## ***Gravesham Borough Council***

*Detailed Modelling Study*

*December 2023*

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# Document Control Sheet

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## Table of Contents

## List of Tables



## List of Figures

# Executive Summary

Bureau Veritas have been commissioned by Gravesham Borough Council to help prepare a new Air Quality Action Plan (AQAP). The Council currently have four AQMAs. Three of the AQMAs in question have been declared in relation to traffic emissions; which have been designated for exceedances of the $NO_2$ annual mean Air Quality Strategy objective. The remaining AQMA, has been designated for industrial emissions, regarding $PM_{10}$, the council will be seeking to revoke the Northfleet Industrial Area AQMA in the coming year, therefore will not be included in the updated AQAP.

A dispersion modelling assessment has been completed whereby $NO_2$ concentrations have been predicted across all relevant areas within the district at both specific receptor locations, and across a number of gridded areas to allow the production of concentration isopleths. This has been used to supplement local monitoring data to provide a clear picture of the pollutant conditions within the borough.

Following the completion of the analysis of both monitoring data and modelled concentrations across all of the assessed areas main results and recommendations have been made in terms of the AQMAs within Gravesham:

- AQMA No.1 (A2 Trunk Road) – GR142 passive monitoring continues to report high concentrations within 10% of the $NO_2$ AQS Objective, with distance correction reports compliance in 2022. It is recommended passive monitoring is still carried out at this site and close to the main relevant exposure sites within this AQMA. The council will need to maintain monitoring at the current locations until at earliest to the end of 2024 for revocation to be considered.

- AQMA No.3 (A226 One-way system in Gravesend) – It is suggested that current passive monitoring locations are maintained as all sites report compliance in 2022 with two reporting within 10% of the $NO_2$ AQS Objective (GR13 and GR119). Revocation at earliest would need 3 more years of monitoring with GR13 and GR119 currently reporting no years of compliance

- AQMA No.4 (A227/B261 Wrotham Road/Old Road West Junction) – It is recommended to continue passive monitoring at both GR57 and GR59 sites due to only having one year of compliance, if compliance continues, revocation at earliest would need 2 more years of monitoring.

Results of the 2022 passive monitoring concentrations in combination with roads and receptor modelling show that the current AQMA boundaries cover the relevant areas, the modelling suggests there are no further areas that would need be investigated with the current monitoring network to be maintained until full compliance.

# 1 Introduction

Bureau Veritas have been commissioned by Gravesham Borough Council to complete a detailed assessment in order to review the designation of the Council's existing Air Quality Management Areas (AQMAs), and to help inform a new Air Quality Action Plan (AQAP). The Council's last published AQAP was in 2006, and the details presented within this assessment are to be used to develop an updated AQAP.

The Council currently have four AQMAs. Details of the AQMAs included within this assessment are as follows, and maps detailing the locations of the AQMAs are presented in Figure 1.1 to Figure 1.3. All three AQMAs have been declared for exceedances of the $NO_2$ mean annual Air Quality Strategy (AQS) objective:

- AQMA No.1 – A2 Trunk (The A2 Trunk Road AQMA. An area extending either side of the length of the A2 within the borough);
- AQMA No.3 – A226 One-way system in Gravesend (An area incorporating the entirety of the A226 One-way system in Gravesend) ;
- AQMA No.4 – A227/B261 Wrotham Road/Old Road West Junction (An area encompassing the junction of the A227 Wrotham Road and B261 Old Road West extending south to a point just beyond the Woodlands Restaurant); Details of the AQMAs included within this assessment for $NO_2$ are as follows, and maps detailing the locations of the AQMAs are presented in Figure 1.1 to Figure 1.4:

Details of the AQMA (declared for $PM_{10}$) not included within this assessment is as follows. The automatic station (Gravesham Industrial Background) has reported 5 years of compliance of the $PM_{10}$ AQS Objective and therefore the council will be seeking to revoke this AQMA in 2024:

- AQMA No.2 – Northfleet Industrial Area (An area encompassing the Northfleet Industrial Area in Gravesham);

## 1.1 Scope of Report

The assessment seeks, with reasonable certainty, to predict the magnitude and geographical extent of any exceedances of the AQS objectives, providing the Council with updated modelling data that can be utilised for the development and/or update of AQAP measures.

The areas considered as part of this study are illustrated in the figures shown under each AQMA heading within this report. The following are the main objectives of this report:

- To assess the air quality at selected locations (receptors) at the façades of areas of relevant exposure, representative of worst-case exposure within, and close to the existing AQMA boundaries, based on modelling of emissions from road traffic on the local road network;
- To determine the geographical extent of any potential exceedance of the annual mean AQS objective for $NO_2$;
- To determine the relative contributions of various source types to the overall pollutant concentrations through the completion of a source apportionment study; and
- To put forward recommendations as to the extent of any changes to the current AQMA boundary and any changes to the declaration of the specific AQMAs.

The approach adopted in this assessment to assess the impact of road traffic emissions on air quality utilised the atmospheric dispersion model ADMS-Roads, focusing on emissions of oxides of nitrogen ($NO_x$), which comprise of nitric oxide (NO) and $NO_2$.

In order to provide consistency with the Council's own work on air quality, the guiding principles for air quality assessments as set out in the latest guidance and tools provided by Defra for air quality assessment (LAQM.TG(16)[1]) have been utilised.

**Figure 1.1 – Map of AQMA No.1 (A2 Trunk)**

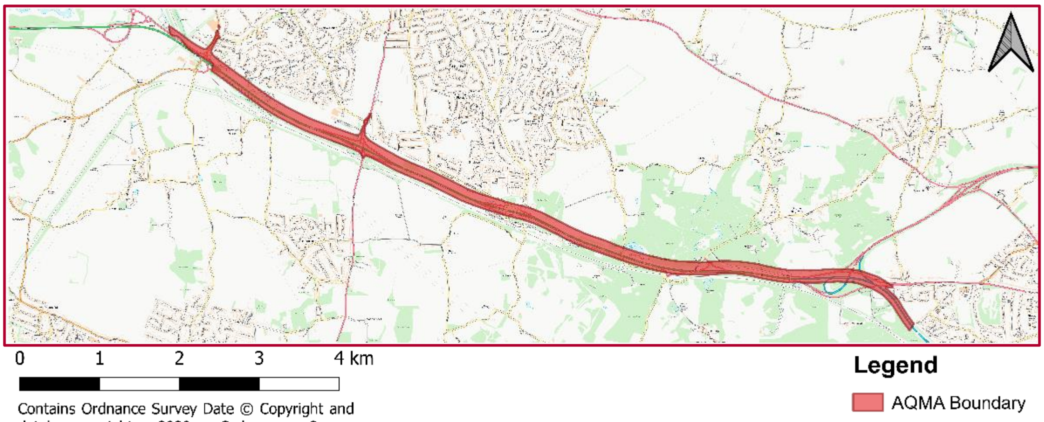


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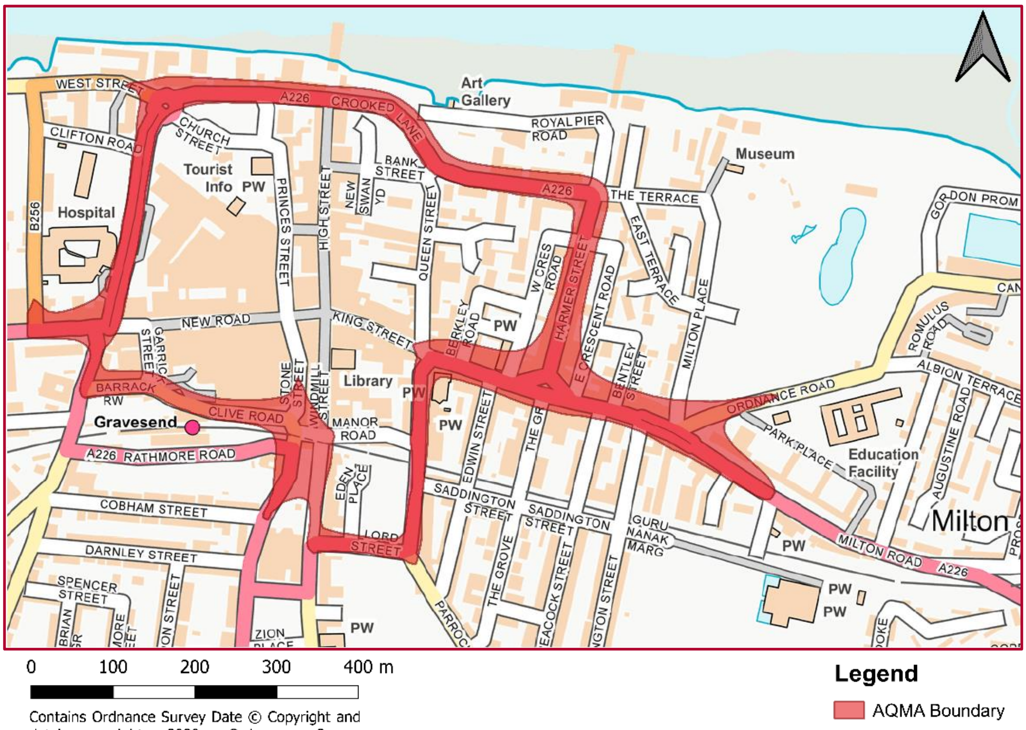
**Figure 1.2 – Map of AQMA No.3 (A226 One-way system in Gravesend)**

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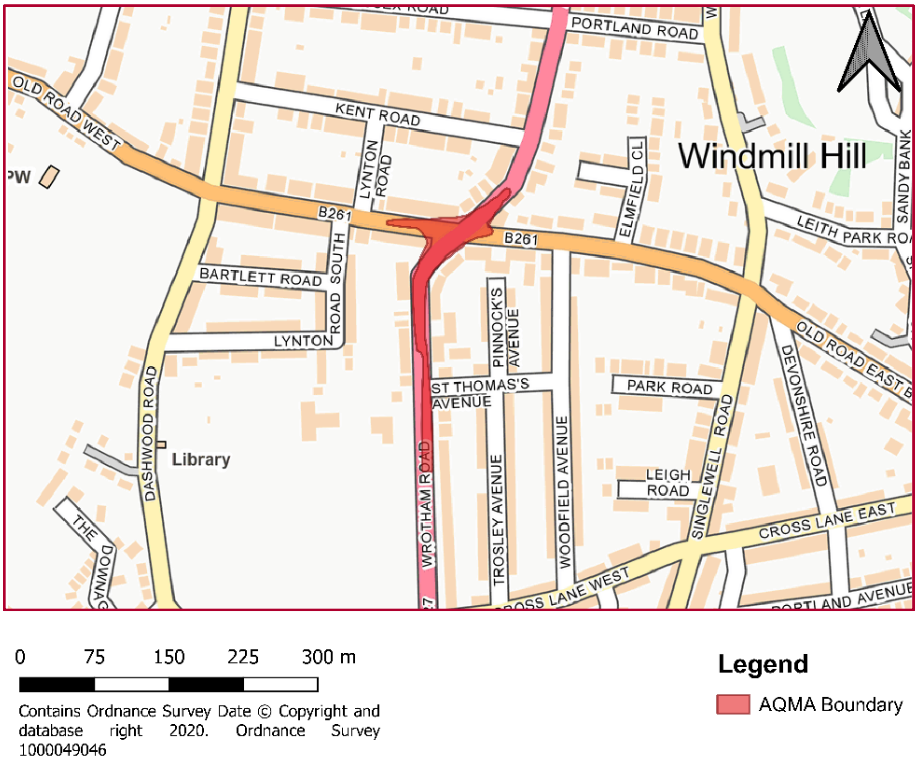
[1] Local Air Quality Management Technical Guidance LAQM.TG(16), April 2016, published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

**Figure 1.3 – AQMA No.4 (A227/B261 Wrotham Road/Old Road West Junction)**



# 2 Assessment Methodology

Atmospheric modelling to predict the pollutant concentrations emitted from road traffic sources was carried out using ADMS Roads version 5.0.0.1, developed by Cambridge Environmental Research Consultants (CERC). The approach used was based upon the following:

- Prediction of $NO_2$ (where relevant) concentrations to which existing receptors may be exposed to, and a comparison with the relevant AQS objectives;
- Quantification of relative $NO_2$ contribution of sources to overall $NO_2$ pollutant concentration; and
- Determination of the geographical extent of any potential exceedances in regards to the existing AQMA boundaries and proposed boundary changes stated in the previous assessment.

Pollutant concentrations have been predicted within a base year of 2022, with model inputs relevant to the assessment based upon the same year..

## 2.1 Traffic Inputs

Traffic flows for the road links included within the model have been sourced from the DfT traffic count online resource[2]. This data source provides an average annual daily traffic (AADT) flow for the relevant road link in terms of a number of vehicle types; cars, LGVs (light goods vehicles), HGVs (heavy goods vehicles), buses and coaches, and motorcycles.

The traffic data utilised within the dispersion modelling, both the location of the DfT count points and the count point specific data are presented in Appendix A.

It is important to note that some of the traffic data used is based on estimates either from nearby links or estimated from the most recent manual counts.

Traffic speeds were modelled at the relevant speed limit for each road. However, in accordance with LAQM.TG(22), where appropriate, traffic speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to occur.

The Emissions Factors Toolkit (EFT) version 12.0[3] has been used to determine vehicle emission factors for input into the ADMS-Roads model. The emission factors are based upon the traffic data inputs used within the assessment, with total vehicle flows and proportion of vehicle types taken from existing DfT data. The pre-set national values for vehicle fleet in terms of vehicle Euro Class has been utilised in the absence of a vehicle fleet specific information for the Gravesham area.

## 2.2 General Model Inputs

A site surface roughness value of 0.5m was entered into the ADMS-roads model, consistent with the suburban nature of the modelled domain. In accordance with CERC's ADMS Roads user guide[4], a minimum Monin-Obukhov Length of 30m will be used for the ADMS Roads model to reflect the urban topography of the model domain.

One year of hourly sequential meteorological data from a representative synoptic station is required by the dispersion model. For the completion of the modelling 2022 meteorological data from the Heathrow airport weather station has been utilised within in this assessment. This particular site has been chosen due to it being the nearest site with a complete data set for 2022 and is representative the Gravesham Borough Council area.

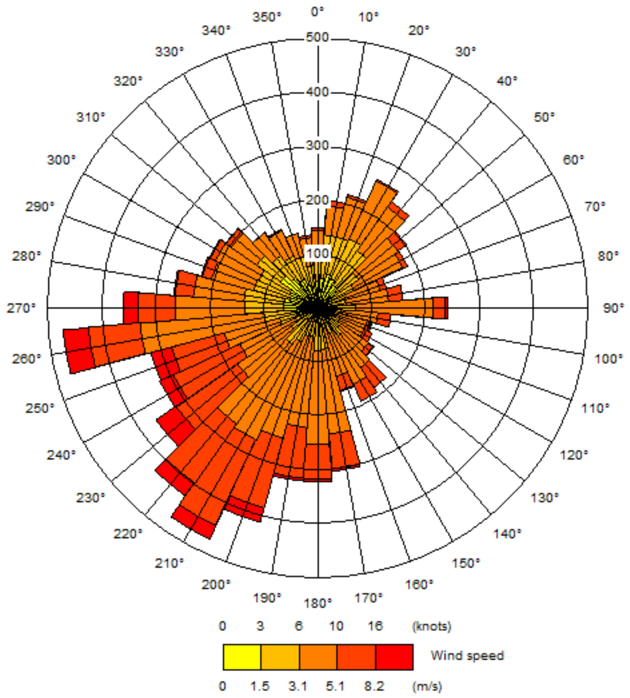
[2] Department for Transport, traffic count data for available road links (2022), available at https://www.gov.uk/government/collections/road-traffic-statistics

[3] Defra, Emissions Factors Toolkit (2023), available at http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

[4] CERC, ADMS-Roads User Guide Version 5 (2020)

A wind rose for this site for the year 2022 is presented in Figure 2.1.

**Figure 2.1 – Wind Rose for Heathrow Airport 2022 Meteorological Data**



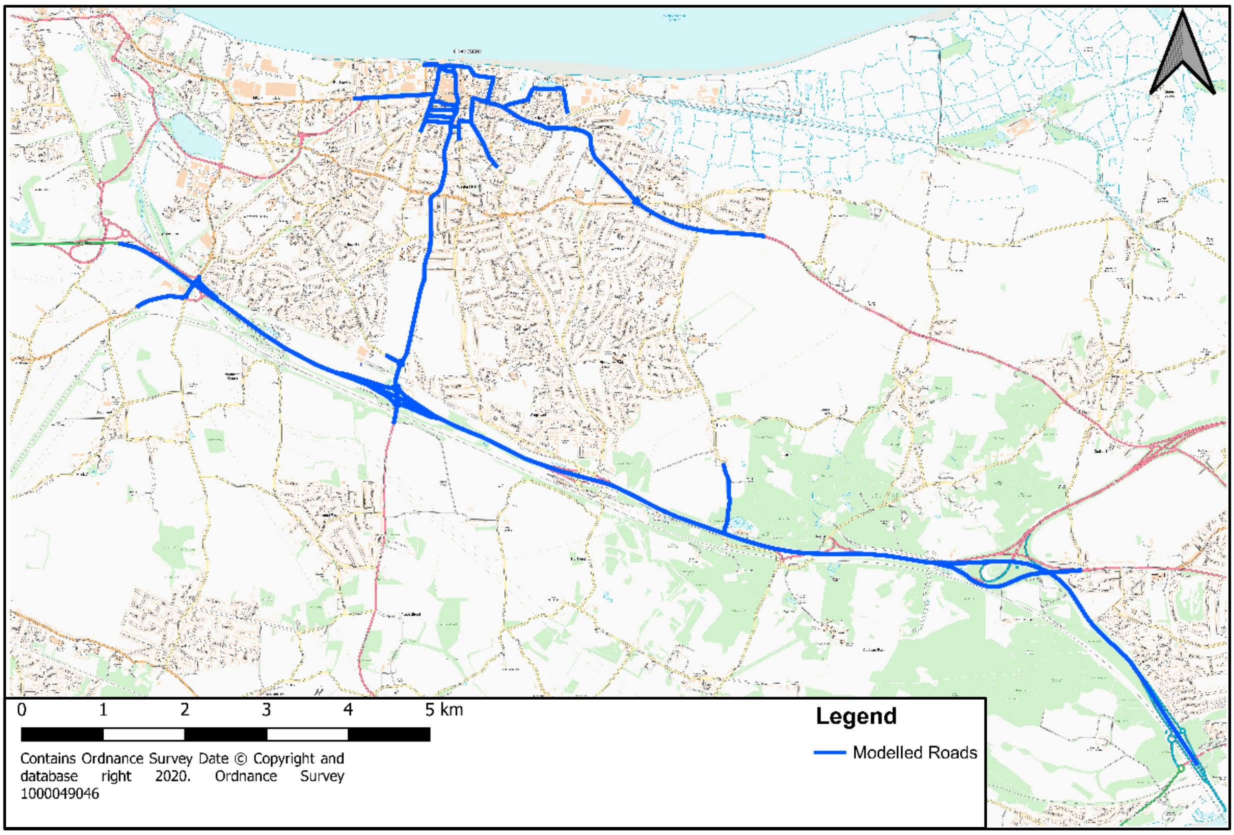

## 2.3 Emission Sources

A total of 122 road sources were included throughout the model domain. No point sources have been included within the model under the assumption that road traffic is the primary source of the $NO_2$ emissions. The road links drawn are presented in Figure 2.2. Street canyons were also included along some stretches of road where the roads were surrounded by buildings/walls on both sides. Areas of street canyons are shown in

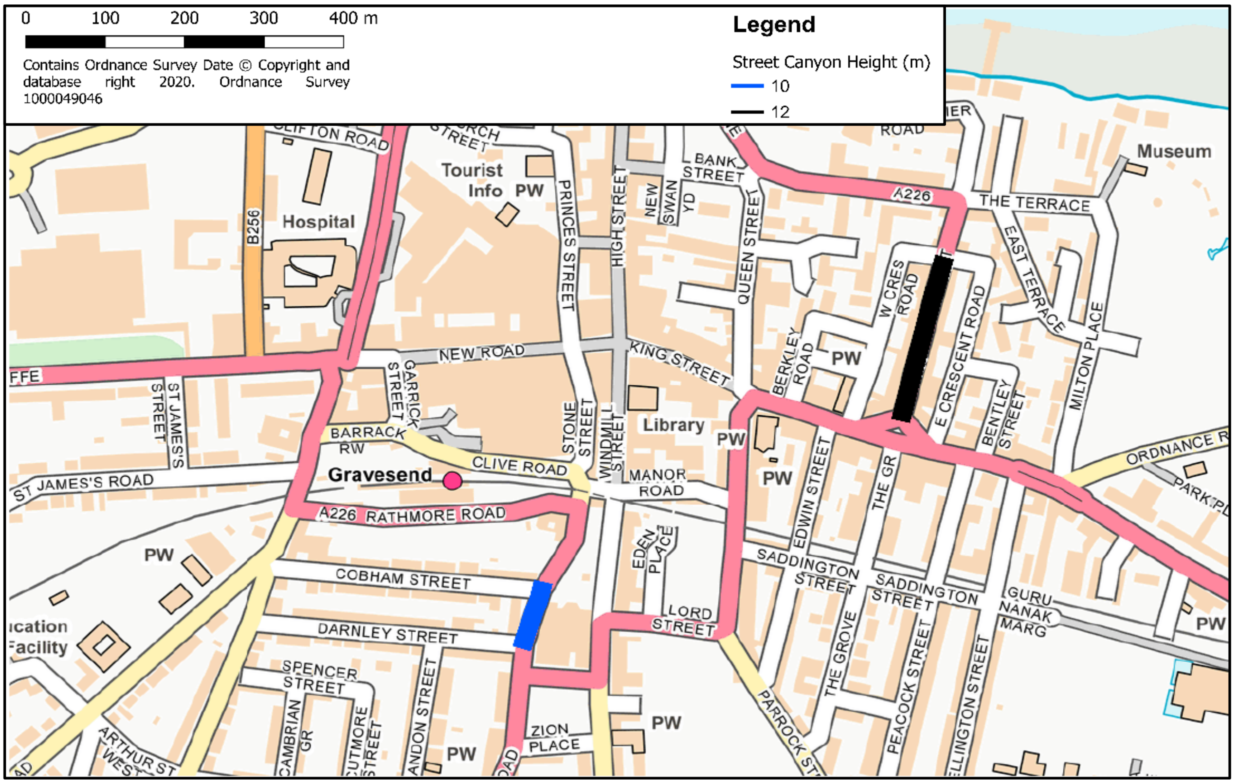
Figure 2.3.

The roads were drawn along the primary and main roads throughout Gravesham Borough Council, ensuring to include those running through the AQMAs. These were however restricted due to the availability of traffic data along these roads.

### Figure 2.2 – Modelled Road Sources




### Figure 2.3 – Modelled Canyons and Canyon Height



## 2.4 Sensitive Receptors

50 discrete receptors were included within the assessment to represent locations of relevant exposure. The locations were identified through the completion of a desktop study. In addition, concentrations were also modelled across regular gridded area's set across the AQMAs, with a spatial resolution between the receptors of 55m x 30m, and 40m x 110m. The gridded receptor model was split into 9 separate domains, with the maximum resolution along the section covering the A2, running from Watling Street A2 East to Watling Street A2 West. These were supplemented with additional receptor points added close to the modelled road links, using the intelligent gridding tool in ADMS-Roads.

There were 35 discrete receptors representing ground level exposure modelled at a height of 1.5m. The remaining 15 receptors were included at an increased height of between 2.5 – 11m to represent exposure at buildings with residential usage on the first and second storey levels, as well as elevated properties uphill from the roads.

## 2.5 Review of Air Quality Monitoring

In line with the declared AQMAs, during 2022 the Council's monitoring programme consisted solely of recording $NO_2$ concentrations using a network of 2 automatic monitoring stations and 61 passive monitoring sites, 57 of these locations are roadside sites, 3 are urban background sites and 1 industrial background site, and five of which are triplicate sites. Monitoring locations were inputted within the model, however only 39 passive monitors were used due to 22 monitors not located near roads with traffic data, therefore not included within the model. The details and results of the passive monitoring within Gravesham for 2022 used in the study are shown in Table 2.1.

**Table 2.1 – Gravesham 2022 $NO_2$ Monitoring Results**

| Site ID | Site Name | Site Type | AQMA | OS Grid Ref (X Y) | Annual Mean $NO_2$ Concentration ($\mu g/m^3$) 2022 | Data Capture 2022 (%) |
|---|---|---|---|---|---|---|
| GR8 | Painters Ash School Northfleet, Air Monitoring Station, Northfleet | R | Y | 562586, 172071 | 22.4 | 92.3 |
| GR13 | 88 West Street, Gravesend, Kent, DA11 0BX Pelican Crossing | R | Y | 564696, 174437 | 37.6 | 92.3 |
| GR24 | 28- 29 Milton Road (Lamp post), Gravesend, Kent, DA12 2RF | R | Y | 565129, 174052 | 35.0 | 92.3 |
| GR31 | 32 Harmer Street GF (façade), Gravesend, DA12 2AX | R | Y | 565055, 174148 | 34.0 | 92.3 |
| GR39 | 19 Stone Street (Downpipe), Gravesend, DA12 1AP | R | Y | 564734, 174032 | 29.3 | 92.3 |
| GR40 | Somerset Public House (signpost), 10 Darnley Road, Gravesend, DA11 0RU | R | Y | 564488, 174094 | 35.3 | 92.3 |
| GR45 | Princes Street (Signpost) (Opp Jury Street), Gravesend, Kent, DA11 0AA | R | N | 564705, 174266 | 21.7 | 84.6 |
| GR47 | 29- 31 Harmer Street (façade), Gravesend, DA12 2AP | R | Y | 565041, 174174 | 35.0 | 92.3 |
| GR57 | 61 Old Road West (Hairdressers - façade), Gravesend, Kent, DA11 0LW | R | Y | 564462, 173158 | 31.7 | 82.7 |
| GR58 | The Venue (Lamppost), Milton Road, Gravesend, DA12 2rf | R | Y | 565168, 174041 | 31.6 | 92.3 |

| Site ID | Site Name | Site Type | AQMA | OS Grid Ref (X Y) | Annual Mean $NO_2$ Concentration (µg/m³) 2022 | Data Capture 2022 (%) |
|---|---|---|---|---|---|---|
| GR61 | 62 New Road (Pounce - Down Pipe), Gravesend, Kent, DA11 0AD | R | Y | 564429, 174155 | 30.2 | 92.3 |
| GR62 | The Terrace (façade), Gravesend, DA12 2BB | R | Y | 565004, 174330 | 24.8 | 76.9 |
| GR66 | Russell Quay (Lamppost), West Street, Gravesend, DA11 0BE | R | N | 564512, 174450 | 26.3 | 82.7 |
| GR78 | Canal Tavern Public House, Canal Road, Gravesend, DA12 2RS | R | N | 565658, 174190 | 26.9 | 92.3 |
| GR96 | Parrock Street, Gravesend, DA12 1EZ | R | Y | 564967, 173719 | 25.0 | 92.3 |
| GR104 | 8 Roman Road (Downpipe), Northfleet | R | Y | 562465, 172153 | 26.9 | 84.6 |
| GR107 | 46 Pepper Hill (Façade), Northfleet | R | Y | 562272, 172281 | 27.7 | 92.3 |
| GR116 | Saxon Close, Northfleet, Lamp post opposite No.38. | R | Y | 562484, 172225 | 26.3 | 92.3 |
| GR118 | 40 Windmill Street, Gravesend DA12 1BA (Façade) | R | N | 564760, 173862 | 30.3 | 92.3 |
| GR119 | Woodville Place (lamp post) | R | N | 564732, 173821 | 39.4 | 92.3 |
| GR122 | King & Taylor 10-12 Wrotham Road (façade) DA11 | R | N | 564666, 173891 | 31.4 | 92.3 |
| GR123 | City Praise Centre Lower Higham Road, Gravesend, Kent, DA12 2LY | R | N | 566538, 173109 | 20.8 | 92.3 |
| GR125 | Café Taj (Façade), 170 Parrack Street, Gravesend | R | Y | 564880, 173937 | 28.3 | 92.3 |
| GR127 | 17 Darnley Road | R | N | 564459, 173977 | 24.0 | 92.3 |
| GR128 | 1a Railway Place (façade) | R | Y | 564733, 174002 | 26.0 | 92.3 |
| GR129 | 20 Stone Street (façade) | R | N | 564701, 173977 | 23.4 | 92.3 |
| GR130 | 6 Wrotham Road, The Hair Shop (Façade) | R | N | 564682, 173939 | 25.7 | 84.6 |
| GR131 | 7 Wrotham Road, Martin Tolhurst Solicitors (façade) | R | N | 564664, 173964 | 21.8 | 92.3 |
| GR133 | 23 Wrotham Road (façade) | R | N | 564651, 173799 | 27.5 | 92.3 |
| GR134 | 17 Wrotham Road (façade) | R | N | 564654, 173831 | 27.6 | 82.7 |
| GR135 | 25 Wrotham Road (lamp post adjacent to building) | R | N | 564653, 173765 | 31.1 | 84.6 |
| GR136 | Woodville Place, Lamp Post opp, 17 Wrotham Road | R | N | 564686, 173823 | 30.1 | 92.3 |
| GR138 | Telegraph Post, Foxbury Manor, Old Watling Street, Rochester | R | N | 570583, 169549 | 24.8 | 92.3 |
| GR140 | Nuxley Toys, 13-14 Milton Road | R | Y | 564956, 174102 | 30.8 | 75.0 |
| GR141 | Park Pale, Telegraph Post | R | Y | 569577, 169601 | 21.2 | 84.6 |
| GR142 | Inn on the Lake, Watling Street, Shorne DA12 3HB (Light post) | R | Y | 567495, 169817 | **42.9** | 92.3 |
| GR143 | 29 Wrotham Road (Façade) | R | N | 564643, 173746 | 28.2 | 92.3 |

| Site ID | Site Name | Site Type | AQMA | OS Grid Ref (X Y) | Annual Mean $NO_2$ Concentration (µg/m$^3$) 2022 | Data Capture 2022 (%) |
|---|---|---|---|---|---|---|
| GR145 | Lamp post adjacent Chantry Community Academy, Ordnance Road | R | N | 565338, 174062 | 29.3 | 92.3 |
| R – Roadside<br>In **bold**, exceedance of the $NO_2$ annual mean AQS objective of 40µg/m$^3$ | | | | | | |

## 2.6 Model Outputs

Background pollutant values for 2022 derived from the Defra background maps database[5] have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of $NO_x$.

To avoid duplication of the road source contribution from 'Primary Roads' in the modelling and assessment process, these source sectors have been removed from the overall background concentrations reported. This has been completed using the Defra $NO_x$ Sector Removal Tool[6] v8.0.

Gravesham Borough Council carries out monitoring of $NO_2$ at a number of background monitoring sites using 2 automatic monitoring stations, 3 background passive monitoring tube sites and 1 industrial monitoring site during 2022. For modelling purposes, the Defra Background maps have been used as opposed to the available background monitoring data due to there not being sufficient monitoring sites to have a representative cover of the modelling domain.

The background concentrations used within this assessment are presented in Appendix C (Table C.1).

For the prediction of annual mean $NO_2$ concentrations for the modelled scenarios, the output of the ADMS-Roads model for road $NO_x$ contributions has been converted to total $NO_2$ following the methodology in LAQM.TG(22), using the $NO_x$ to $NO_2$ conversion tool developed on behalf of Defra. This assessment has utilised the current version of the $NO_x$ to $NO_2$ conversion tool, version 7.1[7].

Verification of the model has been carried out using a number of local authority $NO_2$ passive monitoring locations, in accordance with the methodology detailed within LAQM.TG(22). A total of 39 roadside passive monitoring sites were modelled throughout Gravesham. The locations and heights of these tubes have been adjusted within the model and validated where required via a desktop study.

An initial verification was carried out using all 39 sites. It was identified that using this model wide verification factor resulted in many sites significantly over or under predicting (outside of the ±25% acceptance level). The model could not be adjusted and improved any further and it was therefore determined that this inaccuracy was likely due to the size of the model domain resulting in a verification factor that is attempting to be representative of varying road types. Therefore, it was decided that separate verification factors were required to cover different geographical areas throughout the model. Details of these verifications are provided in Appendix B. The final verification factors applied are:

- Trunk Road Verification – 1.582
- Non-Trunk Road Verification – 2.060

### 2.6.1 Source Apportionment

To help inform the development of measures as part of the action plan stage of the project, a source apportionment exercise was undertaken for the following vehicle classes.

- Petrol, Diesel and Alternative Fuelled (electric, bioethanol and liquefied petroleum gas) Cars;

[5] Defra Background Maps (2020), http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

[6] Defra $NO_2$ Adjustment for $NO_x$ Sector Removal Tool (2020), available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

[7] Defra $NO_x$ to $NO_2$ Calculator (2020), available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

- Petrol, Diesel and Alternative Fuelled LGVs;
- HGVs;
- Bus and Coaches; and
- Motorcycles.

This provides vehicle contributions of $NO_x$ as a proportion of the total $NO_x$ concentration, which will allow the Council to develop specific AQAP measures targeting a reduction in emissions from specific vehicle types. As there has been no locally defined fleet information, national averages in terms of euro class proportions of different vehicles have been utilised. The national averages for England are the pre-set values set within the latest version of the EFT that has been used to derive specific emission rates.

It should be noted that emission sources of $NO_2$ are dominated by a combination of direct $NO_2$ (f-$NO_2$) and oxides of nitrogen ($NO_x$), the latter of which is chemically unstable and rapidly oxidised upon release to form $NO_2$. Reducing levels of $NO_x$ emissions therefore reduces concentrations of $NO_2$. As a consequence, the source apportionment study has considered the emissions of $NO_x$, which are assumed to be representative of the main sources of $NO_2$.

With regards to the discrete receptor locations, consideration has been given to the following groups of receptors located within, and within 20m of the boundary, of each designated AQMA. The source apportionment study has evaluated the following receptor combinations:

- The average $NO_x$ contributions across all modelled locations. This provides useful information when considering possible action measures to test and adopt. It will however understate road $NO_x$ concentrations in problem areas;
- The $NO_x$ contributions at the receptor with the maximum road $NO_x$ and $NO_2$ contribution. This provides a comparison to the previous group, with the identification of the most prominent vehicle source at receptor with the highest predicted $NO_2$ concentration.

# 3 Modelling Results

The following section provides a detailed assessment for each AQMA, comparing both the monitoring completed within the AQMA over a five-year period, with the modelled concentrations of annual mean $NO_2$ for 2022. Details of each monitoring location and the monitoring results have been taken from the 2023 Annual Status Report[8] completed by the Council. For each AQMA, recommendations have been put forward in terms of the current determination of the specific AQMA, in relation to potential changes to the designation or boundary. Furthermore, additional analysis of receptor locations outside the existing AQMAs has been completed to assess if there are any areas outside declared AQMAs where annual mean concentrations of $NO_2$ are predicted to be in exceedance of the annual mean objective.

In line with the standardised LAQM reporting, the tabulated results present any exceedances of the annual mean AQS objective of 40µg/m$^3$ in bold, and any predicted concentrations in exceedance of 60µg/m$^3$ have been bolded and underlined. Additionally, annual mean concentrations that are within 10% of the objective have been presented in italics in order to ensure that any uncertainty in relation to the predicted modelling concentrations is taken into consideration for any recommendations made in terms of AQMA designation, amendment, or revocation.

Contour results have also been produced for each designation within the AQMAs, with concentration isopleths presented at >60 µg/m$^3$, 40 µg/m$^3$ – 36 µg/m$^3$ (within 10% of the 40µg/m$^3$ objective) and <36 µg/m$^3$ for AQMA 1 and 40µg/m$^3$, 40µg/m$^3$ – 36µg/m$^3$ (within 10% of the 40µg/m$^3$ objective) for AQMA 3 and 4 .These have been produced from a gridded results layer covering the model domain. In addition, ADMS-roads automatically places a high number of additional receptors close to each modelled road link to increase the spatial resolution of the receptors.

In addition, the $NO_x$ source apportionment results for each AQMA which have been split across the vehicle classifications detailed in Section 2.6, are presented in both tabulated and pie chart formats. This allows a cross comparison between the main vehicular sources to be completed across each AQMA and will aid the development of measures specific to each AQMA.

## 3.1 AQMA No.1 (A2 Trunk)

### 3.1.1 Council Monitoring Data

AQMA No.1 is currently designated for exceedances of the annual mean $NO_2$ AQS objective. The current boundary incorporates the A2 trunk road, an area extending either side of the length of the A2 within the borough. Currently there are seven passive monitoring sites located within, and near to, the current AQMA boundary. These are presented in Table 3.1, and the monitoring results from the previous five years are also shown.

GR8, GR92, GR104, GR110 GR107, GR116, GR138 and GR141 are located near or within the boundary of AQMA No.1, and it can be seen that there have consistently been no exceedances of the annual mean $NO_2$ objective for these monitoring locations over the last five years. Conversely, GR142 has reported an exceedance for the last five years, located inside of the AQMA boundary on A2 Watling Street. GR142 has also consistently reported the highest concentration out of the 7 monitoring locations for the past five years, this is likely to be due to the traffic emissions from the A2 trunk road and the close proximity of the passive monitoring site to the roadside. This site is subject to fall off with distance correction, following distance correction calculations, GR142 reported a concentration of 32.2 µg/m$^3$ in 2022. The last exceedance GR142 reported following distance calculations was in 2019 with a concentration of 42.9 µg/m$^3$, therefore under distance correction GR142 has reported compliance for one year (excluding COVID years 2020/2021).

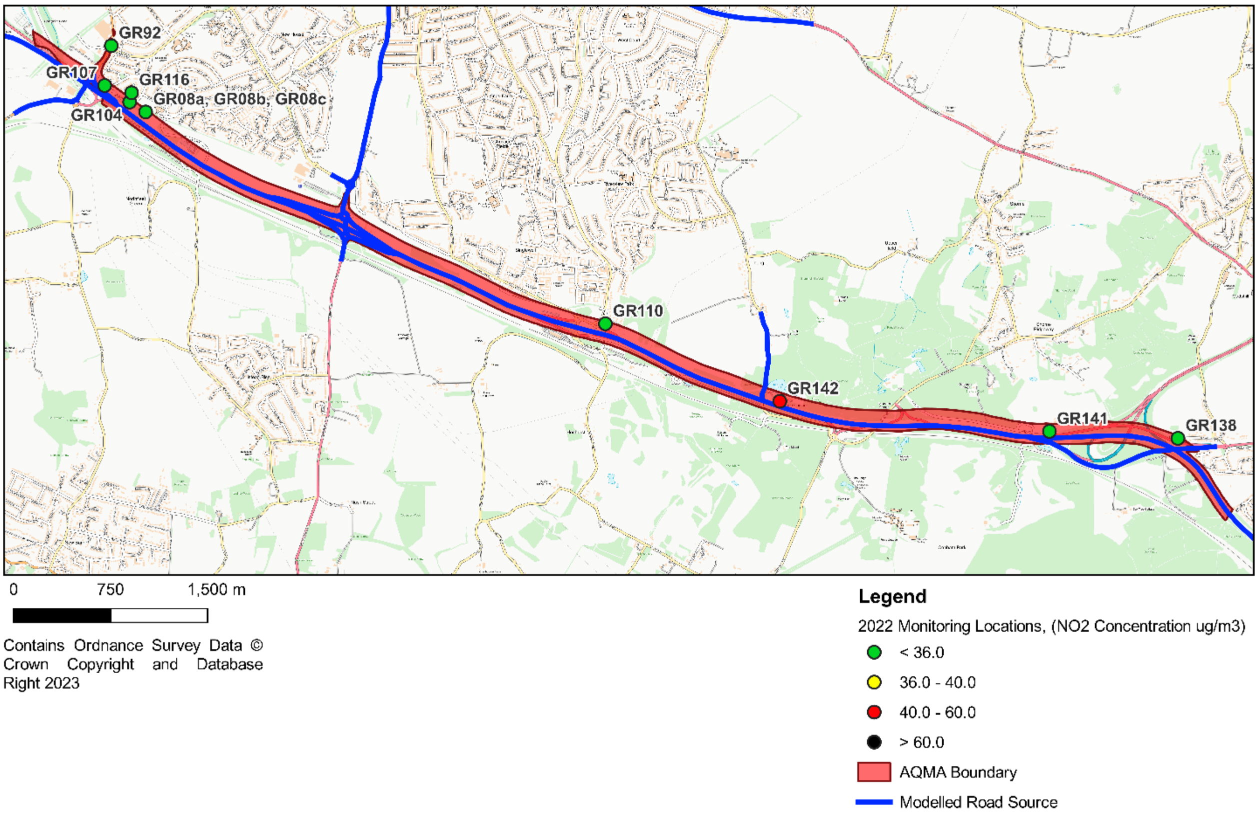
[8] Gravesham Borough Council (2023), 2023 Air Quality Annual Status Report

**Table 3.1 – Current $NO_2$ Monitoring Within, or in Close Proximity to AQMA No.1**

| Site | Site Type | OS Grid Ref X | OS Grid Ref Y | Distance to Relevant Exposure (m) | Height (m) | Annual Mean $NO_2$ Concentration ($\mu g/m^3$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2018 | 2019 | 2020 | 2021 | 2022 |
| **GR8** | R | 562589 | 172076 | 0.0 | 3.0 | 30.4 | 30.9 | 24.3 | 23.9 | 22.4 |
| **GR92** | R | 562323 | 172589 | 0.0 | 1.5 | *36.9* | *38.6* | 33.3 | 33.0 | 29.0 |
| **GR104** | R | 562465 | 172153 | 0.0 | 8.7 | 33.4 | 34.2 | 29.2 | 28.3 | 26.9 |
| **GR107** | R | 562272 | 172281 | 0.0 | 1.96 | 35.0 | *36.3* | 30.6 | 29.8 | 27.7 |
| **GR110** | R | 566149 | 170436 | 0.0 | 1.9 | 35.3 | *38.7* | 32.1 | 29.7 | 28.3 |
| **GR116** | R | 562480 | 172225 | 7.5 | 2.69 | 32.2 | 32.3 | 28.3 | 29.3 | 26.3 |
| **GR138** | R | 570583 | 169549 | 6.1 | 1.8 | 28.8 | 30.2 | 25.3 | 24.1 | 24.8 |
| **GR141** | R | 569588 | 169603 | 9.4 | 1.95 | 29.3 | 27.1 | 25.2 | 22.5 | 21.2 |
| **GR142** | R | 567500 | 169836 | 25.2 | 2.35 | **55.0** | **59.8** | **46.1** | **41.1** | **42.9** |

In **bold**, exceedance of the annual mean $NO_2$ AQS objective of $40\mu g/m^3$.
When **underlined**, $NO_2$ annual mean exceeds $60\mu g/m^3$, indicating a potential exceedance of the $NO_2$ 1-hour mean objective
Annual mean concentrations that are within 10% of the objective have been presented in *italics*
R= Roadside

**Figure 3.1 – AQMA No.1, Modelled Roads and Monitoring Locations**




## 3.1.2 Modelled Receptors, Annual Mean $NO_2$

Table 3.2 provides the modelled annual mean $NO_2$ concentrations predicted at existing residential receptor locations in 2022. 3 discrete receptor locations are positioned within AQMA No.1. None of these locations have a predicted exceedances of the annual mean $NO_2$ objective, at R9, with all sites modelling concentrations below the AQS objective.

Figure 3.2 presents the modelled receptor locations alongside their predicted annual mean $NO_2$ concentrations. From this, it can be seen that all receptors have a predicted concentrations of less than 40 µg/m$^3$. The maximum reported concentration out of these receptors is at receptor R9, with a predicted concentration of 32.1 µg/m$^3$. The nearest passive monitoring location to this is GR142, which reported an annual mean $NO_2$ concentration in 2022 of 42.9 µg/m$^3$. When distance correction to a relevant point of exposure was applied, the concentration dropped to 32.2 µg/m$^3$. The modelled receptor R9 is within 0.1 µg/m$^3$ of the distance corrected monitored value at this location. It should be noted that there are no monitoring locations located further west along the A2 near relevant exposure. It is therefore difficult to verify the concentrations at these modelled receptors, and the results should be considered with a degree of caution.

From the annual mean $NO_2$ concentration contour plots presented in Figure 3.3 and Figure 3.4, it can be seen that the extent of the predicted exceedances of the annual mean objective are constrained to the A2 junctions/roundabouts. The contour lines follow the geometry of the road, with the exceedance limit not coming into range of any residential properties in the nearby vicinity to the A2. The wind direction originating from the South West, as presented in Figure 2.1, causes the exceedance contour line to be located closer to the southbound carriageway.

**Table 3.2 – AQMA No.1, Summary of Modelled Receptor Results ($NO_2$)**

| Receptor ID | OS Grid X | OS Grid Y | Height (m) | In AQMA? | AQS objective (µg/m$^3$) | Modelled 2022 Annual Mean $NO_2$ (µg/m$^3$) | % of AQS objective |
|---|---|---|---|---|---|---|---|
| **R7** | 565139.3 | 170892.8 | 1.5 | Y | 40 | 28.1 | 70.2 |
| **R8** | 565787.8 | 170805.9 | 1.5 | Y | 40 | 27.6 | 69.0 |
| **R9** | 567491.1 | 169863.6 | 1.5 | Y | 40 | 32.1 | 80.4 |

**Figure 3.2 – AQMA No.1, Modelled Receptor $NO_2$ Concentrations**

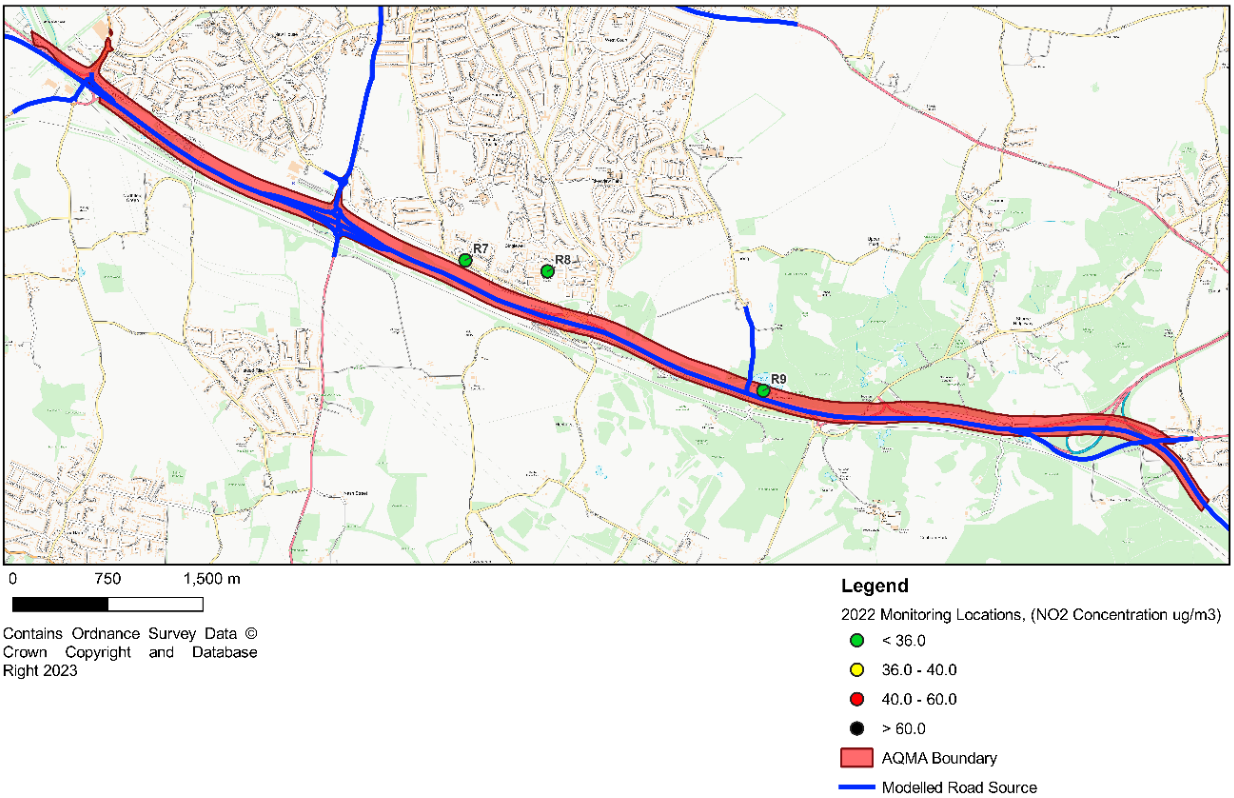


**Figure 3.3 – Modelled $NO_2$ Concentration Isopleth (A2 West)**

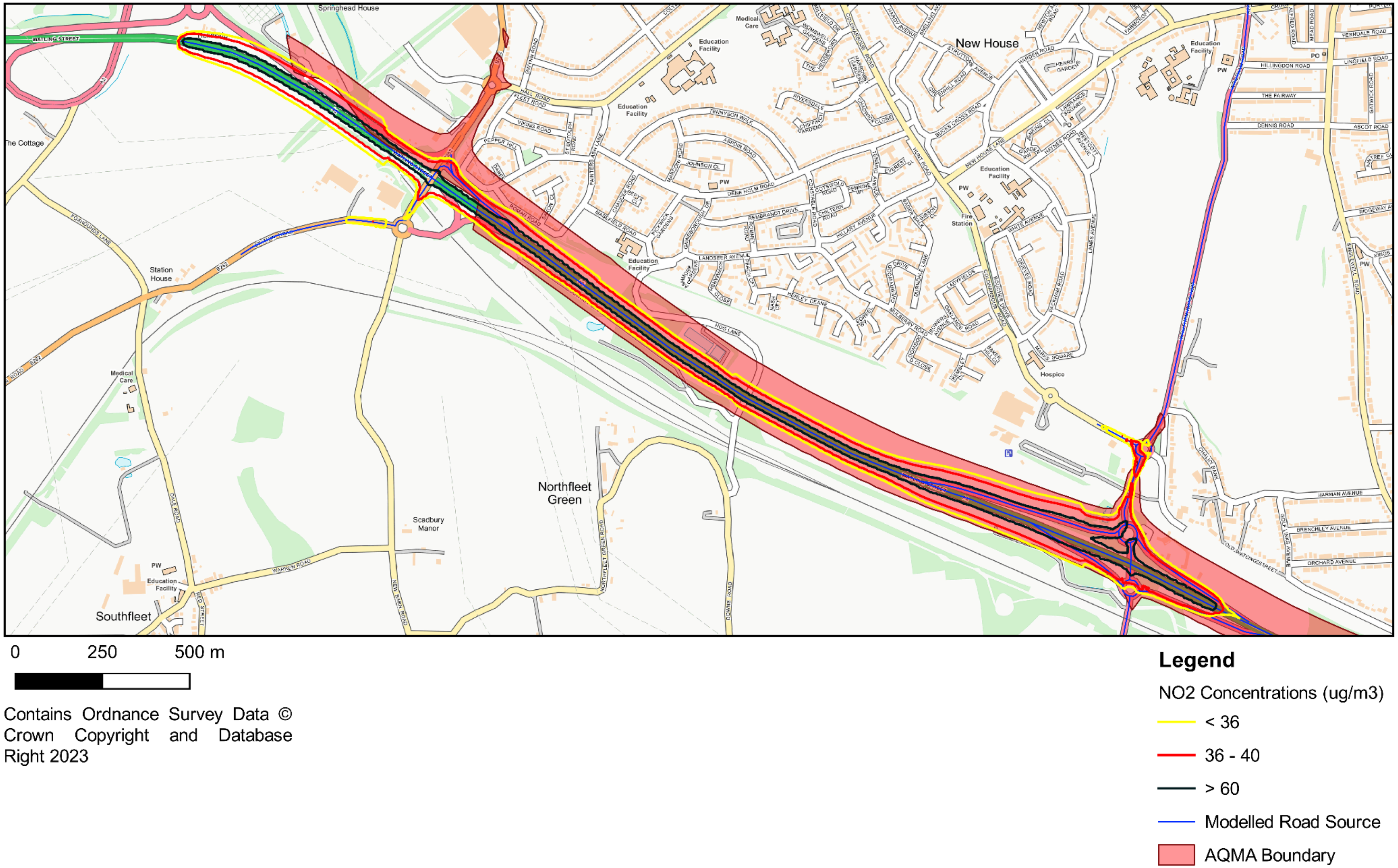
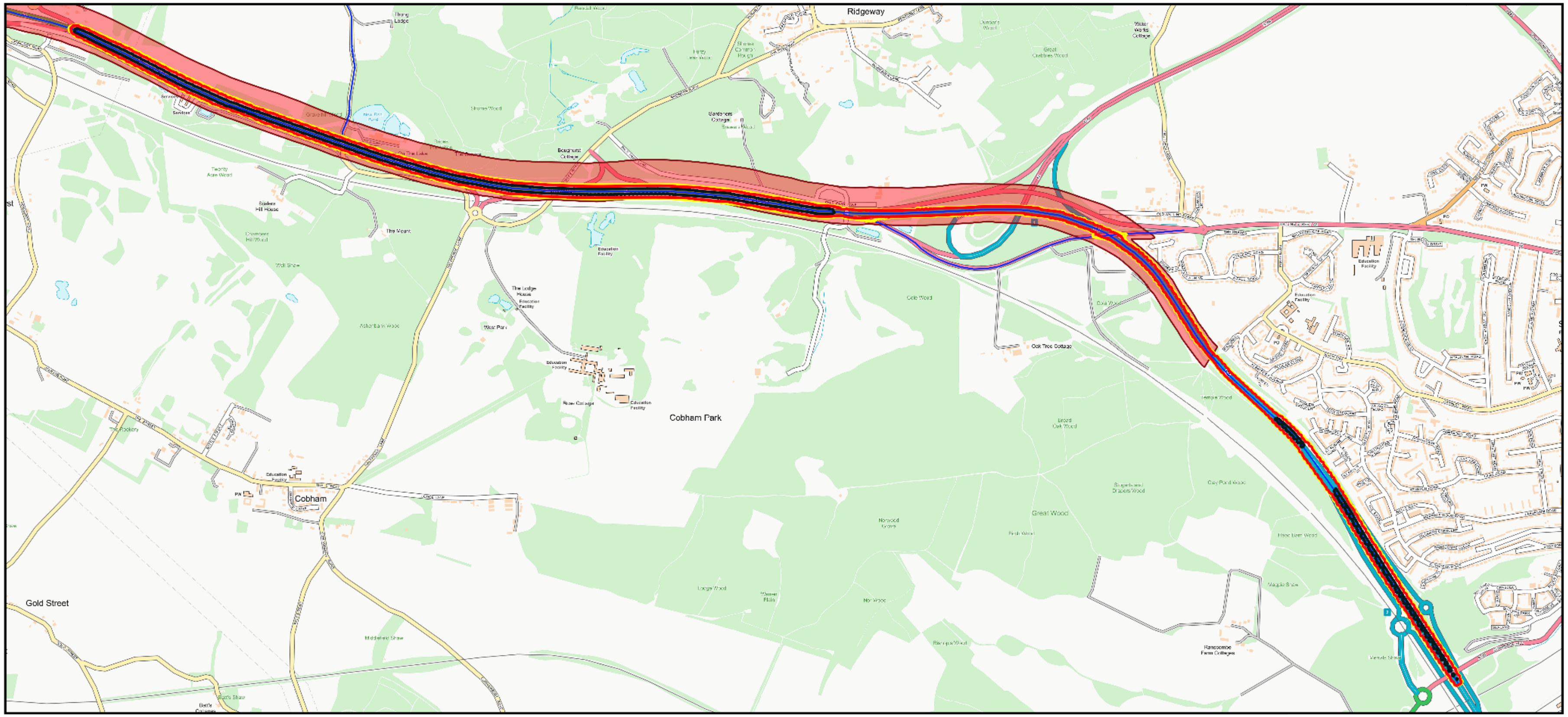


**Figure 3.4 – Modelled $NO_2$ Concentration Isopleth (A2 East)**




0 500 1,000 m

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**Legend**

NO2 Concentrations (ug/m3)

- < 36
- 36 - 40
- > 60
- Modelled Road Source
- AQMA Boundary

### 3.1.3 AQMA No.1 Source Apportionment

The source apportionment completed for the modelled receptors within the boundary of AQMA No.1 incorporates the 3 receptors as detailed within Table 3.3 below. Apportionment for $NO_x$ concentrations have been completed for the two separate groups in terms of the receptors as detailed in Section 2.6.1, with the results presented in Table 3.3.

When considering the average $NO_x$ concentration across all modelled receptors, road traffic accounts for 17.1 µg/m$^3$ (34.6%) of total $NO_x$ concentration (23.8 µg/m$^3$). Of the 8.1 µg/m$^3$ total road $NO_x$, Diesel LGVs account for the greatest contribution (14.3%) of any of the vehicle types, followed by Diesel Cars (12.9%) and HGVs (4.8%). The remaining vehicle source groups (Petrol and Alternative Fuel Cars and LGVs, and Motorcycles) contribute less than 2.3% each.

The receptor with the maximum road $NO_x$ concentration is receptor R9, whereby the total road $NO_x$ was predicted to be 19.9 µg/m$^3$. At receptor R9 road traffic accounts for 58.5% of total $NO_x$ concentration (34.0 µg/m$^3$). Of the 34.0 µg/m$^3$ total road $NO_x$ the separate vehicle apportionment remains similar to the average source apportionment  but with an increased apportionment to Petrol Cars (3.8%), Diesel Cars (21.2%), Petrol LGVs (0.1%), Diesel HGVs (24.2%) and Buses & Coaches (0.3%), with the remaining vehicle source group contributing less than 0.2%.

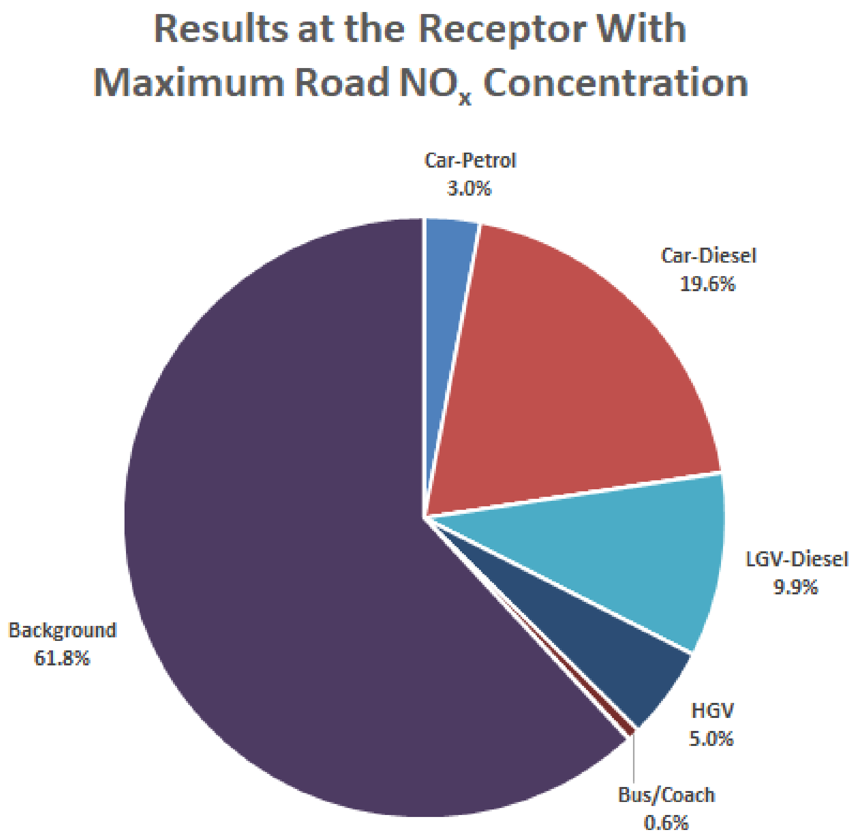
Figure 3.6 shows the contribution of local $NO_x$ background concentrations across the A2 in Gravesham. The 'Industry' source represents the emissions from combustion in industry, energy production, extraction of fossil fuel and waste. 'Domestic', institutional, and commercial space heating. 'Other' source represents emission from shipping, off-road and other emissions, 'Point' representing individual point sources and 'Rural' representing regional rural emissions. The remaining emissions are as stated in the figure. The breakdown in background concentrations have been produced using $NO_x$ local background concentrations derived from Defra background map for the grid squares covered by the modelled area.

Emissions from 'Rural' sources is the largest background contribution, representing 53.5% of the total background $NO_x$, this is followed by 'Other' sources contributing 18.4%. 'Domestic', 'Industry' and 'Point' sources represent less than 7.3% each, and 'Road' sources represents 11.2%.

**Table 3.3 – $NO_x$ Source Apportionment Results: AQMA No.1**

| Results | All Vehicles | Car | | | LGV | | | HGV | Bus and Coach | Motorcycle | Background |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Petrol | Diesel | EV/LPG | Petrol | Diesel | EV/LPG | | | | |
| **Average across all modelled receptors** | | | | | | | | | | | |
| **$NO_x$ Concentration (µg/m$^3$)** | 8.1 | 0.5 | 3.0 | 0.0 | 0.0 | 3.4 | 0.0 | 1.1 | 0.0 | 0.0 | 15.4 |
| **Percentage of Total $NO_x$** | 34.6% | 2.3% | 12.9% | 0.0% | 0.0% | 14.3% | 0.0% | 4.8% | 0.2% | 0.1% | 65.4% |
| **Percentage Contribution to Road $NO_x$** | 100.0% | 6.6% | 37.3% | 0.0% | 0.1% | 41.4% | 0.0% | 13.9% | 0.5% | 0.2% | - |
| **At The Receptor With the Maximum Road $NO_x$ Concentration (R9)** | | | | | | | | | | | |
| **$NO_x$ Concentration (µg/m$^3$)** | 19.9 | 1.3 | 7.2 | 0.0 | 0.0 | 8.3 | 0.0 | 3.0 | 0.1 | 0.0 | 14.1 |
| **Percentage of Total $NO_x$** | 58.5% | 3.8% | 21.2% | 0.0% | 0.1% | 24.2% | 0.0% | 8.8% | 0.3% | 0.1% | 41.5% |
| **Percentage Contribution to Road $NO_x$** | 100.0% | 6.6% | 36.2% | 0.0% | 0.2% | 41.4% | 0.0% | 15.0% | 0.5% | 0.2% | - |

**Figure 3.5 – $NO_x$ Source Apportionment Results: AQMA No.1**



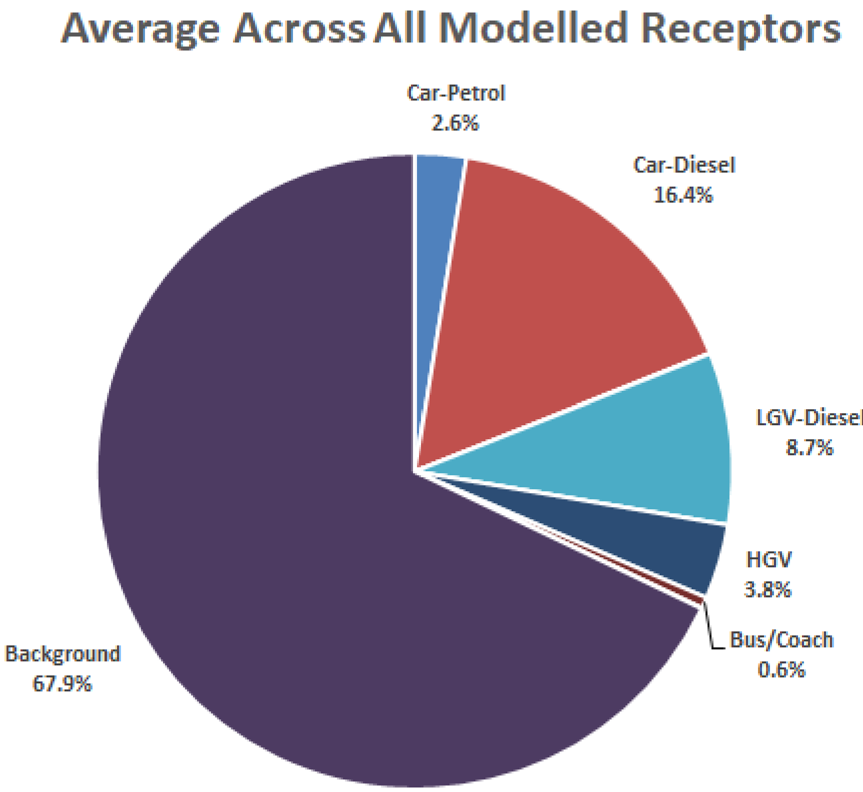
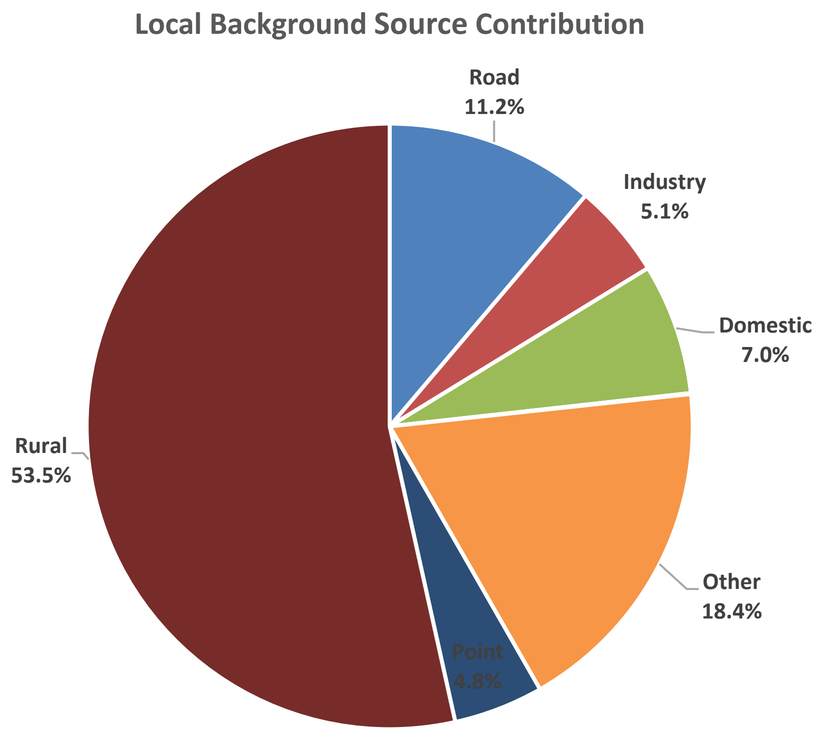



**Figure 3.6 – Average Local Background NOx Source Contributions Across All Modelled Receptors in AQMA No.1**



## 3.2 AQMA No.3 (A226 One-way system in Gravesend AQMA)

### 3.3.1 Council Monitoring Data

AQMA No.3 is currently designated for exceedances of the annual mean $NO_2$ AQS objective with the current boundary incorporating the Gravesham Town Centre one-way system. Currently there are 29 monitoring sites measuring annual mean $NO_2$ concentrations within or near to the current AQMA boundary. These are presented in Figure 3.7, and the monitoring results from the previous five years are shown in Table 3.4.

Within AQMA No.3 no passive monitoring sites within the AQMA boundary are exceeding the annual mean $NO_2$ objective in 2022, with GR13 and GR119 reporting within 10% at 37.6 µg/m$^3$ and 39.4 µg/m$^3$. GR119 has consistently reported the highest concentrations out of the 29 monitoring locations for the past five years, this is likely to be influenced by heavy traffic flow at an intersection causing increased idling of vehicles. Similarly, to GR119, GR13, GR24 and GR31 are located on routes prone to traffic idling, the remaining exceeding passive monitoring locations are located at junctions, therefore exposed to periods of traffic idling as a result of queuing vehicles.

From 2021 – 2022 28 sites reported a decrease in $NO_2$ concentrations, and 1 sites reported an increase.

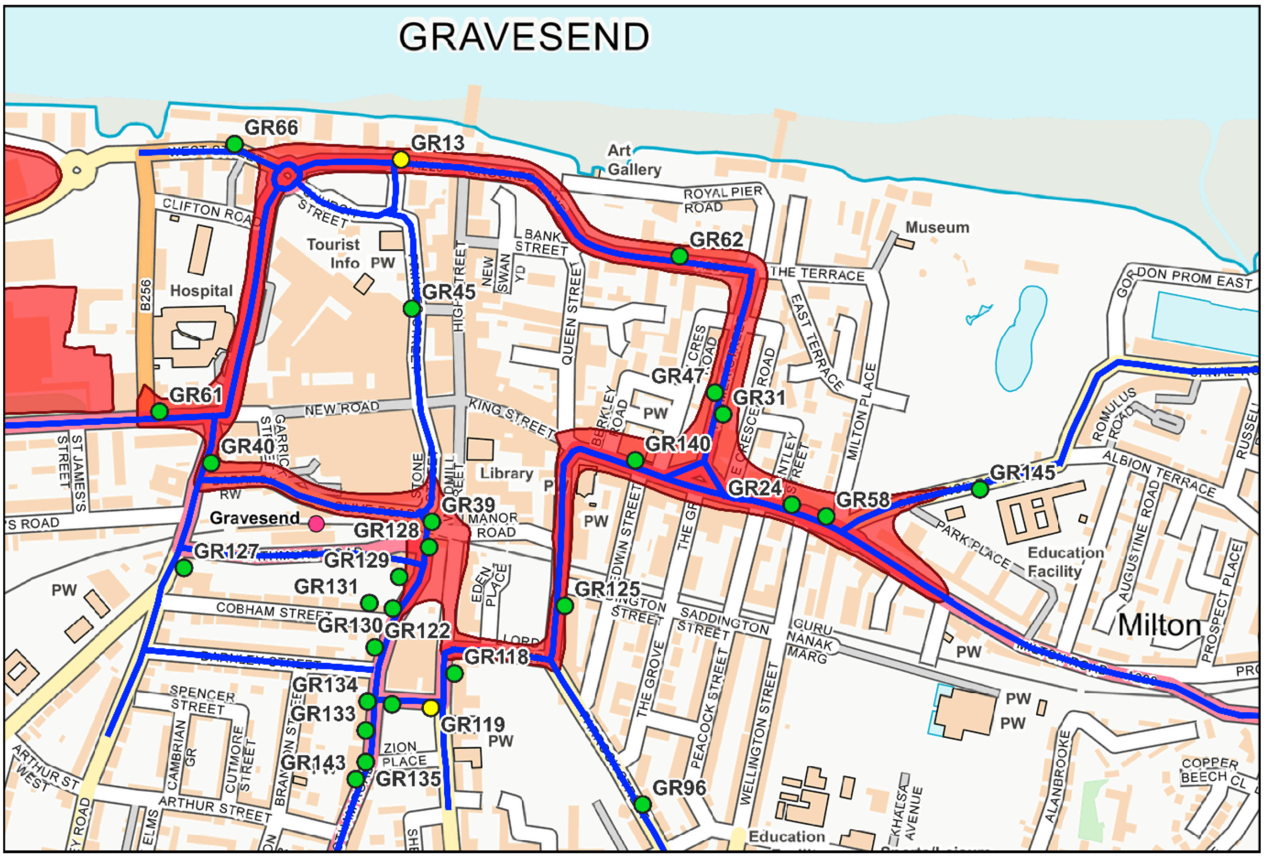
**Table 3.4 – Current $NO_2$ Monitoring Within, or in Close Proximity to AQMA No.3**

| Site | Site Type | OS Grid Ref X | OS Grid Ref Y | Distance to Relevant Exposure (m) | Height (m) | Annual Mean $NO_2$ Concentration (µg/m$^3$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2018 | 2019 | 2020 | 2021 | 2022 |
| **GR13** | R | 564696 | 564696 | 0.08 | 2.85 | **47.1** | **46.1** | *38.0* | **41.2** | *37.6* |
| **GR24** | R | 565128 | 565128 | 0.2 | 2.5 | **45.4** | **42.7** | *36.7* | **40.0** | 35.0 |
| **GR31** | R | 565052 | 565052 | 0 | 2.7 | **42.9** | **43.7** | *38.2* | 37.4 | 34.0 |
| **GR39** | R | 564730 | 564730 | 0.1 | 2.5 | 35.8 | 35.0 | 28.3 | 31.0 | 29.3 |
| **GR40** | R | 564486 | 564486 | 0.05 | 2.5 | **45.2** | **43.4** | 35.0 | *38.3* | 35.3 |
| **GR45** | R | 564708 | 564708 | 6.8 | 2.5 | 27.0 | 29.3 | 24.1 | 24.4 | 21.7 |
| **GR47** | R | 565043 | 565043 | 0 | 2.5 | **45.4** | **42.9** | *36.3* | **41.0** | 35.0 |
| **GR58** | R | 565166 | 565166 | 0.02 | 2.7 | *37.6* | *38.0* | 31.2 | 33.0 | 31.6 |
| **GR61** | R | 564429 | 564429 | 0.2 | 3 | 35.5 | 35.1 | 27.7 | 30.7 | 30.2 |
| **GR62** | R | 565004 | 565004 | 0 | 2.8 | 30.7 | 30.8 | 25.8 | 25.6 | 24.8 |
| **GR66** | R | 564512 | 564512 | 0.1 | 2.5 | 31.9 | 31.6 | 27.9 | 28.2 | 26.3 |
| **GR78** | R | 565658 | 565658 | 0.2 | 2.5 | 31.3 | 32.5 | 26.2 | 27.5 | 26.9 |
| **GR96** | R | 564963 | 564963 | 2 | 2.28 | 32.4 | 31.4 | 27.3 | 25.5 | 25.0 |
| **GR118** | R | 564755 | 564755 | 0 | 2.4 | 34.8 | 34.9 | 29.0 | 30.9 | 30.3 |
| **GR119** | R | 564729 | 564729 | 0 | 2.5 | **53.4** | **49.5** | *37.6* | **41.7** | *39.4* |
| **GR122** | R | 564667 | 564667 | 0 | 2.5 | *36.1* | *37.0* | 30.7 | 32.6 | 31.4 |
| **GR125** | R | 564877 | 564877 | 0 | 2.4 | 32.1 | 33.2 | 27.5 | 29.6 | 28.3 |
| **GR127** | R | 564456 | 564456 | 0 | 2.5 | 30.1 | 30.4 | 24.9 | 26.6 | 24.0 |
| **GR128** | R | 564727 | 564727 | 0 | 2.4 | 30.9 | 31.8 | 26.0 | 29.6 | 26.0 |
| **GR129** | R | 564694 | 564694 | 0 | 2.5 | 27.8 | 28.4 | 24.7 | 25.0 | 23.4 |
| **GR130** | R | 564687 | 564687 | 0 | 2.2 | 30.6 | 31.3 | 26.0 | 27.0 | 25.7 |
| **GR131** | R | 564661 | 564661 | 2.2 | 1.8 | 24.9 | 26.4 | 22.5 | 22.1 | 21.8 |
| **GR133** | R | 564657 | 564657 | 0 | 1.9 | *36.3* | *36.2* | 28.7 | 28.3 | 27.5 |
| **GR134** | R | 564659 | 564659 | 0 | 2 | 32.8 | 33.7 | 24.9 | 25.2 | 27.6 |

| Site | Site Type | OS Grid Ref X | OS Grid Ref Y | Distance to Relevant Exposure (m) | Height (m) | Annual Mean $NO_2$ Concentration (µg/m$^3$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2018 | 2019 | 2020 | 2021 | 2022 |
| **GR135** | R | 564657 | 564657 | 0 | 2.6 | **44.8** | **43.9** | *36.8* | 35.7 | 31.1 |
| **GR136** | R | 564686 | 564686 | 0.2 | 2.7 | *39.3* | *37.4* | 32.3 | 31.1 | 30.1 |
| **GR140** | R | 564955 | 564955 | 0 | 2.44 | *38.1* | *38.5* | 33.7 | 34.2 | 30.8 |
| **GR143** | R | 564646 | 564646 | 0 | 1.97 | *36.6* | *37.0* | 29.5 | 29.0 | 28.2 |
| **GR145** | R | 565336 | 565336 | 17 | 2.57 | 32.2 | 30.6 | 28.9 | 29.6 | 29.3 |

In **bold**, exceedance of the annual mean $NO_2$ AQS objective of 40µg/m$^3$.When **underlined**, $NO_2$ annual mean exceeds 60µg/m$^3$, indicating a potential exceedance of the $NO_2$ 1-hour mean objective
Annual mean concentrations that are within 10% of the objective have been presented in *italics*
R= Roadside

**Figure 3.7 – AQMA No.3, Modelled Roads and Monitoring Locations**




0 100 200 m

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**Legend**

2022 Monitoring Locations, (NO2 Concentration ug/m3)
< 36.0
36.0 - 40.0
40.0 - 60.0
> 60.0
AQMA Boundary
Modelled Road Source

### 3.3.2 Modelled Receptors, Annual Mean $NO_2$

Table 3.5 provides the modelled annual mean $NO_2$ concentrations predicted at existing residential receptor locations in 2022. 16 discrete receptor locations are positioned within the boundary of AQMA No.3, with a further 20 being located in close proximity to the boundary. There are no predicted exceedances of the annual mean $NO_2$ objective at any receptors, 6 receptors model concentrations within 10% of the $NO_2$ AQS.

Modelled receptor R42 reports the highest concentration at 37.0 µg/m$^3$, the closest passive monitoring station is GR13 which monitored a concentration of 37.6 µg/m$^3$. R42 is located inside the AQMA boundary, GR13 remains representative of a one way road in close proximity to residential housing. An additional 8 receptors were placed around GR13 to represent concentrations at differing heights to model at first and second floor flat heights. All receptors reported compliance, with only GR40 within 10% at 36.0 µg/m$^3$.

The remaining receptor locations are predicted to be well below the objective limit value.

Table 3.6 presents the modelled receptor locations alongside their predicted annual mean $NO_2$ concentrations. Out of 42 receptors, 41 have predicted concentration of less than 36 µg/m$^3$, and 2 receptors within 10% of the AQS objective.

From the annual mean $NO_2$ concentration contour plots presented in Figure 3.9, it can be seen that the extent of the predicted exceedances of the annual mean objective are constrained at approaching junctions and roundabouts. The contour lines follow the geometry of the road, there are some residential properties located on the A226 West Street and Harmer Street that are within the contour for concentrations within 10% of the AQS objective.

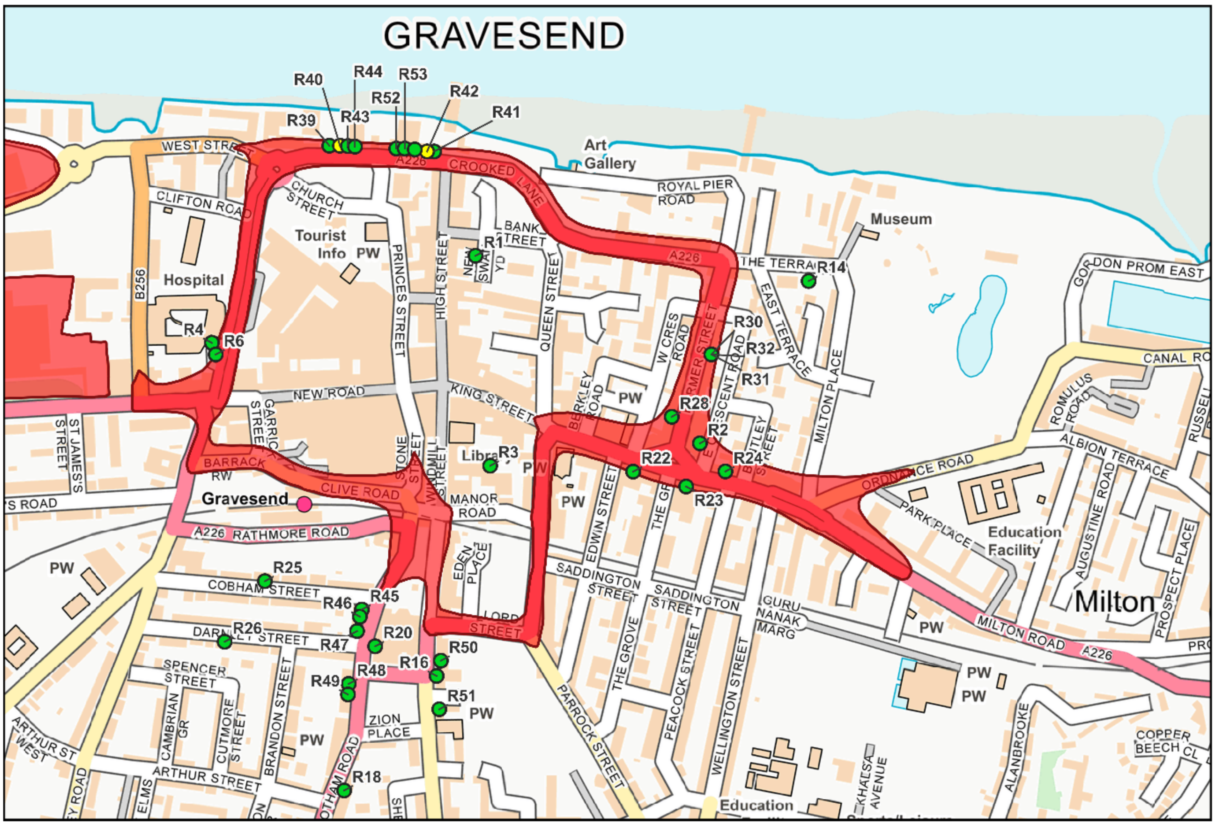
**Table 3.5 – AQMA No.3, Summary of Modelled Receptor Results ($NO_2$)**

| Receptor ID | OS Grid X | OS Grid Y | Height (m) | In AQMA? | AQS objective (µg/m$^3$) | Modelled 2022 Annual Mean $NO_2$ (µg/m$^3$) | % of AQS objective |
|---|---|---|---|---|---|---|---|
| R1 | 564799.38 | 174313.73 | 1.5 | N | 40 | 28.9 | 72.2 |
| R2 | 565057.44 | 174097.92 | 1.5 | Y | 40 | 33.3 | 83.2 |
| R3 | 564816.19 | 174072.11 | 1.5 | N | 40 | 30.1 | 75.2 |
| R4 | 564496.12 | 174213.55 | 1.5 | Y | 40 | 30.2 | 75.5 |
| R6 | 564500.56 | 174200.12 | 1.5 | Y | 40 | 31.2 | 78.1 |
| R11 | 564612.81 | 173562.98 | 1.5 | N | 40 | 25.6 | 64.0 |
| R12 | 564651.19 | 173573.33 | 1.5 | N | 40 | 21.6 | 53.9 |
| R13 | 565017.5 | 173505.69 | 1.5 | N | 40 | 20.4 | 51.0 |
| R14 | 565182.44 | 174284.61 | 1.5 | N | 40 | 26.1 | 65.3 |
| R15 | 564063.19 | 174108.88 | 1.5 | N | 40 | 29.7 | 74.1 |
| R16 | 564754.62 | 173830.34 | 1.5 | N | 40 | 32.0 | 80.1 |
| R17 | 565026.38 | 173605.11 | 1.5 | N | 40 | 25.0 | 62.4 |
| R18 | 564648.25 | 173698.55 | 1.5 | N | 40 | 27.1 | 67.7 |
| R19 | 564601.12 | 173630.5 | 1.5 | N | 40 | 24.5 | 61.3 |
| R20 | 564683.94 | 173864.44 | 1.5 | N | 40 | 31.9 | 79.7 |
| R22 | 564980.62 | 174065.38 | 1.5 | Y | 40 | 32.5 | 81.1 |
| R23 | 565041.56 | 174048.27 | 1.5 | Y | 40 | 34.3 | 85.9 |
| R24 | 565086.75 | 174065.58 | 1.5 | Y | 40 | 30.3 | 75.7 |
| R25 | 564557.12 | 173939.38 | 1.5 | N | 40 | 21.2 | 53.1 |
| R26 | 564510.81 | 173869.66 | 1.5 | N | 40 | 27.7 | 69.1 |
| R27 | 565025 | 174128.5 | 5 | Y | 40 | 31.9 | 79.8 |
| R28 | 565025 | 174128.5 | 8 | N | 40 | 30.3 | 75.7 |
| R29 | 565025 | 174128.5 | 11 | Y | 40 | 29.4 | 73.4 |

| Receptor ID | OS Grid X | OS Grid Y | Height (m) | In AQMA? | AQS objective (µg/m³) | Modelled 2022 Annual Mean $NO_2$ (µg/m³) | % of AQS objective |
|---|---|---|---|---|---|---|---|
| **R30** | 565070.56 | 174200.17 | 5 | N | 40 | 31.0 | 77.6 |
| **R31** | 565070.56 | 174200.17 | 8 | Y | 40 | 29.7 | 74.3 |
| **R32** | 565070.56 | 174200.17 | 11 | N | 40 | 31.4 | 78.5 |
| **R39** | 564631.25 | 174440.3 | 4 | Y | 40 | 32.4 | 80.9 |
| **R40** | 564643.5 | 174440.3 | 1.5 | Y | 40 | *36.0* | 90.1 |
| **R41** | 564751.75 | 174433.66 | 4 | Y | 40 | 32.0 | 80.1 |
| **R42** | 564743.62 | 174433.66 | 1.5 | Y | 40 | *37.0* | 92.6 |
| **R43** | 564652.56 | 174439.88 | 4 | Y | 40 | 32.4 | 81.0 |
| **R44** | 564660.75 | 174439.25 | 1.5 | Y | 40 | 28.6 | 71.5 |
| **R45** | 564668.62 | 173906.73 | 1.5 | N | 40 | 29.5 | 73.8 |
| **R46** | 564666.31 | 173898.55 | 2.5 | N | 40 | 28.2 | 70.5 |
| **R47** | 564658.31 | 173880.25 | 1.5 | N | 40 | 28.5 | 71.3 |
| **R48** | 564653.5 | 173821.22 | 1.5 | N | 40 | 28.3 | 70.7 |
| **R49** | 564652.69 | 173809 | 1.5 | N | 40 | 28.1 | 70.2 |
| **R50** | 564759.5 | 173847.91 | 4 | Y | 40 | 26.9 | 67.4 |
| **R51** | 564757.69 | 173792.02 | 4 | Y | 40 | 33.9 | 84.9 |
| **R52** | 564708.25 | 174437 | 4 | Y | 40 | 32.5 | 81.3 |
| **R53** | 564717.94 | 174437 | 4 | Y | 40 | 32.4 | 80.9 |
| **R54** | 564729.5 | 174435.97 | 4 | Y | 40 | 24.1 | 60.3 |

In **bold**, exceedance of the annual mean $NO_2$ AQS objective of 40µg/m³.
When **underlined**, $NO_2$ annual mean exceeds 60µg/m³, indicating a potential exceedance of the $NO_2$ 1-hour mean objective
Annual mean concentrations that are within 10% of the objective have been presented in *italics*

## Figure 3.8 – AQMA No.3, Modelled Receptor $NO_2$ Concentrations




0 100 200 m

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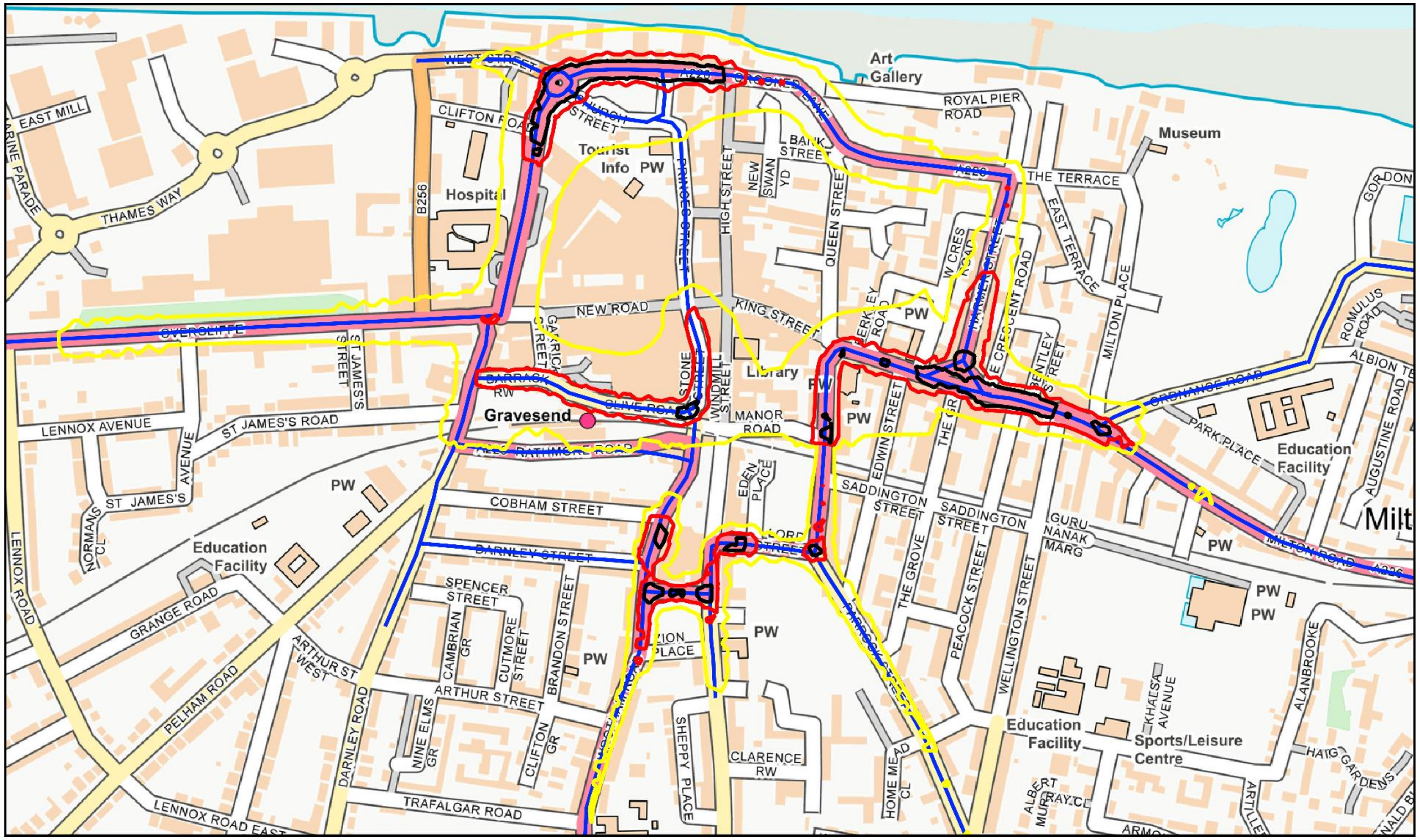
**Legend**

2022 Monitoring Locations, (NO2 Concentration ug/m3)

- < 36.0
- 36.0 - 40.0
- 40.0 - 60.0
- > 60.0
- AQMA Boundary

**Figure 3.9 – AQMA No.3 Modelled $NO_2$ Concentration Isopleth**

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**Legend**

NO2 Concentrations (ug/m3)

- >30 (yellow)
- 36 - 40 (red)
- >40 (black)
- Modelled Road Source (blue)

### 3.3.3 AQMA No.3 Source Apportionment

The source apportionment completed for the modelled receptors within the boundary of AQMA No.3 incorporates the 27 receptors as detailed within Table 3.6. Apportionment for $NO_x$ concentrations has been completed for the two separate groups in terms of the receptors as detailed in Section 2.6.1, with the results presented in Table 3.6.

When considering the average NOx concentration across all modelled receptors, road traffic accounts for 15.1 µg/m3 (29.9%) of total NOx concentration (50.5 µg/m3). Of the 15.1 µg/m3 total road NOx, Diesel Cars account for the greatest contribution (12.1%) of any of the vehicle types, followed by Diesel LGVs (6.2%) and HGVs (5.2%) Buses & Coaches (4.5%). The remaining vehicle source groups (Petrol and Alternative Fuel Cars and LGVs, and Motorcycles) contribute less than 2.6% each.

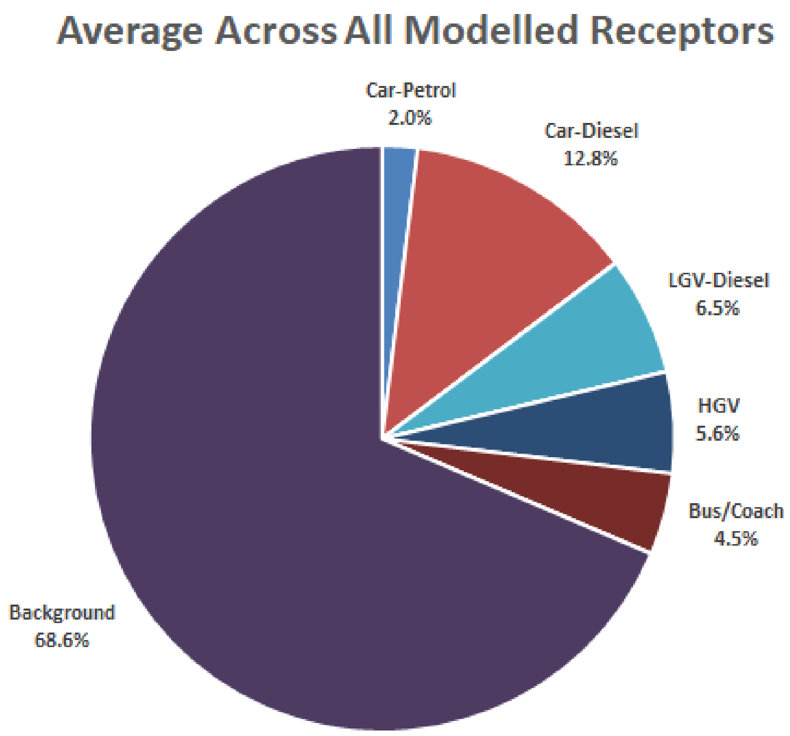
The receptor with the maximum road NOx concentration is receptor R24, located on Milton Road, whereby the total road NOx was predicted to be 28.1 µg/m3. At receptor R24 road traffic accounts for 42.3% of total NOx concentration (66.5 µg/m3). Of the 28.1 µg/m3 total road NOx the separate vehicle apportionment remains similar to average source apportionment but with a significant increased apportionment to Diesel Cars (16.1%), and a slight increased apportionment at Diesel LGVs (8.2) and HGVs (6.3%), Petrol Cars, with the remaining vehicle source groups contributing less than 2.4% each. Bus & coaches apportionment increases by two times compared to the average with an apportionment of 9.3%.

Figure 3.11 shows the background contribution to local $NO_x$ concentrations across Gravesham Town Centre AQMA No.3. Background $NO_x$ contributes 68.64% to the total $NO_x$ within AQMA No.3, the breakdown shows that emissions from ‘Other’ sources has the largest contribution of 51.3% of the total background $NO_x$, followed by ‘Rural’ sources contributing 27.0%. ‘Domestic’ emissions contribute 7.5%, and the remaining local background sources represent less than 3.0% of $NO_x$ emissions. The local breakdown suggests, there is an increased influence from ‘Other’ emission source, whereby the nearby Gravesham Pier and the Thames being a main transport route for shipments to Tilbury Docks, ship emissions is likely to be contributing largely to background sources.

**Table 3.6 – $NO_x$ Source Apportionment Results: AQMA No.3**

| Results | All Vehicles | Car | | | LGV | | | HGV | Bus and Coach | Motorcycle | Background |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Petrol | Diesel | EV/LPG | Petrol | Diesel | EV/LPG | | | | |
| **Average across all modelled receptors** | | | | | | | | | | | |
| $NO_x$ Concentration (µg/m$^3$) | 15.1 | 0.9 | 6.1 | 0.0 | <0.0 | 3.1 | 0.0 | 2.6 | 2.3 | <0.0 | 35.4 |
| Percentage of Total $NO_x$ | 29.9% | 1.8% | 12.1% | 0.0% | <0.0% | 6.2% | 0.0% | 5.2% | 4.5% | <0.0% | 70.1% |
| Percentage Contribution to Road $NO_x$ | 100.0% | 6.2% | 40.5% | 0.0% | 0.1% | 20.7% | 0.0% | 17.6% | 14.9% | <0.0% | - |
| **At The Receptor With the Maximum Road $NO_x$ Concentration (R16)** | | | | | | | | | | | |
| $NO_2$ Concentration (µg/m$^3$) | 28.1 | 1.6 | 10.7 | 0.0 | <0.0 | 5.5 | 0.0 | 4.2 | 6.2 | <0.0 | 38.4 |
| Percentage of Total $NO_2$ | 42.3% | 2.4% | 16.1% | 0.0% | <0.0% | 8.2% | 0.0% | 6.3% | 9.3% | <0.0% | 57.7% |
| Percentage Contribution to Road $NO_2$ | 100.0% | 5.6% | 38.0% | 0.0% | 0.1% | 19.5% | 0.0% | 14.9% | 22.0% | <0.0% | - |

**Figure 3.10 – Average Local Background $NO_x$ Source Contributions Across All Modelled Receptors in AQMA No.3**



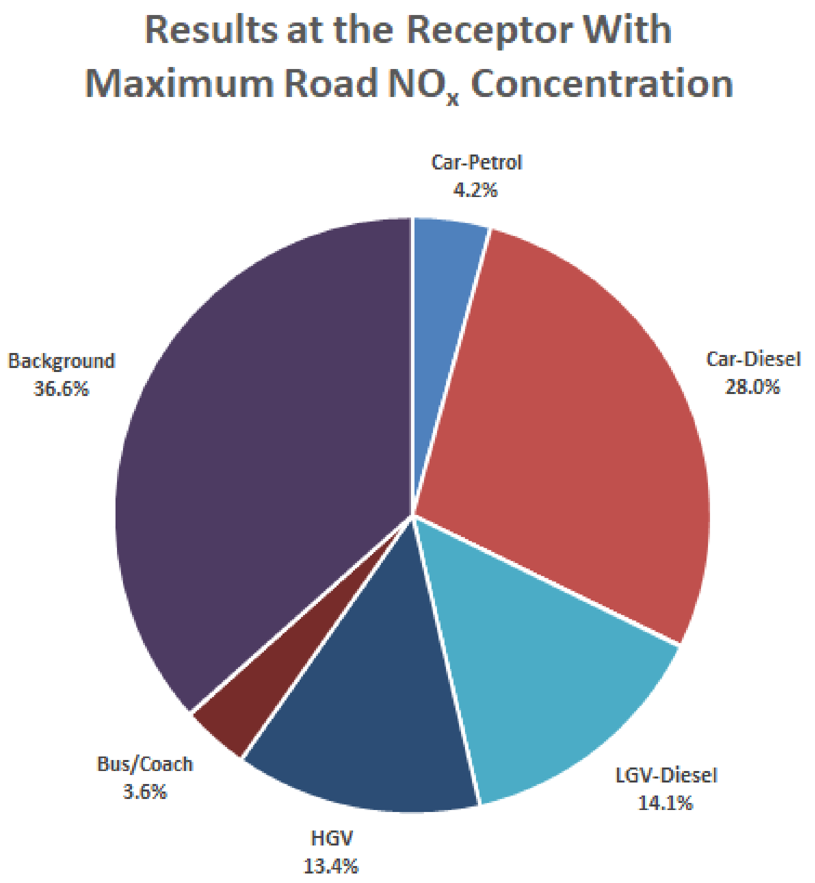
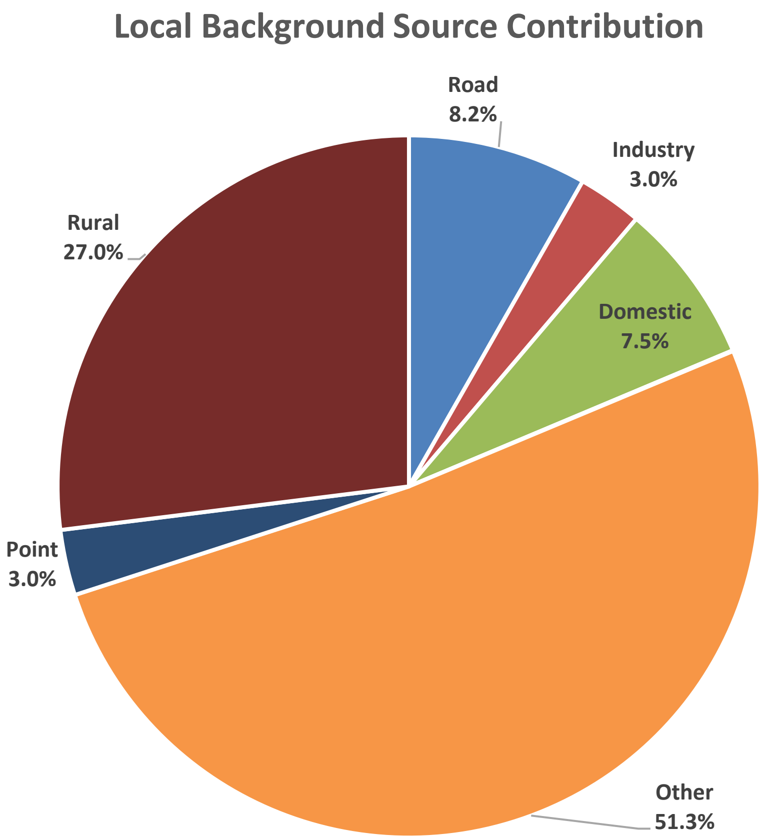



**Figure 3.11 – Average Local Background NOx Source Contributions Across All Modelled Receptors in AQMA No.3**



## 3.3 AQMA No.4 (A227/B261 Wrotham Road/Old Road West Junction)

### 3.4.1 Council Monitoring Data

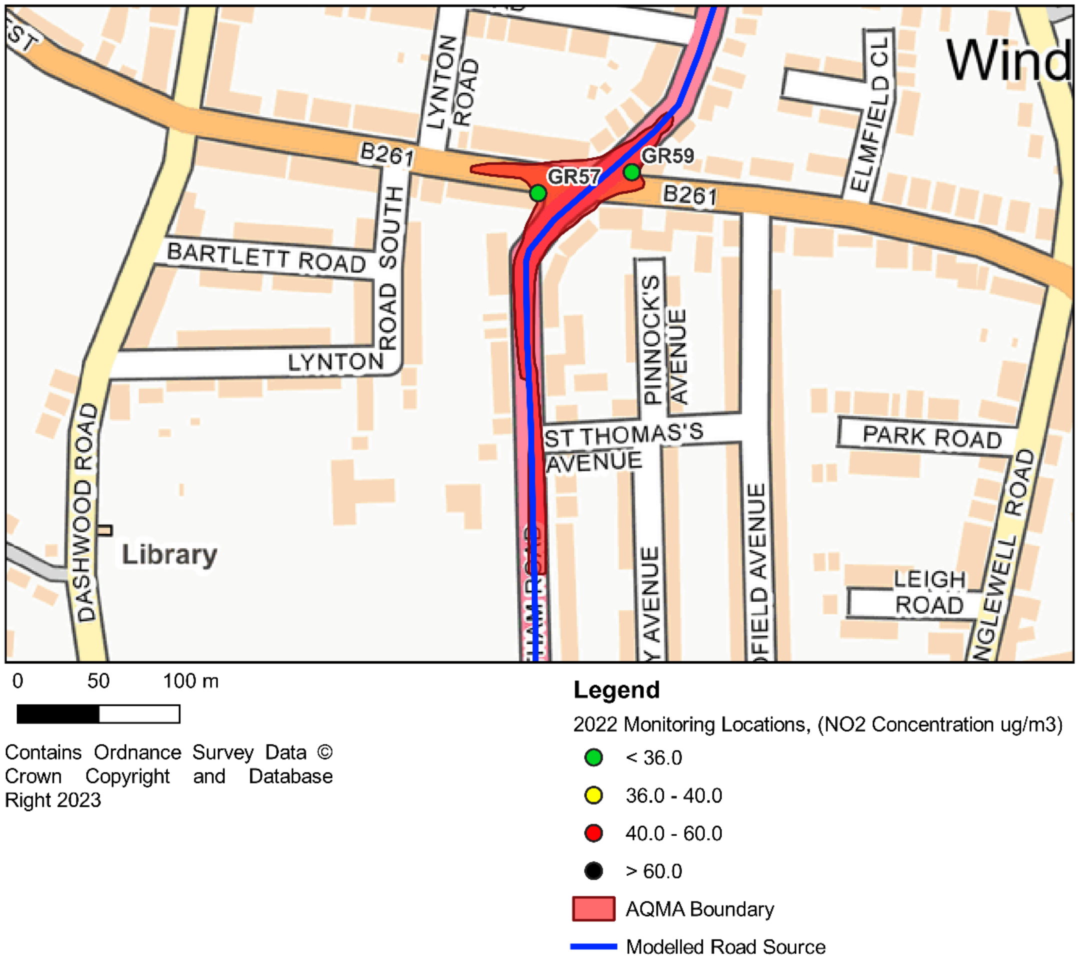
AQMA No.4 is currently designated for exceedances of the annual mean $NO_2$ AQS objective with the current boundary incorporating Wrotham Road and Old Road West Junction within Gravesham. Currently there are 2 monitoring sites measuring annual mean $NO_2$ concentrations within the current AQMA boundary. Both GR57 and GR59 were both compliant in 2022, and both have reported one year of compliance (excluding COVID years 2020/2021).

**Table 3.7 – Current $NO_2$ Monitoring Within, or in Close Proximity to AQMA No.4**

| Site | Site Type | OS Grid Ref X | OS Grid Ref Y | Distance to Relevant Exposure (m) | Height (m) | Annual Mean $NO_2$ Concentration (µg/m³) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2018 | 2019 | 2020 | 2021 | 2022 |
| **GR57** | R | 564472 | 564472 | 0.3 | 2.7 | *38.4* | **40.2** | 31.1 | 33.7 | 31.7 |
| **GR59** | R | 564530 | 173171 | 0.4 | 2 | *39.5* | *37.7* | 30.2 | 32.4 | 28.7 |

In **bold**, exceedance of the annual mean $NO_2$ AQS objective of 40µg/m³.
When **underlined**, $NO_2$ annual mean exceeds 60µg/m³, indicating a potential exceedance of the $NO_2$ 1-hour mean objective
Annual mean concentrations that are within 10% of the objective have been presented in *italics*
R= Roadside

**Figure 3.12 – AQMA No.4, Modelled Roads and Monitoring Locations**

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### 3.4.2 Modelled Receptors, Annual Mean $NO_2$

It is important to note that due to limited traffic data available for the B261 which crosses the junction and AQMA boundary, it is not possible to verify the model performance with absolute accuracy due to full traffic counts not being available for the B261 (Old Road West) road section within this AQMA. The concentrations in this AQMA have been verified using the Non-Trunk Road verification factor, due to being in close proximity of Gravesham Town Centre, and the road type and traffic composition being of similar nature. Monitoring covers the junction appropriately to capture the exceedances, receptor modelling north and south of Wrotham Road has been carried out however, due to limited traffic data, modelling was not undertaken from east to west of this junction.

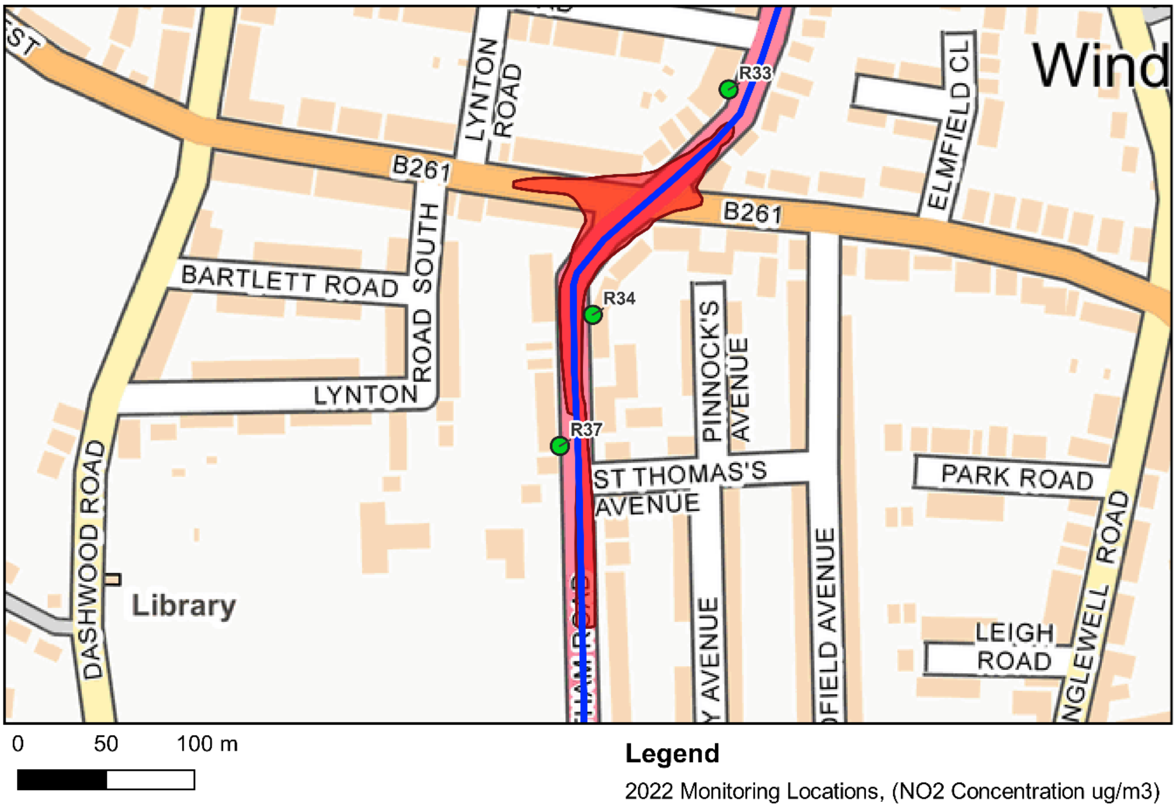
Four discrete receptors are located within and close to the boundary of AQMA No.4. All of the receptor locations do not have a predicted concentration in exceedance of the annual mean $NO_2$ objective, nor are they within 10% of the objective. Due to limited traffic data in the area, the concentrations at all four recpetors are considered to be slightly underpredicting, therefore results should be treated with caution.

From the annual mean $NO_2$ concentration contour plots presented in Figure 3.14, it can be seen that concentrations are low at the junction with no contours representing exceedances, the high concentrations are constrained to the B621 south approaching junction and the Cross Lane junction north. Residential areas on both sides of the road also come into contact with the <25 µg/m$^3$ limit contour.

**Table 3.8 – AQMA No.4, Summary of Modelled Receptor Results ($NO_2$)**

| Receptor ID | OS Grid X | OS Grid Y | Height (m) | Inside AQMA? | AQS objective (µg/m$^3$) | 2022 Annual Mean $NO_2$ (µg/m$^3$) | % of AQS objective |
|---|---|---|---|---|---|---|---|
| **R33** | 564552.55 | 173226.68 | 1.5 | Y | 40 | 24.1 | 60.3 |
| **R34** | 564475.56 | 173099.06 | 1.5 | Y | 40 | 27.1 | 67.7 |
| **R35** | 564572.05 | 173286.92 | 1.5 | N | 40 | 24.3 | 60.7 |
| **R37** | 564456.93 | 173024.74 | 1.5 | Y | 40 | 24.4 | 60.9 |

**Figure 3.13 – AQMA No.4, Modelled Receptors $NO_2$ Concentrations**

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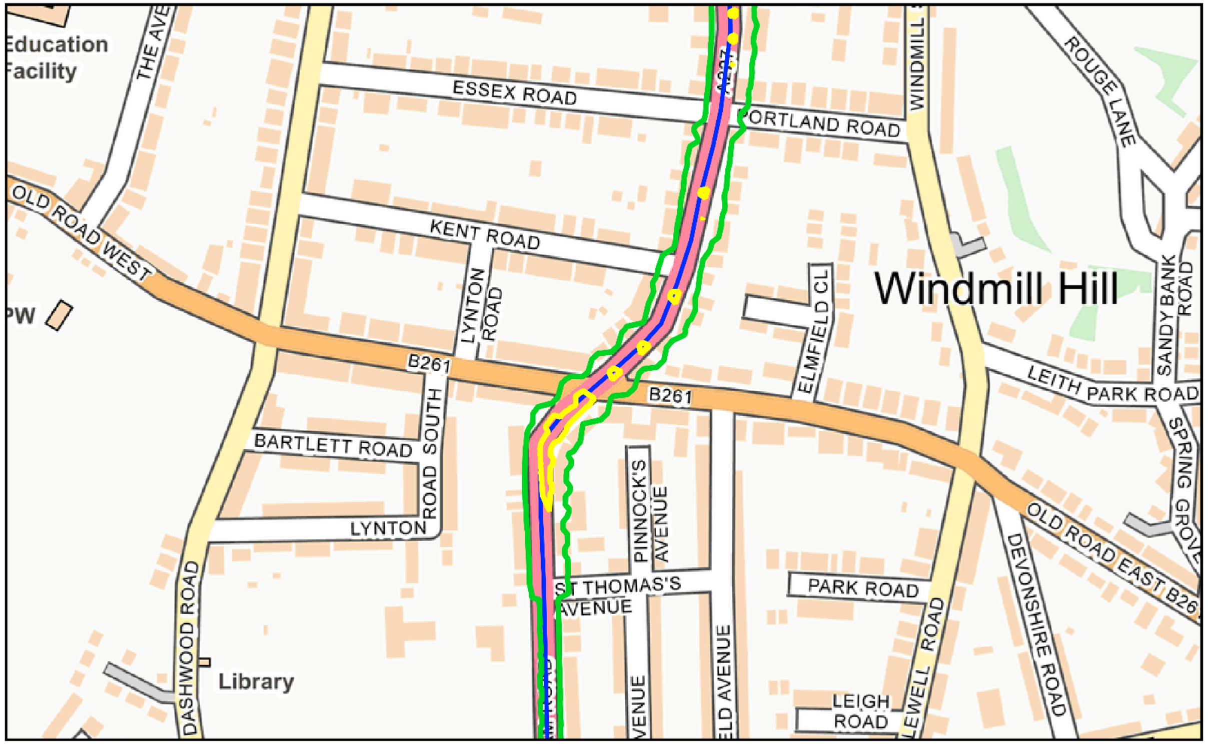
**Legend**

2022 Monitoring Locations, (NO2 Concentration ug/m3)

- < 36.0
- 36.0 - 40.0
- 40.0 - 60.0
- > 60.0
- AQMA Boundary
- Modelled Road Source

**Figure 3.14 – AQMA No.4 Modelled $NO_2$ Concentration Isopleth**




0 50 100 m

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**Legend**

NO2 Concentrations (ug/m3)

- <25
- 25 - 30
- 36 - 40
- >40
- Modelled Road Source

### 3.4.3 AQMA No.4 Source Apportionment

The source apportionment completed for the modelled receptors within the boundary of AQMA No.4 incorporates the 4 receptors as detailed within Table 3.9. Apportionment for $NO_x$ concentrations have been completed for the two separate groups in terms of the receptors as detailed in Section 2.6.1, with the results presented in Table 3.9.

When considering the average $NO_x$ concentration across all modelled receptors, road traffic accounts for 12.6 µg/m$^3$ (32.1%) of total $NO_x$ concentration (39.3 µg/m$^3$). Of the 39.3 µg/m$^3$ total road $NO_x$, Diesel Cars and HGVs account for the greatest contribution (16.4%) and (3.8%) of any of the vehicle types, followed by Diesel LGVs (8.7%). The remaining vehicle source groups (Petrol and Alternative Fuel Cars and LGVs, and Motorcycles) contribute less than 2.6% each.

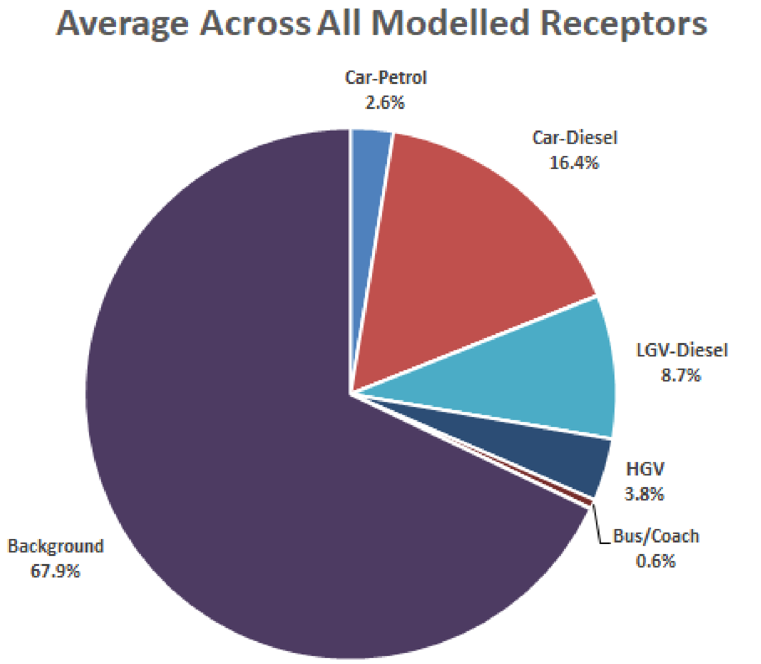
The receptor with the maximum road $NO_x$ concentration is receptor R34, whereby the total road $NO_x$ was predicted to be 16.5 µg/m$^3$. At receptor R34 road traffic accounts for 38.2% of total $NO_x$ concentration (43.2 µg/m$^3$). Of the 43.2 µg/m$^3$ total road $NO_x$ the separate vehicle apportionment remains similar to average source apportionment the previous average assessment but with a slight increase apportionment to Diesel Cars (19.6%) and LGVs (9.9%), and slight increase to the remaining vehicle source groups contributing less than 5.0%.

Figure 3.16 shows the background contribution to local $NO_x$ concentrations across AQMA No.4. Background $NO_x$ contributes 67.9% to the total $NO_x$ within AQMA No.4, the breakdown shows that emissions from 'Rural' sources has the largest contribution of 35.0% of the total background $NO_x$, followed by 'Other' sources contributing 33.0%. 'Domestic' emissions contribute 11.1%, and the remaining local background sources represent less than 3.5% of $NO_x$ emissions.

**Table 3.9 – $NO_x$ Source Apportionment Results: AQMA No.4**

| Results | All Vehicles | Car | | | LGV | | | HGV | Bus and Coach | Motorcycle | Background |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Petrol | Diesel | EV/LPG | Petrol | Diesel | EV/LPG | | | | |
| **Average across all modelled receptors** | | | | | | | | | | | |
| **$NO_x$ Concentration (µg/m$^3$)** | 12.6 | 1.0 | 6.4 | 0.0 | 0.0 | 3.4 | 0.0 | 1.5 | 0.2 | 0.0 | 26.7 |
| **Percentage of Total $NO_x$** | 32.1% | 2.6% | 16.4% | 0.0% | 0.0% | 8.7% | 0.0% | 3.8% | 0.6% | 0.0% | 67.9% |
| **Percentage Contribution to Road $NO_x$** | 100.0% | 8.1% | 51.0% | 0.0% | 0.1% | 27.1% | 0.0% | 11.9% | 1.7% | 0.1% | - |
| **At Receptor With Maximum Road $NO_x$ Concentration (R34)** | | | | | | | | | | | |
| **$NO_x$ Concentration (µg/m$^3$)** | 16.5 | 1.3 | 8.5 | 0.0 | 0.0 | 4.3 | 0.0 | 2.1 | 0.3 | 0.0 | 26.7 |
| **Percentage of Total $NO_x$** | 38.2% | 3.0% | 19.6% | 0.0% | 0.0% | 9.9% | 0.0% | 5.0% | 0.6% | 0.0% | 61.8% |
| **Percentage Contribution to Road $NO_x$** | 100.0% | 7.8% | 51.3% | 0.0% | 0.1% | 25.9% | 0.0% | 13.0% | 1.7% | 0.1% | - |

**Figure 3.15 – $NO_x$ Source Apportionment Results: AQMA No.4**



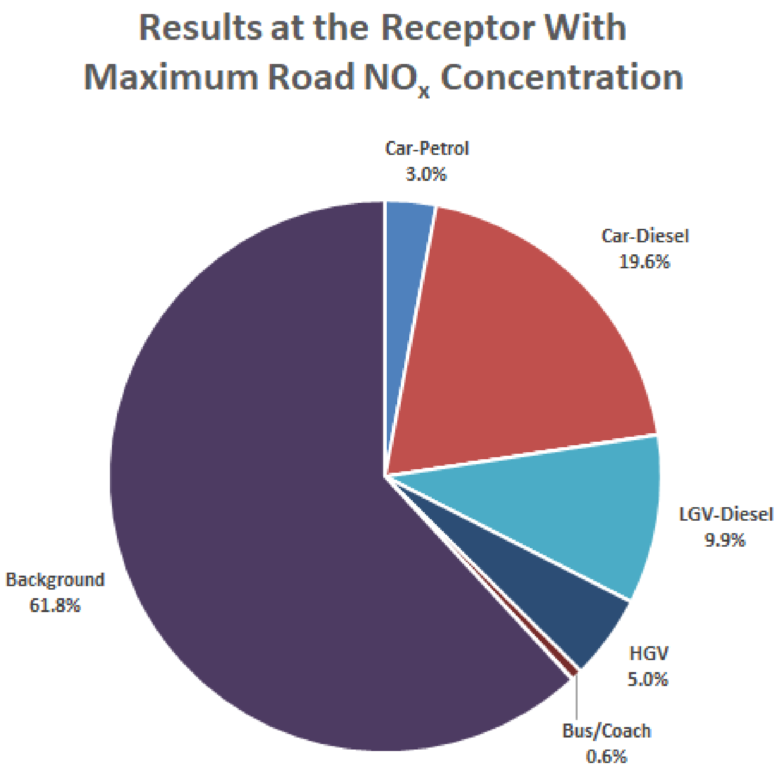
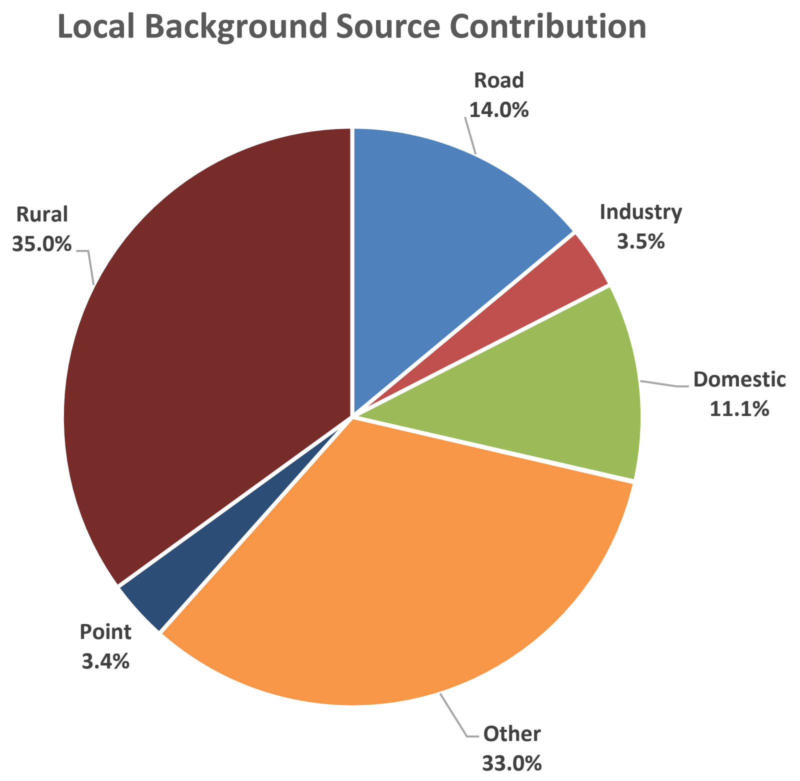



**Figure 3.16 – Average Local Background $NO_x$ Source Contributions Across All Modelled Receptors in AQMA No.3**



# 4 Conclusions and Recommendations

Following the completion of the analysis of both monitoring data and modelled concentrations across the assessed areas, including the three designated AQMAs where traffic data is available, a number of recommendations have been made in terms of the current designations of the AQMAs within Gravesham.

## 4.1 AQMA No.1 (A2 Trunk Road)

AQMA No.1 is currently designated for exceedances of the annual mean $NO_2$ and to reduce overall traffic emissions, from 2018 – 2022 eight out of nine passive monitors within this period monitored concentrations below the $NO_2$ AQS objective, with no location displaying a significant trend of increase. GR142, which was deployed from 2017 onwards, is the only passive monitor to display exceedances in 2022. However, with distance correction applied to a point of relevant exposure (modelled receptor R9), concentrations are within 10% of the $NO_2$ AQS objective in 2022, with a calculated reduction to 32.2 µg/m$^3$. The remaining discrete receptor locations have predicted concentrations below the AQS objective at relevant receptor locations within and in close proximity to the AQMA.

The A2 is a National Highways controlled road and therefore the measures to be developed would have to be a collaboration between the Council and National Highways. From the source apportionment completed, road traffic sources account for 34.6% of the $NO_x$ concentrations, with main contributions from Diesel LGVs. Within the source apportionment calculations, background concentrations contribute 65.4% of total $NO_x$ concentrations at this AQMA. The breakdown of local background emissions show that ‘Rural’ and ‘Other’ emission sources have influence on $NO_x$ concentrations within AQMA No.1, contributing 53.5% and 18.4% of $NO_x$ emissions, followed by ‘Industry’ emission source of 5.1%. Rural emissions is most likely attributed to agricultural processes south of the A2, and the large contribution from ‘Road’ emission source is contributed by the M25 motorway, the A2 trunk road, and the M2 motorway.

It is recommended passive monitoring is still carried out close to the main relevant exposure sites within this AQMA. The remaining passive monitoring locations show stable low concentrations well below the AQS $NO_2$ Objective. Five out of nine passive monitoring locations have 5 years compliance. The remaining 4 sites report one year of compliance (excluding COVID years 2020/2021). Taking into account fall off with distance calculations, GR142 has now been compliant for 1 year, therefore the council will need to maintain monitoring at these locations until under at earliest to the end of 2024 for revocation to be considered.

## 4.2 AQMA No.3 (A226 One Way System in Gravesend)

AQMA No.3 is currently designated for exceedances of the annual mean $NO_2$, there are 28 passive monitoring sites within or close to the AQMA, all 28 stations report compliance of the $NO_2$ AQS objective with two still reporting within 10% of the AQS objective (GR13 (A226 West Street) and GR119 (Woodville Place)). The receptor modelling results at 42 discrete locations predict that there are no sites with concentrations greater than 40 µg/m$^3$ and only 2 locations reporting concentrations within 10% of the AQS objective (R40 and R42), both of these sites are located on the A226 West Street near passive monitoring site GR13.

A226 West Street north of Gravesham Town Centre continues to report high concentrations from 2018 – 2022 with exceedances in the 2018, 2019 and 2021. Modelling receptors at ground and first floor flat level amongst the residential properties shows that along West Street the concentrations at 1.5m and 4m report concentrations within 10% of the $NO_2$ AQS objective, with receptors R40 and R42 reporting 36.0 µg/m$^3$ and 37.0 µg/m$^3$ respectively. This road is susceptible to traffic idling due to busier volumes of traffic and a one way narrow road which could also exacerbate queuing of vehicles, which may explain higher concentrations at road level at R40 and R42.

The council have added additional passive monitors on Windmill Street, the modelling of two receptors on this road link R16 and R51 report concentrations of 32.0 µg/m$^3$ and 33.9 µg/m$^3$, both showing compliance.

From the source apportionment completed, Diesel Cars have the highest contribution to the $NO_x$ concentrations within AQMA. The breakdown of local background emissions show that ‘Other’ emission source largely influenced $NO_x$ concentrations within Gravesham Town Centre, background emissions is likely to be contributed from the influence of shipment boats, due to being located on the Thames, which is a main passage route to Tilbury Docks.

AQMA No.3 reports compliance in both 2022 passive monitoring and modelled receptors. However, two passive monitoring stations GR13 and GR119 report concentrations within 10% of the AQS objective with concentrations 37.6 µg/m$^3$ and 39.4 µg/m$^3$. In addtion, both R40 and R42 modelled concentrations were within 10% of the $NO_2$ AQS Objective which are located on A226 West Street in close proximity to GR13.

Overall, the current compliance performance is as follows: 2 sites with no years of compliance, 10 sites with one year compliance (excluding COVID years 2020/2021), 1 site with 2 years compliance and 15 sites with 5 years of compliance. Therefore, it is expected that revocation at earliest would need 3 more years of monitoring with GR13 and GR119 currently reporting no years of compliance.

## 4.3 AQMA No.4 (A227/B621 Wrotham Road/Old Road West Junction)

AQMA No.4 is currently designated for exceedances of the annual mean $NO_2$, two passive monitors are located within or close to the AQMA boundary. The receptor modelling results predict that all receptors model concentrations less than 36 µg/m$^3$, with the highest concentration at R34 of 27.1 µg/m$^3$.

It is recommended that monitoring is still to be carried out, both passive monitoring sites currently have one year of compliance due to the exclusion of the 2020/2021 covid years, therefore the council at earliest could consider revocation in 2025 if 2022, 2023 and 2024 data reports compliance under 10% of the $NO_2$ AQS Objective.

From the source apportionment completed, Diesel Cars and HGVs have a significant contribution to the $NO_x$ and $NO_2$ concentrations within this route.

# Appendices

# Appendix A – Traffic Data

**Figure A.1 – DfT Count Point Locations**

### Table A.1 – DfT Traffic Data

| Source ID | Description | 2022 Traffic Flow (AADT) | % Car | % LGV | % HGV | % Bus/ Coach | % Motorcycle |
|---|---|---|---|---|---|---|---|
| 48310 | Estimated using previous year's AADF on this link | 9645 | 81.9 | 13.3 | 2.7 | 1.6 | 0.5 |
| 16774 | Estimated using previous year's AADF on this link | 16774 | 80.3 | 14.4 | 2.4 | 2.4 | 0.4 |
| 46824 | Estimated using previous year's AADF on this link | 46824 | 80.2 | 13.0 | 2.3 | 3.5 | 1.1 |
| 74499 | Estimated using previous year's AADF on this link* | 74499 | 80.3 | 14.4 | 2.4 | 2.4 | 0.4 |
| 90096 | Estimated using previous year's AADF on this link | 90096 | 84.2 | 12.9 | 1.9 | 0.3 | 0.8 |
| 945708 | Manual Count* | 945708 | 88.2 | 10.9 | 0.2 | 0.0 | 0.7 |
| 90097 | Manual Count | 90097 | 85.1 | 12.1 | 2.3 | 0.1 | 0.4 |
| 74500 | Estimated using previous year's AADF on this link | 74500 | 85.1 | 10.6 | 1.5 | 2.2 | 0.6 |
| 90098 | Estimated using previous year's AADF on this link | 90098 | 81.4 | 14.6 | 2.9 | 0.2 | 1.0 |
| 81430 | Manual Count | 81430 | 71.1 | 19.8 | 7.8 | 0.2 | 1.1 |
| 81440 | Estimated using previous year's AADF on this link | 81440 | 76.6 | 20.4 | 2.0 | 0.2 | 0.8 |
| 81439 | Estimated using previous year's AADF on this link | 9568 | 80.0 | 15.6 | 3.0 | 0.4 | 1.0 |
| 81429 | Estimated using previous year's AADF on this link | 112939 | 70.0 | 20.0 | 9.2 | 0.2 | 0.6 |
| 81438 | Estimated using previous year's AADF on this link | 72042 | 76.2 | 19.6 | 2.9 | 0.2 | 1.0 |
| 81428 | Manual Count | 142694 | 70.4 | 21.1 | 7.7 | 0.2 | 0.7 |
| 74808 | Automatic Counter | 8562 | 70.4 | 21.0 | 7.7 | 0.2 | 0.7 |
| 91266 | Estimated from nearby links | 123697 | 71.2 | 20.0 | 7.6 | 0.2 | 0.9 |
| 802078 | Estimated using previous year's AADF on this link | 2663 | 85.6 | 13.5 | 0.3 | 0.0 | 0.6 |
| 36100 | Estimated using previous year's AADF on this link | 125473 | 72.2 | 19.2 | 7.6 | 0.2 | 0.9 |
| 89324 | Estimated using previous year's AADF on this link | 62736 | 72.2 | 19.2 | 7.6 | 0.2 | 0.9 |
| 74805 | Estimated using previous year's AADF on this link | 15572 | 78.3 | 19.2 | 1.2 | 0.7 | 0.6 |
| 73650 | Dependent on a neighbouring counted link | 95949 | 69.2 | 20.4 | 9.7 | 0.2 | 0.5 |

**Notes:**
*** = Estimates based on manual counts conducted more than 2 years ago**

# Appendix B – Verification

**Table B.1 – Details of All Passive $NO_2$ Monitoring Locations within Gravesham Borough Council**

All passive monitoring stations deployed within 2022 in Gravesham were not used within the report due to limited traffic data available for road receptors near these passive monitoring locations.

| Site ID | X Coordinate | Y Coordinate | Valid Data Capture 2022 (%) | Site Type | Height (m) |
|---|---|---|---|---|---|
| GR08 | 562589 | 172076 | 92.3 | Roadside | 3 |
| GR13 | 564696 | 174431 | 92.3 | Roadside | 2.85 |
| GR19 | 562155 | 174360 | 92.3 | Industrial Background | 2 |
| GR24 | 565128 | 174049 | 92.3 | Roadside | 2.5 |
| GR31 | 565052 | 174149 | 92.3 | Roadside | 2.7 |
| GR39 | 564730 | 174030 | 92.3 | Roadside | 2.5 |
| GR40 | 564486 | 174095 | 92.3 | Roadside | 2.5 |
| GR45 | 564708 | 174266 | 84.6 | Roadside | 2.5 |
| GR47 | 565043 | 174173 | 92.3 | Roadside | 2.5 |
| GR52 | 562449 | 174191 | 92.3 | Roadside | 2.5 |
| GR55 | 563943 | 173378 | 92.3 | Roadside | 2.7 |
| GR56 | 565210 | 172980 | 92.3 | Roadside | 2.5 |
| GR57 | 564472 | 173158 | 82.7 | Roadside | 2 |
| GR58 | 565166 | 174036 | 92.3 | Roadside | 2.7 |
| GR59 | 564530 | 173171 | 92.3 | Roadside | 2.5 |
| GR60 | 563899 | 173368 | 76.9 | Roadside | 2.7 |
| GR61 | 564429 | 174152 | 92.3 | Roadside | 3 |
| GR62 | 565004 | 174324 | 76.9 | Roadside | 2.8 |
| GR66 | 564512 | 174448 | 82.7 | Roadside | 2.5 |
| GR67 | 565214 | 172958 | 92.3 | Roadside | 2.5 |
| GR68 | 564808 | 173086 | 82.7 | Roadside | 2.7 |
| GR69 | 567270 | 171925 | 92.3 | Background | 2.5 |
| GR72 | 562437 | 173175 | 92.3 | Background | 2.8 |
| GR75 | 564087 | 173080 | 92.3 | Background | 2 |
| GR78 | 565658 | 174195 | 92.3 | Roadside | 2.5 |
| GR92 | 562323 | 172589 | 92.3 | Roadside | 1.5 |
| GR94 | 564392 | 166012 | 84.6 | Roadside | 2.75 |
| GR96 | 564963 | 173717 | 92.3 | Roadside | 2.28 |
| GR98 | 562529 | 174049 | 84.6 | Roadside | 2.75 |
| GR104 | 562465 | 172153 | 84.6 | Roadside | 2.6 |
| GR107 | 562272 | 172281 | 92.3 | Roadside | 1.96 |
| GR109 | 565229 | 172955 | 92.3 | Roadside | 1.6 |
| GR110 | 566149 | 170436 | 92.3 | Roadside | 1.9 |
| GR112 | 561502 | 174682 | 92.3 | Roadside | 2.54 |
| GR116 | 562480 | 172225 | 92.3 | Roadside | 2.69 |
| GR118 | 564755 | 173862 | 92.3 | Roadside | 2.4 |
| GR119 | 564729 | 173824 | 92.3 | Roadside | 2.5 |
| GR122 | 564667 | 173891 | 92.3 | Roadside | 2.5 |
| GR123 | 566538 | 173109 | 92.3 | Roadside | 2 |
| GR124 | 561338 | 174925 | 92.3 | Roadside | 2.6 |
| GR125 | 564877 | 173937 | 92.3 | Roadside | 2.4 |
| GR127 | 564456 | 173979 | 92.3 | Roadside | 2.5 |
| GR128 | 564727 | 174002 | 92.3 | Roadside | 2.4 |
| GR129 | 564694 | 173969 | 92.3 | Roadside | 2.5 |
| GR130 | 564687 | 173934 | 84.6 | Roadside | 2.2 |
| GR131 | 564661 | 173940 | 92.3 | Roadside | 1.8 |
| GR133 | 564657 | 173799 | 92.3 | Roadside | 1.9 |

| | | | | | |
|---|---|---|---|---|---|
| GR134 | 564659 | 173831 | 82.7 | Roadside | 2 |
| GR135 | 564657 | 173764 | 84.6 | Roadside | 2.6 |
| GR136 | 564686 | 173828 | 92.3 | Roadside | 2.7 |
| GR137 | 570719 | 171143 | 84.6 | Roadside | 0.73 |
| GR138 | 570583 | 169549 | 92.3 | Roadside | 1.8 |
| GR139 | 563178 | 173976 | 92.3 | Roadside | 2.28 |
| GR140 | 564955 | 174098 | 75 | Roadside | 2.44 |
| GR141 | 569588 | 169603 | 84.6 | Roadside | 1.95 |
| GR142 | 567500 | 169836 | 92.3 | Roadside | 2.35 |
| GR143 | 564646 | 173745 | 92.3 | Roadside | 1.97 |
| GR144 | 564728 | 172826 | 92.3 | Roadside | 3.7 |
| GR145 | 565336 | 174066 | 92.3 | Roadside | 2.57 |
| GR146 | 567150 | 171231 | 92.3 | Roadside | 2.4 |
| GR147 | 567051 | 168432 | 92.3 | Roadside | 2.1 |
| GR148 | 571572 | 172847 | 84.6 | Roadside | 1.7 |
| GR149 | 571445 | 172881 | 84.6 | Roadside | 2.5 |
| GR150 | 571250 | 172933 | 84.6 | Roadside | 2.2 |
| GR151 | 571371 | 172270 | 84.6 | Roadside | - |
| GR152 | 562974 | 173653 | 92.3 | Roadside | 1.7 |

# Model Verification

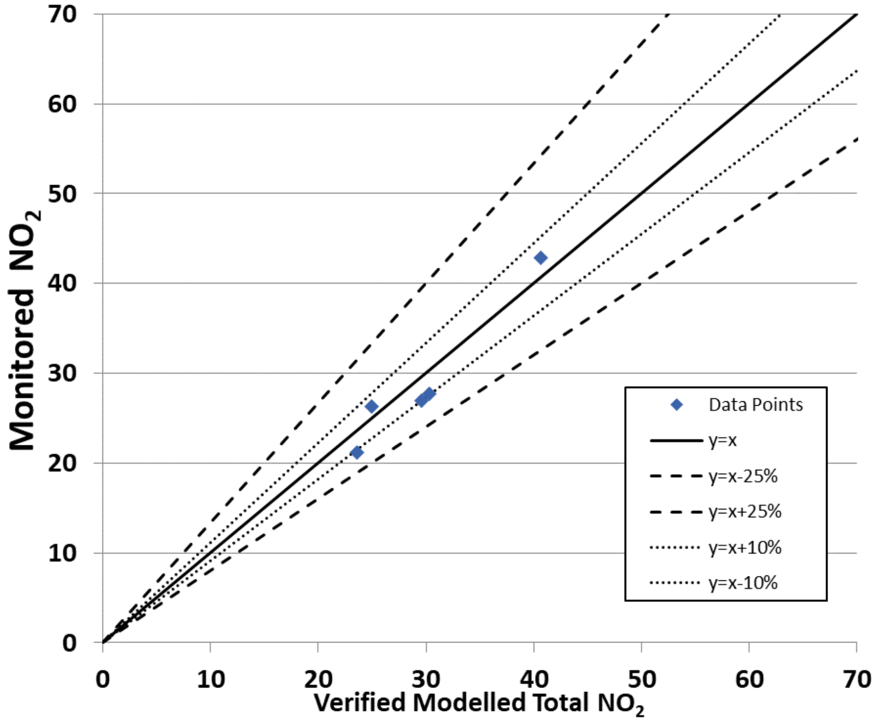
## AQMA No.1 (A2 Trunk Road)

The results of AQMA No.1 final verification factor are presented in Table B.3 and Figure B.1. All DT locations are within the ±25% acceptance level. Alongside this, the RMSE for this verification is 2.3µg/m$^3$, and the $R^2$ value is 0.946, indicating that this finalised verification is performing accurately. It is important to note that the $R^2$ value is influenced by the number of data points used to produce a line, and in this case, there are only 7. The verification factor used for any receptors in AQMA No.1 is 1.582. GR110 and 146 were taken out from final verification due to limited traffic data near the passive monitoring sites, GR110 is not located near the modelled A2 Trunk Road, and saw significant underpredictions within the model.

**Table B.2 – Final Model Verification (A2 Trunk Road AQMA)**

| Site ID | Ratio of monitored road contribution $NO_x$ / modelled road contribution $NO_x$ | Adjustment factor for modelled road contribution $NO_x$ | Adjusted modelled road contribution $NO_x$ (µg/m$^3$) | Adjusted modelled total $NO_x$ (including background $NO_x$) (µg/m$^3$) | Modelled total $NO_2$ (based upon empirical $NO_x$ / $NO_2$ relationship) (µg/m$^3$) | Monitored total $NO_2$ (µg/m$^3$) | % Difference (adjusted modelled $NO_2$ vs. monitored $NO_2$) |
|---|---|---|---|---|---|---|---|
| GR104 | 1.17 | 1.582 | 20.6 | 47.9 | 29.5 | 26.9 | 9.8 |
| GR107 | 1.20 | | 22.1 | 49.4 | 30.3 | 27.7 | 9.4 |
| GR116 | 1.97 | | 11.2 | 38.5 | 24.9 | 26.3 | -5.3 |
| GR141 | 1.07 | | 14.4 | 36.6 | 23.6 | 21.2 | 11.1 |
| GR142 | 1.75 | | 49.4 | 72.8 | 40.6 | 42.9 | -5.3 |

**Figure B.1 – Final AQMA No.1 Adjusted Verification Monitored $NO_2$ Concentrations vs. Verified Modelled $NO_2$**




## AQMA No.3 (A226 One-way system in Gravesend) and AQMA No.3 (A227/B261 Wrotham Road/Old Road West Junction)

The results of AQMA No.3 final verification factor are presented in Table B.3 and

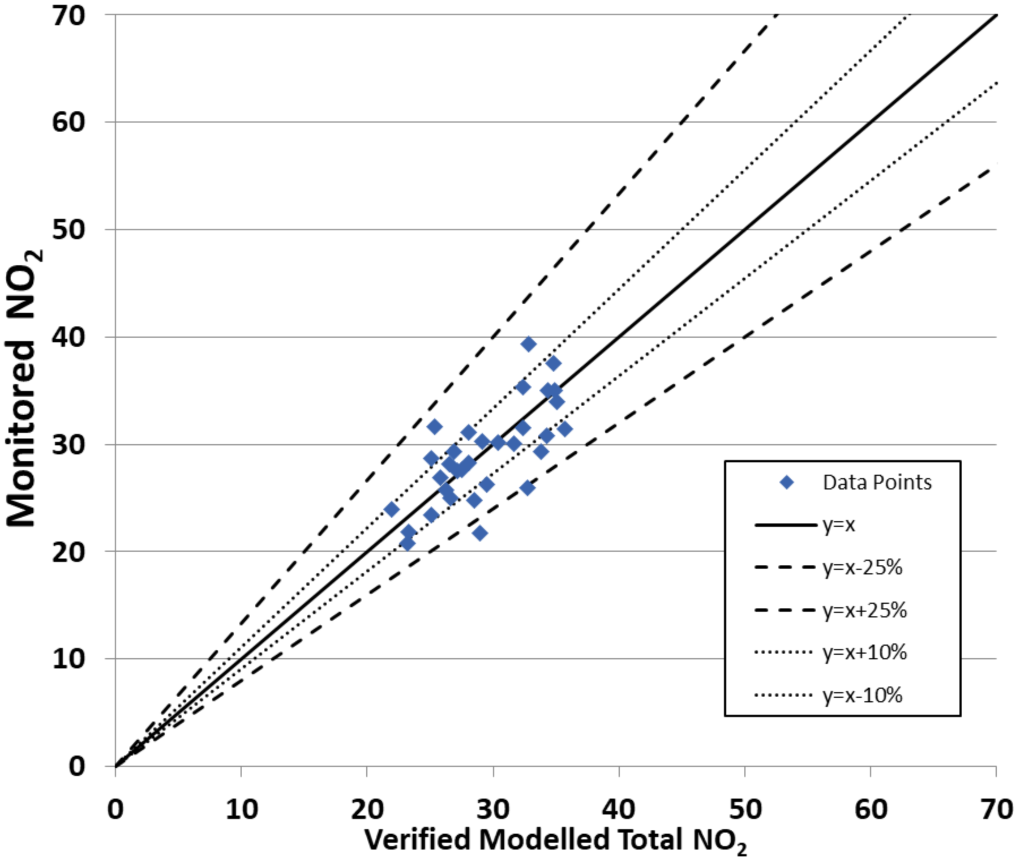
Figure B.2. 30 out of 32 passive monitoring locations are within the ±25% acceptance level. GR45 is using estimated traffic data from a nearby DfT road link therefore even with verification is reporting +33%, this road is a minor road and is in close proximity to the AQMA boundary and therefore not significant. GR128 is modelled to its realistic extent and no further adjustments could be made, GR128 does not report any exceedance within the area despite the overprediction. The RMSE for this verification is 3.2µg/m³, and the $R^2$ value is 0.609, indicating that this finalised verification is performing accurately. It is important to note that the $R^2$ value is influenced by the number of data points used to produce a line, and in this case, there are only 5. The verification factor used for receptors in AQMA No.3 and AQMA No.4 is 2.060. GR57 was taken out from the final verification due to no traffic data being available close to the passive monitoring location.

**Table B.3 – Final AQMA No.4 (A226 One-way system in Gravesend) Verification**

| Site ID | Ratio of monitored road contribution $NO_x$ / modelled road contribution $NO_x$ | Adjustment factor for modelled road contribution $NO_x$ | Adjusted modelled road contribution $NO_x$ (µg/m³) | Adjusted modelled total $NO_x$ (including background $NO_x$) (µg/m³) | Modelled total $NO_2$ (based upon empirical $NO_x$ / $NO_2$ relationship) (µg/m³) | Monitored total $NO_2$ (µg/m³) | % Difference (adjusted modelled $NO_2$ vs. monitored $NO_2$) |
|---|---|---|---|---|---|---|---|
| GR13 | 2.83 | 2.060 | 16.0 | 59.5 | 34.8 | 37.6 | -7.4 |
| GR24 | 2.20 | | 19.9 | 58.3 | 34.4 | 35.0 | -1.8 |
| GR31 | 1.84 | | 21.4 | 59.8 | 35.1 | 34.0 | 3.1 |
| GR39 | 0.70 | | 14.0 | 57.5 | 33.9 | 29.3 | 15.5 |
| GR40 | 3.20 | | 11.0 | 54.5 | 32.4 | 35.3 | -8.3 |

| Site ID | Ratio of monitored road contribution $NO_x$ / modelled road contribution $NO_x$ | Adjustment factor for modelled road contribution $NO_x$ | Adjusted modelled road contribution $NO_x$ (µg/m$^3$) | Adjusted modelled total $NO_x$ (including background $NO_x$) (µg/m$^3$) | Modelled total $NO_2$ (based upon empirical $NO_x$ / $NO_2$ relationship) (µg/m$^3$) | Monitored total $NO_2$ (µg/m$^3$) | % Difference (adjusted modelled $NO_2$ vs. monitored $NO_2$) |
|---|---|---|---|---|---|---|---|
| GR45 | -5.03 | | 4.0 | 47.6 | 28.9 | 21.7 | 33.4 |
| GR47 | 2.09 | | 21.0 | 59.4 | 34.9 | 35.0 | -0.4 |
| GR57 | 4.08 | | 13.2 | 39.9 | 25.4 | 31.7 | -20.0 |
| GR58 | 1.86 | | 15.7 | 54.2 | 32.4 | 31.6 | 2.4 |
| GR59 | 3.27 | | 12.6 | 39.3 | 25.1 | 28.7 | -12.7 |
| GR61 | 1.97 | | 6.9 | 50.4 | 30.4 | 30.2 | 0.5 |
| GR62 | 0.17 | | 8.0 | 46.4 | 28.5 | 24.8 | 15.1 |
| GR66 | -0.45 | | 5.1 | 48.6 | 29.5 | 26.3 | 12.0 |
| GR78 | 3.81 | | 2.6 | 41.0 | 25.8 | 26.9 | -4.1 |
| GR96 | 1.64 | | 15.7 | 42.4 | 26.6 | 25.0 | 6.4 |
| GR118 | 2.30 | | 20.8 | 47.5 | 29.1 | 30.3 | -3.9 |
| GR119 | 3.10 | | 28.6 | 55.3 | 32.8 | 39.4 | -16.6 |
| GR122 | 1.51 | | 34.9 | 61.6 | 35.7 | 31.4 | 13.8 |
| GR123 | 1.09 | | 9.9 | 35.8 | 23.2 | 20.8 | 11.5 |
| GR125 | 2.12 | | 18.6 | 45.3 | 28.0 | 28.3 | -0.9 |
| GR127 | 3.34 | | 6.5 | 33.2 | 21.9 | 24.0 | -8.6 |
| GR128 | -0.30 | | 11.7 | 55.2 | 32.7 | 26.0 | 25.9 |
| GR129 | 1.52 | | 12.7 | 39.4 | 25.1 | 23.4 | 7.2 |
| GR130 | 1.92 | | 14.9 | 41.6 | 26.2 | 25.7 | 2.0 |
| GR131 | 1.41 | | 9.1 | 35.8 | 23.3 | 21.8 | 6.7 |
| GR133 | 2.14 | | 16.8 | 43.5 | 27.2 | 27.5 | -1.2 |
| GR134 | 2.09 | | 17.5 | 44.2 | 27.5 | 27.6 | -0.4 |
| GR135 | 2.75 | | 18.7 | 45.4 | 28.1 | 31.1 | -9.7 |
| GR136 | 1.80 | | 26.2 | 52.9 | 31.7 | 30.1 | 5.3 |
| GR140 | 1.07 | | 14.9 | 58.4 | 34.3 | 30.8 | 11.3 |
| GR143 | 2.50 | | 15.6 | 42.3 | 26.6 | 28.2 | -5.8 |
| GR145 | 4.18 | | 4.7 | 43.1 | 26.9 | 29.3 | -8.3 |

**Figure B.2 – Final A226 One-way system in Gravesend AQMA Adjusted Verification Monitored $NO_2$ Concentrations vs. Verified Modelled $NO_2$**



# Appendix C – Background Concentrations

**Table C.1 – 2022 Background Concentrations in Gravesham**

| Grid Square (X, Y) | $NO_2$ | $NO_x$ |
|---|---|---|
| 563500,172500 | 16.6 | 23.3 |
| 563500,173500 | 18.9 | 27.2 |
| 563500,174500 | 24.2 | 37.8 |
| 564500,172500 | 16.2 | 22.7 |
| 564500,173500 | 18.5 | 26.7 |
| 564500,174500 | 26.9 | 43.5 |
| 565500,172500 | 15.9 | 22.2 |
| 565500,173500 | 17.7 | 25.4 |
| 565500,174500 | 24.5 | 38.4 |
| **Background locations have been taken from the Defra Background Mapping resource for Gravesham Borough Council.** | | |