

# Further assessment for the Air Quality Management Area at Ferry Lane, Felixstowe

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**Further assessment for the Air Quality Management Area  
at Ferry Lane, Felixstowe**

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**Prepared for: Project Record:** Further assessment and action plan for the Air  
Quality Management Area at Ferry Lane,  
Felixstowe

**Client:** Suffolk Coastal District Council, Environmental  
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(Denise Lavender)

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## Executive summary

This report constitutes an air quality further assessment conducted by the Transport Research Laboratory (TRL Ltd) for Suffolk Coastal District Council (SCDC) as part of their Local Air Quality Management (LAQM) duties. The focus of the further assessment is an area to the south west of Felixstowe where an Air Quality Management Area (AQMA) was declared for annual nitrogen dioxide (NO<sub>2</sub>) concentrations at the Dooley Inn public house on Ferry Lane in 2009<sup>1</sup>.

Annual mean concentrations of NO<sub>2</sub> and particulate matter with an aerodynamic diameter of less than 10 microns (PM<sub>10</sub>) and short-term (hourly) concentrations of sulphur dioxide (SO<sub>2</sub>) have been modelled using the ADMS-Roads dispersion model for the base year of 2008 and the future year of 2013. The method used for conducting the modelling assessment is in line with Defra's technical guidance LAQM TG (09) (Defra, 2009b). Modelled concentrations of oxides of nitrogen (NO<sub>x</sub>) from the road for the base year of 2008 exhibit a tendency for under-prediction compared to results calculated from NO<sub>2</sub> diffusion tube monitoring in the same year. The model has been verified and adjusted accordingly in line with LAQM TG (09) (Defra, 2009b).

The modelling assessment has confirmed the findings of the 2008 detailed assessment (SCDC, 2008a), with exceedance of the NO<sub>2</sub> annual average objective concentration predicted at the Dooley Inn public house on Ferry Lane. There are no predicted exceedances of the PM<sub>10</sub> or SO<sub>2</sub> objectives in the base year of 2008. Based on the modelled results, the recommendation is that the existing AQMA boundary for NO<sub>2</sub> is appropriate and should not be revoked. The Council may wish to extend the AQMA boundary to include areas which could exceed the air quality objective for annual average NO<sub>2</sub> when model uncertainty is taken into account. There is, however, no requirement for local authorities to assess the uncertainty of model predictions under the LAQM process (Defra, 2009b) and therefore the Council is not obligated to extend the AQMA boundary.

A source apportionment exercise has been carried out to determine the contribution of sources to the total modelled concentration of NO<sub>x</sub> at the Dooley Inn public house on Ferry Lane. Container handling activities in the port and heavy duty vehicles (HDVs) on roads external to the port were found to make the greatest contribution to NO<sub>x</sub> concentrations at this receptor. The findings of the source apportionment exercise will be used to inform the air quality action plan. Within the action plan, the baseline situation in the future year of 2013 will be assessed, incorporating the Felixstowe South Reconfiguration (FSR). The baseline situation will be compared with the situations resulting from the implementation of various action plan measures to determine the impact these measures are likely to have on air quality within the AQMA and surrounding area.

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<sup>1</sup><http://www.suffolkcoastal.gov.uk/NR/rdonlyres/E3D38E32-3D86-4030-A4C8-8DB234C7C502/0/AQMADooleyInn.pdf>



# 1 Introduction

This report constitutes a further assessment of air quality for an area to the south west of Felixstowe following the designation of an Air Quality Management Area (AQMA) for annual average nitrogen dioxide (NO<sub>2</sub>) concentrations at the Dooley Inn on Ferry Lane in 2009<sup>2</sup>. This further assessment report fulfils the requirements of the Local Air Quality Management (LAQM) framework, introduced under Part IV of the Environment Act 1995. Under this framework, local authorities are required to assess concentrations of specified air pollutants against standards and objectives listed in the Air Quality Strategy (AQS) document for England, Scotland, Wales and Northern Ireland (Defra, 2007). In England, the air quality objectives applicable to LAQM are implemented by the Air Quality (England) Regulations 2000 (SI 928) and the Air Quality (England) (Amendment) Regulations 2002 (SI 3043). A summary of the regulated pollutants and the relevant AQS objectives is presented in Appendix A. The findings of Suffolk Coastal District Council's (SCDC's) previous air quality review and assessment reports are summarised in section 2.

The LAQM process requires a further assessment of existing and future air quality to be submitted to Defra within 12 months of the declaration of an AQMA under section 84(1) of the Environment Act 1995 (Defra, 2009a). The aim of the further assessment report is to confirm exceedance of the air quality objectives, define the improvement in air quality and reduction in emissions required to attain the objectives and provide information on source contributions. The specific aims of this report are to:

1. Calculate the improvement in NO<sub>2</sub> concentrations (relative to 2008 values) that is required to meet the annual average NO<sub>2</sub> objective value at selected relevant receptors.
2. Assess whether the current AQMA designation at the Dooley Inn on Ferry Lane is correct and whether any changes are needed (including clarification of the boundary based on contour plots and model uncertainty calculation).
3. Determine the contribution of key sources to total oxides of nitrogen (NO<sub>x</sub>) concentrations at the Dooley Inn on Ferry Lane by undertaking a source apportionment exercise.
4. Take into account new guidance or local developments that may have occurred since previous review and assessment reports.
5. Inform the selection of interventions to be used in an air quality action plan.

The main element of the further assessment was to conduct an atmospheric dispersion modelling exercise using the ADMS-Roads model for a base year of 2008. This year has been selected for the availability of monitoring data (used to minimise uncertainty in the model results) and the availability of meteorological data (used as an input to the dispersion model). The results from the modelling exercise for the base year of 2008 are presented in this report. Modelling has also been undertaken for the future year of 2013 and the findings of this exercise are to be presented in the air quality action plan report. Within the air quality action plan report, the baseline situation for the future year of 2013 (incorporating the Felixstowe South Reconfiguration (FSR)) will be compared with the situations resulting from the implementation of measures to improve air quality.

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<sup>2</sup><http://www.suffolkcoastal.gov.uk/NR/rdonlyres/E3D38E32-3D86-4030-A4C8-8DB234C7C502/0/AQMADooleyInn.pdf>

## 2 Background

SCDC has completed three rounds of review and assessment as part of the LAQM process. The findings of the Council's air quality reports completed to date are summarised in Table 2.1, Table 2.2 and Table 2.3. The first round of review and assessment was completed in 2001. No AQMA's were declared as part of the first round (see Table 2.1). The second round of review and assessment was completed in 2005 and consisted of an updating and screening assessment (SCDC, 2003), a detailed assessment (SCDC, 2004) and a progress report (SCDC, 2005). The second round of review and assessment concluded that there was a potential risk of the air quality objectives for NO<sub>2</sub>, particulate matter with an aerodynamic diameter of less than 10 microns (PM<sub>10</sub>) and sulphur dioxide (SO<sub>2</sub>) being exceeded within the Suffolk Coastal district (see Table 2.2). An AQMA was declared for annual average NO<sub>2</sub> concentrations at Lime Kiln Quay Road/The Thoroughfare/St John's Street junction, Woodbridge<sup>3</sup> in March 2006 on the basis of the findings of the second round of review and assessment (see Table 2.2). The third round of review and assessment has recently been completed and consisted of an updating and screening assessment (SCDC, 2006), a detailed assessment (SCDC, 2008a) and a progress report (SCDC, 2008b). On the basis of the third round of review and assessment, an AQMA was declared in 2009 for annual average NO<sub>2</sub> concentrations at the Dooley Inn on Ferry Lane, Felixstowe<sup>4</sup> (see Table 2.3).

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<sup>3</sup><http://www.suffolkcoastal.gov.uk/NR/rdonlyres/8D3BCDF2-1563-4440-B6CE-C3667B450273/0/SCDCAQMONo12006.pdf>

<sup>4</sup><http://www.suffolkcoastal.gov.uk/NR/rdonlyres/E3D38E32-3D86-4030-A4C8-8DB234C7C502/0/AQMADooleyInn.pdf>

**Table 2.1: Main findings from Suffolk Coastal District Council first round of air quality review and assessment reports.**

Report and reference	Main outcomes
Report on the first stage review and assessment of air quality in Suffolk Coastal (SCDC, 1999)	<p><u>Negligible risk</u> of exceedance of the air quality objectives for benzene and 1,3-butadiene and no further action needs to be taken.</p> <p>The risk of exceedance of the air quality objectives for lead, carbon monoxide (CO), NO<sub>2</sub>, PM<sub>10</sub> and SO<sub>2</sub> is such that a second stage review and assessment will need to be undertaken to determine the risk more precisely.</p>
Report on the second stage review and assessment of air quality in the Suffolk Coastal District (SCDC, 2000)	<p><u>Negligible risk</u> of exceedance of the air quality objectives for lead and CO and further review and assessment is not necessary at this time.</p> <p><u>Significant risk</u> of exceedance of the air quality objectives for NO<sub>2</sub>, PM<sub>10</sub> and SO<sub>2</sub> at relevant locations and <u>further review and assessment is necessary</u>.</p>
Report on the third stage review and assessment of air quality in the Suffolk Coastal District (SCDC, 2001)	<p><u>Negligible risk</u> of exceedance of the air quality objectives and further assessment not necessary at this time for:</p> <ul style="list-style-type: none"> <li>• NO<sub>2</sub> from traffic using the A14 trunk road and traffic using High Road West, Felixstowe.</li> <li>• PM<sub>10</sub> from: traffic using the A1152 (specifically the crossroads of the A1152 and B1438 at Melton); traffic using High Road West, Felixstowe; traffic using the Lime Kiln Quay Road/The Thoroughfare/St John's Street junction, Woodbridge; and the combined emission 'footprint' of White Mountain Roadstone Limited, A12 traffic, Foxhall Four Quarry and Foxhall Landfill Site.</li> </ul> <p>Insufficient information to date and therefore <u>further review and assessment required for</u>:</p> <ul style="list-style-type: none"> <li>• SO<sub>2</sub> and PM<sub>10</sub> emissions from shipping at the Port of Felixstowe.</li> <li>• PM<sub>10</sub> emissions from the combined emission 'footprint' of Roadworks (1952) Limited and Sinks Pit Quarry.</li> </ul> <p><u>Risk of NO<sub>2</sub> air quality objectives being exceeded and further review and assessment required for</u>:</p> <ul style="list-style-type: none"> <li>• Emissions from traffic using the A1152 (specifically the crossroads of the A1152 and B1438 at Melton)</li> <li>• Emissions from traffic using Lime Kiln Quay Road/The Thoroughfare/St John's Street junction, Woodbridge.</li> </ul>
Air quality review and assessment stage 3 (AEA Technology, 2001)	<p><u>Unlikely risk</u> of exceedance of the air quality objectives for NO<sub>2</sub> at the Melton and Woodbridge road junctions and an AQMA is not required.</p>

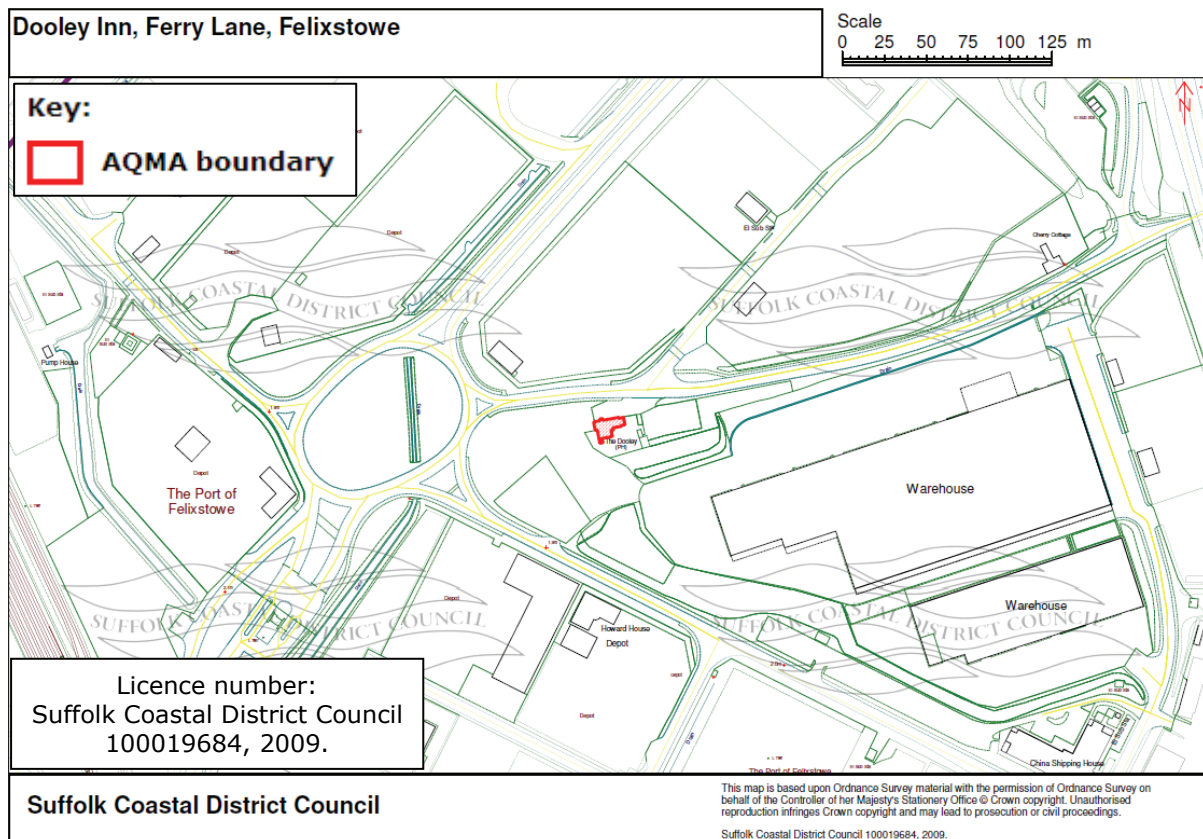
**Table 2.2: Main findings from Suffolk Coastal District Council second round of air quality review and assessment reports.**

Report and reference	Main outcomes
Report on the updating and screening assessment of air quality in the Suffolk Coastal District (SCDC, 2003)	<p><u>Unlikely risk</u> of exceedance of the air quality objectives for CO, benzene and 1,3-butadiene. No further assessment necessary.</p> <p><u>Potential risk</u> of exceedance of the air quality objectives for lead, NO<sub>2</sub>, PM<sub>10</sub> and SO<sub>2</sub> at receptor locations. <u>Further investigation is necessary.</u></p>
Report on the detailed assessment and continued updating and screening assessment of air quality in the Suffolk Coastal District (SCDC, 2004)	<p><u>Unlikely risk</u> of exceedance of the air quality objectives for lead and no further assessment is necessary.</p> <p><u>Potential risk</u> of exceedance of the air quality objectives for NO<sub>2</sub>, PM<sub>10</sub> and SO<sub>2</sub> at receptor locations. <u>Further investigation is necessary for:</u></p> <ul style="list-style-type: none"> <li>Emissions of NO<sub>2</sub> from traffic using the junction of Lime Kiln Quay Road/The Thoroughfare St John's Street junction, Woodbridge.</li> <li>Emissions of NO<sub>2</sub>, PM<sub>10</sub> and SO<sub>2</sub> from activities on and associated with the Port of Felixstowe, incorporating assessment of emissions generated by the Bathside Bay and FSR planning applications if they are granted permission.</li> </ul>
Progress report: Air Quality in the Suffolk Coastal District (SCDC, 2005)	<p>Outlines the findings of detailed modelling undertaken as part of the FSR planning application:</p> <ul style="list-style-type: none"> <li><u>No risk of exceedance</u> of the air quality objective for PM<sub>10</sub> at receptors from emissions resulting from activities on and associated with the Port of Felixstowe. No further review and assessment necessary.</li> <li><u>Exceedance of the air quality objective for annual average NO<sub>2</sub></u> in 2005 at receptor locations situated in The Downs (close to the Port of Felixstowe Road) and Spriteshall Lane (close to Dock Spur roundabout).</li> </ul> <p><i>NO<sub>2</sub> diffusion tube monitoring undertaken in 2004 does not correspond with the above modelling results. Seven new diffusion tube sites established at the start of 2005 to obtain further information for receptor locations close to the Port of Felixstowe and along the A14.</i></p> <p><u>Exceedance of the air quality objective for annual average NO<sub>2</sub></u> predicted for the end of 2005 at the Dooley Inn, Ferry Lane. Two new NO<sub>2</sub> diffusion tube sites established on the building.</p> <p>At the end of 2005, SCDC to determine if declaration of an AQMA is necessary for receptor locations near to the Port of Felixstowe and/or along the A14 based on 12 months of monitoring information from the new NO<sub>2</sub> diffusion tube sites in Felixstowe and the Trimleys. The findings to be reported in the next updating and screening assessment.</p>
Detailed assessment of the Woodbridge road junction (AEA Technology, 2005)	<p><b>Declaration of an AQMA for the annual average objective for NO<sub>2</sub> is required for Lime Kiln Quay Road/The Thoroughfare/St John's Street junction, Woodbridge.</b></p>

**Table 2.3: Main findings from Suffolk Coastal District Council third round of air quality review and assessment reports.**

Report and reference	Main outcomes
Report on the updating and screening assessment of air quality in the Suffolk Coastal District (SCDC, 2006)	<p><u>Unlikely risk</u> of exceedance of the air quality objectives for CO, benzene, 1,3-butadiene and lead and no further assessment is necessary.</p> <p><u>Potential risk</u> of exceedance of the air quality objectives for NO<sub>2</sub>, PM<sub>10</sub> and SO<sub>2</sub> at receptor locations resulting from emissions from activities on and associated with the Port of Felixstowe. A <u>detailed assessment is required</u> to investigate these emissions.</p>
Air quality review and assessment: detailed assessment for Adastral Close and Ferry Lane, Felixstowe (SCDC, 2008a)	<p>AQMA declaration for SO<sub>2</sub> <u>not required</u>.</p> <p>AQMA declaration for PM<sub>10</sub> <u>not required</u>.</p> <p><u>Exceedance of the annual average objective</u> for NO<sub>2</sub> at the Dooley Inn, Ferry Lane, Felixstowe (modelling indicated that this the only relevant receptor location at which the objective was not met).</p> <p><u>Risk of exceedance</u> of the annual average objective for NO<sub>2</sub> at fifteen properties at the west end of Adastral Close in 2010 and beyond following the FSR.</p> <p>Source apportionment studies indicated that container handling operations by rubber tyred gantry (RTG) crane and internal movement vehicles (IMVs) will potentially make the greatest contribution to oxides of nitrogen (NO<sub>x</sub>) concentrations in 2010 both at Adastral Close and the Dooley Inn, Ferry Lane.</p> <p><b>Declaration of an AQMA for the annual average objective for NO<sub>2</sub> is required for the Dooley Inn, Ferry Lane, Felixstowe.</b></p>
Progress report: air quality in the Suffolk Coastal District (SCDC, 2008b)	<p>Work on production of the draft action plan for the Lime Kiln Quay Road/The Thoroughfare/St John's Street junction, Woodbridge is continuing. Public consultation will be undertaken following Defra's approval of the completed draft action plan.</p> <p>Public consultation on the findings of the 2008 detailed assessment (SCDC, 2008a) is to be undertaken following approval of the report by Defra.</p>

The AQMA at the Dooley Inn on Ferry Lane was declared on the basis of the findings of a detailed assessment report completed in 2008 (SCDC, 2008a). The focus of this detailed assessment was the Port of Felixstowe and the A14 approach road. The assessment took into account future developments from the FSR and the Bathside Bay Container Terminal (SCDC, 2008a). The report concluded that there was no need to declare an AQMA for PM<sub>10</sub> or SO<sub>2</sub> concentrations. The Dooley Inn on Ferry Lane was the one relevant receptor location where the annual average objective for NO<sub>2</sub> was not met. NO<sub>2</sub> concentrations of approximately 42.0 and 36.0 µg/m<sup>3</sup> were measured using diffusion tubes at two sites at this location in 2008 (see section 3) and the continuous analyser located at the Dooley Inn recorded an annual average NO<sub>2</sub> concentration of 42.0 µg/m<sup>3</sup> in the same year. The detailed assessment found that container handling equipment at the Port of Felixstowe was contributing to NO<sub>2</sub> concentrations at the Dooley Inn on Ferry Lane and residential properties on Adastral Close (SCDC, 2008a). The Port of Felixstowe authority advised that they were investigating the possibility of installing electricity supply points to be used when this equipment is idling and the assessment concluded that if this is done the air quality objective for NO<sub>2</sub> should be met at Adastral Close (SCDC, 2008a). As such, the declaration of an AQMA for annual average NO<sub>2</sub> concentrations was deemed necessary only for the Dooley Inn on Ferry Lane. The existing AQMA boundary is illustrated in Figure 2.1.



**Figure 2.1: Air Quality Management Area declaration for the Dooley Inn, Ferry Lane, Felixstowe.**

(Source: The Suffolk Coastal District Council Air Quality Management Area Order No 2, 2009<sup>5</sup>).

<sup>5</sup><http://www.suffolkcoastal.gov.uk/NR/rdonlyres/E3D38E32-3D86-4030-A4C8-8DB234C7C502/0/AQMADooleyInn.pdf>



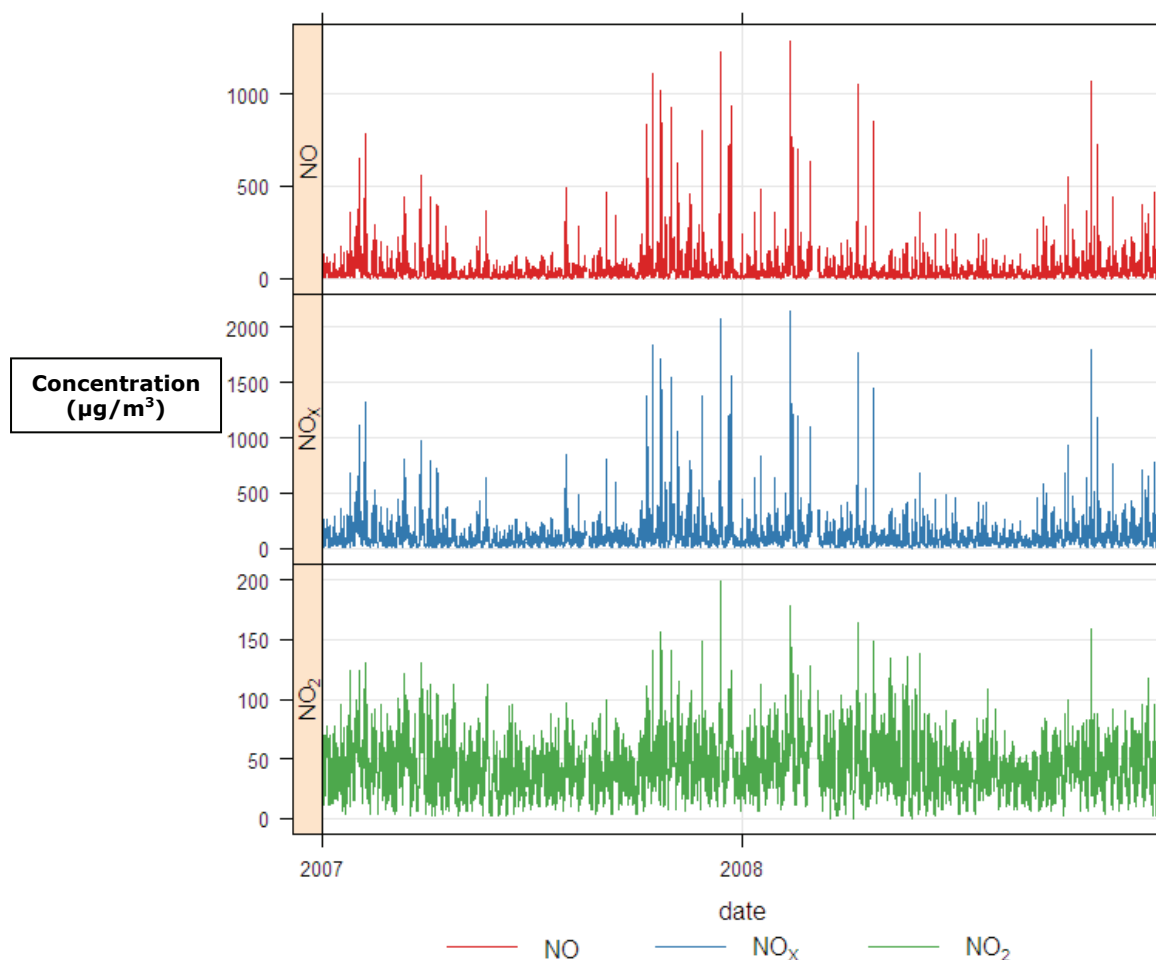
### 3 Monitoring data

#### 3.1 Automatic monitoring

For this further assessment, SCDC provided automatic monitoring data collected at the Dooley Inn, Ferry Lane for the base year of 2008 and for 2007. Table 3.1 presents statistics for the concentrations of NO<sub>2</sub> and NO<sub>x</sub> recorded at the Dooley Inn site in 2008. Figure 3.1 illustrates the trend in NO<sub>2</sub>, NO<sub>x</sub> and nitric oxide (NO) concentrations recorded in 2007 and 2008. Similarly to 2007, the annual average objective for NO<sub>2</sub> was exceeded in 2008. The location of the automatic monitoring site is illustrated in Figure 4.6.

**Table 3.1: Automatic monitoring data, Dooley Inn, Ferry Lane, Felixstowe, 2008.**

Pollutant	NO <sub>2</sub> (µg/m <sup>3</sup> )	NO <sub>x</sub> (µg/m <sup>3</sup> )
Average	42.01	102.55
Minimum	0.00	0.00
Maximum	178.00	2145.00
Standard deviation	21.32	117.98
Data capture	97.12%	97.12%
Exceedance of hourly average objective (200 µg/m <sup>3</sup> )	0	-



**Figure 3.1: Automatic monitoring data, NO<sub>2</sub>, NO<sub>x</sub> and NO (µg/m<sup>3</sup>), Dooley Inn, 2007 and 2008.**

### **3.2 Nitrogen dioxide (NO<sub>2</sub>) diffusion tube monitoring**

SCDC undertakes diffusion tube monitoring for NO<sub>2</sub> at a total of 19 locations in Felixstowe. The Port of Felixstowe authority also undertakes diffusion tube monitoring for NO<sub>2</sub> at 10 locations within the port boundary.

SCDC diffusion tubes are supplied and analysed by Harwell Scientifics. Monitoring is undertaken using Palmes passive diffusion tubes exposed on a monthly basis. The tubes are prepared by spiking acetone triethanolamine (TEA) (50:50) on to the grids (prior to the tubes being assembled) and the tubes are then desorbed with distilled water and the extract analysed using a segmented flow auto-analyser with ultraviolet detection<sup>6</sup>. Harwell Scientifics is UKAS accredited and has demonstrated 'good' performance in the Workplace Analysis Scheme for Proficiency (WASP) for the period July 2007 to July 2008 (report available on the Local Authority Air Quality Support Helpdesk website<sup>7</sup>). The analysis undertaken meets the guidelines set out in Defra's guidance for ambient NO<sub>2</sub> monitoring<sup>8</sup>.

The Port of Felixstowe authority diffusion tubes are supplied and analysed by Gradko International, using the 20% TEA in water method<sup>9</sup>. This laboratory is UKAS accredited and has demonstrated 'good' performance in the WASP for analysis of NO<sub>2</sub> diffusion tubes for the period July 2007 to July 2008 (report available on the Local Authority Air Quality Support Helpdesk website<sup>7</sup>). The analysis undertaken meets the guidelines set out in Defra's guidance for ambient NO<sub>2</sub> monitoring<sup>8</sup>.

The annual average concentration recorded in 2008 at each diffusion tube site is presented in Table 3.2 (note that data are bias corrected by an average of 0.8 for SCDC tubes and an average of 0.92 for Port of Felixstowe authority tubes). The 2008 monitoring data were used to compare the modelled outputs at receptors in order to verify and adjust the model as outlined in section 5. The locations of the monitoring sites used in this assessment are illustrated in Figure 4.6.

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<sup>6</sup>Personal communication with SCDC

<sup>7</sup>[http://www.laqmsupport.org.uk/Summary\\_of\\_Laboratory\\_Performance\\_in\\_WASP\\_R98-102.pdf](http://www.laqmsupport.org.uk/Summary_of_Laboratory_Performance_in_WASP_R98-102.pdf)

<sup>8</sup>[http://www.airquality.co.uk/reports/cat05/0802141004\\_NO2\\_WG\\_PracticalGuidance\\_Issue1a.pdf](http://www.airquality.co.uk/reports/cat05/0802141004_NO2_WG_PracticalGuidance_Issue1a.pdf)

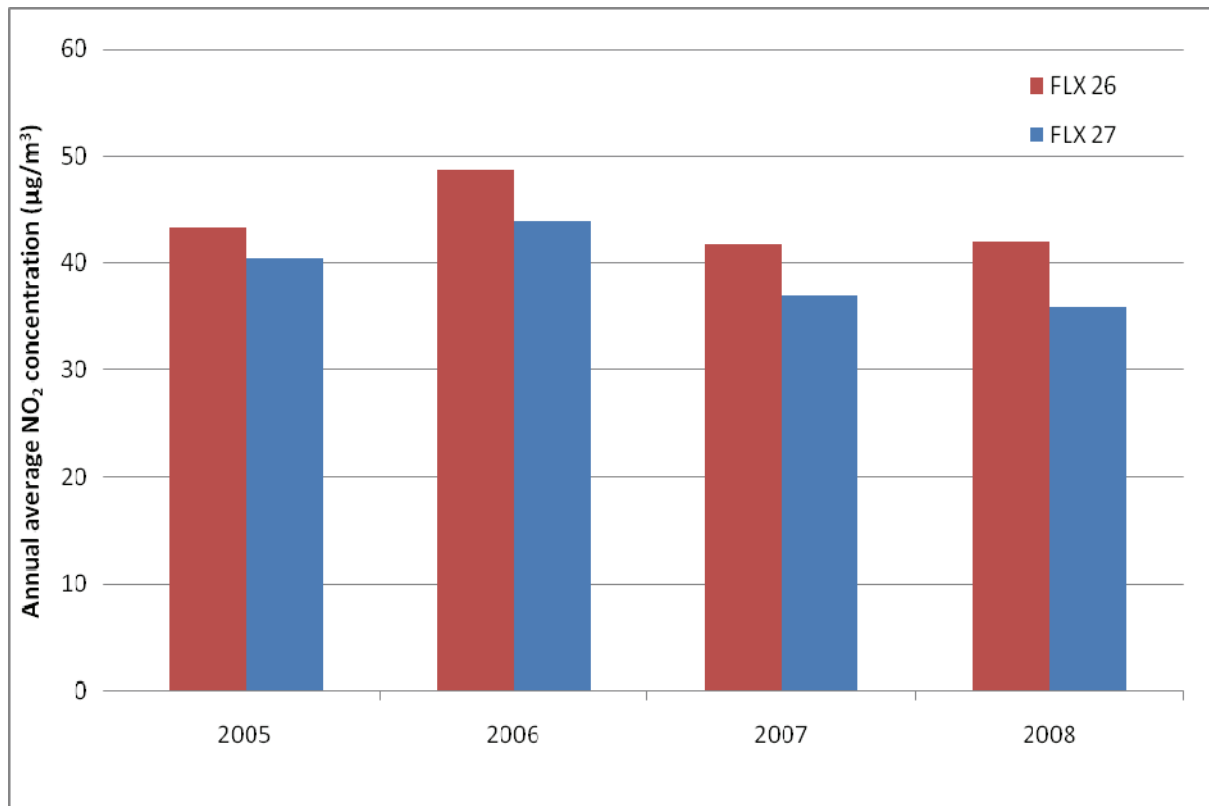
<sup>9</sup>Personal communication with the Port of Felixstowe authority

**Table 3.2: Nitrogen dioxide (NO<sub>2</sub>) diffusion tube location and concentrations, 2008.**

Site name	Site classification	Easting	Northing	Height (m)	Bias adjusted NO <sub>2</sub> concentration (µg/m <sup>3</sup> )
<b>Suffolk Coastal District Council diffusion tube sites</b>					
FLX 4	Urban background	630800	235420	-	24.00
FLX 12	Roadside	630360	234890	2.3	32.00
FLX 13	Industrial/Roadside	627950	234240	2	-
FLX 14 a,b,c (triplicate)	Industrial	628600	232840	2	29.00
FLX 17 a,b,c (triplicate)	Roadside	628810	236320	2	30.00
FLX 18 a,b,c (triplicate)	Roadside	627510	238140	-	31.00
FLX 19	Urban background	628490	263010	2	28.00
FLX 20	Industrial/Roadside	628670	233980	2	28.00
FLX 21	Urban background	629250	234430	2.3	27.00
FLX 22	Industrial	629170	233440	1.8	28.00
FLX 23 a,b (duplicate)	Roadside	628540	236590	-	32.00
FLX 24	Roadside	628340	234620	2.5	34.00
FLX 25	Roadside	628520	235300	2	33.00
FLX 26 a,b,c (triplicate/co-located with continuous analyser)	Industrial/Roadside	627960	234230	3.4	<b>42.00</b>
FLX 27	Industrial/Roadside	627950	234240	2	36.00
FLX 28	Roadside	628400	234870	1.8	30.00
FLX 29	Industrial	628710	232890	2	30.00
FLX 30	Industrial	628730	223280	2	26.00
FLX 31	Industrial	628630	232790	2	33.00
FLX 32	Industrial	628830	232870	2	27.00
<b>Port of Felixstowe authority diffusion tube sites</b>					
75 Park LT7402	-	628500	232600	2	37.53
75 Park LT7507	-	628600	232500	2	30.56
90 Park LT7403	-	628600	232700	2	32.38
90 Park LT7410	-	628600	232600	2	30.73
Central Eng car park (Stores car park)	-	627800	234100	2	<b>48.16</b>
LT7404 (Landguard Eng)	-	628600	232700	2	36.99
Mallard House	-	627400	234300	2	<b>47.65</b>
Pier House LT7113	-	628600	233000	2	35.29
Pier House LT7120	-	628500	232900	2	34.22
North Quay Office	-	626600	234200	10	<b>52.54</b>

Concentrations in **bold** indicate exceedance of the NO<sub>2</sub> annual average AQS objective concentration

The annual average NO<sub>2</sub> concentrations recorded at the Dooley Inn diffusion tube sites between 2005 and 2008 are illustrated in Figure 3.2. Concentrations generally exhibit a slight decline between 2006 and 2008.



**Figure 3.2: Annual average NO<sub>2</sub> concentrations at the Dooley Inn diffusion tube monitoring sites, 2005-2008.**

## 4 Modelling assessment method

### 4.1 Introduction

Atmospheric dispersion modelling for the base year of 2008 and 2013 has been undertaken using the Gaussian-based ADMS-Roads (Extra) software suite, developed by Cambridge Environmental Research Consultants (CERC)<sup>10</sup>. The ADMS-Roads model uses a number of input parameters to simulate the dispersion of pollutant emissions, predicting pollutant concentrations at specified receptors and across a user-defined area. The input parameters include emission source activity data, local meteorological conditions, chemical reactions and background pollutant concentrations. This chapter outlines how the model was set up, including the sources modelled and inputs such as background pollutant concentrations and meteorological data.

### 4.2 Modelled sources

#### 4.2.1 *Vehicles on public roads*

##### 4.2.1.1 *Traffic flows and speeds*

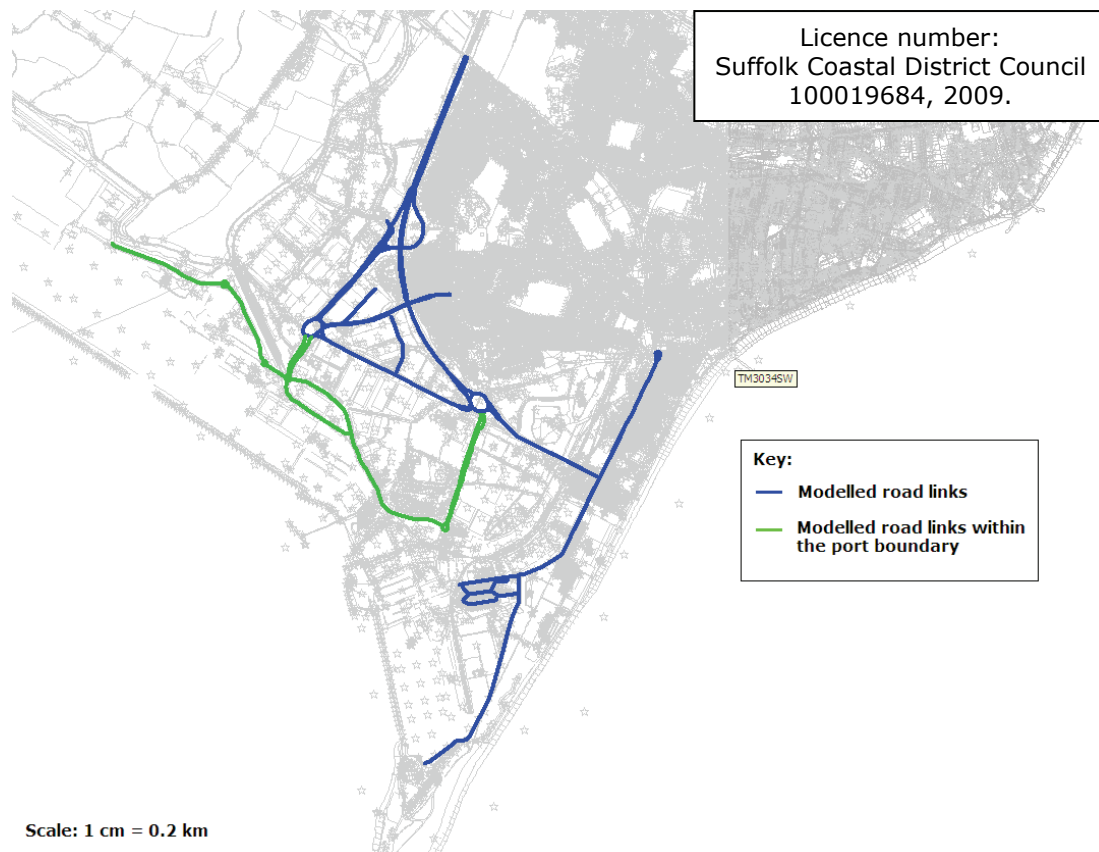
Information regarding traffic flows and average speeds on public roads within the modelling domain were obtained from a number of sources including SCDC, the Highways Agency Traffic Information Database<sup>11</sup> (TRADS) and the National Atmospheric Emission Inventory<sup>12</sup> (NAEI). Traffic data used in this assessment for each modelled road link are provided in Appendix B. TRADS data were applied on stretches of the A14; NAEI data were applied to the A154 and the A45; and SCDC counts were applied to Ferry Lane. Information for a number of local roads (including Adastral Close, Dooley Road, Hodgkinson Road and View Point Road) was unavailable from the sources listed above. A number of assumptions regarding the flows and speeds on these roads were therefore made (see Appendix B). Traffic flows were required in an annual average daily traffic flow (AADT) format and speeds were converted to km/hour. These data were used to calculate emission rates, which were input to the dispersion model (see section 4.3). The modelled road network is illustrated in Figure 4.1.

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<sup>10</sup><http://www.cerc.co.uk/software/admsroads.htm>

<sup>11</sup><http://trads.hatris.co.uk/>

<sup>12</sup><http://www.naei.org.uk>



**Figure 4.1: Modelled road network.**

Where traffic data were provided for years other than 2008, these flows were forecast to 2008 based on DfT growth factors (using the English Regional Traffic Growth forecast spreadsheet<sup>13</sup>) and local factors in TEMPRO<sup>14</sup>. The same method was used to forecast traffic flows from the base year of 2008 to the future year of 2013 for the assessment of scenarios to be included in an air quality action plan.

#### 4.2.1.2 Diurnal profile

Generic profiles based on TRADS data for A roads (A14, A154 and A45) and typical profiles for minor roads (Carr Road, Dooley Road, Ferry Lane, Hodgkinson Road and Langer Road) were applied in the modelling assessment.

#### 4.2.1.3 Queuing

SCDC provided information on the length (metres) and duration (hours) of traffic queues to be included in the modelling assessment. The dispersion model has the ability to 'switch on/off' these queues at appropriate times of the day. From the information supplied by SCDC, the following queues were input to the model:

- Langer Road: 300 metres from Junction with A45, 3 hours between 07:00 and 10:00 and 3 hours between 16:00 and 19:00.
- A154: 300 metres from Junction with A45/Langer Road, 3 hours between 07:00 and 10:00 and 3 hours between 16:00 and 19:00.
- A45: 600 metres from Junction with A154/Langer Road, 1 hour between 08:00 and 09:00 and 1 hour between 17:00 and 18:00.

<sup>13</sup><http://www.uwe.ac.uk/aqm/review/mfaqfiles/RTF-Automated-Traffic-Growth-Calculator-v3-1.xls>

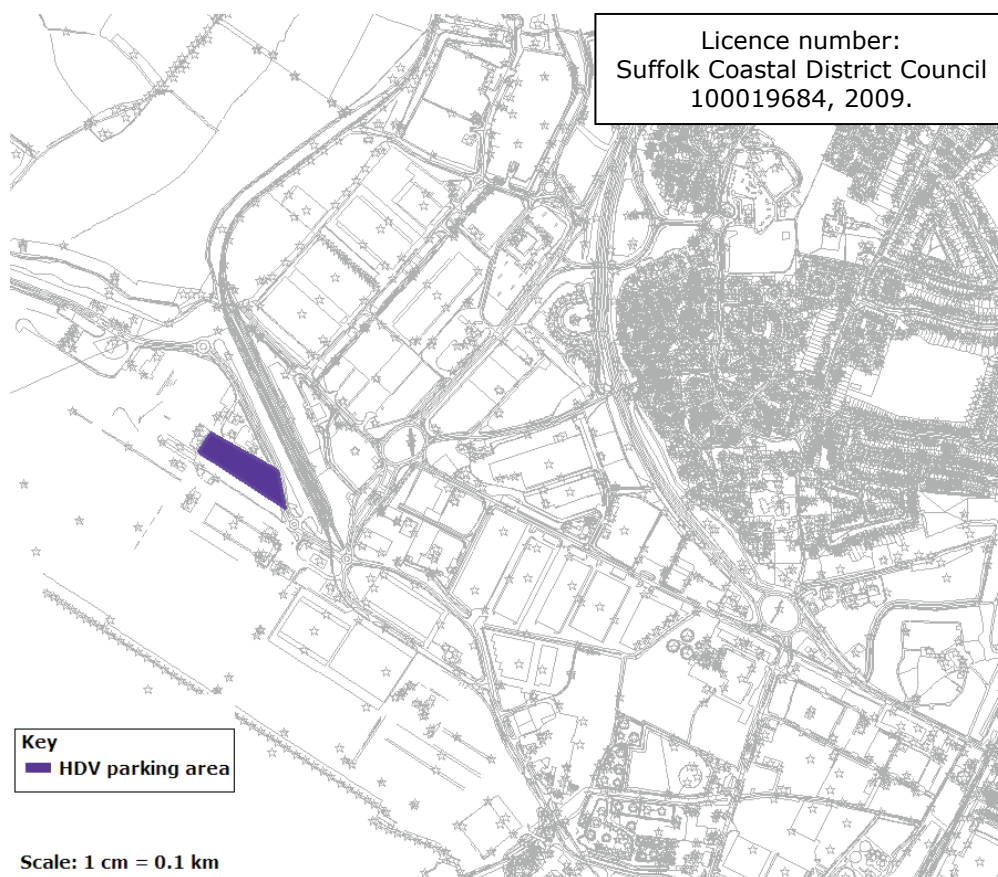
<sup>14</sup><http://www.dft.gov.uk/tempro/>

## 4.2.2 Vehicles within the Port of Felixstowe

### 4.2.2.1 Heavy Duty Vehicles (HDVs) and private vehicles

Information provided by the Port of Felixstowe authority was used to determine movements of Heavy Duty Vehicles (HDVs) entering/exiting the Port (at gate 1 and gate 2) and moving within the port. An average speed of 20 km/h was assumed for HDVs travelling through the gates and an average speed of 30 km/h was assumed for HDVs on all other roads within the port. It was assumed that a total of 1000 private vehicles (as an AADT flow, of which 100% are Light Duty Vehicles (LDVs)) enter/exit the Port through the gates. This was divided between the gates at a rate of 80% at gate 2 and 20% at gate 1 (based on information provided by the Port of Felixstowe authority) and added to the HDV movements on the relevant links to obtain an AADT flow for these road sources. An average speed of 30 km/h was assumed for private vehicles travelling within the port. An average speed of 10 km/h was assumed for all vehicles at roundabouts within the port boundary. This information was input to the model as a series of road sources within the port boundary (see Figure 4.1).

HDVs entering/exiting the port are required to park in a designated area whilst paperwork is completed and occasionally as on-port storage in poor weather conditions<sup>15</sup>. This activity has been input to the model as an area source (see Figure 4.2).

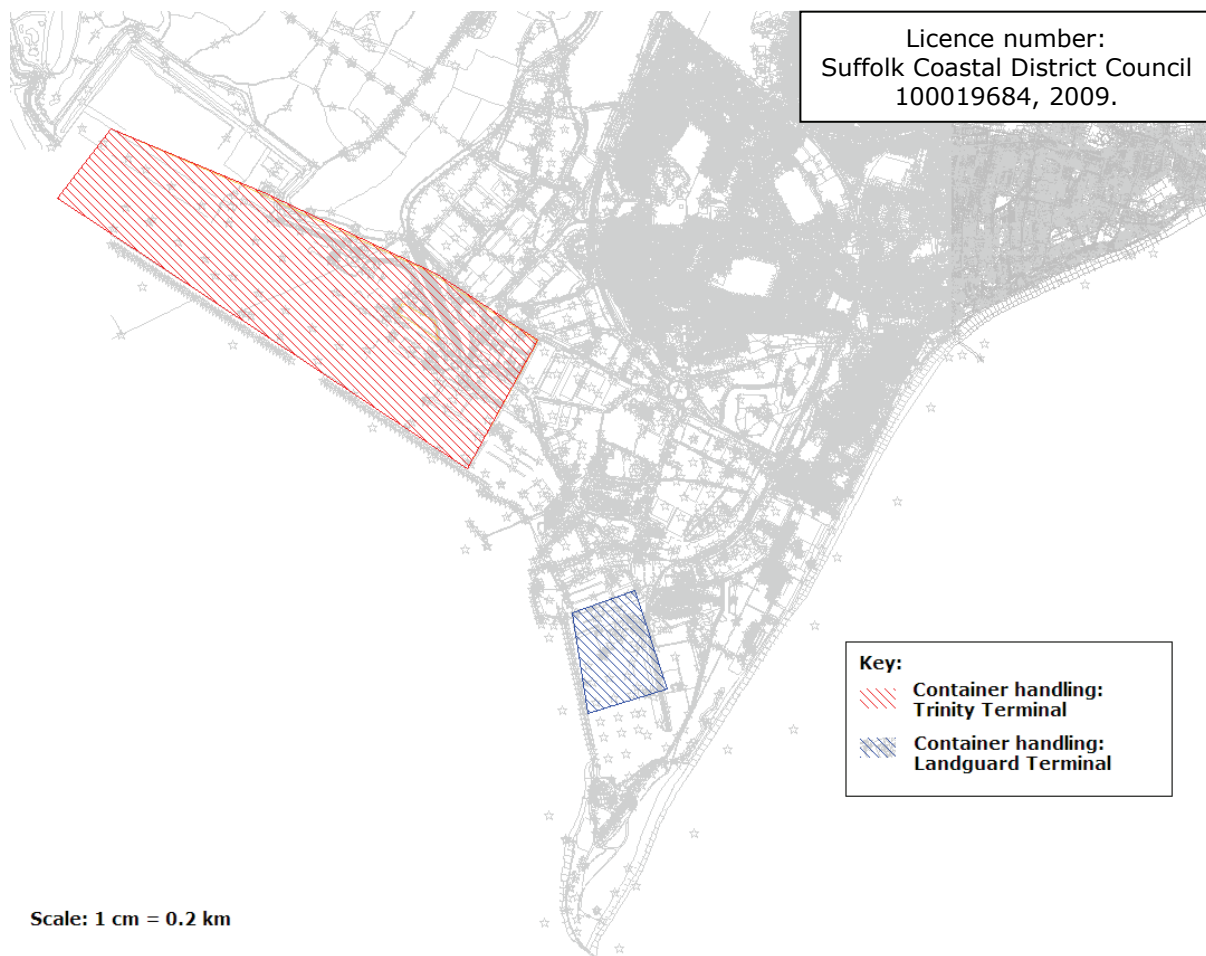


**Figure 4.2: Modelled Heavy Duty Vehicle (HDV) parking area.**

<sup>15</sup>Personal communication with the Port of Felixstowe authority

#### 4.2.2.2 Container handling

Internal movement vehicles (IMVs) within the port were assumed to be Euro III off-road vehicles. Information on the fuel used by these vehicles and that used by rubber tyred gantry (RTG) cranes was obtained from the Port of Felixstowe authority (in 2008, it was assumed that IMVs used 7 million litres of gas oil per year and RTG cranes used 8 million litres of gas oil per year<sup>16</sup>). Container handling operations were assumed to occur in two areas within the port: at Trinity Terminal and at Landguard Terminal. This information was input to the model as four area sources (two sources overlaid to represent IMVs and RTGs at each terminal) at a height of 2.5 metres for IMVs and 10 metres for RTGs (see Figure 4.3).



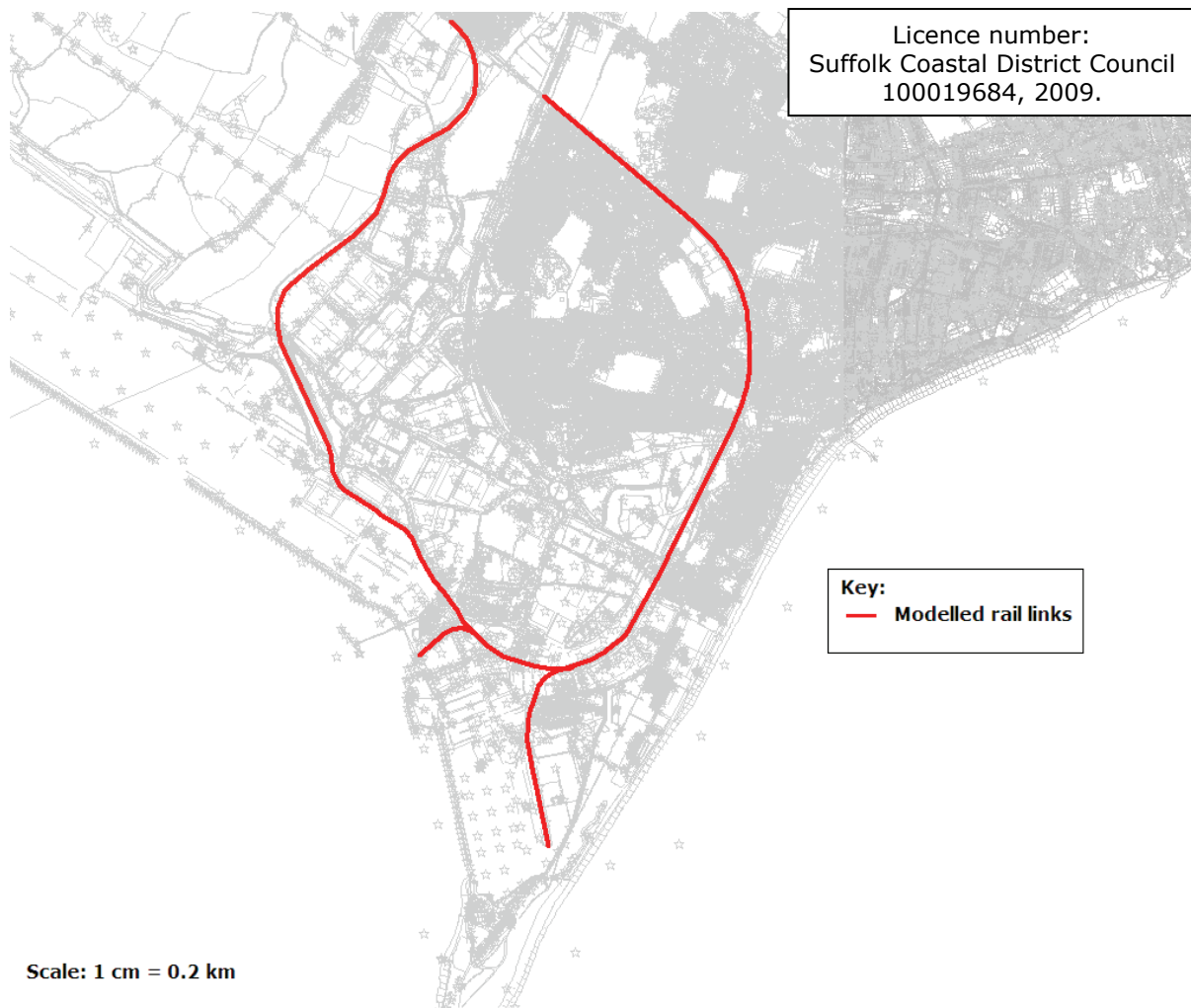
**Figure 4.3: Modelled container handling areas.**

#### 4.2.3 Rail

Annual rail movements from both the south and north rail terminals were obtained from the Port of Felixstowe authority. In 2008, there were a total of 5,460 trains per year arriving/departing at the south terminal and 10,868 trains arriving/departing at the north terminal. Rail movements were input to the model in a similar manner to road sources (see Figure 4.4).

<sup>16</sup>Personal communication with the Port of Felixstowe authority



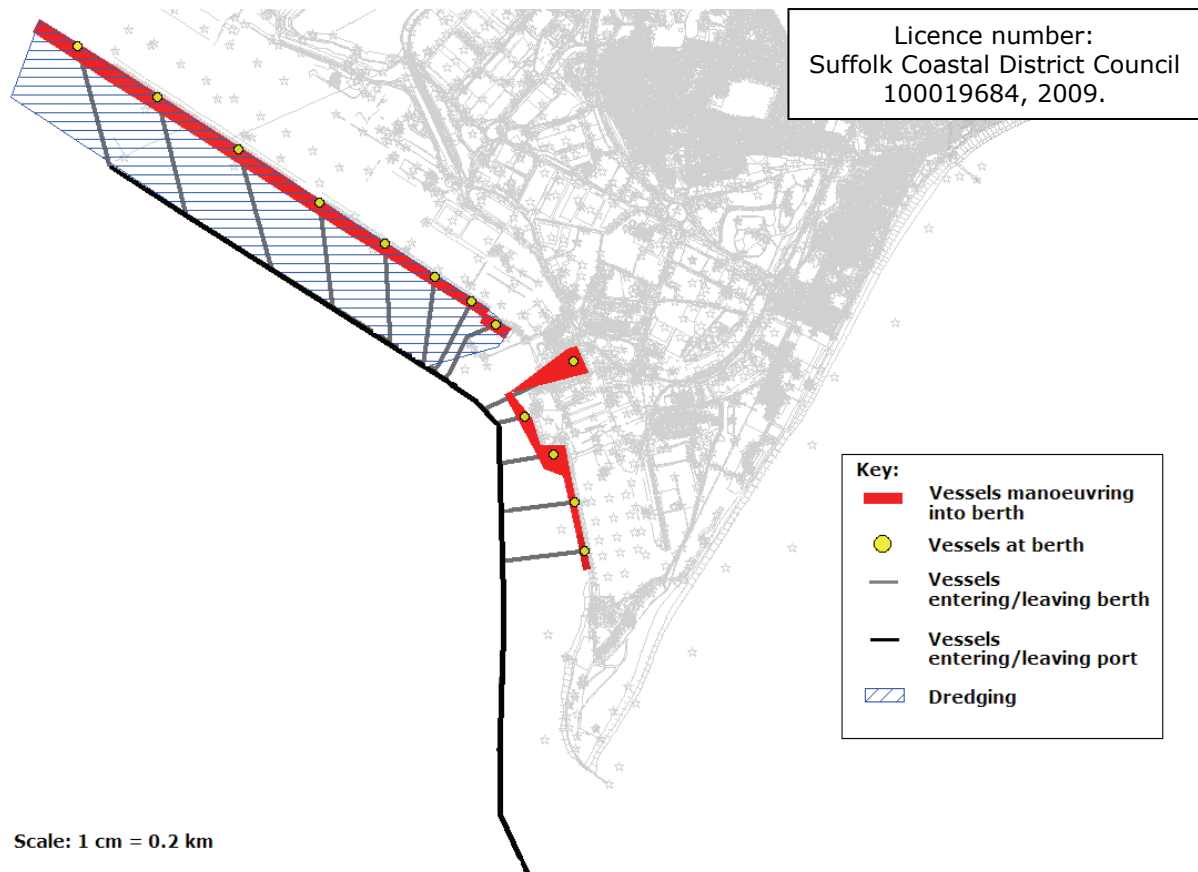


**Figure 4.4: Modelled rail network.**

#### **4.2.4 Shipping**

Annual vessel movements were obtained from the Port of Felixstowe authority (see Appendix C) and assigned to a berth number according to 'fore' and 'aft' bollard number (using the map provided by the Port of Felixstowe authority). With the exception of dredging operations (see section 4.2.4.4), shipping operations have been averaged across the year.

The modelling assessment assumed that the following types of vessel operate to and from the port: container ships, general cargo ships, roll on/off (RoRo) ferries and dredgers (note that tug operations have not been included). Three operating conditions have been considered for container ships, general cargo ships and RoRo ferries: manoeuvring into port ('channelling'), manoeuvring into berth ('berthing') and stationary vessels ('at berth'). For each operation, a number of assumptions have been made regarding load factors on the main and auxiliary engines (see Appendix C). The modelled network is shown in Figure 4.5.



**Figure 4.5: Modelled shipping network.**

#### 4.2.4.1 Channelling

Vessels entering and leaving the port have been input to the model as industrial line sources with stack heights between 25 and 50 metres (see Figure 4.5).

#### 4.2.4.2 Berthing

Vessels manoeuvring into berth have been input to the model as volume sources with stack heights between 25 and 50 metres (see Figure 4.5).

#### 4.2.4.3 At berth

Stationary vessels are represented in the model as point sources with stack heights between 25 and 50 metres (see Figure 4.5).

#### 4.2.4.4 Dredging

The modelling assessment has assumed that dredging operations occur in a 1 km<sup>2</sup> area adjacent to the dock side at Trinity Terminal (see Figure 4.5). Two sizes of dredger have been accounted for (see Appendix C) and seasonal variation has been included.

## 4.3 Emissions calculation

### 4.3.1 Vehicles on public roads

The most recent version of the Highways Agency Design Manual for Roads and Bridges (DMRB) (version 1.03c) (Highways Agency *et al*, 2007) has been used to generate emission rates for NO<sub>x</sub> and PM<sub>10</sub> for each modelled road link.

In order to use the DMRB to produce an emissions estimate for each road link, the following information is required:

- Year of interest.
- Length of road link (km).
- AADT.
- Annual average speed.
- Road type (A, B, C or D), where:
  - A = all motorways and A roads.
  - B = urban roads which are neither motorways or A roads.
  - C = any other roads.
  - D = fleet composition known.
- Proportions of different generic vehicle categories in the traffic.

The 'road type' parameter acts as a proxy for differences in the coarse composition of the traffic under different conditions. When selecting road types A, B or C, only the proportions of LDVs and HDVs are specified. The selection of road type D allows a more detailed classification to be specified (*i.e.* percentage of passenger cars, light goods vehicles (LGVs), buses and coaches, rigid heavy goods vehicles (HGVs) and articulated HGVs). Road type D was selected for the A154, A45, Carr Road, Langer Road, Adastral Close, View Point Road, Trinity Avenue and sections of the A14 as detailed fleet composition was available. Road type A was selected for sections of the A14 and the roundabout joining the A45 with the A14. Road type B was selected for Dooley Road, Ferry Lane, Hodgkinson Road and the roundabout joining the A154 with the B1082. The DMRB spreadsheet calculates emissions on an annual basis and these are manipulated to derive emission rates in g/km/s (*i.e.* suitable for use by the ADMS-Roads model).

### 4.3.2 Vehicles within the Port of Felixstowe

#### 4.3.2.1 Heavy Duty Vehicles (HDVs) and private vehicles

The DMRB spreadsheet was used to calculate emissions for the road sources within the Port of Felixstowe (see section 4.3.1). Within the DMRB spreadsheet, road type C was selected to represent roads within the port (the fleet composition was derived using the numbers of HDVs and private vehicles discussed in section 4.2.2.1).

#### 4.3.2.2 Container handling

The Port of Felixstowe authority provided information on the fuel used by IMVs and RTGs each year (IMVs use 7 million litres of gas oil per year and RTG cranes use 8 million litres of gas oil per year). An emission rate (g/m<sup>2</sup>/s) was obtained from the NAEI<sup>17</sup> for NO<sub>x</sub>, PM and SO<sub>2</sub> for both IMVs and RTGs assuming a density of gas oil of 0.85 kg fuel/litre and emission rates of 35 kg/T, 3.2 kg/T and 2 kg/T for NO<sub>x</sub>, PM and SO<sub>2</sub>

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<sup>17</sup><http://www.naei.org.uk/>

respectively. Total emissions for each vehicle type for the base year of 2008 were split between the terminals as follows: 90% at Trinity Terminal and 10% at Landguard Terminal.

#### **4.3.3 Rail**

Emission rates for Class 66 trains of 387.47 g/km for NO<sub>x</sub> and 5.1 g/km for particulate matter (PM) were obtained from the NAEI<sup>18</sup> and applied to the modelled rail links to obtain an emission rate for NO<sub>x</sub> and PM<sub>10</sub> in g/km/s. The trains entering and leaving port have an average load of 707 tonnes<sup>19</sup>. The effect of variation away from average load conditions has not been accounted for in this assessment because emission factors for specific loads were not available.

#### **4.3.4 Shipping**

Emission rates for shipping were obtained from the most recent published sources of information (Entec, 2002; Entec, 2007; SCG, 2007). At the time of writing, updated emission factors had been submitted to Defra, but had not yet been agreed and released to the public domain<sup>20</sup>. The emission rates used in this assessment are summarised below:

- Main engine: NO<sub>x</sub> 10.2 g/kWh, PM 0.9 g/kWh, SO<sub>2</sub> 0.9 g/kWh.
- Auxiliary engine: NO<sub>x</sub> 12.7 g/kWh, PM 0.9 g/kWh, SO<sub>2</sub> 0.3 g/kWh.

Heavy and light fuel oils have been considered within the emissions calculations according to size of vessel and operation being undertaken.

### **4.4 Modelled receptor locations**

Pollutant concentrations have been modelled at 25 receptors (see Figure 4.6). These receptors include 21 diffusion tube monitoring sites and 4 other locations where there is potential for public exposure. A number of the Council's diffusion tube monitoring sites were excluded from the modelling assessment because of their distance from relevant sources.

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<sup>18</sup><http://www.naei.org.uk/>

<sup>19</sup>Personal communication with the Port of Felixstowe authority

<sup>20</sup>Personal communication with Entec



**Figure 4.6: Modelled receptor locations.**

#### 4.5 Background sources

The ADMS-Roads model was set up to model emissions from the road, rail, container handling and shipping sources. The contribution of emissions from other sources (e.g. industries) in the local area and regional sources were included from background files relevant to Felixstowe, according to the recommended methodology in LAQM TG (09) (Defra, 2009b). Background concentrations have been taken from the appropriate grid

squares in the UK Air Quality Archive<sup>21</sup> and are shown in Table 4.1. These concentrations were compared with values recorded at the nearest background and rural monitoring sites in the UK Automatic Monitoring Network (shown in Table 4.2). The background concentrations used in the modelling assessment were most similar to the concentrations measured at the rural monitoring site at St Osyth.

An average PM<sub>10</sub> concentration of 17.1 µg/m<sup>3</sup> was input to the base year (2008) dispersion model. NO<sub>x</sub> and NO<sub>2</sub> background concentrations were determined for each receptor location based on the appropriate grid (see Table 4.1).

**Table 4.1: Background concentrations (NO<sub>2</sub> and NO<sub>x</sub>), modelling domain, 2008.**

Receptor	Grid square	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )
<b>Suffolk Coastal District Council diffusion tube sites</b>			
FLX20	628500 233500	15.40	20.41
FLX22	629500 233500	15.07	19.89
FLX24	628500 234500	17.73	24.10
FLX25	628500 235500	17.14	23.11
FLX26	627500 234500	14.67	19.27
FLX27	627500 234500	14.67	19.27
FLX28	628500 234500	17.73	24.10
FLX29	628500 232500	13.61	17.69
FLX30	628500 232500	13.61	17.69
FLX31	628500 232500	13.61	17.69
FLX32	628500 232500	13.61	17.69
<b>Port of Felixstowe authority diffusion tube sites</b>			
1 North Quay Office	626500 234500	13.95	18.20
2 Mallard House	627500 234500	14.67	19.27
4 Pier House	628500 233500	15.40	20.41
5 Pier House	628500 232500	13.61	17.69
6 Landguard Eng	628500 232500	13.61	17.69
7 90 Park	628500 232500	13.61	17.69
8 90 Park	628500 232500	13.61	17.69
9 75 Park	628500 232500	13.61	17.69
10 75 Park	628500 232500	13.61	17.69

**Table 4.2: Annual mean concentrations of NO<sub>2</sub> and NO<sub>x</sub>, urban background and rural sites in UK Automatic Monitoring Network, 2008.**

Site name	Site type	Approximate distance from Felixstowe (km)	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )
Southend-on-Sea	Urban background	65	22.8	33.8
St Osyth	Rural	25	12.6	16.3
Thurrock	Urban background	95	32.0	55.5

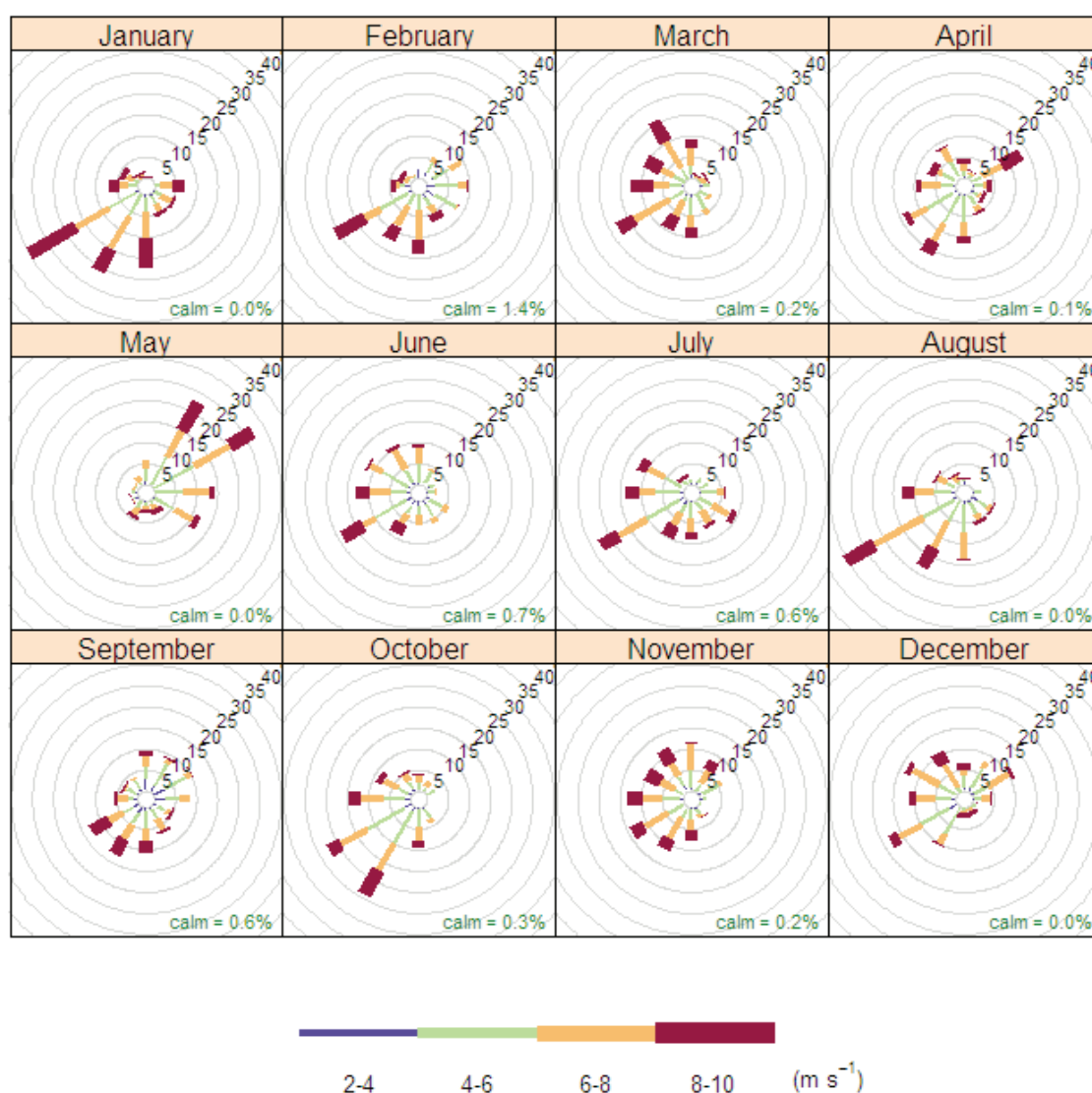
#### 4.6 Meteorological data

The ADMS-Roads model applies hourly sequential meteorological data to calculate atmospheric dispersion. This calculation involves a number of meteorological parameters

<sup>21</sup><http://www.airquality.co.uk/>



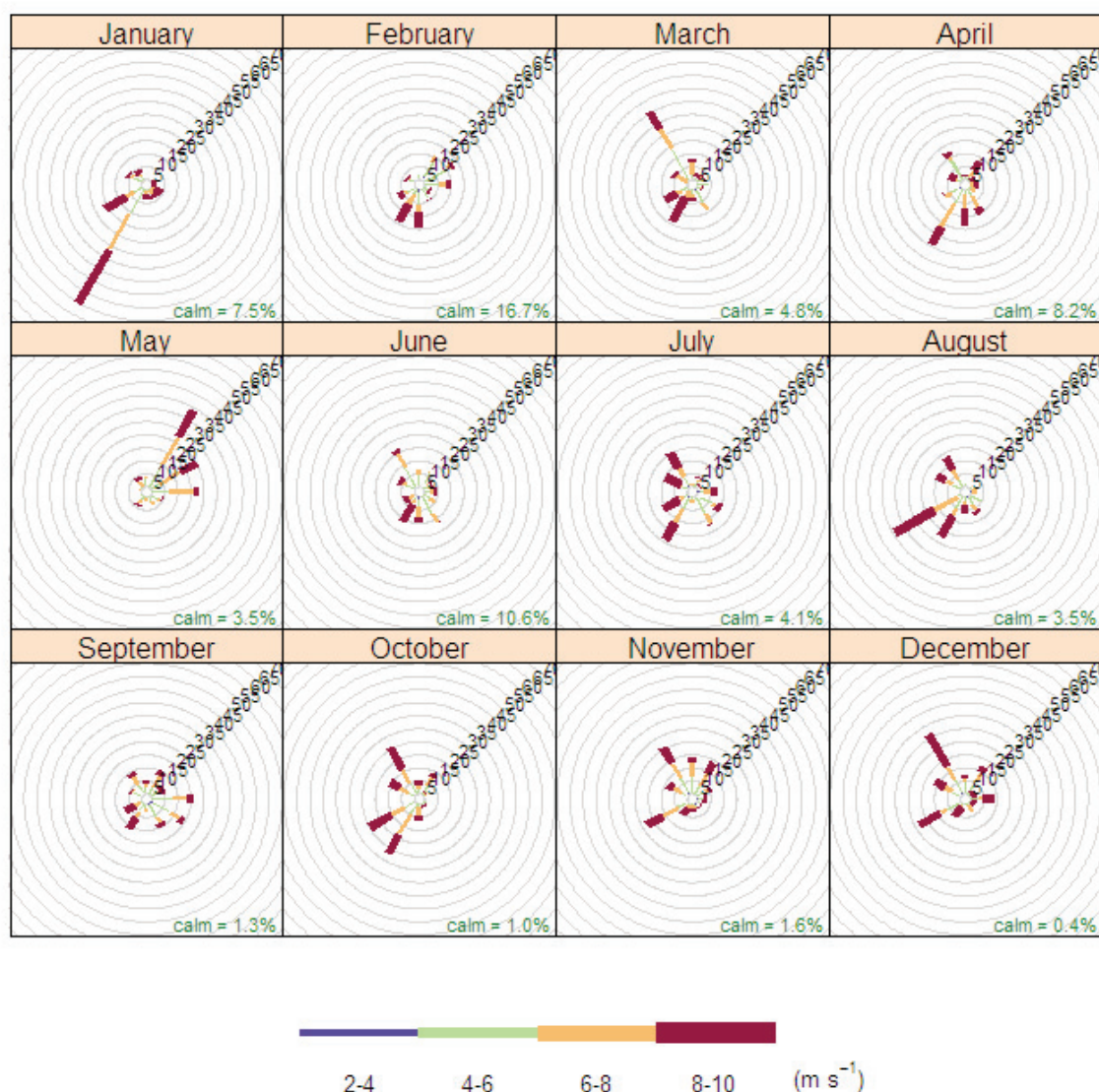
including wind speed and direction, cloud cover and near surface temperature (the latter two parameters being important for the calculation of atmospheric stability, which affects how pollutants disperse). Meteorological data collected at Wattisham was used in the modelling assessment as this was the nearest meteorological office site with a good dataset for 2008. Wattisham is situated approximately 30 miles north-west of Felixstowe. As this site is further inland than the port it can be considered to be unrepresentative of the situation at the port. A surface roughness of 0.1 metres was therefore input to the model at the meteorological site and 0.3 metres was used to represent the surface roughness within the model domain. Wind direction and wind speed data collected at Wattisham are illustrated in Figure 4.7. The dominant wind direction is from the west-south-west, with an average wind speed of 4.7 m/s.



**Figure 4.7: Wind rose by month based on data from Wattisham meteorological station, 2008.**

Meteorological data recorded at the port in 2008 were provided by the Port of Felixstowe authority at various sites. A wind rose for this site is given in Figure 4.8. The wind direction is similar at both sites in each month, with the dominant wind direction over the year being from the south-west. The port site had an average wind speed of 6.9

m/s, which is noticeably higher than that at Wattisham. The maximum wind speed at the port was 26 m/s, compared to 16 m/s at Wattisham on 1<sup>st</sup> March 2008.



**Figure 4.8: Wind rose by month based on data from Port of Felixstowe meteorological station, 2008.**

#### 4.7 Model output

For the base year of 2008, modelling predictions were undertaken at the selected receptors and over a 4.8 km by 5.8 km calculation grid (known as the modelling domain). The ADMS-Roads model has applied a default 12,234 receptor points to this domain. The 'intelligent gridding' feature of the ADMS-Roads model was utilised whereby further receptor points are added in close proximity to emission sources to optimise the modelling at relevant locations (*i.e.* for maximum public exposure). The method used in this study complies with the recommendations regarding receptor grid spacing described in LAQM TG (09) (Defra, 2009b).



## 5 Results

### 5.1 Nitrogen dioxide concentrations at receptors

#### 5.1.1 Modelling errors: systematic and random

The results predicted by a dispersion model may differ from measured concentrations for a number of reasons (Defra, 2009b). For example:

- Different estimates of background concentrations;
- Meteorological uncertainties;
- Uncertainties in source activity data (e.g. traffic flows, stack emissions and emissions factors);
- Difference in model input parameters (e.g. surface roughness length, minimum Monin-Obukhov and overall modelling limitations);
- Uncertainties associated with monitoring data, including locations of monitoring sites.

Errors may be systematic (*i.e.* the model consistently under- or over-predicts measured concentrations) or random (*i.e.* the model under-predicts measured concentrations at some locations and over-predicts measured concentrations at others). Examples of factors which could lead to systematic errors include over-estimation of emissions (leading to over-prediction of measured concentrations) or over-estimation of the wind speed across the modelling domain (which could lead to increased simulated dispersion within the domain and therefore under-estimation of measured concentrations). A random error may be caused by, for example, local topographical features not being accounted for in the modelling process.

In the case of systematic errors, it is not always possible to identify one single cause of the error. This is because the errors associated with each model input are combined with each other and any inherent errors in the model itself. Systematic errors can, however, be quantified and accounted for through comparison of modelled results with measured results to determine the relationship between them. This is known as model verification (see section 5.1.2). Having accounted for the systematic modelling error, the residual random error can be addressed by calculating the model uncertainty (see section 5.1.3).

#### 5.1.2 Model verification

Model verification is the process by which errors associated with the modelling process are investigated and minimised. For this assessment, model verification has been undertaken in line with LAQM TG (09) (Defra, 2009b). The process of verification involves the comparison of the measured NO<sub>x</sub> source (road) concentration with the modelled NO<sub>x</sub> source concentration. If the results differ by more than 10%, an adjustment factor is calculated and applied to the modelled concentrations to minimise uncertainty in the results.

LAQM TG (09) states that model adjustment should be based on NO<sub>x</sub> concentrations rather than NO<sub>2</sub> concentrations (Defra, 2009b). The bias adjusted annual mean NO<sub>2</sub> concentrations obtained from diffusion tube monitoring have been used to calculate a measured road NO<sub>x</sub> concentration using the NO<sub>x</sub>/NO<sub>2</sub> calculator provided as part of the toolset in LAQM TG (09)<sup>22</sup>. This calculator was set up for the year 2008 and regional area of Suffolk Coastal with specific background concentrations for each receptor (as provided in Table 4.1). A default value of primary NO<sub>2</sub> for the UK fleet (15%) was assumed.

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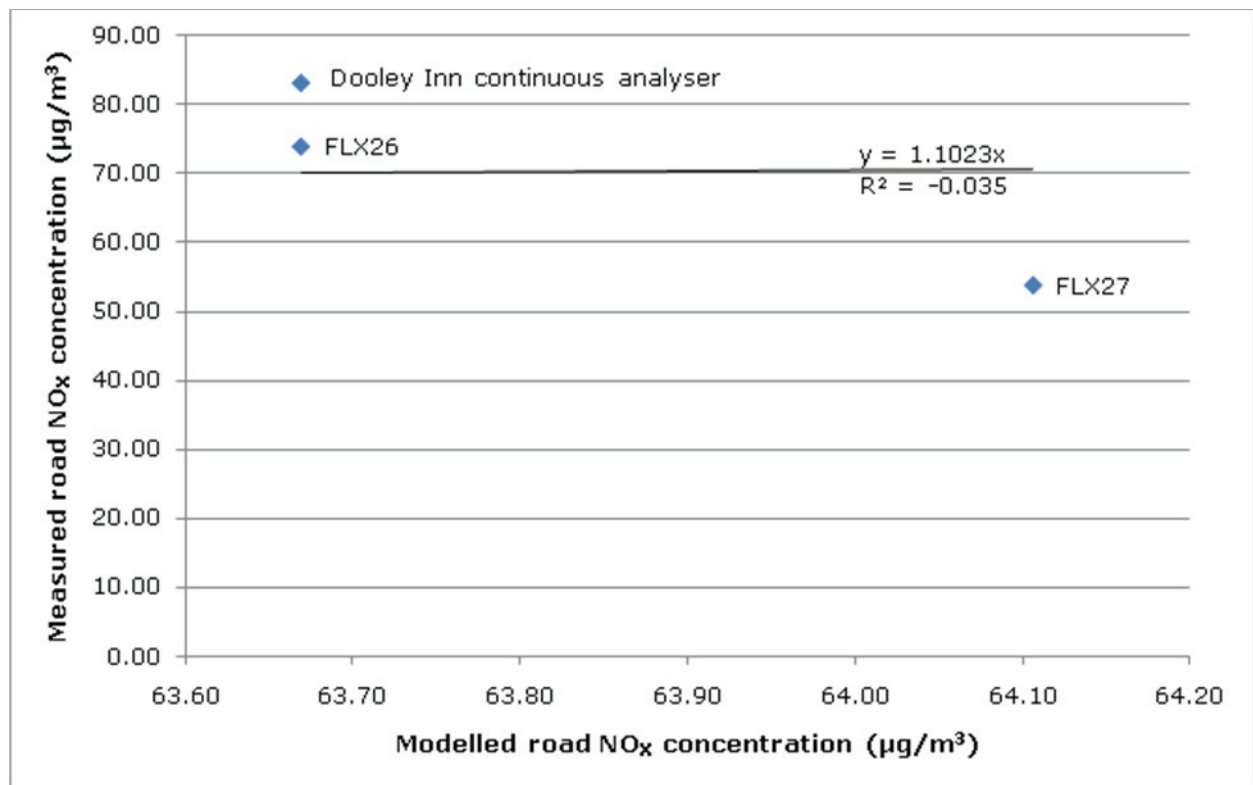
<sup>22</sup><http://www.airquality.co.uk/laqm/tools.php>

Table 5.1 presents the unadjusted modelled NO<sub>x</sub> concentrations at each receptor and the difference compared with measured NO<sub>x</sub> concentrations.

**Table 5.1: Unadjusted modelled NO<sub>x</sub> and measured NO<sub>x</sub> concentration, percentage difference, 2008.**

Site name	Unadjusted modelled NO <sub>x</sub> (µg/m <sup>3</sup> )	Measured NO <sub>x</sub> (µg/m <sup>3</sup> )	% difference
<b>Suffolk Coastal District Council diffusion tube sites</b>			
FLX20	23.84	29.25	-18.49%
FLX22	16.65	30.03	-44.55%
FLX24	30.80	40.01	-23.01%
FLX25	38.26	38.61	-0.90%
FLX26	63.67	74.02	-13.98%
FLX26 analyser	63.67	83.28	-23.55%
FLX27	64.11	53.84	19.07%
FLX28	32.61	28.98	12.54%
FLX29	19.12	38.86	-50.81%
FLX30	18.52	28.27	-34.48%
FLX31	25.47	47.42	-46.29%
FLX32	15.50	30.84	-49.73%
<b>Port of Felixstowe authority diffusion tube sites</b>			
1 North Quay Office	65.68	100.31	-34.52%
2 Mallard House	82.27	95.95	-14.26%
4 Pier House	22.21	41.08	-45.93%
5 Pier House	25.37	42.69	-40.57%
6 Landguard Eng	28.96	50.12	-42.21%
7 90 Park	26.08	37.98	-31.33%
8 90 Park	23.47	27.28	-13.95%
9 75 Park	42.19	51.63	-18.28%
10 75 Park	28.79	40.42	-28.76%

LAQM TG (09) (Defra, 2009b) recommends that a combination of continuous monitoring and diffusion tube sites is used for the verification and adjustment of NO<sub>x</sub>/NO<sub>2</sub>. For this assessment, the results from two diffusion tube monitoring sites (FLX26 and FLX27) and from the continuous analyser at Dooley Inn were selected for use in the model verification process. Figure 5.1 illustrates the relationship between the measured and monitored NO<sub>x</sub> concentration at these three sites. The equation of the trend line shown in Figure 5.1 demonstrates the relationship between modelled NO<sub>x</sub> and measured NO<sub>x</sub> concentrations. The intercept for the trend line is set through zero and the resulting equation has been used to obtain a factor (1.1023) which was applied to the modelled NO<sub>x</sub> concentrations to obtain the adjusted modelled NO<sub>x</sub> concentrations at each receptor (see Table 5.2) and across the grid (*i.e.* modelled NO<sub>x</sub> multiplied by 1.1023 = adjusted modelled NO<sub>x</sub>).



**Figure 5.1: Comparison between modelled and monitored NO<sub>x</sub> concentrations, 2008.**

**Table 5.2 Adjusted modelled NO<sub>x</sub> concentrations, 2008.**

Site name	Modelled NO <sub>x</sub> (µg/m <sup>3</sup> )	Adjusted modelled NO <sub>x</sub> (µg/m <sup>3</sup> )
<b>Suffolk Coastal District Council diffusion tube sites</b>		
FLX20	23.8	26.3
FLX22	16.7	18.4
FLX24	30.8	34.0
FLX25	38.3	42.2
FLX26	63.7	70.2
FLX26 analyser	63.7	70.2
FLX27	64.1	70.7
FLX28	32.6	36.0
FLX29	19.1	21.1
FLX30	18.5	20.4
FLX31	25.5	28.1
FLX32	15.5	17.1
<b>Port of Felixstowe authority diffusion tube sites</b>		
1 North Quay Office	65.7	72.4
2 Mallard House	82.3	90.7
4 Pier House	22.2	24.5
5 Pier House	25.4	28.0
6 Landguard Eng	29.0	31.9
7 90 Park	26.1	28.8
8 90 Park	23.5	25.9
9 75 Park	42.2	46.5
10 75 Park	28.8	31.7
<b>Other receptor locations</b>		
55 Dovedale	14.6	16.1
Wardens House	4.3	4.8
Caravan Park	14.0	15.5
Cherry Cottage	40.7	44.8

The adjusted modelled NO<sub>x</sub> concentrations have been input to the NO<sub>x</sub>/NO<sub>2</sub> calculator provided as part of the toolset in LAQM TG (09)<sup>23</sup> to derive an adjusted modelled NO<sub>2</sub> concentration for each receptor location and across the grid. As with the previous calculation, the calculator was set up for the year 2008 and regional area of Suffolk Coastal with specific background concentrations input for each receptor (as provided in Table 4.1) and assuming a default value of primary NO<sub>2</sub> for the UK fleet of 15%.

Following the model verification process, the model predicts exceedance of the NO<sub>2</sub> annual average objective concentration at five sites. These include the Dooley Inn diffusion tubes and automatic analyser and two sites within the port boundary, as indicated in Table 5.3. The sites within the port boundary are not relevant to the LAQM process as there is no relevant public exposure at these locations. As such, it is not necessary or appropriate to declare an AQMA within the port boundary.

<sup>23</sup><http://www.airquality.co.uk/laqm/tools.php>

**Table 5.3: Adjusted modelled NO<sub>2</sub> concentration and comparison with measured NO<sub>2</sub> 2008.**

Site name	Adjusted modelled NO <sub>2</sub> concentration (µg/m <sup>3</sup> )	Measured NO <sub>2</sub> concentration (µg/m <sup>3</sup> )	Model under/over prediction (%)
<b>Suffolk Coastal District Council diffusion tube sites</b>			
FLX20	26.8	28.0	-4.14%
FLX22	23.3	28.0	-16.75%
FLX24	31.9	34.0	-6.32%
FLX25	34.2	33.0	3.76%
FLX26	<b>40.9</b>	<b>42.0</b>	-2.57%
FLX26 analyser	<b>40.9</b>	<b>42.0</b>	-2.59%
FLX27	<b>41.1</b>	36.0	14.06%
FLX28	32.6	30.0	8.57%
FLX29	23.1	30.0	-23.03%
FLX30	22.8	26.0	-12.27%
FLX31	25.9	33.0	-21.45%
FLX32	21.4	27.0	-20.74%
<b>Port of Felixstowe authority diffusion tube sites</b>			
1 North Quay Office	<b>41.0</b>	<b>48.2</b>	-14.91%
2 Mallard House	<b>46.4</b>	<b>47.7</b>	-2.72%
4 Pier House	26.1	32.4	-19.23%
5 Pier House	25.9	31.4	-17.50%
6 Landguard Eng	27.4	33.9	-19.13%
7 90 Park	26.2	29.7	-11.75%
8 90 Park	25.1	25.6	-2.18%
9 75 Park	32.7	34.4	-4.97%
10 75 Park	27.4	30.6	-10.51%
<i>Average (all diffusion tube sites)</i>	30.62	33.47	-8.5%
<b>Other receptor locations</b>			
55 Dovedale	24.9	-	-
Wardens House	15.9	-	-
Caravan Park	22.1	-	-
Cherry Cottage	35.7	-	-

Concentrations in **bold** indicate exceedance of the NO<sub>2</sub> annual average AQS objective concentration

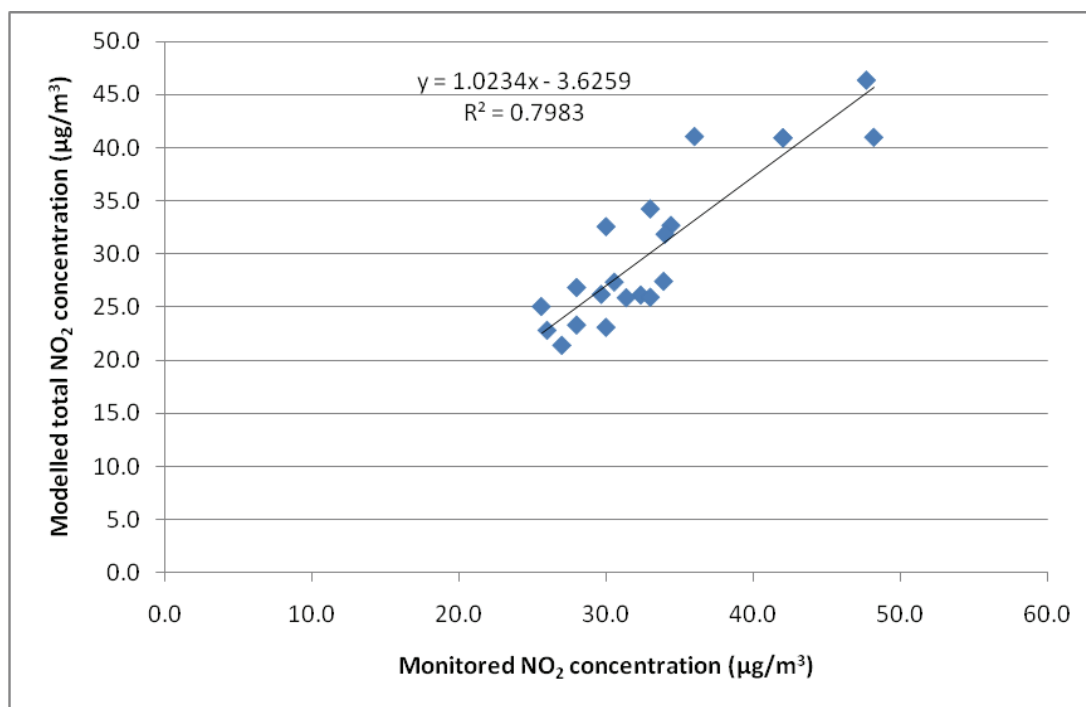
### 5.1.3 Model uncertainty

An evaluation of model performance in the form of quantification of the effects of random errors can be used to demonstrate the extent to which the modelled results agree with or diverge from the observations (*i.e.* the measured results) (Defra, 2009b). The uncertainty of the model can be expressed as the standard deviation of the model (SDM). The SDM is calculated using the following formula:

$$\text{SDM} = U \times \text{NO}_2 \text{ annual mean objective value } (\mu\text{g}/\text{m}^3)$$

Where: U = Standard deviation of differences between each adjusted modelled result and corrected modelled result ÷ measured data mean.

The corrected modelled result is calculated using the equation of the trend line shown in Figure 5.2 (see Table 5.4). This scatter plot shows the monitored and the adjusted modelled NO<sub>2</sub> annual average concentrations for each diffusion tube location included in the modelling assessment (data in Table 5.3).



**Figure 5.2: Comparison between monitored and modelled total NO<sub>2</sub>, 2008.**

**Table 5.4: Difference between corrected modelled NO<sub>2</sub> and adjusted modelled NO<sub>2</sub> concentrations, 2008.**

Site name	Measured NO <sub>2</sub> (µg/m <sup>3</sup> )	Adjusted modelled NO <sub>2</sub> (µg/m <sup>3</sup> )	Corrected adjusted modelled NO <sub>2</sub> (µg/m <sup>3</sup> ) <i>using equation: Corrected modelled = (1.0234 x measured) - 3.6259</i>	Difference between corrected adjusted modelled NO <sub>2</sub> and adjusted modelled NO <sub>2</sub>
<b>Suffolk Coastal District Council diffusion tube sites</b>				
FLX20	28.00	26.84	27.24	0.40
FLX22	28.00	23.31	27.24	3.93
FLX24	34.00	31.85	33.85	2.00
FLX25	33.00	34.24	32.75	-1.49
FLX26	<b>42.00</b>	40.92	42.67	1.75
FLX26 analyser	<b>42.01</b>	40.92	42.68	1.76
FLX27	36.00	41.06	36.06	-5.00
FLX28	30.00	32.57	29.44	-3.13
FLX29	30.00	23.09	29.44	6.35
FLX30	26.00	22.81	25.03	2.22
FLX31	33.00	25.92	32.75	6.83
FLX32	27.00	21.40	26.14	4.74
<b>Port of Felixstowe authority diffusion tube sites</b>				
1 North Quay Office	<b>48.16</b>	40.98	49.46	8.48
2 Mallard House	<b>47.65</b>	46.36	48.91	2.55
4 Pier House	32.35	26.13	32.04	5.91
5 Pier House	31.37	25.88	30.95	5.07
6 Landguard Eng	33.90	27.42	33.75	6.33
7 90 Park	29.68	26.19	29.09	2.90
8 90 Park	25.61	25.05	24.60	-0.45
9 75 Park	34.40	32.69	34.29	1.60
10 75 Park	30.56	27.35	30.06	2.71
<i>Standard deviation of difference between corrected adjusted modelled NO<sub>x</sub> and adjusted modelled NO<sub>x</sub> at each receptor location = 3.4</i>				

The standard deviation of the differences between each adjusted modelled result and corrected modelled result is used to calculate 'U'.

U = Standard deviation of differences between each adjusted modelled result and corrected modelled result ÷ measured data mean

$$U = 3.4 \div 33.5$$

$$U = 0.10$$

This equates to an uncertainty value of 10% for the annual mean NO<sub>2</sub> concentration.

Finally, the standard deviation of the model (SDM) is calculated as below:

$$SDM = 0.10 \times 40$$

$$SDM = 4.0 \mu\text{g}/\text{m}^3 \text{ for NO}_2.$$

This uncertainty value implies that locations where modelled concentrations range from 36 µg/m<sup>3</sup> to 44 µg/m<sup>3</sup> (*i.e.* 4 µg/m<sup>3</sup> above and below the annual average objective) could exceed the annual average objective concentration of 40 µg/m<sup>3</sup>.

## 5.2 Particulate matter (PM<sub>10</sub>) concentrations at receptors

Annual average modelled concentrations of PM<sub>10</sub> at each receptor are presented in Table 5.5. The model output shows no exceedances of the PM<sub>10</sub> annual average objective of 40 µg/m<sup>3</sup>. As such, it is not necessary to produce a contour plot to show the PM<sub>10</sub> concentrations over the grid.

**Table 5.5: Annual average PM<sub>10</sub> concentrations at modelled receptor locations, 2008.**

Site name	Modelled PM <sub>10</sub> annual average concentration (µg/m <sup>3</sup> )
<b>Suffolk Coastal District Council diffusion tube sites</b>	
FLX20	18.34
FLX22	17.98
FLX24	18.72
FLX25	18.50
FLX26	21.06
FLX26 analyser	21.06
FLX27	21.12
FLX28	18.63
FLX29	18.48
FLX30	18.46
FLX31	19.06
FLX32	18.20
<b>Port of Felixstowe authority diffusion tube sites</b>	
1 North Quay Office	22.91
2 Mallard House	23.93
4 Pier House	18.39
5 Pier House	19.08
6 Landguard Eng	19.33
7 90 Park	19.15
8 90 Park	18.95
9 75 Park	20.36
10 75 Park	19.39
<b>Other receptor locations</b>	
55 Dovedale	18.00
Wardens House	17.43
Caravan Park	17.95
Cherry Cottage	19.30

### 5.3 Sulphur dioxide (SO<sub>2</sub>) concentrations at receptors

Annual average concentrations of SO<sub>2</sub> modelled at each receptor are presented in Table 5.6.



**Table 5.6: Annual average SO<sub>2</sub> concentrations at modelled receptor locations, 2008.**

Site name	Modelled SO <sub>2</sub> annual average concentration (µg/m <sup>3</sup> )
<b>Suffolk Coastal District Council diffusion tube sites</b>	
FLX20	0.48
FLX22	0.29
FLX24	0.66
FLX25	0.39
FLX26	1.81
FLX26 analyser	1.81
FLX27	1.86
FLX28	0.54
FLX29	0.72
FLX30	0.72
FLX31	1.10
FLX32	0.56
<b>Port of Felixstowe authority diffusion tube sites</b>	
1 North Quay Office	3.58
2 Mallard House	4.04
4 Pier House	0.66
5 Pier House	1.13
6 Landguard Eng	1.27
7 90 Park	1.17
8 90 Park	1.05
9 75 Park	1.90
10 75 Park	1.33
<b>Other receptor locations</b>	
55 Dovedale	0.40
Wardens House	0.21
Caravan Park	0.31
Cherry Cottage	0.91

Table 5.7 presents the SO<sub>2</sub> percentiles, which are equivalent to the air quality objectives as follows:

- 15-minute objective (no more than 35 exceedances per year of 266 µg/m<sup>3</sup> measured over a 15-minute averaging period): approximately equal to the 99.9<sup>th</sup> percentile;
- 1-hour objective (no more than 24 exceedances per year of 350 µg/m<sup>3</sup> measured over a 1-hour averaging period): approximately equal to the 99.7<sup>th</sup> percentile;
- 24-hour objective (no more than 3 exceedances per year of 125 µg/m<sup>3</sup> measured over a 24-hour averaging period): approximately equal to the 99<sup>th</sup> percentile.

In line with LAQM TG (09) (Defra, 2009b) the relevant percentiles have been calculated as follows:

- 99.9%ile of total 15-minute average SO<sub>2</sub> = 15-minute average SO<sub>2</sub> source contribution + (2 x annual average background SO<sub>2</sub>)

- 99.7%ile of total 1-hour average SO<sub>2</sub> = 1-hour average SO<sub>2</sub> source contribution + (2 x annual average background SO<sub>2</sub>)
- 99%ile of total 24-hour average SO<sub>2</sub> = 24-hour average SO<sub>2</sub> source contribution + (2 x annual average background SO<sub>2</sub>)

It should be noted that there are no SO<sub>2</sub> monitoring sites within the Suffolk Coastal District with available data for the base year of 2008. LAQM TG (09) (Defra, 2009) states that SO<sub>2</sub> background maps derived from a base year of 2001 remain unchanged. The future year calculator available on the LAQM tools section of the UK Air Quality Archive<sup>24</sup> does not, however, provide a means of calculating SO<sub>2</sub> background concentrations. In this modelling assessment, therefore, the background concentration of SO<sub>2</sub> for the base year of 2008 was assumed to remain unchanged from the background concentration in 2005, which was calculated in the detailed assessment (SCDC, 2008a). The detailed assessment report (SCDC, 2008a) assumed the concentration in 2005 was equal to 75% of the 2001 concentration (*i.e.* 2005 background SO<sub>2</sub> concentration = 2.3 µg/m<sup>3</sup>). The approach used in the detailed assessment (SCDC, 2008a) is in line with LAQM TG (03) (Defra, 2003).

The model output shows no exceedances of the SO<sub>2</sub> objectives at any relevant receptor locations in 2008. As such, it is not necessary to produce a contour plot to show the SO<sub>2</sub> concentrations over the grid.

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<sup>24</sup><http://www.airquality.co.uk/laqm/tools.php>

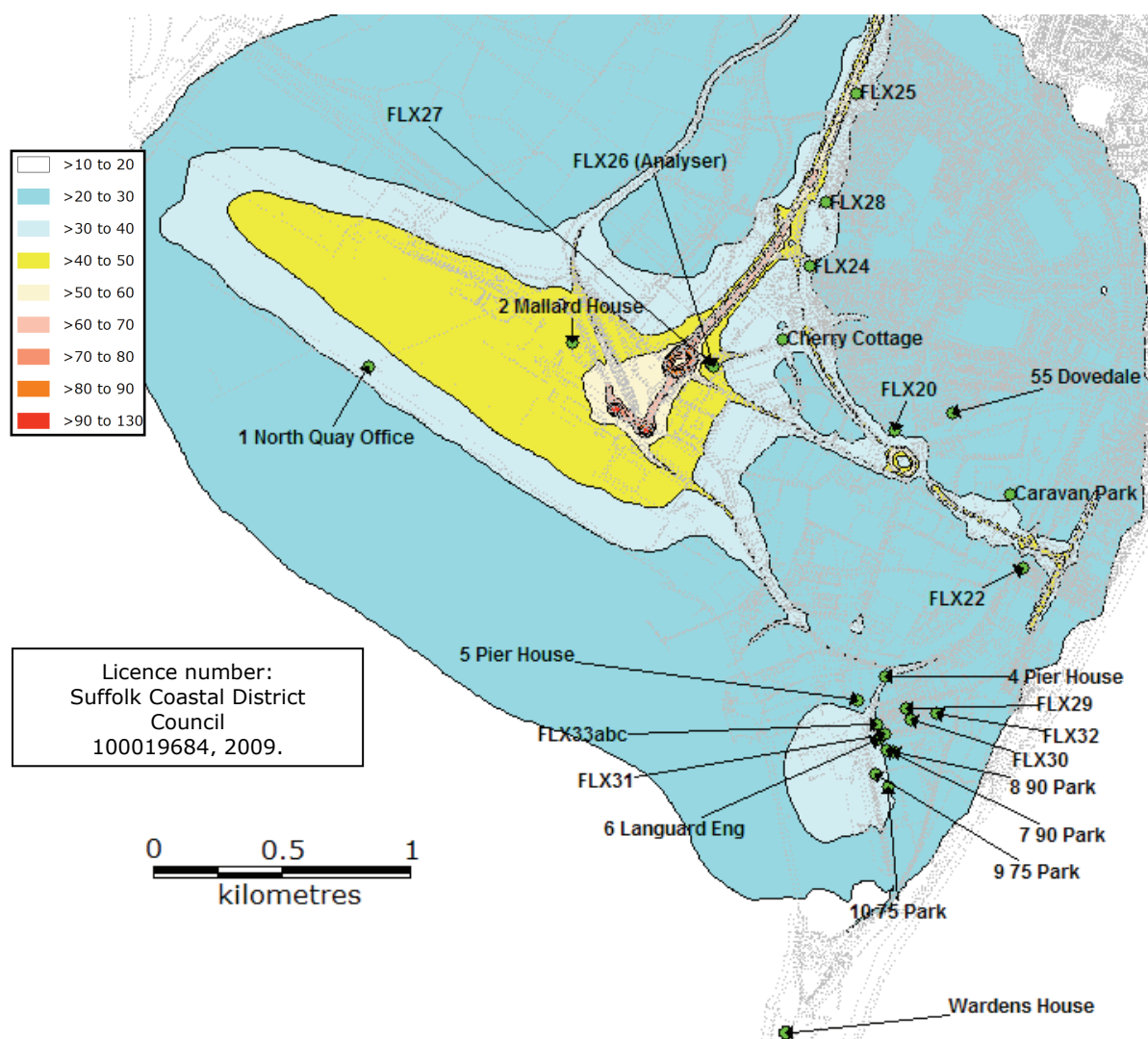
**Table 5.7: SO<sub>2</sub> concentrations (percentiles) at modelled receptor locations, 2008.**

Site name	99.9% 15-minute average SO <sub>2</sub> source contribution (µg/m <sup>3</sup> )	SO <sub>2</sub> 99.9 <sup>th</sup> percentile (µg/m <sup>3</sup> )*	99.7% 1-hour average SO <sub>2</sub> source contribution (µg/m <sup>3</sup> )	SO <sub>2</sub> 99.7 <sup>th</sup> percentile (µg/m <sup>3</sup> )*	99.9% 24-hour average SO <sub>2</sub> source contribution (µg/m <sup>3</sup> )	SO <sub>2</sub> 99 <sup>th</sup> percentile (µg/m <sup>3</sup> )*
<b>Suffolk Coastal District Council diffusion tube sites</b>						
FLX20	6.14	10.74	5.13	9.73	1.67	6.27
FLX22	4.94	9.54	4.02	8.62	1.12	5.72
FLX24	4.20	8.80	3.88	8.48	2.39	6.99
FLX25	3.08	7.68	2.80	7.40	1.42	6.02
FLX26	8.56	13.16	8.04	12.64	4.90	9.50
FLX26 analyser	8.56	13.16	8.04	12.64	4.90	9.50
FLX27	8.79	13.39	8.24	12.84	5.02	9.62
FLX28	3.66	8.26	3.24	7.84	1.91	6.51
FLX29	5.67	10.27	4.46	9.06	2.08	6.68
FLX30	5.59	10.19	4.42	9.02	2.18	6.78
FLX31	6.48	11.08	5.30	9.90	3.09	7.69
FLX32	5.56	10.16	4.31	8.91	1.75	6.35
<b>Port of Felixstowe authority diffusion tube sites</b>						
1 North Quay Office	13.57	18.17	12.74	17.34	9.33	13.93
2 Mallard House	13.04	17.64	11.92	16.52	7.40	12.00
4 Pier House	5.58	10.18	4.65	9.25	1.96	6.56
5 Pier House	6.99	11.59	6.27	10.87	2.97	7.57
6 Landguard Eng	6.87	11.47	5.87	10.47	3.43	8.03
7 90 Park	7.15	11.75	5.71	10.31	3.32	7.92
8 90 Park	6.64	11.24	5.40	10.00	3.06	7.66
9 75 Park	10.75	15.35	8.93	13.53	5.15	9.75
10 75 Park	9.16	13.76	7.63	12.23	3.79	8.39
<b>Other receptor locations</b>						
55 Dovedale	5.20	9.80	4.33	8.93	1.46	6.06
Wardens House	4.20	8.80	3.33	7.93	1.26	5.86
Caravan Park	5.17	9.77	4.11	8.71	1.20	5.80
Cherry Cottage	5.52	10.12	5.26	9.86	3.19	7.79

\*Modelled SO<sub>2</sub> source contribution + (2 x annual average background SO<sub>2</sub>)

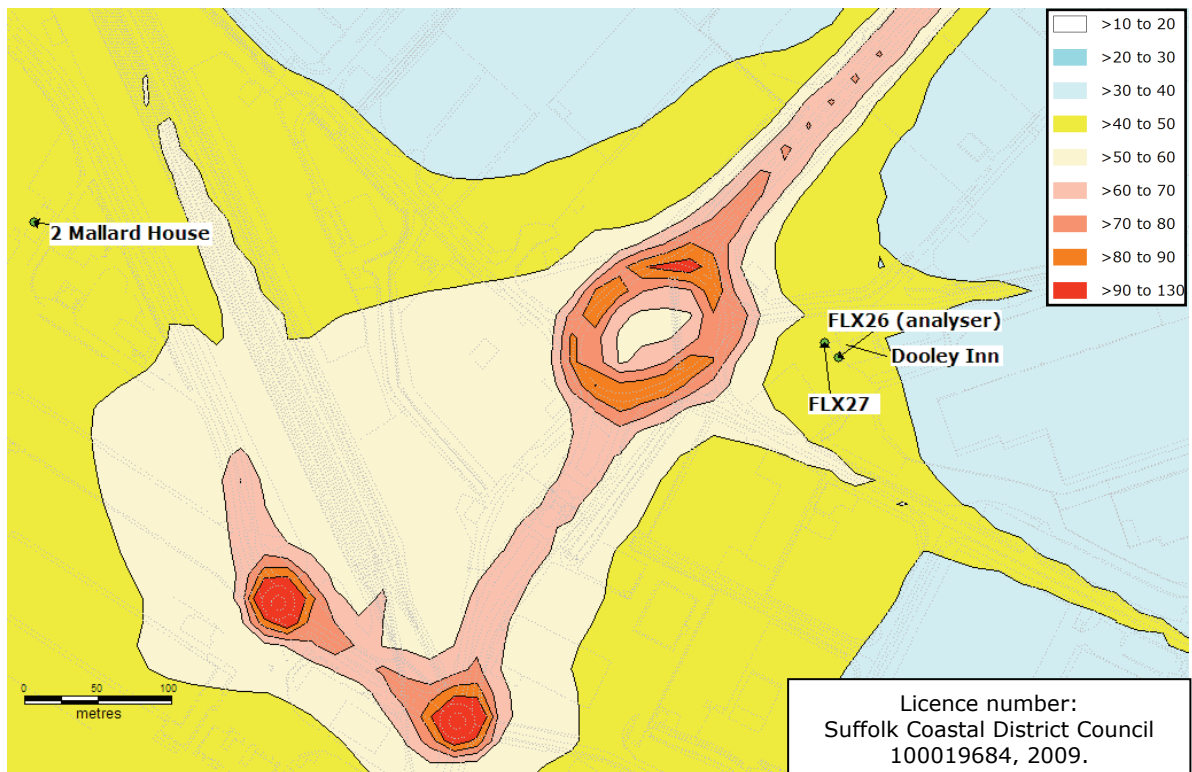
## 5.4 Concentrations over the model domain

In addition to modelling concentrations of NO<sub>2</sub>, PM<sub>10</sub> and SO<sub>2</sub> at selected receptors, concentrations of NO<sub>2</sub> have been modelled across the domain for the base year of 2008 (see section 4.7 for discussion of method). Figure 5.3 illustrates exceedance of the NO<sub>2</sub> annual average objective value across the Trinity Terminal in the area where container handling takes place (yellow to red shaded area). The area of exceedance incorporates receptors at the Dooley Inn and Mallard House. The receptor at Mallard House is within the port boundary and is not therefore relevant to the LAQM process because there is no relevant public exposure at this location. As such, it is not necessary or appropriate to declare an AQMA within the port boundary.



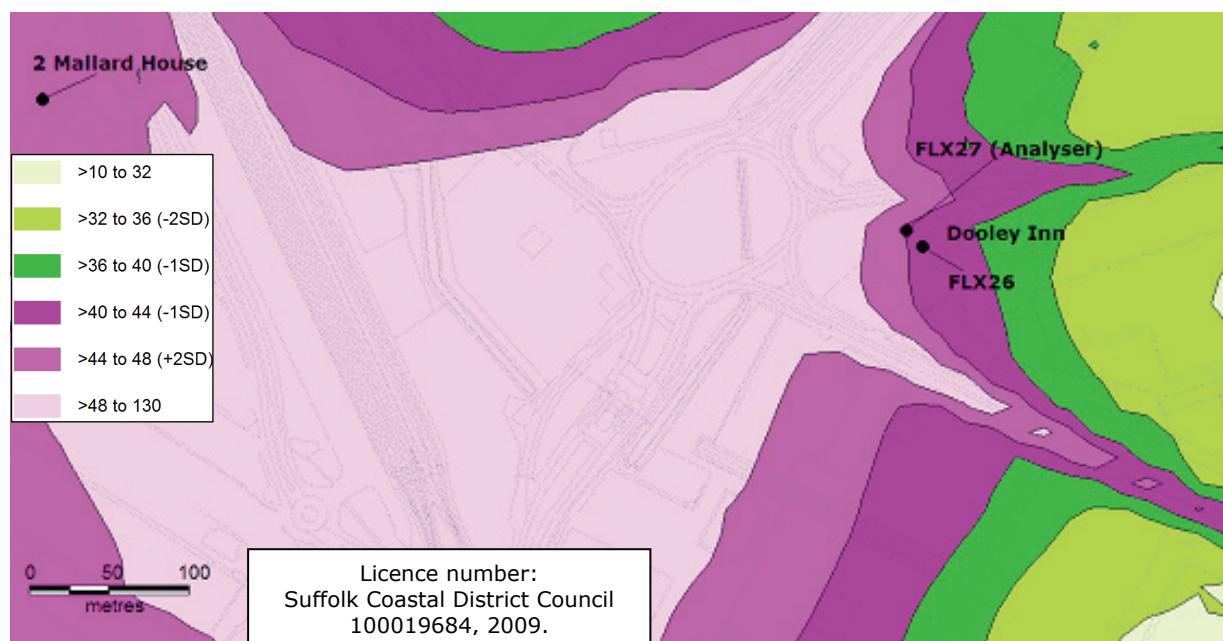
**Figure 5.3: Annual mean  $\text{NO}_2$  concentration ( $\mu\text{g}/\text{m}^3$ ) over the model domain, 2008.**

Figure 5.4 illustrates a zoomed image of the predicted concentrations in the vicinity of the Dooley Inn on Ferry Lane. This image confirms the findings of the 2008 detailed assessment (SCDC, 2008a) and shows that the current AQMA designation is correct based on the 2008 results.



**Figure 5.4: Zoomed plot of annual mean NO<sub>2</sub> concentration (µg/m<sup>3</sup>), Dooley Inn, Ferry Lane, 2008.**

Figure 5.5 also shows a zoomed image of the annual average NO<sub>2</sub> concentration. In this case, however, the contour bands have been modified to incorporate modelling uncertainty (*i.e.*  $\pm 2$  standard deviations from the annual average objective concentration) (see section 5.1.3). The area of potential exceedance is represented by the green and dark pink bands. At the centre of the light pink band is a region where the air quality is 'almost certain' ( $+2$  standard deviations) to exceed the air quality objective. Similarly, the region within the centre of the light green band is 'almost certain' ( $-2$  standard deviations) to comply with the objective. The Dooley Inn public house is situated in close proximity to the light pink region. In compliance with LAQM TG (09) (Defra, 2009b), SCDC are able to decide on the appropriate level of uncertainty that is used to define the AQMA boundary. The Council may wish to revise the boundary based on Figure 5.5, but the Council is not obligated to modify the AQMA boundary to incorporate model uncertainty.



**Figure 5.5: Zoomed plot of annual mean NO<sub>2</sub> concentration ( $\mu\text{g}/\text{m}^3$ ) incorporating modelling uncertainty bandwidths, Dooley Inn, Ferry Lane, 2008.**

## 6 Source apportionment

As part of the further assessment, a source apportionment exercise was conducted to calculate the proportion of NO<sub>x</sub> that is emitted from different sources, based on the modelling for the year 2008. This exercise has followed the recommended methodology outlined in LAQM TG (09) (Defra, 2009b). ADMS-Roads was run separately for different groups of sources to calculate their individual contributions to modelled NO<sub>x</sub> concentrations. For road vehicles, emissions were recalculated for HDVs and LDVs separately and the model was re-run with these emission rates.

The contribution of each source type was calculated for the receptor located at the Dooley Inn (FLX26). The results from this exercise are presented in Table 6.1. These results show that container handling operations (including vehicles on roads within the port boundary) are the largest group of sources that contribute to the modelled NO<sub>x</sub> concentrations at the Dooley Inn. Of the other source types, NO<sub>x</sub> emissions from HDVs travelling on roads outside the port boundary are the next largest contributor. NO<sub>x</sub> emissions from rail and LDVs are found to have a minimal impact on concentrations at the Dooley Inn. Background sources (as defined in section 4.5) make up the third largest contribution to NO<sub>x</sub> concentrations at the Dooley Inn. These findings will help SCDC in identifying appropriate measures to reduce emissions from the port vehicles and HDVs as part of the development of their air quality action plan.

**Table 6.1: Percentage contribution to NO<sub>x</sub> concentrations at the Dooley Inn receptor by source type, 2008.**

Source	Percentage contribution to NO <sub>x</sub> concentrations at the Dooley Inn receptor
External roads (HDV)	28.5%
External roads (LDV)	1.6%
Container handling	36.9%
Shipping	9.4%
Rail	1.1%
Background	22.6%

## 7 Conclusions

This air quality further assessment has been conducted on behalf of SCDC to clarify the AQMA designation at the Dooley Inn public house on Ferry Lane in Felixstowe. Air quality monitoring results for 2008 indicate that measured NO<sub>2</sub> concentrations exceeded the annual average objective value at the Dooley Inn and at several diffusion tube sites within the Port of Felixstowe boundary. (Those sites within the port boundary are not relevant to the LAQM process as there is no relevant public exposure at these locations). NO<sub>2</sub> concentrations at the Dooley Inn diffusion tube monitoring sites have declined slightly between 2006 and 2008.

A detailed air dispersion modelling exercise was conducted in order to confirm the measured concentrations and to determine if the situation has changed since the council produced their air quality detailed assessment (SCDC, 2008a). The ADMS-Roads model showed a tendency to under-predict NO<sub>x</sub> concentrations compared to those calculated from the NO<sub>2</sub> diffusion tube monitoring. As a result of this, the model was adjusted in line with LAQM TG (09) (Defra, 2009b). The resulting modelled NO<sub>2</sub> concentrations showed an average under-prediction at all modelled receptors of 8.5%. The model uncertainty was calculated as 4 µg/m<sup>3</sup>, which means that locations with modelled concentrations between 36 and 44 µg/m<sup>3</sup> could potentially exceed the annual average objective value of 40 µg/m<sup>3</sup>.

Ultimately, the modelling assessment has confirmed the findings of the 2008 detailed assessment (SCDC, 2008a). The NO<sub>2</sub> annual average objective concentration is likely to be exceeded at the Dooley Inn public house on Ferry Lane. This objective is also predicted to be exceeded at two receptors within the port boundary (North Quay Office and Mallard House). The locations within the port boundary are not relevant for public exposure and therefore declaration of an AQMA which incorporates these locations is not necessary or appropriate. In accordance with Figure 5.5 (which illustrates the uncertainty of the modelled results), SCDC may decide that it is appropriate to re-define the boundary of the existing AQMA. There is, however, no requirement for local authorities to assess the uncertainty of model predictions under the LAQM process (Defra, 2009b) and therefore the Council is not obligated to extend the AQMA boundary. Modelled concentrations of PM<sub>10</sub> and SO<sub>2</sub> were within the relevant AQS objective values across the model domain.

The source apportionment exercise found that at the Dooley Inn, the main contribution to modelled NO<sub>x</sub> concentrations was from container handling and vehicle activities in the port, followed by emissions from HDVs on roads outside the port boundary. Hence, successful air pollution mitigation strategies are likely to require joint-working and cooperation with the Port of Felixstowe authority.



## Acknowledgements

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## Glossary of terms and abbreviations

AADT	Annual average daily traffic
ADMS	Atmospheric dispersion modelling system
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
CO	Carbon monoxide
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
FSR	Felixstowe South Reconfiguration
GIS	Geographic Information System
HDV	Heavy duty vehicle (over 7.5 tonnes)
HGV	Heavy goods vehicle
IMV	Internal movement vehicle
LAQM	Local air quality management
LAQM PG	Local air quality management policy guidance
LAQM TG	Local air quality management technical guidance
LDV	Light duty vehicle (between 3.5 tonnes and 7.5 tonnes)
LGV	Light goods vehicle
NAEI	National Atmospheric Emission Inventory
NO	Nitric oxide
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>x</sub>	Oxides of nitrogen
O <sub>3</sub>	Ozone
PM	Particulate matter
PM <sub>10</sub>	Particulate matter with an aerodynamic diameter less than 10 microns
RTG	Rubber tyred gantry
SCDC	Suffolk Coastal District Council
SO <sub>2</sub>	Sulphur dioxide
TRADS	Traffic Information Database
TRL	Transport Research Laboratory
UKAS	United Kingdom Accreditation Service
WASP	Workplace Analysis Scheme for Proficiency

## Appendix A Air Quality Strategy (AQS) Objectives

**Table A.1: Summary of Air Quality Strategy (AQS) Objectives (Defra, 2007).**

Pollutant	Objective	Compliance date
NO <sub>2</sub>	Hourly mean concentration should not exceed 200 µg/m <sup>3</sup> more than 18 times a year. Annual mean concentration should not exceed 40 µg/m <sup>3</sup> .	31 December 2005
Particulate matter, expressed as PM <sub>10</sub>	24-hour mean concentration should not exceed 50 µg/m <sup>3</sup> more than 35 times a year. Annual mean concentration should not exceed 40 µg/m <sup>3</sup> .	31 December 2004 31 December 2005
	<i>Scotland:</i> 24-hour mean concentration should not exceed 50 µg/m <sup>3</sup> more than 7 times a year. Annual mean concentration should not exceed 18 µg/m <sup>3</sup> .	31 December 2010
Particulate matter, expressed as PM <sub>2.5</sub>	<i>UK urban areas</i> Target of 15% reduction in concentrations at urban background.	Between 2010 and 2020
	Annual mean concentration should not exceed 25 µg/m <sup>3</sup> .	31 December 2004
	<i>Scotland:</i> Annual mean concentration should not exceed 12 µg/m <sup>3</sup> .	
Benzene	Running annual mean concentration should not exceed 16.25 µg/m <sup>3</sup> .	31 December 2003
	<i>Scotland &amp; Northern Ireland:</i> Running annual mean concentration should not exceed 3.25 µg/m <sup>3</sup> .	31 December 2010
	<i>England &amp; Wales:</i> Annual mean concentration should not exceed 5 µg/m <sup>3</sup> .	31 December 2010
1,3-butadiene	Running annual mean concentration should not exceed 2.25 µg/m <sup>3</sup> .	31 December 2003
CO	Maximum daily running 8-hour mean concentration should not exceed 10 mg/m <sup>3</sup> . In Scotland it is expressed as a running 8-hr mean.	31 December 2003
PAHs	Annual mean concentration of B(a)P should not exceed 0.25 ng/m <sup>3</sup>	31 December 2010
Lead (Pb)	Annual mean concentration should not exceed 0.5 µg/m <sup>3</sup> . Annual mean concentration should not exceed 0.25 µg/m <sup>3</sup> .	31 December 2004 31 December 2008
SO <sub>2</sub>	Hourly mean of 350 µg/m <sup>3</sup> not to be exceeded more than 24 times a year. 24-hour mean of 125 µg/m <sup>3</sup> not to be exceeded more than 3 times a year. 15-min mean of 266 µg/m <sup>3</sup> not to be exceeded more than 35 times a year.	31 December 2004 31 December 2005
Ozone (O <sub>3</sub> )	Running 8-hour concentration of 100 µg/m <sup>3</sup> not to be exceeded more than 10 times a year	31 December 2005

Appendix B Traffic data

Table B.1: Traffic data, 2008.

Road link	AADT	Annual average speed (km/h)	Fleet composition						Total % HDV
			% passenger cars	% light goods vehicles	Total % LDV	% buses and coaches	% rigid HGV	% articulated HGV	
A14_4	4544	70.0	65.4	8.5	-	0.1	2.9	23.0	-
A14_5	4544	70.0	65.4	8.5	-	0.1	2.9	23.0	-
A14_6	9089	70.0	65.4	8.5	-	0.1	2.9	23.0	-
A14_EB_1	3607	94.9	-	-	73.1	-	-	-	26.9
A14_EB_3	10986	91.6	-	-	68.8	-	-	-	31.2
A14_WB_1	3929	85.9	-	-	74.1	-	-	-	25.9
A14_WB_3	10378	92.7	-	-	67.7	-	-	-	32.3
A154/B1082_R	9000	5.0	-	-	98.0	-	-	-	2.0
A154_14	4805	30.0	87.8	10.6	-	0.9	0.5	0.1	-
A154_15	4805	30.0	87.8	10.6	-	0.9	0.5	0.1	-
A154_16	9610	30.0	87.8	10.6	-	0.9	0.5	0.1	-
A154_17	3015	30.0	63.8	10.0	-	0.1	5.9	20.1	-
A154_18	3015	30.0	63.8	10.0	-	0.1	5.9	20.1	-
A154_19	6030	30.0	63.8	10.0	-	0.1	5.9	20.1	-
A154_20	3015	30.0	63.8	10.0	-	0.1	5.9	20.1	-
A154_21	3015	30.0	63.8	10.0	-	0.1	5.9	20.1	-
A154_22	10204	30.0	57.9	6.3	-	0.2	4.1	31.5	-
A154_23	10204	30.0	57.9	6.3	-	0.2	4.1	31.5	-
A45/A14_R	7500	30.0	-	-	40.0	-	-	-	60.0
A45_1	9797	30.0	85.1	12.6	-	0.1	1.5	0.6	
A45_2	9797	30.0	85.1	12.6	-	0.1	1.5	0.6	
A45_3	4898	30.0	85.1	12.6	-	0.1	1.5	0.6	
A45_4	4898	30.0	85.1	12.6	-	0.1	1.5	0.6	
CarrRd_1	3967	30.0	79.8	17.0	-	1.0	1.2	0.9	
CarrRd_2	3967	30.0	79.8	17.0	-	1.0	1.2	0.9	
DooleyRd	500	20.0	-	-	40.0	-	-	-	60.0
FerryLane_EB_1	2818	20.0	-	-	79.6	-	-	-	20.4

Road link	AADT	Annual average speed (km/h)	Fleet composition					
			% passenger cars	% light goods vehicles	Total % LDV	% buses and coaches	% rigid HGV	% articulated HGV
Ferrylane_EB_2	2818	20.0	-	-	79.6	-	-	-
Ferrylane_EB_3	2818	20.0	-	-	79.6	-	-	-
Ferrylane_WB_1	879	20.0	-	-	45.6	-	-	-
Ferrylane_WB_2	879	20.0	-	-	45.6	-	-	-
Ferrylane_WB_3	879	20.0	-	-	45.6	-	-	-
Ferrylane_WB_4	879	20.0	-	-	45.6	-	-	-
HodgkinsonRd_1	500	20.0	-	-	40.0	-	-	-
HodgkinsonRd_2	500	20.0	-	-	40.0	-	-	-
LangerRd_1	3967	30.0	79.8	17.0	-	1.0	1.2	0.9
Trinity_R	9802	5.0	59.7	6.2	-	0.2	3.6	30.4
TrinityAvenue_1	9802	30.0	59.7	6.2	-	0.2	3.6	30.4
TrinityAvenue_2	9802	30.0	59.7	6.2	-	0.2	3.6	30.4
TrinityAvenue_3	9802	30.0	59.7	6.2	-	0.2	3.6	30.4
TrinityAvenue_4	3000	30.0	59.7	6.2	-	0.2	3.6	30.4
TrinityAvenue_5	3000	30.0	59.7	6.2	-	0.2	3.6	30.4
TrinityAvenue_6	3000	30.0	59.7	6.2	-	0.2	3.6	30.4
AdastralClose_1	2500	30.0	79.8	17.0	-	1.0	1.2	0.9
AdastralClose_2	2500	30.0	79.8	17.0	-	1.0	1.2	0.9
AdastralClose_3	2500	30.0	79.8	17.0	-	1.0	1.2	0.9
AdastralClose_4	2500	30.0	79.8	17.0	-	1.0	1.2	0.9
ViewPointRd	1500	30.0	79.8	17.0	-	1.0	1.2	0.9
HGV_1	345	30.0	-	-	36.2	-	-	-
HGV_2	345	30.0	-	-	36.2	-	-	-
HGV_3	940	30.0	-	-	53.2	-	-	-
HGV_G1_In_1	297	20.0	-	-	33.7	-	-	-
HGV_G1_Out_1	297	20.0	-	-	33.7	-	-	-
HGV_G2_In_1	2237	20.0	-	-	17.9	-	-	-
HGV_G2_Out_1	2237	20.0	-	-	17.9	-	-	-
HGV_R1	9889	10.0	-	-	10.0	-	-	-
HGV_R2	1873	10.0	-	-	53.4	-	-	-

Road link	AADT	Annual average speed (km/h)	Fleet composition						Total % HDV
			% passenger cars	% light goods vehicles	Total % LDV	% buses and coaches	% rigid HGV	% articulated HGV	
IMV_1	4725	30.0	-	-	5.3	-	-	-	94.7
IMV_2	4725	30.0	-	-	5.3	-	-	-	94.7
IMV_3	690	30.0	-	-	36.2	-	-	-	63.8
IMV_4	690	30.0	-	-	36.2	-	-	-	63.8
IMV_R1	9200	10.0	-	-	2.7	-	-	-	97.3
IMV_R2	1380	10.0	-	-	36.2	-	-	-	63.8

Appendix C Shipping data

Table C.1: Shipping data, 2008.

Berth number	Vessel type	Gross tonnage	Number of ships per year in berth	Time in port (hours)	Time manoeuvring into berth (hours)	Time manoeuvring into channel (hours)	Main engine (kW)	Auxiliary engine (kW)
Roll on/roll off (RoRo) ferries								
R1	RoRo ferry	22900	789	24	0.50	0.25	16200	190
R2	RoRo ferry	22900	410	24	0.50	0.25	16200	190
Trinity Terminal								
2	Feeder container	<5000	301	36	0.50	0.50	2008	190
3	Feeder container	<5000	356	36	0.50	0.50	2008	190
4	Container	5000-20000	594	24	0.50	0.50	11250	690
5	Container	20000-50000	518	24	0.50	0.50	25411	1415
6	Container	50000-100000	138	44	0.50	0.50	52885	2470
7	Container	100000+	138	44	0.50	0.50	83107	3211
Landguard Terminal								
0	General cargo ships	<5000	5	24	0.50	0.50	2008	1100
1	General cargo ships	<5000	35	24	0.50	0.50	2008	1100
8	Containers	5000-20000	246	18	0.50	0.50	11250	690
9	Containers	5000-20000	48	18	0.50	0.50	11250	690
Other								
Dredger 1	Brabo	-	-	-	-	0.17	11000	-
Dredger 2	Crestway	-	-	-	-	1.00	6050	-
Dock basin	Tank ships	<5000	7	18	0.50	0.50	2008	190





# Further assessment for the Air Quality Management Area at Ferry Lane, Felixstowe



This report constitutes an air quality further assessment conducted by the Transport Research Laboratory (TRL Ltd) for Suffolk Coastal District Council (SCDC) as part of their Local Air Quality Management (LAQM) duties. The focus of the further assessment is an area to the south west of Felixstowe where an Air Quality Management Area (AQMA) was declared for annual nitrogen dioxide (NO<sub>2</sub>) concentrations at the Dooley Inn public house on Ferry Lane in 2009.

Annual mean concentrations of NO<sub>2</sub> and particulate matter with an aerodynamic diameter of less than 10 microns (PM<sub>10</sub>) and short-term (hourly) concentrations of sulphur dioxide (SO<sub>2</sub>) have been modelled using the ADMS-Roads dispersion model for the base year of 2008. The modelling assessment has confirmed the findings of the 2008 detailed assessment, with exceedance of the NO<sub>2</sub> annual average objective concentration predicted at the Dooley Inn public house on Ferry Lane. There are no predicted exceedances of the PM<sub>10</sub> or SO<sub>2</sub> objectives in the base year of 2008. Based on the modelled results, the recommendation is that the existing AQMA boundary for NO<sub>2</sub> is appropriate and should not be revoked.

A source apportionment exercise has been carried out to determine the contribution of sources to the total modelled concentration of oxides of nitrogen (NO<sub>x</sub>) at the Dooley Inn public house on Ferry Lane. Container handling activities in the port and heavy duty vehicles (HDVs) on roads external to the port were found to make the greatest contribution to NO<sub>x</sub> concentrations at this receptor.

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