Ospringe Street AQMA
LAQM Further Assessment

January 2013

DOCUMENT CONTROL SHEET

Issue/Revision	Issue 1	Issue 2		
Remarks	Draft for Comment	Final		
Date	28 August 2012	09 January 2013		
Submitted to	David Ledger	Sue Kennedy		
Prepared by	Lakhu Luhana	Lakhu Luhana		
Signature				
Approved by	Ben Warren	Ben Warren		
Signature				
Project number	AGGX5751725	AGGX5751725		
File reference		2830		

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Any questions or matters arising from this Report should be addressed in the first instance to the Project Manager (Lakhu Luhana).

Bureau Veritas UK Limited
Brandon House
180 Borough High Street
London
SE1 1LB

Telephone: +44 (0) 207 661 0700
Fax:: +44 (0) 027 661 0741
Registered in England 1758622
www.bureauveritas.co.uk

Registered Office
Brandon House
180 Borough High Street
London
SE1 1LB

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Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government guidance when undertaking such work.

Bureau Veritas has been commissioned by Swale Borough Council to provide a Further Assessment for the Ospringe Street AQMA declared in 2010.

The Further Assessment has been undertaken in accordance with DEFRA LAQM.TG(09)[1] Guidance methodologies, and updated tools released in 2012. This report aims through assessment of monitoring data and modelled predictions;

- to confirm the original assessment of air quality in the Ospringe AQMA against the prescribed objectives;
- to refine knowledge of the sources of pollution so that air quality action plan measures can be properly targeted;
- to detail source apportionment of pollutants, including relevance of background contributions and the different vehicle classification on the roads of concern; and
- to estimate the population exposed to exceedences of the AQS objectives in the proposed AQMA.

The information from the Further Assessment is required to assist with the preparation of Action Plan measures for this exceedence area in order that the measures may be targeted and focused, thereby prioritising the most cost-effective approach to reducing air pollutant concentrations.

The following are the findings of this Further Assessment:

- Updated monitoring and modelled results confirm that the Ospringe Street AQMA is still required in Faversham, as the NO_2 annual mean objective is still likely to be exceeded at relevant receptor locations;
- Compared to the Detailed Assessment, the 40µg/m3 and 36µg/m^3 contours have moved further north and south of Ospringe Street / London Road;
- The updated model results show that the AQMA should be extended in the east to include The Mount along London Road, which was recently converted to 17 flats ;
- The source apportionment shows that, road traffic pollution levels contribute significantly to the overall NO_x and NO_2 levels, respectively (85.4% and 73.5%). The average background contributions to the total NO_x and NO_2 levels across the AQMA are 22% and 35% respectively. Of the road traffic emissions, Heavy Goods Vehicles (HGVs) are the most significant contributors (35% of NO_x and 30% of NO_2), followed by cars (31% of NO_x and 27% of NO_2);
- The maximum reduction in NO_x concentrations (associated with road traffic) required to comply with the AQS objectives in the AQMA is about 83µg/m^3 (equivalent to a 59% reduction in road-NO_x levels). This equates to about 23µg/m^3 reduction in NO_2 (36% reduction). Consequently, measures formulated in the Local Action Plan should aim to reduce the levels of NO_x / NO_2 within the AQMA by these amounts or more;

[1] Defra (2009), Local Air Quality Management Technical Guidance LAQM.TG(09)

- Based on a population exposure calculation, it is estimated that 226 people are exposed to exceedences of the NO_2 annual mean AQS objective in the Ospringe AQMA; and
- Using roadside nitrogen dioxide projection factors from the Technical Guidance LAQM.TG(09), it is estimated that the annual mean objective is likely to be met at all locations by 2018. However, this could be an optimistic estimate, as projected concentrations are likely to be underestimated as shown by recent NO_2 monitoring trends across the UK.

1 Introduction

1.1 Project Background

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government guidance when undertaking such work. Bureau Veritas (BV) have been commissioned by Swale Borough Council to carry out the Local Air Quality Management (LAQM) Further Assessment in accordance with LAQM Technical Guidance 2009 (TG(09)) for the Ospringe Street/London Road (Air Quality Management Area (AQMA), in Faversham, declared in 2010.

This report is intended to supplement information gathered in the previous 2010 Detailed Assessment for the Ospringe Street AQMA in order to fulfil the Further Assessment requirements. It is also intended to inform Council of any need to extend or alter the AQMA.

The AQMA has been declared based on an exceedence of the annual mean Air Quality Strategy (AQS) objective for NO_2.

1.2 Legislative Background

The significance of existing and future pollutant levels are assessed in relation to the national air quality standards and objectives, established by Government. The revised Air Quality Strategy (AQS)[2] for the UK (released in July 2007) provides the over-arching strategic framework for air quality in the UK and contains national air quality standards and objectives established by the UK Government and devolved administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from the Limit Values prescribed in the EU Directives transposed into national legislation by member states.

The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The Directive 2008/50/EC[3] introduces new obligatory standards for $PM_{2.5}$ for Government but places no statutory duty on local Government to work towards achievement.

The Air Quality Standards (England) Regulations 2010[4] came into force on 11th June 2010 in order to align and bring together in one statutory instrument the Government's obligations to fulfil the requirements of the CAFE Directive.

The objectives for ten pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulates - PM_{10} and $PM_{2.5}$, ozone and Polycyclic Aromatic Hydrocarbons (PAHs)) have been prescribed within the Air Quality Strategy[2] based on the Air Quality (England) Regulations 2000 (SI 928) and the Air Quality (England) (Amendment) Regulations 2002 (SI 3043).

This assessment focuses on those pollutants included in Air Quality Regulations for the purpose of Local Air Quality Management[5], in respect of pollutant sources affecting air quality within the Council's administrative area. The objectives set out in the AQS for these pollutants are presented in the table below.

The locations where the AQS objectives apply are defined in the AQS as locations outside buildings or other natural or man-made structures above or below ground where members of the public are

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[2] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007), Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

[3] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

[4] The Air Quality Standards Regulations 2010, Statutory Instrument No 1001, The Stationary Office Limited

[5] The Air Quality (England) (Amendments) Regulations 2002 (Statutory Instrument 3043)

regularly present and might reasonably be expected to be exposed [to pollutant concentrations] over the relevant averaging period of the AQS objective. Typically these include residential properties and schools/care homes for longer period (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives.

Table 1 - Air Quality Objectives Included in the Air Quality Regulations for the Purpose of Local Air Quality Management

Pollutant	Objective	Concentration measured as	Date to be achieved by and maintained thereafter
Benzene All authorities	16.25 µg/m^3	running annual mean	31.12.2003
Authorities in England and Wales only	5.00 µg/m^3	annual mean	31.12.2010
1,3 Butadiene All authorities	2.25 µg/m^3	running annual mean	31.12.2003
Carbon monoxide Authorities in England, Wales and Northern Ireland only	10.0 mg/m^3	maximum daily running 8-hour mean	31.12.2003
Lead All authorities	0.5 µg/m^3	annual mean	31.12.2004
	0.25 µg/m^3	annual mean	31.12.2008
Nitrogen dioxide [a] All authorities	200 µg/m^3, not to be exceeded more than 18 times a year	hourly mean	31.12.2005
	40 µg/m^3	annual mean	31.12.2005
Particles (PM_{10}) (gravimetric) [b] All authorities	50 µg/m^3, not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 µg/m^3	annual mean	31.12.2004
Sulphur dioxide All authorities	350 µg/m^3 not to be exceeded more than 24 times a year	1 hour mean	31.12.2004
	125 µg/m^3 not to be exceeded more than 3 times a year	24 hour mean	31.12.2004
	266 µg/m^3 not to be exceeded more than 35 times a year	15 minute mean	31.12.2005

a EU Limit values in respect of nitrogen dioxide to be achieved by 1st January 2010. There are, in addition, separate EU limit values for carbon monoxide, sulphur dioxide, lead and PM10, to be achieved by 2005, and benzene by 2010.

b Measured using the European gravimetric transfer sampler or equivalent.

1.3 Local Air Quality Management (LAQM) Review and Assessment

As established by the Environment Act 1995 Part IV, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives set down by Government for a number of pollutants. The process of review and assessment of air quality undertaken by local authorities is set out under the LAQM regime and involves a phased three yearly assessment of local air quality. Where the results of the review and assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an AQMA – a geographic area defined by high levels of pollution and exceedences of AQS objectives.

The LAQM regime was first set down in the 1997 National Air Quality Strategy (NAQS)[6] and introduced the idea of local authority 'Review and Assessment'. The Government subsequently published policy and technical guidance related to the review and assessment processes in 1998. This guidance has since been reviewed and the latest documents include Policy Guidance (LAQM.PG(09))[7] and Technical Guidance (LAQM.TG(09))[8] released in February 2009 in anticipation of the fourth round of review and assessment. The guidance lays down a progressive, but continuous, framework for the local authorities to carry out their statutory duties to monitor, assess and review air quality in their area and produce action plans to meet the air quality objectives.

1.4 Summary of Review and Assessment in Swale Borough Council

Between 1998 and 2001, Swale Borough Council undertook its first round of review and assessment of air quality, which concluded that it was not necessary to declare an AQMA for any pollutant.

During the second round of review and assessment (2003 – 2005), measured exceedences of the nitrogen dioxide objective along the A2 at Ospringe resulted in a Detailed Assessment in 2005. Although dispersion modelling confirmed the risk of exceedence in the area, the report concluded that there were too many uncertainties due to lack of monitoring data. Therefore, an extensive monitoring programme was devised, including the installation of a new continuous monitoring station closer to the street canyon section, before deciding whether an AQMA was required for Ospringe.

During the third round of review and assessment, commencing in 2006 with a new Updating and Screening Assessment (USA), new exceedences of the NO_2 annual mean objective at several locations along the A2 in Newington were measured, and therefore a Detailed Assessment was carried out for this area. The Detailed Assessment, completed in 2007, recommended that an AQMA be declared in Newington based on the predicted exceedences in the High Street, following a 6-month monitoring period to provide more accurate NO_2 data. Additional monitoring confirmed the need for an AQMA, which was declared in March 2009 for parts of London Road and High Street in Newington. A Further Assessment, completed in 2010, confirmed the need for the AQMA and provided additional information, which was used to prepare the Air Quality Action Plan (AQAP) for the Newington AQMA. The draft AQAP was completed in 2010.

The fourth round of review and assessment commenced with the USA 2009. This identified measured exceedences of the annual mean nitrogen dioxide objective at seven locations in Swale outside the Newington AQMA, in Sittingbourne, and in Ospringe. Two of these sites were assessed in a new Detailed Assessment in 2009 focused on Canterbury Road/ East Street and St Paul's Street in Sittingbourne. The recommendation of the Detailed Assessment 2009 was to consider further AQMA designations at these locations, in addition to undertaking additional monitoring. The need for an AQMA in Ospringe was also reassessed in a new Detailed Assessment completed in 2010. The report confirmed the need for an AQMA in Ospringe, which was declared in May 2011.

The 2010 Annual Progress report confirmed exceedences of the annual mean NO_2 objective in Sittingbourne and Ospringe. For Sittingbourne, it was decided to carry out additional monitoring before considering declaration at these locations.

Swale Borough Council has reviewed the automatic monitoring sites within the borough and has installed an NO_2 analyser site in the Newington High Street AQMA, which commenced monitoring in January 2011. In addition, a new continuous monitor was installed at Canterbury Road/East Street

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6 DoE, 1997, 'The United Kingdom National Air Quality Strategy', The Stationary Office

7 Policy Guidance LAQM.PG(09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

8 Technical Guidance LAQM.TG (09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

in March 2011. Further monitoring at the original Newington site was carried out for 6 months during 2010 prior to the new site becoming operational.

Additionally, in 2011 an inventory of emissions in the Blue Town and Queenborough areas of Swale was completed. These findings have given a greater understanding of emission levels in Swale, will provide a baseline should any similar work be carried out in the future, and will help in any future modelling of atmospheric pollution levels in the borough. It was concluded that ships contribute the highest percentage of emissions for NOx, PM_{10} and SO_2 in the study area. Over 93% of the SO_2 emissions are attributed to marine vessels. They also contribute over 66% of overall NOx emissions, and 75% of PM_{10} emissions.

The 2011 Progress Report found that the further monitoring of the Canterbury Road/ East Street and St Paul's Street areas in 2010 confirmed the findings of the 2009 Detailed Assessment. It concluded AQMAs based on exceedences of the annual mean NO_2 concentrations should be declared for these two areas.

Figure 1 – Map of Newington AQMA

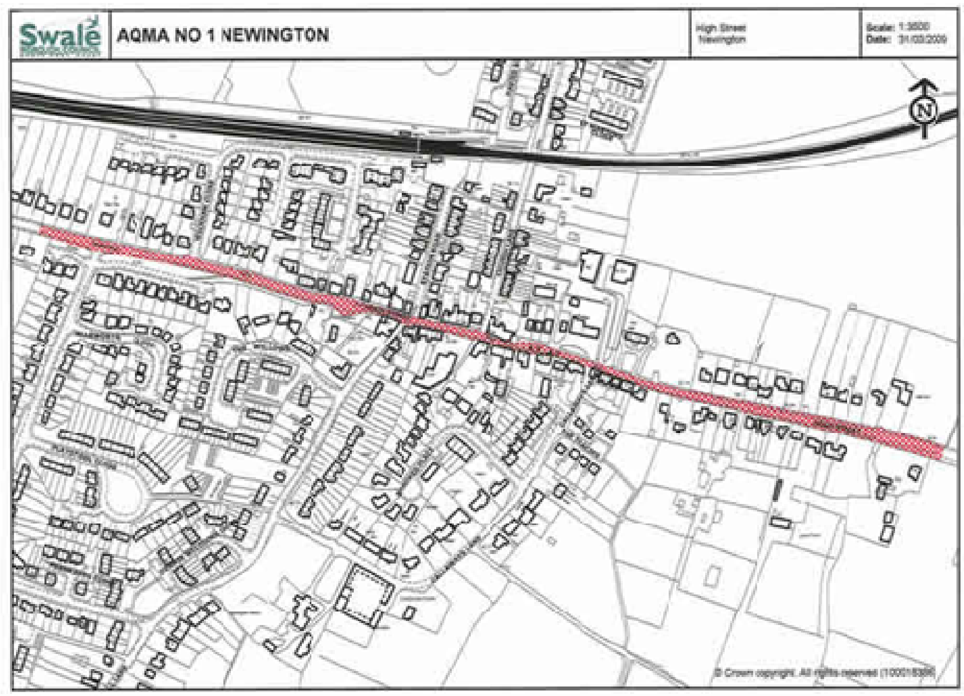
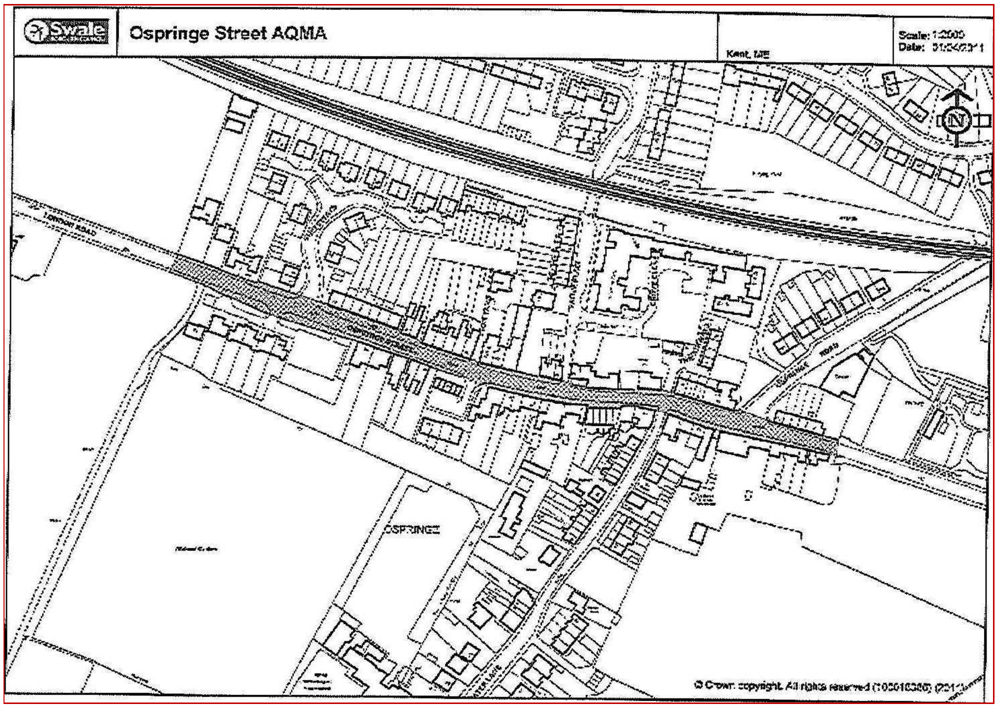


Figure 2 - Map of Ospringe AQMA



1.5 Scope and Methodology of the Further Assessment

The purpose of this Further Assessment is to provide the Local Authority with an opportunity to supplement the information gathered in the previous LAQM reports and confirm whether an AQMA is still required or whether its geographic extent requires amendment.

The methodology for the Further Assessment is based on dispersion modelling and includes the following:

- Review of additional monitoring since the Detailed Assessment – including continuous monitoring and diffusion tubes where possible;
- Assessment of the reduction in pollutant concentrations that is required to meet the AQS objectives in the AQMA;
- Consideration of any new guidance or policy issued since the decision to declare the AQMA;
- Source apportionment of pollutants, including relevance of background contributions and the different vehicle classification on the roads of concern; and
- Estimation of the population exposed to exceedences of the AQS objectives in the AQMA.

The dispersion modelling for the Assessment was carried out using the Cambridge Environmental Research Consultants (CERC) ADMS-Roads (v3.1) atmospheric dispersion model. Results from nitrogen dioxide monitoring sites located in the assessment area were used to verify and adjust the modelled results. Concentrations of NO_x and NO_2 were predicted for the year 2011.

The dispersion modelling was undertaken in accordance with the methodologies provided in the Technical Guidance (LAQM.TG (09)) for Further Assessments and used the latest tools released in 2012.

2 Baseline Information

2.1 Traffic Data

The following roads were included in the modelling:

- The A2 Ospringe Street / London Road;
- The B2040 Ospringe Road; and
- Water Lane.

The traffic data for 2011 was obtained from the following sources:

- Traffic data for the A2 Ospringe Street / London Road was obtained from Department for Transport's (DfT) traffic counts website[9]. The site provides traffic data for Annual Average Daily Flows (AADF) and detailed breakdown into vehicle categories – motor cycles, cars, Light Goods Vehicles (LGVs), buses, rigid and artic heavy goods vehicles.
- Traffic data for the B2040 Ospringe Road was obtained from the Ospringe DA 2010[10]. The report provides traffic flows for 2009, which were projected to 2011 using the latest version of Tempro[11] and National Traffic Model adjusted for the Faversham area. The data was provided as LDVs (Light Duty Vehicles – include motorcycles, cars and LGVs) and HDVs (Heavy Duty Vehicles – include buses and rigid and artic HGVs). The proportion of subclasses within LDVs and HDVs was assumed the same as on Ospringe Street/London Road.
- Water Lane is an unclassified minor road. Data for Water Lane was obtained from the Swale USA 2006[12]. The report provides traffic flows for 2005, which were projected to 2011 using the latest version of Tempro[13] and National Traffic Model adjusted for the Faversham area. The data was provided as LDVs (Light Duty Vehicles – include motorcycles, cars and LGVs) and HDVs (Heavy Duty Vehicles – include buses and rigid and artic HGVs). The proportion of subclasses within LDVs and HDVs was assumed the same as on Ospringe Street/London Road.

The average speed of vehicles was assumed to be the speed limit (30mph/48kph), although speed was reduced to 30kph near junctions.

In order to calculate NO_x exhaust emissions, traffic data was combined with the latest road-traffic Emission Factors Toolkit (EFT)[14], released by DEFRA in 2012. The traffic data used in this assessment is summarised in Table 2.

[9] http://www.dft.gov.uk/traffic-counts/

[10] Ospringe NO2 LAQM Detailed Assessment 2010 BV/AQ/AGGX4140128/2653, August 2010

[11] Tempro (Trip End Model Presentation Program) version 6.2, 62 datasets, Department for Transport

[12] Swale BC LAQM Updating and Screening Assessment, BV/AQ/AMCX0425, June 2006

[13] Tempro (Trip End Model Presentation Program) version 6.2, 62 datasets, Department for Transport

[14] Emission Factors Toolkit v5.1.2 – Available at http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html

Table 2 - Further Assessment Traffic data

Road		AADT	M. Cycles	Cars	LGVs	Buses	HGVs Rigid	HGVs Artic
The A2 Ospringe St / London Rd	Flow	16948	127	13252	2519	68	606	376
	%		0.7%	78.2%	14.9%	0.4%	3.6%	2.2%
The B2040 Ospringe Rd	Flow	3566	27	2868	545	8	72	45
	%		0.8%	80.4%	15.3%	0.2%	2.0%	1.3%
Water Lane	Flow	1237	10	1016	193	1	11	7
	%		0.8%	82.1%	15.6%	0.1%	0.9%	0.5%

2.2 Air Quality Monitoring Data

2.2.1 Automatic Monitoring data

In 2011, Swale Borough Council undertook automatic monitoring of nitrogen dioxide (NO_2) at three roadside locations using chemiluminescence analysers. One of these sites is located in the Ospringe AQMA and is called Ospringe Roadside (2) site.

The Ospringe Roadside (2) site is located within the area being modelled and its results have been used in the model verification processes. The site is located beside a single storey building which gives more open aspect compared to nearby street canyons where concentrations are influenced by poor dispersion. The results from Ospringe Roadside (2) 2008-2011 are shown in Table 3. The data do not show any exceedences of the annual mean objective for NO_2. The annual mean concentration of 38.8µg/m^3 shown for 2011 is lower than adjusted results from diffusion tubes at worst case locations within the canyon, which show exceedence of the 40µg/m^3 threshold.

Table 3 – Annual Mean NO_2 Concentration, µg/m^3, for Ospringe Roadside Site, 2008-2011

Site Name	X OS Grid Ref	Y OS Grid Ref	Valid Data Capture 2011 %	Annual Mean Concentration, µg/m3			
				2008	2009	2010	2011
Ospringe Roadside 2	600395	160892	97	34	31	38.6	38.8

2.2.2 Nitrogen Dioxide Diffusion Tube Data

Table 4 provides details of non-automatic monitoring locations within the area covered by this Further Assessment. Non-automatic monitoring is undertaken using passive NO_2 diffusion tubes. All the diffusion tubes fall within the Ospringe AQMA. The location of diffusion tubes is shown in Figure 3.

The Council monitored NO_2 at a number of sites across the Borough in 2011, a number of which are triplicate sites. Seven of these sites are in the location of this Detailed Assessment and are used in this study.

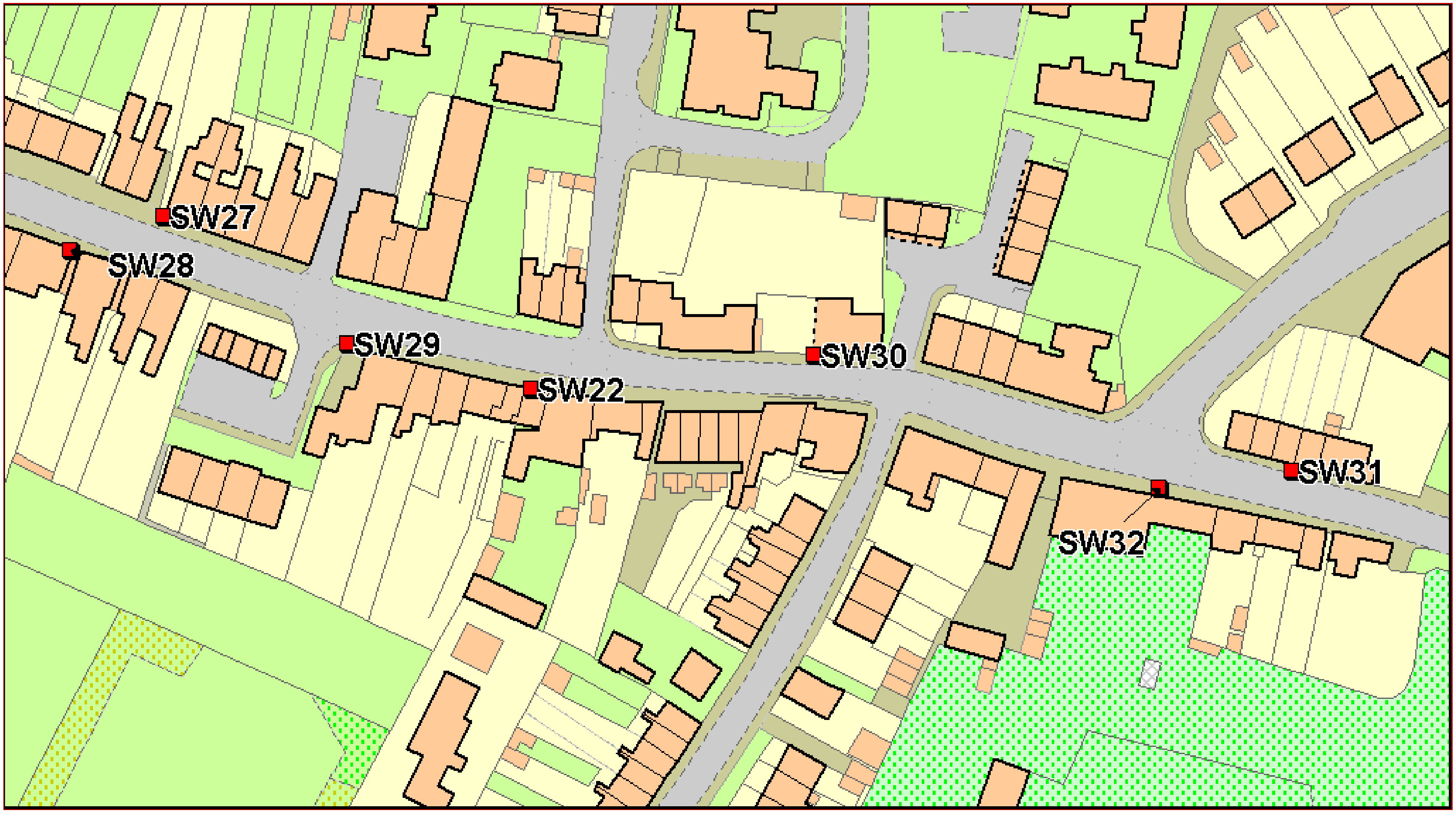
The diffusion tubes are supplied and analysed by Environmental Science Group formally Harwell Scientifics utilising the 50% Triethanolamine (TEA) in acetone preparation method.

With regard to the application of a bias adjustment factor for the diffusion tubes, the technical guidance LAQM.TG (09) recommends use of a local bias adjustment factor where available with good data capture and relevant to the diffusion tube sites. For 2011, local bias adjustment factor of 0.89 derived from the Ospringe co-location study has been used. Bias adjustment factor for the previous years reported in Table 4 is also derived from local co-location studies.

Table 4 – Diffusion Tube results from the Assessment Area

Site ID	Name	X	Y	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Data Capture 2011 %	NO_2 Annual Average (µg/m^3 - Bias Adjusted)				
						2007 Bias Factor: 0.81	2008 Bias Factor: 0.78	2009 Bias Factor: 0.81	2010 Bias Factor: 0.85	2011 Bias Factor: 0.89
SW22	Site 1, 35 Ospringe Street, Faversham	600307	160863	Y-0	100	**49.0**	**54.0**	**48.0**	**60.0**	**59.6**
SW27	Site 3, 44 Ospringe Street, Faversham	600241	160894	Y-0	83	28.0	25.0	24.0	28.0	27.8
SW28	Mayors Arms, Ospringe Street, Faversham	600224	160888	Y-0	92	**49.0**	**52.0**	**43.0**	**58.0**	**56.7**
SW29	Opp Lions Yard Site 5 43 Ospringe Road	600286	160868	Y-0	100	**46.0**	**50.0**	**45.0**	**54.0**	**55.1**
SW30 x3	ZW3 Ospringe Street, Faversham (triplicate)	600358	160869	Y-0	100	32.0	35.0	30.0	39.0	38.8
SW31	Site 7, 4 Ospringe Street, Faversham	600444	160849	Y-1.4	100	**47.0**	**46.0**	**41.0**	**55.0**	**46.5**
SW32	Site 8, 11 Ospringe Street, Faversham	600419	160844	Y1.2	100	39.0	**47.0**	**41.0**	**49.0**	**45.9**

Figure 3 – Location of Diffusion Tubes in Ospringe AQMA



2.2.3 Background Concentrations

Dispersion modelling allows the estimation of the road traffic contributions to overall NO_x concentrations, also referred to as road-NO_x concentrations. To predict the overall concentrations, background pollutant concentrations were added to the road traffic contribution.

As there is no local background air quality monitoring site in Swale Borough Council, background concentrations for NO_x and NO_2 were obtained from the latest UK pollutant background maps[15]. These maps provide a modelled background pollutant concentration for each OS 1km×1km grid square in the UK. At the time of reporting, revised 2010 background maps have been released. The 2010 maps are based on updated information available since the production of 2008-based maps. Therefore, whilst a map for 2011 is not available, the 2010 map has been used for the assessment. This represents a conservative approach.

Modelled pollutant concentrations of NO_X and NO_2 were obtained for the 1km square in which the AQMA is located. Background air quality levels used in this assessment are shown in Table 5.

Table 5 - Background Concentrations Used for the Assessment

Pollutant	Estimated National Background Map at Ospringe - 2010 ($\mu g/m^3$) *
NO_x	23.9
NO_2	16.7

* From grid square (x=600500, y=160500)

3 Dispersion Modelling Methodology

Detailed dispersion modelling of road-NO_x emissions was undertaken using ADMS-Roads (version 3.1) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC). Conversion to NO_2 was based on the updated NO_X/NO_2 conversion model released by Defra in January 2010 as part of the updated LAQM.TG (09) tools[16], and background maps and Emission Factor Toolkit (EFT) released in 2012.

ADMS-Roads is an advanced Gaussian dispersion model, which has been extensively used in local air quality management and has formed the basis for many AQMA declarations. A number of validation studies have been completed, showing overall good agreement between model outputs and observations at continuous monitoring sites but that local verification is important to improve performance.

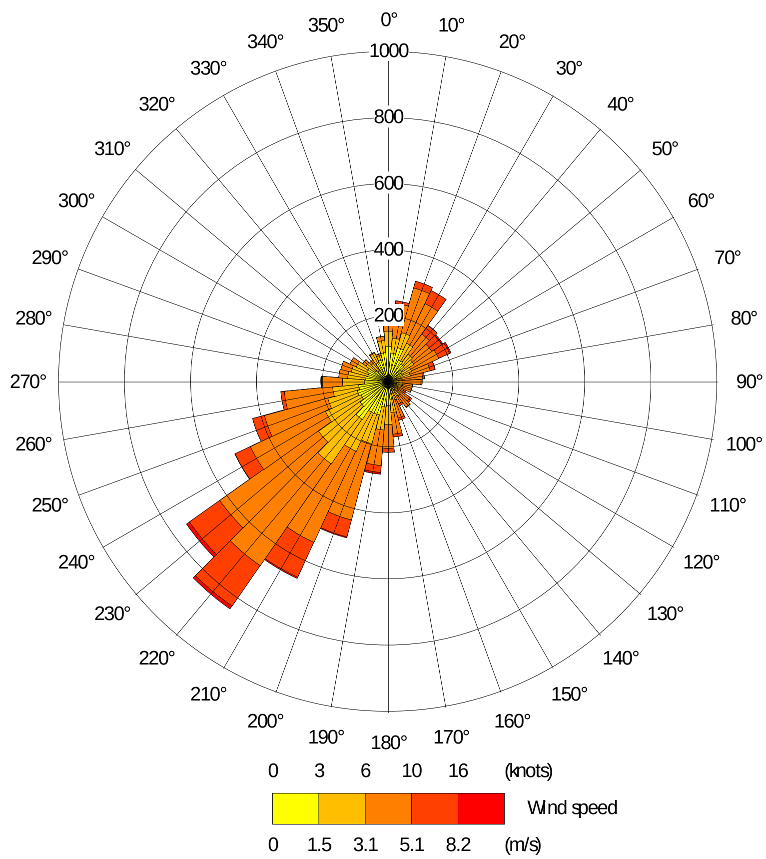
Dispersal of pollutant emissions is dependent (amongst other factors like topography and street canyon effects) upon the prevailing meteorological conditions at the time of emissions release. Hourly sequential meteorological data for 2011 from the closest Met Office station (Charlwood) has been used in this assessment. The wind rose derived from meteorological data is shown in Figure 4.

[15] Estimated background air pollution levels for the UK - http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

[16] http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php

Where street canyons were identified from maps and available geographic tools, these have been incorporated into the modelling to account for reduced dispersion.

Figure 4 – Charlwood 2011 Hourly Sequential Meteorological data



4 Results

4.1 Model Verification and Adjustment

Model verification was carried out at monitoring sites prior to predicting concentrations within the assessment area at sensitive receptor locations. The objectives of the model verification are:

- to evaluate model performance;
- to show that the baseline is well established; and
- to provide confidence in the assessment results.

Comparison of the modelled and monitored results was carried out based on local NO_2 monitoring data from diffusion tubes in the assessment area. NO_2 concentrations were calculated from predicted NO_x concentrations, using the latest NO_x/NO_2 conversion model released by Defra in January 2010[16].

During the verification process, Bureau Veritas aim to ascertain whether all final modelled NO_2 concentrations are within 25% of the monitored NO_2 concentrations. Modelled results may not compare as well at some locations for a number of reasons including:

- Errors in traffic flow and speed data estimates;
- Model setup (including street canyons, road widths, receptor locations);
- Model limitations (treatment of roughness and meteorological data);
- Uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors and annualisation of short-term data); and
- Uncertainty in emission factors.

The above factors were investigated as part of the model verification process to minimise the uncertainties as far as practicable.

All of the monitoring sites except one were included in the model verification. This included one continuous monitor and five diffusion tubes. The diffusion tube SW27 was not included in the verification as results were about 30µg/m^3 lower than the other nearby tubes, and therefore would have reduced predicted concentrations.

The model verification results are provided in Table 6 . The model verification yielded an adjustment factor of 1.917. The model predicted road-NO_x for all the specific and grid receptors was multiplied with this factor. The adjusted road-NO_x values were used to calculate NO_2 concentrations using the latest NO_x/NO_2 conversion model[16]. The full verification methodology is shown in Appendix 1. Final verified concentrations are in good agreement with monitoring data, as modelled results are within ±25% of monitored concentrations.

Table 6 - Model Verification Results at Monitoring Sites Ospringe AQMA

Site	Within AQMA (Yes/No)	Modelled NO_2 2011 (µg/m^3)	Monitored NO_2 2011 (µg/m^3)	Difference (Modelled - Monitored) (µg/m^3)	Percentage Difference
SW22	Yes	**58.3**	**59.6**	-1.3	-2.2%
SW28	Yes	**58.2**	**56.7**	1.5	2.7%
SW29	Yes	**60.0**	**55.1**	4.9	8.9%
SW31	Yes	**52.0**	**46.5**	5.5	11.8%
SW32	Yes	**40.1**	**45.9**	-5.8	-12.6%
Ospringe2_SW30	Yes	**46.1**	38.8	7.3	18.9%
Summary					
Number of sites	Within ±10%			3	
	Between ± 10-25%			3	
	Exceeds ±25%			0	
	Total			**6**	
In bold: exceedence of NO_2 annual mean AQS objective					

4.2 Modelled NO_2 Concentrations

Annual average NO_2 concentrations were predicted for 2011 at a number of specific receptors across the modelled area representing relevant public exposure, located at the facade of properties. Additionally, predictions were made on a 3m grid spacing across the assessment area to produce NO_2 concentration isopleth maps for year 2011. All properties were modelled having ground floor exposure (1.5m). The locations of the specific receptors are shown in Figure 5.

Figure 5 - Specific Receptor Locations

The results for specific receptors are presented in Table 7 below. Diagrams showing the 40µg/m^3 and 36µg/m^3 contour lines are presented in Appendix 2.

Results of the predicted annual mean concentrations at fifty one specific receptors are summarised below:

- The model predicted exceedences of the NO_2 annual mean AQS objective for annual NO_2 in 2011 along Ospringe Street/London Road, which confirms the need for an AQMA;
- 39 receptors show exceedences of the annual mean NO_2 objective (>40µg/m^3);
- 2 receptors show concentrations within 10% of the objective (36µg/m^3);
- 10 receptors show concentrations below 36µg/m^3; and
- All the receptors placed outside the AQMA show concentrations less than 36µg/m^3, which indicate that the exceedences are not occurring.

The predicted results are systematically higher by about 8-12µg/m^3 compared to the Detailed Assessment results, which used 2009 as the baseline year. This trend is also reflected in the monitoring data. The average of annual mean NO_2 concentrations from all the monitoring locations in the AQMA in 2009, 2010 and 2011 was 38.9µg/m^3, 49.0µg/m^3 and 47.2µg/m^3 respectively.

The NO_2 concentration contour map shows exceedences of the annual mean objective at The Mount, situated east of the current AQMA along London Road. Recently, The Mount was converted to 17 flats. Therefore, the Council should consider extending the AQMA along London Road to include The Mount.

Table 7 - Predicted NO_2 Concentrations at Specific Modelled Receptors

Receptor ID	X(m)	Y(m)	Z(m)	In AQMA?	Annual Mean NO_2 2011, µg/m^3
1	600450.8	160902.4	1.5	No	29.5
2	600454.7	160846.7	1.5	Yes	**56.3**
3	600454.1	160836.9	1.5	Yes	**46.9**
4	600442.8	160839.2	1.5	Yes	**46.1**
5	600430.6	160841.7	1.5	Yes	**44.9**
6	600431.7	160852.5	1.5	Yes	**58.0**
7	600402.6	160847.2	1.5	Yes	**42.1**
8	600410.0	160858.7	1.5	Yes	**56.1**
9	600392.1	160863.6	1.5	Yes	**54.9**
10	600388.6	160851.3	1.5	Yes	**42.3**
11	600377.3	160868.0	1.5	Yes	**54.3**
12	600374.4	160856.2	1.5	Yes	**44.8**
13	600370.0	160869.6	1.5	Yes	**51.4**
14	600367.4	160858.3	1.5	Yes	**45.3**
15	600356.7	160860.5	1.5	Yes	**45.0**
16	600346.9	160869.5	1.5	Yes	**50.7**
17	600349.0	160860.7	1.5	Yes	**43.8**
18	600337.5	160858.9	1.5	Yes	38.8
19	600330.7	160860.5	1.5	Yes	**40.4**

Receptor ID	X(m)	Y(m)	Z(m)	In AQMA?	Annual Mean NO_2 2011, µg/m^3
20	600330.1	160870.5	1.5	Yes	**50.4**
21	600321.0	160875.3	1.5	Yes	**45.3**
22	600318.2	160861.1	1.5	Yes	39.4
23	600312.3	160874.9	1.5	Yes	**57.3**
24	600310.6	160862.9	1.5	Yes	**60.0**
25	600304.7	160876.5	1.5	Yes	**57.7**
26	600302.7	160864.0	1.5	Yes	**59.7**
27	600435.2	160890.2	1.5	No	32.2
28	600444.6	160896.4	1.5	No	30.9
29	600462.9	160910.0	1.5	No	28.5
30	600475.3	160916.8	1.5	No	27.9
31	600488.8	160924.0	1.5	No	27.4
32	600433.4	160859.1	1.5	Yes	**48.1**
33	600291.5	160878.9	1.5	Yes	**58.6**
34	600291.1	160866.6	1.5	Yes	**61.8**
35	600277.2	160869.9	1.5	Yes	**63.0**
36	600278.2	160882.0	1.5	Yes	**60.5**
37	600257.7	160871.6	1.5	Yes	34.1
38	600261.8	160887.0	1.5	Yes	**57.6**
39	600240.2	160883.1	1.5	Yes	**60.7**
40	600246.4	160892.1	1.5	Yes	**58.8**
41	600225.9	160887.8	1.5	Yes	**58.8**
42	600229.7	160899.7	1.5	Yes	**49.0**
43	600215.4	160891.4	1.5	Yes	**58.5**
44	600216.0	160905.7	1.5	Yes	**46.8**
45	600201.6	160911.0	1.5	Yes	**46.4**
46	600189.6	160914.9	1.5	Yes	**45.2**
47	600171.0	160924.7	1.5	Yes	**41.1**
48	600162.7	160897.2	1.5	Yes	28.0
49	600146.9	160903.0	1.5	Yes	27.9
50	600134.1	160906.6	1.5	Yes	27.5
51	600138.4	160935.0	1.5	Yes	**42.8**

Analysis of UK continuous NO_2 monitoring data has shown that the annual mean concentration greater than 60µg/m^3 [17] indicate a risk of exceedences of the hourly mean NO_2 objective, of 18 hourly means over 200µg/m^3. The predicted annual mean concentrations at four receptors were in excess of 60µg/m^3, which indicated a potential for exceedences of the hourly mean NO_2 objective. The dispersion model was used to calculate 99.8th percentile and was found to be less than 200µg/m^3 at all the modelled receptors. However, it will be appropriate to continue monitoring to assess the potential for exceedences of the hourly mean objective.

[17] Analysis of the relationship between annual mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective – AEA - 2008

4.3 Source Apportionment

The breakdown of vehicle classification was taken into account in the model set-up. This has allowed determination of NO_x source apportionment at specific (worst-case) receptors in the modelled area where exceedences were predicted. The source apportionment was carried out for the following vehicle classes:

- Cars;
- Light Goods Vehicles (LGVs);
- Buses; and
- Heavy Goods Vehicles (HGVs).

LAQM.TG(09) also recommends the calculation of regional background (for which local authorities do not have control over) and local background contribution (which authorities should have some influence over).

Proportions of each background source category from the modelled background maps have been used to categorise the regional and local background NO_x and NO_2 concentrations in the assessment area. As undertaking NO_2 source apportionment is not as simple as for NO_x due to the non-linear relationship between NO_x and NO_2 emissions, NO_2 contributions have been estimated based on Technical Guidance LAQM.TG(09).

The tables below summarise the results for NO_x and NO_2 respectively at the worst-case receptor on Ospringe Street, representing public exposure in the exceedence areas.

4.3.1 NO_x Source Apportionment

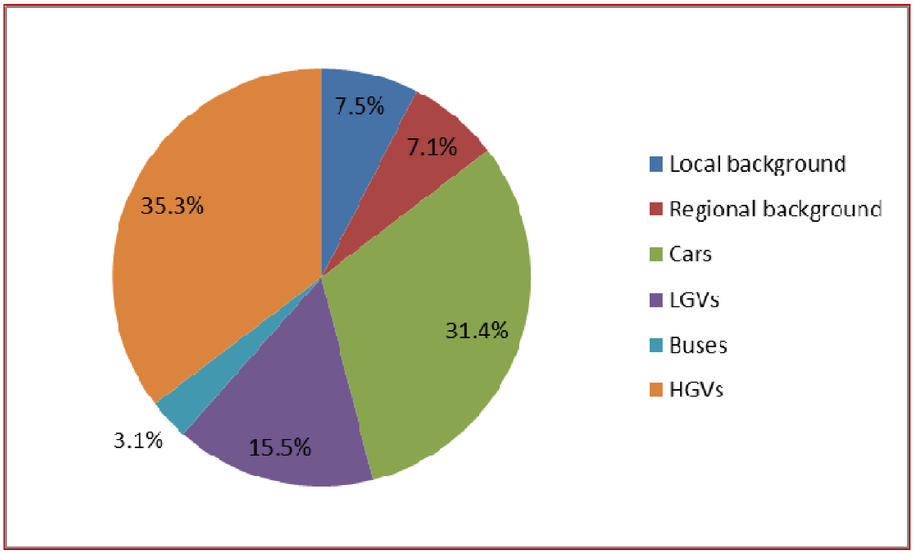
The source apportionment indicates that, at the worst-case receptor (Specific Receptor 35) located on Ospringe Street:

- Road traffic emissions of NO_x account for 85.4% of the total NO_x concentration;
- Local background sources contribute to 7.5% of the total NO_x concentration, while regional background sources (outside the local authority's control) contribute to 7.1% of the total NO_x;
- The breakdown of road-traffic contribution shows that HGVs account for about 35.3% of the overall NO_x concentration, followed by cars (31.4%), LGVs (15.5%) and buses (3.1%),

Table 8 - Source Apportionment of NOx concentrations

Receptor (Maximum Modelled Concentration)	Specific Receptor 35
Total NOx in µg/m^3 (Total Background + Local Road Source)	163.6
NO_X Total Background (Local + Regional) in µg/m^3	23.9
NO_X Local Background in µg/m^3	12.3
NO_X Regional Background in µg/m^3	11.6
Local Road Source Contributions in µg/m^3	139.7
NO_X CAR	51.4
NO_X LGV	25.3
NO_X BUS	5.2
NO_X HGV	57.8
% Local Background	7.5%
% Regional Background	7.1%
% Road Traffic	85.4%
% due to CAR traffic	31.4%
% due to LGV traffic	15.5%
% due to BUS traffic	3.1%
% due to HGV traffic	35.3%
% CAR contribution of total road traffic	36.8%
% LGV contribution of total road traffic	18.1%
% BUS contribution of total road traffic	3.7%
% HGV contribution of total road traffic	41.4%

Figure 6 - NO_X Source Apportionment Graph



4.3.2 NO_2 Source Apportionment

The source apportionment indicates that, at the worst-case receptor (specific receptor 35) located on Ospringe Street:

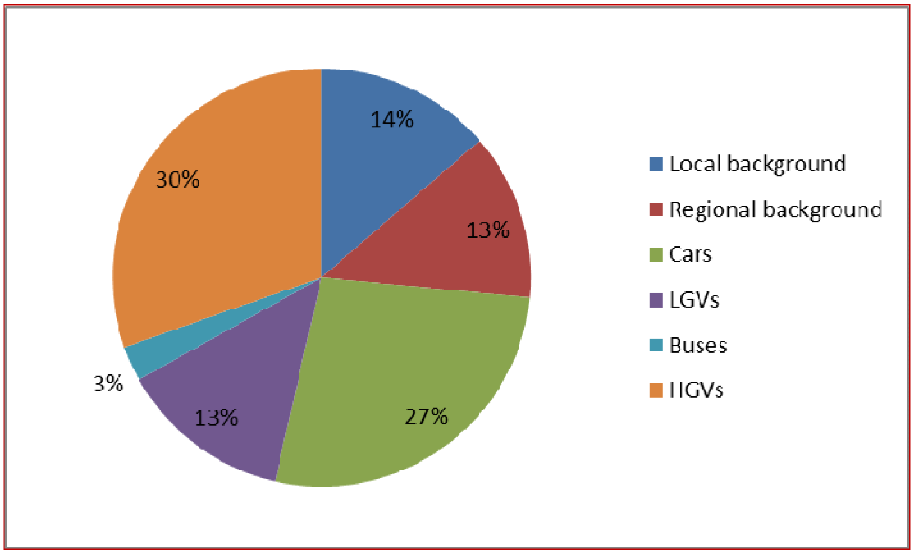
- Road traffic emissions of NO_2 account for 73.5% of the total NO_2 concentration;
- Local background sources contribute to 13.6% of the total NO_2 concentration, while regional background sources (outside the local authority's control) contribute to 12.9% of the total NO_2; and
- The breakdown of road-traffic contribution shows that HGVs account for about 30.4% of the overall NO_2 concentration, followed by cars (27%), LGVs (13.3%) and buses (3.7%).

The contribution of HGVs to the total NO_x and NO_2 concentrations is quite significant especially if compared to the proportion of the vehicle fleet they represent (about 5.8% on Ospringe Street/London Road).

Table 9 - Source Apportionment of NO_2 concentrations

Receptor (Maximum Modelled Concentration)	Specific Receptor 35
Total NO_2 in µg/m^3 (Total Background + Local Road Source)	**63.0**
NO_2 Total Background (Local + Regional) in µg/m^3	16.7
NO2 Local Background in µg/m^3	8.6
NO2 Regional Background in µg/m^3	8.1
Local Road Source Contributions in µg/m^3	46.3
NO_2 CAR	17.0
NO_2 LGV	8.4
NO_2 BUS	1.7
NO_2 HGV	19.1
% Local Background	13.6%
% Regional Background	12.9%
% Road Traffic	73.5%
% due to CAR traffic	27.0%
% due to LGV traffic	13.3%
% due to BUS traffic	2.7%
% due to HGV traffic	30.4%
% CAR contribution of total road traffic	36.8%
% LGV contribution of total road traffic	18.1%
% BUS contribution of total road traffic	3.7%
% HGV contribution of total road traffic	41.4%

Figure 7 - NO_2 Source Apportionment Graph



4.4 Required Reduction in Concentrations to Comply with Objectives

One of the requirements of the Further Assessment is to determine the amount of NO_2 reduction required at the worst-case receptors within an AQMA. This approach highlights the maximum reduction in NO_2 required (as NO_x, in µg/m^3) to comply with the AQS objective, and assumes that other receptors will require less of a reduction. For the current assessment, the approach to estimate the required NO_2 reduction was to determine the levels of NO_x for the highest concentrations predicted at sensitive receptors relevant of public exposure.

The methodology to determine the required reduction in NO_x and NO_2 is described in LAQM.TG(09) Section 7.2[18]. For NO_x, it requires the calculation of "current" and "required" road-NO_x concentrations.

The "required" road-NOx is the road NO_x concentration required to give a total NO_2 concentration of 40µg/m^3. It has been calculated based on the NO_x/NO_2 calculator and the local NO_2 background concentration.

The maximum predicted road-NO_x reduction required within the proposed AQMA to comply with the NO_2 AQS objective is 83.2µg/m^3 at receptor 35, equivalent to a reduction of 59.6% in road-NO_x concentrations. This equates to a 23µg/m^3 reduction in NO_2 (equivalent to a reduction of 36.5% in total NO_2 concentrations). This is at the worst-case location, and therefore required reductions at all other receptors will be less, as shown in Table 10. Consequently, the formulation of the Action Plan should aim to reduce the levels of NO_x / NO_2 within the AQMA by these amounts.

[18] An erratum in Box 7.2 of LAQM.TG(09) was corrected and is available at http://laqm.defra.gov.uk/supporting-guidance.html

Table 10 - Required NOx and NO_2 Reduction

Receptor Name and Location	Concentration (ug/m3)				Required Reduction in Local Road-NO_X		Modelled NO_2 ($\mu g/m^3$)	NO_2 AQS Objective ($\mu g/m^3$)	Required Reduction in NO_2	
	Modelled Total NOx	Background NOx	Road NOx-current	Road NOx-required (equivalent to 40$\mu g/m^3$ NO_2)	$\mu g/m^3$	%			$\mu g/m^3$	%
Specific Receptor 5	163.6	23.9	139.7	56.6	83.2	59.5%	**63.0**	40	23.0	36.5%

4.5 Expected Date of Compliance with Objectives

As mentioned in Technical Guidance LAQM.TG(09), local authorities should provide an indication of the date by which the objectives are expected to be met. For this purpose, the guidance refers to a series of adjustment factors that can be used to project annual mean roadside nitrogen dioxide concentration to future years, up to 2020 (Box 2.1 page 2-4). These factors have been updated and are available on the LAQM Support website[19].

Using the updated factors with the highest concentrations from Ospringe AQMA the date of predicted compliance has been calculated and shown in Table 11 below.

Table 11 - Date of Compliance with the annual mean NO_2 objective

Area	Worst Case receptor	Modelled NO_2 level ($\mu g/m^3$)	Predicted Year of Compliance
Ospringe Street	Specific Receptor 35	**63.0**	2018

However, analysis of recent NO_2 roadside monitoring data has shown that concentrations have not decreased as previously expected and that NO_2 urban levels have remained stable[20]. Therefore, this result should be considered as optimistic, as projected concentrations are likely to be underestimated. A recent guidance note from Defra[21] discusses a number of alternate assumptions that could be used to project future year NO_2 concentrations at roadside locations. The note provides a reduction rate of -0.68% per annum at the roadside locations based on recent research[22]. If this trend continues over the coming years, it is considered more likely that the objective would continue to be exceeded beyond 2020. However, it is important to note that the projected concentration based on -0.6 rate may be conservative as reduction rate is anticipated to surge beyond 2017 as Euro 6 vehicles permeate the traffic fleet. Moreover, the compliance date reported in Table 11 is based on results from the worst-case receptor, it is anticipated that the compliance will be achieved earlier at most receptors within the AQMA where concentrations are in the range of 40-50$\mu g/m^3$.

4.6 Population Exposure

Technical Guidance LAQM.TG(09) requires local authorities to estimate the number of people exposed to pollutant concentrations above the relevant air quality objectives.

The council provided number of residential properties in the AQMA. The Office for National Statistics[23] provides an average number of 2.26 people per UK household in 2011. Based on the number of residential properties in the exceedence area and the average number of people per UK household, the number of people exposed to the exceedences of the annual mean NO_2 is reported in Table 12 below.

[19] http://laqm.defra.gov.uk/supporting-guidance.html - Errata to LAQM.TG(09) – "Is the example in Box 2.1 of TG(09) correct?"

[20] http://laqm.defra.gov.uk/faqs/faqs.html - Recent FAQs - "Measured NO_x / NO_2 not declining in line with national forecasts"

[21] Defra Local Air Quality Management – Note on Projecting NO_2 Concentrations, April 2012, http://laqm.defra.gov.uk/documents/BureauVeritas_NO2Projections_2766_Final-30_04_2012.pdf

[22] Carslaw et al (2011). *Trends in NOx and NO2 emissions and ambient measurements in the UK*. Prepared for Defra.

[23] http://www.ons.gov.uk/ons/rel/family-demography/families-and-households/2011/stb-families-households.html#tab-Household-size

Table 12 - Population Exposure

AQMA	Number of houses in exceedence	Population exposed
Ospringe Street	100	226

5 Summary, Conclusions and Recommendations

5.1 Summary

As part of the Local Air Quality Management (LAQM) regime, a Further Assessment based on detailed dispersion modelling was carried out for the Ospringe Street Air Quality Management Area (AQMA), declared in Faversham within Swale Borough Council due to exceedences of the NO_2 annual mean Air Quality Strategy objective.

The Further Assessment is required as part of the Review and Assessment of air quality for local authorities that have declared or amended an AQMA, with the objective of supplementing information gathered in the previous assessments.

The Further Assessment has been undertaken in accordance with Defra's Technical Guidance LAQM.TG (09) methodologies, based on advanced atmospheric dispersion modelling of NO_2 traffic emissions, relying on updated background pollutant concentrations, monitoring, traffic and meteorological data for the year 2011.

Source apportionment of pollutant contributions was carried out to determine contributions of vehicle emissions and other sources to NO_X / NO_2 concentrations. The NO_x reduction to comply with the NO_2 annual mean AQS objective was calculated based on the highest concentration results at sensitive receptors relevant of public exposure (facades of properties).

The information from the Further Assessment is required to assist the preparation of the Action Plan measures for the AQMA in order that the measures may be targeted and focused, thereby prioritising the most cost-effective approach to reducing air pollutant concentrations in the AQMA.

5.2 Conclusions

The findings of this report are the following:

- Updated monitoring and modelled results confirm that the Ospringe Street AQMA is still required in Faversham, as the NO_2 annual mean objective is still likely to be exceeded at relevant receptor locations;
- Compared to the Detailed Assessment, the 40µg/m^3 and 36µg/m^3 contours have moved further north and south of Ospringe Street / London Road;
- The updated model results show that the AQMA should be extended in the east to include The Mount along London road, which was recently converted to 17 flats ;
- The source apportionment shows that, road traffic pollution levels contribute significantly to the overall NO_x and NO_2 levels, respectively (85.4% and 73.5%). The average background contributions to the total NO_x and NO_2 levels across the AQMA are 22% and 35% respectively. Of the road traffic emissions, Heavy Goods Vehicles (HGVs) are the most significant contributors (35% of NO_x and 30% of NO_2), followed by cars (31% of NO_x and 27% of NO_2);
- The maximum reduction in NO_x concentrations (associated with road traffic) required to comply with the AQS objectives in the AQMA is about 83µg/m3 (equivalent to a 59% reduction in road-NO_x levels). This equates to about 23µg/m3 reduction in NO_2 (36% reduction). Consequently, measures formulated in the Local Action Plan should aim to reduce the levels of NO_x / NO_2 within the AQMA by these amounts or more;
- Based on a population exposure calculation, it is estimated that 226 people are exposed to exceedences of the NO_2 annual mean AQS objective in the Ospringe AQMA; and

- Using roadside nitrogen dioxide projection factors from the Technical Guidance LAQM.TG(09), it is estimated that the annual mean objective is likely to be met at all locations by 2018. However, this could be an optimistic estimate, as projected concentrations are likely to be underestimated as shown by recent NO_2 monitoring trends across the UK.

5.3 Recommendations

The predicted results at four receptors are in excess of 60µg/m^3. The monitored annual mean concentrations are also close to 60µg/m^3 (59.6µg/m^3 at diffusion tube SW22). The results indicate a potential for exceedences of the hourly mean NO_2 objective. The model was used to predict the 99.8th percentile and all predicted percentiles were below the 200µg/m^3. In the light of modelled and monitored results, it is recommended the Council to consider relocating the continuous monitor at one of the receptor locations where the predicted concentrations are in excess of 60µg/m^3.

Monitoring should be continued at the current locations and additional diffusion tube monitoring may be carried out at background locations in order to provide a better estimate of the local background concentrations.

Results of the source apportionment should be used to propose adequate mitigation measures in the Air Quality Action Plan. For example, it is likely that targeting HGVs would help reducing NO_2 concentration towards a level below the Air Quality Strategy objective, as they are the main contributors in overall road NOx / NO_2 levels.

It is also recommended that the Action Plan not only consider the implementation of local measures to be applied within the AQMA, but also other measures that may be relevant across a number of areas across the town.

As the maximum reduction in annual mean NO_2 is required in the order of 23µg/m^3 (36% of the current levels), compliance with the objective is unlikely to be achieved through the implementation of a single measure, but is likely to require the combination of several measures.

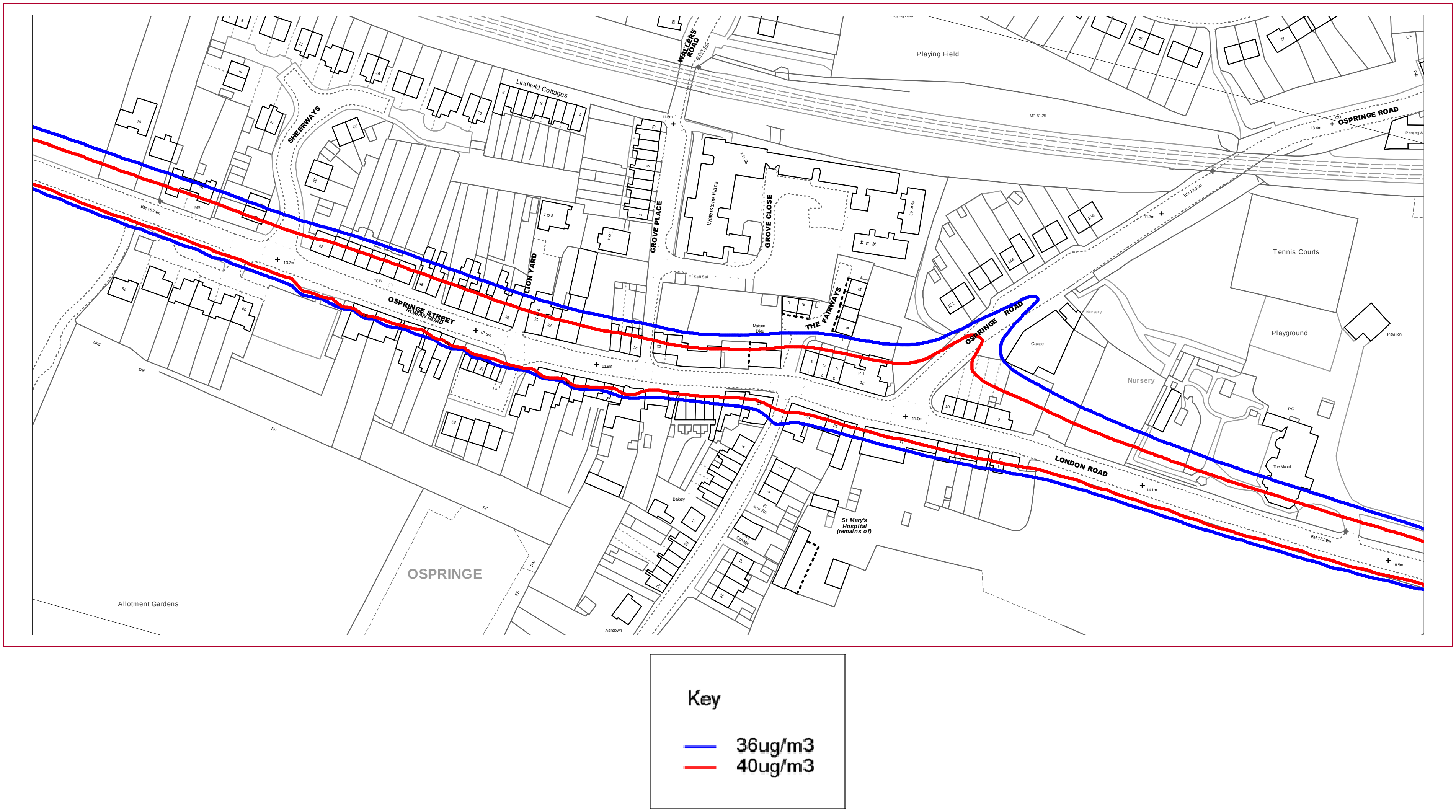
Appendices

Appendix 1 – Model Verification

Site	Background NO_2 (µg/m³)	Background NO_x (µg/m³)	Monitored Road Contribution NO_x (µg/m³)	Modelled Road Contribution NO_x (µg/m³)	Ratio of Monitored Road NO_x/Modelled Road NO_x	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO_x (µg/m³)	Adjusted Modelled Total NO_x (µg/m³)	Modelled Total NO_2 (µg/m³)	Monitored Total NO_2 (µg/m³)	% Difference NO_2 [(Modelled - Monitored)/ Monitored]
SW22	16.7	23.9	131.8	62.7	2.10	1.916	120.1	141.3	**56.7**	**59.6**	-4.8%
SW28			119.9	62.6	1.92		119.9	141.1	**56.7**	**56.7**	0.0%
SW29			113.6	66.4	1.71		127.2	148.4	**58.5**	**55.1**	6.2%
SW31			82.3	50.2	1.64		96.2	117.4	**50.5**	**46.5**	8.5%
SW32			80.2	30.2	2.66		57.9	79.1	38.8	**45.9**	-15.6%
Ospringe2_SW30			80.6	39.5	2.04		75.7	96.9	**44.5**	38.8	14.7%

In bold, exceedence of the NO_2 annual mean AQS objective of 40µg/m³

Appendix 2 – Modelled NO_2 Contour Results



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Swale Borough Council
Swale House, East Street
Sittingbourne
Kent, ME10 3HT

Customer Service Centre 01795 417 850