FIRST REVIEW OF AIR QUALITY

FOREWORD BY MRS MARIAN MUNT, ENVIRONMENT PORTFOLIO HOLDER

This Council's commitment to the environment is stated in the Performance Plan 2001 as "a district where consideration for the care and long term future of our surroundings, natural and man made, is part of every day life and decision making, ensuring that the district is a healthy and attractive place to live."

The 3rd Stage Review reports on further work, identified last year by my predecessor, Simon Bannister, in his foreword to the Stage 2 Review, primarily on sulphur dioxide emissions from shipping around the Port area. The modelling results of sulphur emissions first carried out in the Stage 2 Review have now been validated, following the setting up of a monitoring site in the Langdon Cliff area of Dover.

A decision has been made to declare an Air Quality Management Area around the Eastern Docks which follows careful analysis of monitoring results by our scientific consultants, the Environmental Research Group (Kings College, London) and efforts will now be made to reach the national targets by 2005 through implementation of action plans. I am confident that improvements can be made to air quality, learning of the close co-operation which has developed between the Environmental Health Department of Dover District Council and technical staff from the Dover Harbour Board Authority. I hope that this good working relationship can continue throughout the challenging times ahead when redevelopment and expansion of the Port is considered to be essential for future viability.

The declaration of an Air Quality Management Area gives us a good starting position to tackle issues relating to emissions from shipping, both in European and international waters, and to lobby Government to introduce legislation providing stricter controls over the burning of fossil fuels, similar to those operating in US and Baltic waters.

This report will be submitted to the Secretary of State for the Department of Food and Rural Affairs and to other stakeholders.

If you wish to make comment on any part of this report, or require further information please contact Alan Hargreaves, Environmental Services Manager at Dover District Council.

Marian Munt
Environment and Public Protection Portfolio Holder

Contents

List of Tables

List of Figures

Executive Summary

The Dover District Council is required under Part IV of the Environment Act 1995 to undertake the Local Air Quality Management (LAQM) process, through the review and assessment of air quality.

This process is to enable local authorities to appraise current and future air quality for their geographical area, against the current Air Quality Strategy (AQS) objectives, for future years. These are set out in the Air Quality Regulations 2000. If the results of this assessment are such that one or more objectives are unlikely to be met by the relevant year, the Council is then required to designate an Air Quality Management Area (AQMA) and prepare a written action plan.

The Council has previously undertaken the Stage 1 and Stage 2 review and assessment of air quality within its area. The conclusion from the Stage 2 report confirmed the likelihood that the sulphur dioxide objective would not be met in an area close to the Port of Dover. As a result the Council undertook an ongoing series of continuous measurements in line with the government's guidance. The purpose of which was to assess the current air quality arising in this area and assist with this, the Council's Stage 3 review and assessment. The measurement was also undertaken following consultation with the government's consultants.

The monitoring results confirm that on 20 occasions, during the six month study period, the 100 ppb standard for a 15 minute mean period was exceeded. The results also demonstrate that the 15 minute objective is considerably more stringent than either the 1 hour or 24 hour objectives.

No measurement is precisely accurate and therefore the uncertainty of the SO_2 measurements undertaken needs to be considered carefully. Previous work elsewhere has confirmed a 10% uncertainty for these measurements and when this is taken into account the possible under/over prediction of the measurements, is as follows: the number of occasions when 90 ppb is exceeded is 35 and the number of occasions when 110 ppb is exceeded is 17. To meet the objective the 100 ppb standard should not to be exceeded more than 35 times a year.

This consideration of the uncertainty of the SO_2 measurements indicates that there is a possibility that the 15 minute objective has already been exceeded. Conversely, it also indicates the possibility that the objective has not been breached in this 6 month study period. However on a pro-rata basis even at this lower level of uncertainty (i.e. 110ppb) there is clearly a potential that the 15 minute mean objective will be exceeded. An analysis of the frequency of occasions when the 100 ppb is being exceeded confirms that there is no specific diurnal or monthly variation.

The conclusion of the monitoring is that it is reasonable to predict that the objective will exceeded assuming that current emission and meteorological conditions remain. This conclusion thus supports the finding of the earlier Stage 2 report, which indicated the likelihood of the objective being exceeded.

The Council having satisfied itself of the likelihood of the objective being exceeded is also required to confirm whether members of the public are likely to regularly present and likely to be exposed over the 15 minute averaging period of the objective. This is confirmed from examination of the area near to the monitoring site and also from the area predicted in the Stage 2 report.

The Council is further required to identify the geographical extent of the area. The monitoring undertaken alone however does not provide this and therefore the Council has used the outcome of the Stage 2 modelling. This modelling estimated both the source strength and also the dispersion of pollutant emissions to produce pollution contours equivalent to the objective. A comparison with the monitoring site results indicates that the predictions made are below the measurement. Therefore as a precautionary approach the Council have taken the contour, which equates with the monitoring site location as the boundary of its proposed Air Quality Management Area (AQMA). This is shown in Figure 7 on page 17 of the report.

The Council will now seek to complete its consultation with the relevant statutory agencies, the Dover Harbour Board and other interested parties. Following the period for consultation the Council will designate by order an Air Quality Management Area and then proceed to Stage 4 ("further review and assessment") of the LAQM process and seek to continue working with the Dover Harbour Board to improve air quality.

1.0 Introduction

1.0.1 This report provides the final part of the three-stage review and assessment process for the Dover District Council ("the Council"), which assists with the local air quality management process, laid down by Part IV of the Environment Act 1995.

1.0.2 The purpose of the review and assessment of air quality is to enable local authorities to appraise current and future air quality for their geographical area, against the current Air Quality Strategy (AQS) objectives, for future years. These are set out in the Air Quality Regulations 2000 (see Table 1 below for sulphur dioxide only). If the results of this assessment are such that one or more objectives are unlikely to be met by the relevant year, the Council is then required to designate an Air Quality Management Area (AQMA) and prepare a written action plan.

1.0.3 The Council has followed the phased approach required by the Government and has undertaken the first and second stages of the review and assessment. The Council's Stage 2 review and assessment indicated the likelihood of an exceedence of the AQS objectives for the following pollutant only:

- *Sulphur dioxide (SO_2)*

The Stage 2 report predicted that the 15-minute SO_2 AQS objective would be exceeded in an area close to the Port in the town of Dover. Relevant exposure was also identified within this area.

Table 1 AQS Objectives for SO_2

Objective Concentration	Objective Measured as	Date to be achieved by
266µg m^{-3} (100ppb) not to be exceeded more than 35 times a year	15 minute mean	31st December 2005
350µg m^{-3} (132ppb) not to be exceeded more than 24 times a year	1 hour mean	31st December 2004
125µg m^{-3} (47ppb) not to be exceeded more than 3 times a year	24 hour mean	31st December 2004

1.1 Development of Review and Assessment

1.1.1 In the third stage of review and assessment, local authorities are expected to undertake a detailed and accurate appraisal of potential impacts. Guidance (LAQM.TG4 (00)) advises that a local authority should investigate the areas within its boundaries where there is the *likelihood* of a failure to achieve air quality objectives and the potential for exposure of individuals. The authority should also estimate the magnitude and geographical extent of such exceedences.

1.2 Exposure

1.2.1 The AQS objectives are based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS), European Union standards and WHO guidelines. These all recognise that the potential impact on human health is a crucial factor and hence it is human exposure to air pollutants in non-occupational settings that needs

assessment. The exposure of individuals to air pollution is highly complex however and dependant on many individual factors.

1.2.2 Therefore, to simplify this issue, local authorities are also required, when undertaking the stages of the review and assessment to have regard to public exposure. This relates to the averaging period of the various objectives. The following is the example quoted from Box 1.2 of TG 4 (00) for the 15 minute mean averaging period and it refers to *all locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.*

1.3 Government Guidance

1.3.1 Separate LAQM technical guidance notes have been produced, which refer to the use of detailed emission inventories, validated dispersion models, high quality continuous monitoring and pollutant specific guidance. Importantly the issue of background pollution is addressed in LAQM.TG4 (00). There is however limited Stage 3 guidance for each specific pollutant.

1.3.2 The government has highlighted that each review and assessment report is the responsibility of each individual authority, and highlighted the importance of making clear the assumptions used and also the concerns surrounding the treatment of emissions and background concentrations. QA/QC procedures should be described in detail and uncertainties in the monitoring and modelling accounted for.

1.3.3 Paragraph 2.04 of circular 15/97 also advises that the guidance is not prescriptive and that local authorities should use professional and technical judgement to decide how best to conduct an air quality review and assessment, in the light of local circumstances.

1.4 Sources of SO_2

1.4.1 SO_2 is formed by the oxidation of sulphur impurities in fuels (such as coal and heavy oils) during combustion processes. UK emissions of SO_2 are dominated by a relatively small number of large emitters such as power stations; with 65% of the total UK SO_2 emissions dominated by coal fired power stations (DETR, 2000c). However there are also significant emissions from the industrial sector, including refineries (DETR, 2000a). In comparison road transport contributes less than 2% of emissions and may generally be considered insignificant.

1.4.2 Paragraphs 7.21 and 7.23 of LAQM TG 4 (00) highlight that there is the potential for SO_2 emissions to arise from other forms of transport these include railways and shipping. In the case of shipping movements there is the potential for significant impact where there are large numbers of ships (e.g. at major ports), and there is the potential for public exposure within close proximity (within 500 metres)(DETR, 2000c). The key source of SO_2 emissions near the Port of Dover is likely to be the combustion of gas oil and bunker fuel by ship engines.

2.0 Stage 3 methodology

2.0.1 Modelling in the Council's Stage 2 Review and Assessment report (December 2000) predicted that the port area would breach the 15 minute mean AQS Objective. As a consequence of this a SO_2 analyser was installed near to Centenary Cottages on Langdon Cliff to gather continuous SO_2 measurements and permit comparison with the dispersion modelling work undertaken.

2.0.2 The relevant section of the Stage 2 report is appended as appendix 1 to this report. This details the assumptions used for the modelling undertaken. The report also incorporates comments made by the Dover Harbour Board and the DEFRA (i.e. the former DETR) in response to the Stage 2 report.

2.1 The Monitoring Site Location

2.1.1 Langdon Cliff lies at the north-east edge of the Port of Dover, which itself abuts the town of Dover. The Port of Dover serves the passenger and freight ferry industry from the Eastern Docks to the south of Langdon Cliff and cruise ships and fast passenger ferries from the Western Docks to the south west of Langdon Cliff. To the west of the Eastern Docks along the A20 is residential housing. A map of the Port of Dover is shown in Figure 1 below, the Langdon Cliff SO_2 monitoring site and the Harbour Board meteorological station are both highlighted.

2.2 Pollution Measurement

2.2.1 To assist with the interpretation of the SO_2 measurements from the Langdon Cliff site data were also used from the following KAQMN fixed sites: Folkestone Suburban, Maidstone Roadside and Sevenoaks Background. Table 2 summarises the key details for each site used in this study.

Table 2 Summary of Site Details

Code	Site Name	Start date	Location	Parameters*
ZD3	Langdon Cliff	April 2001	Langdon Cliff, Dover	SO_2
ZF1	Folkestone Suburban	July 1997	Cheriton, Folkestone	SO_2, NO_2, PM_{10}, O_3, Temperature and Pressure
ZM2	Maidstone Roadside	June 1999	Bridge Gyratory, Fairmeadow	SO_2, NO_2, PM_{10}, CO
ZV1	Sevenoaks Background	January 1998	Greatness, Sevenoaks	SO_2, NO_2, PM_{10}, O_3, CO, Wind Direction

*SO_2 - Sulphur Dioxide, NO_2 -Nitrogen Dioxide, PM_{10} - Particulates, O_3 - Ozone, CO - Carbon Monoxide

2.2.2 Continuous SO_2 measurements at each site have been undertaken using an ultra-violet fluorescence technique, which measures the secondary fluorescent radiation emitted when ambient air is exposed to ultra–violet radiation. This excites SO_2 molecules in the sample to higher but unstable excited states that decay giving rise to secondary fluorescent radiation (DETR, 2000b). The measurements are stored as 15 minute means.

2.2.3 To further aid interpretation meteorological measurements (wind direction and wind speed) have been used in this study. These have been kindly provided by the Dover Harbour Board from the equipment installed at the Prince of Wales Pier in the Western Docks of the Port of Dover (OSGB grid reference: 632647 140263 see

Figure 1) and we gratefully acknowledge this assistance. For the purposes of this study the meteorological measurements are assumed to be representative of the monitoring site.

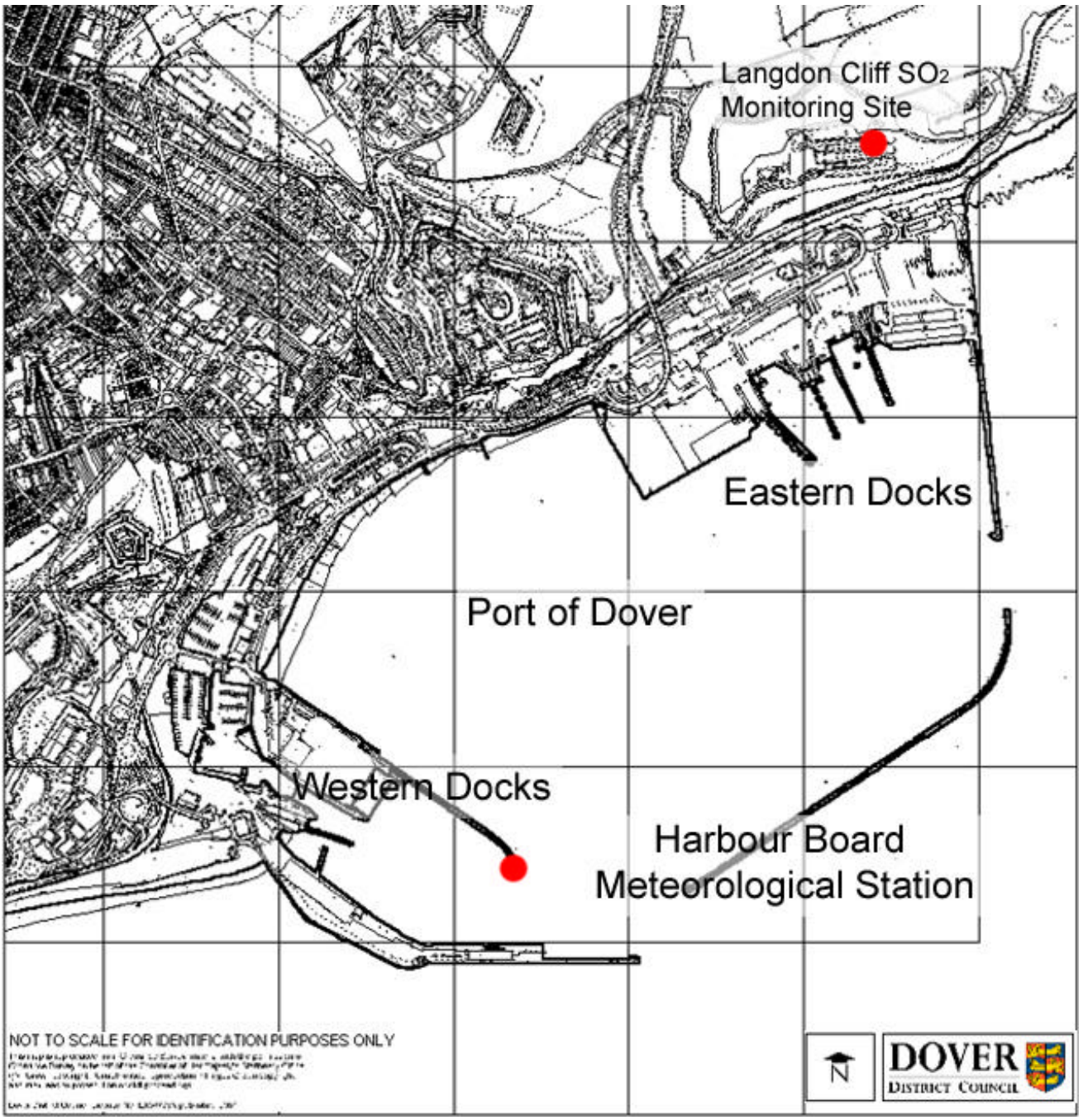


Figure 1 The area surrounding the Port of Dover.

2.3 Quality Assurance and Quality Control

2.3.1 All four sites used in this study are subjected to the rigorous QA/QC procedures used in the KAQMN, which mirror those of the UK Automatic Urban and Rural Network (UKAURN).

2.3.2 SO_2 analysers are calibrated on a fortnightly basis using SO_2 gas of known concentration traceable to National Meteorological Standards. Non-traceable SO_2 sources are used to automatically assess analyser performance on a daily basis. The permanent SO_2 analysers are subject to regular independent audit.

2.3.3 Measurements are collected frequently from each analyser and subjected to daily automatic and manual checks at least twice per day. The data capture for the Langdon Cliff site during the study period was greater than 90%. This is the recommended standard for monitoring undertaken as part of a Third Stage Review and Assessment (DETR, 2000c).

2.3.4 No scientific measurement is absolutely accurate or absolutely precise. The combination of accuracy and precision is termed the uncertainty. Estimates of uncertainty associated with air quality measurement are discussed in the 1996 LAQN Annual Report (SEIPH, 1997).

2.3.5 This suggests that a working uncertainty of 10% (2σ) should be considered when discussing high values and long-term averages of SO_2. This is justified on the basis of both mathematical modelling and equipment performance tests.

2.3.6 The uncertainty of the SO_2 measurements needs to be carefully considered when evaluating and estimating the exceedences of the AQS Objective, because the statistical distribution of the data means that a 10% uncertainty in the measurement does not imply a 10% uncertainly in the number of exceedences of the EPAQS Standard.

2.4 Data Analysis

2.4.1 Pollution measured in a particular location will be influenced by the local and distant sources. In order to study the local sources around the Langdon Cliff site it is necessary to make a best estimate of the prevailing background pollution. The background concentration may simply be subtracted from the measurements made at Langdon Cliff to calculate the contribution from local sources.

2.4.2 “Background” SO_2 concentrations in this study have been deduced by averaging the measurements from the following sites, Folkestone Suburban, Maidstone Roadside and Sevenoaks Background. This helps minimise the effects from local sources near to those sites and thus to produce a representative best estimate of the background SO_2 concentration in Kent.

2.4.3 Air pollution concentrations vary not only with changes in emissions but also with variations in meteorological conditions. An initial study of diurnal variations has been executed as a useful way to differentiate between the underlying changes in pollution emissions and changes caused by the weather.

2.4.4 Pollution roses have been used to display pollution concentration related to each wind direction. For the purposes of analysis of the study period, data have been averaged into thirty-six 10^o wind direction bins.

2.4.5 This study examines SO_2 measurements made at Langdon Cliff over a 6 month period from April to October 2001. The Review and Assessment: Pollutant Specific Guidance – LAQM.TG4 (00) (DETR, 2000c) highlights that monitoring for Stage 3 Review and Assessment should ideally be undertaken for a full year. This however was discussed with the DEFRA Helpline and it was agreed for the purposes of this Stage 3 that 6 months monitoring would be acceptable. It should also be noted that the monitoring is continuing and will be reconsidered further at the next stage of the process.

3.0 Comparison of SO_2 Measurements with the AQS Objectives

3.0.1 Table 3 below summarises how the measurements from Langdon Cliff during the 6 month study period from April to October 2001 compare to the AQS Objectives for SO_2. These figures confirm that on 20 occasions during the six month study period the 100 ppb standard was exceeded. The results also demonstrate that the 15 minute objective is considerably more stringent than either the 1 hour or 24 hour Objectives.

3.0.2 As discussed in the Section 2.3, the uncertainty of the SO_2 measurements needs to be considered carefully because a 10% uncertainty in the measurement does not imply a 10% uncertainly in the number of exceedences of the 100 ppb Standard (illustrated in Table 3). When this possible under/over prediction of the measurements is considered, the number of occasions when 90ppb is exceeded is 35 and the number of occasions when 110ppb is exceeded is 17.

3.0.3 A consideration of this uncertainty of the SO_2 measurements indicates that there is a possibility that the 15 minute objective has already been exceeded. Conversely, it also indicates the possibility that the objective has not been breached in this 6 month study period. However on a pro-rata basis even at this lower level of uncertainty (i.e. 110ppb) there is clearly a potential that the 15 minute mean AQS Objective will be exceeded.

Table 3 Comparison of the Langdon Cliff SO_2 Measurements with the AQS Objectives

AQS Objective Concentration	Number of Exceedences from Apr-Oct 2001
15 minute mean of 266µg m^{-3} (100ppb), not to be exceeded more than 35 times a year	20 (17-35)(range for 100ppb ±10%)
1 hour mean of 350µg m^{-3} (132ppb), not to be exceeded more than 24 times a year	0
24 hour mean of 125µg m^{-3} (47ppb), not to be exceeded more than 3 times a year	0

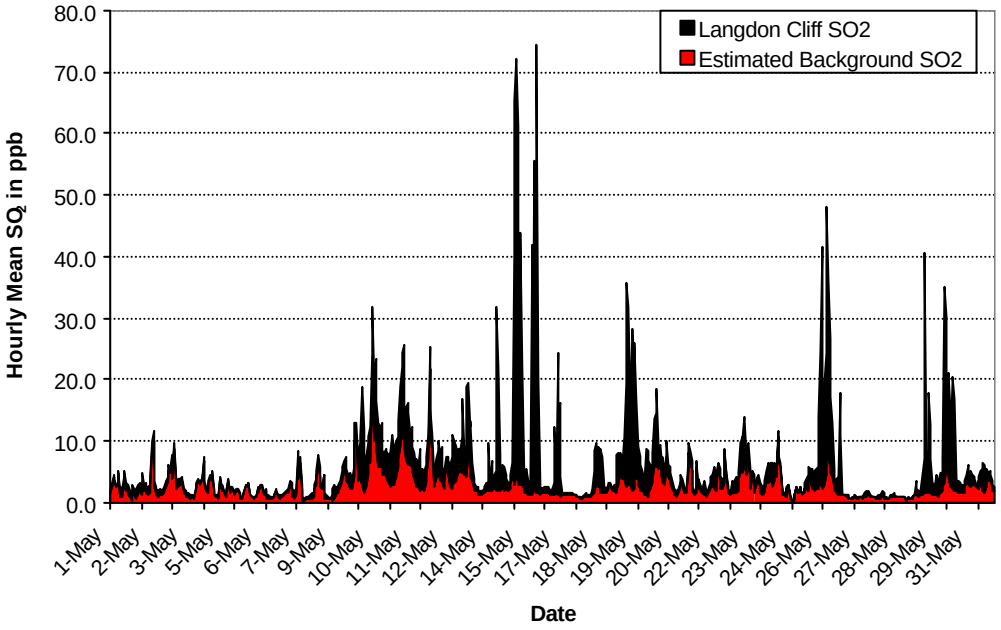
3.0.4 Table 4 overleaf lists the dates and times of the 15 minute mean SO_2 measurements greater than 90ppb at Langdon Cliff monitoring site from the beginning of April to the end of October 2001.

Table 4 The date and time of the 15 minute mean SO_2 measurements greater than 90ppb at Langdon Cliff from April to October 2001

Date Time	SO_2 >90ppb	Date Time	SO_2 >90ppb
03/04/01 22:00	98	16/06/01 04:00	94
03/04/01 22:30	123	16/06/01 09:45	102
03/04/01 22:45	136	24/06/01 12:00	115
22/04/01 14:00	93	24/06/01 12:15	131
23/04/01 16:15	91	06/07/01 12:30	93
23/04/01 16:30	92	29/07/01 00:00	135
15/05/01 09:45	99	29/07/01 04:00	92
15/05/01 10:00	134	24/08/01 08:15	131
15/05/01 12:30	108	24/08/01 08:30	111
15/05/01 13:30	115	24/08/01 09:00	97
15/05/01 14:00	93	24/08/01 09:15	143
15/05/01 14:15	137	24/08/01 09:45	95
15/05/01 14:30	182	24/08/01 10:00	117
15/05/01 15:00	91	24/08/01 22:30	170
15/05/01 15:15	125	24/08/01 22:45	103
16/05/01 08:00	119	25/08/01 02:00	92
16/05/01 08:15	91	25/08/01 02:15	118
16/06/01 03:45	91		

3.1 Time Series Analysis

3.1.1 Hourly mean analysis showed the SO_2 concentrations to be substantially elevated above estimated background concentrations. Figure 2 illustrates this for the month of May 2001, with relatively short lived SO_2 spikes at Langdon Cliff far exceeding the estimated background concentrations, observed as SO_2 emissions pass over the site. During the monitoring period at Langdon



Cliff the maximum hourly SO_2 reading was 110ppb and the maximum hourly SO_2 from estimated background SO_2 was 21ppb.

Figure 2 Time Series of hourly mean SO_2 at Langdon Cliff for May 2001 compared to the estimated background SO_2 in Kent

3.1.2 The maximum 15 minute mean SO_2 measured on Langdon Cliff during the study period was 182ppb.

3.2 Diurnal Analysis

3.2.1 Analysis of the time of day when elevated 15 minute mean SO_2 concentrations occurred over the study period is shown below in Figure 3. From this analysis it is clear that SO_2 concentrations above the estimated background levels (i.e. assumed to be above 10ppb) tend to occur between 06:00 and 17:00 hours. It should be noted that this does not coincide fully with port activity, which is constant throughout the day apart from between midnight and 3.00am. The number of readings greater than 90 ppb reflects this.

3.2.2 There appears to be no clear pattern in the time of day that SO_2 concentrations exceed 90ppb, this is evident from both Figure 3 and Table 4 above. This is because the occurrence of elevated SO_2 concentrations depends on both meteorological conditions (such as wind speed and direction) and the emissions source. (Note that between 00:30 and 01:00 hours there are no readings because an automatic zero and span calibration occurs every night at this time).

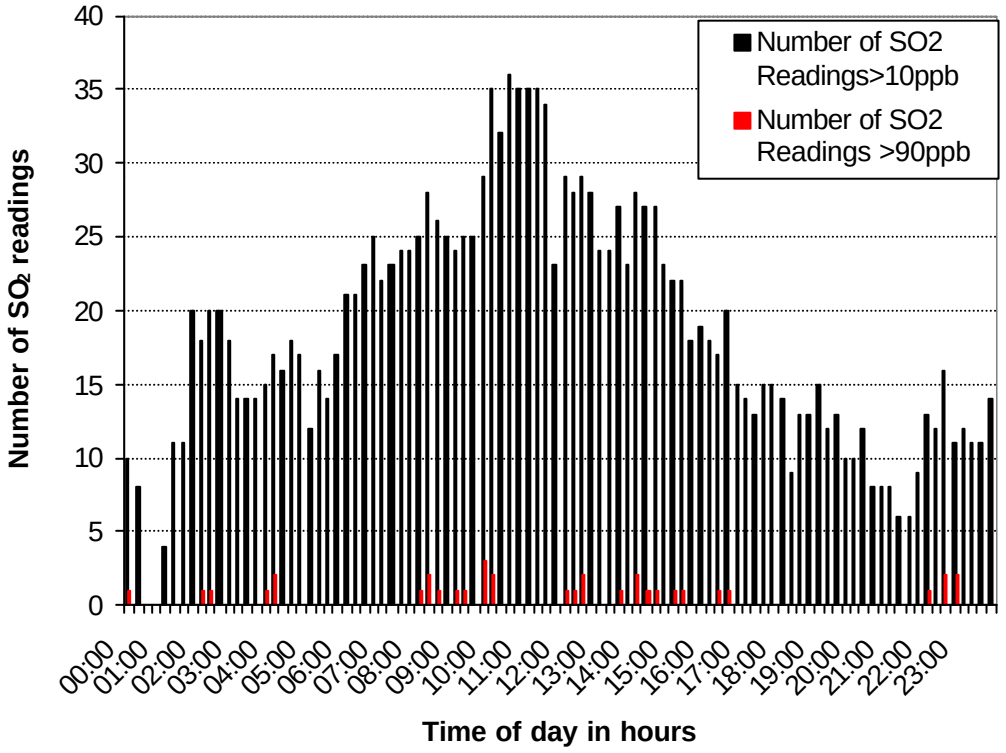


Figure 3 Number of mean SO_2 measurements over 10ppb and 90ppb for each 15 minute period over 24 hours

3.2.3 The relative increase in readings greater than 10 ppb during the day may reflect either greater general activity during the day in Dover or the effect of land and sea breezes at the monitoring site. A more detailed analysis than is necessary here would be required to confirm this aspect.

3.3 Analysis of SO_2 Peaks and Meteorological Conditions

3.3.1 The frequency of wind from each 10^o sector measured at the Harbour Board Meteorological Station during the study period is shown in Figure 4. The frequency of the wind direction needs to be considered when assessing the accuracy of the pollution roses. South westerly winds clearly dominated the study period with relatively little wind being measured from the south-east direction (100^o – 180^o).

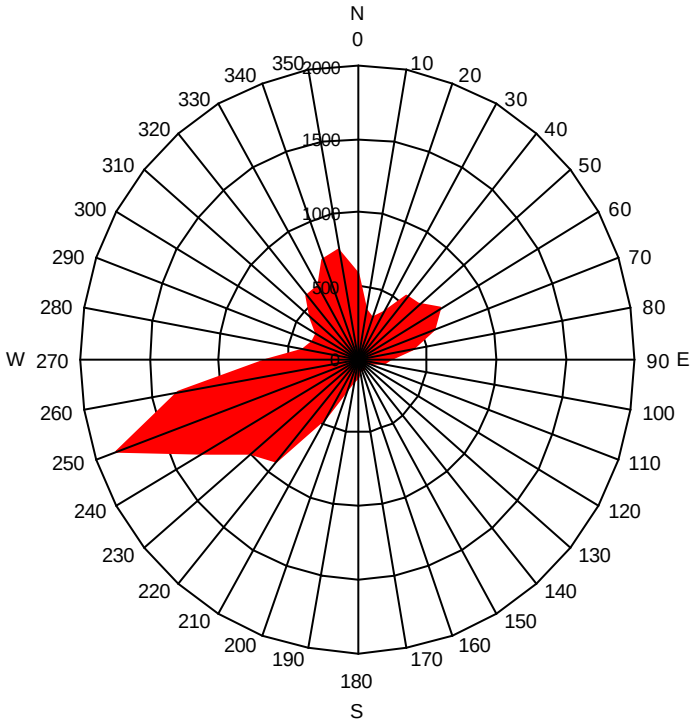


Figure 4 Frequency of wind (15 minute mean) from each 10^o sector at the Harbour Board meteorological station at Prince of Wales Pier in the Western Docks during the study period

3.3.2 The mean SO_2 measured at Langdon Cliff by wind direction measured is shown in Figure 5. The highest mean SO_2 is measured when the wind originates from directions between 180^o – 210^o. These south westerly winds pass over both the Western and Eastern Docks and produce mean SO_2 concentrations triple that when the wind blows from the north.

3.3.3 Figure 6 shows the number of SO_2 measurements above the background levels (10ppb was used in this case) by wind direction. There are only a few measurements over 10ppb when the wind direction originates from 120^o.

Figure 6 illustrates that the majority of SO_2 measurements above background levels occur when the wind originates between 180^o and 230^o.

3.3.4 Analysis of meteorological conditions when SO_2 measurements are greater than 90ppb indicated that these were most likely to occur at wind speeds between 0 and 10 m/s when the wind direction originates from the Eastern and Western Docks between 180^o and 220^o.

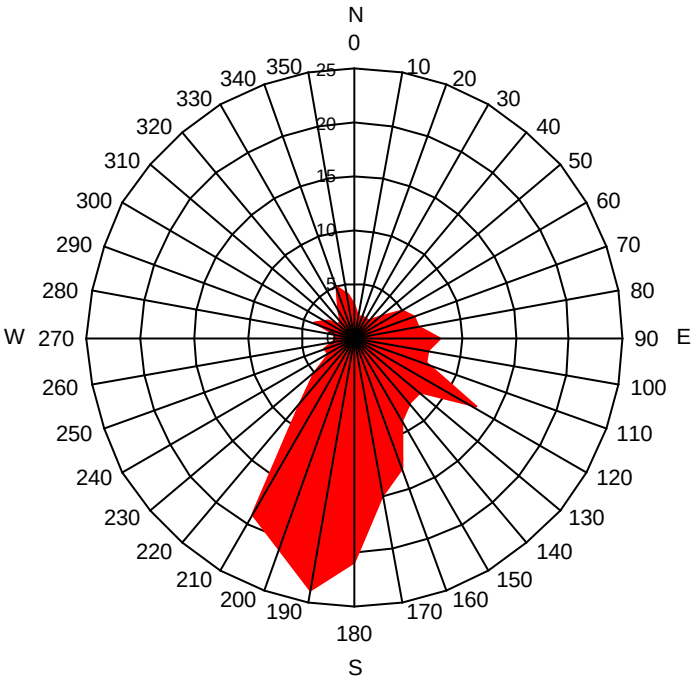


Figure 5 Mean SO_2 at Langdon Cliff by wind direction from the Harbour Board meteorological station

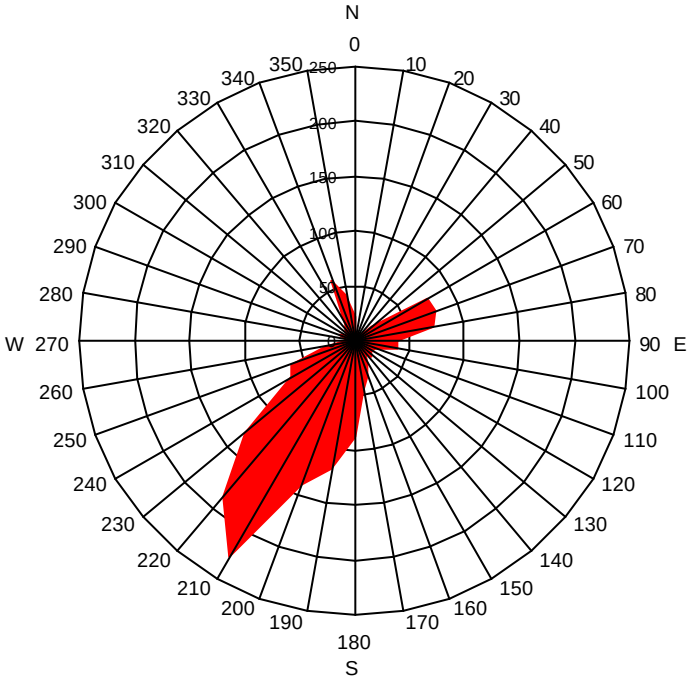


Figure 6 The number of 15 minute mean SO_2 measurements over 10ppb at Langdon Cliff by wind direction

3.4 Identification of Air Quality Management Area

3.4.1 The Council having identified the likelihood that an AQS objective will be exceeded is required to confirm that relevant exposure is likely and then designate an Air Quality Management Area (AQMA). To achieve this aim the Council has combined information from both the monitoring undertaken and the previous Stage 2 report.

3.4.2 The DEFRA guidance referred to earlier in section 1.2.2 identifies relevant exposure at all locations where members of the public might reasonably be exposed for a period of 15 minutes or longer. This therefore includes all areas where the public has access, such as public footpaths, picnic sites, as well as residential areas.

3.4.3 An examination of the area near to the monitoring site reveals that relevant exposure arises at houses close to the site and also that members of the public have access to the area nearby. Thus the possibility of relevant exposure arising is confirmed. Similarly the potential for relevant exposure was identified in the Stage 2 report (see page 23 of the appendix which identifies the area predicted to exceed).

3.4.4 The Council having confirmed relevant exposure is also required to identify the geographical extent of the possible exposure to enable it to designate an AQMA. This area cannot be determined from the monitoring results alone, since this relates to a point location only.

3.4.5 It is therefore necessary to determine an area predicted to exceed which is based on assumptions of both the emissions arising and also the dispersion of those emissions. This was previously undertaken in the Stage 2 modelling, although it should be recognized that the 15 minute AQS objective poses many challenges to air pollution modelling, as it is the most uncertain of the objectives to predict. This is further complicated by both the local topography surrounding the town of Dover and any local meteorological effects that might arise.

3.4.6 Despite these major difficulties the modelling undertaken highlighted an area where the 99.9^{th} percentile (i.e. equivalent to the AQS objective) would exceed 100 ppb. Closer examination of this area (see page 23 of the appendix and Figure 7) confirms that the monitoring site is beyond the boundary of the area predicted to exceed. In fact the monitoring site can be found at the 75 ppb contour, thus indicating that model may be under predicting, or that additional sources need to be taken into account.

3.4.7 To allow for this potential under prediction and to take a precautionary approach the Council intend to designate the AQMA based on the 75 ppb contour. This recognizes that the monitoring site is likely to exceed the objective as outlined earlier (in section 3.0).

3.4.8 An important assumption to note is that the Stage 2 modelling was based on a no change scenario in terms of emissions. This infers that SO_2 emissions will remain constant between now and the objective date (i.e. the 31 December 2005). The monitoring also clearly reflects the impact of the current emissions. The Dover Harbour Board have advised the Council in recent correspondence that there are moves afoot in the maritime industry to reduce emissions from a range of vessels, some of which may have an effect prior to 2005. These will need to be considered in the future when details become available.

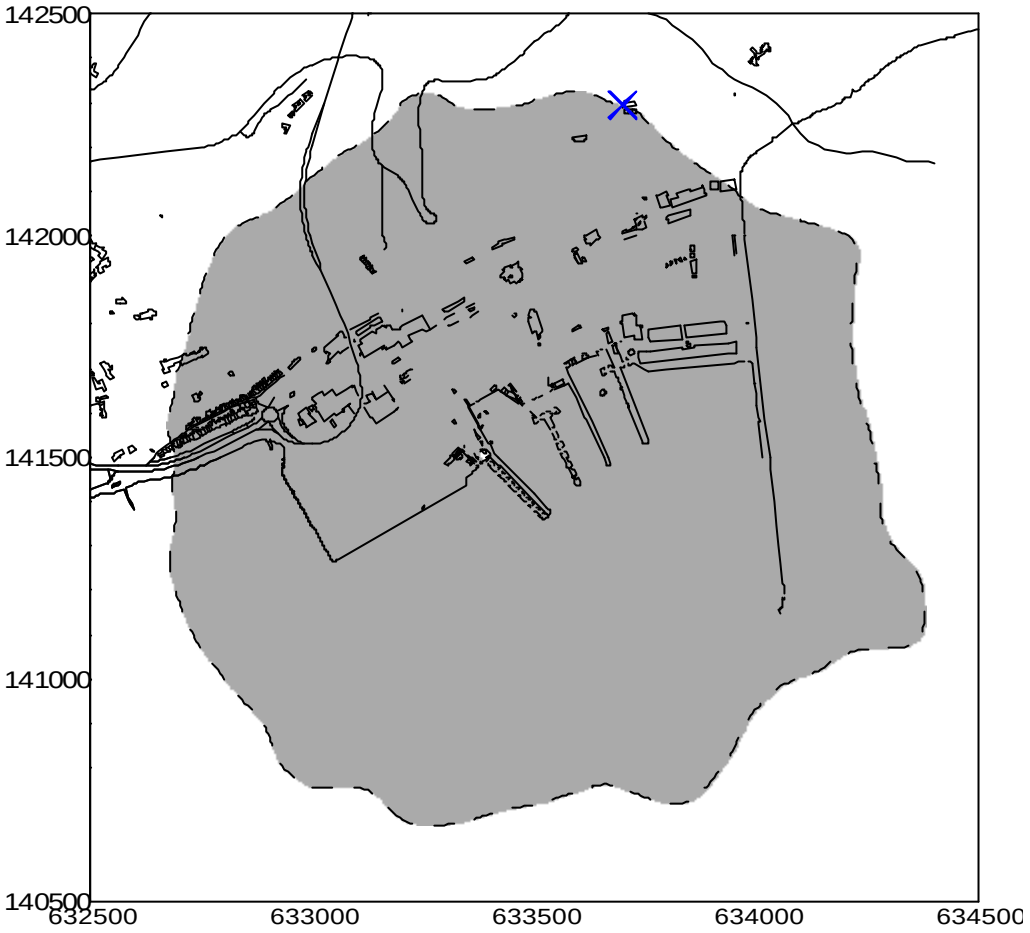


Figure 7 Proposed area of Dover AQMA (hatched)

(Note – X marks the Langdon Cliff SO_2 monitoring site)

Proposed AQMA includes:

Part of Jubilee Way
Marine Parade
Athol Terrace
Part of Langdon Cliffs
East Cliff

4.0 Conclusions

4.01 The SO_2 measurements from Langdon Cliff for 6 months (between April to October 2001) show concentrations to be substantially elevated above background levels, and identify that the 15 minute mean EPAQS Standard of 100ppb was exceeded on 20 occasions.

4.02 The 1 hour and 24 hour AQS Standards were not observed to be exceeded during the 6 month study period. (The UK Air Quality Strategy Objectives are based on the recommendations of the Expert Panel on Air Quality Standards and the requirements of the EU Air Quality Directive (96/62/EC)).

4.03 The uncertainty of the SO_2 measurements needs to be considered carefully because a 10% uncertainty in the measurement does not imply a 10% uncertainly in the number of measurements exceeding the Standard. When this possible under/over prediction of the measurements by 10% is considered, the number of occasions when 90ppb was exceeded was 35 and the number of occasions when 110ppb was exceeded was 17.

4.04 Analysis of the measurements to date indicates no clear pattern of either diurnal or monthly variation. Therefore it is reasonable to predict that the AQS Objective will not be achieved if monitoring continues for a full year assuming that current emission and meteorological conditions remain.

4.05 This finding agrees with the conclusion from the dispersion modelling undertaken in the Stage 2 Review and Assessment and confirms the prospect that the SO_2 15 minute AQS Objective will be exceeded at the end of 2005.

4.06 It is not possible to derive an area where the Objective might be exceeded from the monitoring data alone. The Stage 2 modelling however does provide a basis for this. The modelling provides a representation of both the source strength and the likely dispersion, based on an emissions scenario, where the emissions in 2005 remain as today. The predicted concentration at the monitoring site is under predicted by approximately 25% and to allow for this and to adopt a precautionary approach the Council's AQMA boundary is based on the likelihood that the Objective will be exceeded at the monitoring site (see Figure 7).

4.1 Recommendations

4.1.1 The Council will now seek to complete its consultation with the relevant statutory agencies, the Dover Harbour Board and other interested parties.

4.1.2 Following the period for consultation, which will be six weeks from the distribution of this report, the Council will designate by order an Air Quality Management Area for the area indicated in Figure 7.

4.1.3 The Council will continue to undertake measurements at the Langdon Cliff monitoring site.

4.1.4 The Council once the AQMA is designated, will then proceed to Stage 4 ("further review and assessment") of the LAQM process and seek to continue working with the Dover Harbour Board and shipping operators to improve air quality in the district of Dover.

References

Council Directive 96/62 EC (21 November, 1996) Ambient air quality assessment and management, (The Framework Directive). The Official Journal of the European Communities. En Series, L296/55.

Department of the Environment, Transport and the Regions, Scottish Executive, National Assembly for Wales, Department of the Environment in Northern Ireland (DETR, 1995). Expert Panel on Air Quality Standards – Sulphur Dioxide. TSO.

Department of the Environment, Transport and the Regions (DETR, 2000a). The Air Quality Strategy for England, Wales and Northern Ireland. HMSO.

Department of the Environment, Transport and the Regions (DETR, 2000b). Review and Assessment: Monitoring Air Quality - LAQM.TG1(00). HSMO.

Department of the Environment, Transport and the Regions (DETR, 2000c). Review and Assessment: Pollutant Specific Guidance - LAQM.TG4(00). HMSO.

Department of Environment, Food and Rural Affairs (DEFRA, 2001). The Air Quality Strategy for England, Wales and Northern Ireland: a consultation document on the proposals for air quality objectives for particles, benzene, carbon monoxide and polyaromatic hydrocarbons. HMSO.

Dover District Council (Dover DC, 2000). Stage 2 Review and Assessment.

South East Institute of Public Health (SEIPH, 1997). The Aim Project and Air Quality in London 1996.

APPENDIX 1

Reproduced from the Council's Stage 2 report - modelling of emissions from the port of Dover

1) Method for estimating – port emissions

a) Emissions from ships in port (marine gas oil only)

For Dover – Calais crossing only, for fleet of 7 ships, each doing 10 crossings per day (supplied via P&O)

Ship activity per return trip - based on

2 crossings (outward and return including docking) taking 1.5 hrs each (based on experience)
2 turnarounds (loading/ unloading) taking 1 hour each

Total time = 5 hours
=>5 return trips/ day

Time spent in Dover per ship = 1 hour/ return trip
= 5 hours/ day
= 35 hrs/ week

Total time spent by ships in Dover = 35hours /day

Which is equivalent to 1.5 ships in port in Dover all the time

Gas oil only burnt in port – estimated to be 20tonnes per vessel per week (supplied via P&O)

And therefore fuel use is 571kg/hr per vessel

S in gas oil is 0.2%

=>Mass of SO_2 released is = 2.28kg/hr

Therefore the SO_2 emission rate is 0.63g/s per ship

A worst case can be assumed to be 3 ships in port = 2g/s

(With the ships representing the Calais/Zebrugge/ Sea France ferries)

b) Emissions from ships in port (bunker fuel only)

Ships using main engines burn bunker "C" fuel, with an S content of 2.75%
The time for each ship to enter and leave dock is estimated to be 20 minutes (based on SEIPH-ERG study of the ships emissions for the Environment Agency).
Average daily consumption is $50m^3$/day, which equates to approximately 14hours sailing. Density of bunker "C" is 0.99 (g/ml using P&O data).

=>Mass of SO_2 released is = 97kg/hr

Therefore the SO_2 emission rate is 27g/s per ship

On the basis that there is an average of 1.5 ships in port at any one time a worst case can be assumed that one ship is constantly operating in the port area.

c) **The total SO_2 emission rate for the port can therefore be assumed as 30g/s.**

d) For comparison purposes emissions information from National Atmospheric Emission Inventory, which is derived using a different methodology, is included on the next page:

The highest SO_2 emission for the 1 km grid square incorporating the Port of Dover is 385 tonnes per annum, which represents an emission rate of 12.2g/s.

2) Modelling method

The emissions from the port were treated as a point source based on the above estimation, sited in the dock area. This is a simplification since it assumes that the emissions arising in transit and the emissions whilst docked arise from a fixed source. It is considered however that this is likely to be an overestimate, based on the Environment Agency study referred to earlier. The estimated funnel height was derived from the ferry operators.

The modelling was undertaken using ADMS3, which is a new generation stack model, using 1998 sequential meteorological data from Heathrow. Modelling predictions were made for 99.9th percentile hourly concentrations. The 15-minute objective was then calculated from this concentration using the conversion factor given in the Environment Agency's GN24 guidance for stationary sources. This was then added to the annual background concentration 1996 derived from the DETR funded NETCEN www site.

Table 1 Specific Stack and Emissions Details of Modelled SO_2 Emission Source

Operator	Stack Height (m)	Stack Diameter (m)	Exit Vel. (m/s)	Vol. Flow (m3/s) STP	Gas Temp. (K)	SO_2 emission g/s
Dover Ships	30	1	5	3.9	373	30

3) Results of screening

The predictions for the 15-minute AQS objective for 2005 are shown on the next page

Prediction of SO2 15 minute mean AQS objective for the Port of Dover for the 2005