Sevenoaks District Council

Detailed Assessment of Swanley AQMAs

November 2022

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Document Control Sheet

Identification	
Client	Sevenoaks District Council
Document Title	Detailed Assessment of Swanley AQMAs
Bureau Veritas Ref No.	AIR15072141

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Configuration				
Version	**Date**	**Author**	**Reason for Issue/Summary of Changes**	**Status**
1.0	14/11/2022	A Smith	Initial draft for client comment	Draft

	Name	Job Title	Signature
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Executive Summary

Bureau Veritas have been commissioned by Sevenoaks District Council to complete a review of the Council's existing Air Quality Management Areas (AQMAs) within the Swanley Area following the publication of their Air Quality Action Plan (AQAP). The Council currently have two AQMAs within Swanley, both have been declared in relation to traffic emissions, designated for exceedances of the NO_2 annual mean Air Quality Strategy objective. The AQAP was developed to asses and improve air quality in the declared AQMAs within Sevenoaks. However, the two AQMAs within Swanley were not assessed due to the lack of available and representative traffic data for use within the detailed assessment, caused by the COVID-19 pandemic. The Council however consider it important to quantify the existing air quality within these AQMAs now that representative traffic data is available.

A dispersion modelling assessment has been completed whereby NO_2 concentrations have been predicted across all relevant areas within and around the Swanley AQMAs 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 a number of recommendations have been made in terms of the AQMAs within Swanley:

- **AQMA No.8 Swanley Town Centre** – Exceedances have been predicted by the model along the High Street, near to the junction of Bevan Place. It is believed that residential receptors are located here at 1st floor level. A small two-sided street canyon has been modelled in this area, as identified by a development taking place shown in Google Streetview. Monitoring carried out over the past 5 years have indicated exceedances, however once distance correction has been carried out it is predicted that there are no exceedances at the ground level façade. The Council should continue monitoring, deploying additional monitoring as close to any existing residential receptors as possible. If exceedances continue to be identified, then measures should be implemented to reduce NO_2 concentrations, however if no exceedances occur in future years then this AQMA can be revoked.

- **AQMA No.14 Junction of Birchwood Road and London Road** – The model has predicted concentrations within 10% of the AQS objective at one location. The model is shown to be under predicting in this area by up to 10.8%, and therefore caution should be taken. Monitoring carried out within this AQMA has reported exceedances over the past 5 years, and when distance correction has been carried out, exceedances continue to be predicted at the nearest relevant exposure. The Council should therefore retain this AQMA and consider deploying additional monitoring at relevant exposure in order to confirm these predictions. The Council should also consider updating the AQAP to include measures which focus on reducing emissions from Diesel Cars and LGVs, and to reduce congestion at this junction, in order to further reduce NO_2 concentrations.

- No amendments to either of the AQMA boundaries is required based on the modelling conducted, as no exceedances were identified outside of the existing boundaries.

1 Introduction

Bureau Veritas was originally commissioned by Sevenoaks District Council (the Council) to complete a detailed assessment in order to review the designation of the Council's nine Air Quality Management Areas (AQMAs) in 2019 to help inform a new Air Quality Action Plan (AQAP). At the time of the assessment, no traffic data was available for the two AQMAs located within Swanley, and the COVID-19 pandemic meant that traffic surveys carried out would not be representative of typical traffic flows. The assessment therefore focused on the seven remaining AQMAs, and the AQAP was subsequently published in February 2022.

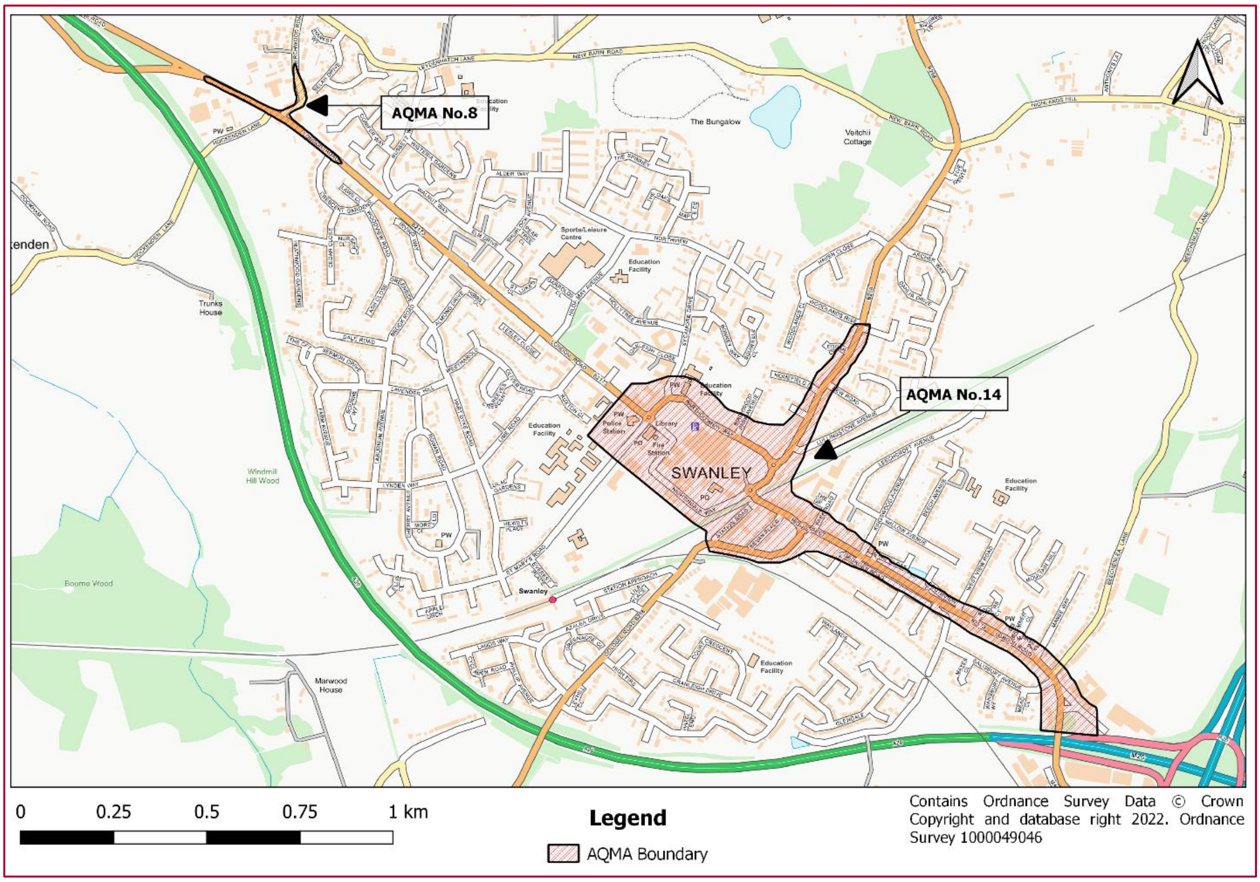
The AQAP details a measure to complete a detailed modelling assessment of the Swanley area to quantify the local air quality, and as such, Bureau Veritas has been commissioned in 2022 to complete the assessment. This utilises traffic survey data which has been collected in 2022.

The Council currently has two declared AQMAs within the Swanley area. 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:

- **AQMA No.8 (Swanley Town Centre)** – An area encompassing Swanley Town Centre, High Street and London Road. Declared in 2006 for exceedances of the annual mean NO_2 Air Quality Strategy (AQS) objective; and

- **AQMA No.14 (Junction of Birchwood and London Roads, Swanley) M25** – Declared in 2014 for exceedances of the annual mean NO_2 AQS objective.

Figure 1.1 – Swanley AQMAs



1.1 Scope of Report

The assessment seeks, with reasonably 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 to AQAP measures.

The following are the main objectives of this report:

- To assess the air quality at selected locations (receptors) at the façades of locations 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(22)[1]) have been utilised.

[1] Local Air Quality Management Technical Guidance LAQM.TG(22), August 2022, published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

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 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 2019, with model inputs relevant to the assessment based upon the same year, with the exception to traffic data sourced from 2022 traffic surveys. The original assessment for Sevenoaks utilised a 2018 base year as 2019 monitoring data was not available at the time of the assessment. It has therefore been considered appropriate to use 2019 as the latest year where data is available prior to any significant impacts resulting from the COVID-19 pandemic. Motorway sections which are likely to have an influence on NO_x concentrations within the Swanley area have been included, as modelled within the original Sevenoaks model (utilising 2019 DfT traffic count data)

2.1 Traffic Inputs

Traffic flows for the road links included within the model have been sourced from both traffic surveys conducted by Intelligent Data Collection and the DfT traffic count online resource[2].

Independent traffic surveys were conducted at five locations within Swanley to determine traffic flows on the major road links to be modelled. Five automatic traffic counts were deployed, which provided average annual daily traffic (AADT) flows alongside average speeds. In addition to this, one automatic number plate recognition (ANPR) camera was deployed in order to provide a detailed breakdown of vehicle types within the area so that specific euro class splits can be utilised. The proportion of vehicle types identified at the ANPR location was used to inform the proportional vehicle split at the other ATC monitoring locations.

As the traffic surveys were carried out in 2022, a TEMPro reduction factor of 1.0216 has been used to de-growth the data to representative figures for 2019. This factor is specific to the Sevenoaks District, for the years 2019 to 2022. TEMPro (the Trip End Model Presentation Programme) is provided by the DfT and provides forecast data on trips for transport and planning purposes. Whilst it is typically used for forecasting purposes, it can also be used to backcast traffic data where required.

The DfT traffic count data source, utilised for the motorways, provides an 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 Emissions Factor Toolkit (EFT) version 9.0[3] default euro class splits for 2019 were utilised on the motorway road sections.

The traffic data used within the dispersion modelling 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 data, which has been estimated from manual counts that were carried out over 3 years ago, have been highlighted in Appendix A. This may lead to some uncertainty in the accuracy of the traffic data.

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.

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[2] Department for Transport, traffic count data for available road links (2020), available at https://www.gov.uk/government/collections/road-traffic-statistics

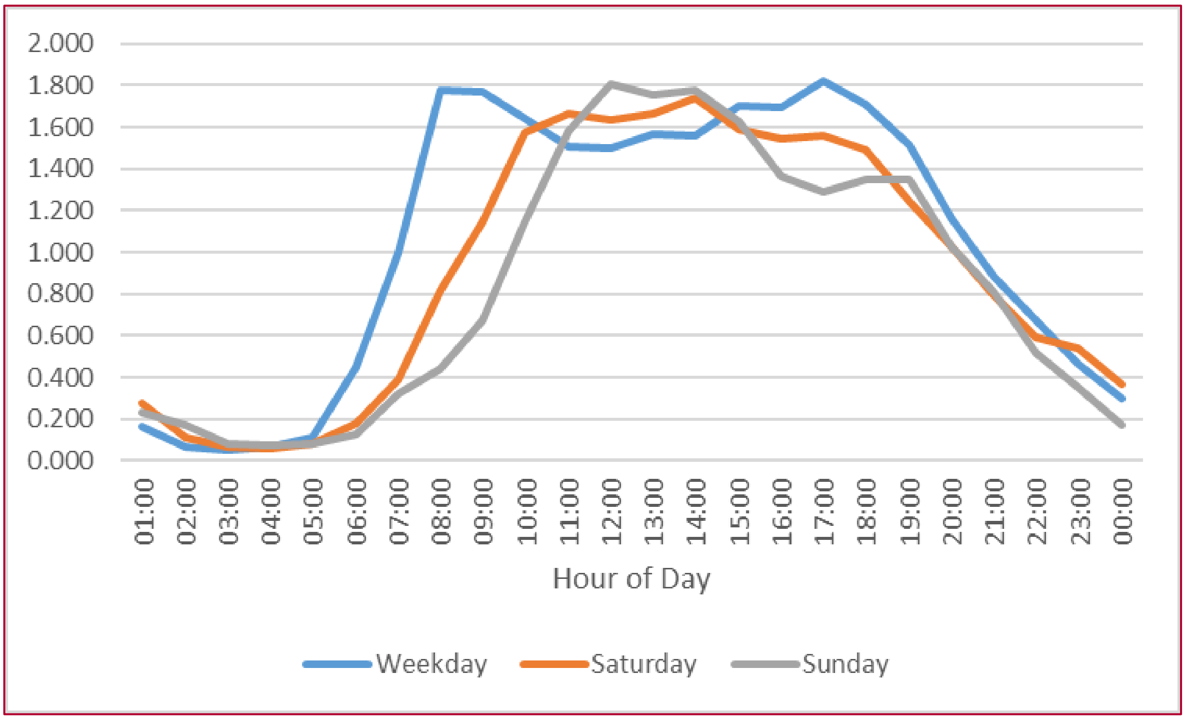
[3] Defra, Emissions Factors Toolkit (2019), available at http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

The EFT 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 the ANPR and existing DfT data. User-defined values for vehicle fleet in terms of vehicle Euro Class has been utilised for road sections within Swanley, however the pre-set national values have been utilised for the motorways in the absence of a vehicle fleet specific information for these. The decision to not use the ANPR based splits for the motorways was due to the motorways being much more likely to have a differing vehicle composition to the roads running through Swanley.

ANPR survey data has also been used to characterise the local diurnal profile of vehicle flows on the roads of interest. These have been included within the ADMS Roads model in the form of an additional model input, which has been applied to allow the temporal variation in emissions throughout the day and across the week to be reflected in the calculated emissions and therefore the predicted concentrations. The diurnal profile was only applied to the roads running through Swanley, as opposed to the motorways, as it is considered likely that the motorways would have a different profile. This however could not be determined as no independent traffic surveys were completed on the motorway sections as part of this assessment, and therefore it was assumed that emissions would remain constant throughout each day of the week.

The diurnal profile utilised is illustrated in Figure 2.1.

Figure 2.1 – Diurnal Profile for Vehicle Emissions Used in the Modelling



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.

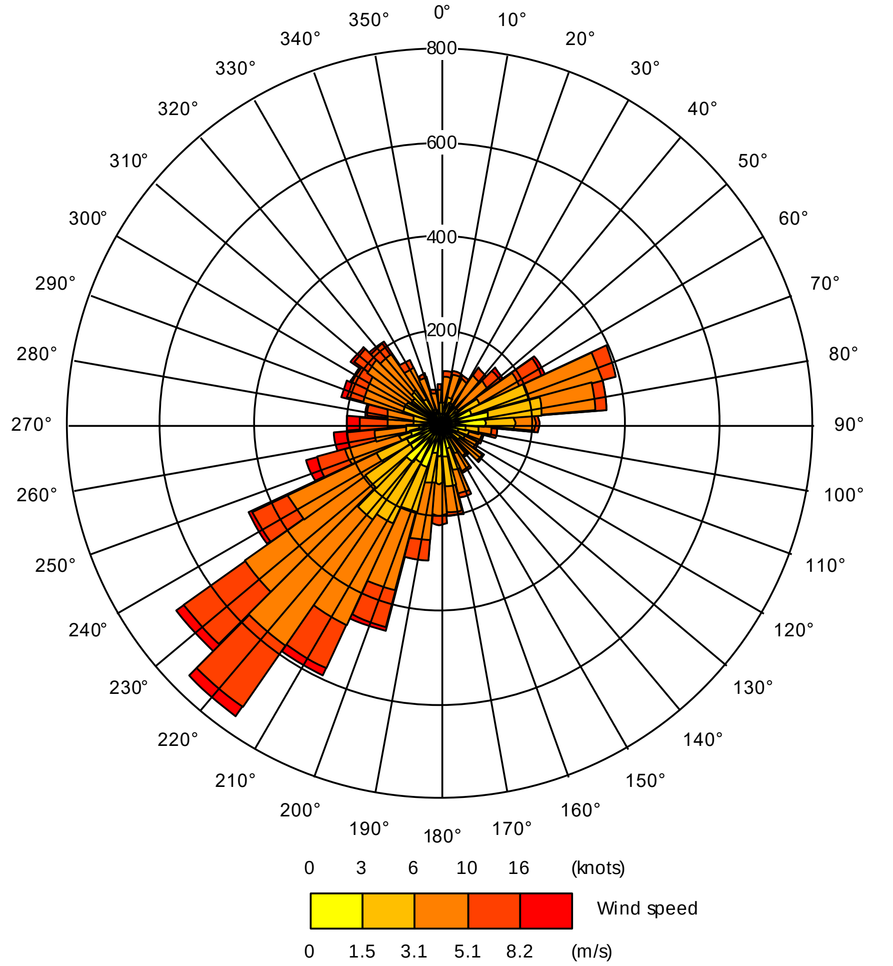
One year of hourly sequential meteorological data from a representative synoptic station is required by the dispersion model. For the completion of the modelling 2019 meteorological data from the Gatwick airport weather station has been utilised within in this assessment. This particular site has been chosen due to it being the nearest site with a complete data set for 2019 and is representative of an inland suburban area alongside

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

being at a similar elevation to the Sevenoaks District Council area. Gatwick airport was also utilised in the original Sevenoaks model.

A wind rose for this site for the year 2019 is presented in Figure 2.2.

Figure 2.2 – Wind Rose for Gatwick Airport 2019 Meteorological Data



2.3 Emission Sources

A total of 64 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 2.3. 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 2.4. These were identified using Google Streetview as part of the desktop study. No variation in the gradient of the road sources was included, and remained at the default 0%, assuming the area is flat.

The roads were drawn along the primary roads within the Swanley area, ensuring to include those running through the AQMAs. These were however restricted due to where available traffic data was located.

Figure 2.3 – Modelled Road Sources

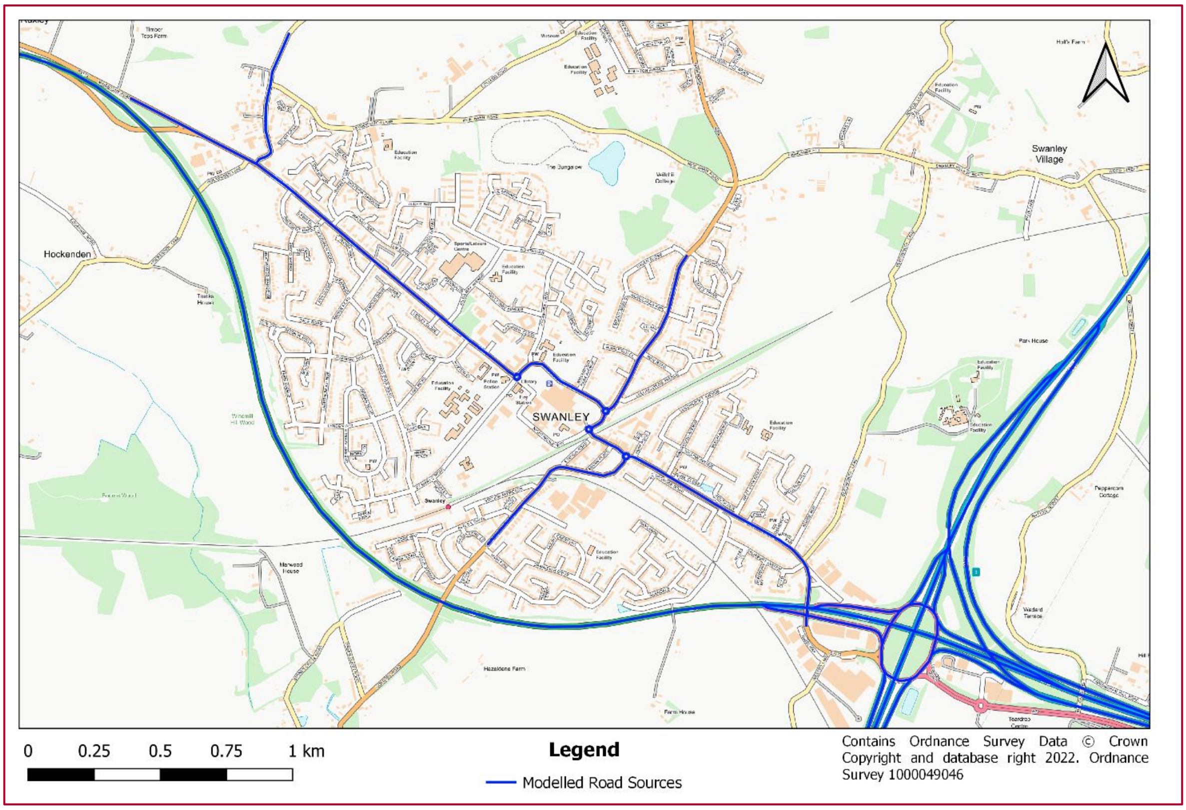
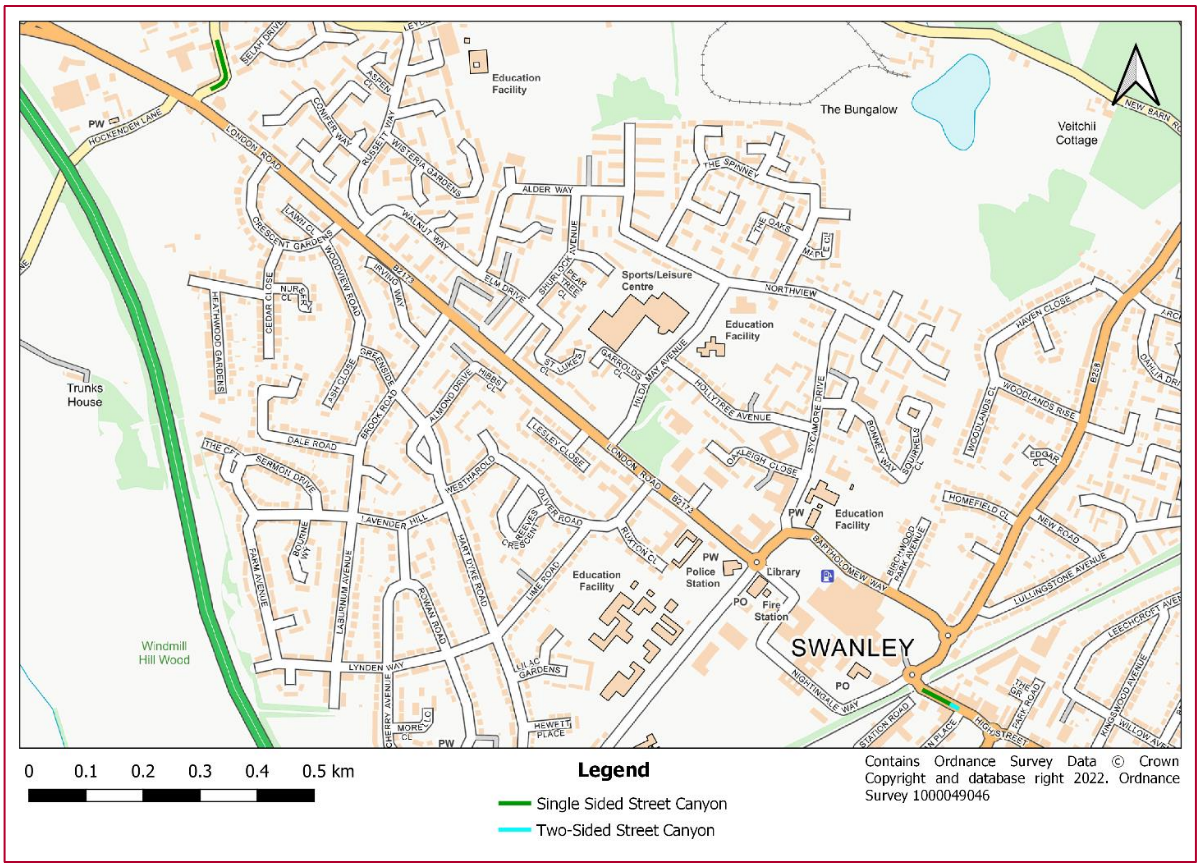


Figure 2.4 – Modelled Canyons and Canyon Height

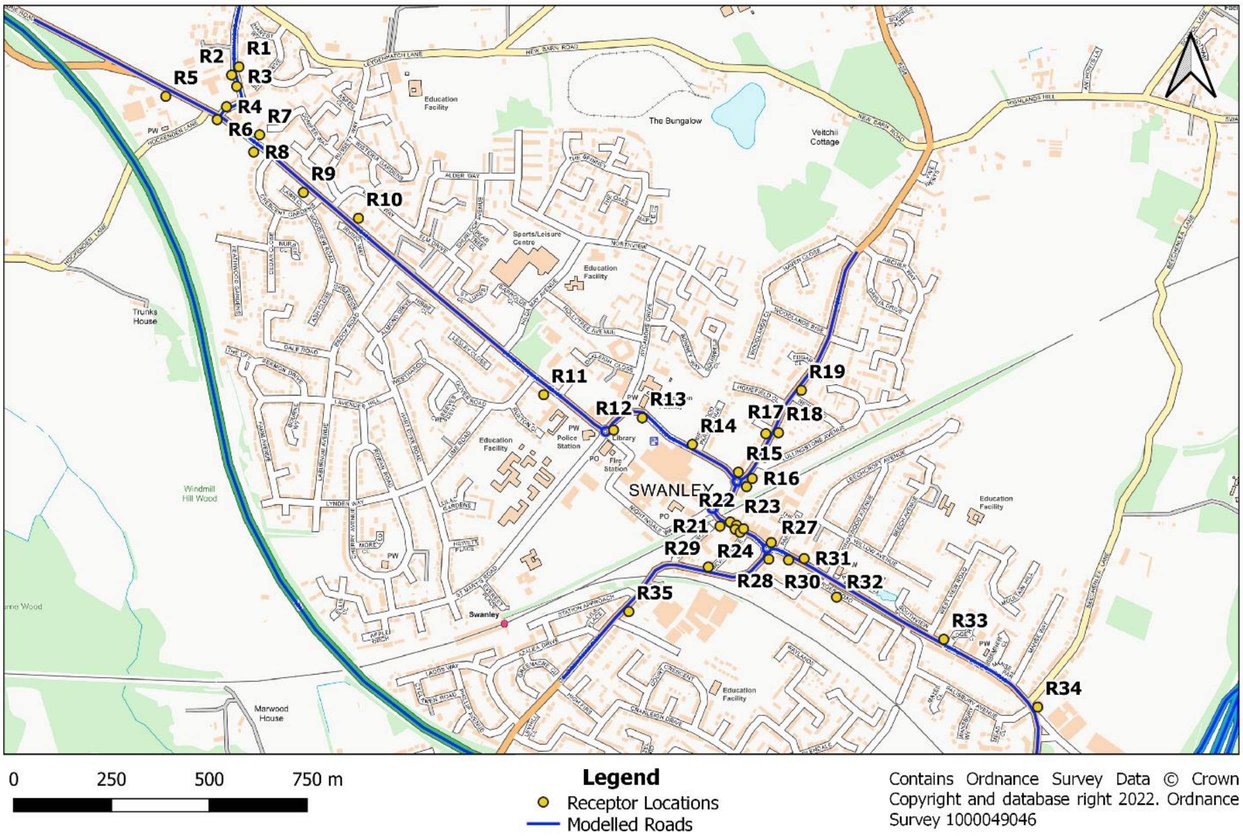


2.4 Sensitive Receptors

There are 35 discrete receptors included within the assessment to represent locations of relevant exposure and are displayed in Figure 2.5. The locations were identified through the completion of a desktop study, and where relevant exposure is believed to be present. In addition, concentrations were also modelled across regular gridded area's set across the AQMAs, with a spatial resolution between the receptors of approximately 12m x 12m, and 15m x 15m. Two grids were utilised to maintain a high resolution whilst remaining within ADMS-Road's capabilities. A receptor height of 1.5m was used for all gridded receptors modelled. The gridded receptor model was split into 2 separate domains to ensure a high resolution was maintained. These were supplemented with additional receptor points added close to the modelled road links, using the intelligent gridding tool in ADMS-Roads.

The majority of the discrete receptors (29) were included at a height of 1.5m to represent ground level exposure, whereas 6 receptors were included at an increased height of 4m to represent exposure at buildings with residential usage on the first storey levels.

Figure 2.5 – Discrete Receptor Locations



2.5 Model Outputs

Background pollutant values for 2019 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 'Motorway Roads' and 'Trunk A Roads' in the modelling and assessment process, these source sectors have been removed from the overall background concentrations reported both inside and outside the grid squares. The influence of 'Primary A Roads' inside

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

the grid squares has also been removed. This has been completed using the Defra NO_x Sector Removal Tool[6] v7.0.

Sevenoaks District Council carries out monitoring of NO_2 at a number of background monitoring sites using both an automatic monitor and diffusion tubes. For modelling purposes, the Defra Background maps have been used as opposed to the available background monitoring data due to there not being any representative background monitoring sites covering the modelling domain.

The background concentrations used within this assessment are presented in Appendix C.

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]. The road contribution is then added to the appropriate NO_2 background concentration value to obtain an overall total NO_2 concentration.

2.5.1 Verification

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 7 roadside diffusion tubes are located within the Swanley area and within the existing AQMAs. Details of these are presented in Table B.1. The locations and heights of these tubes have been adjusted and validated where required via a desktop study.

Verification was carried out using all 7 sites, with the results being presented in Table B.2. It was identified that using this model wide verification factor resulted in all sites predicting with the ±25% acceptance level. There were no further adjustments which could be made to the model further improve the verification. A verification factor of 2.517 was therefore utilised.

Full details of the model verification completed can be found in Appendix B.

2.5.2 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;
- 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. Locally defined fleet information has been used to determine local Euro Class proportions alongside national averages utilised for the motorways to derive specific emission rates. Details of the local Euro Class proportions are provided in Appendix A. The national averages for England are the pre-set values set within the latest version of the EFT.

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

[6] Defra NO_2 Adjustment for NO_x Sector Removal Tool (2019), available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

[7] Defra NO_x to NO_2 Calculator (2019), available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

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 the designated AQMAs. 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 average NO_x contributions across all locations with modelled NO_2 concentration greater than 40µg/m^3. This provides an indication of source apportionment in problematic areas (i.e. only where the annual mean AQS objective is exceeded). As such, this information should be considered with more scrutiny when testing and adopting action measures; and
- The NO_x contributions at the receptor with the maximum road NO_x and NO_2 contribution. This provides a comparison to the previous two groups, 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 of the two AQMAs, comparing both the monitoring completed within the AQMAs over a five year period with the modelled concentrations of annual mean NO_2. Details of each monitoring location and the monitoring results have been taken from the 2022 Annual Status Report[8] completed by the Council. There is a focus on 2019 monitoring data as this is comparable to the modelled results (which used 2019 as a baseline), however the recent monitoring data is also included for completeness. It should be noted that 2020 and 2021 monitoring data is not considered to be typical of normal conditions at the time of writing due to the impact of the COVID-19 pandemic on traffic levels and air quality. Whilst this provides a good indication of how much pollutant concentrations can decrease from removing road vehicles, it is not currently known whether this will be a short term effect or have longer term implications.

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 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 both 40µg/m^3 and 36µg/m^3 (within 10% of the 40µg/m^3 objective).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 2.5, are presented in both tabulated and pie charts 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.8 Swanley Town Centre

3.1.1 Council Monitoring Data

AQMA 8 is currently designated for exceedances of the annual mean NO_2 AQS objective. The current boundary encompasses Swanley Town Centre, High Street and London Road to the boundary of the M20. Currently there are three diffusion tubes monitoring annual mean NO_2 concentrations located within the current AQMA boundary. These are presented in Figure 3.1, and the monitoring results from the previous five years are shown in Figure 3.1 – AQMA No.8, Modelled Roads and Monitoring Locations

[8] Seveonaks District Council (2019), 2019 Air Quality Annual Status Report

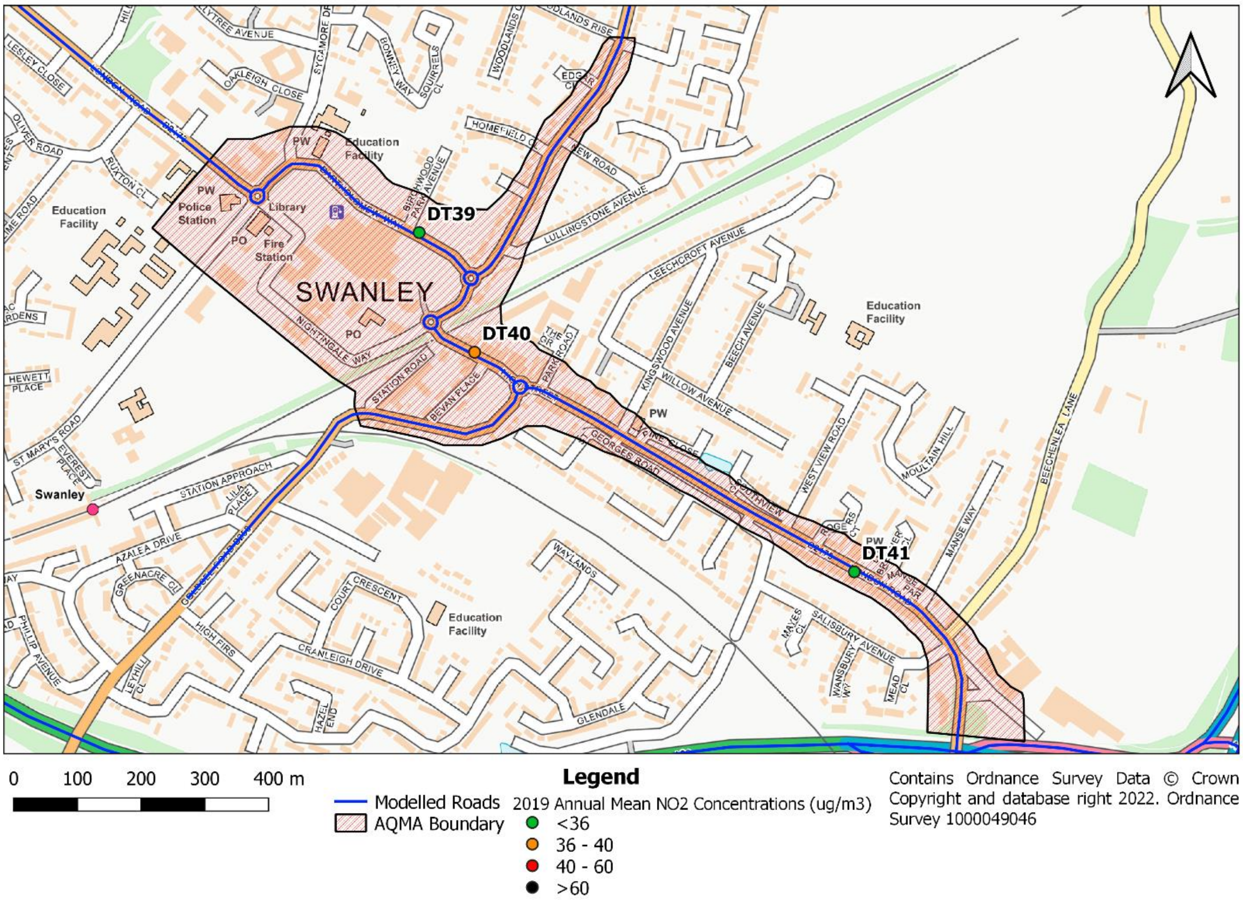


Table 3.1.

Exceedances of the annual mean NO_2 objective have been reported at both DT40 and DT41 in the past five years (2017 and 2018). DT40 has consistently reported the highest concentration out of all three monitoring locations for the past five years. DT40 continued to report a concentration within 10% of the AQS objective in 2019. This is likely due to being located within a small street canyon and between two junctions.

Following the application of distance correction to predict annual mean NO_2 concentrations at the closest point of relevant exposure for sites that are exceeding or within 10% of the AQS objective in 2019, as detailed within Table 3.2, the predicted concentration from DT40 is reported to be below the annual mean NO_2 objective.

Figure 3.1 – AQMA No.8, Modelled Roads and Monitoring Locations

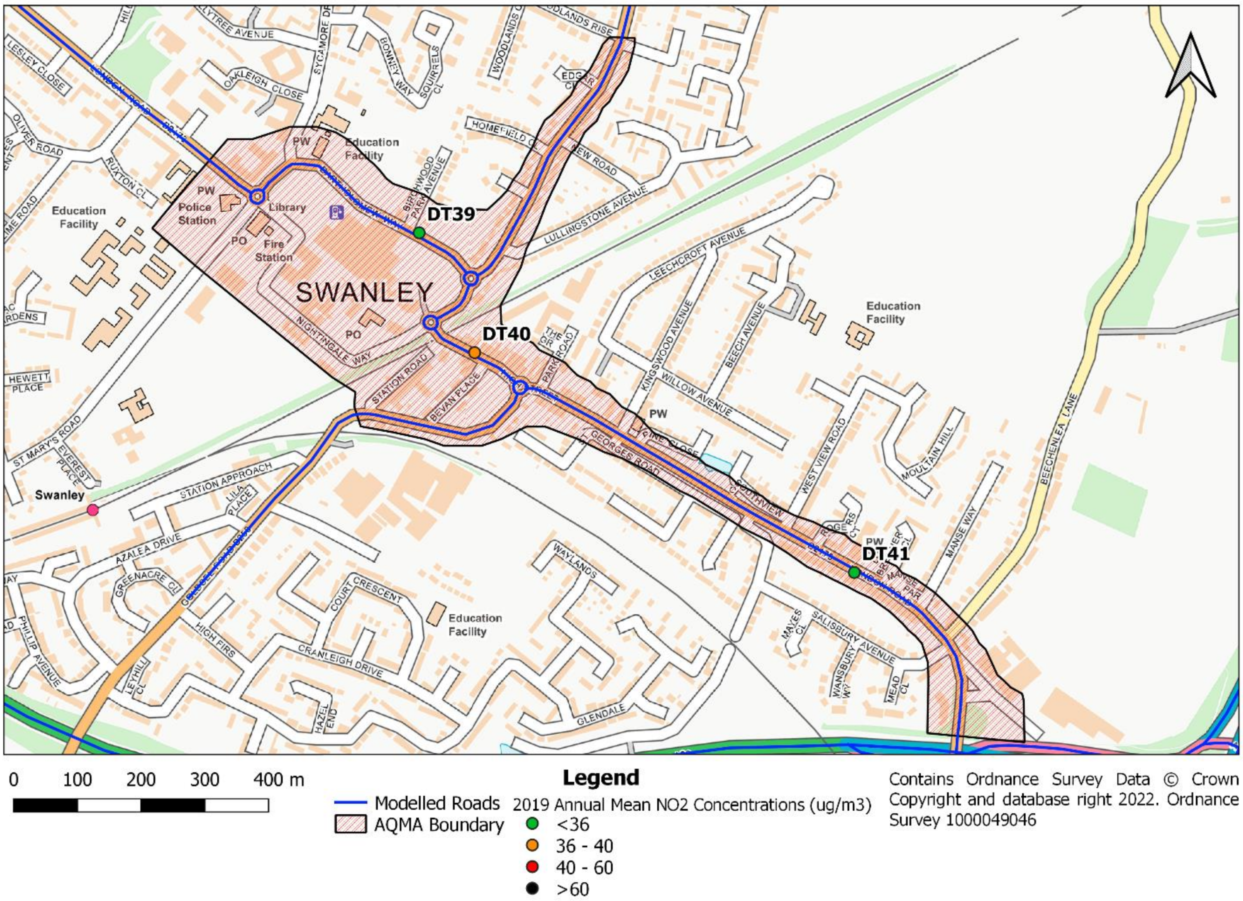


Table 3.1 – Current NO_2 Monitoring Within AQMA No.8

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)				
						2017	2018	2019	2020	2021
DT39	R	551492	168695	13.0	2.5	34.5	*36.4*	34.8	28.1	29.4
DT40	R	551579	168507	2.0	2.5	**40.9**	**45.6**	*37.5*	28.4	34.1
DT41	R	552175	168162	6.0	2.5	**40.1**	*38.6*	32.6	27.2	29.5

In *italics*, concentration is within 10% of the annual mean NO_2 AQS objective (i.e. 36 – 40µg/m³)
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
R= Roadside

Table 3.2 – 2019 NO_2 Monitoring Within AQMA No.8, Distance Corrected

Site	Site Type	Distance to Kerbside (m)	Distance from Kerbside to Relevant Exposure (m)	Monitored Concentration (µg/m³)	Distance Corrected Concentration (µg/m³)
DT40	R	0.5	2.5	37.5	31.4

In *italics*, concentration is within 10% of the annual mean NO_2 AQS objective (i.e. 36 – 40µg/m³)
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
R= Roadside

3.1.2 Modelled Receptors, Annual Mean NO_2

Table 3.3 provides the modelled annual mean NO_2 concentrations predicted at existing residential receptor locations in 2019. There are 23 discrete receptor locations positioned within the boundary of AQMA No.8, with 1 receptor located at a specific sensitive receptor (Montessori Group Preschool). Two additional receptors located in close proximity to the AQMA were also modelled. Two receptors located within the AQMA, R25 and R26, have predicted exceedances of the annual mean NO_2 objective, with concentrations predicted to be 56.0µg/m^3 and 49.8µg/m^3 respectively. All other receptor locations have a concentration predicted to be below 10% of 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 the exceedances being predicted at R25 and R26 are located along the High Street, just westwards of the junction to Bevan Place. Both of these receptors are positioned at a height of 4m as it is believed there are residential receptors above the commercial properties. Additionally, a small double-sided street canyon has been modelled here hence why concentrations are lower elsewhere along this stretch. The nearest diffusion tube monitoring location to these receptors is DT40, which reported an annual mean NO_2 concentration in 2019 of 37.5µg/m^3. The model is over predicting concentrations at this location by 12.9%, therefore indicating that modelled concentrations are likely to also be slightly over predicted in this location and should be considered as a conservative prediction. Despite this over prediction, an exceedance would still be considered at R25 and R26 even if the model was not over predicting by 12.9%.

The additional sensitive receptor located at the Montessori Group Preschool, R20, has a predicted annual mean NO_2 concentration of 27.5µg/m^3 in 2019, therefore is predicted to be below the annual mean NO_2 objective.

From the annual mean NO_2 concentration contour plots presented in Figure 3.3, it can be seen that the extent of the predicted exceedances of the annual mean objective are focused around the roundabout junctions within the AQMA, and are retained within the AQMA boundary. The contour lines follow the geometry of the road, and with the exception of the section of the High Street around R25 and 26, the exceedance limit does not come into contact with any other residential areas located within the AQMA. Additionally, whilst there are contours for concentrations greater than 60µg/m^3 (which would indicate a potential exceedance of the 1-hour NO_2 AQS objective, as per LAQM.TG(22)), none of these are in areas where members of public would be expected to spend 1-hour or more.

Table 3.3 – AQMA No.8, Summary of Modelled Receptor Results (NO_2)

Receptor ID	OS Grid X	OS Grid Y	Height (m)	In AQMA?	AQS objective (µg/m^3)	2019 Annual Mean NO_2 (µg/m^3)	% of AQS objective
R11	551079	168846	1.5	N	40	20.1	50
R12	551258	168755	1.5	Y	40	32.8	82
R13	551331	168787	1.5	Y	40	25.1	63
R14	551459	168719	1.5	Y	40	28.8	72
R15	551577	168648	1.5	Y	40	35.2	88
R16	551612	168631	1.5	Y	40	26.2	65
R17	551647	168746	1.5	Y	40	22.3	56
R18	551680	168749	1.5	Y	40	22.3	56
R19	551738	168857	1.5	Y	40	22.1	55
R20	551598	168610	1.5	Y	40	27.5	69
R21	551530	168510	1.5	Y	40	25.2	63
R22	551556	168520	4	Y	40	34.3	86
R23	551572	168512	4	Y	40	24.4	61
R24	551569	168501	4	Y	40	35.7	89
R25	551581	168494	4	Y	40	**56.0**	140
R26	551590	168503	4	Y	40	**49.8**	125
R27	551661	168468	4	Y	40	30.1	75
R28	551655	168425	1.5	Y	40	27.3	68

Receptor ID	OS Grid X	OS Grid Y	Height (m)	In AQMA?	AQS objective (µg/m^3)	2019 Annual Mean NO_2 (µg/m^3)	% of AQS objective
R29	551500	168405	1.5	Y	40	24.3	61
R30	551705	168423	1.5	Y	40	27.0	67
R31	551745	168427	1.5	Y	40	31.1	78
R32	551828	168328	1.5	N	40	22.0	55
R33	552102	168220	1.5	Y	40	29.6	74
R34	552342	168047	1.5	Y	40	32.0	80
R35	551297	168291	1.5	N	40	22.3	56

In *italics*, concentration is within 10% of the annual mean NO_2 AQS objective (i.e. 36 – 40µg/m^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

Figure 3.2 – AQMA No.8, Modelled Receptor NO_2 Concentrations

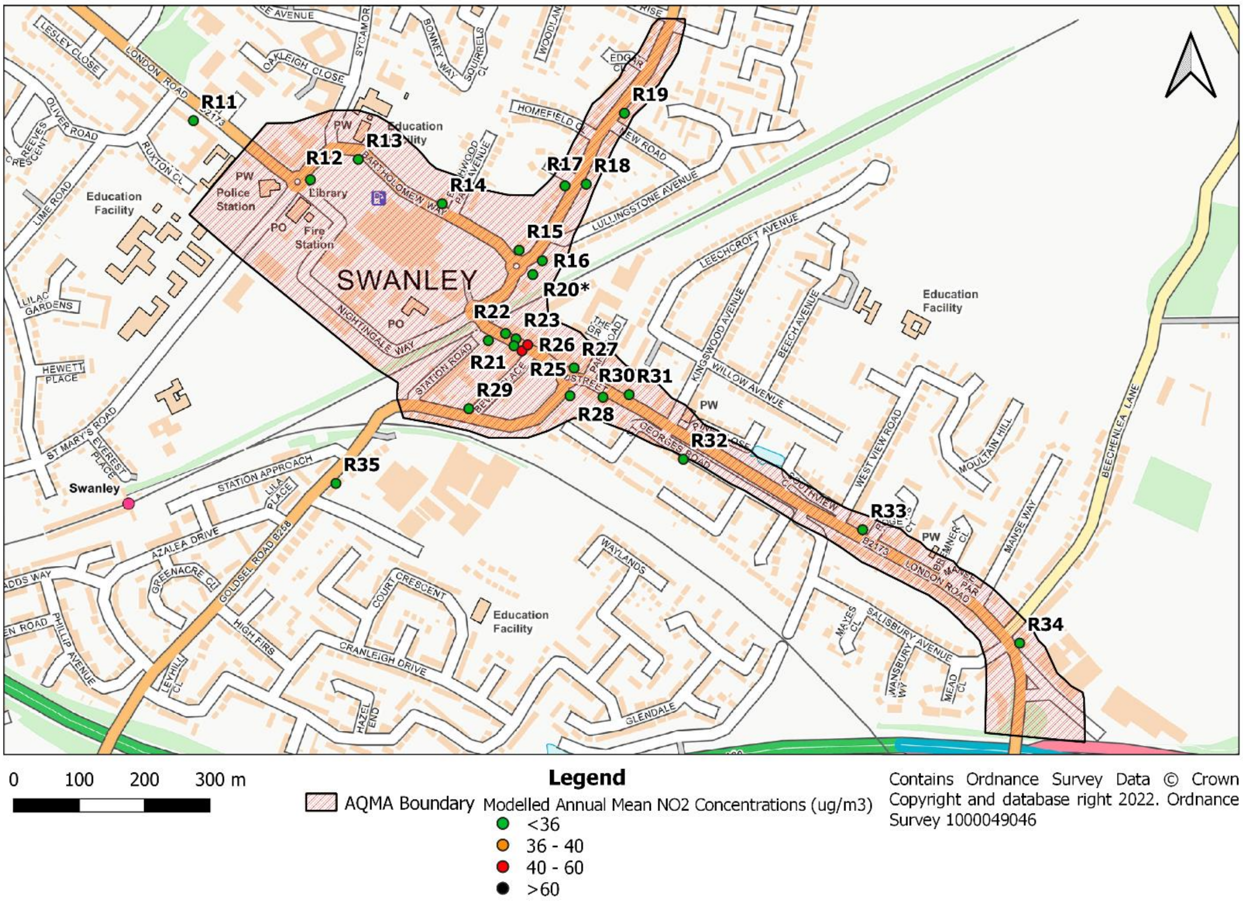
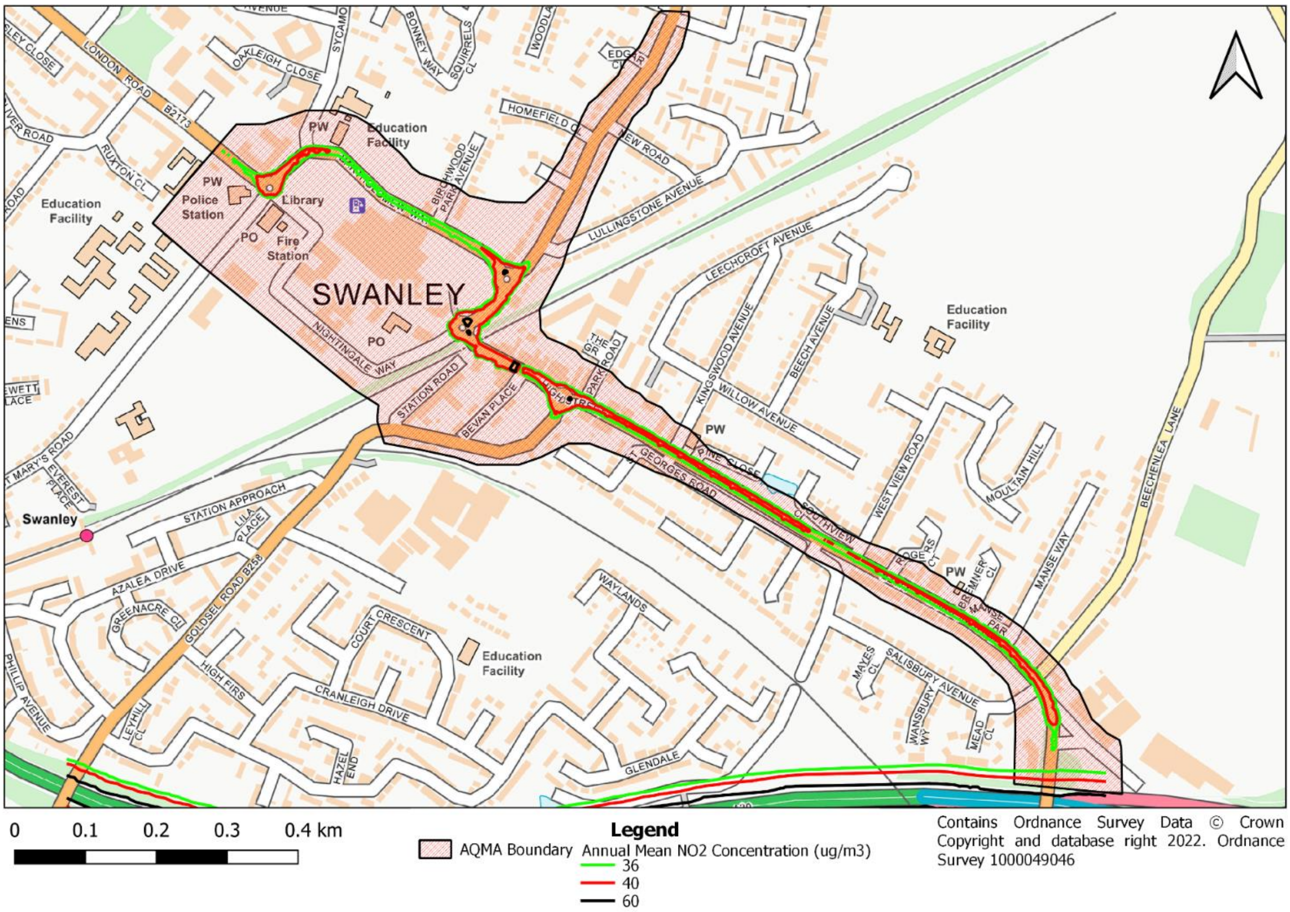


Figure 3.3 – AQMA No.8, Modelled NO_2 Concentration Isopleths



3.1.3 AQMA No.8 Source Apportionment

The source apportionment completed for the modelled receptors within the boundary of AQMA No.8 incorporates the 23 receptors as detailed within Table 3.3 above. Apportionment for NO_x concentrations have been completed for the three separate groups in terms of the receptors as detailed in Section 2.5, with the results presented in Table 3.4 and Figure 3.4.

When considering the average NO_x concentration across all modelled receptors, road traffic accounts for 33.5µg/m^3 (65.0%) of total NO_x concentration (51.5µg/m^3). Of vehicle types contributing to the 51.5µg/m^3 total NO_x concentration, Diesel Cars account for the greatest contribution (27.5%) of any of the vehicle types, followed by Diesel LGVs (18.5%), HGVs (13.1%) and Petrol Cars (5.0%). The remaining vehicle source groups (Petrol LGVs, Alternative Fuel Cars and LGVs, Bus and Coach, and Motorcycles) contribute less than 0.7% each.

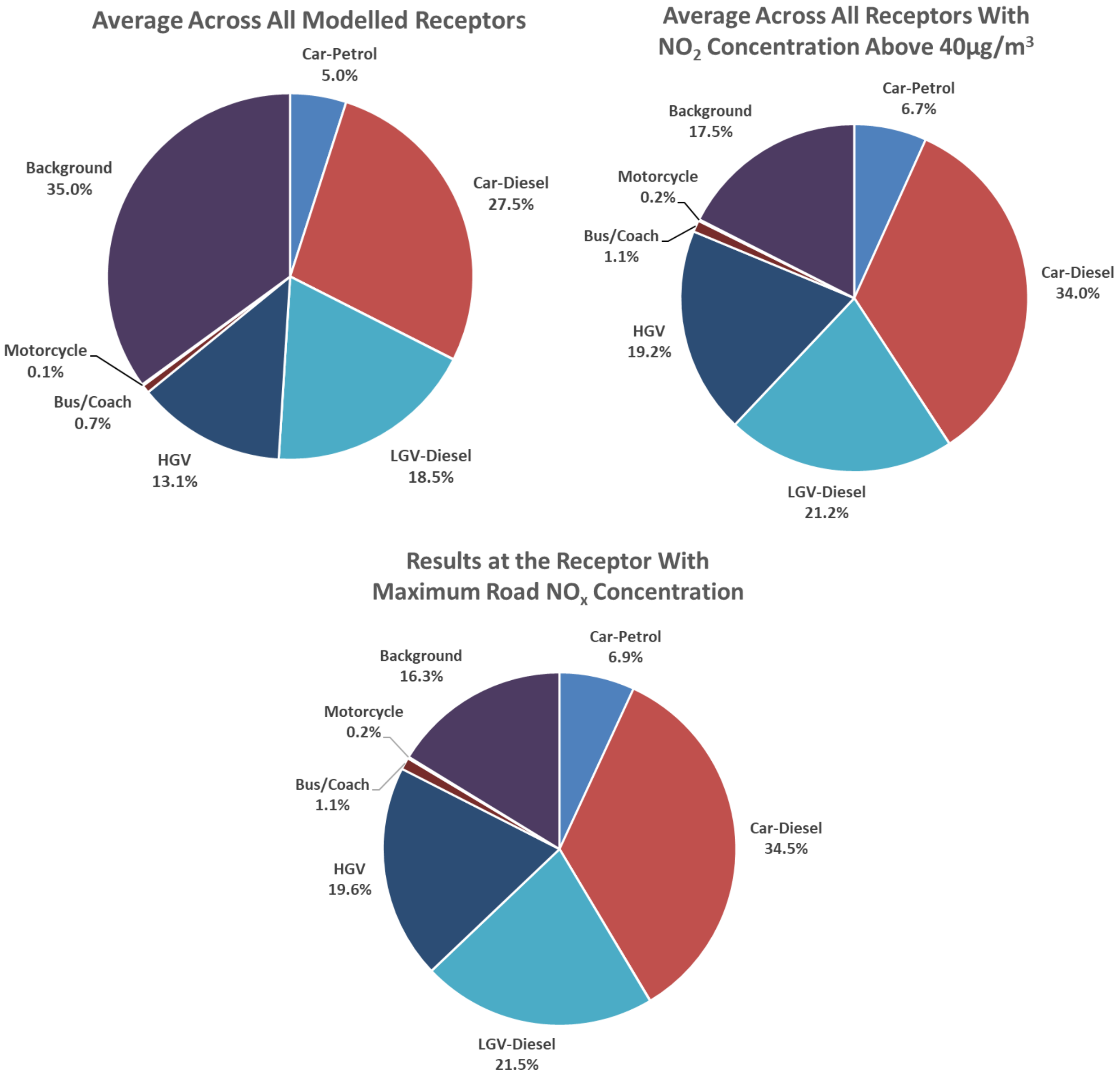
Averaged across the receptors where an exceeding annual mean NO_2 concentration is predicted (R25 and R26), road traffic accounts for 86.0µg/m^3 (82.5%) of the total NO_x concentration (104.3µg/m^3). Of vehicle types contributing to the total NO_x concentration, a similar distribution is observed, whereby Diesel Cars account for the greatest contribution (34.0%), followed by Diesel LGVs (21.2%), HGVs (19.2%) and Petrol Cars (6.7%), with the remaining vehicle source groups contributing less than 1.1% each.

The receptor with the maximum road NO_x concentration is receptor R25, whereby the total road NO_x was predicted to be 94.1µg/m^3. At this receptor, road traffic accounts for 83.7% of total NO_x concentration (112.4µg/m^3). Of the total NO_x concentration, the separate vehicle apportionment remains similar to the previous assessments but with a slightly increased apportionment to Diesel Cars, Diesel LGVs and HGVs, and a slightly decreased apportionment Petrol Cars. The remaining vehicle source groups contributing less than 1.1% each.

Table 3.4 – NO_x Source Apportionment Results: AQMA No.8

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)	33.5	2.6	14.2	0.0	0.0	9.5	0.0	6.8	0.4	0.1	18.1
Percentage of Total NO_x	65.0%	5.0%	27.5%	0.0%	0.0%	18.5%	0.0%	13.1%	0.7%	0.1%	35.0%
Percentage Contribution to Road NO_x	100.0%	7.6%	42.3%	0.0%	0.0%	28.5%	0.0%	20.2%	1.1%	0.2%	-
Average Across All Receptors with NO_2 Concentration exceeding the AQS annual mean objective											
NO_x Concentration (µg/m^3)	86.0	7.0	35.5	0.0	0.0	22.2	0.0	20.0	1.1	0.2	18.3
Percentage of Total NO_x	82.5%	6.7%	34.0%	0.0%	0.0%	21.2%	0.0%	19.2%	1.1%	0.2%	17.5%
Percentage Contribution to Road NO_x	100.0%	8.2%	41.2%	0.0%	0.0%	25.8%	0.0%	23.3%	1.3%	0.2%	-
At Receptor with Maximum Road NOx Concentration (R25											
NO_x Concentration (µg/m^3)	94.1	7.7	38.8	0.0	0.0	24.1	0.0	22.0	1.2	0.2	18.3
Percentage of Total NO_x	83.7%	6.9%	34.5%	0.0%	0.0%	21.5%	0.0%	19.6%	1.1%	0.2%	16.3%
Percentage Contribution to Road NO_x	100.0%	8.2%	41.2%	0.0%	0.0%	25.6%	0.0%	23.4%	1.3%	0.2%	-

Figure 3.4 – NO_x Source Apportionment Results: AQMA No.8



3.2 AQMA No.14 Junction of Birchwood and London Roads

3.2.1 Council Monitoring Data

AQMA No.14 is currently designated for exceedances of the annual mean NO_2 AQS objective with the current boundary covering the junction of Birchwood Road and London Road located within Sevenoaks. Currently there are three diffusion tubes monitoring annual mean NO_2 concentrations located within the current AQMA boundary, with one additional diffusion tube (DT93) located just northwards along Birchwood Road outside the AQMA boundary. The current diffusion tube monitoring sites located within the AQMA are presented in Figure 3.5, and results for the previous five years are detailed in Table 3.5.

DT83, DT94 and DT95 are all located within the boundary of AQMA No.8 and it can be seen that there have been reported exceedances at DT83 in 2017, 2018 and 2019. No exceedances have been reported at any of the other diffusion tube locations, including DT93, nor are any of the concentrations within 10% of the AQS objective.

Following the application of distance correction to predict annual mean NO_2 concentrations at the closest point of relevant exposure at sites which are either exceeding or within 10% of the AQS objective, as detailed within Table 3.6, DT83 shows a predicted concentration to still be in exceedance of the annual mean NO_2 objective in 2019 at the nearest relevant exposure.

Figure 3.5 – AQMA No.14, Modelled Roads and Monitoring Locations

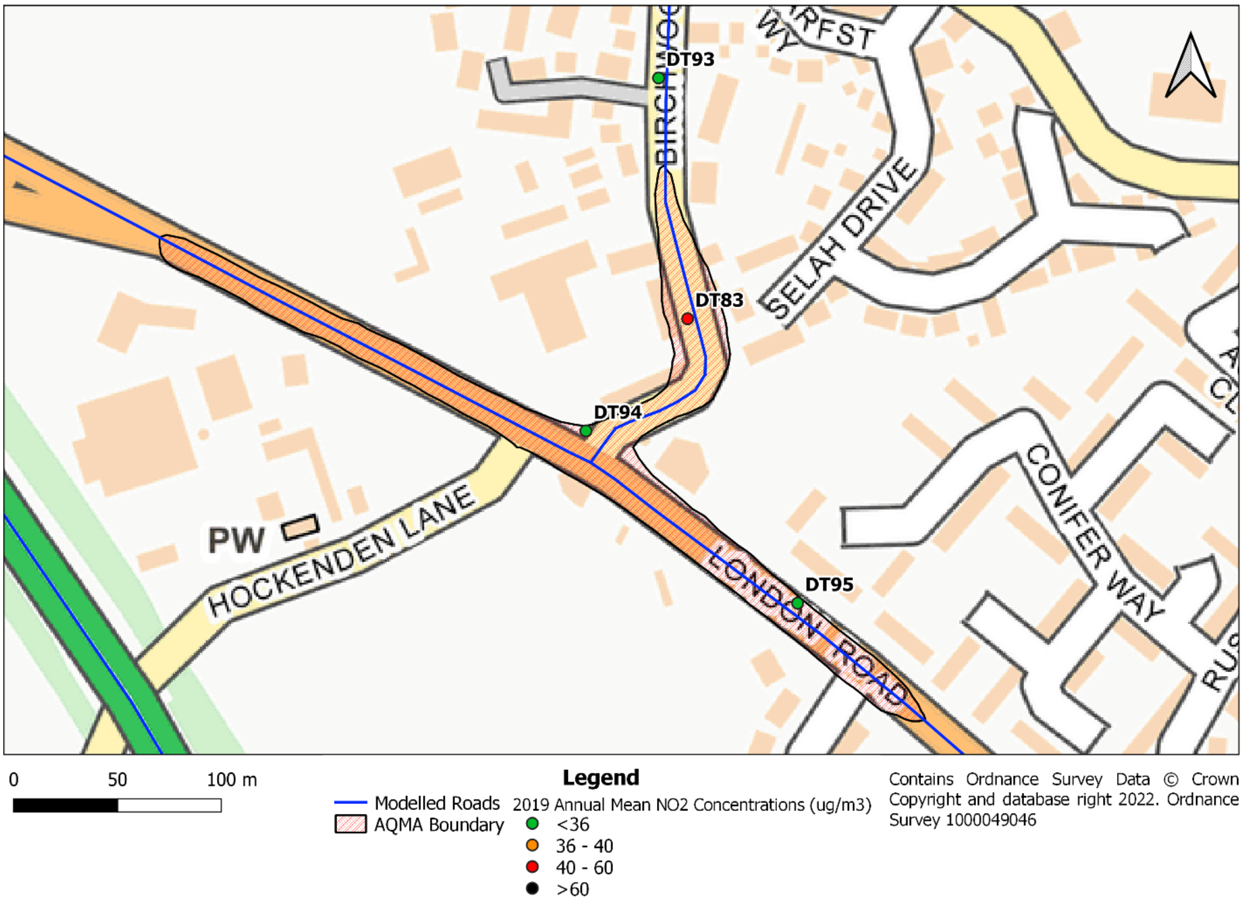


Table 3.5 – Current NO_2 Monitoring Within, or in Close Proximity to AQMA No.14

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)				
						2017	2018	2019	2020	2021
DT83	R	550297	169682	0.5	2.5	**49.8**	**46.7**	**42.4**	33.3	33.1
DT93	R	550283	169743	10.0	2.5	27.2	28.8	25.9	19.5	20.2
DT94	R	550283	169743	10.0	2.0	32.2	33.8	28.6	22.8	22.7
DT95	R	550258	169575	20.0	2.5	33.6	33.0	30.2	25.0	25.3

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
R= Roadside

Table 3.6 – 2019 NO_2 Monitoring Within AQMA No.14, Distance Corrected

Site	Site Type	Distance to Kerbside (m)	Distance from Kerbside to Relevant Exposure (m)	Monitored Concentration 2018 (µg/m³)	Distance Corrected Concentration (µg/m³)
DT83	R	1.0	1.5	**42.4**	**40.2**

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
R= Roadside

3.2.2 Modelled Receptors, Annual Mean NO_2

Table 3.7 provides the modelled annual mean NO_2 concentrations predicted at existing residential receptor locations in 2019. 4 discrete receptor locations are positioned within the AQMA boundary or in very close proximity to AQMA No.14 (i.e. on the edge of the AQMA boundary), with a further 6 being located nearby. None of these receptor locations have predicted and exceedance of the annual mean NO_2 objective.

Figure 3.6 presents the modelled receptor locations alongside their predicted annual mean NO_2 concentrations. The maximum predicted NO_2 concentration is 36.8µg/m³ at R3, which is located at the residential property on Birchwood Road nearest to monitoring location DT83. The model is shown to be underpredicting NO_2 concentrations at DT83 by up to 10.8%. Therefore a degree of caution should be taken into account when considering the model outputs in this location, as the true concentration could be slightly higher.

From the annual mean NO_2 concentration contour plots presented in Figure 3.7, it can be seen that the extent of the predicted exceedances of the annual mean objective follow the geometry of the road and are located within the existing AQMA boundary. The exceedance limit is not believed to come into contact with any residential properties surrounding the junction.

Table 3.7 – AQMA No.14, Summary of Modelled Receptor Results (NO_2)

Receptor ID	OS Grid X	OS Grid Y	Height (m)	Inside AQMA?	AQS objective (µg/m³)	2019 Annual Mean NO_2 (µg/m³)	% of AQS objective
R1	550300	169684	1.5	N	40	25.5	64
R2	550281	169663	1.5	Y	40	23.1	58
R3	550294	169634	1.5	Y	40	*36.8*	92
R4	550268	169582	1.5	Y	40	35.2	88
R5	550113	169607	1.5	N	40	24.0	60
R6	550244	169549	1.5	Y	40	28.5	71
R7	550353	169510	1.5	N	40	22.9	57
R8	550338	169466	1.5	N	40	21.1	53
R9	550465	169363	1.5	N	40	20.4	51

Receptor ID	OS Grid X	OS Grid Y	Height (m)	Inside AQMA?	AQS objective (µg/m^3)	2019 Annual Mean NO_2 (µg/m^3)	% of AQS objective
R10	550605	169297	1.5	N	40	21.6	54
In *italics*, concentration is within 10% of the annual mean NO_2 AQS objective (i.e. 36 – 40µg/m^3) In **bold**, exceedance of the annual mean NO_2 AQS objective of 40µg/m^3. When <u>**underlined**</u>, NO_2 annual mean exceeds 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective							

Figure 3.6 – AQMA No.14, Modelled Receptor Locations

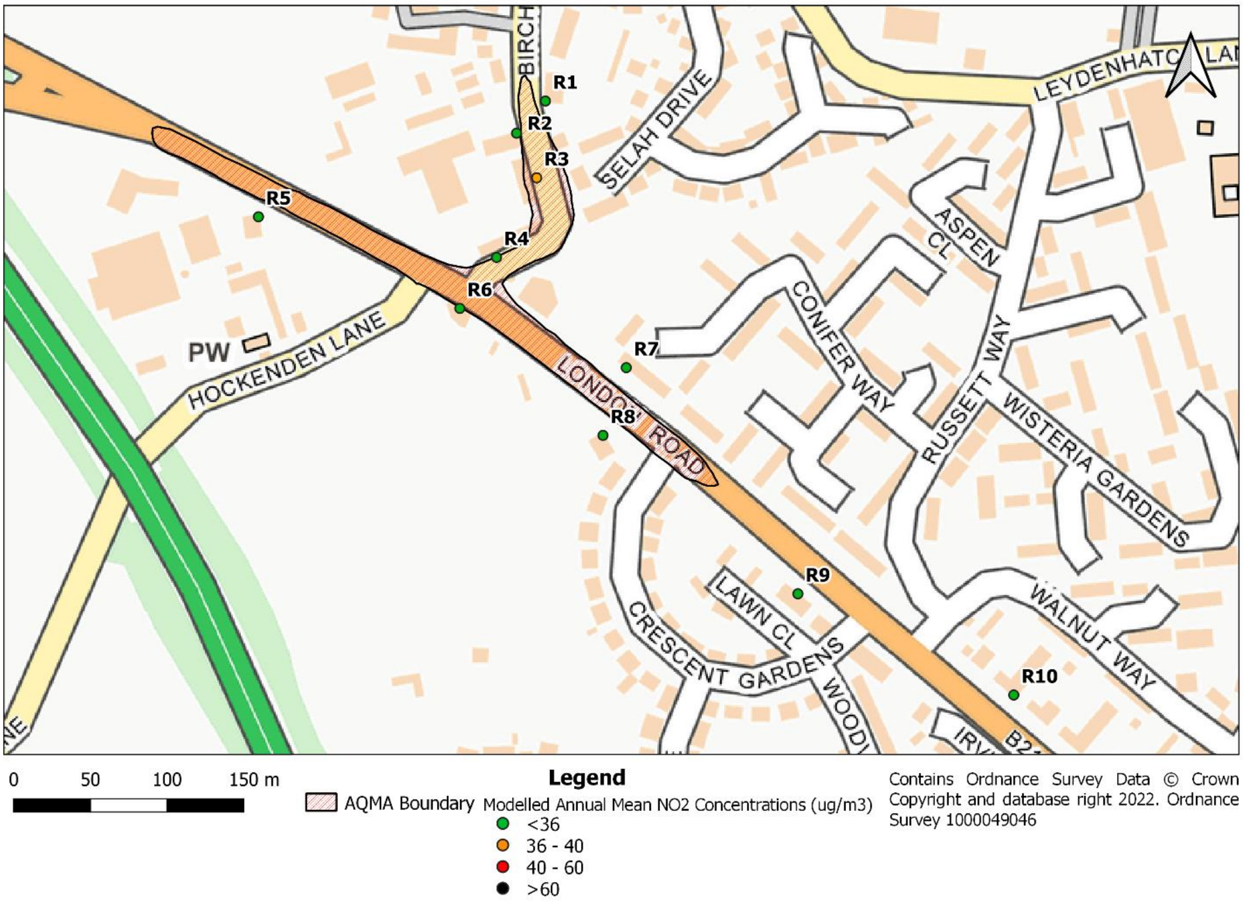
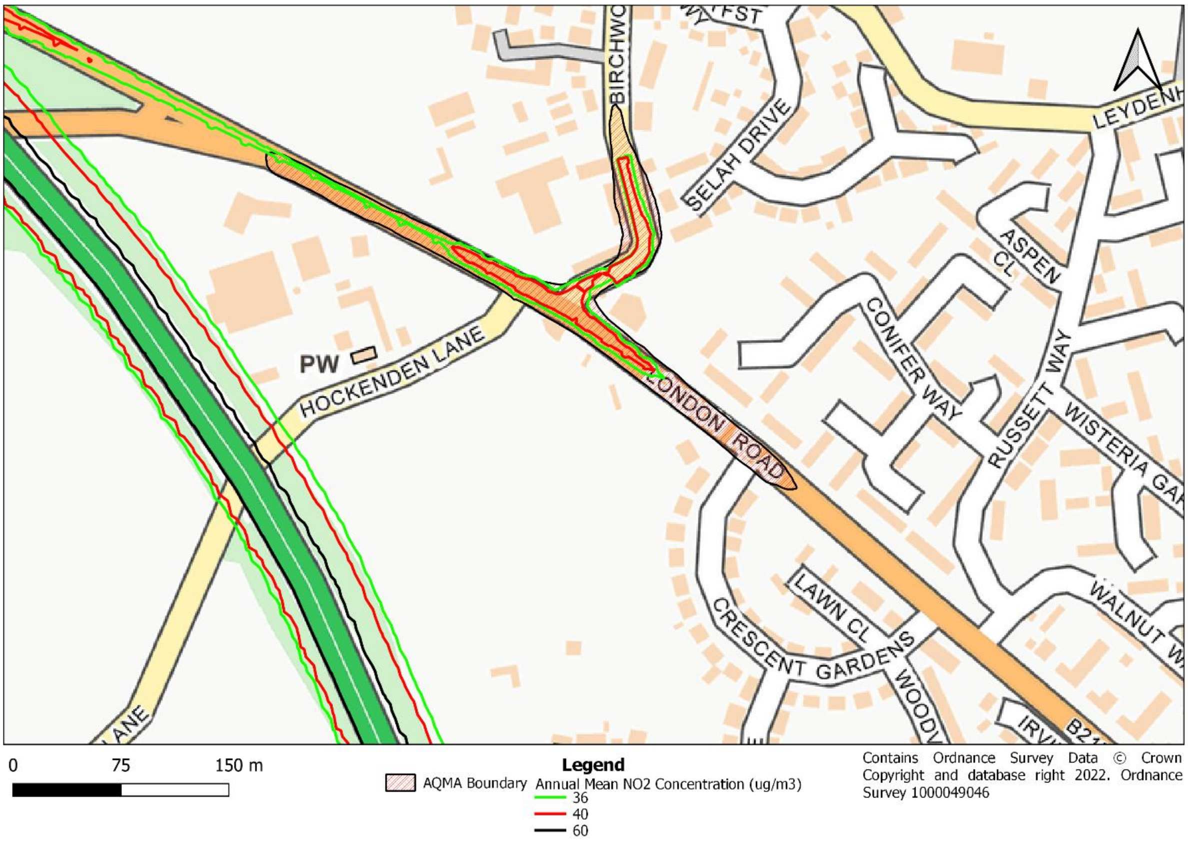


Figure 3.7 – AQMA No.14 Modelled NO_2 Concentration Isopleths



3.2.3 AQMA No.2 Source Apportionment

The source apportionment completed for the modelled receptors within the boundary of AQMA No.14 incorporates the 4 receptors as detailed within Table 3.7 above. Apportionment for NO_x concentrations have been completed for two separate groups in terms of the receptors as detailed in Section 2.5, excluding the average across all receptors with NO_2 concentrations exceeding the AQS annual mean objective as no exceedance was reported. The results are presented in Table 3.8 and

Figure 3.8.

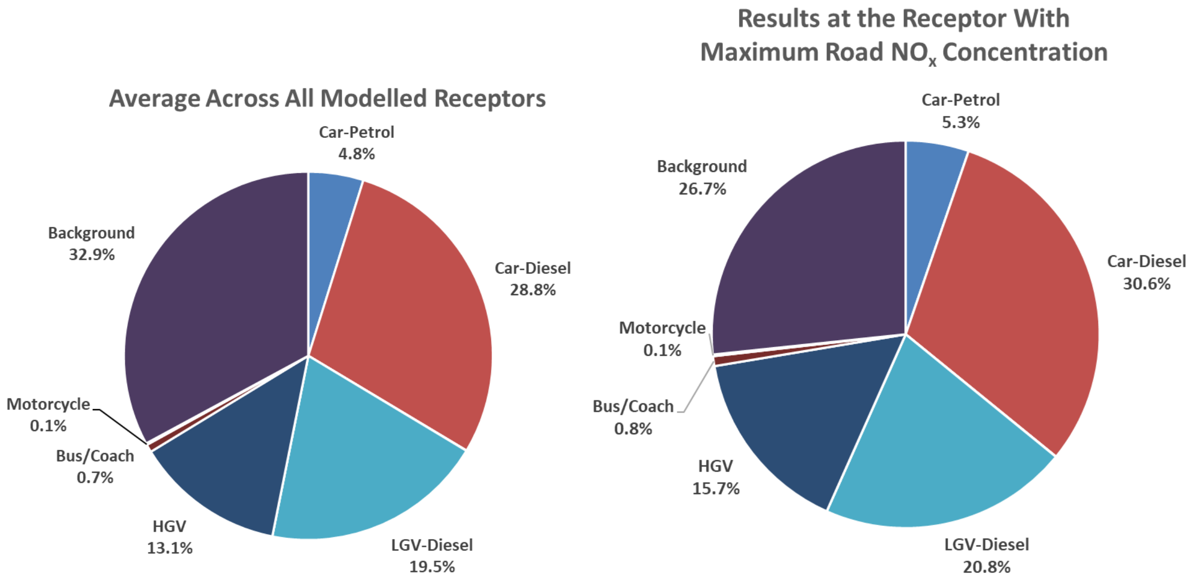
When considering the average NO_x concentration across all modelled receptors, road traffic accounts for 35.7µg/m^3 (67.1%) of total NO_x concentration (53.1µg/m^3). Of the total NO_x concentration, Diesel Cars account for the greatest contribution (28.8%) of any of the vehicle types, followed by Diesel LGVs (19.5%), HGVs (13.1%) and Petrol Cars (4.8%). The remaining vehicle source groups (Petrol LGVs, Alternative Fuel Cars and LGVs, Bus and Coach, and Motorcycles) contribute less than 0.7% each.

The receptor with the maximum road NO_x concentration is receptor R3, whereby the total road NO_x was predicted to be 48.1µg/m^3. At this receptor, road traffic accounts for 73.3% of total NO_x concentration (65.6µg/m^3). Of the total NO_x, the separate vehicle apportionment remains similar to the previous assessment whereby the major contributor is from Diesel Cars, followed by Diesel LGVs, HGVs and Petrol Cars, with the remaining vehicle source groups contributing less than 0.8% each.

Table 3.8 – NO_x Source Apportionment Results: AQMA No.14

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)	35.7	2.6	15.3	0.0	0.0	10.4	0.0	7.0	0.4	0.1	17.5
Percentage of Total NO_x	67.1%	4.8%	28.8%	0.0%	0.0%	19.5%	0.0%	13.1%	0.7%	0.1%	32.9%
Percentage Contribution to Road NO_x	100.0%	7.2%	42.9%	0.0%	0.0%	29.1%	0.0%	19.6%	1.0%	0.2%	-
At The Receptor with the Maximum Road NO_x Concentration (R3)											
NO_x Concentration (µg/m^3)	48.1	3.5	20.1	0.0	0.0	13.6	0.0	10.3	0.5	0.1	17.5
Percentage of Total NO_x	73.3%	5.3%	30.6%	0.0%	0.0%	20.8%	0.0%	15.7%	0.8%	0.1%	26.7%
Percentage Contribution to Road NO_x	100.0%	7.2%	41.7%	0.0%	0.0%	28.3%	0.0%	21.4%	1.1%	0.2%	-

Figure 3.8 – NO_x Source Apportionment Results: AQMA No.14



4 Conclusions and Recommendations

Following the completion of the analysis of both monitoring data and modelled concentrations across the two assessed AQMAs within Swanley, a number of recommendations have been made in terms of the current designations of the AQMAs within Sevenoaks. It should be noted that there is a focus on 2019 monitoring concentrations, with 2019 being used as the baseline year for any modelling carried out. This is due to the COVID-19 pandemic and UK Government enforced restrictions occurring throughout 2020 and 2021 and a reduction/change in typical traffic patterns, resulting in monitored NO_2 concentrations to be lower than what would typically be expected. As such, 2019 has been utilised as a conservative worst-case scenario whilst the long term impacts of the COVID-19 pandemic are not fully understood.

4.1 AQMA No.8 Swanley Town Centre

AQMA No.8 is currently designated for exceedances of the annual mean NO_2, with three monitoring locations located within the AQMA using NO_2 diffusion tubes. Exceedances of the annual mean NO_2 objective have been reported at two of the monitoring locations over the past five years (DT 40 and DT41). However, when distance corrected to the nearest relevant exposure, as per LAQM.TG(22), both sites have predicted annual mean concentrations to be below the AQS objective.

Discrete receptor locations have been modelled throughout the AQMA and two exceedances have been predicted along the High Street, near to the junction to Bevan Place and in close proximity to DT40. Both of these receptors are located at 4m height, as it is assumed there are residential residences above the ground floor commercial units. The model is shown to be overpredicting in this area, and therefore this is considered to be a slight conservative estimation, however even with this in consideration an exceedance is still predicted in this area. No other exceedances have been predicted within the AQMA.

The modelled exceedances are likely due to a small section of this road being modelled as a two-sided street canyon, as identified during the desktop review using Google Streetview. It appears that the development of a larger property is taking place from 2020 onwards, with the façade being brought forwards, therefore predicted to amplify the street canyon effects. It is however not known whether any properties along this stretch are used for residential purposes.

It is advised that the Council continues to monitor throughout this AQMA, especially at the location of DT40, to ensure that NO_2 concentrations continue to remain compliant. The Council should also deploy monitoring closer to any residential properties if they exist along this stretch, including at the façade of the new property once construction is completed. Care should be taken with the development of the High Street along this stretch, as this is located between two junctions where congestion occurs, and further development could further exasperate the street canyon effects observed. If residential properties are present, then the Council should strongly consider implementing measures to reduce pollution concentrations along this stretch if monitoring reports exceedances.

The modelling carried out has not indicated that any amendments to the AQMA boundary are required.

From the source apportionment completed, Diesel Cars and LGVs account for over half of the total NO_x concentrations predicted at the worst case receptor. Therefore, if any measures need to be implemented to further reduce NO_2 concentrations then it would be advisable to focus on reducing the emissions from these vehicle types.

If monitoring continues to show that the AQMA is compliant and below 10% of the AQS objective in future years following the completion of the development along the High Street, then the Council could consider revoking the AQMA.

4.2 AQMA No.14 Junction of Birchwood and London Roads

AQMA No.14 is currently designated for exceedances of the annual mean NO_2 AQS objective and monitoring is completed within, and close to the AQMA using NO_2 diffusion tubes. DT83, located within a section of Birchwood Road considered to be a single-sided street canyon, has reported exceedances for three of the past five years. Once distance corrected to a point of relevant exposure this site continued to predict a concentration greater than 40µg/m³. All other monitoring locations within or in close proximity to the AQMA have however continually reported concentrations below 40µg/m³ for the past 5 years.

From the modelling conducted, concentrations at relevant receptors are predicted to be below the AQS objective, however at the discrete receptor R3 (the receptor nearest to DT83) the concentration is within 10% of the AQS objective. R3 is likely to be slightly under predicting, therefore caution should be taken when considering the discrete receptor results in this location, as these are also likely to be under predicted.

It is recommended that monitoring continues to be carried out within this AQMA, and where possible to deploy a monitoring location at a relevant point of exposure in order to confirm whether the model is predicting the results accurately. Despite this, exceedances, even following distance correction, have been reported within the past 5 years so the AQMA should be retained.

The modelling carried out has not indicated that any amendments to the AQMA boundary are required.

From the source apportionment completed, Diesel Cars and LGVs account for approximately half of the total NO_x concentrations predicted at the worst case receptor. Therefore, any measures to be implemented to further reduce NO_2 concentrations should be focused on reducing the emissions from these vehicle types.

The Council should consider whether any updates are required to their recently published AQAP in order to consider any further measures to assist in reducing NO_2 concentrations within this AQMA, focusing on the relevant vehicle types and at reducing congestion.

Appendices

Appendix A – Traffic Data

Figure A.1 – Traffic Survey Locations

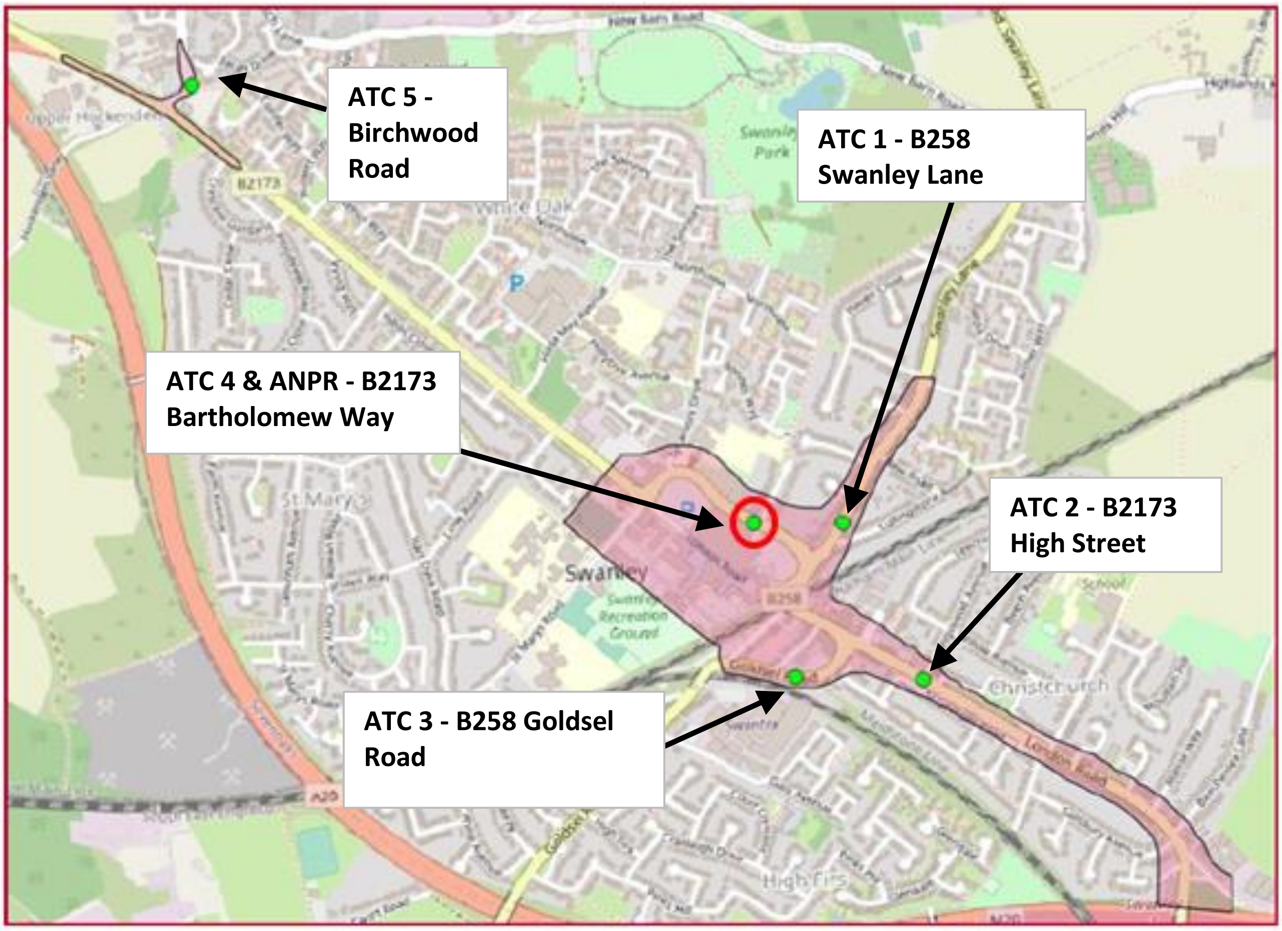


Table A.1 –Traffic Data

ID	Source	2019 Traffic Flow (AADT)	% Car	% LGV	% HGV	% Bus/ Coach	% Motorcycle
ATC 1	Traffic Survey	10278	86.4	10.2	2.3	0.1	0.9
ATC 2	Traffic Survey	19800	82.0	12.9	4.0	0.1	0.9
ATC 3	Traffic Survey	11242	84.2	11.7	3.1	0.1	0.9
ATC 4	Traffic Survey	19605	85.7	10.3	2.9	0.1	1.0
ATC 5	Traffic Survey	9675	81.5	15.0	2.6	0.1	0.8
36247	DFT	54690	75.5	18.7	4.1	0.3	1.4
73157	DFT	43754	75.5	18.7	4.1	0.3	1.4
7824	DFT	130741	66.7	20.8	11.7	0.3	0.5
38019	DFT	121788	71.8	19.0	8.6	0.2	0.5
27865	DFT	58459	68.8	17.5	12.6	0.3	0.9

Table A.2 – User Input Euro Class Splits

Vehicle Type	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5	Euro 6
Petrol Car	0.00	0.00	0.01	0.19	0.26	0.53
Diesel Car	0.00	0.00	0.00	0.16	0.35	0.49
Petrol LGV	0.00	0.00	0.00	0.00	0.21	0.79
Diesel LGV	0.00	0.00	0.00	0.11	0.22	0.67
RIGID HGV Diesel	0.00	0.00	0.01	0.11	0.37	0.51
ARTICULATE HGV Diesel	0.00	0.00	0.00	0.02	0.02	0.96
Bus Coach Diesel	0.00	0.00	0.02	0.51	0.17	0.31
Motorcycle	0.00	0.00	0.00	0.00	0.00	0.00
Full Hybrid Petrol Car	0.00	0.00	0.01	0.01	0.15	0.82
Full Hybrid Diesel Car	0.00	0.00	0.00	0.00	0.08	0.92
Battery EV Car	0.00	0.00	0.00	0.00	0.04	0.96
LPG Car	0.00	0.00	0.00	0.00	0.00	1.00
Full Petrol Hybrid LGV	0.00	0.00	0.00	0.00	0.00	1.00
Battery EV LGV	0.00	0.00	0.00	0.00	0.08	0.92
LPG LGV	0.00	0.00	0.00	0.00	0.00	0.00

Appendix B – Verification

Table B.1 – Details of Passive NO_2 Monitoring Locations Used for Verification within the Swanley Area, Sevenoaks District Council

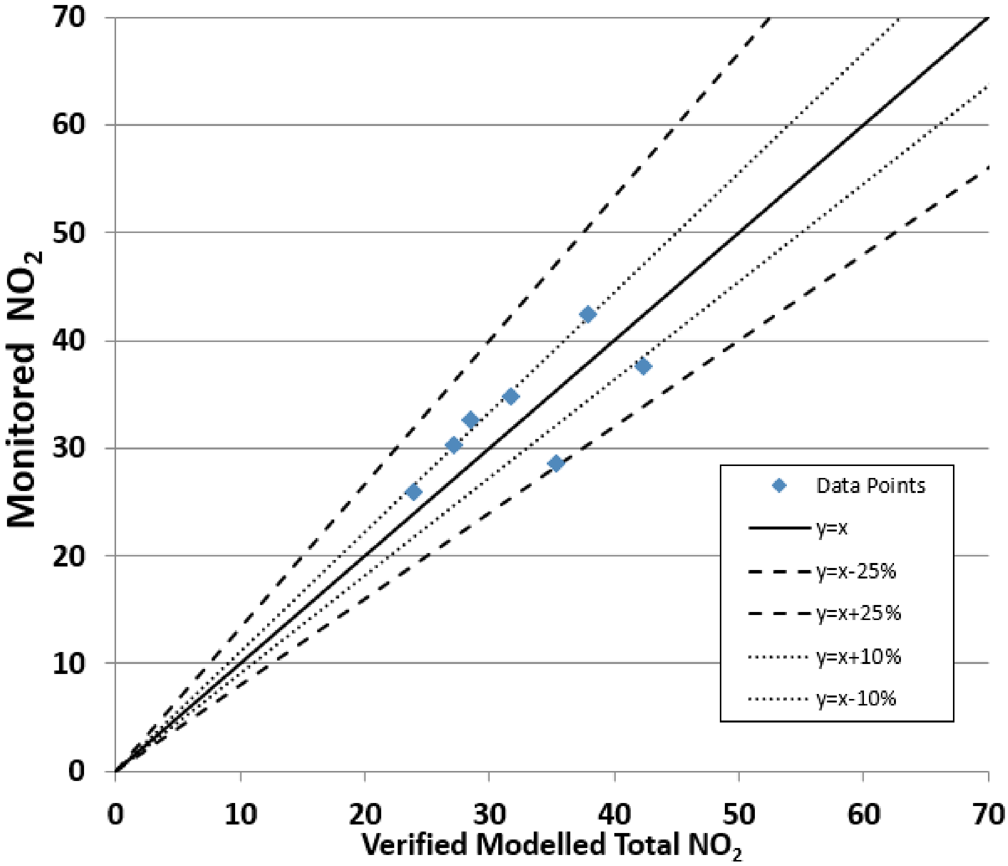
Site ID	X Coordinate	Y Coordinate	Site Type	Height (m)
DT39	551492	168695	Roadside	2.5
DT40	551579	168507	Roadside	2.5
DT41	552175	168162	Roadside	2.5
DT83	550297	169682	Roadside	2.5
DT93	550283	169743	Roadside	2.5
DT94	550283	169743	Roadside	2.0
DT95	550258	169575	Roadside	2.5

Table B.2 – 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)
DT39	2.99	2.517	35.99	54.27	31.69	34.79	-8.92
DT40	2.05		59.96	78.24	42.38	37.52	12.94
DT41	3.19		32.45	48.20	28.46	32.57	-12.61
DT83	3.05		50.56	68.04	37.86	42.44	-10.79
DT93	3.00		20.90	38.38	23.89	25.89	-7.74
DT94	1.70		44.94	62.42	35.34	28.56	23.72
DT95	3.12		27.35	44.83	27.09	30.22	-10.37

The results of the verification is presented in Table B.2 and Figure B.1, and it can be seen that all monitoring sites are modelled to be within the ±25% acceptance level. The verification factor for the model is 2.517, with an RMSE of 4.3µg/m³ and a R^2 value of 0.491. This verification factor shall be used for all remaining modelled receptors. Whilst DT83 is not modelling an exceedance, whereas a monitored exceedance is reported, it is important to note that with consideration of the model uncertainty as indicated by the RMSE, an exceedance could be considered.

Figure B.1 – Adjusted Verification Monitored NO_2 Concentrations vs. Verified Modelled NO_2



Appendix C – Background Concentrations

Table C.1 – Background Concentrations

Grid Square (X, Y)	NO_2 (µg/m^3)	NO_x (µg/m^3)
550500, 169500	15.7	21.7
551500, 169500	14.8	20.3
552500, 169500	14.7	20.1
550500, 168500	16.6	23.0
551500, 168500	16.1	22.3
552500, 168500	17.8	24.9
Background locations have been taken from the Defra Background Mapping resource for Sevenoaks District Council.		