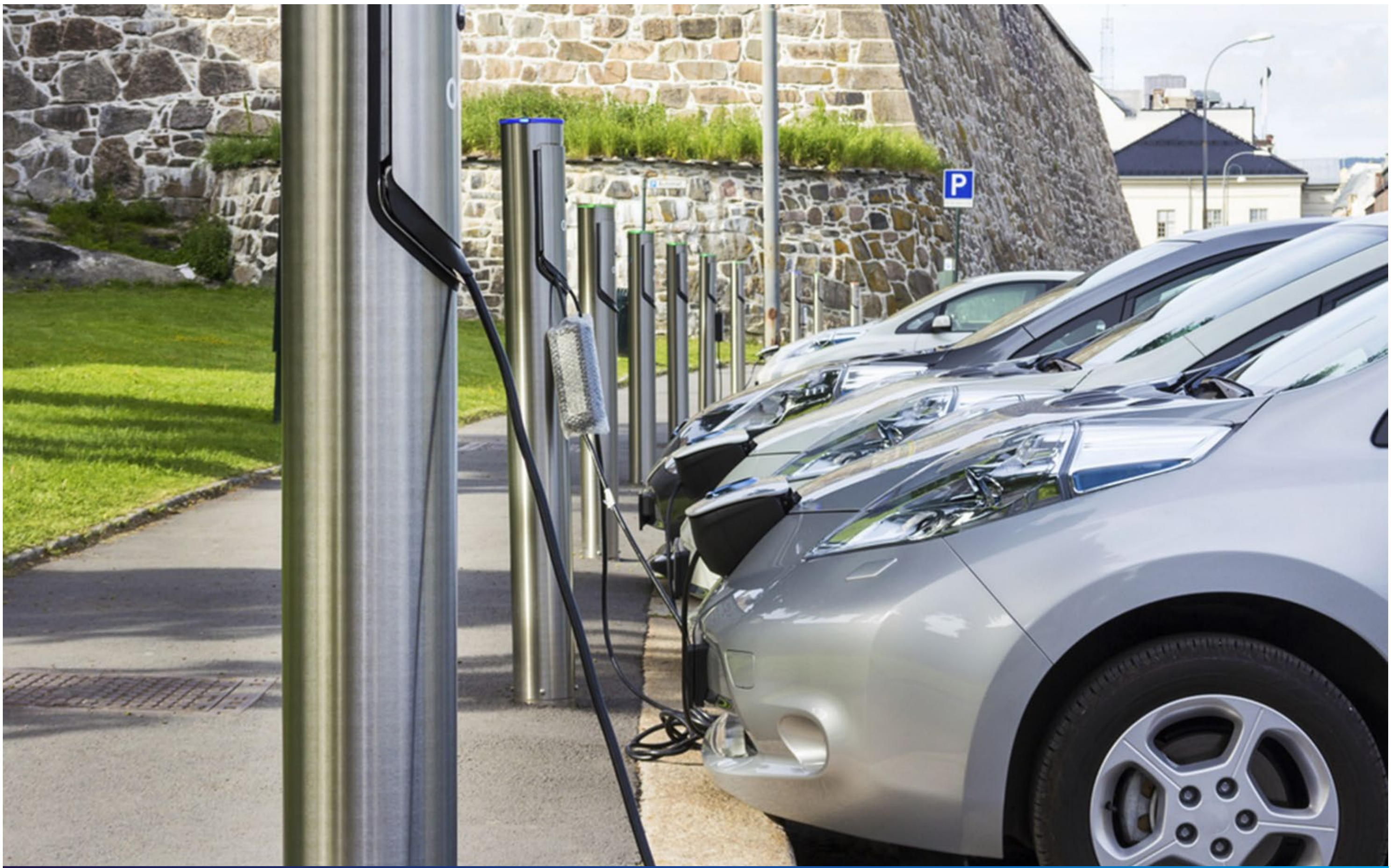

SITTINGBOURNE AND TEYNHAM AIR QUALITY MANAGEMENT AREAS

Detailed assessment

Report for: Swale District Council

Ricardo ref. ED18432112 Issue: 2 18/12/23

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ED18432112

Contact:
Mark Attree, Gemini Building, Fermi Avenue, Harwell, Didcot, OX11 0QR, UK

T: +44 (0) 1235 753 295
E: mark.attree@ricardo.com

Author:
Eleri Paterson Hughes, Anton Girard-Sequeira

Approved by:
Mark Attree

Signed

Date:
18/12/23

Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001.

EXECUTIVE SUMMARY

Annual mean concentrations of NO_2 measured by monitors in and around two Swale Air Quality Management Areas (AQMAs) for Teynham (AQMA 5) and East Street Sittingbourne (AQMA 3) have been consistently below the government Air Quality Objective for five and four years, respectively. Defra have expressly indicated to Swale that both AQMAs should begin the process of revocation in their feedback of the 2022 and 2023 Annual Status Reports.

To ensure that any decisions are made on robust evidence, Swale continued to monitor air quality for an additional year (2023) and commissioned Ricardo to carry out a Detailed Assessment of NO_2 concentrations in the AQMAs, considering the future committed developments that could impact air quality in these areas.

Ricardo have therefore carried out air quality modelling to assess:

- whether citizens of Swale are likely to be impacted by exposure to concentrations of NO_2 at locations in the AQMAs where monitoring is not currently undertaken.
- whether citizens of Swale within the AQMAs are likely to be exposed to elevated concentrations of NO_2 in the future if traffic increases beyond current levels.

To achieve these goals, modelling was carried out for two years:

1. a 2022 baseline, using traffic data provided by the Council, SWECO and national forecasts for the vehicle fleet composition; and
2. a 2028 future scenario considering the impact of future committed developments that could adversely impact concentrations in the AQMAs. This scenario was modelled assuming that all traffic generated by each development would run through the two AQMAs.

Sensitivity testing was also carried out into the potential impact of reduced fleet turnover in Swale relative to national projections.

All modelling was carried out following appropriate LAQM technical guidance and best practice.

The conclusions of the study are summarised in Box 1.

Box 1: Key conclusions of the Detailed Assessment

- No relevant receptor is predicted to have an annual mean NO_2 concentration within 10% of the Air Quality Objective for annual mean NO_2 at any location of relevant exposure in 2022.
- The Sittingbourne and Teynham AQMAs continue to be below 10% of the Air Quality Objective for annual mean NO_2 at all locations of relevant exposure in the modelled 2028 scenario.
- The model results therefore indicate the AQMAs can be revoked without risk of future exceedances.

CONTENTS

1. INTRODUCTION

Ricardo have been commissioned by Swale Borough Council (SBC) to carry out a Detailed Assessment to quantify public exposure to concentrations of Nitrogen Dioxide (NO_2) across Sittingbourne and Teynham. Defra have expressly indicated to Swale that both AQMAs should begin the process of revocation in their feedback of the 2022 and 2023 Annual Status Reports.

Ricardo have therefore carried out air quality modelling to assess:

- whether citizens of Swale are likely to be impacted by exposure to concentrations of NO_2 at locations in the AQMAs where monitoring is not currently undertaken.
- whether citizens of Swale within the AQMAs are likely to be exposed to elevated concentrations of NO_2 in the future if traffic increases beyond current levels.

To achieve these goals, modelling was carried out for two years:

1. a 2022 baseline, using traffic data provided by the Council, SWECO and national forecasts for the vehicle fleet composition; and
2. a 2028 future scenario considering the impact of future committed developments that could adversely impact concentrations in the AQMAs. This scenario was modelled assuming that all traffic generated by each development would run through the two AQMAs.

This report sets out the modelling methodology and results of the assessment.

2. AIR QUALITY STANDARDS

The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland (Defra, 2007) sets out UK policy on air quality including a framework for reducing hazards to health from air pollution and meeting international commitments. It sets standards and objectives for ten main air pollutants (including nitrogen dioxide, PM_{10} and $PM_{2.5}$) to protect health, vegetation and ecosystems. The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$ (EU Directive 2008/50/EC) and is implemented in UK law through the Air Quality Standards Regulations (2010). The limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$ are the same numerical concentrations as the UK objectives.

The AQOs which are relevant to this air quality impact assessment are detailed in Table 2-1.

Table 2-1: National Air Quality Objectives (AQOs)

Pollutant	Measured As	Objective
Nitrogen dioxide (NO_2)	Annual Mean	40 µg/m^3
	1-hour Mean	200 µg/m^3 not to be exceeded more than 18 times a year
Particles (PM_{10})	Annual Mean	40 µg/m^3
	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year
Particles ($PM_{2.5}$)	Annual Mean	20 µg/m^3

LAQM.TG (22) sets out that the annual mean AQOs for human health apply at locations where the public may be regularly exposed, such as building facades of residential properties, schools, hospitals and care homes. The 1-hour and 24-hour mean AQOs apply at locations where it is reasonable to expect members of the public to spend at least these periods of time, such as busy shopping streets and school playgrounds for the 1-hour mean, and hotels or residential gardens for the 24-hour mean.

3. AIR QUALITY IN SWALE

The UK parliament passed the UK Environment Act (1995, updated 2022) which requires local authorities to undertake routine assessment of the quality of their air. To support compliance with this objective, the UK government also introduced the Local Air Quality Management (LAQM) framework to ensure that local authorities undertake this assessment, and that action is undertaken when measured concentrations of air pollutant are above threshold values set in its Air Quality Standards regulation.

In accordance with this framework SBC has established an air quality monitoring network to monitor concentrations of pollutants at locations in the borough where citizens are most likely to experience prolonged exposure to elevated pollutant concentrations.

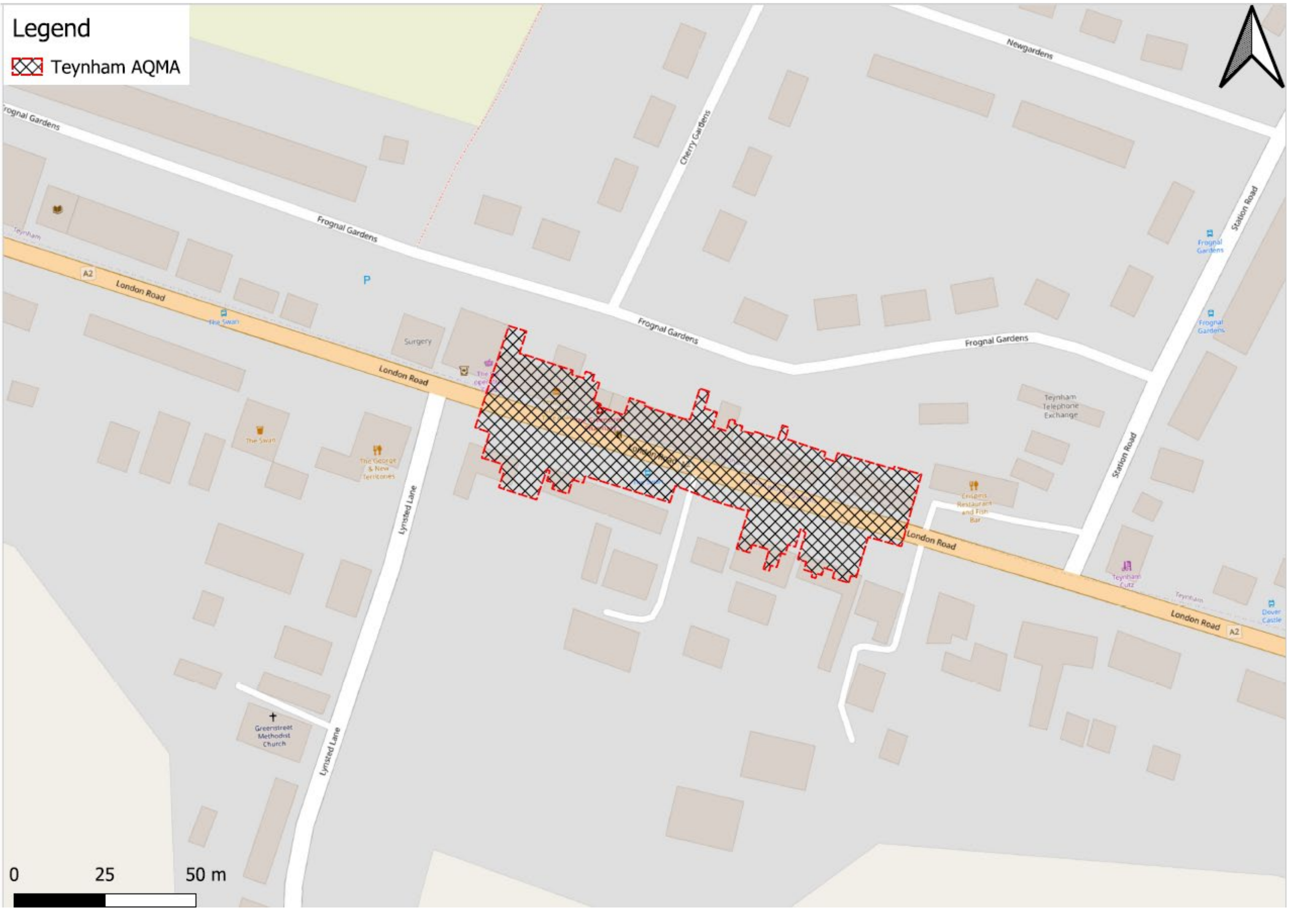
The data collected by this monitoring network identified that concentrations of Nitrogen Dioxide (NO_2) along East Street in Sittingbourne and London Road in Teynham exceeded the standard set in the regulations for annual mean NO_2 concentrations (40µg/m^3). In response, a further investigation was carried out to fully understand the causes of these elevated concentrations and a plan was drawn up to bring NO_2 concentrations into compliance.

As a result, part of the street in each location was declared as an Air Quality Management Area (AQMA) in recognition of the problem in 2013 (Sittingbourne) and 2015 (Teynham). These AQMAs are illustrated in Figure 3-1 and Figure 3-2.

Figure 3-1: Sittingbourne AQMA

Contains map data © OpenStreetMap and contributors

Figure 3-2: Teynham AQMA



Contains map data © OpenStreetMap and contributors

Trends in monitored concentrations in Sittingbourne and Teynham are presented in Figure 3-1 and Figure 3-2, respectively. Actions implemented by SBC to bring the AQMAs into compliance with the standard have been successful. Measurements from monitoring sites in the AQMAs show a long-term reduction in NO_2 concentrations, with short-term increases in 2021 and 2022 due to increases in traffic relative to the exceptionally low traffic in 2020.

As a result, annual mean concentrations of NO_2 measured within both AQMAs have been compliant with the Air Quality Standard since 2019. Annual mean concentrations have been below 90% of the Air Quality Objective at all locations since 2019, and at all but SW56 and SW80 since 2018.

Figure 3-1: Sampled NO_2 concentrations within the East Street Sittingbourne AQMA (2018 – 2022)

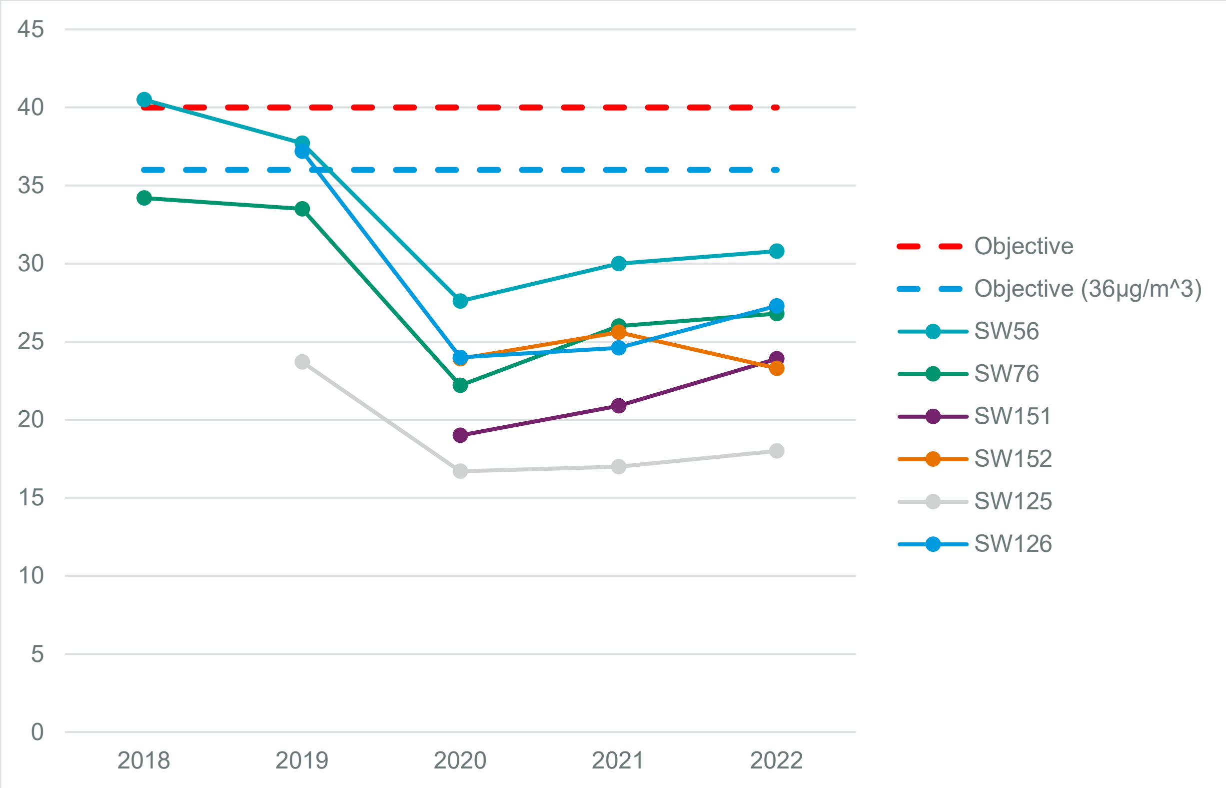
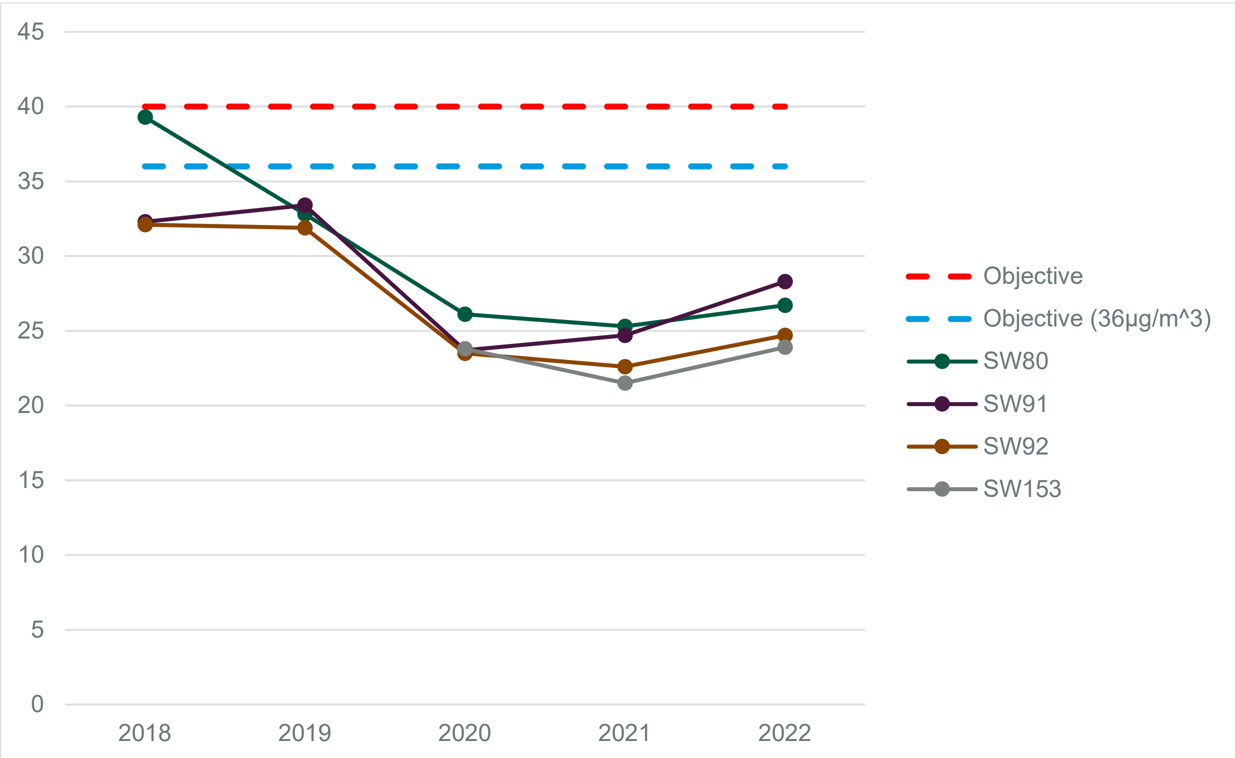


Figure 3-2: Sampled NO_2 concentrations within the Teynham AQMA (2018 – 2022)



4. AIR QUALITY MODELLING

4.1 OVERALL APPROACH

The modelling was carried out following best practice techniques detailed in LAQM Technical Guidance[1] and model guidance published by model developers.

Air pollutant concentrations were modelled for a baseline year of 2022 to assess current public exposure to NO_2 concentrations. Ratified measurements from diffusion tubes in and adjacent to the AQMAs were compared to the modelled concentrations at each location; this process is called model verification and is summarised in Section 6.

Once the model was confirmed to be performing adequately, the verified model was then used to predict concentrations at sensitive receptors in and around the Swale AQMAs.

In order to demonstrate the robustness of compliance in future years, modelling was also carried out for a 2030 future scenario. This scenario was modelled as a 'worst case' scenario, including predicted traffic from future developments up to 2030 while assuming that the local vehicle fleet is lags 2 years behind national projections in terms of emissions technology.

4.2 CHOICE OF MODEL

The latest version of ADMS-Roads (5.1), a dispersion model developed by Cambridge Environmental Research Consultants (CERC), was selected as the most appropriate tool for undertaking this study. This is an internationally recognised model that is widely used in assessments for Local Authorities in the UK.

CERC have carried out extensive validation of the ADMS models by comparing modelled results with standard field, laboratory and numerical data sets, participating in EU workshops on short range dispersion models, comparing data between UK M4 and M25 motorway field monitoring data, carrying out comparison studies on behalf of local authorities and Defra.

ADMS-Roads includes advanced features for treatment of street canyons and other road geometry.

4.3 MODEL DOMAINS

Figure 4-1 and Figure 4-2 show the chosen study areas of the model. These areas were selected to include all major road sources in Sittingbourne and Teynham. The model domain for Sittingbourne extends beyond the intersection of St Michael's Road with Crown Quay Lane and includes the intersection of East Street with the High Street. The model domain for Teynham accounts for incoming traffic on London Road and Lynsted Lane to Teynham.

[1] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf

Figure 4-1: Model domain for Sittingbourne

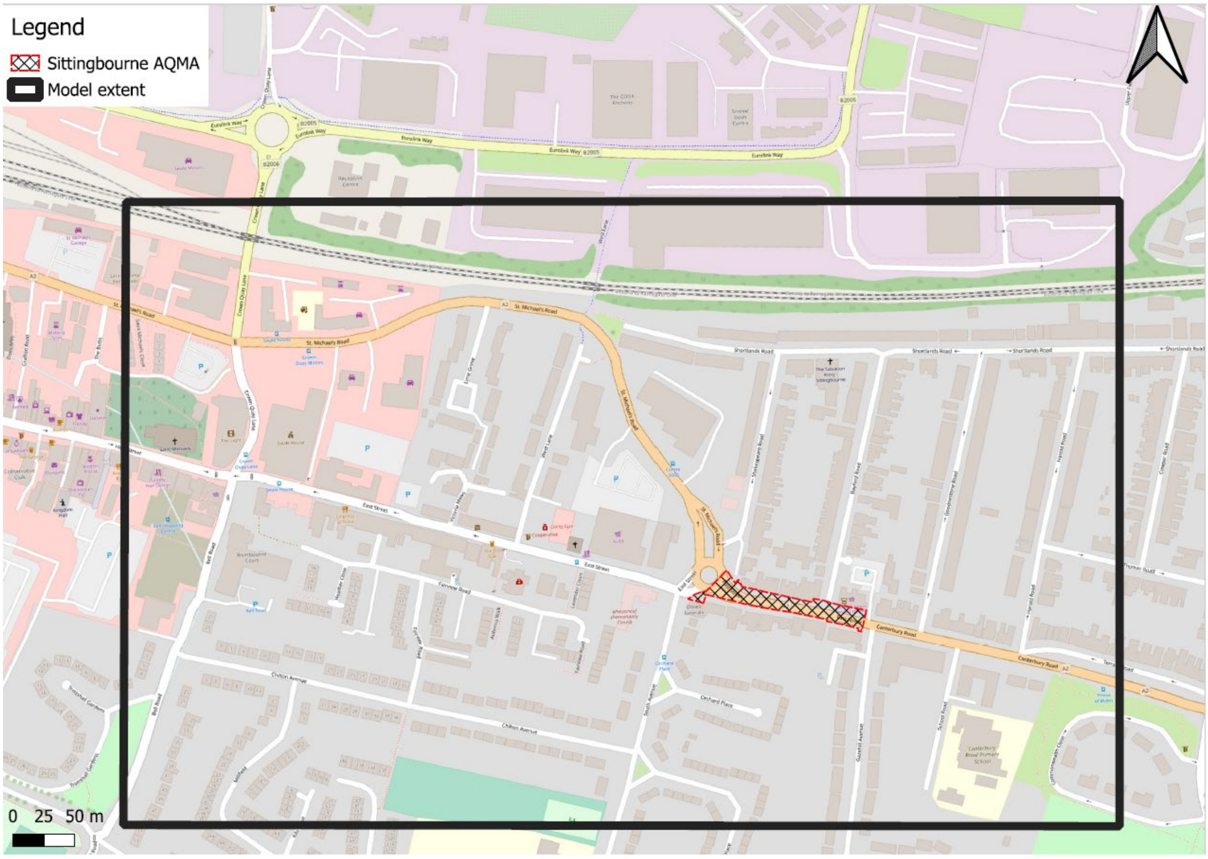
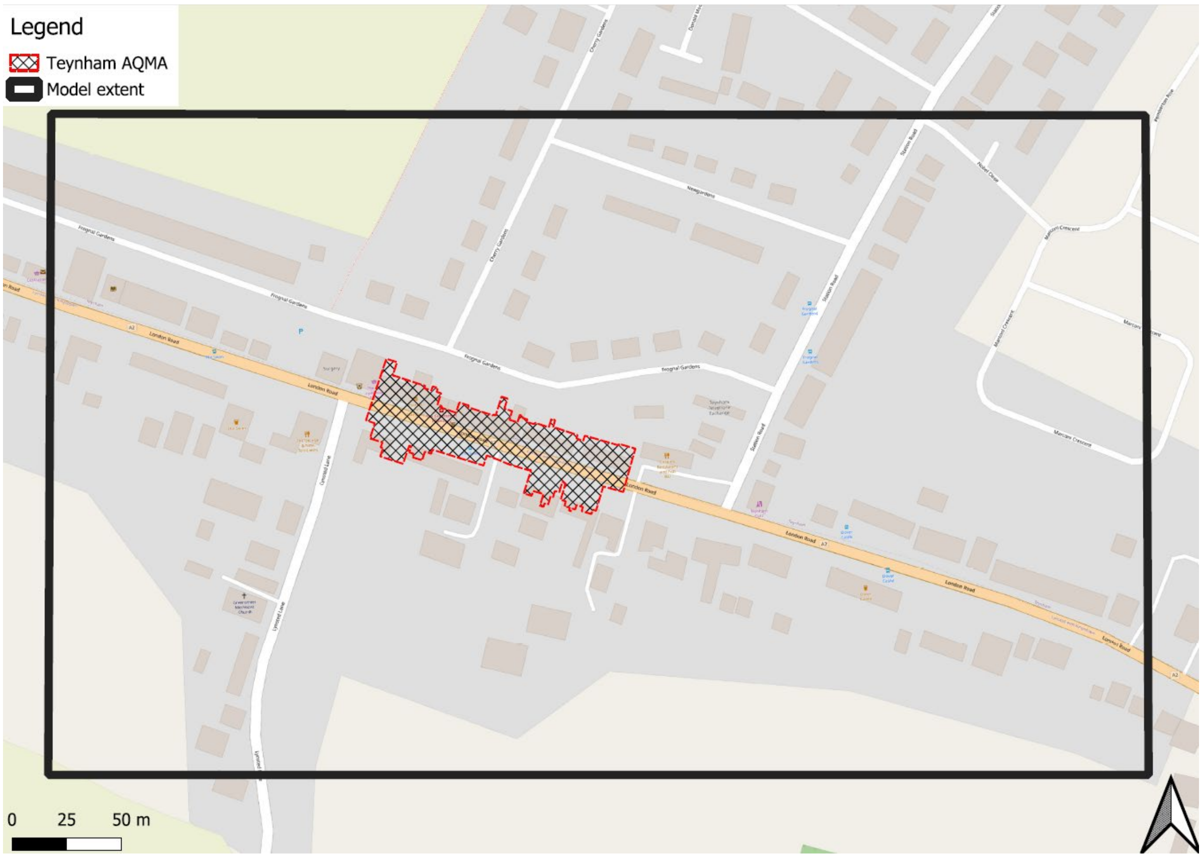


Figure 4-2: Model domain for Teynham



4.4 SENSITIVE RECEPTORS

In each AQMA, the closest point on each building façade to the nearest road was included in the model to capture worst-case concentrations at sensitive receptors.

4.4.1 Sittingbourne AQMA

Figure 4-3 presents the locations of the modelled sensitive receptors in the Sittingbourne AQMA; Table 4-1 provides the exact locations of the receptors. All receptors were modelled at ground level to capture worst case concentrations.

Figure 4-3: Location of modelled sensitive receptors in Sittingbourne

Table 4-1: Sensitive receptor locations, Sittingbourne

ID	Address	X coordinate	Y coordinate	Height (m)
1	151 East Street	591397.7	163489.7	0
2	153 East Street	591411.1	163486.9	0
3	157 East Street	591420.5	163484.9	0
4	155 East Street	591415.1	163486	0
5	159 East Street	591425.5	163483.9	0
6	161a East Street	591431.2	163482.6	0
7	163 East Street	591435.6	163481.6	0
8	165 East Street	591439.5	163480.9	0
9	167a East Street	591443.8	163479.9	0
10	169 East Street	591448.3	163478.8	0

ID	Address	X coordinate	Y coordinate	Height (m)
11	171 East Street	591452.5	163477.9	0
12	Magic Wok	591458.3	163480	0
13	1 Canterbury Road	591483.9	163473.9	0
14	Adriana's Nails	591490.6	163455.9	0
15	Canterbury Court	591480.9	163458.4	0
16	7 Canterbury Road	591472.7	163460.3	0
17	132B East Street	591464.4	163463.1	0
18	130 East Street	591459.4	163463.8	0
19	128 East Street	591454.9	163464.7	0
20	126 East Street	591451.6	163465.6	0
21	124 East Street	591444.9	163467	0
22	122 East Street	591436.9	163466.1	0
23	120A East Street	591429.8	163466.8	0
24	118, Eastleigh House, East Street	591419.8	163468.7	0
25	116 East Street	591410.5	163470.2	0
26	114 East Street	591405.2	163471.3	0
27	112 East Street	591395.8	163473.5	0
28	110 East Street	591390.9	163474.4	0
29	108 East Street	591380.6	163476.7	0
30	106 East Street	591373.8	163478.3	0
31	104 East Street	591369.7	163479	0
32	Doves Funeral Directors	591361.1	163477.8	0

4.4.2 Teynham AQMA

Figure 4-4 presents the locations of the modelled sensitive receptors in the Sittingbourne AQMA; Table 4-2 provides the exact locations of the receptors. All receptors were modelled at ground level to capture worst case concentrations.

Figure 4-4: Location of modelled sensitive receptors in Teynham

Table 4-2: Sensitive receptor locations, Teynham

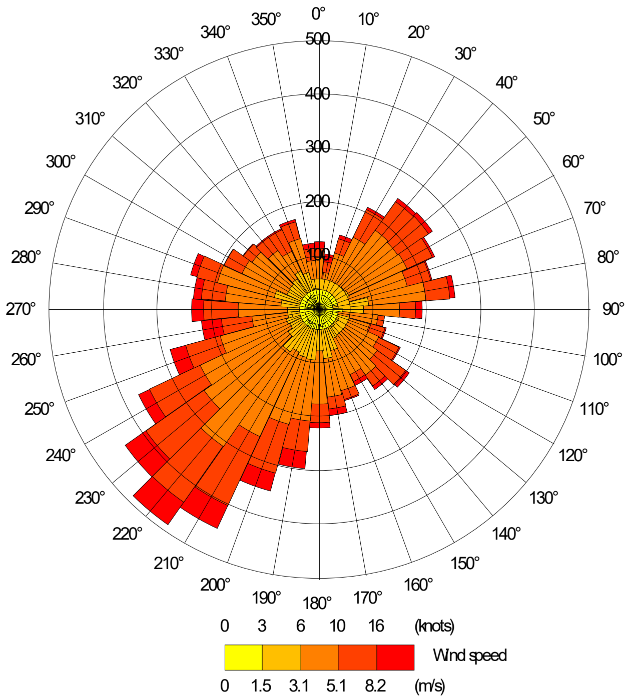
ID	Address	X coordinate	Y coordinate	Height (m)
33	LTR Supplies, London Road	595154.8	162473	0
34	Denture Centre, London Road	595161.3	162471	0
35	72 London Road	595150.7	162462.3	0
36	70 London Road	595161.6	162459.8	0
37	FJ Williams Joinery & Carpentry	595197	162447.6	0
38	68 London Road	595187.1	162450.4	0
39	Teynham C Chinese	595167.8	162469.1	0
40	The Greenstreet Pharmacy	595177.2	162465.4	0
41	103 London Road	595184.9	162465.6	0
42	101 London Road	595188.8	162462.1	0
43	99 London Road	595196.5	162460.3	0
44	97 London Road	595204.2	162457.4	0
45	95 London Road	595208.2	162455.6	0
46	93 London Road	595211.6	162454.8	0

ID	Address	X coordinate	Y coordinate	Height (m)
47	91A London Road	595217	162453.2	0
48	91B London Road	595223.4	162453	0
49	89 London Road	595229.2	162448.7	0
50	87 London Road	595235.2	162446.7	0
51	85 London Road	595244.1	162444.9	0
52	83 London Road	595247	162444.2	0
53	81 London Road	595250.7	162443.3	0
55	79 London Road	595254.8	162441.6	0
56	77 London Road	595259.1	162441.7	0
57	75 London Road	595262.4	162440.8	0
58	42 London Road	595257.2	162422.4	0
59	44 London Road	595247.8	162428.6	0
60	46 London Road	595245.5	162429.3	0
61	48 London Road	595242.3	162430.2	0
62	50 London Road	595237.8	162431.5	0
63	52 London Road	595230	162434.6	0
64	54 London Road	595225.2	162436.9	0
65	54A London Road	595221.3	162438.2	0
66	56 London Road	595211.3	162434.1	0

4.5 METEOROLOGY

One year of meteorological data from the Met Office Manston Airfield site was used in this study. Missing data was filled in with information from the nearby London Gatwick and Southend met stations. A wind rose for the filled Manston 2022 dataset is presented in Figure 4-5.

Figure 4-5: Windrose of meteorological data collected at Manston Airfield during 2022



4.6 SURFACE ROUGHNESS

In ADMS-Roads, a length scale parameter called the surface roughness length is used to characterise the study area in terms of its effects on wind speed and turbulence. The modelling used a surface roughness length of 0.5m in both Sittingbourne and Teynham, to represent a moderately built-up area.

The difference in land use at the meteorological site and the model domain was accounted for by using a surface roughness of 0.2m for the meteorological site.

4.7 CHEMISTRY AND BACKGROUND CONCENTRATIONS

The interconversion of NO and NO_2 emissions in the presence of ozone was calculated using the NOx:NO_2 calculator[2] published by Defra, following the approach outlined in LAQM.TG (22). Background concentrations were taken from the background maps published by Defra[3] for use with this tool. To avoid double-counting, contributions from local primary roads were removed from the background maps. The background concentrations used in this study are presented in Table 4-3.

Table 4-3: Annual mean background concentrations, Sittingbourne and Teynham, 2022.

Pollutant	Background concentration ($\mu g.m^{-3}$)
NOx	14.3
PM_{10}	15.2
$PM_{2.5}$	10.1

[2] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/

[3] https://uk-air.defra.gov.uk/data/laqm-background-home

5. EMISSIONS INVENTORY

The development of the emission inventory for Sittingbourne and Teynham was carried out through the following process:

1. Collation of local traffic flow, speed and queuing data;
2. Collation of national fleet fuel and technology statistics;
3. The traffic and fleet data were combined with emission factors from the most recent version of the Emissions Factors Toolkit (EFT), version 11[4] to provide total annual emissions of NOx and PM for the modelled road links.

Further detail on the emissions inventory compilation is provided below.

5.1 TRAFFIC FLOWS AND SPEEDS

5.1.1 2022

A hybrid traffic volume dataset was compiled from data collected by SBC, traffic models developed by SWECO covering both AQMA areas, and from the DfT traffic count network[5]. Traffic flows were provided for vehicle categories including cars, LGVs, HGVs, buses and coaches, and motorcycles. Where detailed vehicle split information was not available, the average vehicle split across other count points in Swale were used. Traffic counts from years other than 2022 were projected to 2022 using national projections from the Tempro.

The traffic flows used in the assessment are summarised in Table 5-1. Traffic speeds were estimated based on council traffic count data, the SWECO modelled data and local knowledge. Speeds were reduced within 30m of major junctions in the model domain following the approach outlined in LAQM.TG (22).

Table 5-1: Modelled traffic flows, 2022

Route	AQMA	Traffic flows					Speed (km/h)
		AADT	Car	LGV	HGV	Bus	
A2 St Michaels Road (Crown Quay Ln to Aldi)	Sittingbourne	18749	16461	1526	761	18	33
High street (West of Bell Road)	Sittingbourne	1338	1133	131	41	1	15
Crown Quay Road (East St to St Michael's Rd)	Sittingbourne	3860	3512	199	149	4	25
A2 St Michaels Road (Aldi to East St)	Sittingbourne	17825	15974	1180	671	16	20
Bell Road (Avenue of Remembrance to Chilton Ave)	Sittingbourne	10888	9905	725	258	6	18
Crown Quay Road (St Michael's Rd to Eurolink Way)	Sittingbourne	8753	8033	512	208	5	15
East Street (West Ln to St Michael's Rd)	Sittingbourne	1481	1010	252	219	5	25
East Street (West of west lane)	Sittingbourne	1727	1499	121	66	2	15
A2 East Street (St Michael's Rd to Gaze Hill Avenue)	Sittingbourne	21938	19626	1470	841	20	30
A2 East Street (Gaze Hill Ave to Rectory Rd)	Sittingbourne	20773	18548	1392	833	20	30
London Road (Flaxfield to Lynsted Ln/Flaxfield Rd to Frognal Lane)	Teynham	16444	14302	1260	881	21	40
London Road (Lynsted Ln to Station Rd)	Teynham	16067	13919	1283	864	21	40
London Road (Station Rd to Lewson Street)	Teynham	15937	13577	1434	926	22	40

[4] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html. Version 12 was published following the conclusion of this study; a sensitivity test into the effects of using version 12 is provided in Section 8.

[5] https://roadtraffic.dft.gov.uk

5.1.2 2028

A review of currently committed developments in Swale which may lead to increased traffic flows along the A2 was carried out to quantify maximum potential increases in traffic across the road network.

For the 2028 scenario, 11,170 vehicles were added onto each road link, with the assumption that every committed development within the area would be completed, with an additional 500 vehicles to represent potential uncertainty in predictions of traffic generation from future developments.

To account for the changes in speeds with the additional traffic flows, speeds were additionally reduced by 5$km.h^{-1}$ along each road modelled for the future scenario.

5.2 EMISSION FACTORS

Emissions from all modelled road traffic sources were calculated using speed-dependent vehicle emission factors for NOx, primary NO_2, and particulates from the Emissions Factors Toolkit (EFT) version 11[11]. These factors provide emission factors categorised by vehicle size, age, and Euro classification, taking into account average vehicle mileage and engine degradation. Emission factors are provided for roads with uphill or downhill gradients.

5.3 VEHICLE FLEET COMPOSITION

5.3.1 2022

National projections provided by the EFT were used as a data source for vehicle composition. Table 5-2 and Table 5-3 present the derived fleet age split in 2022.

Table 5-2: Fleet age splits for 2022, light vehicles

Region	Vehicle type	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6	Euro 6c	Euro 6d
National average	Petrol Car	-	-	-	1%	6%	19%	13%	62%	-
	Diesel Car	-	-	-	1%	5%	28%	17%	24%	24%
	Petrol LGV	-	-		2%	6%	18%	14%	60%	-
	Diesel LGV	-	-	-	1%	5%	19%	13%	29%	33%
	Full Hybrid Petrol Car	-	-	-	0%	1%	7%	6%	86%	-
	Plugin Hybrid Petrol Car	-	-	-	-	-	2%	6%	93%	-
	Full Diesel Hybrid Car	-	-	-	-	-	2%	3%	24%	71%

Table 5-3: Fleet age splits for 2022, heavy vehicles

Region	Vehicle type	Pre-Euro I	Euro I	Euro II	Euro III	Euro IV	Euro V EGR	Euro V SCR	Euro VI
National average	Rigid HGV	0%	0%	0%	1%	2%	2%	7%	88%
	Artic HGV	0%	0%	0%	0%	0%	1%	3%	96%
	Buses / Coaches	0%	0%	0%	4%	3%	4%	11%	77%

5.3.2 2028

As for 2022, National projections provided with the EFT were used as a data source for vehicle composition. Table 5-4 and Table 5-5 present the derived fleet age split in 2028 for light and heavy vehicles, respectively.

Table 5-4: Fleet age splits for 2028, light vehicles

Region	Vehicle type	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6	Euro 6c	Euro 6d
National average	Petrol Car	-	-	-	-	< 1%	3%	5%	92%	-
	Diesel Car	-	-	-	-	< 1%	6%	8%	16%	69%

Region	Vehicle type	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6	Euro 6c	Euro 6d
	Petrol LGV	-	-		-	< 1%	1%	1%	97%	
	Diesel LGV	-	-	-	-	< 1%	4%	5%	13%	78%
	Full Hybrid Petrol Car	-	-	-	-	-	< 1%	1%	8%	92%
	Plugin Hybrid Petrol Car	-	-	-	-	-	< 1%	1%	99%	-
	Full Diesel Hybrid Car	-	-	-	-	-	< 1%	1%	8%	92%

Table 5-5: Fleet age splits for 2028, heavy vehicles

Region	Vehicle type	Pre-Euro I	Euro I	Euro II	Euro III	Euro IV	Euro V EGR	Euro V SCR	Euro VI
National average	**Rigid HGV**	-	-	-	-	< 1%	< 1%	1%	99%
	Artic HGV	-	-	-	-	< 1%	< 1%	< 1%	100%
	Buses / Coaches	-	-	-	-	< 1%	1%	3%	96%

5.4 TIME-VARYING EMISSION FACTORS

The variation of traffic flow during the day has been taken into account by applying national average diurnal profiles published by the Department for Transport[6] to the road emissions.

[6] https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra

6. MODEL ADJUSTMENT AND VERIFICATION

Once the base year model has been developed it is verified against monitoring data and adjusted to ensure the best possible fit between modelled and real-world concentrations, following the approach outlined in the LAQM Technical Guidance. Following this guidance, the adjustment process is carried out for NO_X (NO and NO_2) as NO and NO_2 interconvert in the atmosphere following emission from vehicle exhausts in a non-linear fashion.

The derived adjustment factor is then applied to road emissions in all modelled scenarios. Following this adjustment, model verification is carried out by comparing the total predicted NO_2 concentrations against the measured NO_2 concentrations.

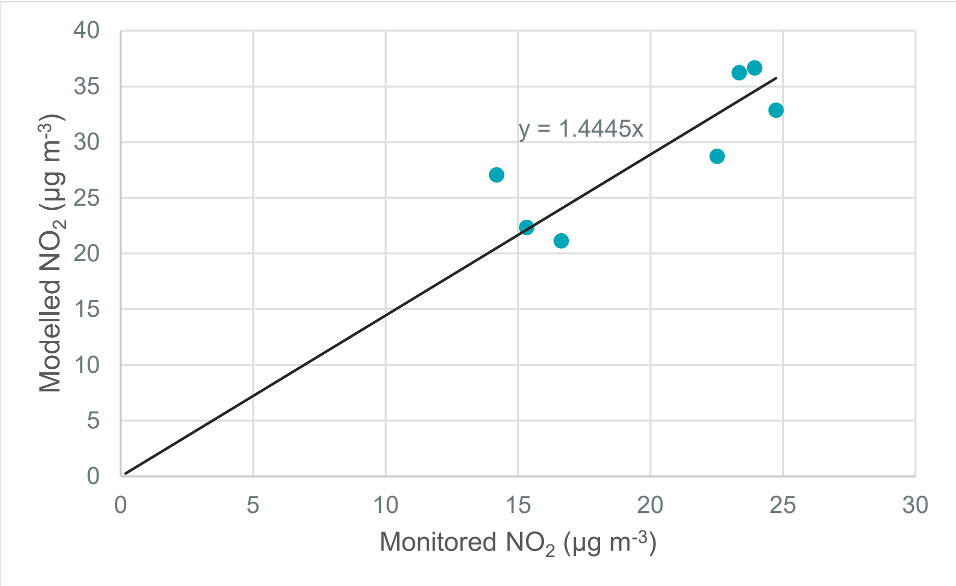
A total of 7 monitoring locations located within the study area were used for model verification.

Following an initial model verification step, iterative improvements were made to the model to improve model performance in areas where the model was not accurately predicting real-world concentrations. These improvements included refinements to road geometry and street canyon locations in order to more closely reflect real-world dispersion conditions.

6.1 MODEL CALIBRATION AND ADJUSTMENT

Figure 6-1 shows model performance at locations where measurements were collected in 2022.

Figure 6-1: Measured and modelled annual mean road NOx contributions at monitoring sites, 2022, µg.m^{-3}



A model adjustment factor was derived following the approach outlined in LAQM.TG (22). Following this approach, an adjustment factor of 1.44 was used for annual mean NOx concentrations.

6.2 MODEL VERIFICATION

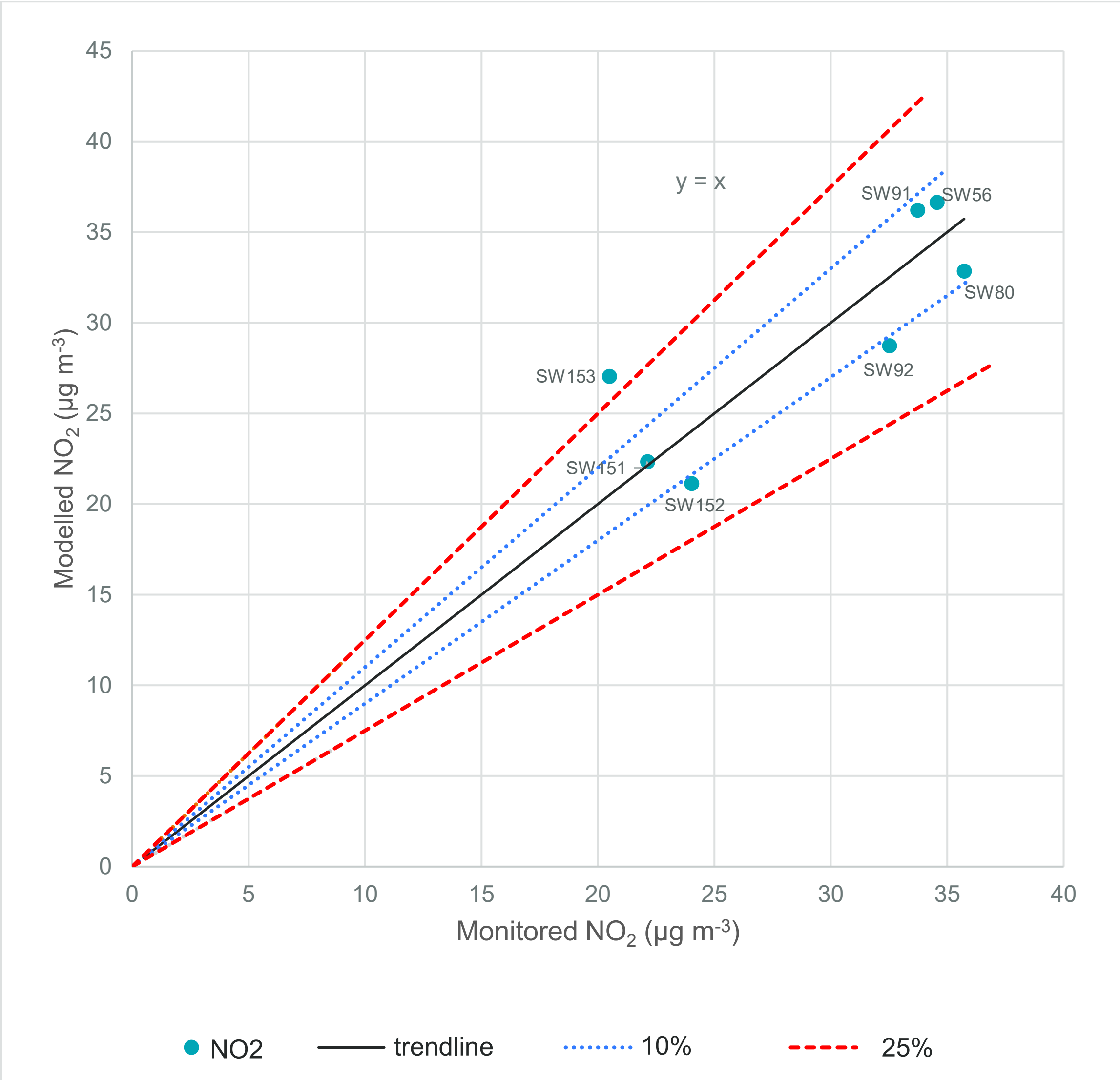
Figure 6-2 presents the model performance with respect to adjusted modelled NO_2 at monitoring locations in 2022. If the model perfectly predicted concentrations at every monitoring location, all concentrations would lie on the "y=x" trendline, plotted in black in the figure. Locations where the model prediction is within 10% of the monitored concentration lie within the blue lines, and locations where the model prediction is within 25% of the monitored concentration lie within the red lines on the figure.

The model performs within the 25% acceptable threshold for model performance across all monitoring locations except for SW153, where the model overpredicts concentrations and therefore provides a conservative estimate of potential exposure to poor air quality. SW153 is not located within either of the two AQMAs.

The model performs within the ideal 10% threshold across most sites, including at the locations of maximum predicted concentrations across the two AQMAs. This gives confidence that the model is correctly predicting worst-case human exposure across the two areas.

Model performance was evaluated using the Root Mean Square Error, following LAQM.TG (22). The RMSE for this study is 3.5 µg.m^{-3}, within the 4 µg.m^{-3} ideal threshold identified in the guidance, demonstrating that the model performs well and lending confidence to model predictions of concentrations across the model domain.

Figure 6-2: Measured and modelled annual mean road NO_2 contributions at monitoring sites, 2022, µg.m^{-3}



7. RESULTS

The model described above was used to predict annual mean NO_2 concentrations at buildings within and around the AQMAs at sensitive receptors and across a grid of receptors covering the domain described in Section 3.2.

7.1 SITTINGBOURNE AQMA

Table 7-1 presents modelled annual mean NO_2 concentrations in 2022 and 2028 at the sensitive receptors in the Sittingbourne AQMA described in Section 4.3.

No location is predicted to exceed the Air Quality Objective for annual mean NO_2 concentrations in either modelled baseline scenario. Furthermore, concentrations are more than 10% below the objective at all receptors. The maximum predicted concentrations occur near junctions in Sittingbourne.

No exceedances of the objective are predicted to occur at any receptors in 2028, demonstrating that there is substantial headroom to account for potential uncertainty in traffic flows and vehicle fleet composition in future years. The effect of the increase in traffic flows along the road network is party balanced out by the projected improvement in average emissions from vehicles as engine technology improves and older, more polluting vehicles fall into disuse.

As a result, compliance is highly likely to be maintained in the future.

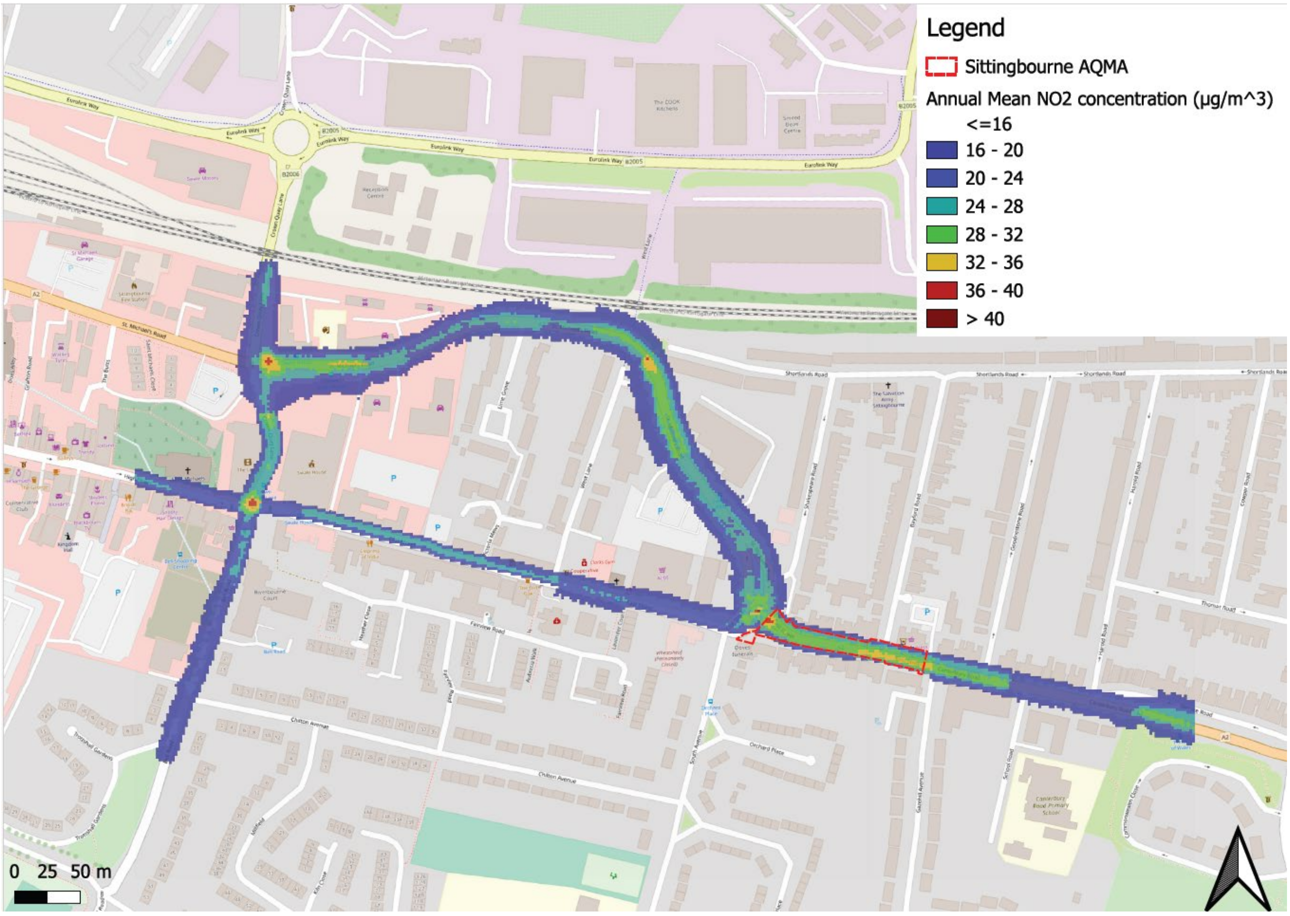
Table 7-1: Annual average NO_2 concentrations at sensitive receptors in the Sittingbourne AQMA, $\mu g.m^{-3}$. For comparison with the Air Quality Objective of 40 $\mu g.m^{-3}$.

Receptor ID	Address	Annual Mean NO_2 ($\mu g.m^{-3}$)	
		2022 Baseline	2028
1	151 East Street	26.2	26.9
2	153 East Street	25.4	25.8
3	157 East Street	25.7	25.9
4	155 East Street	25.5	25.8
5	159 East Street	25.7	25.9
6	161a East Street	26.0	26.2
7	163 East Street	26.1	26.4
8	165 East Street	26.1	26.3
9	167a East Street	26.3	26.5
10	169 East Street	27.0	27.3
11	171 East Street	27.0	27.3
12	Magic Wok	25.6	25.8
13	1 Canterbury Road	25.7	25.8
14	Adriana's Nails	29.7	30.1
15	Canterbury Court	29.7	30.2
16	7 Canterbury Road	29.6	30.1
17	132B East Street	31.0	31.6
18	130 East Street	30.5	31.1
19	128 East Street	30.4	31.0
20	126 East Street	30.6	31.2
21	124 East Street	30.5	31.1
22	122 East Street	25.0	25.0
23	120A East Street	24.4	24.5
24	118, Eastleigh House, East Street	24.3	24.3
25	116 East Street	24.0	24.1

Receptor ID	Address	Annual Mean NO_2 (µg.m^{-3})	
		2022 Baseline	2028
26	114 East Street	24.0	24.1
27	112 East Street	24.0	24.1
28	110 East Street	24.5	24.8
29	108 East Street	14.8	14.5
30	106 East Street	14.7	14.3
31	104 East Street	15.6	15.5
32	Doves Funeral Directors	13.8	13.3

Figure 7-1 presents annual mean NO_2 concentrations in the Sittingbourne AQMA in the 2028 scenario. Annual average NO_2 concentrations (µg/m^3) are predicted to be more than 10% below the UK Air Quality Objective of 40 µg/m^3 at all locations of relevant exposure in the AQMA and across the rest of the road network in Sittingbourne.

Figure 7-1: Predicted annual mean NO_2 concentrations, Sittingbourne, 2028, µg.m^{-3}



7.2 TEYNHAM AQMA

Table 7-2 presents modelled annual mean NO_2 concentrations in 2022 and 2028 at the sensitive receptors in the Teynham AQMA described in Section 4.3. Concentrations at all relevant receptors within the AQMA are more than 10% below the Air Quality Objective for annual mean NO_2 concentrations.

As for the Sittingbourne AQMA, no exceedances of the objective are predicted to occur at any receptors in 2028, demonstrating that there is substantial headroom to account for potential uncertainty in traffic flows and vehicle fleet composition in future years.

As a result, compliance is highly likely to be maintained in the future.

Table 7-2: Annual average NO_2 concentrations at sensitive receptors in the Teynham AQMA, $\mu g.m^{-3}$. For comparison with the Air Quality Objective of 40 $\mu g.m^{-3}$.

Receptor ID	Address	Annual Mean NO_2 ($\mu g.m^{-3}$)	
		2022 Baseline	2028
33	LTR Supplies, London Road	26.0	26.6
34	Denture Centre, London Road	25.9	26.5
35	72 London Road	26.9	27.6
36	70 London Road	28.1	29.0
37	FJ Williams Joinery & Carpentry	26.2	26.9
38	68 London Road	25.9	26.6
39	Teynham C Chinese	25.6	26.2
40	The Greenstreet Pharmacy	26.3	27.0
41	103 London Road	26.0	26.7
42	101 London Road	25.7	26.4
43	99 London Road	25.9	26.6
44	97 London Road	25.5	26.1
45	95 London Road	26.1	26.8
46	93 London Road	25.8	26.5
47	91A London Road	25.6	26.3
48	91B London Road	26.1	26.8
49	89 London Road	26.5	27.2
50	87 London Road	26.6	27.3
51	85 London Road	25.2	25.9
52	83 London Road	25.8	26.5
53	81 London Road	26.0	26.7
55	79 London Road	26.1	26.8
56	77 London Road	26.1	26.8
57	75 London Road	25.9	26.6
58	42 London Road	24.9	25.5
59	44 London Road	24.9	25.6
60	46 London Road	24.9	25.5
61	48 London Road	24.7	25.3
62	50 London Road	25.1	25.8
63	52 London Road	25.3	26.0
64	54 London Road	24.8	25.4
65	54A London Road	24.9	25.5
66	56 London Road	25.0	25.6

Figure 7-2 presents annual mean NO_2 concentrations in the Teynham AQMA in the 2028 scenario. Annual average NO_2 concentrations (µg/m^3) are predicted to be more than 10% below the UK Air Quality Objective of 40 µg/m^3 at all locations of relevant exposure in Teynham.

Figure 7-2: Predicted annual mean NO_2 concentrations, Teynham, 2028, µg.m^{-3}

8. SENSITIVITY TESTING

In order to quantify and reduce uncertainty around key model inputs, sensitivity testing was carried out to assessment impact of:

a. The impact of a 2-year delay to fleet renewal in Swale relative to national projections. This assumption reflects potentially reduced rates of purchase of new vehicles in 2020 and 2021.
b. The use of version 12 of the Emission Factor Toolkit, which was published after completion of the modelling presented in this report.

The results of the sensitivity testing are presented below.

8.1 FLEET RENEWAL DELAY

The impact of slower than expected replacement of older vehicles in the fleet during 2020 and 2021 was assessed by running the 2022 baseline model using the fleet for 2020 from the national projections published by Defra. The fleet split for 2020 is presented in Tables 8-1 and 8-2 for light and heavy vehicles respectively.

Table 8-1: Fleet age splits for 2020, light vehicles

Region	Vehicle type	Pre-Euro 1	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6	Euro 6c	Euro 6d
National average	Petrol Car	-	-	0%	3%	11%	25%	15%	46%	-
	Diesel Car	-	-	0%	1%	9%	33%	19%	27%	8%
	Petrol LGV	-	-	1%	4%	12%	27%	17%	44%	-
	Diesel LGV	-	-	0%	2%	10%	26%	17%	45%	-
	Full Hybrid Petrol Car	-	-	-	0%	3%	12%	09%	76%	-
	Plugin Hybrid Petrol Car	-	-	-	-	-	5%	17%	79%	-
	Full Diesel Hybrid Car	-	-	-	-	-	3%	6%	48%	43%

Table 8-2: Fleet age splits for 2020, heavy vehicles

Region	Vehicle type	Pre-Euro I	Euro I	Euro II	Euro III	Euro IV	Euro V EGR	Euro V SCR	Euro VI
National average	Rigid HGV	-	-	0%	3%	3%	4%	11%	78%
	Artic HGV	-	-	0%	0%	1%	2%	7%	90%
	Buses / Coaches	-	-	1%	7%	5%	6%	17%	64%

The results of the sensitivity test are presented in Table 8-3, which shows the maximum predicted concentration at a sensitive receptor in each AQMA in the baseline and fleet delay scenarios. A 2-year delay to fleet renewal is not predicted to lead to maximum predicted concentrations in either AQMA exceeding the Air Quality Objective of 40 µg.m^{-3}.

Table 8-3: Maximum predicted concentrations at sensitive receptors in each AQMA in the 2022 baseline and 2-year fleet delay sensitivity test scenarios, µg.m^{-3}

AQMA	Maximum predicted annual mean NO_2 concentration across all relevant receptors, µg.m^{-3}	
	2022 baseline	2022 “2-year fleet delay” test
Sittingbourne	31.0	32.4
Teynham	28.1	30.0

8.2 EMISSIONS FACTORS TOOLKIT VERSION 12

Following completion of the modelling process, a new version of the Emissions Factors Toolkits, version 12 (as opposed to version 11 which was used in the original modelling), was published by Defra and the devolved administrations. This updated tool includes use of the COPERT v5.6 NOx and PM speed-based emissions factors, updated from COPERT v5.3, as taken form the European Environmental Agency (EEA) emission calculation tool.

An emissions sensitivity test was carried out to assess the impact of using these new factors in the 2028 scenario. Using the updated emissions factors in the EFT v12 was found to reduce predicted emissions across major roads in 2028; as a result, the current assessment presents a worst-case assessment of concentrations in the AQMAs in future years.

9. CONCLUSIONS

Annual mean concentrations of NO_2 measured by monitors in and around two Swale Air Quality Management Areas (AQMAs) for Teynham (AQMA 5) and East Street Sittingbourne (AQMA 3) have been consistently below the government Air Quality Objective for five and four years, respectively. Defra have expressly indicated to Swale that both AQMAs should begin the process of revocation in their feedback of the 2022 and 2023 Annual Status Reports.

To ensure that any decisions are made on robust evidence, Swale continued to monitor air quality for an additional year (2023) and commissioned Ricardo to carry out a Detailed Assessment of NO_2 concentrations in the AQMAs, considering the future committed developments that could impact air quality in these areas.

Modelling was carried out for two years:

1. a 2022 baseline, using traffic data provided by the Council, SWECO and national forecasts for the vehicle fleet composition; and
2. a 2028 future scenario considering the impact of future committed developments that could adversely impact concentrations in the AQMAs. This scenario was modelled assuming that all traffic generated by each development would run through the two AQMAs.

Sensitivity testing was also carried out into the potential impact of reduced fleet turnover in Swale relative to national projections.

The model accurately predicts concentrations at monitoring stations in the Swale AQMAs in 2022, demonstrating that the model correctly represents real-world conditions.

The modelling undertaken through this study shows that:

- no location is predicted to exceed the Air Quality Objective for annual mean NO_2 at any location of relevant exposure in 2022.
- no locations are predicted to exceed the Air Quality Objective in 2028.
- a delay to fleet renewal rates will not jeopardise compliance in the AQMA.

Based on the data available, this Detailed Assessment indicates that the Sittingbourne and Teynham AQMAs can be revoked without risk of future exceedances.

T: +44 (0) 1235 75 3000
E: enquiry@ricardo.com
W: ee.ricardo.com