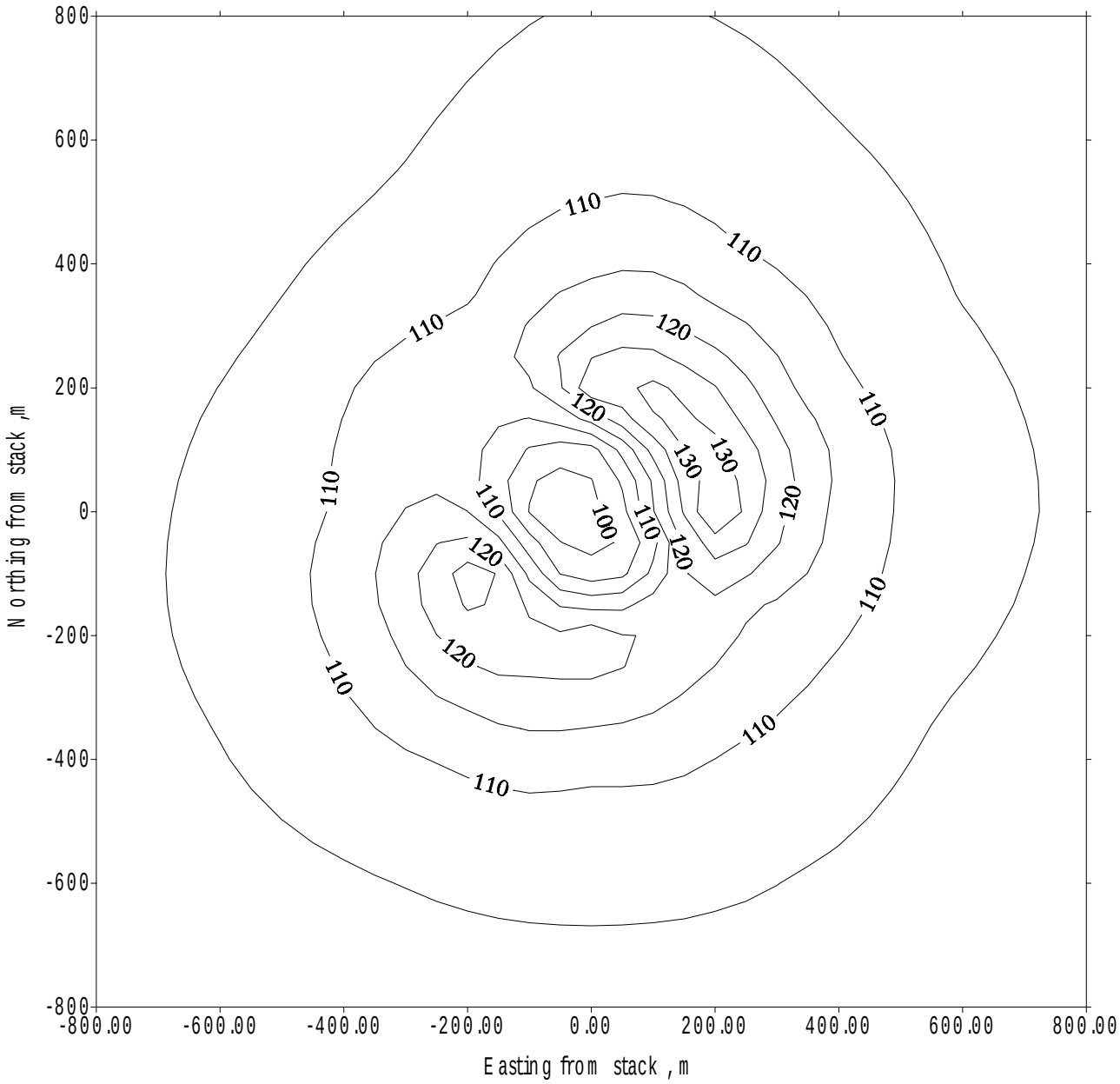
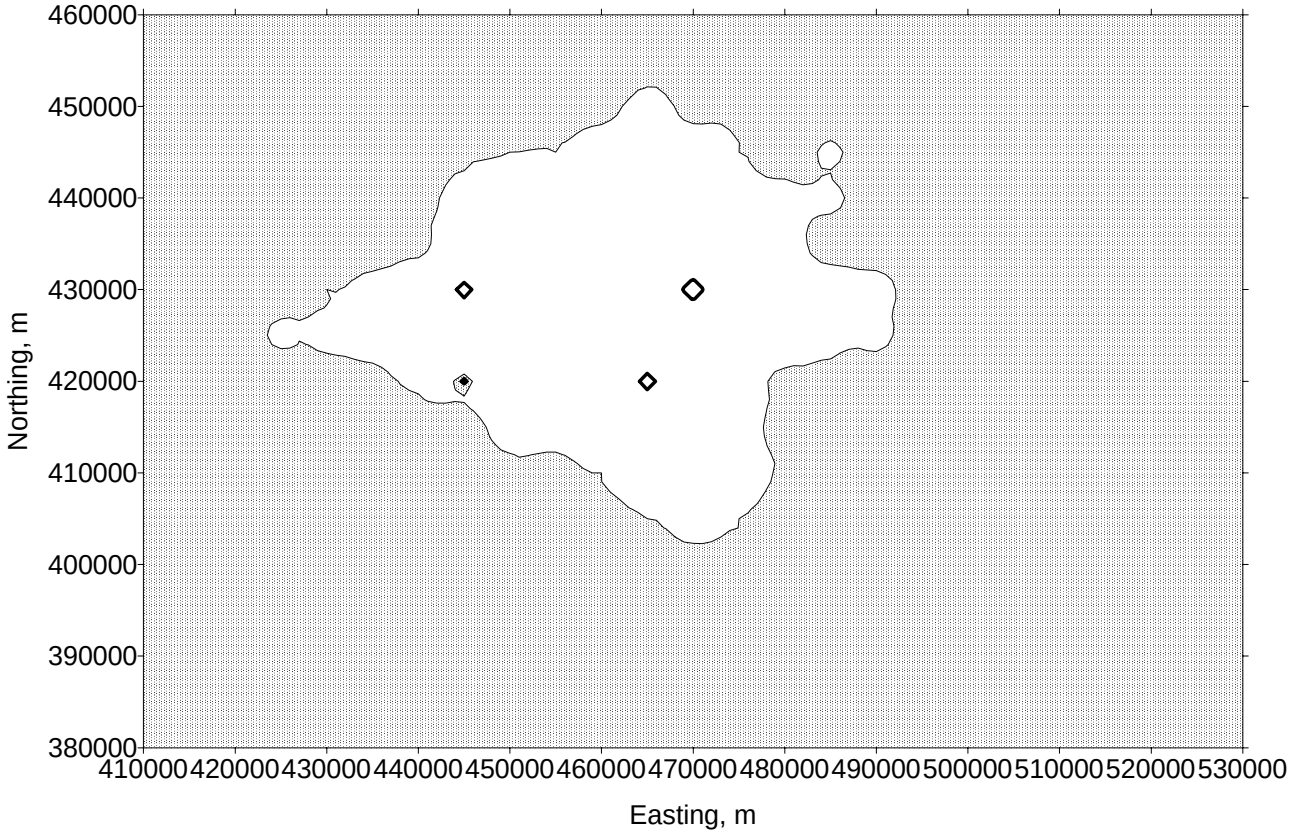


Figure 3 Modelled total 99.8th percentile nitrogen dioxide concentrations, ppb, using the sum of squares method (Method B) assuming all oxides of nitrogen released are converted to nitrogen dioxide. 50 m stack. Liverpool Centre background concentrations. Stack 99.8th percentile = Background 99.8th percentile.



The χ^2 test is not applicable in the shaded area. Contours within the unshaded area show the area over which χ^2 is outside the 95 % confidence limits i.e. for χ^2 =9.49. All areas are within the 99% confidence limits.

Figure 4 χ^2 plot of modelled frequency of exceedence of limit concentration.

Appendices

CONTENTS

Appendix A
Results obtained at the location of the largest annual average concentrations

In the following tables concentrations are in ppb and emission rates in g/s.

Table A1: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 50 m stack: Receptor at location of highest annual mean

%ile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	96	26	24	17	147	96	96	96	96	95	4
	0.5	97	0	0	143	108	106	64	62	55	156	98	100	100	98	95	22
	1	123	0	0	190	138	135	111	110	102	178	100	106	110	102	95	44
	2	210	0	0	285	218	213	206	205	197	245	106	116	205	197	95	89
	10	960	0	0	1045	962	957	966	965	957	968	149	202	965	957	95	445
99.9	0.1	81	84	74	87	80	79	24	23	15	91	79	80	80	79	79	4
	0.5	81	92	74	119	90	89	56	54	47	101	81	84	84	81	79	20
	1	99	107	92	158	115	112	95	94	86	123	84	89	94	86	79	40
	2	174	182	165	237	182	178	174	173	165	187	89	98	173	165	79	81
	10	807	833	769	869	801	797	806	805	797	802	128	176	805	797	79	405
99.8	0.1	71	77	60	78	72	71	23	22	14	0	71	72	72	71	71	4
	0.5	73	79	63	107	81	80	52	50	43	0	73	76	76	73	71	19
	1	87	94	84	142	104	101	87	86	78	0	76	80	86	78	71	39
	2	155	161	150	213	164	161	158	157	149	0	80	90	157	149	71	77
	10	730	752	709	781	720	717	726	725	717	0	117	164	725	717	71	386
98	0.1	32	34	31	35	32	32	19	18	11	35	32	33	33	32	32	3
	0.5	34	36	33	48	37	35	32	31	23	40	34	35	35	34	32	13
	1	46	47	44	64	48	44	48	47	39	50	35	38	47	39	32	26
	2	74	76	71	96	76	69	80	79	71	78	38	45	79	71	32	52
	10	326	344	319	352	328	296	336	335	327	329	64	95	335	327	32	262

Normalised values

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100%ile	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.27	0.25	0.18	1.55	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	0.00	0.00	1.46	1.11	1.09	0.65	0.64	0.56	1.60	1.00	1.03	1.03	1.00	0.98
	1	1.00	0.00	0.00	1.55	1.12	1.10	0.90	0.89	0.83	1.45	0.82	0.86	0.89	0.83	0.77
	2	1.00	0.00	0.00	1.36	1.04	1.02	0.98	0.98	0.94	1.17	0.50	0.56	0.98	0.94	0.45
	10	1.00	0.00	0.00	1.09	1.00	1.00	1.01	1.00	1.00	1.01	0.15	0.21	1.00	1.00	0.10
99.9	0.1	1.00	1.04	0.92	1.07	0.99	0.98	0.30	0.28	0.19	1.13	0.98	0.99	0.99	0.98	0.98
	0.5	1.00	1.14	0.91	1.46	1.12	1.09	0.69	0.67	0.58	1.24	1.01	1.04	1.04	1.01	0.98
	1	1.00	1.08	0.93	1.60	1.16	1.14	0.96	0.95	0.87	1.25	0.85	0.90	0.95	0.87	0.80
	2	1.00	1.05	0.95	1.37	1.05	1.03	1.00	0.99	0.95	1.08	0.51	0.57	0.99	0.95	0.46
	10	1.00	1.03	0.95	1.08	0.99	0.99	1.00	1.00	0.99	0.99	0.16	0.22	1.00	0.99	0.10
99.8	0.1	1.00	1.08	0.85	1.10	1.01	1.01	0.33	0.31	0.20	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.08	0.86	1.46	1.12	1.09	0.71	0.69	0.59	0.00	1.00	1.04	1.04	1.00	0.97
	1	1.00	1.08	0.96	1.64	1.20	1.17	1.00	0.99	0.90	0.00	0.87	0.93	0.99	0.90	0.82
	2	1.00	1.03	0.97	1.37	1.05	1.03	1.02	1.01	0.96	0.00	0.52	0.58	1.01	0.96	0.46
	10	1.00	1.03	0.97	1.07	0.99	0.98	0.99	0.99	0.98	0.00	0.16	0.22	0.99	0.98	0.10
98	0.1	1.00	1.06	0.96	1.09	1.01	1.00	0.60	0.56	0.33	1.10	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.06	0.97	1.41	1.10	1.04	0.94	0.90	0.69	1.17	0.99	1.03	1.03	0.99	0.94
	1	1.00	1.03	0.96	1.41	1.06	0.97	1.05	1.03	0.86	1.11	0.77	0.84	1.03	0.86	0.70
	2	1.00	1.03	0.97	1.30	1.04	0.93	1.09	1.07	0.97	1.05	0.52	0.61	1.07	0.97	0.43
	10	1.00	1.06	0.98	1.08	1.01	0.91	1.03	1.03	1.01	1.01	0.20	0.29	1.03	1.01	0.10
Correlation coefficient							-0.05									

Table A2: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 50 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	198	0	0	218	200	200	44	39	30	196	199	200	200	199	198	9
	0.5	252	0	0	297	225	226	123	118	109	222	204	209	209	204	198	46
	1	326	0	0	396	286	287	222	217	208	283	209	220	220	209	198	93
	2	475	0	0	594	450	451	420	415	406	449	220	243	415	406	198	185
	10	2025	0	0	2178	1999	2000	2004	1999	1990	1999	310	421	1999	1990	198	927
99.9	0.1	106	121	84	109	100	100	34	29	20	120	100	100	100	100	99	5
	0.5	108	143	97	149	113	114	74	69	59	132	102	105	105	102	99	25
	1	139	187	124	198	145	145	123	118	109	159	105	111	118	109	99	51
	2	229	262	212	297	228	228	222	217	208	238	111	123	217	208	99	101
	10	1026	1051	975	1089	1004	1004	1014	1009	1000	1006	160	221	1009	1000	99	507
99.8	0.1	78	93	74	86	79	79	32	27	18	0	79	79	79	79	78	4
	0.5	90	98	78	117	90	90	63	58	49	0	81	83	83	81	78	21
	1	109	121	100	156	115	115	102	97	88	0	83	88	97	88	78	42
	2	178	193	168	234	181	181	180	175	166	0	88	98	175	166	78	85
	10	805	840	785	858	793	793	804	799	790	0	129	180	799	790	78	424
98	0.1	50	52	48	55	51	50	29	24	15	47	50	51	51	50	50	4
	0.5	52	54	51	75	58	56	49	44	35	55	52	55	55	52	50	20
	1	65	67	64	100	75	70	74	69	60	73	55	60	69	60	50	41
	2	110	116	107	150	118	109	124	119	110	117	60	70	119	110	50	82
	10	506	534	496	550	511	462	524	519	510	511	99	149	519	510	50	410

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.20	0.15	0.99	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	0.00	0.00	1.18	0.90	0.90	0.49	0.47	0.43	0.88	0.81	0.83	0.83	0.81	0.79
	1	1.00	0.00	0.00	1.21	0.88	0.88	0.68	0.67	0.64	0.87	0.64	0.68	0.68	0.64	0.61
	2	1.00	0.00	0.00	1.25	0.95	0.95	0.88	0.87	0.85	0.94	0.46	0.51	0.87	0.85	0.42
	10	1.00	0.00	0.00	1.08	0.99	0.99	0.99	0.99	0.98	0.99	0.15	0.21	0.99	0.98	0.10
99.9	0.1	1.00	1.14	0.79	1.03	0.94	0.94	0.32	0.28	0.18	1.14	0.94	0.95	0.95	0.94	0.93
	0.5	1.00	1.33	0.90	1.38	1.05	1.06	0.68	0.64	0.55	1.23	0.95	0.98	0.98	0.95	0.92
	1	1.00	1.34	0.89	1.42	1.04	1.04	0.88	0.85	0.78	1.15	0.75	0.80	0.85	0.78	0.71
	2	1.00	1.14	0.93	1.30	1.00	1.00	0.97	0.95	0.91	1.04	0.49	0.54	0.95	0.91	0.43
	10	1.00	1.02	0.95	1.06	0.98	0.98	0.99	0.98	0.97	0.98	0.16	0.22	0.98	0.97	0.10
99.8	0.1	1.00	1.19	0.95	1.10	1.01	1.01	0.41	0.35	0.22	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.09	0.87	1.30	1.00	1.00	0.70	0.65	0.54	0.00	0.90	0.92	0.92	0.90	0.87
	1	1.00	1.11	0.92	1.43	1.05	1.05	0.94	0.89	0.80	0.00	0.76	0.81	0.89	0.80	0.72
	2	1.00	1.09	0.95	1.32	1.02	1.02	1.01	0.99	0.93	0.00	0.50	0.55	0.99	0.93	0.44
	10	1.00	1.04	0.97	1.07	0.98	0.98	1.00	0.99	0.98	0.00	0.16	0.22	0.99	0.98	0.10
98	0.1	1.00	1.04	0.96	1.10	1.01	1.01	0.58	0.49	0.29	0.94	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.04	0.98	1.44	1.12	1.08	0.94	0.85	0.67	1.06	1.01	1.06	1.06	1.01	0.96
	1	1.00	1.03	0.98	1.54	1.16	1.08	1.14	1.07	0.92	1.12	0.85	0.92	1.07	0.92	0.77
	2	1.00	1.05	0.98	1.36	1.07	0.99	1.13	1.08	1.00	1.06	0.54	0.63	1.08	1.00	0.45
	10	1.00	1.06	0.98	1.09	1.01	0.91	1.04	1.03	1.01	1.01	0.20	0.29	1.03	1.01	0.10
Correlation coefficient							0.004									

Table A3: Comparison of modelled concentrations, ppb: Manchester Town Hall oxides of nitrogen: 50 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	803	799	176	181	130	1026	799	804	804	799	795	27
	0.5	795	0	0	1193	907	889	494	499	448	1112	817	840	840	817	795	134
	1	892	0	0	1590	1152	1124	891	897	846	1320	840	885	897	846	795	267
	2	1664	0	0	2385	1815	1779	1686	1692	1641	1926	885	974	1692	1641	795	535
	10	7975	0	0	8745	8038	7998	8046	8052	8001	8063	1243	1691	8052	8001	795	2673
99.9	0.1	572	622	462	629	578	575	153	159	108	633	576	579	579	576	572	21
	0.5	572	622	462	858	655	642	382	388	337	704	590	607	607	590	572	105
	1	672	721	640	1144	834	814	668	674	623	873	607	643	674	623	572	210
	2	1214	1260	1177	1716	1315	1290	1240	1246	1195	1340	643	713	1246	1195	572	421
	10	5790	5970	5546	6292	5796	5769	5816	5822	5771	5802	925	1277	5822	5771	572	2104
99.8	0.1	451	523	413	496	456	454	141	147	96	0	454	457	457	454	451	18
	0.5	451	523	416	677	518	508	322	327	276	0	466	481	481	466	451	88
	1	550	587	535	902	662	646	547	553	502	0	481	510	553	502	451	176
	2	982	1020	944	1353	1043	1024	998	1004	953	0	510	569	1004	953	451	352
	10	4642	4789	4507	4961	4580	4559	4606	4612	4561	0	746	1041	4612	4561	451	1762
98	0.1	196	208	188	216	199	196	116	122	71	245	198	200	200	198	196	12
	0.5	213	225	204	294	230	217	194	200	149	271	206	215	215	206	196	58
	1	286	301	279	392	299	274	292	298	247	331	215	235	298	247	196	115
	2	457	474	443	588	472	426	488	494	443	491	235	273	494	443	196	231
	10	1995	2100	1958	2156	2017	1816	2056	2062	2011	2021	389	582	2062	2011	196	1153

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.23	0.16	1.29	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	0.00	0.00	1.50	1.14	1.12	0.62	0.63	0.56	1.40	1.03	1.06	1.06	1.03	1.00
	1	1.00	0.00	0.00	1.78	1.29	1.26	1.00	1.01	0.95	1.48	0.94	0.99	1.01	0.95	0.89
	2	1.00	0.00	0.00	1.43	1.09	1.07	1.01	1.02	0.99	1.16	0.53	0.59	1.02	0.99	0.48
	10	1.00	0.00	0.00	1.10	1.01	1.00	1.01	1.01	1.00	1.01	0.16	0.21	1.01	1.00	0.10
99.9	0.1	1.00	1.09	0.81	1.10	1.01	1.01	0.27	0.28	0.19	1.11	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.09	0.81	1.50	1.14	1.12	0.67	0.68	0.59	1.23	1.03	1.06	1.06	1.03	1.00
	1	1.00	1.07	0.95	1.70	1.24	1.21	0.99	1.00	0.93	1.30	0.90	0.96	1.00	0.93	0.85
	2	1.00	1.04	0.97	1.41	1.08	1.06	1.02	1.03	0.98	1.10	0.53	0.59	1.03	0.98	0.47
	10	1.00	1.03	0.96	1.09	1.00	1.00	1.00	1.01	1.00	1.00	0.16	0.22	1.01	1.00	0.10
99.8	0.1	1.00	1.16	0.92	1.10	1.01	1.01	0.31	0.33	0.21	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.16	0.92	1.50	1.15	1.13	0.71	0.73	0.61	0.00	1.03	1.07	1.07	1.03	1.00
	1	1.00	1.07	0.97	1.64	1.20	1.17	0.99	1.01	0.91	0.00	0.87	0.93	1.01	0.91	0.82
	2	1.00	1.04	0.96	1.38	1.06	1.04	1.02	1.02	0.97	0.00	0.52	0.58	1.02	0.97	0.46
	10	1.00	1.03	0.97	1.07	0.99	0.98	0.99	0.99	0.98	0.00	0.16	0.22	0.99	0.98	0.10
98	0.1	1.00	1.06	0.96	1.10	1.02	1.00	0.59	0.62	0.36	1.25	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.06	0.96	1.38	1.08	1.02	0.91	0.94	0.70	1.27	0.97	1.01	1.01	0.97	0.92
	1	1.00	1.05	0.98	1.37	1.04	0.96	1.02	1.04	0.86	1.16	0.75	0.82	1.04	0.86	0.69
	2	1.00	1.04	0.97	1.29	1.03	0.93	1.07	1.08	0.97	1.08	0.51	0.60	1.08	0.97	0.43
	10	1.00	1.05	0.98	1.08	1.01	0.91	1.03	1.03	1.01	1.01	0.20	0.29	1.03	1.01	0.10
Correlation coefficient							-0.05									

Table A4: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 50 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	523	527	160	153	102	1013	521	524	524	521	518	17
	0.5	518	0	0	777	593	609	367	360	309	1054	533	547	547	533	518	87
	1	609	0	0	1036	756	781	626	619	568	1155	547	576	619	568	518	174
	2	1091	0	0	1554	1192	1224	1144	1137	1086	1478	576	635	1137	1086	518	348
	10	5226	0	0	5698	5253	5288	5288	5281	5230	5324	810	1102	5281	5230	518	1742
99.9	0.1	393	465	359	432	397	400	147	140	90	624	395	398	398	395	393	14
	0.5	393	465	362	590	452	464	305	297	247	662	405	417	417	405	393	72
	1	495	521	472	786	578	597	501	494	443	754	417	441	494	443	393	145
	2	854	896	825	1179	912	935	894	887	836	1031	441	490	887	836	393	289
	10	4016	4160	3849	4323	3996	4022	4038	4031	3980	4024	635	877	4031	3980	393	1446
99.8	0.1	355	370	312	391	359	362	144	136	86	0	357	360	360	357	355	14
	0.5	356	373	332	533	409	420	286	278	228	0	367	378	378	367	355	69
	1	452	471	434	710	524	541	463	456	405	0	378	401	456	405	355	139
	2	791	804	766	1065	827	848	818	811	760	0	401	448	811	760	355	277
	10	3625	3794	3562	3905	3614	3637	3658	3651	3600	0	587	820	3651	3600	355	1387
98	0.1	178	186	171	193	178	177	126	118	68	242	177	178	178	177	175	10
	0.5	203	211	199	263	206	203	196	188	138	264	184	192	192	184	175	51
	1	269	277	262	350	269	259	283	276	225	314	192	210	276	225	175	103
	2	428	444	415	525	424	398	458	451	400	453	210	244	451	400	175	206
	10	1807	1898	1765	1925	1805	1642	1858	1851	1800	1812	348	520	1851	1800	175	1030

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.02	0.31	0.29	0.20	1.96	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	0.00	0.00	1.50	1.14	1.18	0.71	0.69	0.60	2.03	1.03	1.06	1.06	1.03	1.00
	1	1.00	0.00	0.00	1.70	1.24	1.28	1.03	1.02	0.93	1.90	0.90	0.95	1.02	0.93	0.85
	2	1.00	0.00	0.00	1.42	1.09	1.12	1.05	1.04	1.00	1.35	0.53	0.58	1.04	1.00	0.47
	10	1.00	0.00	0.00	1.09	1.01	1.01	1.01	1.01	1.00	1.02	0.15	0.21	1.01	1.00	0.10
99.9	0.1	1.00	1.18	0.91	1.10	1.01	1.02	0.37	0.36	0.23	1.59	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.18	0.92	1.50	1.15	1.18	0.77	0.76	0.63	1.68	1.03	1.06	1.06	1.03	1.00
	1	1.00	1.05	0.95	1.59	1.17	1.21	1.01	1.00	0.90	1.52	0.84	0.89	1.00	0.90	0.79
	2	1.00	1.05	0.97	1.38	1.07	1.10	1.05	1.04	0.98	1.21	0.52	0.57	1.04	0.98	0.46
	10	1.00	1.04	0.96	1.08	1.00	1.00	1.01	1.00	0.99	1.00	0.16	0.22	1.00	0.99	0.10
99.8	0.1	1.00	1.04	0.88	1.10	1.01	1.02	0.40	0.38	0.24	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.05	0.93	1.50	1.15	1.18	0.80	0.78	0.64	0.00	1.03	1.06	1.06	1.03	1.00
	1	1.00	1.04	0.96	1.57	1.16	1.20	1.02	1.01	0.90	0.00	0.84	0.89	1.01	0.90	0.79
	2	1.00	1.02	0.97	1.35	1.05	1.07	1.03	1.02	0.96	0.00	0.51	0.57	1.02	0.96	0.45
	10	1.00	1.05	0.98	1.08	1.00	1.00	1.01	1.01	0.99	0.00	0.16	0.23	1.01	0.99	0.10
98	0.1	1.00	1.05	0.96	1.08	1.00	1.00	0.71	0.67	0.38	1.36	0.99	1.00	1.00	0.99	0.98
	0.5	1.00	1.04	0.98	1.29	1.02	1.00	0.96	0.93	0.68	1.30	0.90	0.95	0.95	0.90	0.86
	1	1.00	1.03	0.97	1.30	1.00	0.96	1.05	1.02	0.84	1.17	0.71	0.78	1.02	0.84	0.65
	2	1.00	1.04	0.97	1.23	0.99	0.93	1.07	1.05	0.94	1.06	0.49	0.57	1.05	0.94	0.41
	10	1.00	1.05	0.98	1.07	1.00	0.91	1.03	1.02	1.00	1.00	0.19	0.29	1.02	1.00	0.10
Correlation coefficient							0.08									

Table A5: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 50 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	80	0	0	87	80	80	50	56	32	479	79	80	80	79	79	3
	0.5	103	0	0	119	93	94	82	87	63	482	81	83	87	81	79	13
	1	131	0	0	158	121	123	121	127	103	489	83	88	127	103	79	27
	2	200	0	0	237	192	194	200	206	182	511	88	97	206	182	79	53
	10	824	0	0	869	816	818	832	838	814	941	124	168	838	814	79	266
99.9	0.1	70	74	68	76	70	70	49	55	31	295	69	70	70	69	69	3
	0.5	84	88	81	104	82	83	77	82	58	298	71	73	82	71	69	13
	1	115	118	109	138	107	109	111	117	93	306	73	78	117	93	69	25
	2	176	185	170	207	170	171	180	186	162	332	78	86	186	162	69	51
	10	731	747	693	759	715	717	732	738	714	768	112	154	738	714	69	254
99.8	0.1	67	69	66	74	68	68	49	55	31	0	67	68	68	67	67	3
	0.5	79	84	77	101	79	80	76	81	57	0	69	71	81	69	67	13
	1	109	112	104	134	104	106	109	115	91	0	71	76	115	91	67	26
	2	171	178	169	201	165	167	176	182	158	0	76	85	182	158	67	52
	10	706	729	690	737	695	697	712	718	694	0	111	155	718	694	67	262
98	0.1	54	55	53	58	54	54	47	53	29	114	54	54	54	54	53	3
	0.5	63	64	61	80	64	62	69	74	50	119	56	58	74	56	53	16
	1	84	87	82	106	85	81	95	101	77	131	58	63	101	77	53	31
	2	137	141	134	159	134	125	148	154	130	165	63	74	154	130	53	62
	10	558	592	542	583	555	504	572	578	554	562	105	157	578	554	53	312

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.09	1.00	1.01	0.63	0.70	0.40	6.01	1.00	1.00	1.00	1.00	0.99
	0.5	1.00	0.00	0.00	1.15	0.90	0.91	0.79	0.85	0.62	4.70	0.79	0.81	0.85	0.79	0.77
	1	1.00	0.00	0.00	1.20	0.92	0.94	0.92	0.97	0.78	3.72	0.64	0.67	0.97	0.78	0.60
	2	1.00	0.00	0.00	1.19	0.96	0.97	1.00	1.03	0.91	2.56	0.44	0.48	1.03	0.91	0.40
	10	1.00	0.00	0.00	1.05	0.99	0.99	1.01	1.02	0.99	1.14	0.15	0.20	1.02	0.99	0.10
99.9	0.1	1.00	1.06	0.97	1.08	1.00	1.00	0.70	0.78	0.44	4.21	0.99	1.00	1.00	0.99	0.99
	0.5	1.00	1.05	0.95	1.23	0.97	0.98	0.91	0.98	0.69	3.54	0.84	0.87	0.98	0.84	0.82
	1	1.00	1.02	0.95	1.20	0.93	0.94	0.96	1.01	0.81	2.65	0.63	0.67	1.01	0.81	0.60
	2	1.00	1.05	0.96	1.18	0.96	0.97	1.02	1.06	0.92	1.89	0.44	0.49	1.06	0.92	0.39
	10	1.00	1.02	0.95	1.04	0.98	0.98	1.00	1.01	0.98	1.05	0.15	0.21	1.01	0.98	0.09
99.8	0.1	1.00	1.03	0.99	1.10	1.01	1.02	0.73	0.81	0.46	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.06	0.98	1.27	1.00	1.02	0.96	1.03	0.73	0.00	0.88	0.90	1.03	0.88	0.85
	1	1.00	1.03	0.96	1.23	0.96	0.97	1.00	1.06	0.84	0.00	0.66	0.70	1.06	0.84	0.62
	2	1.00	1.04	0.99	1.18	0.97	0.98	1.03	1.06	0.92	0.00	0.44	0.49	1.06	0.92	0.39
	10	1.00	1.03	0.98	1.04	0.99	0.99	1.01	1.02	0.98	0.00	0.16	0.22	1.02	0.98	0.09
98	0.1	1.00	1.02	0.98	1.08	1.00	0.99	0.88	0.98	0.54	2.12	0.99	1.00	1.00	0.99	0.98
	0.5	1.00	1.02	0.98	1.27	1.03	1.00	1.10	1.19	0.81	1.91	0.89	0.93	1.19	0.89	0.85
	1	1.00	1.04	0.97	1.26	1.01	0.96	1.13	1.20	0.91	1.55	0.69	0.75	1.20	0.91	0.63
	2	1.00	1.03	0.98	1.16	0.98	0.91	1.08	1.12	0.95	1.21	0.46	0.54	1.12	0.95	0.39
	10	1.00	1.06	0.97	1.05	0.99	0.90	1.03	1.04	0.99	1.01	0.19	0.28	1.04	0.99	0.10
Correlation coefficient							0.04									

Table A6: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 25 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	96	26	24	17	148	96	97	97	96	95	2
	0.5	107	0	0	143	109	107	64	62	55	157	99	103	103	99	95	10
	1	143	0	0	190	139	135	111	110	102	180	103	112	112	103	95	20
	2	214	0	0	285	218	214	206	205	197	246	112	128	205	197	95	39
	10	957	0	0	1045	962	957	966	965	957	968	178	261	965	957	95	196
99.9	0.1	79	84	74	87	80	80	24	23	15	91	80	80	80	80	79	2
	0.5	81	92	74	119	91	89	56	54	47	101	83	86	86	83	79	8
	1	97	100	94	158	116	113	95	94	86	124	86	93	94	86	79	17
	2	171	176	168	237	182	179	174	173	165	188	93	108	173	165	79	34
	10	795	822	781	869	801	797	806	805	797	802	151	223	805	797	79	169
99.8	0.1	71	78	60	78	72	72	23	22	14	0	72	72	72	72	71	2
	0.5	73	79	64	107	82	80	52	50	43	0	74	78	78	74	71	8
	1	88	91	84	142	104	102	87	86	78	0	78	84	86	78	71	16
	2	154	158	148	213	164	161	158	157	149	0	84	98	157	149	71	31
	10	715	728	701	781	720	717	726	725	717	0	137	204	725	717	71	156
98	0.1	33	34	31	35	33	32	19	18	11	35	32	33	33	32	32	1
	0.5	34	35	33	48	38	35	32	31	23	40	34	36	36	34	32	4
	1	42	43	41	64	49	44	48	47	39	50	36	39	47	39	32	9
	2	71	72	69	96	76	68	80	79	71	78	39	47	79	71	32	17
	10	326	327	324	352	328	291	336	335	327	329	68	105	335	327	32	85

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.27	0.25	0.18	1.55	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	0.00	0.00	1.33	1.02	1.00	0.59	0.58	0.51	1.46	0.92	0.96	0.96	0.92	0.88
	1	1.00	0.00	0.00	1.33	0.97	0.95	0.78	0.77	0.72	1.26	0.72	0.78	0.78	0.72	0.66
	2	1.00	0.00	0.00	1.33	1.02	1.00	0.96	0.96	0.92	1.15	0.52	0.60	0.96	0.92	0.44
	10	1.00	0.00	0.00	1.09	1.00	1.00	1.01	1.01	1.00	1.01	0.19	0.27	1.01	1.00	0.10
99.9	0.1	1.00	1.06	0.94	1.10	1.01	1.01	0.30	0.29	0.19	1.15	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.14	0.91	1.46	1.12	1.10	0.69	0.67	0.58	1.25	1.02	1.06	1.06	1.02	0.98
	1	1.00	1.04	0.97	1.63	1.20	1.17	0.98	0.97	0.89	1.28	0.89	0.97	0.97	0.89	0.82
	2	1.00	1.02	0.98	1.38	1.06	1.04	1.02	1.01	0.96	1.09	0.54	0.63	1.01	0.96	0.46
	10	1.00	1.03	0.98	1.09	1.01	1.00	1.01	1.01	1.00	1.01	0.19	0.28	1.01	1.00	0.10
99.8	0.1	1.00	1.09	0.85	1.10	1.01	1.01	0.33	0.31	0.20	0.00	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.08	0.88	1.46	1.12	1.10	0.71	0.69	0.59	0.00	1.02	1.06	1.06	1.02	0.97
	1	1.00	1.04	0.95	1.61	1.19	1.16	0.99	0.97	0.89	0.00	0.88	0.96	0.97	0.89	0.81
	2	1.00	1.02	0.96	1.38	1.07	1.05	1.03	1.02	0.97	0.00	0.55	0.63	1.02	0.97	0.46
	10	1.00	1.02	0.98	1.09	1.01	1.00	1.02	1.01	1.00	0.00	0.19	0.28	1.01	1.00	0.10
98	0.1	1.00	1.03	0.94	1.07	0.99	0.97	0.58	0.54	0.32	1.07	0.98	0.99	0.99	0.98	0.97
	0.5	1.00	1.03	0.97	1.41	1.11	1.03	0.94	0.90	0.69	1.18	0.99	1.05	1.05	0.99	0.94
	1	1.00	1.02	0.97	1.52	1.15	1.04	1.14	1.11	0.93	1.20	0.85	0.93	1.11	0.93	0.76
	2	1.00	1.02	0.98	1.36	1.08	0.96	1.13	1.12	1.01	1.10	0.56	0.66	1.12	1.01	0.45
	10	1.00	1.00	0.99	1.08	1.01	0.89	1.03	1.03	1.00	1.01	0.21	0.32	1.03	1.00	0.10
Correlation coefficient							-0.06									

Table A7: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 25 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	198	0	0	218	201	202	44	39	30	197	200	201	201	200	198	4
	0.5	253	0	0	297	227	232	123	118	109	224	207	215	215	207	198	20
	1	329	0	0	396	288	295	222	217	208	285	215	233	233	215	198	41
	2	481	0	0	594	452	461	420	415	406	450	233	267	415	406	198	82
	10	1998	0	0	2178	1999	2010	2004	1999	1990	1999	371	545	1999	1990	198	408
99.9	0.1	106	121	84	109	100	101	34	29	20	121	100	101	101	100	99	2
	0.5	106	134	100	149	114	116	74	69	59	133	104	108	108	104	99	11
	1	150	165	132	198	145	149	123	118	109	161	108	117	118	109	99	21
	2	232	246	224	297	229	233	222	217	208	238	117	135	217	208	99	42
	10	1017	1038	998	1089	1004	1009	1014	1009	1000	1006	189	279	1009	1000	99	212
99.8	0.1	78	94	74	86	79	79	32	27	18	0	79	79	79	79	78	2
	0.5	93	97	81	117	90	92	63	58	49	0	82	85	85	82	78	9
	1	112	123	105	156	115	118	102	97	88	0	85	93	97	88	78	17
	2	183	194	172	234	181	185	180	175	166	0	93	107	175	166	78	34
	10	803	819	783	858	793	797	804	799	790	0	151	224	799	790	78	171
98	0.1	50	52	48	55	51	50	29	24	15	47	51	51	51	51	50	1
	0.5	53	55	51	75	59	57	49	44	35	55	53	56	56	53	50	7
	1	64	66	63	100	75	71	74	69	60	73	56	61	69	60	50	13
	2	110	111	108	150	118	109	124	119	110	117	61	73	119	110	50	27
	10	511	514	506	550	512	457	524	519	510	511	107	163	519	510	50	134

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.02	0.22	0.20	0.15	0.99	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	0.00	0.00	1.17	0.90	0.92	0.49	0.47	0.43	0.88	0.82	0.85	0.85	0.82	0.78
	1	1.00	0.00	0.00	1.20	0.88	0.90	0.68	0.66	0.63	0.87	0.65	0.71	0.71	0.65	0.60
	2	1.00	0.00	0.00	1.24	0.94	0.96	0.87	0.86	0.84	0.94	0.48	0.56	0.86	0.84	0.41
	10	1.00	0.00	0.00	1.09	1.00	1.01	1.00	1.00	1.00	1.00	0.19	0.27	1.00	1.00	0.10
99.9	0.1	1.00	1.15	0.80	1.03	0.95	0.95	0.32	0.28	0.19	1.14	0.95	0.95	0.95	0.95	0.94
	0.5	1.00	1.27	0.94	1.40	1.08	1.10	0.69	0.65	0.56	1.25	0.98	1.02	1.02	0.98	0.93
	1	1.00	1.10	0.88	1.32	0.97	0.99	0.82	0.79	0.72	1.07	0.72	0.78	0.79	0.72	0.66
	2	1.00	1.06	0.97	1.28	0.99	1.01	0.96	0.94	0.90	1.03	0.51	0.58	0.94	0.90	0.43
	10	1.00	1.02	0.98	1.07	0.99	0.99	1.00	0.99	0.98	0.99	0.19	0.27	0.99	0.98	0.10
99.8	0.1	1.00	1.21	0.95	1.10	1.01	1.02	0.41	0.35	0.22	0.00	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.05	0.87	1.26	0.97	0.99	0.68	0.63	0.53	0.00	0.88	0.92	0.92	0.88	0.84
	1	1.00	1.10	0.94	1.39	1.03	1.05	0.91	0.87	0.78	0.00	0.76	0.83	0.87	0.78	0.70
	2	1.00	1.06	0.94	1.28	0.99	1.01	0.98	0.96	0.90	0.00	0.51	0.58	0.96	0.90	0.43
	10	1.00	1.02	0.97	1.07	0.99	0.99	1.00	1.00	0.98	0.00	0.19	0.28	1.00	0.98	0.10
98	0.1	1.00	1.04	0.96	1.10	1.02	1.01	0.58	0.49	0.29	0.94	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.04	0.97	1.41	1.10	1.07	0.92	0.84	0.65	1.04	1.00	1.05	1.05	1.00	0.94
	1	1.00	1.02	0.98	1.55	1.17	1.11	1.15	1.08	0.93	1.13	0.86	0.95	1.08	0.93	0.78
	2	1.00	1.01	0.99	1.37	1.08	0.99	1.13	1.09	1.00	1.06	0.56	0.66	1.09	1.00	0.46
	10	1.00	1.01	0.99	1.08	1.00	0.90	1.03	1.02	1.00	1.00	0.21	0.32	1.02	1.00	0.10
Correlation coefficient							0.05									

Table A8: Comparison of modelled concentrations, ppb: Manchester Town Hall oxides of nitrogen: 25 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	805	801	176	181	130	1029	802	809	809	802	795	12
	0.5	795	0	0	1193	913	892	494	499	448	1120	830	865	865	830	795	59
	1	954	0	0	1590	1160	1125	891	897	846	1330	865	934	934	865	795	118
	2	1706	0	0	2385	1821	1777	1686	1692	1641	1934	934	1073	1692	1641	795	235
	10	7988	0	0	8745	8039	7990	8046	8052	8001	8065	1491	2187	8052	8001	795	1177
99.9	0.1	572	622	462	629	580	576	153	159	108	634	577	582	582	577	572	9
	0.5	572	622	464	858	659	644	382	388	337	709	598	624	624	598	572	44
	1	656	721	640	1144	839	815	668	674	623	879	624	676	676	624	572	88
	2	1214	1242	1175	1716	1318	1287	1240	1246	1195	1344	676	780	1246	1195	572	176
	10	5829	5952	5666	6292	5797	5763	5816	5822	5771	5803	1093	1614	5822	5771	572	881
99.8	0.1	451	523	413	496	457	455	141	147	96	0	455	459	459	455	451	7
	0.5	451	524	416	677	521	509	322	327	276	0	472	493	493	472	451	36
	1	554	572	517	902	665	646	547	553	502	0	493	535	553	502	451	71
	2	957	986	942	1353	1046	1022	998	1004	953	0	535	619	1004	953	451	142
	10	4555	4655	4439	4961	4580	4554	4606	4612	4561	0	872	1293	4612	4561	451	712
98	0.1	197	210	188	216	199	196	116	122	71	245	198	200	200	198	196	4
	0.5	208	223	200	294	231	215	194	200	149	272	207	218	218	207	196	19
	1	269	277	263	392	300	270	292	298	247	331	218	240	298	247	196	38
	2	441	447	435	588	472	419	488	494	443	492	240	285	494	443	196	75
	10	1999	2012	1985	2156	2017	1785	2056	2062	2011	2021	418	640	2062	2011	196	376

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.23	0.16	1.29	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	0.00	0.00	1.50	1.15	1.12	0.62	0.63	0.56	1.41	1.04	1.09	1.09	1.04	1.00
	1	1.00	0.00	0.00	1.67	1.22	1.18	0.93	0.94	0.89	1.39	0.91	0.98	0.98	0.91	0.83
	2	1.00	0.00	0.00	1.40	1.07	1.04	0.99	0.99	0.96	1.13	0.55	0.63	0.99	0.96	0.47
	10	1.00	0.00	0.00	1.09	1.01	1.00	1.01	1.01	1.00	1.01	0.19	0.27	1.01	1.00	0.10
99.9	0.1	1.00	1.09	0.81	1.10	1.01	1.01	0.27	0.28	0.19	1.11	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.09	0.81	1.50	1.15	1.13	0.67	0.68	0.59	1.24	1.05	1.09	1.09	1.05	1.00
	1	1.00	1.10	0.98	1.74	1.28	1.24	1.02	1.03	0.95	1.34	0.95	1.03	1.03	0.95	0.87
	2	1.00	1.02	0.97	1.41	1.09	1.06	1.02	1.03	0.98	1.11	0.56	0.64	1.03	0.98	0.47
	10	1.00	1.02	0.97	1.08	0.99	0.99	1.00	1.00	0.99	1.00	0.19	0.28	1.00	0.99	0.10
99.8	0.1	1.00	1.16	0.92	1.10	1.01	1.01	0.31	0.33	0.21	0.00	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.16	0.92	1.50	1.16	1.13	0.71	0.73	0.61	0.00	1.05	1.09	1.09	1.05	1.00
	1	1.00	1.03	0.93	1.63	1.20	1.17	0.99	1.00	0.91	0.00	0.89	0.97	1.00	0.91	0.81
	2	1.00	1.03	0.98	1.41	1.09	1.07	1.04	1.05	1.00	0.00	0.56	0.65	1.05	1.00	0.47
	10	1.00	1.02	0.97	1.09	1.01	1.00	1.01	1.01	1.00	0.00	0.19	0.28	1.01	1.00	0.10
98	0.1	1.00	1.07	0.95	1.09	1.01	0.99	0.59	0.62	0.36	1.24	1.01	1.02	1.02	1.01	0.99
	0.5	1.00	1.07	0.96	1.41	1.11	1.03	0.93	0.96	0.72	1.31	1.00	1.05	1.05	1.00	0.94
	1	1.00	1.03	0.98	1.46	1.11	1.00	1.08	1.11	0.92	1.23	0.81	0.89	1.11	0.92	0.73
	2	1.00	1.01	0.99	1.33	1.07	0.95	1.11	1.12	1.00	1.12	0.55	0.65	1.12	1.00	0.44
	10	1.00	1.01	0.99	1.08	1.01	0.89	1.03	1.03	1.01	1.01	0.21	0.32	1.03	1.01	0.10
Correlation coefficient							-0.07									

Table A9: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 25 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	525	529	160	153	102	1015	523	527	527	523	518	8
	0.5	518	0	0	777	597	617	367	360	309	1060	541	563	563	541	518	38
	1	690	0	0	1036	761	792	626	619	568	1164	563	609	619	568	518	77
	2	1200	0	0	1554	1196	1235	1144	1137	1086	1487	609	699	1137	1086	518	153
	10	5280	0	0	5698	5254	5298	5288	5281	5230	5327	971	1425	5281	5230	518	767
99.9	0.1	393	465	358	432	398	402	147	140	90	625	397	400	400	397	393	6
	0.5	393	465	375	590	455	470	305	297	247	666	411	429	429	411	393	30
	1	512	548	495	786	581	604	501	494	443	759	429	465	494	443	393	61
	2	882	944	869	1179	914	943	894	887	836	1036	465	536	887	836	393	121
	10	4012	4159	3938	4323	3997	4029	4038	4031	3980	4026	751	1109	4031	3980	393	605
99.8	0.1	355	370	313	391	360	363	144	136	86	0	358	362	362	358	355	6
	0.5	361	370	350	533	411	425	286	278	228	0	372	388	388	372	355	28
	1	468	487	457	710	527	547	463	456	405	0	388	421	456	405	355	56
	2	798	822	776	1065	829	855	818	811	760	0	421	488	811	760	355	112
	10	3641	3699	3538	3905	3615	3644	3658	3651	3600	0	686	1018	3651	3600	355	560
98	0.1	178	187	172	193	178	177	126	118	68	242	177	179	179	177	175	3
	0.5	203	210	198	263	207	203	196	188	138	265	185	195	195	185	175	17
	1	262	270	257	350	269	258	283	276	225	315	195	215	276	225	175	34
	2	418	428	410	525	425	396	458	451	400	454	215	254	451	400	175	67
	10	1802	1820	1790	1925	1805	1619	1858	1851	1800	1812	373	572	1851	1800	175	336

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.02	0.31	0.29	0.20	1.96	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	0.00	0.00	1.50	1.15	1.19	0.71	0.69	0.60	2.05	1.04	1.09	1.09	1.04	1.00
	1	1.00	0.00	0.00	1.50	1.10	1.15	0.91	0.90	0.82	1.69	0.82	0.88	0.90	0.82	0.75
	2	1.00	0.00	0.00	1.30	1.00	1.03	0.95	0.95	0.91	1.24	0.51	0.58	0.95	0.91	0.43
	10	1.00	0.00	0.00	1.08	1.00	1.00	1.00	1.00	0.99	1.01	0.18	0.27	1.00	0.99	0.10
99.9	0.1	1.00	1.18	0.91	1.10	1.01	1.02	0.37	0.36	0.23	1.59	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.18	0.95	1.50	1.16	1.19	0.77	0.76	0.63	1.69	1.05	1.09	1.09	1.05	1.00
	1	1.00	1.07	0.97	1.53	1.13	1.18	0.98	0.96	0.87	1.48	0.84	0.91	0.96	0.87	0.77
	2	1.00	1.07	0.99	1.34	1.04	1.07	1.01	1.01	0.95	1.17	0.53	0.61	1.01	0.95	0.45
	10	1.00	1.04	0.98	1.08	1.00	1.00	1.01	1.00	0.99	1.00	0.19	0.28	1.00	0.99	0.10
99.8	0.1	1.00	1.04	0.88	1.10	1.01	1.02	0.40	0.38	0.24	0.00	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.02	0.97	1.48	1.14	1.18	0.79	0.77	0.63	0.00	1.03	1.08	1.08	1.03	0.98
	1	1.00	1.04	0.98	1.52	1.13	1.17	0.99	0.97	0.87	0.00	0.83	0.90	0.97	0.87	0.76
	2	1.00	1.03	0.97	1.33	1.04	1.07	1.03	1.02	0.95	0.00	0.53	0.61	1.02	0.95	0.44
	10	1.00	1.02	0.97	1.07	0.99	1.00	1.00	1.00	0.99	0.00	0.19	0.28	1.00	0.99	0.10
98	0.1	1.00	1.05	0.97	1.08	1.00	1.00	0.71	0.67	0.38	1.36	0.99	1.01	1.01	0.99	0.98
	0.5	1.00	1.03	0.98	1.29	1.02	1.00	0.96	0.93	0.68	1.30	0.91	0.96	0.96	0.91	0.86
	1	1.00	1.03	0.98	1.34	1.03	0.99	1.08	1.05	0.86	1.20	0.74	0.82	1.05	0.86	0.67
	2	1.00	1.02	0.98	1.25	1.01	0.95	1.09	1.08	0.96	1.08	0.51	0.61	1.08	0.96	0.42
	10	1.00	1.01	0.99	1.07	1.00	0.90	1.03	1.03	1.00	1.01	0.21	0.32	1.03	1.00	0.10
Correlation coefficient							0.10									

Table A10: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 25 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	80	0	0	87	80	80	50	56	32	479	80	80	80	80	79	1
	0.5	103	0	0	119	93	93	82	87	63	483	82	86	87	82	79	6
	1	138	0	0	158	122	122	121	127	103	491	86	93	127	103	79	12
	2	216	0	0	237	192	193	200	206	182	514	93	107	206	182	79	23
	10	838	0	0	869	816	817	832	838	814	945	148	217	838	814	79	117
99.9	0.1	71	74	69	76	70	70	49	55	31	295	70	70	70	70	69	1
	0.5	88	92	85	104	82	82	77	82	58	299	72	75	82	72	69	5
	1	118	123	115	138	107	108	111	117	93	308	75	82	117	93	69	11
	2	185	191	178	207	170	170	180	186	162	334	82	94	186	162	69	21
	10	729	752	714	759	716	716	732	738	714	770	132	195	738	714	69	106
99.8	0.1	68	70	66	74	68	68	49	55	31	0	68	68	68	68	67	1
	0.5	84	86	80	101	80	80	76	81	57	0	70	73	81	70	67	5
	1	111	117	107	134	105	105	109	115	91	0	73	80	115	91	67	11
	2	173	179	168	201	165	166	176	182	158	0	80	92	182	158	67	21
	10	700	719	686	737	695	696	712	718	694	0	130	192	718	694	67	106
98	0.1	54	55	53	58	54	53	47	53	29	114	54	54	54	54	53	1
	0.5	62	63	62	80	64	61	69	74	50	120	56	59	74	56	53	5
	1	85	87	83	106	85	79	95	101	77	131	59	65	101	77	53	10
	2	137	139	134	159	134	123	148	154	130	166	65	77	154	130	53	20
	10	556	561	552	583	555	495	572	578	554	562	113	173	578	554	53	102

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.09	1.00	1.00	0.62	0.70	0.40	6.00	1.00	1.01	1.01	1.00	0.99
	0.5	1.00	0.00	0.00	1.15	0.90	0.90	0.79	0.84	0.61	4.67	0.80	0.83	0.84	0.80	0.76
	1	1.00	0.00	0.00	1.15	0.88	0.89	0.88	0.92	0.75	3.56	0.62	0.67	0.92	0.75	0.57
	2	1.00	0.00	0.00	1.10	0.89	0.89	0.93	0.95	0.84	2.39	0.43	0.49	0.95	0.84	0.37
	10	1.00	0.00	0.00	1.04	0.97	0.97	0.99	1.00	0.97	1.13	0.18	0.26	1.00	0.97	0.09
99.9	0.1	1.00	1.04	0.97	1.07	0.99	0.99	0.69	0.77	0.43	4.16	0.98	0.99	0.99	0.98	0.97
	0.5	1.00	1.04	0.96	1.17	0.93	0.93	0.87	0.93	0.66	3.38	0.82	0.85	0.93	0.82	0.78
	1	1.00	1.05	0.97	1.17	0.91	0.91	0.94	0.99	0.79	2.61	0.64	0.69	0.99	0.79	0.59
	2	1.00	1.03	0.96	1.12	0.92	0.92	0.98	1.01	0.88	1.81	0.44	0.51	1.01	0.88	0.37
	10	1.00	1.03	0.98	1.04	0.98	0.98	1.00	1.01	0.98	1.06	0.18	0.27	1.01	0.98	0.09
99.8	0.1	1.00	1.03	0.97	1.08	1.00	1.00	0.72	0.80	0.45	0.00	0.99	1.00	1.00	0.99	0.99
	0.5	1.00	1.03	0.96	1.20	0.95	0.95	0.90	0.97	0.68	0.00	0.84	0.87	0.97	0.84	0.80
	1	1.00	1.05	0.96	1.20	0.94	0.94	0.98	1.03	0.82	0.00	0.66	0.71	1.03	0.82	0.60
	2	1.00	1.03	0.97	1.16	0.95	0.96	1.02	1.05	0.91	0.00	0.46	0.53	1.05	0.91	0.39
	10	1.00	1.03	0.98	1.05	0.99	0.99	1.02	1.03	0.99	0.00	0.19	0.27	1.03	0.99	0.10
98	0.1	1.00	1.02	0.98	1.08	1.00	0.99	0.87	0.98	0.54	2.11	0.99	1.00	1.00	0.99	0.98
	0.5	1.00	1.01	0.99	1.28	1.03	0.99	1.10	1.19	0.81	1.92	0.90	0.95	1.19	0.90	0.85
	1	1.00	1.02	0.98	1.25	1.01	0.94	1.12	1.19	0.91	1.55	0.70	0.77	1.19	0.91	0.63
	2	1.00	1.02	0.98	1.16	0.98	0.90	1.08	1.13	0.95	1.21	0.48	0.56	1.13	0.95	0.39
	10	1.00	1.01	0.99	1.05	1.00	0.89	1.03	1.04	1.00	1.01	0.20	0.31	1.04	1.00	0.10
Correlation coefficient							0.01									

Table A11: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 100 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	95	26	24	17	147	95	96	96	95	95	10
	0.5	95	0	0	143	108	107	64	62	55	155	96	98	98	96	95	50
	1	113	0	0	190	137	135	111	110	102	177	98	101	110	102	95	100
	2	208	0	0	285	217	215	206	205	197	244	101	106	205	197	95	201
	10	968	0	0	1045	961	959	966	965	957	968	123	151	965	957	95	1003
99.9	0.1	80	84	74	87	80	79	24	23	15	91	79	80	80	79	79	10
	0.5	81	90	74	119	90	89	56	54	47	100	80	82	82	80	79	51
	1	97	104	89	158	115	113	95	94	86	123	82	85	94	86	79	102
	2	168	181	158	237	181	179	174	173	165	186	85	90	173	165	79	203
	10	800	853	726	869	801	799	806	805	797	802	107	136	805	797	79	1015
99.8	0.1	71	77	60	78	72	71	23	22	14	0	71	72	72	71	71	11
	0.5	71	79	64	107	81	80	52	50	43	0	72	74	74	72	71	54
	1	91	94	84	142	103	102	87	86	78	0	74	77	86	78	71	107
	2	154	170	145	213	163	162	158	157	149	0	77	83	157	149	71	215
	10	717	792	674	781	720	718	726	725	717	0	101	131	725	717	71	1074
98	0.1	33	34	31	35	32	32	19	18	11	35	32	33	33	32	32	9
	0.5	35	37	34	48	37	36	32	31	23	40	33	35	35	33	32	45
	1	46	49	45	64	48	45	48	47	39	50	35	37	47	39	32	91
	2	74	78	71	96	76	71	80	79	71	77	37	42	79	71	32	181
	10	329	348	311	352	328	302	336	335	327	329	57	82	335	327	32	906

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.27	0.25	0.18	1.55	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.12	0.67	0.65	0.58	1.64	1.01	1.03	1.03	1.01	1.00
	1	1.00	0.00	0.00	1.68	1.22	1.20	0.98	0.97	0.91	1.57	0.87	0.89	0.97	0.91	0.84
	2	1.00	0.00	0.00	1.37	1.04	1.03	0.99	0.98	0.95	1.17	0.48	0.51	0.98	0.95	0.46
	10	1.00	0.00	0.00	1.08	0.99	0.99	1.00	1.00	0.99	1.00	0.13	0.16	1.00	0.99	0.10
99.9	0.1	1.00	1.05	0.92	1.08	0.99	0.99	0.30	0.28	0.19	1.13	0.99	0.99	0.99	0.99	0.98
	0.5	1.00	1.11	0.91	1.46	1.11	1.10	0.69	0.67	0.58	1.23	0.99	1.01	1.01	0.99	0.98
	1	1.00	1.08	0.92	1.63	1.18	1.17	0.98	0.97	0.89	1.26	0.84	0.87	0.97	0.89	0.81
	2	1.00	1.08	0.94	1.41	1.08	1.07	1.04	1.03	0.98	1.11	0.50	0.54	1.03	0.98	0.47
	10	1.00	1.07	0.91	1.09	1.00	1.00	1.01	1.01	1.00	1.00	0.13	0.17	1.01	1.00	0.10
99.8	0.1	1.00	1.08	0.85	1.10	1.01	1.01	0.33	0.31	0.20	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.11	0.90	1.49	1.14	1.12	0.72	0.70	0.60	0.00	1.02	1.04	1.04	1.02	1.00
	1	1.00	1.04	0.92	1.56	1.14	1.12	0.96	0.94	0.86	0.00	0.81	0.85	0.94	0.86	0.78
	2	1.00	1.11	0.94	1.39	1.06	1.05	1.03	1.02	0.97	0.00	0.50	0.54	1.02	0.97	0.46
	10	1.00	1.11	0.94	1.09	1.00	1.00	1.01	1.01	1.00	0.00	0.14	0.18	1.01	1.00	0.10
98	0.1	1.00	1.04	0.95	1.07	0.99	0.98	0.59	0.54	0.32	1.07	0.98	0.99	0.99	0.98	0.98
	0.5	1.00	1.05	0.97	1.37	1.07	1.02	0.91	0.88	0.67	1.14	0.95	0.99	0.99	0.95	0.91
	1	1.00	1.06	0.97	1.39	1.05	0.98	1.04	1.01	0.85	1.09	0.75	0.80	1.01	0.85	0.69
	2	1.00	1.06	0.95	1.30	1.03	0.95	1.08	1.06	0.96	1.05	0.50	0.57	1.06	0.96	0.43
	10	1.00	1.06	0.95	1.07	1.00	0.92	1.02	1.02	1.00	1.00	0.17	0.25	1.02	1.00	0.10
Correlation coefficient							-0.03									

Table A12: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 100 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	198	0	0	218	200	200	44	39	30	196	199	199	199	199	198	21
	0.5	237	0	0	297	224	226	123	118	109	220	201	204	204	201	198	105
	1	298	0	0	396	285	288	222	217	208	282	204	210	217	208	198	209
	2	419	0	0	594	449	454	420	415	406	448	210	221	415	406	198	418
	10	1994	0	0	2178	1999	2004	2004	1999	1990	1999	256	314	1999	1990	198	2091
99.9	0.1	106	121	84	109	100	100	34	29	20	120	99	100	100	99	99	13
	0.5	106	139	95	149	113	114	74	69	59	131	101	103	103	101	99	64
	1	134	180	120	198	144	146	123	118	109	159	103	106	118	109	99	127
	2	229	255	202	297	228	230	222	217	208	237	106	113	217	208	99	254
	10	1012	1079	913	1089	1004	1006	1014	1009	1000	1006	134	170	1009	1000	99	1272
99.8	0.1	78	93	74	86	79	79	32	27	18	0	78	79	79	78	78	12
	0.5	90	97	77	117	89	90	63	58	49	0	80	81	81	80	78	59
	1	109	121	98	156	114	115	102	97	88	0	81	85	97	88	78	118
	2	187	198	167	234	181	182	180	175	166	0	85	91	175	166	78	236
	10	834	860	770	858	793	795	804	799	790	0	111	144	799	790	78	1180
98	0.1	50	52	48	55	51	50	29	24	15	47	50	51	51	50	50	14
	0.5	54	55	52	75	58	57	49	44	35	55	52	54	54	52	50	71
	1	66	68	64	100	75	72	74	69	60	72	54	58	69	60	50	142
	2	109	118	104	150	118	111	124	119	110	117	58	66	119	110	50	283
	10	507	546	481	550	511	473	524	519	510	511	89	129	519	510	50	1415

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.20	0.15	0.99	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	0.00	0.00	1.25	0.94	0.95	0.52	0.50	0.46	0.93	0.85	0.86	0.86	0.85	0.83
	1	1.00	0.00	0.00	1.33	0.96	0.97	0.75	0.73	0.70	0.95	0.68	0.70	0.73	0.70	0.66
	2	1.00	0.00	0.00	1.42	1.07	1.08	1.00	0.99	0.97	1.07	0.50	0.53	0.99	0.97	0.47
	10	1.00	0.00	0.00	1.09	1.00	1.00	1.01	1.00	1.00	1.00	0.13	0.16	1.00	1.00	0.10
99.9	0.1	1.00	1.14	0.79	1.03	0.94	0.94	0.32	0.28	0.18	1.13	0.94	0.94	0.94	0.94	0.93
	0.5	1.00	1.32	0.89	1.40	1.06	1.07	0.69	0.65	0.56	1.24	0.95	0.97	0.97	0.95	0.93
	1	1.00	1.34	0.89	1.47	1.07	1.08	0.91	0.88	0.81	1.18	0.76	0.79	0.88	0.81	0.74
	2	1.00	1.11	0.88	1.30	0.99	1.00	0.97	0.95	0.91	1.03	0.46	0.49	0.95	0.91	0.43
	10	1.00	1.07	0.90	1.08	0.99	0.99	1.00	1.00	0.99	0.99	0.13	0.17	1.00	0.99	0.10
99.8	0.1	1.00	1.19	0.95	1.10	1.01	1.01	0.41	0.35	0.22	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.08	0.85	1.30	0.99	1.00	0.70	0.65	0.54	0.00	0.88	0.90	0.90	0.88	0.87
	1	1.00	1.11	0.90	1.43	1.05	1.06	0.94	0.89	0.80	0.00	0.75	0.78	0.89	0.80	0.72
	2	1.00	1.06	0.89	1.25	0.97	0.97	0.96	0.94	0.89	0.00	0.45	0.49	0.94	0.89	0.42
	10	1.00	1.03	0.92	1.03	0.95	0.95	0.96	0.96	0.95	0.00	0.13	0.17	0.96	0.95	0.09
98	0.1	1.00	1.04	0.96	1.10	1.01	1.01	0.58	0.49	0.29	0.94	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.02	0.96	1.39	1.08	1.05	0.91	0.82	0.64	1.01	0.96	1.00	1.00	0.96	0.93
	1	1.00	1.03	0.97	1.52	1.13	1.09	1.12	1.05	0.90	1.10	0.82	0.88	1.05	0.90	0.76
	2	1.00	1.08	0.95	1.37	1.08	1.02	1.14	1.09	1.01	1.07	0.53	0.60	1.09	1.01	0.46
	10	1.00	1.08	0.95	1.08	1.01	0.93	1.03	1.02	1.00	1.01	0.18	0.25	1.02	1.00	0.10
Correlation coefficient							0.03									

Table A13: Comparison of modelled concentrations, ppb: Manchester Town Hall oxides of nitrogen: 100 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	801	799	176	181	130	1024	797	800	800	797	795	60
	0.5	795	0	0	1193	901	892	494	499	448	1105	807	818	818	807	795	301
	1	876	0	0	1590	1146	1133	891	897	846	1312	818	842	897	846	795	603
	2	1671	0	0	2385	1811	1795	1686	1692	1641	1919	842	888	1692	1641	795	1206
	10	8031	0	0	8745	8037	8019	8046	8052	8001	8061	1029	1262	8052	8001	795	6029
99.9	0.1	572	622	462	629	577	576	153	159	108	631	574	576	576	574	572	53
	0.5	572	622	462	858	651	645	382	388	337	700	582	592	592	582	572	264
	1	686	753	615	1144	830	821	668	674	623	869	592	613	674	623	572	528
	2	1181	1313	1095	1716	1312	1300	1240	1246	1195	1336	613	654	1246	1195	572	1056
	10	5745	6180	5173	6292	5796	5783	5816	5822	5771	5801	777	981	5822	5771	572	5278
99.8	0.1	451	523	413	496	455	454	141	147	96	0	453	455	455	453	451	49
	0.5	451	523	414	677	515	510	322	327	276	0	460	470	470	460	451	245
	1	578	622	536	902	659	652	547	553	502	0	470	489	553	502	451	490
	2	950	1075	917	1353	1041	1032	998	1004	953	0	489	527	1004	953	451	980
	10	4548	4985	4269	4961	4579	4570	4606	4612	4561	0	641	831	4612	4561	451	4899
98	0.1	196	207	188	216	199	197	116	122	71	244	198	199	199	198	196	40
	0.5	223	235	213	294	230	220	194	200	149	270	204	211	211	204	196	199
	1	299	310	284	392	298	280	292	298	247	329	211	227	298	247	196	398
	2	462	491	443	588	471	437	488	494	443	490	227	258	494	443	196	797
	10	1997	2151	1908	2156	2017	1859	2056	2062	2011	2021	350	505	2062	2011	196	3983

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.23	0.16	1.29	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.12	0.62	0.63	0.56	1.39	1.01	1.03	1.03	1.01	1.00
	1	1.00	0.00	0.00	1.82	1.31	1.29	1.02	1.02	0.97	1.50	0.93	0.96	1.02	0.97	0.91
	2	1.00	0.00	0.00	1.43	1.08	1.07	1.01	1.01	0.98	1.15	0.50	0.53	1.01	0.98	0.48
	10	1.00	0.00	0.00	1.09	1.00	1.00	1.00	1.00	1.00	1.00	0.13	0.16	1.00	1.00	0.10
99.9	0.1	1.00	1.09	0.81	1.10	1.01	1.01	0.27	0.28	0.19	1.10	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.09	0.81	1.50	1.14	1.13	0.67	0.68	0.59	1.22	1.02	1.04	1.04	1.02	1.00
	1	1.00	1.10	0.90	1.67	1.21	1.20	0.97	0.98	0.91	1.27	0.86	0.89	0.98	0.91	0.83
	2	1.00	1.11	0.93	1.45	1.11	1.10	1.05	1.05	1.01	1.13	0.52	0.55	1.05	1.01	0.48
	10	1.00	1.08	0.90	1.10	1.01	1.01	1.01	1.01	1.00	1.01	0.14	0.17	1.01	1.00	0.10
99.8	0.1	1.00	1.16	0.92	1.10	1.01	1.01	0.31	0.33	0.21	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.16	0.92	1.50	1.14	1.13	0.71	0.73	0.61	0.00	1.02	1.04	1.04	1.02	1.00
	1	1.00	1.08	0.93	1.56	1.14	1.13	0.95	0.96	0.87	0.00	0.81	0.85	0.96	0.87	0.78
	2	1.00	1.13	0.97	1.42	1.10	1.09	1.05	1.06	1.00	0.00	0.51	0.55	1.06	1.00	0.47
	10	1.00	1.10	0.94	1.09	1.01	1.00	1.01	1.01	1.00	0.00	0.14	0.18	1.01	1.00	0.10
98	0.1	1.00	1.06	0.96	1.10	1.01	1.00	0.59	0.62	0.36	1.25	1.01	1.02	1.02	1.01	1.00
	0.5	1.00	1.05	0.95	1.32	1.03	0.99	0.87	0.90	0.67	1.21	0.91	0.95	0.95	0.91	0.88
	1	1.00	1.04	0.95	1.31	1.00	0.94	0.98	1.00	0.83	1.10	0.71	0.76	1.00	0.83	0.65
	2	1.00	1.06	0.96	1.27	1.02	0.95	1.06	1.07	0.96	1.06	0.49	0.56	1.07	0.96	0.42
	10	1.00	1.08	0.96	1.08	1.01	0.93	1.03	1.03	1.01	1.01	0.18	0.25	1.03	1.01	0.10
Correlation coefficient							-0.02									

Table A14: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 100 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	522	527	160	153	102	1012	520	521	521	520	518	39
	0.5	518	0	0	777	589	608	367	360	309	1049	526	533	533	526	518	196
	1	596	0	0	1036	752	781	626	619	568	1148	533	548	619	568	518	393
	2	1095	0	0	1554	1190	1226	1144	1137	1086	1470	548	579	1137	1086	518	786
	10	5239	0	0	5698	5252	5292	5288	5281	5230	5321	670	823	5281	5230	518	3929
99.9	0.1	393	465	358	432	396	400	147	140	90	623	394	396	396	394	393	36
	0.5	393	465	359	590	449	463	305	297	247	658	400	407	407	400	393	181
	1	469	506	449	786	575	597	501	494	443	749	407	421	494	443	393	363
	2	820	902	766	1179	910	937	894	887	836	1027	421	449	887	836	393	725
	10	3976	4323	3589	4323	3996	4025	4038	4031	3980	4023	534	674	4031	3980	393	3626
99.8	0.1	355	370	312	391	358	361	144	136	86	0	356	358	358	356	355	39
	0.5	356	370	331	533	407	419	286	278	228	0	362	370	370	362	355	193
	1	449	487	423	710	522	541	463	456	405	0	370	385	456	405	355	386
	2	789	832	745	1065	826	849	818	811	760	0	385	415	811	760	355	771
	10	3619	3878	3354	3905	3614	3640	3658	3651	3600	0	504	654	3651	3600	355	3857
98	0.1	177	186	172	193	177	177	126	118	68	242	176	178	178	176	175	36
	0.5	210	215	201	263	206	205	196	188	138	263	182	189	189	182	175	178
	1	275	284	267	350	268	263	283	276	225	313	189	203	276	225	175	356
	2	428	456	409	525	424	406	458	451	400	452	203	230	451	400	175	711
	10	1830	1934	1732	1925	1805	1678	1858	1851	1800	1812	313	451	1851	1800	175	3556

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.02	0.31	0.29	0.20	1.95	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.14	1.17	0.71	0.69	0.60	2.02	1.01	1.03	1.03	1.01	1.00
	1	1.00	0.00	0.00	1.74	1.26	1.31	1.05	1.04	0.95	1.93	0.89	0.92	1.04	0.95	0.87
	2	1.00	0.00	0.00	1.42	1.09	1.12	1.04	1.04	0.99	1.34	0.50	0.53	1.04	0.99	0.47
	10	1.00	0.00	0.00	1.09	1.00	1.01	1.01	1.01	1.00	1.02	0.13	0.16	1.01	1.00	0.10
99.9	0.1	1.00	1.18	0.91	1.10	1.01	1.02	0.37	0.36	0.23	1.59	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.18	0.91	1.50	1.14	1.18	0.77	0.76	0.63	1.67	1.02	1.04	1.04	1.02	1.00
	1	1.00	1.08	0.96	1.68	1.23	1.27	1.07	1.05	0.95	1.60	0.87	0.90	1.05	0.95	0.84
	2	1.00	1.10	0.93	1.44	1.11	1.14	1.09	1.08	1.02	1.25	0.51	0.55	1.08	1.02	0.48
	10	1.00	1.09	0.90	1.09	1.01	1.01	1.02	1.01	1.00	1.01	0.13	0.17	1.01	1.00	0.10
99.8	0.1	1.00	1.04	0.88	1.10	1.01	1.02	0.40	0.38	0.24	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.04	0.93	1.50	1.14	1.18	0.80	0.78	0.64	0.00	1.02	1.04	1.04	1.02	1.00
	1	1.00	1.09	0.94	1.58	1.16	1.21	1.03	1.02	0.90	0.00	0.82	0.86	1.02	0.90	0.79
	2	1.00	1.05	0.94	1.35	1.05	1.08	1.04	1.03	0.96	0.00	0.49	0.53	1.03	0.96	0.45
	10	1.00	1.07	0.93	1.08	1.00	1.01	1.01	1.01	0.99	0.00	0.14	0.18	1.01	0.99	0.10
98	0.1	1.00	1.05	0.97	1.09	1.00	1.00	0.71	0.67	0.38	1.37	1.00	1.00	1.00	1.00	0.99
	0.5	1.00	1.03	0.96	1.25	0.98	0.98	0.93	0.90	0.66	1.25	0.87	0.90	0.90	0.87	0.84
	1	1.00	1.03	0.97	1.27	0.98	0.96	1.03	1.00	0.82	1.14	0.69	0.74	1.00	0.82	0.64
	2	1.00	1.07	0.96	1.23	0.99	0.95	1.07	1.05	0.94	1.06	0.47	0.54	1.05	0.94	0.41
	10	1.00	1.06	0.95	1.05	0.99	0.92	1.02	1.01	0.98	0.99	0.17	0.25	1.01	0.98	0.10
Correlation coefficient							0.09									

Table A15: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 100 m stack: Receptor at location of highest annual mean

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	79	0	0	87	80	80	50	56	32	479	79	79	79	79	79	6
	0.5	97	0	0	119	92	95	82	87	63	481	80	81	87	80	79	30
	1	119	0	0	158	121	124	121	127	103	487	81	84	127	103	79	60
	2	191	0	0	237	192	196	200	206	182	508	84	88	206	182	79	120
	10	823	0	0	869	816	820	832	838	814	938	102	125	838	814	79	599
99.9	0.1	70	74	68	76	70	70	49	55	31	295	69	69	69	69	69	6
	0.5	81	84	77	104	81	83	77	82	58	297	70	71	82	70	69	32
	1	111	117	103	138	107	110	111	117	93	305	71	74	117	93	69	64
	2	171	180	157	207	169	173	180	186	162	330	74	79	186	162	69	127
	10	720	763	636	759	715	719	732	738	714	767	94	118	738	714	69	637
99.8	0.1	67	69	65	74	68	68	49	55	31	0	67	68	68	67	67	7
	0.5	79	82	75	101	79	81	76	81	57	0	68	70	81	68	67	36
	1	108	116	100	134	104	107	109	115	91	0	70	73	115	91	67	73
	2	170	185	162	201	165	168	176	182	158	0	73	78	182	158	67	146
	10	709	764	658	737	695	699	712	718	694	0	95	123	718	694	67	728
98	0.1	54	55	53	58	54	54	47	53	29	114	53	54	54	53	53	11
	0.5	62	64	61	80	64	63	69	74	50	119	55	57	74	55	53	54
	1	84	88	80	106	85	83	95	101	77	130	57	61	101	77	53	108
	2	137	143	130	159	134	128	148	154	130	165	61	70	154	130	53	215
	10	563	597	534	583	555	515	572	578	554	562	95	136	578	554	53	1077

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.02	0.63	0.71	0.40	6.06	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	0.00	0.00	1.22	0.95	0.98	0.84	0.90	0.66	4.97	0.83	0.84	0.90	0.83	0.82
	1	1.00	0.00	0.00	1.32	1.01	1.04	1.01	1.06	0.86	4.08	0.68	0.70	1.06	0.86	0.66
	2	1.00	0.00	0.00	1.24	1.00	1.02	1.05	1.08	0.95	2.66	0.44	0.46	1.08	0.95	0.41
	10	1.00	0.00	0.00	1.06	0.99	1.00	1.01	1.02	0.99	1.14	0.12	0.15	1.02	0.99	0.10
99.9	0.1	1.00	1.06	0.97	1.08	1.00	1.00	0.70	0.78	0.44	4.21	0.99	0.99	0.99	0.99	0.99
	0.5	1.00	1.03	0.95	1.27	1.00	1.02	0.94	1.01	0.72	3.65	0.86	0.88	1.01	0.86	0.85
	1	1.00	1.06	0.93	1.25	0.97	0.99	1.00	1.06	0.84	2.76	0.65	0.67	1.06	0.84	0.62
	2	1.00	1.05	0.92	1.21	0.99	1.01	1.05	1.09	0.95	1.93	0.43	0.46	1.09	0.95	0.40
	10	1.00	1.06	0.88	1.05	0.99	1.00	1.02	1.02	0.99	1.06	0.13	0.16	1.02	0.99	0.10
99.8	0.1	1.00	1.03	0.97	1.10	1.01	1.02	0.73	0.81	0.46	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.03	0.95	1.27	1.00	1.03	0.96	1.03	0.73	0.00	0.87	0.88	1.03	0.87	0.85
	1	1.00	1.08	0.93	1.24	0.97	0.99	1.01	1.07	0.84	0.00	0.65	0.67	1.07	0.84	0.62
	2	1.00	1.08	0.95	1.18	0.97	0.99	1.03	1.07	0.93	0.00	0.43	0.46	1.07	0.93	0.39
	10	1.00	1.08	0.93	1.04	0.98	0.99	1.00	1.01	0.98	0.00	0.13	0.17	1.01	0.98	0.09
98	0.1	1.00	1.02	0.98	1.08	1.00	1.00	0.88	0.98	0.54	2.11	0.99	1.00	1.00	0.99	0.98
	0.5	1.00	1.03	0.98	1.28	1.03	1.02	1.10	1.19	0.81	1.91	0.89	0.92	1.19	0.89	0.85
	1	1.00	1.04	0.96	1.26	1.01	0.98	1.13	1.20	0.92	1.55	0.68	0.73	1.20	0.92	0.63
	2	1.00	1.04	0.95	1.16	0.98	0.93	1.08	1.12	0.95	1.20	0.45	0.51	1.12	0.95	0.39
	10	1.00	1.06	0.95	1.04	0.99	0.92	1.02	1.03	0.98	1.00	0.17	0.24	1.03	0.98	0.09
Correlation coefficient							0.08									

Appendix B
Results obtained at the location of the largest annual maximum concentrations

In the following tables concentrations are in ppb and emission rates in g/s.

Table B1: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 50 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	97	26	24	17	147	95	95	95	95	95	2
	0.5	95	0	0	143	107	112	64	62	55	155	95	95	95	95	95	10
	1	100	0	0	190	137	144	111	110	102	176	95	95	110	102	95	19
	2	195	0	0	285	217	226	206	205	197	243	95	96	205	197	95	39
	10	955	0	0	1045	961	972	966	965	957	968	97	99	965	957	95	195
99.9	0.1	79	84	74	87	79	80	24	23	15	91	79	79	79	79	79	4
	0.5	83	92	77	119	89	93	56	54	47	99	79	79	79	79	79	22
	1	103	143	84	158	114	120	95	94	86	122	79	80	94	86	79	44
	2	167	279	132	237	181	189	174	173	165	186	80	81	173	165	79	89
	10	798	1379	610	869	801	809	806	805	797	802	83	88	805	797	79	445
99.8	0.1	71	77	60	78	71	72	23	22	14	0	71	71	71	71	71	6
	0.5	77	84	72	107	80	84	52	50	43	0	71	72	72	71	71	31
	1	92	111	81	142	103	108	87	86	78	0	72	72	86	78	71	62
	2	150	211	117	213	163	170	158	157	149	0	72	73	157	149	71	125
	10	718	1027	567	781	720	728	726	725	717	0	77	83	725	717	71	623

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.02	0.27	0.25	0.18	1.55	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.18	0.67	0.65	0.58	1.63	1.00	1.00	1.00	1.00	1.00
	1	1.00	0.00	0.00	1.90	1.37	1.44	1.11	1.10	1.02	1.76	0.95	0.95	1.10	1.02	0.95
	2	1.00	0.00	0.00	1.46	1.11	1.16	1.06	1.05	1.01	1.25	0.49	0.49	1.05	1.01	0.49
	10	1.00	0.00	0.00	1.09	1.01	1.02	1.01	1.01	1.00	1.01	0.10	0.10	1.01	1.00	0.10
99.9	0.1	1.00	1.06	0.94	1.10	1.01	1.02	0.30	0.29	0.19	1.15	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.11	0.93	1.43	1.08	1.13	0.67	0.65	0.56	1.20	0.95	0.96	0.96	0.95	0.95
	1	1.00	1.38	0.81	1.53	1.10	1.16	0.92	0.91	0.83	1.18	0.77	0.77	0.91	0.83	0.76
	2	1.00	1.67	0.79	1.42	1.08	1.13	1.04	1.03	0.99	1.11	0.48	0.48	1.03	0.99	0.47
	10	1.00	1.73	0.76	1.09	1.00	1.01	1.01	1.01	1.00	1.00	0.10	0.11	1.01	1.00	0.10
99.8	0.1	1.00	1.08	0.85	1.10	1.01	1.02	0.33	0.31	0.20	0.00	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.09	0.94	1.38	1.04	1.09	0.67	0.65	0.56	0.00	0.93	0.93	0.93	0.93	0.92
	1	1.00	1.20	0.88	1.54	1.12	1.18	0.95	0.93	0.85	0.00	0.78	0.78	0.93	0.85	0.77
	2	1.00	1.41	0.78	1.42	1.09	1.13	1.05	1.04	1.00	0.00	0.48	0.49	1.04	1.00	0.47
	10	1.00	1.43	0.79	1.09	1.00	1.01	1.01	1.01	1.00	0.00	0.11	0.12	1.01	1.00	0.10
Correlation coefficient							0.12									

Table B2: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 50 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	198	0	0	218	199	200	44	39	30	195	198	198	198	198	198	4
	0.5	198	0	0	297	223	225	123	118	109	219	198	198	198	198	198	20
	1	199	0	0	396	283	287	222	217	208	280	198	199	217	208	198	41
	2	397	0	0	594	448	453	420	415	406	447	199	200	415	406	198	81
	10	1981	0	0	2178	1999	2003	2004	1999	1990	1998	202	206	1999	1990	198	406
99.9	0.1	99	121	84	109	100	100	34	29	20	120	99	99	99	99	99	6
	0.5	109	137	97	149	112	113	74	69	59	130	99	100	100	99	99	28
	1	176	185	112	198	143	145	123	118	109	158	100	100	118	109	99	56
	2	211	351	179	297	227	229	222	217	208	236	100	101	217	208	99	112
	10	1003	1725	752	1089	1004	1006	1014	1009	1000	1006	104	110	1009	1000	99	558
99.8	0.1	79	93	74	86	79	79	32	27	18	0	78	78	78	78	78	7
	0.5	93	114	77	117	89	89	63	58	49	0	78	79	79	78	78	34
	1	115	161	93	156	114	115	102	97	88	0	79	79	97	88	78	68
	2	177	231	133	234	180	182	180	175	166	0	79	81	175	166	78	137
	10	786	1128	622	858	793	794	804	799	790	0	85	91	799	790	78	684

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.20	0.15	0.99	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.12	1.14	0.62	0.60	0.55	1.11	1.00	1.00	1.00	1.00	1.00
	1	1.00	0.00	0.00	1.99	1.42	1.44	1.12	1.09	1.04	1.41	1.00	1.00	1.09	1.04	0.99
	2	1.00	0.00	0.00	1.50	1.13	1.14	1.06	1.05	1.02	1.12	0.50	0.50	1.05	1.02	0.50
	10	1.00	0.00	0.00	1.10	1.01	1.01	1.01	1.01	1.00	1.01	0.10	0.10	1.01	1.00	0.10
99.9	0.1	1.00	1.22	0.85	1.10	1.01	1.01	0.34	0.30	0.20	1.21	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.26	0.89	1.36	1.03	1.04	0.67	0.63	0.54	1.19	0.91	0.91	0.91	0.91	0.91
	1	1.00	1.05	0.64	1.13	0.81	0.82	0.70	0.67	0.62	0.90	0.57	0.57	0.67	0.62	0.56
	2	1.00	1.66	0.85	1.41	1.08	1.09	1.05	1.03	0.98	1.12	0.47	0.48	1.03	0.98	0.47
	10	1.00	1.72	0.75	1.09	1.00	1.00	1.01	1.01	1.00	1.00	0.10	0.11	1.01	1.00	0.10
99.8	0.1	1.00	1.17	0.93	1.08	0.99	0.99	0.40	0.34	0.22	0.00	0.98	0.98	0.98	0.98	0.98
	0.5	1.00	1.23	0.83	1.26	0.95	0.96	0.68	0.63	0.52	0.00	0.84	0.85	0.85	0.84	0.84
	1	1.00	1.40	0.81	1.36	0.99	1.00	0.89	0.85	0.76	0.00	0.68	0.69	0.85	0.76	0.68
	2	1.00	1.31	0.75	1.32	1.02	1.03	1.02	0.99	0.94	0.00	0.45	0.46	0.99	0.94	0.44
	10	1.00	1.43	0.79	1.09	1.01	1.01	1.02	1.02	1.00	0.00	0.11	0.12	1.02	1.00	0.10
Correlation coefficient							0.03									

Table B3: Comparison of modelled concentrations, ppb: Manchester Town Centre oxides of nitrogen: 50 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	799	806	176	181	130	1022	795	795	795	795	795	12
	0.5	795	0	0	1193	895	922	494	499	448	1098	796	797	797	796	795	58
	1	818	0	0	1590	1140	1182	891	897	846	1304	797	798	897	846	795	117
	2	1613	0	0	2385	1807	1859	1686	1692	1641	1913	798	801	1692	1641	795	234
	10	7973	0	0	8745	8036	8093	8046	8052	8001	8060	811	827	8052	8001	795	1170
99.9	0.1	572	622	462	629	575	580	153	159	108	630	572	573	573	572	572	23
	0.5	607	720	559	858	646	665	382	388	337	695	574	575	575	574	572	116
	1	770	1057	622	1144	826	855	668	674	623	863	575	578	674	623	572	231
	2	1248	2052	917	1716	1309	1345	1240	1246	1195	1332	578	585	1246	1195	572	463
	10	5774	10018	4383	6292	5795	5835	5816	5822	5771	5800	603	635	5822	5771	572	2313
99.8	0.1	451	523	413	496	454	457	141	147	96	0	451	452	452	451	451	28
	0.5	513	607	451	677	511	526	322	327	276	0	453	455	455	453	451	142
	1	622	781	548	902	655	678	547	553	502	0	455	459	553	502	451	284
	2	976	1337	763	1353	1038	1066	998	1004	953	0	459	466	1004	953	451	568
	10	4584	6520	3578	4961	4579	4610	4606	4612	4561	0	490	528	4612	4561	451	2841

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.23	0.16	1.29	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.16	0.62	0.63	0.56	1.38	1.00	1.00	1.00	1.00	1.00
	1	1.00	0.00	0.00	1.94	1.39	1.44	1.09	1.10	1.03	1.59	0.97	0.98	1.10	1.03	0.97
	2	1.00	0.00	0.00	1.48	1.12	1.15	1.05	1.05	1.02	1.19	0.49	0.50	1.05	1.02	0.49
	10	1.00	0.00	0.00	1.10	1.01	1.02	1.01	1.01	1.00	1.01	0.10	0.10	1.01	1.00	0.10
99.9	0.1	1.00	1.09	0.81	1.10	1.01	1.01	0.27	0.28	0.19	1.10	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.19	0.92	1.41	1.06	1.10	0.63	0.64	0.56	1.14	0.94	0.95	0.95	0.94	0.94
	1	1.00	1.37	0.81	1.49	1.07	1.11	0.87	0.87	0.81	1.12	0.75	0.75	0.87	0.81	0.74
	2	1.00	1.64	0.73	1.38	1.05	1.08	0.99	1.00	0.96	1.07	0.46	0.47	1.00	0.96	0.46
	10	1.00	1.73	0.76	1.09	1.00	1.01	1.01	1.01	1.00	1.00	0.10	0.11	1.01	1.00	0.10
99.8	0.1	1.00	1.16	0.92	1.10	1.01	1.01	0.31	0.33	0.21	0.00	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.18	0.88	1.32	1.00	1.03	0.63	0.64	0.54	0.00	0.88	0.89	0.89	0.88	0.88
	1	1.00	1.26	0.88	1.45	1.05	1.09	0.88	0.89	0.81	0.00	0.73	0.74	0.89	0.81	0.73
	2	1.00	1.37	0.78	1.39	1.06	1.09	1.02	1.03	0.98	0.00	0.47	0.48	1.03	0.98	0.46
	10	1.00	1.42	0.78	1.08	1.00	1.01	1.00	1.01	0.99	0.00	0.11	0.12	1.01	0.99	0.10
Correlation coefficient							0.08									

Table B4: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 50 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	521	522	160	153	102	1010	518	518	518	518	518	8
	0.5	518	0	0	777	585	591	367	360	309	1044	519	519	519	519	518	38
	1	524	0	0	1036	749	758	626	619	568	1140	519	520	619	568	518	76
	2	1042	0	0	1554	1187	1199	1144	1137	1086	1462	520	522	1137	1086	518	152
	10	5186	0	0	5698	5252	5264	5288	5281	5230	5319	528	539	5281	5230	518	762
99.9	0.1	393	465	358	432	395	397	147	140	90	622	393	393	393	393	393	16
	0.5	413	495	370	590	446	451	305	297	247	654	394	395	395	394	393	79
	1	518	705	449	786	572	579	501	494	443	744	395	397	494	443	393	159
	2	895	1389	613	1179	908	917	894	887	836	1022	397	402	887	836	393	318
	10	4039	6862	2995	4323	3995	4005	4038	4031	3980	4022	415	436	4031	3980	393	1590
99.8	0.1	355	370	312	391	357	358	144	136	86	0	355	356	356	355	355	22
	0.5	376	449	355	533	404	408	286	278	228	0	357	358	358	357	355	112
	1	465	534	393	710	519	525	463	456	405	0	358	361	456	405	355	224
	2	797	1039	574	1065	824	831	818	811	760	0	361	367	811	760	355	447
	10	3637	5119	2836	3905	3614	3622	3658	3651	3600	0	385	416	3651	3600	355	2236

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.31	0.29	0.20	1.95	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.14	0.71	0.69	0.60	2.01	1.00	1.00	1.00	1.00	1.00
	1	1.00	0.00	0.00	1.98	1.43	1.45	1.19	1.18	1.08	2.18	0.99	0.99	1.18	1.08	0.99
	2	1.00	0.00	0.00	1.49	1.14	1.15	1.10	1.09	1.04	1.40	0.50	0.50	1.09	1.04	0.50
	10	1.00	0.00	0.00	1.10	1.01	1.02	1.02	1.02	1.01	1.03	0.10	0.10	1.02	1.01	0.10
99.9	0.1	1.00	1.18	0.91	1.10	1.01	1.01	0.37	0.36	0.23	1.58	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.20	0.90	1.43	1.08	1.09	0.74	0.72	0.60	1.58	0.95	0.96	0.96	0.95	0.95
	1	1.00	1.36	0.87	1.52	1.10	1.12	0.97	0.95	0.86	1.44	0.76	0.77	0.95	0.86	0.76
	2	1.00	1.55	0.69	1.32	1.01	1.02	1.00	0.99	0.93	1.14	0.44	0.45	0.99	0.93	0.44
	10	1.00	1.70	0.74	1.07	0.99	0.99	1.00	1.00	0.99	1.00	0.10	0.11	1.00	0.99	0.10
99.8	0.1	1.00	1.04	0.88	1.10	1.01	1.01	0.40	0.38	0.24	0.00	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.19	0.94	1.42	1.07	1.08	0.76	0.74	0.61	0.00	0.95	0.95	0.95	0.95	0.94
	1	1.00	1.15	0.85	1.53	1.12	1.13	1.00	0.98	0.87	0.00	0.77	0.78	0.98	0.87	0.76
	2	1.00	1.30	0.72	1.34	1.03	1.04	1.03	1.02	0.95	0.00	0.45	0.46	1.02	0.95	0.45
	10	1.00	1.41	0.78	1.07	0.99	1.00	1.01	1.00	0.99	0.00	0.11	0.11	1.00	0.99	0.10
Correlation coefficient							0.03									

Table B5: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 50 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	79	0	0	87	80	80	50	56	32	478	79	79	79	79	79	1
	0.5	79	0	0	119	92	93	82	87	63	480	79	79	87	79	79	6
	1	84	0	0	158	120	122	121	127	103	485	79	79	127	103	79	12
	2	162	0	0	237	191	193	200	206	182	505	79	80	206	182	79	23
	10	794	0	0	869	816	818	832	838	814	935	81	82	838	814	79	116
99.9	0.1	69	74	68	76	70	70	49	55	31	294	69	69	69	69	69	3
	0.5	75	83	72	104	81	82	77	82	58	297	69	69	82	69	69	14
	1	117	138	79	138	106	108	111	117	93	303	69	70	117	93	69	28
	2	186	254	119	207	169	170	180	186	162	328	70	71	186	162	69	56
	10	744	1213	536	759	715	717	732	738	714	765	73	77	738	714	69	279
99.8	0.1	67	69	65	74	68	68	49	55	31	0	67	67	67	67	67	4
	0.5	71	77	67	101	79	79	76	81	57	0	67	68	81	67	67	21
	1	92	117	74	134	104	105	109	115	91	0	68	68	115	91	67	42
	2	163	216	119	201	165	166	176	182	158	0	68	69	182	158	67	84
	10	700	976	540	737	695	697	712	718	694	0	73	78	718	694	67	422

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.63	0.71	0.40	6.06	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.16	1.17	1.03	1.11	0.80	6.08	1.00	1.00	1.11	1.00	1.00
	1	1.00	0.00	0.00	1.88	1.43	1.45	1.44	1.51	1.22	5.77	0.94	0.94	1.51	1.22	0.94
	2	1.00	0.00	0.00	1.46	1.18	1.19	1.23	1.27	1.12	3.12	0.49	0.49	1.27	1.12	0.49
	10	1.00	0.00	0.00	1.09	1.03	1.03	1.05	1.06	1.03	1.18	0.10	0.10	1.06	1.03	0.10
99.9	0.1	1.00	1.07	0.99	1.10	1.01	1.01	0.71	0.79	0.45	4.27	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.10	0.96	1.37	1.07	1.08	1.02	1.09	0.78	3.94	0.92	0.92	1.09	0.92	0.92
	1	1.00	1.19	0.68	1.18	0.91	0.92	0.95	1.00	0.80	2.60	0.60	0.60	1.00	0.80	0.59
	2	1.00	1.36	0.64	1.11	0.91	0.91	0.97	1.00	0.87	1.76	0.37	0.38	1.00	0.87	0.37
	10	1.00	1.63	0.72	1.02	0.96	0.96	0.98	0.99	0.96	1.03	0.10	0.10	0.99	0.96	0.09
99.8	0.1	1.00	1.03	0.97	1.10	1.01	1.01	0.73	0.81	0.46	0.00	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.09	0.95	1.42	1.11	1.12	1.06	1.15	0.81	0.00	0.95	0.95	1.15	0.95	0.94
	1	1.00	1.27	0.80	1.46	1.13	1.14	1.18	1.25	0.99	0.00	0.73	0.74	1.25	0.99	0.73
	2	1.00	1.33	0.73	1.23	1.01	1.02	1.08	1.12	0.97	0.00	0.42	0.43	1.12	0.97	0.41
	10	1.00	1.39	0.77	1.05	0.99	1.00	1.02	1.03	0.99	0.00	0.10	0.11	1.03	0.99	0.10
Correlation coefficient							0.03									

Table B6: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 25 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	96	26	24	17	147	95	95	95	95	95	1
	0.5	108	0	0	143	107	110	64	62	55	155	96	96	96	96	95	6
	1	144	0	0	190	137	141	111	110	102	176	96	97	110	102	95	12
	2	216	0	0	285	217	222	206	205	197	243	97	100	205	197	95	24
	10	968	0	0	1045	961	968	966	965	957	968	107	120	965	957	95	121
99.9	0.1	80	84	74	87	80	80	24	23	15	91	79	79	79	79	79	1
	0.5	81	92	74	119	90	92	56	54	47	99	80	80	80	80	79	7
	1	95	115	87	158	114	118	95	94	86	122	80	82	94	86	79	13
	2	187	212	140	237	181	186	174	173	165	186	82	84	173	165	79	27
	10	862	963	700	869	801	806	806	805	797	802	93	106	805	797	79	133
99.8	0.1	71	78	60	78	72	72	23	22	14	0	71	71	71	71	71	2
	0.5	74	81	69	107	81	83	52	50	43	0	72	73	73	72	71	8
	1	88	107	81	142	103	106	87	86	78	0	73	74	86	78	71	17
	2	148	201	125	213	163	167	158	157	149	0	74	78	157	149	71	33
	10	716	935	599	781	720	725	726	725	717	0	88	105	725	717	71	167

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.27	0.25	0.18	1.55	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.32	0.99	1.02	0.59	0.58	0.51	1.44	0.89	0.89	0.89	0.89	0.88
	1	1.00	0.00	0.00	1.32	0.95	0.98	0.77	0.76	0.71	1.23	0.67	0.68	0.76	0.71	0.66
	2	1.00	0.00	0.00	1.32	1.01	1.03	0.96	0.95	0.92	1.13	0.45	0.46	0.95	0.92	0.44
	10	1.00	0.00	0.00	1.08	0.99	1.00	1.00	1.00	0.99	1.00	0.11	0.12	1.00	0.99	0.10
99.9	0.1	1.00	1.05	0.93	1.09	1.00	1.00	0.30	0.28	0.19	1.13	0.99	0.99	0.99	0.99	0.99
	0.5	1.00	1.14	0.91	1.46	1.11	1.13	0.69	0.67	0.58	1.23	0.98	0.99	0.99	0.98	0.98
	1	1.00	1.21	0.92	1.66	1.20	1.24	1.00	0.99	0.91	1.29	0.85	0.86	0.99	0.91	0.83
	2	1.00	1.13	0.75	1.27	0.97	0.99	0.93	0.92	0.88	0.99	0.44	0.45	0.92	0.88	0.42
	10	1.00	1.12	0.81	1.01	0.93	0.93	0.94	0.93	0.92	0.93	0.11	0.12	0.93	0.92	0.09
99.8	0.1	1.00	1.10	0.85	1.10	1.01	1.01	0.33	0.31	0.20	0.00	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.09	0.93	1.44	1.09	1.12	0.70	0.68	0.58	0.00	0.97	0.98	0.98	0.97	0.96
	1	1.00	1.21	0.92	1.61	1.17	1.20	0.98	0.97	0.89	0.00	0.82	0.84	0.97	0.89	0.80
	2	1.00	1.36	0.84	1.44	1.10	1.13	1.07	1.06	1.01	0.00	0.50	0.53	1.06	1.01	0.48
	10	1.00	1.31	0.84	1.09	1.01	1.01	1.01	1.01	1.00	0.00	0.12	0.15	1.01	1.00	0.10
Correlation coefficient							0.07									

Table B7: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 25 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	198	0	0	218	199	203	44	39	30	195	198	199	199	198	198	3
	0.5	272	0	0	297	223	239	123	118	109	220	199	201	201	199	198	13
	1	366	0	0	396	284	308	222	217	208	281	201	203	217	208	198	25
	2	556	0	0	594	449	479	420	415	406	447	203	208	415	406	198	50
	10	2072	0	0	2178	1999	2033	2004	1999	1990	1998	224	249	1999	1990	198	252
99.9	0.1	106	121	84	109	100	101	34	29	20	120	99	99	99	99	99	2
	0.5	112	142	93	149	112	120	74	69	59	130	100	101	101	100	99	8
	1	134	185	116	198	143	155	123	118	109	158	101	102	118	109	99	17
	2	234	271	188	297	227	242	222	217	208	236	102	106	217	208	99	33
	10	1004	1172	877	1089	1004	1020	1014	1009	1000	1006	116	133	1009	1000	99	167
99.8	0.1	80	93	74	86	79	80	32	27	18	0	78	78	78	78	78	2
	0.5	84	106	75	117	89	95	63	58	49	0	79	80	80	79	78	9
	1	110	129	94	156	114	123	102	97	88	0	80	82	97	88	78	18
	2	190	232	149	234	180	191	180	175	166	0	82	85	175	166	78	37
	10	784	1045	662	858	793	805	804	799	790	0	97	115	799	790	78	184

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.02	0.22	0.20	0.15	0.99	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.09	0.82	0.88	0.45	0.44	0.40	0.81	0.73	0.74	0.74	0.73	0.73
	1	1.00	0.00	0.00	1.08	0.77	0.84	0.61	0.59	0.57	0.77	0.55	0.55	0.59	0.57	0.54
	2	1.00	0.00	0.00	1.07	0.81	0.86	0.76	0.75	0.73	0.80	0.37	0.37	0.75	0.73	0.36
	10	1.00	0.00	0.00	1.05	0.96	0.98	0.97	0.97	0.96	0.96	0.11	0.12	0.97	0.96	0.10
99.9	0.1	1.00	1.14	0.79	1.03	0.94	0.96	0.32	0.28	0.18	1.13	0.94	0.94	0.94	0.94	0.93
	0.5	1.00	1.27	0.83	1.33	1.00	1.07	0.66	0.62	0.53	1.17	0.89	0.90	0.90	0.89	0.89
	1	1.00	1.38	0.87	1.48	1.07	1.16	0.92	0.89	0.81	1.18	0.75	0.77	0.89	0.81	0.74
	2	1.00	1.16	0.80	1.27	0.97	1.03	0.95	0.93	0.89	1.01	0.44	0.45	0.93	0.89	0.42
	10	1.00	1.17	0.87	1.08	1.00	1.02	1.01	1.01	1.00	1.00	0.12	0.13	1.01	1.00	0.10
99.8	0.1	1.00	1.16	0.92	1.07	0.98	1.00	0.40	0.34	0.22	0.00	0.98	0.98	0.98	0.98	0.97
	0.5	1.00	1.26	0.89	1.39	1.06	1.13	0.75	0.69	0.58	0.00	0.94	0.95	0.95	0.94	0.93
	1	1.00	1.18	0.86	1.42	1.04	1.12	0.93	0.89	0.80	0.00	0.73	0.75	0.89	0.80	0.71
	2	1.00	1.22	0.78	1.23	0.95	1.01	0.95	0.92	0.87	0.00	0.43	0.45	0.92	0.87	0.41
	10	1.00	1.33	0.84	1.09	1.01	1.03	1.03	1.02	1.01	0.00	0.12	0.15	1.02	1.01	0.10
Correlation coefficient							0.18									

Table B8: Comparison of modelled concentrations, ppb: Manchester Town Hall oxides of nitrogen: 25 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	800	798	176	181	130	1023	796	797	797	796	795	7
	0.5	795	0	0	1193	897	885	494	499	448	1101	800	805	805	800	795	36
	1	902	0	0	1590	1143	1124	891	897	846	1307	805	816	897	846	795	73
	2	1697	0	0	2385	1808	1785	1686	1692	1641	1916	816	836	1692	1641	795	145
	10	8057	0	0	8745	8036	8011	8046	8052	8001	8060	898	1001	8052	8001	795	727
99.9	0.1	572	622	462	629	576	574	153	159	108	630	573	574	574	573	572	7
	0.5	572	622	479	858	648	639	382	388	337	697	577	582	582	577	572	35
	1	720	794	622	1144	827	814	668	674	623	865	582	592	674	623	572	69
	2	1196	1489	1060	1716	1310	1294	1240	1246	1195	1334	592	611	1246	1195	572	138
	10	5772	6876	5032	6292	5795	5777	5816	5822	5771	5800	670	768	5822	5771	572	691
99.8	0.1	451	523	413	496	454	453	141	147	96	0	452	453	453	452	451	8
	0.5	464	524	442	677	513	506	322	327	276	0	456	462	462	456	451	38
	1	619	720	530	902	657	646	547	553	502	0	462	473	553	502	451	76
	2	927	1245	794	1353	1040	1027	998	1004	953	0	473	494	1004	953	451	152
	10	4535	5971	3783	4961	4579	4566	4606	4612	4561	0	559	667	4612	4561	451	762

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.00	0.22	0.23	0.16	1.29	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.11	0.62	0.63	0.56	1.38	1.01	1.01	1.01	1.01	1.00
	1	1.00	0.00	0.00	1.76	1.27	1.25	0.99	0.99	0.94	1.45	0.89	0.90	0.99	0.94	0.88
	2	1.00	0.00	0.00	1.41	1.07	1.05	0.99	1.00	0.97	1.13	0.48	0.49	1.00	0.97	0.47
	10	1.00	0.00	0.00	1.09	1.00	0.99	1.00	1.00	0.99	1.00	0.11	0.12	1.00	0.99	0.10
99.9	0.1	1.00	1.09	0.81	1.10	1.01	1.00	0.27	0.28	0.19	1.10	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.09	0.84	1.50	1.13	1.12	0.67	0.68	0.59	1.22	1.01	1.02	1.02	1.01	1.00
	1	1.00	1.10	0.86	1.59	1.15	1.13	0.93	0.94	0.87	1.20	0.81	0.82	0.94	0.87	0.79
	2	1.00	1.24	0.89	1.43	1.10	1.08	1.04	1.04	1.00	1.12	0.49	0.51	1.04	1.00	0.48
	10	1.00	1.19	0.87	1.09	1.00	1.00	1.01	1.01	1.00	1.00	0.12	0.13	1.01	1.00	0.10
99.8	0.1	1.00	1.16	0.92	1.10	1.01	1.00	0.31	0.33	0.21	0.00	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.13	0.95	1.46	1.11	1.09	0.69	0.71	0.60	0.00	0.98	1.00	1.00	0.98	0.97
	1	1.00	1.16	0.86	1.46	1.06	1.04	0.88	0.89	0.81	0.00	0.75	0.76	0.89	0.81	0.73
	2	1.00	1.34	0.86	1.46	1.12	1.11	1.08	1.08	1.03	0.00	0.51	0.53	1.08	1.03	0.49
	10	1.00	1.32	0.83	1.09	1.01	1.01	1.02	1.02	1.01	0.00	0.12	0.15	1.02	1.01	0.10
Correlation coefficient							-0.03									

Table B9: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 25 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	521	524	160	153	102	1011	519	519	519	519	518	5
	0.5	518	0	0	777	587	598	367	360	309	1046	521	525	525	521	518	24
	1	620	0	0	1036	750	767	626	619	568	1143	525	531	619	568	518	47
	2	1115	0	0	1554	1188	1210	1144	1137	1086	1465	531	545	1137	1086	518	95
	10	5180	0	0	5698	5252	5275	5288	5281	5230	5319	585	652	5281	5230	518	473
99.9	0.1	393	465	358	432	396	398	147	140	90	622	394	394	394	394	393	5
	0.5	393	465	367	590	447	456	305	297	247	656	396	400	400	396	393	24
	1	495	520	449	786	573	586	501	494	443	746	400	406	494	443	393	48
	2	833	950	696	1179	909	925	894	887	836	1024	406	420	887	836	393	95
	10	3964	4651	3482	4323	3996	4013	4038	4031	3980	4022	460	528	4031	3980	393	475
99.8	0.1	355	370	312	391	358	360	144	136	86	0	356	357	357	356	355	6
	0.5	358	393	348	533	405	413	286	278	228	0	359	364	364	359	355	30
	1	465	530	399	710	520	532	463	456	405	0	364	372	456	405	355	60
	2	754	985	637	1065	824	839	818	811	760	0	372	389	811	760	355	120
	10	3596	4676	3025	3905	3614	3629	3658	3651	3600	0	440	525	3651	3600	355	600

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.31	0.29	0.20	1.95	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.15	0.71	0.69	0.60	2.02	1.01	1.01	1.01	1.01	1.00
	1	1.00	0.00	0.00	1.67	1.21	1.24	1.01	1.00	0.92	1.85	0.85	0.86	1.00	0.92	0.84
	2	1.00	0.00	0.00	1.39	1.07	1.08	1.03	1.02	0.97	1.31	0.48	0.49	1.02	0.97	0.46
	10	1.00	0.00	0.00	1.10	1.01	1.02	1.02	1.02	1.01	1.03	0.11	0.13	1.02	1.01	0.10
99.9	0.1	1.00	1.18	0.91	1.10	1.01	1.01	0.37	0.36	0.23	1.58	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.18	0.93	1.50	1.14	1.16	0.77	0.76	0.63	1.67	1.01	1.02	1.02	1.01	1.00
	1	1.00	1.05	0.91	1.59	1.16	1.18	1.01	1.00	0.90	1.51	0.81	0.82	1.00	0.90	0.79
	2	1.00	1.14	0.84	1.42	1.09	1.11	1.07	1.06	1.00	1.23	0.49	0.50	1.06	1.00	0.47
	10	1.00	1.17	0.88	1.09	1.01	1.01	1.02	1.02	1.00	1.01	0.12	0.13	1.02	1.00	0.10
99.8	0.1	1.00	1.04	0.88	1.10	1.01	1.01	0.40	0.38	0.24	0.00	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.10	0.97	1.49	1.13	1.15	0.80	0.78	0.64	0.00	1.00	1.02	1.02	1.00	0.99
	1	1.00	1.14	0.86	1.53	1.12	1.14	1.00	0.98	0.87	0.00	0.78	0.80	0.98	0.87	0.76
	2	1.00	1.31	0.84	1.41	1.09	1.11	1.08	1.08	1.01	0.00	0.49	0.52	1.08	1.01	0.47
	10	1.00	1.30	0.84	1.09	1.00	1.01	1.02	1.02	1.00	0.00	0.12	0.15	1.02	1.00	0.10
Correlation coefficient							0.05									

Table B10: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 25 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	81	0	0	87	80	80	50	56	32	479	79	79	79	79	79	1
	0.5	111	0	0	119	92	94	82	87	63	481	80	80	87	80	79	4
	1	148	0	0	158	120	124	121	127	103	486	80	81	127	103	79	7
	2	221	0	0	237	191	195	200	206	182	506	81	83	206	182	79	14
	10	815	0	0	869	816	820	832	838	814	937	89	99	838	814	79	72
99.9	0.1	70	74	68	76	70	70	49	55	31	294	69	69	69	69	69	1
	0.5	74	79	71	104	81	83	77	82	58	297	70	70	82	70	69	4
	1	98	113	91	138	107	109	111	117	93	304	70	71	117	93	69	8
	2	164	190	143	207	169	172	180	186	162	329	71	74	186	162	69	17
	10	719	817	611	759	715	719	732	738	714	766	81	93	738	714	69	83
99.8	0.1	68	69	65	74	68	68	49	55	31	0	67	67	67	67	67	1
	0.5	74	78	71	101	79	81	76	81	57	0	68	69	81	68	67	6
	1	106	113	90	134	104	106	109	115	91	0	69	70	115	91	67	11
	2	166	206	142	201	165	168	176	182	158	0	70	73	182	158	67	23
	10	704	896	598	737	695	698	712	718	694	0	83	99	718	694	67	113

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.07	0.98	0.99	0.61	0.68	0.39	5.88	0.97	0.97	0.97	0.97	0.97
	0.5	1.00	0.00	0.00	1.07	0.83	0.85	0.74	0.79	0.57	4.33	0.72	0.72	0.79	0.72	0.71
	1	1.00	0.00	0.00	1.07	0.82	0.84	0.82	0.86	0.70	3.29	0.54	0.55	0.86	0.70	0.53
	2	1.00	0.00	0.00	1.07	0.86	0.88	0.90	0.93	0.82	2.29	0.37	0.38	0.93	0.82	0.36
	10	1.00	0.00	0.00	1.07	1.00	1.01	1.02	1.03	1.00	1.15	0.11	0.12	1.03	1.00	0.10
99.9	0.1	1.00	1.06	0.97	1.08	0.99	1.00	0.70	0.78	0.44	4.21	0.99	0.99	0.99	0.99	0.99
	0.5	1.00	1.07	0.96	1.40	1.09	1.12	1.03	1.11	0.79	4.01	0.94	0.95	1.11	0.94	0.93
	1	1.00	1.15	0.93	1.41	1.09	1.11	1.13	1.19	0.95	3.10	0.72	0.73	1.19	0.95	0.70
	2	1.00	1.16	0.87	1.26	1.03	1.05	1.10	1.14	0.99	2.01	0.44	0.45	1.14	0.99	0.42
	10	1.00	1.14	0.85	1.06	1.00	1.00	1.02	1.03	0.99	1.07	0.11	0.13	1.03	0.99	0.10
99.8	0.1	1.00	1.02	0.96	1.09	1.00	1.00	0.72	0.80	0.45	0.00	0.99	0.99	0.99	0.99	0.99
	0.5	1.00	1.05	0.96	1.36	1.06	1.09	1.02	1.10	0.78	0.00	0.92	0.93	1.10	0.92	0.91
	1	1.00	1.07	0.85	1.27	0.98	1.01	1.03	1.09	0.86	0.00	0.65	0.66	1.09	0.86	0.63
	2	1.00	1.24	0.86	1.21	0.99	1.01	1.06	1.09	0.95	0.00	0.42	0.44	1.09	0.95	0.40
	10	1.00	1.27	0.85	1.05	0.99	0.99	1.01	1.02	0.99	0.00	0.12	0.14	1.02	0.99	0.10
Correlation coefficient							0.07									

Table B11: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 100 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	96	26	24	17	147	95	95	95	95	95	4
	0.5	95	0	0	143	107	109	64	62	55	155	95	95	95	95	95	22
	1	100	0	0	190	137	140	111	110	102	176	95	95	110	102	95	43
	2	195	0	0	285	217	220	206	205	197	243	95	95	205	197	95	86
	10	955	0	0	1045	961	966	966	965	957	967	96	96	965	957	95	432
99.9	0.1	79	84	74	87	79	80	24	23	15	91	79	79	79	79	79	22
	0.5	84	118	78	119	89	91	56	54	47	99	79	79	79	79	79	109
	1	94	228	85	158	114	117	95	94	86	122	79	80	94	86	79	218
	2	168	449	112	237	181	184	174	173	165	186	80	80	173	165	79	437
	10	800	2212	519	869	801	804	806	805	797	802	82	85	805	797	79	2184
99.8	0.1	73	79	63	78	71	72	23	22	14	0	71	71	71	71	71	42
	0.5	81	90	73	107	80	82	52	50	43	0	71	72	72	71	71	212
	1	94	155	78	142	103	105	87	86	78	0	72	72	86	78	71	424
	2	142	297	95	213	163	166	158	157	149	0	72	73	157	149	71	849
	10	710	1420	324	781	720	723	726	725	717	0	77	83	725	717	71	4245

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.27	0.25	0.18	1.55	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.15	0.67	0.65	0.58	1.63	1.00	1.00	1.00	1.00	1.00
	1	1.00	0.00	0.00	1.90	1.37	1.40	1.11	1.10	1.02	1.76	0.95	0.95	1.10	1.02	0.95
	2	1.00	0.00	0.00	1.46	1.11	1.13	1.06	1.05	1.01	1.25	0.49	0.49	1.05	1.01	0.49
	10	1.00	0.00	0.00	1.09	1.01	1.01	1.01	1.01	1.00	1.01	0.10	0.10	1.01	1.00	0.10
99.9	0.1	1.00	1.06	0.94	1.10	1.01	1.01	0.30	0.29	0.19	1.15	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.41	0.93	1.41	1.06	1.08	0.66	0.64	0.56	1.18	0.94	0.94	0.94	0.94	0.94
	1	1.00	2.43	0.91	1.68	1.21	1.24	1.01	1.00	0.92	1.30	0.84	0.85	1.00	0.92	0.84
	2	1.00	2.67	0.67	1.41	1.08	1.10	1.04	1.03	0.98	1.11	0.47	0.48	1.03	0.98	0.47
	10	1.00	2.76	0.65	1.09	1.00	1.01	1.01	1.01	1.00	1.00	0.10	0.11	1.01	1.00	0.10
99.8	0.1	1.00	1.08	0.86	1.07	0.98	0.98	0.32	0.30	0.20	0.00	0.97	0.97	0.97	0.97	0.97
	0.5	1.00	1.11	0.90	1.31	0.99	1.01	0.64	0.62	0.53	0.00	0.88	0.88	0.88	0.88	0.88
	1	1.00	1.64	0.83	1.51	1.09	1.12	0.93	0.91	0.83	0.00	0.76	0.77	0.91	0.83	0.76
	2	1.00	2.09	0.67	1.50	1.15	1.17	1.11	1.10	1.05	0.00	0.51	0.52	1.10	1.05	0.50
	10	1.00	2.00	0.46	1.10	1.01	1.02	1.02	1.02	1.01	0.00	0.11	0.12	1.02	1.01	0.10
Correlation coefficient							0.05									

Table B12: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 100 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	198	0	0	218	199	199	44	39	30	195	198	198	198	198	198	9
	0.5	198	0	0	297	222	222	123	118	109	219	198	198	198	198	198	45
	1	199	0	0	396	283	283	222	217	208	280	198	198	217	208	198	90
	2	397	0	0	594	448	448	420	415	406	447	198	199	415	406	198	180
	10	1981	0	0	2178	1999	1999	2004	1999	1990	1998	199	201	1999	1990	198	901
99.9	0.1	99	121	84	109	100	100	34	29	20	120	99	99	99	99	99	27
	0.5	121	177	99	149	112	112	74	69	59	130	99	99	99	99	99	137
	1	176	289	109	198	143	143	123	118	109	158	99	100	118	109	99	274
	2	216	565	176	297	227	227	222	217	208	236	100	101	217	208	99	547
	10	1008	2775	651	1089	1004	1004	1014	1009	1000	1006	103	107	1009	1000	99	2737
99.8	0.1	80	97	74	86	79	79	32	27	18	0	78	78	78	78	78	47
	0.5	98	121	82	117	89	89	63	58	49	0	78	79	79	78	78	233
	1	126	177	97	156	114	114	102	97	88	0	79	79	97	88	78	466
	2	195	313	117	234	180	180	180	175	166	0	79	81	175	166	78	933
	10	782	1544	349	858	793	793	804	799	790	0	85	92	799	790	78	4663

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.20	0.15	0.99	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.12	1.12	0.62	0.60	0.55	1.11	1.00	1.00	1.00	1.00	1.00
	1	1.00	0.00	0.00	1.99	1.42	1.42	1.12	1.09	1.04	1.41	1.00	1.00	1.09	1.04	0.99
	2	1.00	0.00	0.00	1.50	1.13	1.13	1.06	1.05	1.02	1.12	0.50	0.50	1.05	1.02	0.50
	10	1.00	0.00	0.00	1.10	1.01	1.01	1.01	1.01	1.00	1.01	0.10	0.10	1.01	1.00	0.10
99.9	0.1	1.00	1.22	0.85	1.10	1.01	1.01	0.34	0.30	0.20	1.21	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.46	0.82	1.23	0.92	0.92	0.61	0.57	0.49	1.08	0.82	0.82	0.82	0.82	0.82
	1	1.00	1.64	0.62	1.13	0.81	0.81	0.70	0.67	0.62	0.90	0.56	0.57	0.67	0.62	0.56
	2	1.00	2.62	0.82	1.38	1.05	1.05	1.03	1.01	0.96	1.09	0.46	0.47	1.01	0.96	0.46
	10	1.00	2.75	0.65	1.08	1.00	1.00	1.01	1.00	0.99	1.00	0.10	0.11	1.00	0.99	0.10
99.8	0.1	1.00	1.21	0.93	1.07	0.98	0.98	0.40	0.34	0.22	0.00	0.98	0.98	0.98	0.98	0.98
	0.5	1.00	1.24	0.84	1.20	0.91	0.91	0.65	0.60	0.50	0.00	0.80	0.81	0.81	0.80	0.80
	1	1.00	1.41	0.77	1.24	0.90	0.90	0.81	0.77	0.70	0.00	0.63	0.63	0.77	0.70	0.62
	2	1.00	1.61	0.60	1.20	0.93	0.93	0.92	0.90	0.85	0.00	0.41	0.41	0.90	0.85	0.40
	10	1.00	1.97	0.45	1.10	1.01	1.01	1.03	1.02	1.01	0.00	0.11	0.12	1.02	1.01	0.10
Correlation coefficient																

Table B13: Comparison of modelled concentrations, ppb: Manchester Town Hall oxides of nitrogen: 100 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	799	802	176	181	130	1022	795	795	795	795	795	26
	0.5	795	0	0	1193	895	909	494	499	448	1098	795	796	796	795	795	130
	1	818	0	0	1590	1140	1161	891	897	846	1304	796	796	897	846	795	260
	2	1613	0	0	2385	1807	1833	1686	1692	1641	1913	796	797	1692	1641	795	519
	10	7973	0	0	8745	8036	8065	8046	8052	8001	8060	800	805	8052	8001	795	2596
99.9	0.1	572	622	462	629	575	578	153	159	108	630	572	572	572	572	572	114
	0.5	622	852	572	858	646	656	382	388	337	694	573	574	574	573	572	568
	1	781	1650	607	1144	825	840	668	674	623	863	574	577	674	623	572	1135
	2	1206	3246	795	1716	1308	1327	1240	1246	1195	1332	577	581	1246	1195	572	2271
	10	5782	16012	3706	6292	5795	5815	5816	5822	5771	5800	595	618	5822	5771	572	11353
99.8	0.1	462	567	418	496	454	456	141	147	96	0	451	452	452	451	451	194
	0.5	567	622	462	677	511	519	322	327	276	0	453	455	455	453	451	968
	1	674	956	572	902	655	667	547	553	502	0	455	459	553	502	451	1936
	2	1065	1859	667	1353	1038	1053	998	1004	953	0	459	467	1004	953	451	3872
	10	4673	8976	2048	4961	4579	4595	4606	4612	4561	0	490	529	4612	4561	451	19362

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.22	0.23	0.16	1.29	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.14	0.62	0.63	0.56	1.38	1.00	1.00	1.00	1.00	1.00
	1	1.00	0.00	0.00	1.94	1.39	1.42	1.09	1.10	1.03	1.59	0.97	0.97	1.10	1.03	0.97
	2	1.00	0.00	0.00	1.48	1.12	1.14	1.05	1.05	1.02	1.19	0.49	0.49	1.05	1.02	0.49
	10	1.00	0.00	0.00	1.10	1.01	1.01	1.01	1.01	1.00	1.01	0.10	0.10	1.01	1.00	0.10
99.9	0.1	1.00	1.09	0.81	1.10	1.01	1.01	0.27	0.28	0.19	1.10	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.37	0.92	1.38	1.04	1.05	0.61	0.62	0.54	1.12	0.92	0.92	0.92	0.92	0.92
	1	1.00	2.11	0.78	1.46	1.06	1.08	0.86	0.86	0.80	1.11	0.74	0.74	0.86	0.80	0.73
	2	1.00	2.69	0.66	1.42	1.08	1.10	1.03	1.03	0.99	1.10	0.48	0.48	1.03	0.99	0.47
	10	1.00	2.77	0.64	1.09	1.00	1.01	1.01	1.01	1.00	1.00	0.10	0.11	1.01	1.00	0.10
99.8	0.1	1.00	1.23	0.90	1.07	0.98	0.99	0.31	0.32	0.21	0.00	0.98	0.98	0.98	0.98	0.98
	0.5	1.00	1.10	0.81	1.19	0.90	0.92	0.57	0.58	0.49	0.00	0.80	0.80	0.80	0.80	0.80
	1	1.00	1.42	0.85	1.34	0.97	0.99	0.81	0.82	0.74	0.00	0.67	0.68	0.82	0.74	0.67
	2	1.00	1.75	0.63	1.27	0.97	0.99	0.94	0.94	0.89	0.00	0.43	0.44	0.94	0.89	0.42
	10	1.00	1.92	0.44	1.06	0.98	0.98	0.99	0.99	0.98	0.00	0.10	0.11	0.99	0.98	0.10
Correlation coefficient							0.04									

Table B14: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 100 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	521	522	160	153	102	1010	518	518	518	518	518	17
	0.5	518	0	0	777	585	590	367	360	309	1043	518	518	518	518	518	85
	1	524	0	0	1036	748	756	626	619	568	1140	518	519	619	568	518	169
	2	1042	0	0	1554	1187	1196	1144	1137	1086	1462	519	519	1137	1086	518	338
	10	5186	0	0	5698	5252	5261	5288	5281	5230	5318	521	525	5281	5230	518	1692
99.9	0.1	393	465	358	432	395	396	147	140	90	622	393	393	393	393	393	78
	0.5	465	657	386	590	446	449	305	297	247	654	394	395	395	394	393	390
	1	504	1205	430	786	572	578	501	494	443	743	395	396	494	443	393	780
	2	823	2302	557	1179	908	915	894	887	836	1022	396	399	887	836	393	1560
	10	3967	11073	2566	4323	3995	4003	4038	4031	3980	4022	409	424	4031	3980	393	7800
99.8	0.1	356	376	324	391	357	358	144	136	86	0	355	356	356	355	355	152
	0.5	393	465	356	533	404	407	286	278	228	0	357	358	358	357	355	762
	1	495	731	385	710	519	524	463	456	405	0	358	361	456	405	355	1524
	2	740	1440	495	1065	824	829	818	811	760	0	361	367	811	760	355	3048
	10	3580	7042	1599	3905	3614	3620	3658	3651	3600	0	386	416	3651	3600	355	15240

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.31	0.29	0.20	1.95	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.13	1.14	0.71	0.69	0.60	2.01	1.00	1.00	1.00	1.00	1.00
	1	1.00	0.00	0.00	1.98	1.43	1.44	1.19	1.18	1.08	2.18	0.99	0.99	1.18	1.08	0.99
	2	1.00	0.00	0.00	1.49	1.14	1.15	1.10	1.09	1.04	1.40	0.50	0.50	1.09	1.04	0.50
	10	1.00	0.00	0.00	1.10	1.01	1.01	1.02	1.02	1.01	1.03	0.10	0.10	1.02	1.01	0.10
99.9	0.1	1.00	1.18	0.91	1.10	1.01	1.01	0.37	0.36	0.23	1.58	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.41	0.83	1.27	0.96	0.97	0.65	0.64	0.53	1.41	0.85	0.85	0.85	0.85	0.85
	1	1.00	2.39	0.85	1.56	1.14	1.15	0.99	0.98	0.88	1.48	0.78	0.79	0.98	0.88	0.78
	2	1.00	2.80	0.68	1.43	1.10	1.11	1.09	1.08	1.02	1.24	0.48	0.49	1.08	1.02	0.48
	10	1.00	2.79	0.65	1.09	1.01	1.01	1.02	1.02	1.00	1.01	0.10	0.11	1.02	1.00	0.10
99.8	0.1	1.00	1.06	0.91	1.10	1.00	1.01	0.40	0.38	0.24	0.00	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.18	0.91	1.35	1.03	1.04	0.73	0.71	0.58	0.00	0.91	0.91	0.91	0.91	0.90
	1	1.00	1.48	0.78	1.43	1.05	1.06	0.94	0.92	0.82	0.00	0.72	0.73	0.92	0.82	0.72
	2	1.00	1.95	0.67	1.44	1.11	1.12	1.11	1.10	1.03	0.00	0.49	0.50	1.10	1.03	0.48
	10	1.00	1.97	0.45	1.09	1.01	1.01	1.02	1.02	1.01	0.00	0.11	0.12	1.02	1.01	0.10
Correlation coefficient							0.02									

Table B15: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 100 m stack: Receptor at location of highest annual maximum

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	79	0	0	87	80	80	50	56	32	478	79	79	79	79	79	3
	0.5	79	0	0	119	92	92	82	87	63	480	79	79	87	79	79	13
	1	90	0	0	158	120	121	121	127	103	485	79	79	127	103	79	26
	2	162	0	0	237	191	192	200	206	182	505	79	79	206	182	79	52
	10	794	0	0	869	816	817	832	838	814	935	80	80	838	814	79	258
99.9	0.1	70	74	68	76	70	70	49	55	31	294	69	69	69	69	69	14
	0.5	74	126	69	104	81	81	77	82	58	296	69	69	82	69	69	68
	1	87	238	76	138	106	107	111	117	93	303	69	70	117	93	69	137
	2	160	439	119	207	169	170	180	186	162	328	70	70	186	162	69	274
	10	712	1979	473	759	715	716	732	738	714	765	72	75	738	714	69	1370
99.8	0.1	68	70	66	74	68	68	49	55	31	0	67	67	67	67	67	29
	0.5	74	87	69	101	79	79	76	81	57	0	67	68	81	67	67	144
	1	93	148	73	134	104	104	109	115	91	0	68	68	115	91	67	288
	2	152	282	92	201	165	166	176	182	158	0	68	69	182	158	67	575
	10	688	1343	322	737	695	696	712	718	694	0	73	79	718	694	67	2876

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.63	0.71	0.40	6.06	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.50	1.16	1.17	1.03	1.11	0.80	6.08	1.00	1.00	1.11	1.00	1.00
	1	1.00	0.00	0.00	1.75	1.33	1.34	1.34	1.41	1.14	5.38	0.88	0.88	1.41	1.14	0.88
	2	1.00	0.00	0.00	1.46	1.18	1.19	1.23	1.27	1.12	3.12	0.49	0.49	1.27	1.12	0.49
	10	1.00	0.00	0.00	1.09	1.03	1.03	1.05	1.06	1.03	1.18	0.10	0.10	1.06	1.03	0.10
99.9	0.1	1.00	1.06	0.97	1.08	0.99	1.00	0.70	0.78	0.44	4.20	0.99	0.99	0.99	0.99	0.99
	0.5	1.00	1.71	0.93	1.40	1.09	1.10	1.03	1.11	0.79	4.01	0.93	0.94	1.11	0.93	0.93
	1	1.00	2.74	0.88	1.59	1.22	1.23	1.28	1.34	1.07	3.49	0.80	0.80	1.34	1.07	0.79
	2	1.00	2.74	0.74	1.29	1.06	1.06	1.13	1.16	1.01	2.05	0.43	0.44	1.16	1.01	0.43
	10	1.00	2.78	0.66	1.07	1.00	1.01	1.03	1.04	1.00	1.07	0.10	0.10	1.04	1.00	0.10
99.8	0.1	1.00	1.03	0.97	1.08	0.99	1.00	0.72	0.80	0.45	0.00	0.99	0.99	0.99	0.99	0.99
	0.5	1.00	1.18	0.93	1.36	1.06	1.07	1.02	1.10	0.78	0.00	0.91	0.91	1.10	0.91	0.91
	1	1.00	1.59	0.79	1.44	1.12	1.12	1.17	1.24	0.98	0.00	0.73	0.73	1.24	0.98	0.72
	2	1.00	1.86	0.61	1.32	1.08	1.09	1.16	1.20	1.04	0.00	0.45	0.46	1.20	1.04	0.44
	10	1.00	1.95	0.47	1.07	1.01	1.01	1.03	1.04	1.01	0.00	0.11	0.11	1.04	1.01	0.10
Correlation coefficient							0.02									

Appendix C
Results obtained at the location of the largest annual 98 th percentile concentrations

In the following tables concentrations are in ppb and emission rates in g/s.

Table C1: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 50 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	96	26	24	17	147	95	96	96	95	95	4
	0.5	114	0	0	143	108	109	64	62	55	156	97	98	98	97	95	19
	1	155	0	0	190	137	139	111	110	102	177	98	101	110	102	95	38
	2	239	0	0	285	217	220	206	205	197	244	101	107	205	197	95	76
	10	955	0	0	1045	962	964	966	965	957	968	126	157	965	957	95	378
99.9	0.1	80	84	74	87	80	80	24	23	15	91	79	80	80	79	79	4
	0.5	81	92	74	119	90	91	56	54	47	100	80	82	82	80	79	18
	1	96	102	92	158	115	116	95	94	86	123	82	85	94	86	79	36
	2	176	183	167	237	181	183	174	173	165	186	85	91	173	165	79	73
	10	800	872	776	869	801	803	806	805	797	802	109	139	805	797	79	363
99.8	0.1	71	78	60	78	72	72	23	22	14	0	71	72	72	71	71	4
	0.5	73	79	63	107	81	82	52	50	43	0	72	74	74	72	71	18
	1	87	93	80	142	103	105	87	86	78	0	74	77	86	78	71	35
	2	149	165	139	213	163	165	158	157	149	0	77	83	157	149	71	70
	10	728	769	636	781	720	722	726	725	717	0	100	129	725	717	71	352
98	0.1	33	34	31	35	32	32	19	18	11	35	32	33	33	32	32	3
	0.5	36	38	35	48	37	36	32	31	23	40	33	35	35	33	32	17
	1	46	49	45	64	48	46	48	47	39	50	35	37	47	39	32	33
	2	72	75	71	96	76	72	80	79	71	77	37	43	79	71	32	66
	10	326	334	320	352	328	302	336	335	327	329	59	86	335	327	32	330

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.01	0.27	0.25	0.18	1.55	1.00	1.01	1.01	1.00	1.00
	0.5	1	0.00	0.00	1.25	0.95	0.96	0.56	0.55	0.48	1.37	0.85	0.86	0.86	0.85	0.84
	1	1	0.00	0.00	1.22	0.88	0.90	0.71	0.71	0.66	1.14	0.63	0.65	0.71	0.66	0.61
	2	1	0.00	0.00	1.19	0.91	0.92	0.86	0.86	0.83	1.02	0.42	0.45	0.86	0.83	0.40
	10	1	0.00	0.00	1.09	1.01	1.01	1.01	1.01	1.00	1.01	0.13	0.16	1.01	1.00	0.10
99.9	0.1	1	1.05	0.92	1.09	1.00	1.00	0.30	0.28	0.19	1.14	0.99	0.99	0.99	0.99	0.99
	0.5	1	1.14	0.91	1.46	1.11	1.12	0.69	0.67	0.58	1.23	0.99	1.01	1.01	0.99	0.98
	1	1	1.05	0.96	1.64	1.19	1.21	0.99	0.97	0.90	1.28	0.85	0.88	0.97	0.90	0.82
	2	1	1.04	0.95	1.35	1.03	1.04	0.99	0.98	0.94	1.06	0.48	0.52	0.98	0.94	0.45
	10	1	1.09	0.97	1.09	1.00	1.00	1.01	1.01	1.00	1.00	0.14	0.17	1.01	1.00	0.10
99.8	0.1	1	1.10	0.85	1.10	1.01	1.01	0.33	0.31	0.20	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.08	0.86	1.46	1.11	1.12	0.71	0.69	0.59	0.00	0.99	1.01	1.01	0.99	0.97
	1	1	1.08	0.93	1.64	1.20	1.21	1.01	0.99	0.91	0.00	0.85	0.89	0.99	0.91	0.82
	2	1	1.11	0.93	1.43	1.10	1.11	1.06	1.05	1.00	0.00	0.52	0.55	1.05	1.00	0.48
	10	1	1.06	0.87	1.07	0.99	0.99	1.00	1.00	0.99	0.00	0.14	0.18	1.00	0.99	0.10
98	0.1	1	1.03	0.94	1.07	0.98	0.98	0.58	0.54	0.32	1.07	0.98	0.99	0.99	0.98	0.97
	0.5	1	1.05	0.97	1.33	1.04	1.01	0.89	0.85	0.65	1.11	0.93	0.96	0.96	0.93	0.89
	1	1	1.06	0.97	1.39	1.05	1.00	1.04	1.01	0.85	1.09	0.75	0.81	1.01	0.85	0.69
	2	1	1.04	0.98	1.33	1.06	0.99	1.11	1.09	0.99	1.07	0.52	0.59	1.09	0.99	0.44
	10	1	1.03	0.98	1.08	1.01	0.93	1.03	1.03	1.00	1.01	0.18	0.26	1.03	1.00	0.10
Correlation coefficient							0.03									

Table C2: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 50 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	198	0	0	218	200	203	44	39	30	196	199	199	199	199	198	8
	0.5	262	0	0	297	224	241	123	118	109	221	201	204	204	201	198	39
	1	346	0	0	396	285	311	222	217	208	282	204	211	217	208	198	79
	2	515	0	0	594	449	482	420	415	406	448	211	224	415	406	198	158
	10	2003	0	0	2178	1999	2036	2004	1999	1990	1999	263	328	1999	1990	198	789
99.9	0.1	104	122	85	109	100	102	34	29	20	120	99	100	100	99	99	5
	0.5	106	150	93	149	113	121	74	69	59	131	101	103	103	101	99	23
	1	136	186	126	198	144	157	123	118	109	159	103	106	118	109	99	46
	2	225	252	212	297	228	243	222	217	208	237	106	114	217	208	99	91
	10	1032	1099	979	1089	1004	1022	1014	1009	1000	1006	136	174	1009	1000	99	455
99.8	0.1	78	95	74	86	79	80	32	27	18	0	78	79	79	78	78	4
	0.5	87	97	80	117	89	96	63	58	49	0	80	81	81	80	78	19
	1	112	120	101	156	114	124	102	97	88	0	81	84	97	88	78	39
	2	180	192	169	234	181	193	180	175	166	0	84	91	175	166	78	77
	10	790	864	717	858	793	806	804	799	790	0	110	142	799	790	78	387
98	0.1	51	52	48	55	51	51	29	24	15	47	50	51	51	50	50	5
	0.5	57	59	55	75	58	60	49	44	35	55	52	54	54	52	50	26
	1	73	75	70	100	75	77	74	69	60	72	54	58	69	60	50	52
	2	116	121	113	150	118	117	124	119	110	117	58	67	119	110	50	103
	10	513	527	506	550	511	477	524	519	510	511	92	135	519	510	50	516

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.03	0.22	0.20	0.15	0.99	1.00	1.01	1.01	1.00	1.00
	0.5	1	0.00	0.00	1.14	0.86	0.92	0.47	0.45	0.42	0.84	0.77	0.78	0.78	0.77	0.76
	1	1	0.00	0.00	1.14	0.82	0.90	0.64	0.63	0.60	0.81	0.59	0.61	0.63	0.60	0.57
	2	1	0.00	0.00	1.15	0.87	0.94	0.81	0.81	0.79	0.87	0.41	0.43	0.81	0.79	0.38
	10	1	0.00	0.00	1.09	1.00	1.02	1.00	1.00	0.99	1.00	0.13	0.16	1.00	0.99	0.10
99.9	0.1	1	1.17	0.81	1.04	0.96	0.98	0.33	0.28	0.19	1.15	0.95	0.96	0.96	0.95	0.95
	0.5	1	1.42	0.87	1.40	1.06	1.14	0.69	0.65	0.56	1.24	0.95	0.97	0.97	0.95	0.93
	1	1	1.36	0.93	1.45	1.06	1.15	0.90	0.87	0.80	1.16	0.75	0.78	0.87	0.80	0.73
	2	1	1.12	0.94	1.32	1.01	1.08	0.99	0.97	0.92	1.05	0.47	0.51	0.97	0.92	0.44
	10	1	1.07	0.95	1.06	0.97	0.99	0.98	0.98	0.97	0.97	0.13	0.17	0.98	0.97	0.10
99.8	0.1	1	1.22	0.95	1.10	1.01	1.03	0.41	0.35	0.22	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.11	0.92	1.34	1.02	1.10	0.72	0.67	0.56	0.00	0.91	0.93	0.93	0.91	0.89
	1	1	1.07	0.91	1.39	1.02	1.11	0.91	0.87	0.78	0.00	0.72	0.75	0.87	0.78	0.70
	2	1	1.06	0.94	1.30	1.00	1.07	1.00	0.97	0.92	0.00	0.47	0.50	0.97	0.92	0.43
	10	1	1.09	0.91	1.09	1.00	1.02	1.02	1.01	1.00	0.00	0.14	0.18	1.01	1.00	0.10
98	0.1	1	1.02	0.94	1.08	0.99	1.00	0.57	0.48	0.29	0.92	0.99	1.00	1.00	0.99	0.98
	0.5	1	1.04	0.97	1.32	1.02	1.06	0.86	0.78	0.61	0.97	0.92	0.96	0.96	0.92	0.88
	1	1	1.04	0.96	1.38	1.03	1.05	1.02	0.96	0.82	1.00	0.75	0.80	0.96	0.82	0.69
	2	1	1.04	0.97	1.29	1.02	1.01	1.07	1.03	0.94	1.00	0.50	0.58	1.03	0.94	0.43
	10	1	1.03	0.99	1.07	1.00	0.93	1.02	1.01	0.99	1.00	0.18	0.26	1.01	0.99	0.10
Correlation coefficient							0.2									

Table C3: Comparison of modelled concentrations, ppb: Manchester Town Hall oxides of nitrogen: 50 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	802	801	176	181	130	1025	798	800	800	798	795	23
	0.5	795	0	0	1193	901	899	494	499	448	1106	808	821	821	808	795	114
	1	880	0	0	1590	1147	1143	891	897	846	1313	821	847	897	846	795	227
	2	1617	0	0	2385	1811	1807	1686	1692	1641	1920	847	899	1692	1641	795	455
	10	7974	0	0	8745	8037	8032	8046	8052	8001	8062	1055	1316	8052	8001	795	2274
99.9	0.1	572	622	462	629	577	577	153	159	108	632	574	576	576	574	572	19
	0.5	572	622	464	858	651	649	382	388	337	700	583	594	594	583	572	94
	1	703	751	638	1144	830	828	668	674	623	869	594	615	674	623	572	189
	2	1228	1300	1189	1716	1312	1309	1240	1246	1195	1336	615	659	1246	1195	572	378
	10	5765	6160	5584	6292	5796	5792	5816	5822	5771	5801	788	1005	5822	5771	572	1890
99.8	0.1	451	524	413	496	455	455	141	147	96	0	453	455	455	453	451	16
	0.5	451	526	416	677	515	514	322	327	276	0	460	469	469	460	451	80
	1	567	607	534	902	659	657	547	553	502	0	469	488	553	502	451	161
	2	968	1037	868	1353	1041	1039	998	1004	953	0	488	525	1004	953	451	321
	10	4626	4865	4052	4961	4579	4577	4606	4612	4561	0	635	819	4612	4561	451	1606
98	0.1	199	208	189	216	199	197	116	122	71	245	198	199	199	198	196	15
	0.5	231	241	218	294	230	221	194	200	149	270	204	213	213	204	196	73
	1	292	310	281	392	298	281	292	298	247	330	213	229	298	247	196	145
	2	446	459	435	588	471	437	488	494	443	491	229	263	494	443	196	291
	10	2005	2050	1967	2156	2017	1850	2056	2062	2011	2021	362	529	2062	2011	196	1453

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.01	0.22	0.23	0.16	1.29	1.00	1.01	1.01	1.00	1.00
	0.5	1	0.00	0.00	1.50	1.13	1.13	0.62	0.63	0.56	1.39	1.02	1.03	1.03	1.02	1.00
	1	1	0.00	0.00	1.81	1.30	1.30	1.01	1.02	0.96	1.49	0.93	0.96	1.02	0.96	0.90
	2	1	0.00	0.00	1.47	1.12	1.12	1.04	1.05	1.01	1.19	0.52	0.56	1.05	1.01	0.49
	10	1	0.00	0.00	1.10	1.01	1.01	1.01	1.01	1.00	1.01	0.13	0.16	1.01	1.00	0.10
99.9	0.1	1	1.09	0.81	1.10	1.01	1.01	0.27	0.28	0.19	1.10	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.09	0.81	1.50	1.14	1.14	0.67	0.68	0.59	1.22	1.02	1.04	1.04	1.02	1.00
	1	1	1.07	0.91	1.63	1.18	1.18	0.95	0.96	0.89	1.24	0.84	0.88	0.96	0.89	0.81
	2	1	1.06	0.97	1.40	1.07	1.07	1.01	1.01	0.97	1.09	0.50	0.54	1.01	0.97	0.47
	10	1	1.07	0.97	1.09	1.01	1.00	1.01	1.01	1.00	1.01	0.14	0.17	1.01	1.00	0.10
99.8	0.1	1	1.16	0.92	1.10	1.01	1.01	0.31	0.33	0.21	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.17	0.92	1.50	1.14	1.14	0.71	0.73	0.61	0.00	1.02	1.04	1.04	1.02	1.00
	1	1	1.07	0.94	1.59	1.16	1.16	0.96	0.98	0.89	0.00	0.83	0.86	0.98	0.89	0.80
	2	1	1.07	0.90	1.40	1.08	1.07	1.03	1.04	0.98	0.00	0.50	0.54	1.04	0.98	0.47
	10	1	1.05	0.88	1.07	0.99	0.99	1.00	1.00	0.99	0.00	0.14	0.18	1.00	0.99	0.10
98	0.1	1	1.05	0.95	1.08	1.00	0.99	0.58	0.61	0.35	1.23	0.99	1.00	1.00	0.99	0.98
	0.5	1	1.04	0.94	1.27	0.99	0.96	0.84	0.87	0.64	1.17	0.88	0.92	0.92	0.88	0.85
	1	1	1.06	0.96	1.34	1.02	0.96	1.00	1.02	0.85	1.13	0.73	0.79	1.02	0.85	0.67
	2	1	1.03	0.98	1.32	1.06	0.98	1.09	1.11	0.99	1.10	0.51	0.59	1.11	0.99	0.44
	10	1	1.02	0.98	1.08	1.01	0.92	1.03	1.03	1.00	1.01	0.18	0.26	1.03	1.00	0.10
Correlation coefficient							-0.01									

Table C4: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 50 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	522	525	160	153	102	1012	520	521	521	520	518	15
	0.5	518	0	0	777	589	603	367	360	309	1050	526	535	535	526	518	74
	1	603	0	0	1036	753	773	626	619	568	1149	535	552	619	568	518	148
	2	1079	0	0	1554	1190	1216	1144	1137	1086	1471	552	586	1137	1086	518	296
	10	5217	0	0	5698	5252	5281	5288	5281	5230	5321	688	857	5281	5230	518	1482
99.9	0.1	393	465	358	432	397	399	147	140	90	623	394	396	396	394	393	13
	0.5	393	465	367	590	449	459	305	297	247	658	400	408	408	400	393	65
	1	506	525	480	786	576	591	501	494	443	749	408	423	494	443	393	130
	2	883	917	821	1179	910	929	894	887	836	1027	423	452	887	836	393	260
	10	4009	4212	3902	4323	3996	4017	4038	4031	3980	4023	542	690	4031	3980	393	1298
99.8	0.1	355	370	312	391	358	360	144	136	86	0	356	358	358	356	355	13
	0.5	356	376	335	533	407	416	286	278	228	0	362	369	369	362	355	63
	1	455	495	421	710	522	536	463	456	405	0	369	384	456	405	355	126
	2	790	842	726	1065	825	842	818	811	760	0	384	413	811	760	355	253
	10	3694	3893	3214	3905	3614	3633	3658	3651	3600	0	500	644	3651	3600	355	1264
98	0.1	178	186	172	193	178	177	126	118	68	242	176	178	178	176	175	13
	0.5	215	221	206	263	206	203	196	188	138	263	182	190	190	182	175	65
	1	273	285	261	350	268	259	283	276	225	313	190	205	276	225	175	130
	2	419	436	404	525	424	401	458	451	400	452	205	234	451	400	175	259
	10	1812	1845	1774	1925	1805	1664	1858	1851	1800	1812	324	472	1851	1800	175	1297

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.01	0.31	0.29	0.20	1.95	1.00	1.01	1.01	1.00	1.00
	0.5	1	0.00	0.00	1.50	1.14	1.16	0.71	0.69	0.60	2.03	1.02	1.03	1.03	1.02	1.00
	1	1	0.00	0.00	1.72	1.25	1.28	1.04	1.03	0.94	1.90	0.89	0.91	1.03	0.94	0.86
	2	1	0.00	0.00	1.44	1.10	1.13	1.06	1.05	1.01	1.36	0.51	0.54	1.05	1.01	0.48
	10	1	0.00	0.00	1.09	1.01	1.01	1.01	1.01	1.00	1.02	0.13	0.16	1.01	1.00	0.10
99.9	0.1	1	1.18	0.91	1.10	1.01	1.01	0.37	0.36	0.23	1.59	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.18	0.93	1.50	1.14	1.17	0.77	0.76	0.63	1.68	1.02	1.04	1.04	1.02	1.00
	1	1	1.04	0.95	1.55	1.14	1.17	0.99	0.98	0.88	1.48	0.81	0.84	0.98	0.88	0.78
	2	1	1.04	0.93	1.33	1.03	1.05	1.01	1.00	0.95	1.16	0.48	0.51	1.00	0.95	0.44
	10	1	1.05	0.97	1.08	1.00	1.00	1.01	1.01	0.99	1.00	0.14	0.17	1.01	0.99	0.10
99.8	0.1	1	1.04	0.88	1.10	1.01	1.02	0.40	0.38	0.24	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.06	0.94	1.50	1.14	1.17	0.80	0.78	0.64	0.00	1.02	1.04	1.04	1.02	1.00
	1	1	1.09	0.93	1.56	1.15	1.18	1.02	1.00	0.89	0.00	0.81	0.84	1.00	0.89	0.78
	2	1	1.07	0.92	1.35	1.05	1.07	1.04	1.03	0.96	0.00	0.49	0.52	1.03	0.96	0.45
	10	1	1.05	0.87	1.06	0.98	0.98	0.99	0.99	0.97	0.00	0.14	0.17	0.99	0.97	0.10
98	0.1	1	1.04	0.97	1.08	1.00	0.99	0.71	0.67	0.38	1.36	0.99	1.00	1.00	0.99	0.98
	0.5	1	1.03	0.96	1.22	0.96	0.94	0.91	0.88	0.64	1.22	0.85	0.88	0.88	0.85	0.81
	1	1	1.04	0.96	1.28	0.98	0.95	1.04	1.01	0.83	1.15	0.70	0.75	1.01	0.83	0.64
	2	1	1.04	0.96	1.25	1.01	0.96	1.09	1.08	0.96	1.08	0.49	0.56	1.08	0.96	0.42
	10	1	1.02	0.98	1.06	1.00	0.92	1.03	1.02	0.99	1.00	0.18	0.26	1.02	0.99	0.10
Correlation coefficient							0.06									

Table C5: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 50 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	80	0	0	87	80	80	50	56	32	479	79	80	80	79	79	3
	0.5	103	0	0	119	93	94	82	87	63	482	81	83	87	81	79	13
	1	131	0	0	158	121	123	121	127	103	489	83	88	127	103	79	27
	2	200	0	0	237	192	194	200	206	182	511	88	97	206	182	79	53
	10	824	0	0	869	816	818	832	838	814	941	124	168	838	814	79	266
99.9	0.1	70	74	68	76	70	70	49	55	31	295	69	70	70	69	69	3
	0.5	84	88	81	104	82	83	77	82	58	298	71	73	82	71	69	13
	1	115	118	109	138	107	109	111	117	93	306	73	78	117	93	69	25
	2	176	185	170	207	170	171	180	186	162	332	78	86	186	162	69	51
	10	731	747	693	759	715	717	732	738	714	768	112	154	738	714	69	254
99.8	0.1	67	69	66	74	68	68	49	55	31	0	67	68	68	67	67	3
	0.5	79	84	77	101	79	80	76	81	57	0	69	71	81	69	67	13
	1	109	112	104	134	104	106	109	115	91	0	71	76	115	91	67	26
	2	171	178	169	201	165	167	176	182	158	0	76	85	182	158	67	52
	10	706	729	690	737	695	697	712	718	694	0	111	155	718	694	67	262
98	0.1	54	55	53	58	54	54	47	53	29	114	54	54	54	54	53	3
	0.5	63	64	61	80	64	62	69	74	50	119	56	58	74	56	53	16
	1	84	87	82	106	85	81	95	101	77	131	58	63	101	77	53	31
	2	137	141	134	159	134	125	148	154	130	165	63	74	154	130	53	62
	10	558	592	542	583	555	504	572	578	554	562	105	157	578	554	53	312

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.09	1.00	1.01	0.63	0.70	0.40	6.01	1.00	1.00	1.00	1.00	0.99
	0.5	1.00	0.00	0.00	1.15	0.90	0.91	0.79	0.85	0.62	4.70	0.79	0.81	0.85	0.79	0.77
	1	1.00	0.00	0.00	1.20	0.92	0.94	0.92	0.97	0.78	3.72	0.64	0.67	0.97	0.78	0.60
	2	1.00	0.00	0.00	1.19	0.96	0.97	1.00	1.03	0.91	2.56	0.44	0.48	1.03	0.91	0.40
	10	1.00	0.00	0.00	1.05	0.99	0.99	1.01	1.02	0.99	1.14	0.15	0.20	1.02	0.99	0.10
99.9	0.1	1.00	1.06	0.97	1.08	1.00	1.00	0.70	0.78	0.44	4.21	0.99	1.00	1.00	0.99	0.99
	0.5	1.00	1.05	0.95	1.23	0.97	0.98	0.91	0.98	0.69	3.54	0.84	0.87	0.98	0.84	0.82
	1	1.00	1.02	0.95	1.20	0.93	0.94	0.96	1.01	0.81	2.65	0.63	0.67	1.01	0.81	0.60
	2	1.00	1.05	0.96	1.18	0.96	0.97	1.02	1.06	0.92	1.89	0.44	0.49	1.06	0.92	0.39
	10	1.00	1.02	0.95	1.04	0.98	0.98	1.00	1.01	0.98	1.05	0.15	0.21	1.01	0.98	0.09
99.8	0.1	1.00	1.03	0.99	1.10	1.01	1.02	0.73	0.81	0.46	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.06	0.98	1.27	1.00	1.02	0.96	1.03	0.73	0.00	0.88	0.90	1.03	0.88	0.85
	1	1.00	1.03	0.96	1.23	0.96	0.97	1.00	1.06	0.84	0.00	0.66	0.70	1.06	0.84	0.62
	2	1.00	1.04	0.99	1.18	0.97	0.98	1.03	1.06	0.92	0.00	0.44	0.49	1.06	0.92	0.39
	10	1.00	1.03	0.98	1.04	0.99	0.99	1.01	1.02	0.98	0.00	0.16	0.22	1.02	0.98	0.09
98	0.1	1.00	1.02	0.98	1.08	1.00	0.99	0.88	0.98	0.54	2.12	0.99	1.00	1.00	0.99	0.98
	0.5	1.00	1.02	0.98	1.27	1.03	1.00	1.10	1.19	0.81	1.91	0.89	0.93	1.19	0.89	0.85
	1	1.00	1.04	0.97	1.26	1.01	0.96	1.13	1.20	0.91	1.55	0.69	0.75	1.20	0.91	0.63
	2	1.00	1.03	0.98	1.16	0.98	0.91	1.08	1.12	0.95	1.21	0.46	0.54	1.12	0.95	0.39
	10	1.00	1.06	0.97	1.05	0.99	0.90	1.03	1.04	0.99	1.01	0.19	0.28	1.04	0.99	0.10
Correlation coefficient							0.04									

Table C6: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 25 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	96	26	24	17	147	95	96	96	95	95	1
	0.5	97	0	0	143	108	109	64	62	55	156	97	100	100	97	95	7
	1	141	0	0	190	138	139	111	110	102	178	100	105	110	102	95	15
	2	230	0	0	285	218	219	206	205	197	245	105	115	205	197	95	29
	10	962	0	0	1045	962	963	966	965	957	968	144	193	965	957	95	145
99.9	0.1	81	84	74	87	80	80	24	23	15	91	79	80	80	79	79	1
	0.5	81	93	75	119	90	91	56	54	47	100	81	83	83	81	79	7
	1	99	104	96	158	115	116	95	94	86	123	83	88	94	86	79	13
	2	174	186	170	237	182	183	174	173	165	187	88	97	173	165	79	27
	10	800	863	792	869	801	802	806	805	797	802	124	169	805	797	79	133
99.8	0.1	71	77	60	78	72	72	23	22	14	0	71	72	72	71	71	1
	0.5	73	80	64	107	81	82	52	50	43	0	73	75	75	73	71	6
	1	90	92	84	142	104	104	87	86	78	0	75	79	86	78	71	12
	2	155	158	148	213	164	164	158	157	149	0	79	87	157	149	71	24
	10	723	732	704	781	720	721	726	725	717	0	112	153	725	717	71	122
98	0.1	32	34	31	35	32	32	19	18	11	35	32	33	33	32	32	1
	0.5	35	37	34	48	37	36	32	31	23	40	33	35	35	33	32	4
	1	46	48	44	64	48	46	48	47	39	50	35	38	47	39	32	8
	2	72	74	71	96	76	71	80	79	71	77	38	43	79	71	32	17
	10	326	336	319	352	328	301	336	335	327	329	60	88	335	327	32	83

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.01	0.27	0.25	0.18	1.55	1.01	1.01	1.01	1.01	1.00
	0.5	1	0.00	0.00	1.47	1.11	1.12	0.65	0.64	0.56	1.61	1.00	1.03	1.03	1.00	0.98
	1	1	0.00	0.00	1.34	0.98	0.98	0.78	0.78	0.72	1.26	0.71	0.74	0.78	0.72	0.67
	2	1	0.00	0.00	1.24	0.95	0.95	0.90	0.89	0.86	1.07	0.46	0.50	0.89	0.86	0.41
	10	1	0.00	0.00	1.09	1.00	1.00	1.00	1.00	1.00	1.01	0.15	0.20	1.00	1.00	0.10
99.9	0.1	1	1.04	0.91	1.07	0.99	0.99	0.30	0.28	0.19	1.12	0.98	0.99	0.99	0.98	0.98
	0.5	1	1.15	0.92	1.46	1.12	1.12	0.69	0.67	0.58	1.24	1.00	1.03	1.03	1.00	0.98
	1	1	1.05	0.97	1.60	1.16	1.17	0.96	0.95	0.87	1.24	0.84	0.89	0.95	0.87	0.80
	2	1	1.07	0.98	1.36	1.04	1.05	1.00	0.99	0.95	1.07	0.51	0.56	0.99	0.95	0.45
	10	1	1.08	0.99	1.09	1.00	1.00	1.01	1.01	1.00	1.00	0.15	0.21	1.01	1.00	0.10
99.8	0.1	1	1.08	0.85	1.10	1.01	1.01	0.33	0.31	0.20	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1	1.10	0.88	1.46	1.11	1.12	0.71	0.69	0.59	0.00	1.00	1.03	1.03	1.00	0.97
	1	1	1.03	0.94	1.58	1.16	1.16	0.97	0.95	0.87	0.00	0.84	0.88	0.95	0.87	0.79
	2	1	1.01	0.96	1.37	1.05	1.06	1.02	1.01	0.96	0.00	0.51	0.56	1.01	0.96	0.46
	10	1	1.01	0.97	1.08	1.00	1.00	1.00	1.00	0.99	0.00	0.16	0.21	1.00	0.99	0.10
98	0.1	1	1.06	0.97	1.10	1.01	1.01	0.60	0.56	0.33	1.10	1.01	1.02	1.02	1.01	1.00
	0.5	1	1.05	0.97	1.37	1.07	1.03	0.91	0.88	0.67	1.14	0.95	0.99	0.99	0.95	0.91
	1	1	1.05	0.96	1.40	1.06	1.00	1.05	1.02	0.86	1.10	0.76	0.82	1.02	0.86	0.70
	2	1	1.02	0.98	1.33	1.05	0.98	1.11	1.09	0.99	1.07	0.52	0.60	1.09	0.99	0.44
	10	1	1.03	0.98	1.08	1.01	0.92	1.03	1.03	1.00	1.01	0.18	0.27	1.03	1.00	0.10
Correlation coefficient							0.01									

Table C7: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 25 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	202	0	0	218	200	198	44	39	30	196	199	200	200	199	198	3
	0.5	233	0	0	297	225	218	123	118	109	222	203	208	208	203	198	15
	1	288	0	0	396	286	274	222	217	208	283	208	218	218	208	198	30
	2	447	0	0	594	450	435	420	415	406	448	218	239	415	406	198	61
	10	2001	0	0	2178	1999	1983	2004	1999	1990	1999	300	402	1999	1990	198	303
99.9	0.1	106	121	84	109	100	99	34	29	20	120	100	100	100	100	99	2
	0.5	115	147	94	149	113	110	74	69	59	132	102	105	105	102	99	8
	1	140	195	125	198	145	139	123	118	109	159	105	110	118	109	99	17
	2	239	261	218	297	228	221	222	217	208	237	110	121	217	208	99	33
	10	1015	1058	997	1089	1004	996	1014	1009	1000	1006	155	211	1009	1000	99	167
99.8	0.1	78	93	74	86	79	78	32	27	18	0	78	79	79	78	78	1
	0.5	84	106	76	117	90	87	63	58	49	0	80	83	83	80	78	7
	1	108	119	97	156	115	110	102	97	88	0	83	87	97	88	78	13
	2	177	194	165	234	181	175	180	175	166	0	87	96	175	166	78	27
	10	790	816	770	858	793	787	804	799	790	0	123	168	799	790	78	134
98	0.1	50	52	48	55	51	50	29	24	15	47	50	51	51	50	50	1
	0.5	52	54	50	75	58	54	49	44	35	55	52	54	54	52	50	6
	1	62	63	60	100	75	68	74	69	60	72	54	59	69	60	50	13
	2	107	110	103	150	118	106	124	119	110	117	59	67	119	110	50	26
	10	507	523	493	550	511	464	524	519	510	511	94	137	519	510	50	129

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.08	0.99	0.98	0.22	0.19	0.15	0.97	0.98	0.99	0.99	0.98	0.98
	0.5	1	0.00	0.00	1.28	0.97	0.94	0.53	0.51	0.47	0.95	0.87	0.89	0.89	0.87	0.85
	1	1	0.00	0.00	1.37	0.99	0.95	0.77	0.75	0.72	0.98	0.72	0.76	0.76	0.72	0.69
	2	1	0.00	0.00	1.33	1.01	0.97	0.94	0.93	0.91	1.00	0.49	0.53	0.93	0.91	0.44
	10	1	0.00	0.00	1.09	1.00	0.99	1.00	1.00	0.99	1.00	0.15	0.20	1.00	0.99	0.10
99.9	0.1	1	1.14	0.79	1.03	0.94	0.94	0.32	0.28	0.18	1.13	0.94	0.94	0.94	0.94	0.93
	0.5	1	1.28	0.82	1.29	0.98	0.95	0.64	0.60	0.51	1.14	0.89	0.91	0.91	0.89	0.86
	1	1	1.39	0.89	1.41	1.03	0.99	0.88	0.84	0.78	1.14	0.75	0.79	0.84	0.78	0.71
	2	1	1.09	0.91	1.24	0.95	0.92	0.93	0.91	0.87	0.99	0.46	0.51	0.91	0.87	0.41
	10	1	1.04	0.98	1.07	0.99	0.98	1.00	0.99	0.98	0.99	0.15	0.21	0.99	0.98	0.10
99.8	0.1	1	1.19	0.94	1.09	1.01	1.00	0.41	0.35	0.22	0.00	1.00	1.01	1.01	1.00	0.99
	0.5	1	1.26	0.90	1.39	1.07	1.03	0.75	0.70	0.58	0.00	0.96	0.98	0.98	0.96	0.93
	1	1	1.10	0.89	1.44	1.06	1.02	0.94	0.90	0.81	0.00	0.76	0.80	0.90	0.81	0.72
	2	1	1.10	0.93	1.32	1.02	0.99	1.02	0.99	0.94	0.00	0.49	0.54	0.99	0.94	0.44
	10	1	1.03	0.97	1.09	1.00	1.00	1.02	1.01	1.00	0.00	0.16	0.21	1.01	1.00	0.10
98	0.1	1	1.04	0.96	1.10	1.01	1.00	0.58	0.49	0.29	0.94	1.01	1.02	1.02	1.01	1.00
	0.5	1	1.03	0.96	1.44	1.12	1.04	0.94	0.85	0.67	1.05	1.00	1.05	1.05	1.00	0.96
	1	1	1.02	0.97	1.62	1.21	1.10	1.20	1.12	0.97	1.17	0.88	0.95	1.12	0.97	0.81
	2	1	1.03	0.96	1.40	1.11	0.99	1.16	1.12	1.03	1.09	0.55	0.63	1.12	1.03	0.47
	10	1	1.03	0.97	1.09	1.01	0.92	1.03	1.02	1.01	1.01	0.18	0.27	1.02	1.01	0.10
Correlation coefficient							-0.09									

Table C8: Comparison of modelled concentrations, ppb: Manchester Town Hall oxides of nitrogen: 25 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	803	796	176	181	130	1026	799	803	803	799	795	9
	0.5	795	0	0	1193	906	875	494	499	448	1110	816	836	836	816	795	44
	1	884	0	0	1590	1151	1102	891	897	846	1319	836	877	897	846	795	87
	2	1666	0	0	2385	1815	1753	1686	1692	1641	1925	877	959	1692	1641	795	175
	10	8026	0	0	8745	8038	7971	8046	8052	8001	8063	1205	1615	8052	8001	795	873
99.9	0.1	572	622	462	629	578	573	153	159	108	632	575	578	578	575	572	7
	0.5	572	622	462	858	654	632	382	388	337	703	588	604	604	588	572	35
	1	680	720	642	1144	833	799	668	674	623	872	604	637	674	623	572	69
	2	1227	1237	1185	1716	1314	1271	1240	1246	1195	1339	637	702	1246	1195	572	138
	10	5779	5919	5703	6292	5796	5749	5816	5822	5771	5802	897	1222	5822	5771	572	691
99.8	0.1	451	523	413	496	456	452	141	147	96	0	454	456	456	454	451	6
	0.5	451	523	413	677	517	500	322	327	276	0	464	477	477	464	451	28
	1	552	582	517	902	661	634	547	553	502	0	477	503	553	502	451	56
	2	962	979	942	1353	1042	1009	998	1004	953	0	503	555	1004	953	451	111
	10	4563	4620	4461	4961	4580	4544	4606	4612	4561	0	712	973	4612	4561	451	556
98	0.1	196	208	188	216	199	195	116	122	71	245	198	199	199	198	196	4
	0.5	213	225	203	294	230	214	194	200	149	270	205	213	213	205	196	18
	1	285	295	276	392	298	271	292	298	247	330	213	230	298	247	196	36
	2	450	462	435	588	471	425	488	494	443	491	230	264	494	443	196	73
	10	1993	2065	1940	2156	2017	1833	2056	2062	2011	2021	367	538	2062	2011	196	363

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.00	0.22	0.23	0.16	1.29	1.01	1.01	1.01	1.01	1.00
	0.5	1	0.00	0.00	1.50	1.14	1.10	0.62	0.63	0.56	1.40	1.03	1.05	1.05	1.03	1.00
	1	1	0.00	0.00	1.80	1.30	1.25	1.01	1.01	0.96	1.49	0.95	0.99	1.01	0.96	0.90
	2	1	0.00	0.00	1.43	1.09	1.05	1.01	1.02	0.98	1.16	0.53	0.58	1.02	0.98	0.48
	10	1	0.00	0.00	1.09	1.00	0.99	1.00	1.00	1.00	1.00	0.15	0.20	1.00	1.00	0.10
99.9	0.1	1	1.09	0.81	1.10	1.01	1.00	0.27	0.28	0.19	1.11	1.01	1.01	1.01	1.01	1.00
	0.5	1	1.09	0.81	1.50	1.14	1.10	0.67	0.68	0.59	1.23	1.03	1.06	1.06	1.03	1.00
	1	1	1.06	0.94	1.68	1.23	1.18	0.98	0.99	0.92	1.28	0.89	0.94	0.99	0.92	0.84
	2	1	1.01	0.97	1.40	1.07	1.04	1.01	1.02	0.97	1.09	0.52	0.57	1.02	0.97	0.47
	10	1	1.02	0.99	1.09	1.00	0.99	1.01	1.01	1.00	1.00	0.16	0.21	1.01	1.00	0.10
99.8	0.1	1	1.16	0.92	1.10	1.01	1.00	0.31	0.33	0.21	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1	1.16	0.92	1.50	1.15	1.11	0.71	0.73	0.61	0.00	1.03	1.06	1.06	1.03	1.00
	1	1	1.06	0.94	1.63	1.20	1.15	0.99	1.00	0.91	0.00	0.86	0.91	1.00	0.91	0.82
	2	1	1.02	0.98	1.41	1.08	1.05	1.04	1.04	0.99	0.00	0.52	0.58	1.04	0.99	0.47
	10	1	1.01	0.98	1.09	1.00	1.00	1.01	1.01	1.00	0.00	0.16	0.21	1.01	1.00	0.10
98	0.1	1	1.06	0.96	1.10	1.01	1.00	0.59	0.62	0.36	1.25	1.01	1.02	1.02	1.01	1.00
	0.5	1	1.06	0.95	1.38	1.08	1.01	0.91	0.94	0.70	1.27	0.96	1.00	1.00	0.96	0.92
	1	1	1.04	0.97	1.38	1.05	0.95	1.03	1.05	0.87	1.16	0.75	0.81	1.05	0.87	0.69
	2	1	1.03	0.97	1.31	1.05	0.94	1.08	1.10	0.98	1.09	0.51	0.59	1.10	0.98	0.44
	10	1	1.04	0.97	1.08	1.01	0.92	1.03	1.03	1.01	1.01	0.18	0.27	1.03	1.01	0.10
Correlation coefficient							-0.09									

Table C9: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 25 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	523	523	160	153	102	1013	521	523	523	521	518	6
	0.5	518	0	0	777	592	590	367	360	309	1053	531	545	545	531	518	28
	1	673	0	0	1036	755	752	626	619	568	1154	545	571	619	568	518	57
	2	1179	0	0	1554	1192	1188	1144	1137	1086	1476	571	625	1137	1086	518	114
	10	5246	0	0	5698	5253	5248	5288	5281	5230	5323	785	1052	5281	5230	518	569
99.9	0.1	393	465	358	432	397	397	147	140	90	624	395	397	397	395	393	5
	0.5	393	465	361	590	451	449	305	297	247	661	404	415	415	404	393	24
	1	477	504	465	786	577	575	501	494	443	753	415	438	494	443	393	48
	2	846	881	834	1179	912	909	894	887	836	1030	438	482	887	836	393	95
	10	3972	4057	3914	4323	3996	3993	4038	4031	3980	4024	616	839	4031	3980	393	475
99.8	0.1	355	370	314	391	359	359	144	136	86	0	357	359	359	357	355	4
	0.5	356	370	324	533	408	407	286	278	228	0	365	376	376	365	355	22
	1	428	446	411	710	523	521	463	456	405	0	376	396	456	405	355	44
	2	752	781	739	1065	827	824	818	811	760	0	396	437	811	760	355	87
	10	3596	3641	3519	3905	3614	3611	3658	3651	3600	0	561	766	3651	3600	355	437
98	0.1	176	185	171	193	178	176	126	118	68	242	177	178	178	177	175	3
	0.5	195	202	188	263	206	198	196	188	138	263	183	190	190	183	175	16
	1	259	264	252	350	268	252	283	276	225	313	190	205	276	225	175	32
	2	410	432	398	525	424	392	458	451	400	452	205	236	451	400	175	65
	10	1805	1871	1748	1925	1805	1652	1858	1851	1800	1812	327	480	1851	1800	175	325

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.01	0.31	0.29	0.20	1.96	1.01	1.01	1.01	1.01	1.00
	0.5	1	0.00	0.00	1.50	1.14	1.14	0.71	0.69	0.60	2.03	1.03	1.05	1.05	1.03	1.00
	1	1	0.00	0.00	1.54	1.12	1.12	0.93	0.92	0.84	1.71	0.81	0.85	0.92	0.84	0.77
	2	1	0.00	0.00	1.32	1.01	1.01	0.97	0.96	0.92	1.25	0.48	0.53	0.96	0.92	0.44
	10	1	0.00	0.00	1.09	1.00	1.00	1.01	1.01	1.00	1.01	0.15	0.20	1.01	1.00	0.10
99.9	0.1	1	1.18	0.91	1.10	1.01	1.01	0.37	0.36	0.23	1.59	1.01	1.01	1.01	1.01	1.00
	0.5	1	1.18	0.92	1.50	1.15	1.14	0.77	0.76	0.63	1.68	1.03	1.06	1.06	1.03	1.00
	1	1	1.06	0.97	1.65	1.21	1.21	1.05	1.04	0.93	1.58	0.87	0.92	1.04	0.93	0.82
	2	1	1.04	0.99	1.39	1.08	1.07	1.06	1.05	0.99	1.22	0.52	0.57	1.05	0.99	0.46
	10	1	1.02	0.99	1.09	1.01	1.01	1.02	1.01	1.00	1.01	0.16	0.21	1.01	1.00	0.10
99.8	0.1	1	1.04	0.88	1.10	1.01	1.01	0.40	0.38	0.24	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1	1.04	0.91	1.50	1.15	1.14	0.80	0.78	0.64	0.00	1.03	1.05	1.05	1.03	1.00
	1	1	1.04	0.96	1.66	1.22	1.22	1.08	1.07	0.95	0.00	0.88	0.93	1.07	0.95	0.83
	2	1	1.04	0.98	1.42	1.10	1.10	1.09	1.08	1.01	0.00	0.53	0.58	1.08	1.01	0.47
	10	1	1.01	0.98	1.09	1.01	1.00	1.02	1.02	1.00	0.00	0.16	0.21	1.02	1.00	0.10
98	0.1	1	1.05	0.97	1.09	1.01	1.00	0.71	0.67	0.39	1.37	1.00	1.01	1.01	1.00	0.99
	0.5	1	1.04	0.97	1.35	1.06	1.01	1.00	0.97	0.71	1.35	0.94	0.98	0.98	0.94	0.90
	1	1	1.02	0.97	1.35	1.04	0.97	1.09	1.07	0.87	1.21	0.73	0.79	1.07	0.87	0.68
	2	1	1.05	0.97	1.28	1.03	0.96	1.12	1.10	0.98	1.10	0.50	0.58	1.10	0.98	0.43
	10	1	1.04	0.97	1.07	1.00	0.92	1.03	1.03	1.00	1.00	0.18	0.27	1.03	1.00	0.10
Correlation coefficient							-0.01									

Table C10: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 25 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	79	0	0	87	80	80	50	56	32	479	79	80	80	79	79	1
	0.5	101	0	0	119	93	92	82	87	63	482	81	83	87	81	79	4
	1	134	0	0	158	121	121	121	127	103	489	83	87	127	103	79	9
	2	205	0	0	237	192	191	200	206	182	511	87	95	206	182	79	17
	10	837	0	0	869	816	815	832	838	814	941	120	160	838	814	79	87
99.9	0.1	70	74	68	76	70	70	49	55	31	295	69	70	70	69	69	1
	0.5	83	87	80	104	81	81	77	82	58	298	71	73	82	71	69	4
	1	115	118	110	138	107	107	111	117	93	306	73	77	117	93	69	8
	2	178	186	172	207	170	169	180	186	162	332	77	85	186	162	69	17
	10	716	730	712	759	715	715	732	738	714	768	108	147	738	714	69	83
99.8	0.1	67	69	65	74	68	68	49	55	31	0	67	68	68	67	67	1
	0.5	76	81	72	101	79	79	76	81	57	0	69	71	81	69	67	4
	1	105	113	99	134	104	104	109	115	91	0	71	75	115	91	67	8
	2	168	174	163	201	165	165	176	182	158	0	75	83	182	158	67	17
	10	698	707	677	737	695	695	712	718	694	0	106	145	718	694	67	83
98	0.1	54	55	53	58	54	53	47	53	29	114	53	54	54	53	53	1
	0.5	60	61	59	80	64	62	69	74	50	119	55	58	74	55	53	5
	1	80	83	79	106	85	80	95	101	77	130	58	62	101	77	53	10
	2	132	138	127	159	134	125	148	154	130	165	62	71	154	130	53	20
	10	555	573	539	583	555	508	572	578	554	562	99	145	578	554	53	98

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.01	0.63	0.71	0.40	6.06	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	0.00	0.00	1.18	0.92	0.92	0.81	0.87	0.63	4.79	0.81	0.83	0.87	0.81	0.79
	1	1.00	0.00	0.00	1.18	0.90	0.90	0.90	0.95	0.77	3.64	0.62	0.65	0.95	0.77	0.59
	2	1.00	0.00	0.00	1.16	0.94	0.93	0.98	1.00	0.89	2.49	0.43	0.46	1.00	0.89	0.39
	10	1.00	0.00	0.00	1.04	0.97	0.97	0.99	1.00	0.97	1.12	0.14	0.19	1.00	0.97	0.09
99.9	0.1	1.00	1.06	0.97	1.08	1.00	1.00	0.70	0.78	0.44	4.21	0.99	1.00	1.00	0.99	0.99
	0.5	1.00	1.04	0.96	1.24	0.98	0.97	0.92	0.99	0.70	3.57	0.85	0.87	0.99	0.85	0.83
	1	1.00	1.03	0.96	1.20	0.93	0.93	0.97	1.02	0.81	2.66	0.63	0.67	1.02	0.81	0.60
	2	1.00	1.05	0.97	1.16	0.95	0.95	1.01	1.05	0.91	1.87	0.43	0.48	1.05	0.91	0.39
	10	1.00	1.02	0.99	1.06	1.00	1.00	1.02	1.03	1.00	1.07	0.15	0.21	1.03	1.00	0.10
99.8	0.1	1.00	1.03	0.97	1.10	1.01	1.01	0.73	0.81	0.46	0.00	1.01	1.01	1.01	1.01	1.00
	0.5	1.00	1.07	0.95	1.33	1.05	1.04	1.00	1.07	0.76	0.00	0.91	0.94	1.07	0.91	0.88
	1	1.00	1.08	0.94	1.28	0.99	0.99	1.04	1.09	0.87	0.00	0.68	0.71	1.09	0.87	0.64
	2	1.00	1.04	0.97	1.20	0.98	0.98	1.05	1.08	0.94	0.00	0.45	0.49	1.08	0.94	0.40
	10	1.00	1.01	0.97	1.06	1.00	1.00	1.02	1.03	0.99	0.00	0.15	0.21	1.03	0.99	0.10
98	0.1	1.00	1.02	0.98	1.08	1.00	0.99	0.88	0.98	0.54	2.11	0.99	1.00	1.00	0.99	0.98
	0.5	1.00	1.02	0.98	1.32	1.07	1.02	1.14	1.24	0.84	1.98	0.92	0.96	1.24	0.92	0.88
	1	1.00	1.03	0.98	1.32	1.06	1.00	1.18	1.26	0.96	1.63	0.72	0.78	1.26	0.96	0.66
	2	1.00	1.04	0.96	1.20	1.02	0.94	1.12	1.17	0.98	1.25	0.47	0.54	1.17	0.98	0.40
	10	1.00	1.03	0.97	1.05	1.00	0.92	1.03	1.04	1.00	1.01	0.18	0.26	1.04	1.00	0.10
Correlation coefficient							-0.01									

Table C11: Comparison of modelled concentrations, ppb: Manchester Piccadilly sulphur dioxide: 100 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	95	0	0	105	96	96	26	24	17	147	95	95	95	95	95	9
	0.5	95	0	0	143	108	108	64	62	55	155	96	97	97	96	95	47
	1	136	0	0	190	137	138	111	110	102	177	97	99	110	102	95	94
	2	231	0	0	285	217	217	206	205	197	244	99	103	205	197	95	188
	10	991	0	0	1045	961	962	966	965	957	968	114	134	965	957	95	941
99.9	0.1	79	84	74	87	80	80	24	23	15	91	79	79	79	79	79	10
	0.5	81	90	77	119	90	90	56	54	47	100	80	81	81	80	79	48
	1	94	104	91	158	115	115	95	94	86	122	81	83	94	86	79	96
	2	166	185	159	237	181	182	174	173	165	186	83	87	173	165	79	193
	10	797	886	735	869	801	801	806	805	797	802	99	119	805	797	79	964
99.8	0.1	71	77	60	78	72	72	23	22	14	0	71	71	71	71	71	9
	0.5	74	79	63	107	81	81	52	50	43	0	72	73	73	72	71	47
	1	86	91	81	142	103	104	87	86	78	0	73	75	86	78	71	95
	2	151	159	143	213	163	164	158	157	149	0	75	79	157	149	71	189
	10	716	765	676	781	720	721	726	725	717	0	90	110	725	717	71	945
98	0.1	32	34	31	35	32	32	19	18	11	35	32	32	32	32	32	8
	0.5	34	36	33	48	37	36	32	31	23	40	33	34	34	33	32	39
	1	44	46	43	64	48	47	48	47	39	50	34	35	47	39	32	77
	2	71	74	68	96	76	73	80	79	71	77	35	38	79	71	32	154
	10	326	343	309	352	328	313	336	335	327	329	48	64	335	327	32	771

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.01	0.27	0.25	0.18	1.55	1.00	1.00	1.00	1.00	1.00
	0.5	1	0.00	0.00	1.50	1.13	1.14	0.67	0.65	0.58	1.63	1.01	1.02	1.02	1.01	1.00
	1	1	0.00	0.00	1.40	1.01	1.01	0.82	0.81	0.75	1.30	0.71	0.73	0.81	0.75	0.70
	2	1	0.00	0.00	1.23	0.94	0.94	0.89	0.89	0.85	1.05	0.43	0.44	0.89	0.85	0.41
	10	1	0.00	0.00	1.05	0.97	0.97	0.97	0.97	0.97	0.98	0.12	0.13	0.97	0.97	0.10
99.9	0.1	1	1.06	0.94	1.10	1.01	1.01	0.30	0.29	0.19	1.15	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.11	0.95	1.46	1.11	1.11	0.69	0.67	0.58	1.23	0.99	1.00	1.00	0.99	0.98
	1	1	1.11	0.97	1.68	1.22	1.22	1.01	1.00	0.92	1.30	0.86	0.88	1.00	0.92	0.84
	2	1	1.12	0.96	1.43	1.09	1.10	1.05	1.04	1.00	1.12	0.50	0.52	1.04	1.00	0.48
	10	1	1.11	0.92	1.09	1.00	1.01	1.01	1.01	1.00	1.01	0.12	0.15	1.01	1.00	0.10
99.8	0.1	1	1.08	0.85	1.10	1.01	1.01	0.33	0.31	0.20	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.07	0.85	1.44	1.09	1.09	0.70	0.68	0.58	0.00	0.97	0.99	0.99	0.97	0.96
	1	1	1.07	0.95	1.66	1.21	1.21	1.02	1.00	0.92	0.00	0.85	0.88	1.00	0.92	0.83
	2	1	1.05	0.95	1.41	1.08	1.08	1.04	1.04	0.99	0.00	0.50	0.52	1.04	0.99	0.47
	10	1	1.07	0.94	1.09	1.01	1.01	1.01	1.01	1.00	0.00	0.13	0.15	1.01	1.00	0.10
98	0.1	1	1.05	0.97	1.10	1.01	1.01	0.60	0.56	0.33	1.10	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.06	0.97	1.41	1.09	1.07	0.94	0.90	0.69	1.16	0.96	0.99	0.99	0.96	0.94
	1	1	1.05	0.98	1.45	1.09	1.06	1.09	1.06	0.89	1.13	0.76	0.80	1.06	0.89	0.73
	2	1	1.04	0.96	1.35	1.07	1.03	1.13	1.11	1.00	1.09	0.50	0.54	1.11	1.00	0.45
	10	1	1.05	0.95	1.08	1.01	0.96	1.03	1.03	1.00	1.01	0.15	0.20	1.03	1.00	0.10
Correlation coefficient							0.01									

Table C12: Comparison of modelled concentrations, ppb: Liverpool Centre sulphur dioxide: 100 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	200	0	0	218	199	199	44	39	30	195	198	199	199	198	198	20
	0.5	209	0	0	297	224	224	123	118	109	220	200	202	202	200	198	98
	1	243	0	0	396	284	284	222	217	208	281	202	206	217	208	198	196
	2	421	0	0	594	449	449	420	415	406	447	206	214	415	406	198	392
	10	1983	0	0	2178	1999	1999	2004	1999	1990	1998	238	279	1999	1990	198	1961
99.9	0.1	99	121	84	109	100	100	34	29	20	120	99	99	99	99	99	12
	0.5	106	121	93	149	112	113	74	69	59	131	100	101	101	100	99	60
	1	125	175	115	198	144	144	123	118	109	158	101	104	118	109	99	121
	2	223	234	195	297	227	228	222	217	208	237	104	109	217	208	99	242
	10	992	1110	918	1089	1004	1004	1014	1009	1000	1006	124	149	1009	1000	99	1208
99.8	0.1	78	93	74	86	79	79	32	27	18	0	78	78	78	78	78	10
	0.5	87	97	75	117	89	89	63	58	49	0	79	80	80	79	78	52
	1	100	109	89	156	114	114	102	97	88	0	80	82	97	88	78	104
	2	163	186	152	234	180	181	180	175	166	0	82	87	175	166	78	208
	10	782	837	725	858	793	793	804	799	790	0	99	121	799	790	78	1038
98	0.1	50	51	48	55	51	50	29	24	15	47	50	50	50	50	50	12
	0.5	51	52	49	75	58	57	49	44	35	54	51	52	52	51	50	60
	1	61	63	59	100	74	72	74	69	60	72	52	55	69	60	50	120
	2	105	110	99	150	118	113	124	119	110	116	55	60	119	110	50	241
	10	504	533	478	550	511	487	524	519	510	511	75	99	519	510	50	1205

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.09	1.00	1.00	0.22	0.20	0.15	0.98	0.99	0.99	0.99	0.99	0.99
	0.5	1	0.00	0.00	1.42	1.07	1.07	0.59	0.57	0.52	1.05	0.96	0.97	0.97	0.96	0.95
	1	1	0.00	0.00	1.63	1.17	1.17	0.91	0.89	0.85	1.16	0.83	0.85	0.89	0.85	0.81
	2	1	0.00	0.00	1.41	1.07	1.07	1.00	0.99	0.96	1.06	0.49	0.51	0.99	0.96	0.47
	10	1	0.00	0.00	1.10	1.01	1.01	1.01	1.01	1.00	1.01	0.12	0.14	1.01	1.00	0.10
99.9	0.1	1	1.22	0.85	1.10	1.01	1.01	0.34	0.30	0.20	1.21	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.14	0.88	1.40	1.06	1.06	0.69	0.65	0.56	1.23	0.95	0.96	0.96	0.95	0.93
	1	1	1.40	0.92	1.59	1.15	1.15	0.99	0.95	0.87	1.27	0.81	0.83	0.95	0.87	0.79
	2	1	1.05	0.88	1.33	1.02	1.02	1.00	0.98	0.93	1.06	0.47	0.49	0.98	0.93	0.44
	10	1	1.12	0.93	1.10	1.01	1.01	1.02	1.02	1.01	1.01	0.12	0.15	1.02	1.01	0.10
99.8	0.1	1	1.19	0.95	1.10	1.01	1.01	0.41	0.35	0.22	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.11	0.86	1.34	1.02	1.02	0.72	0.67	0.56	0.00	0.91	0.92	0.92	0.91	0.89
	1	1	1.09	0.89	1.56	1.14	1.14	1.02	0.98	0.88	0.00	0.80	0.82	0.98	0.88	0.78
	2	1	1.14	0.93	1.44	1.11	1.11	1.10	1.08	1.02	0.00	0.50	0.53	1.08	1.02	0.48
	10	1	1.07	0.93	1.10	1.01	1.01	1.03	1.02	1.01	0.00	0.13	0.15	1.02	1.01	0.10
98	0.1	1	1.02	0.96	1.10	1.01	1.01	0.58	0.49	0.29	0.93	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.02	0.96	1.47	1.13	1.11	0.96	0.87	0.68	1.07	1.00	1.03	1.03	1.00	0.98
	1	1	1.04	0.98	1.65	1.23	1.19	1.22	1.14	0.98	1.19	0.87	0.91	1.14	0.98	0.82
	2	1	1.05	0.94	1.43	1.13	1.08	1.19	1.14	1.05	1.11	0.53	0.57	1.14	1.05	0.48
	10	1	1.06	0.95	1.09	1.02	0.97	1.04	1.03	1.01	1.01	0.15	0.20	1.03	1.01	0.10
Correlation coefficient							0.00									

Table C13: Comparison of modelled concentrations, ppb: Manchester Town Hall oxides of nitrogen: 100 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	795	0	0	875	801	798	176	181	130	1024	797	798	798	797	795	56
	0.5	795	0	0	1193	899	885	494	499	448	1102	803	810	810	803	795	281
	1	858	0	0	1590	1144	1123	891	897	846	1309	810	826	897	846	795	562
	2	1653	0	0	2385	1809	1783	1686	1692	1641	1917	826	857	1692	1641	795	1124
	10	8013	0	0	8745	8036	8007	8046	8052	8001	8061	949	1103	8052	8001	795	5620
99.9	0.1	572	622	462	629	576	574	153	159	108	631	573	575	575	573	572	50
	0.5	572	622	462	858	649	639	382	388	337	698	579	586	586	579	572	248
	1	663	722	624	1144	828	813	668	674	623	867	586	599	674	623	572	496
	2	1189	1335	1126	1716	1311	1292	1240	1246	1195	1335	599	626	1246	1195	572	992
	10	5765	6509	5200	6292	5795	5775	5816	5822	5771	5801	708	843	5822	5771	572	4958
99.8	0.1	451	523	413	496	455	453	141	147	96	0	452	454	454	452	451	46
	0.5	451	523	416	677	513	506	322	327	276	0	457	464	464	457	451	232
	1	587	615	547	902	657	645	547	553	502	0	464	476	553	502	451	464
	2	963	1071	902	1353	1040	1026	998	1004	953	0	476	502	1004	953	451	928
	10	4544	5194	4354	4961	4579	4564	4606	4612	4561	0	578	705	4612	4561	451	4638
98	0.1	196	207	188	216	198	196	116	122	71	244	197	198	198	197	196	36
	0.5	214	225	204	294	228	220	194	200	149	268	201	206	206	201	196	179
	1	284	293	275	392	297	282	292	298	247	328	206	216	298	247	196	358
	2	454	473	429	588	470	445	488	494	443	489	216	235	494	443	196	716
	10	1999	2175	1813	2156	2017	1913	2056	2062	2011	2021	294	392	2062	2011	196	3580

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.00	0.22	0.23	0.16	1.29	1.00	1.00	1.00	1.00	1.00
	0.5	1	0.00	0.00	1.50	1.13	1.11	0.62	0.63	0.56	1.39	1.01	1.02	1.02	1.01	1.00
	1	1	0.00	0.00	1.85	1.33	1.31	1.04	1.05	0.99	1.53	0.94	0.96	1.05	0.99	0.93
	2	1	0.00	0.00	1.44	1.09	1.08	1.02	1.02	0.99	1.16	0.50	0.52	1.02	0.99	0.48
	10	1	0.00	0.00	1.09	1.00	1.00	1.00	1.00	1.00	1.01	0.12	0.14	1.00	1.00	0.10
99.9	0.1	1	1.09	0.81	1.10	1.01	1.00	0.27	0.28	0.19	1.10	1.00	1.00	1.00	1.00	1.00
	0.5	1	1.09	0.81	1.50	1.13	1.12	0.67	0.68	0.59	1.22	1.01	1.02	1.02	1.01	1.00
	1	1	1.09	0.94	1.72	1.25	1.23	1.01	1.02	0.94	1.31	0.88	0.90	1.02	0.94	0.86
	2	1	1.12	0.95	1.44	1.10	1.09	1.04	1.05	1.01	1.12	0.50	0.53	1.05	1.01	0.48
	10	1	1.13	0.90	1.09	1.01	1.00	1.01	1.01	1.00	1.01	0.12	0.15	1.01	1.00	0.10
99.8	0.1	1	1.16	0.92	1.10	1.01	1.00	0.31	0.33	0.21	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.16	0.92	1.50	1.14	1.12	0.71	0.73	0.61	0.00	1.01	1.03	1.03	1.01	1.00
	1	1	1.05	0.93	1.54	1.12	1.10	0.93	0.94	0.86	0.00	0.79	0.81	0.94	0.86	0.77
	2	1	1.11	0.94	1.41	1.08	1.07	1.04	1.04	0.99	0.00	0.49	0.52	1.04	0.99	0.47
	10	1	1.14	0.96	1.09	1.01	1.00	1.01	1.02	1.00	0.00	0.13	0.16	1.02	1.00	0.10
98	0.1	1	1.06	0.96	1.10	1.01	1.00	0.59	0.62	0.36	1.24	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.05	0.95	1.37	1.07	1.03	0.91	0.93	0.70	1.25	0.94	0.96	0.96	0.94	0.92
	1	1	1.03	0.97	1.38	1.05	1.00	1.03	1.05	0.87	1.15	0.73	0.76	1.05	0.87	0.69
	2	1	1.04	0.94	1.30	1.04	0.98	1.07	1.09	0.98	1.08	0.47	0.52	1.09	0.98	0.43
	10	1	1.09	0.91	1.08	1.01	0.96	1.03	1.03	1.01	1.01	0.15	0.20	1.03	1.01	0.10
Correlation coefficient							-0.04									

Table C14: Comparison of modelled concentrations, ppb: Liverpool Centre oxides of nitrogen: 100 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	518	0	0	570	522	517	160	153	102	1011	519	520	520	519	518	37
	0.5	518	0	0	777	588	566	367	360	309	1047	523	528	528	523	518	183
	1	571	0	0	1036	751	718	626	619	568	1145	528	538	619	568	518	366
	2	1070	0	0	1554	1189	1148	1144	1137	1086	1467	538	558	1137	1086	518	732
	10	5214	0	0	5698	5252	5208	5288	5281	5230	5320	618	718	5281	5230	518	3662
99.9	0.1	393	465	358	432	396	392	147	140	90	623	394	395	395	394	393	34
	0.5	393	465	358	590	448	432	305	297	247	657	398	402	402	398	393	170
	1	475	504	434	786	574	550	501	494	443	747	402	412	494	443	393	341
	2	816	924	749	1179	909	880	894	887	836	1025	412	430	887	836	393	681
	10	3941	4478	3555	4323	3996	3964	4038	4031	3980	4023	486	579	4031	3980	393	3407
99.8	0.1	355	370	312	391	358	355	144	136	86	0	356	357	357	356	355	37
	0.5	355	370	320	533	405	391	286	278	228	0	360	365	365	360	355	183
	1	430	470	393	710	521	499	463	456	405	0	365	375	456	405	355	365
	2	734	853	705	1065	825	798	818	811	760	0	375	395	811	760	355	730
	10	3567	4074	3417	3905	3614	3585	3658	3651	3600	0	455	555	3651	3600	355	3651
98	0.1	175	185	170	193	177	175	126	118	68	241	176	177	177	176	175	32
	0.5	184	191	176	263	205	194	196	188	138	261	179	184	188	179	175	160
	1	241	249	234	350	267	249	283	276	225	311	184	192	276	225	175	320
	2	386	418	361	525	423	394	458	451	400	450	192	210	451	400	175	639
	10	1785	1941	1611	1925	1805	1706	1858	1851	1800	1811	262	350	1851	1800	175	3196

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1	0.00	0.00	1.10	1.01	1.00	0.31	0.29	0.20	1.95	1.00	1.00	1.00	1.00	1.00
	0.5	1	0.00	0.00	1.50	1.13	1.09	0.71	0.69	0.60	2.02	1.01	1.02	1.02	1.01	1.00
	1	1	0.00	0.00	1.81	1.31	1.26	1.10	1.08	0.99	2.00	0.92	0.94	1.08	0.99	0.91
	2	1	0.00	0.00	1.45	1.11	1.07	1.07	1.06	1.02	1.37	0.50	0.52	1.06	1.02	0.48
	10	1	0.00	0.00	1.09	1.01	1.00	1.01	1.01	1.00	1.02	0.12	0.14	1.01	1.00	0.10
99.9	0.1	1	1.18	0.91	1.10	1.01	1.00	0.37	0.36	0.23	1.58	1.00	1.00	1.00	1.00	1.00
	0.5	1	1.18	0.91	1.50	1.14	1.10	0.77	0.76	0.63	1.67	1.01	1.02	1.02	1.01	1.00
	1	1	1.06	0.91	1.66	1.21	1.16	1.06	1.04	0.93	1.57	0.85	0.87	1.04	0.93	0.83
	2	1	1.13	0.92	1.45	1.11	1.08	1.10	1.09	1.03	1.26	0.50	0.53	1.09	1.03	0.48
	10	1	1.14	0.90	1.10	1.01	1.01	1.02	1.02	1.01	1.02	0.12	0.15	1.02	1.01	0.10
99.8	0.1	1	1.04	0.88	1.10	1.01	1.00	0.40	0.38	0.24	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.04	0.90	1.50	1.14	1.10	0.80	0.78	0.64	0.00	1.01	1.03	1.03	1.01	1.00
	1	1	1.09	0.91	1.65	1.21	1.16	1.08	1.06	0.94	0.00	0.85	0.87	1.06	0.94	0.83
	2	1	1.16	0.96	1.45	1.12	1.09	1.11	1.10	1.04	0.00	0.51	0.54	1.10	1.04	0.48
	10	1	1.14	0.96	1.09	1.01	1.01	1.03	1.02	1.01	0.00	0.13	0.16	1.02	1.01	0.10
98	0.1	1	1.06	0.97	1.10	1.01	1.00	0.72	0.68	0.39	1.38	1.00	1.01	1.01	1.00	1.00
	0.5	1	1.04	0.96	1.43	1.11	1.05	1.06	1.02	0.75	1.42	0.97	1.00	1.02	0.97	0.95
	1	1	1.03	0.97	1.45	1.11	1.03	1.17	1.14	0.94	1.29	0.76	0.80	1.14	0.94	0.73
	2	1	1.08	0.94	1.36	1.10	1.02	1.19	1.17	1.04	1.17	0.50	0.54	1.17	1.04	0.45
	10	1	1.09	0.90	1.08	1.01	0.96	1.04	1.04	1.01	1.01	0.15	0.20	1.04	1.01	0.10
Correlation coefficient							-0.09									

Table C15: Comparison of modelled concentrations, ppb: Liverpool Centre nitrogen dioxide: 100 m stack: Receptor at location of highest annual 98th percentile

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background	Emission rate
100	0.1	79	0	0	87	80	79	50	56	32	479	79	79	79	79	79	6
	0.5	91	0	0	119	92	89	82	87	63	481	80	81	87	80	79	28
	1	121	0	0	158	121	116	121	127	103	486	81	82	127	103	79	56
	2	184	0	0	237	191	186	200	206	182	507	82	85	206	182	79	112
	10	810	0	0	869	816	811	832	838	814	937	94	110	838	814	79	558
99.9	0.1	69	74	68	76	70	69	49	55	31	294	69	69	69	69	69	6
	0.5	74	79	69	104	81	78	77	82	58	297	70	71	82	70	69	30
	1	91	110	80	138	107	103	111	117	93	304	71	72	117	93	69	60
	2	163	189	144	207	169	165	180	186	162	329	72	76	186	162	69	120
	10	705	809	641	759	715	711	732	738	714	766	85	102	738	714	69	598
99.8	0.1	67	69	65	74	68	67	49	55	31	0	67	67	67	67	67	7
	0.5	69	73	67	101	79	76	76	81	57	0	68	69	81	68	67	34
	1	87	97	82	134	104	100	109	115	91	0	69	71	115	91	67	69
	2	153	169	144	201	165	161	176	182	158	0	71	75	182	158	67	138
	10	681	796	658	737	695	691	712	718	694	0	86	105	718	694	67	689
98	0.1	53	54	53	58	54	53	47	53	29	114	53	54	54	53	53	10
	0.5	55	56	54	80	64	61	69	74	50	118	54	56	74	54	53	48
	1	69	73	67	106	85	80	95	101	77	129	56	58	101	77	53	97
	2	120	131	112	159	134	126	148	154	130	164	58	64	154	130	53	194
	10	546	595	495	583	555	526	572	578	554	562	79	106	578	554	53	968

Percentile	Stack weighting	Actual	Lower	Upper	A	B	C	D	E	F	G	H	I	J	K	Background
100	0.1	1.00	0.00	0.00	1.10	1.01	1.00	0.63	0.71	0.40	6.06	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	0.00	0.00	1.31	1.01	0.98	0.90	0.96	0.70	5.30	0.88	0.89	0.96	0.88	0.87
	1	1.00	0.00	0.00	1.31	1.00	0.96	1.00	1.05	0.85	4.03	0.67	0.68	1.05	0.85	0.66
	2	1.00	0.00	0.00	1.29	1.04	1.01	1.09	1.12	0.99	2.75	0.45	0.46	1.12	0.99	0.43
	10	1.00	0.00	0.00	1.07	1.01	1.00	1.03	1.03	1.00	1.16	0.12	0.14	1.03	1.00	0.10
99.9	0.1	1.00	1.07	0.99	1.10	1.01	1.00	0.71	0.79	0.45	4.27	1.00	1.00	1.00	1.00	1.00
	0.5	1.00	1.07	0.93	1.40	1.09	1.06	1.03	1.11	0.79	4.01	0.94	0.95	1.11	0.94	0.93
	1	1.00	1.21	0.88	1.52	1.17	1.13	1.22	1.29	1.02	3.35	0.78	0.80	1.29	1.02	0.76
	2	1.00	1.16	0.88	1.27	1.04	1.01	1.11	1.14	0.99	2.02	0.44	0.46	1.14	0.99	0.42
	10	1.00	1.15	0.91	1.08	1.01	1.01	1.04	1.05	1.01	1.09	0.12	0.14	1.05	1.01	0.10
99.8	0.1	1.00	1.03	0.97	1.10	1.01	1.00	0.73	0.81	0.46	0.00	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.06	0.97	1.46	1.14	1.11	1.09	1.18	0.83	0.00	0.98	1.00	1.18	0.98	0.97
	1	1.00	1.11	0.95	1.54	1.19	1.15	1.25	1.32	1.04	0.00	0.79	0.81	1.32	1.04	0.77
	2	1.00	1.11	0.94	1.31	1.08	1.05	1.15	1.19	1.03	0.00	0.46	0.49	1.19	1.03	0.44
	10	1.00	1.17	0.97	1.08	1.02	1.02	1.05	1.05	1.02	0.00	0.13	0.15	1.05	1.02	0.10
98	0.1	1.00	1.02	1.00	1.10	1.01	1.00	0.89	1.00	0.55	2.15	1.00	1.01	1.01	1.00	1.00
	0.5	1.00	1.02	0.99	1.45	1.16	1.10	1.25	1.35	0.92	2.15	0.99	1.01	1.35	0.99	0.96
	1	1.00	1.05	0.96	1.53	1.22	1.15	1.37	1.45	1.11	1.86	0.80	0.84	1.45	1.11	0.76
	2	1.00	1.09	0.93	1.33	1.12	1.05	1.24	1.28	1.08	1.37	0.49	0.53	1.28	1.08	0.44
	10	1.00	1.09	0.91	1.07	1.02	0.96	1.05	1.06	1.02	1.03	0.15	0.19	1.06	1.02	0.10
Correlation coefficient							-0.09									

Appendix D
Nitrogen dioxide concentrations at the location of the largest annual maximum concentrations taking account background ozone

In the following tables concentrations are in ppb and emission rates in g/s.

Table D1: Comparison of modelled nitrogen dioxide concentrations, ppb: 50 m stack at location of maximum hourly oxides of nitrogen

Percentile	Stack weighting	Actual	Lower	Upper	M	N	O	P	Q	R	S	T	U	V	Background	Emission rate
100	0.1	79	0	0	87	49	56	32	79	79	79	79	80	80	79	1
	0.5	79	0	0	119	81	87	63	79	87	79	79	92	88	79	6
	1	84	0	0	158	120	127	103	79	127	79	103	120	89	79	12
	2	106	0	0	164	126	133	109	80	133	79	109	125	91	79	23
	10	116	0	0	196	158	164	140	82	164	81	140	153	114	79	116
99.9	0.1	69	74	68	76	48	55	31	69	69	69	69	70	70	69	3
	0.5	71	74	69	104	76	82	58	69	82	69	69	81	80	69	14
	1	71	74	69	138	110	117	93	70	117	69	93	106	81	69	28
	2	73	76	69	146	118	125	101	71	125	70	101	113	83	69	56
	10	101	117	81	174	146	152	128	77	152	73	128	138	104	69	279
99.8	0.1	67	69	65	74	48	55	31	67	67	67	67	68	68	67	5
	0.5	67	69	66	101	75	81	57	68	81	67	67	79	78	67	25
	1	68	70	66	133	107	114	90	68	114	68	90	103	79	67	50
	2	69	74	67	137	111	118	94	70	118	68	94	106	82	67	99
	10	94	117	77	164	138	144	120	80	144	74	120	130	103	67	495

Percentile	Stack weighting	Actual	Lower	Upper	M	N	O	P	Q	R	S	T	U	V	Background
100	0.1	1.00	0.00	0.00	1.10	0.62	0.71	0.40	1.00	1.00	1.00	1.00	1.01	1.01	1.00
	0.5	1.00	0.00	0.00	1.50	1.02	1.11	0.80	1.00	1.11	1.00	1.00	1.16	1.12	1.00
	1	1.00	0.00	0.00	1.88	1.43	1.51	1.22	0.94	1.51	0.94	1.22	1.43	1.06	0.94
	2	1.00	0.00	0.00	1.54	1.18	1.25	1.02	0.75	1.25	0.75	1.02	1.18	0.86	0.74
	10	1.00	0.00	0.00	1.69	1.36	1.42	1.22	0.71	1.42	0.70	1.22	1.32	0.98	0.68
99.9	0.1	1.00	1.07	0.99	1.10	0.69	0.79	0.45	1.00	1.00	1.00	1.00	1.01	1.01	1.00
	0.5	1.00	1.05	0.98	1.46	1.07	1.16	0.83	0.98	1.16	0.98	0.98	1.14	1.13	0.98
	1	1.00	1.04	0.97	1.94	1.55	1.65	1.31	0.98	1.65	0.98	1.31	1.50	1.14	0.97
	2	1.00	1.04	0.95	2.00	1.62	1.71	1.38	0.97	1.71	0.96	1.38	1.55	1.14	0.95
	10	1.00	1.16	0.80	1.72	1.44	1.51	1.27	0.76	1.51	0.72	1.27	1.37	1.03	0.68
99.8	0.1	1.00	1.03	0.97	1.10	0.71	0.81	0.46	1.00	1.00	1.00	1.00	1.01	1.01	1.00
	0.5	1.00	1.03	0.98	1.50	1.11	1.21	0.86	1.01	1.21	1.00	1.00	1.17	1.17	1.00
	1	1.00	1.03	0.97	1.96	1.58	1.68	1.33	1.01	1.68	1.00	1.33	1.52	1.17	0.99
	2	1.00	1.07	0.97	1.98	1.60	1.70	1.36	1.01	1.70	0.99	1.36	1.54	1.18	0.97
	10	1.00	1.24	0.82	1.74	1.46	1.53	1.28	0.86	1.53	0.78	1.28	1.38	1.09	0.71

Table D2: Comparison of modelled nitrogen dioxide concentrations, ppb: 25 m stack at location of maximum hourly oxides of nitrogen

Percentile	Stack weighting	Actual	Lower	Upper	M	N	O	P	Q	R	S	T	U	V	Background	Emission rate
100	0.1	81	0	0	87	49	56	32	79	79	79	79	80	80	79	1
	0.5	99	0	0	119	81	87	63	80	87	80	80	92	88	79	4
	1	114	0	0	158	120	127	103	81	127	80	103	120	90	79	7
	2	117	0	0	164	126	133	109	83	133	81	109	125	92	79	14
	10	143	0	0	196	158	164	140	99	164	89	140	154	116	79	72
99.9	0.1	70	74	68	76	48	55	31	69	69	69	69	70	70	69	1
	0.5	73	78	70	104	76	82	58	70	82	70	70	81	80	69	4
	1	80	85	76	138	110	117	93	71	117	70	93	107	81	69	8
	2	90	100	83	146	118	125	101	74	125	71	101	113	84	69	17
	10	104	127	99	174	146	152	128	93	152	81	128	139	106	69	83
99.8	0.1	68	69	65	74	48	55	31	67	67	67	67	68	68	67	1
	0.5	71	74	69	101	75	81	57	69	81	68	68	79	78	67	6
	1	79	84	74	133	107	114	90	71	114	69	90	103	80	67	13
	2	85	90	83	137	111	118	94	74	118	71	94	106	82	67	25
	10	100	110	97	164	138	144	120	100	144	84	120	131	105	67	125

Percentile	Stack weighting	Actual	Lower	Upper	M	N	O	P	Q	R	S	T	U	V	Background
100	0.1	1.00	0.00	0.00	1.07	0.60	0.68	0.39	0.97	0.97	0.97	0.97	0.98	0.98	0.97
	0.5	1.00	0.00	0.00	1.20	0.81	0.88	0.64	0.81	0.88	0.80	0.80	0.93	0.89	0.80
	1	1.00	0.00	0.00	1.38	1.05	1.11	0.90	0.71	1.11	0.70	0.90	1.05	0.78	0.69
	2	1.00	0.00	0.00	1.40	1.07	1.13	0.93	0.71	1.13	0.69	0.93	1.07	0.79	0.67
	10	1.00	0.00	0.00	1.37	1.10	1.15	0.98	0.70	1.15	0.62	0.98	1.07	0.81	0.55
99.9	0.1	1.00	1.06	0.97	1.08	0.68	0.78	0.44	0.99	0.99	0.99	0.99	0.99	0.99	0.99
	0.5	1.00	1.07	0.95	1.41	1.03	1.12	0.79	0.96	1.12	0.95	0.95	1.10	1.09	0.94
	1	1.00	1.06	0.95	1.72	1.37	1.46	1.16	0.89	1.46	0.88	1.16	1.33	1.01	0.86
	2	1.00	1.10	0.92	1.62	1.31	1.38	1.12	0.82	1.38	0.79	1.12	1.26	0.93	0.76
	10	1.00	1.22	0.96	1.67	1.40	1.47	1.24	0.89	1.47	0.78	1.24	1.34	1.02	0.66
99.8	0.1	1.00	1.02	0.96	1.09	0.70	0.80	0.45	0.99	0.99	0.99	0.99	1.00	1.00	0.99
	0.5	1.00	1.04	0.97	1.41	1.04	1.14	0.81	0.96	1.14	0.95	0.95	1.11	1.10	0.94
	1	1.00	1.07	0.94	1.69	1.36	1.45	1.14	0.89	1.45	0.87	1.14	1.31	1.01	0.85
	2	1.00	1.05	0.97	1.60	1.30	1.38	1.10	0.87	1.38	0.83	1.10	1.25	0.97	0.79
	10	1.00	1.10	0.97	1.63	1.37	1.44	1.20	1.00	1.44	0.83	1.20	1.31	1.05	0.67

Table D3: Comparison of modelled nitrogen dioxide concentrations, ppb: 100 m stack at location of maximum hourly oxides of nitrogen

Percentile	Stack weighting	Actual	Lower	Upper	M	N	O	P	Q	R	S	T	U	V	Background	Emission rate
100	0.1	79	0	0	87	49	56	32	79	79	79	79	80	80	79	3
	0.5	79	0	0	119	81	87	63	79	87	79	79	92	88	79	13
	1	79	0	0	158	120	127	103	79	127	79	103	120	89	79	26
	2	79	0	0	164	126	133	109	79	133	79	109	125	91	79	52
	10	87	0	0	196	158	164	140	80	164	80	140	153	113	79	258
99.9	0.1	70	74	68	76	48	55	31	69	69	69	69	70	70	69	14
	0.5	70	74	68	104	76	82	58	69	82	69	69	81	80	69	68
	1	71	74	69	138	110	117	93	70	117	69	93	106	81	69	137
	2	74	80	69	146	118	125	101	70	125	70	101	113	83	69	274
	10	87	164	75	174	146	152	128	75	152	72	128	138	104	69	1370
99.8	0.1	67	69	65	74	48	55	31	67	67	67	67	68	68	67	36
	0.5	68	70	66	101	75	81	57	68	81	67	67	79	78	67	181
	1	69	73	67	133	107	114	90	68	114	68	90	103	79	67	361
	2	69	74	67	137	111	118	94	70	118	68	94	106	82	67	722
	10	94	125	77	164	138	144	120	82	144	74	120	130	103	67	3610

Percentile	Stack weighting	Actual	Lower	Upper	M	N	O	P	Q	R	S	T	U	V	Background
100	0.1	1.00	0.00	0.00	1.10	0.62	0.71	0.40	1.00	1.00	1.00	1.00	1.01	1.01	1.00
	0.5	1.00	0.00	0.00	1.50	1.02	1.11	0.80	1.00	1.11	1.00	1.00	1.16	1.12	1.00
	1	1.00	0.00	0.00	2.00	1.52	1.61	1.30	1.00	1.61	1.00	1.30	1.52	1.13	1.00
	2	1.00	0.00	0.00	2.07	1.59	1.68	1.38	1.00	1.68	1.00	1.38	1.58	1.16	1.00
	10	1.00	0.00	0.00	2.24	1.81	1.89	1.61	0.92	1.89	0.91	1.61	1.75	1.30	0.91
99.9	0.1	1.00	1.06	0.97	1.08	0.68	0.78	0.44	0.99	0.99	0.99	0.99	0.99	0.99	0.99
	0.5	1.00	1.06	0.97	1.48	1.08	1.18	0.83	0.99	1.18	0.99	0.99	1.15	1.14	0.99
	1	1.00	1.04	0.97	1.94	1.55	1.65	1.31	0.98	1.65	0.98	1.31	1.50	1.14	0.97
	2	1.00	1.09	0.93	1.97	1.59	1.69	1.36	0.95	1.69	0.94	1.36	1.53	1.12	0.93
	10	1.00	1.89	0.86	1.99	1.67	1.75	1.48	0.86	1.75	0.82	1.48	1.59	1.19	0.79
99.8	0.1	1.00	1.03	0.97	1.10	0.71	0.81	0.46	1.00	1.00	1.00	1.00	1.01	1.01	1.00
	0.5	1.00	1.03	0.97	1.48	1.10	1.20	0.84	1.00	1.20	0.99	0.99	1.16	1.15	0.99
	1	1.00	1.06	0.97	1.93	1.56	1.65	1.31	0.99	1.65	0.98	1.31	1.49	1.15	0.97
	2	1.00	1.07	0.97	1.98	1.60	1.70	1.36	1.01	1.70	0.99	1.36	1.54	1.18	0.97
	10	1.00	1.33	0.83	1.75	1.47	1.54	1.29	0.87	1.54	0.79	1.29	1.39	1.10	0.72